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# THE EUROPEAN JOURNAL

and related problems

### VOLUME 25 • No. 71 • 2014

INDEXED IN EXCERPTA MEDICA

**SUMMARY** 

### 40<sup>th</sup> ESL Congress

### Lymphedema Prevention: from Genetics to Surgery

Searching for Better Lymphedema Patients' Quality of Life

Genoa (Italy) - 25-27 September, 2014 NH Hotel Marina – Molo Ponte Calvi, 5

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#### THE EUROPEAN JOURNAL OF LYMPHOLOGY AND RELATED PROBLEMS (EJLRP)

The EJLRP - official organ of the European Group of Lymphology (ESL), Czech Society of Lymphology, Romanian Society of Lymphology, Greek Society of Lymphology, the Latin-Mediterranean Chapter of Lymphology (LMCL), the Società Italiana di Linfangiologia (SIL) covers all fields of Lymphology and aims to present a multidisciplinair approach to diseases of the lymphatic system, with information on the analysis, control and treatments of such diseases.

#### Topics

The topics include:

- anatomy and anatomopathologyphysiology and physiopathology
- physiology and
   pharmacology
- diagnostic methods (conventional radiology, nuclear medicine, ultrasonography, computed tomography, biopsy, nuclear magnetic resonance)
- therapy (surgery, medicine, radiotherapy, physical)
- oncology (primary lymphatic system diseases, lymphonodal metastatic process)
- immunology
- post-therapeutic complications
- upper and lower limb edemas

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European Society of Lymphology



groupement européen de lymphologie

### 40<sup>th</sup> ESL CONGRESS

### Genoa (Italy) - September 25-27, 2014

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#### NH Hotel Marina – Molo Ponte Calvi, 5

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Genova, Porto antico, il Bigo

"Prevention: the Key of Success for Lymphedema – Free Life"



### 40<sup>th</sup> ESL Congress

### Lymphedema Prevention: from Genetics to Surgery

Searching for Better Lymphedema Patients' Quality of Life

Genoa (Italy) – 25–27 September, 2014 NH Hotel Marina – Molo Ponte Calvi, 5

### **PROGRAM AT A GLANCE**

September 25, 2014

### ATLANTIC ROOM

09.30 am 12.00 pm 2.00 - 3.45 pm 3.45 - 6.15 pm 6.15 - 7.30 pm	ESL Executive Committee Meeting ISL Executive Committee Meeting SESSION I - TRANSLATIONAL LYMPHOLOGY AND EPIDEMIOLOGIC STUDIES SESSION II - ANATOMIC RESEARCHES, PHYSIOLOGIC ASPECTS AND PATHOPHYSIOLOGICAL MECHANISMS OPENING CEREMONY
8.00 pm	WELCOME COCKTAIL AT AQUARIUM OF GENOA
	September 26, 2014
	ATLANTIC ROOM
8.00 - 10.15 am	Session III - PRIMARY AND SECONDARY PREVENTION: DIAGNOSTIC AND OPERATIVE ISSUES
10.15 - 10.45 am	COFFEE BREAK
10.45 am - 1.00 pm	Session IV - PREVENTIVE AND THERAPEUTIC MEANING OF NON-OPERATIVE PROCEDURES
1.00 pm	ISL Executive Committee Meeting
1.00 – 2.00 pm	LUNCH
2.00 - 5.00 pm	Session V - WHICH IS THE PRESENT ROLE OF DIFFERENT TYPES OF SURGERY IN EARLY AND LATE STAGE LYMPHOEDEMAS?
5.00 - 5.30 pm	COFFEE BREAK
5.30 - 7.00 pm	Session VI - LYMPHOEDEMA CLINICAL CORRELATIONS, RISK FACTORS, AND QUALITY OF LIFE
7.00 pm	ESL Executive Committee Meeting

### **IONIO ROOM**

9.30 am - 12.00 pm	SATELLITE WORKSHOP – CIZETA MEDICALI LINFOROLL: A new medical device for an EBM lymphatic drainage
1.00 - 2.00 pm	LUNCH
2.00 - 5.00 pm	<b>SATELLITE WORKSHOP – JUZO</b> Treatment with compression garments for special lymphological issues / Breast lymphedema and genital edema
5.00 - 5.15 pm	COFFEE BREAK
5.15 - 7.45 pm	Session VII - NON-OPERATIVE AND OPERATIVE APPROACHES FOR PREVENTION AND TREATMENT OF LYMPHATIC DISEASES

### September 26, 2014

### **POSTER AREA**

- 11.00 am 1.00 pm POSTER SESSION
- 8.30 pm GALA DINNER AT MERIDIANA PALACE

### September 27, 2014

### **ATLANTIC ROOM**

8.00 -10.20 am	SESSION VIII - MODERN DIAGNOSTIC INVESTIGATIONS AND CLINICAL IMPLICATIONS
10.20 - 10.50 am	COFFEE BREAK
10.50 am - 1.25 pm	Session IX – SPECIAL ASSESSMENT, CLINICAL ASPECTS, AND THERAPEUTIC OPTIONS BEYOND ACQUIRED FORMS: AN OVERVIEW ALSO ON PRIMARY LYMPHOEDEMAS AND OTHER ASSOCIATED LYMPHATIC MALFORMATIONS
1.30 – 2.00 pm	CLOSING REMARKS
2.00 pm	ESL General Assembly

### **IONIO ROOM**

10.50 am - 12.50 pm **SATELLITE WORKSHOP - CTG** *Compression Therapy in Lymphology* 

THE EUROPEAN JOURNAL

#### lymphology and related problems

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### SCIENTIFIC PROGRAM

#### September 25, 2014

#### Atlantic Room

9.30 am	ESL Executive Committee Meeting
12.00 pm	ISL Executive Committee Meeting
2.00-3.45 pm	Session I TRANSLATIONAL LYMPHOLOGY AND EPIDEMIOLOGIC STUDIES
Chairmen:	M. Witte (Tucson, AZ, USA), C. Moffat (London, UK)
Co-Chairmen:	M. Ohkuma (Saitama, Japan), O. Eliska (Prague, Czech Republic)
Lecture	Genetics, GWAS, Surgical Genomics and Translation: Challenges and Promise for Personalized Lymphology M. Witte (Tucson, AZ, USA)
Lecture	Genetic Aspects in Primary Lymphoedema S. Michelini (Rome, Italy)
Lecture	Next Generation Sequencing and Lymphedema Genetics
	R. Erickson (Tucson, AZ, USA)
Lecture	New Mechanisms of Lymphangiogenesis and Lymphedema M. Jeltsch, K. Alitalo (Helsinki, Finland)
Lecture	Epidemiology of Lymphoedema: General Remarks
	K. Benda (Czech Republic)
Lecture	The Development of an International Epidemiology Study LIMPRINT C. Moffat (London, UK)
	Discussion
3.45-6.15 pm	SESSION II ANATOMIC RESEARCHES, PHYSIOLOGIC ASPECTS AND PATHOPHYSIOLOGICAL MECHANISMS
Chairmen:	E. Foeldi (Hinterzarten, Germany), E. Fulcheri (Genoa, Italy)
Co-Chairmen:	K. Benda (Czech Republic), S. Michelini (Rome, Italy)
Lecture	Technological Instrumentation and Absorbing Lymphatic Vessel: History G. Azzali (Parma, Italy)
Lecture	Lymphatic Drainage of the Lumbar Skin: the Perforating Vessels and the Relation with the Iliac Lymph Nodes M. Amore (Buenos Aires, Argentina)
Lecture	Remodeling of Cardiac Lymphatic Vessels caused by Lymphostasis
Lecture	Histopathology of Lymphoedema: History and Future of the Immuno-histochemical Approach E. Fulcheri (Genoa, Italy)
Lecture	Physiology of Lymphatic System, Some Remarks
	O Eliska (Prague, Czech Republic)

Lecture	Experimental Studies in Pathophysiology of Lymphatic System A. Szuba (Wroclaw, Poland)
Lecture	Pathophysiological Bases of Lymphatic Disorders E. Foeldi (Hinterzarten, Germany)
Lecture	Pathophysiological Mechanisms of various types of Lymphoedema G. Thibaut (Nancy, France)
	Discussion
6.15-7.30 pm	OPENING CEREMONY
Welcome Lecture	Mentorship and Scholarship in Lymphatic Surgery
	C. Campisi, MD, PhD, FACS Honorary President of the Congress
8.00 pm	WELCOME COCKTAIL AT AQUARIUM OF GENOA

### September 26, 2014

#### Atlantic Room

8.00-10.15 pm	SESSION III PRIMARY AND SECONDARY PREVENTION: DIAGNOSTIC AND OPERATIVE ISSUES
Chairmen:	G. Thibaut (Nancy, France), A. Pissas (Montpellier, France)
Co-Chairmen:	E. Okada (Toyama, Japan), A. Szuba (Wroclaw, Poland)
Lecture	What do we mean when we speak about Primary and Secondary Lymphoedema Prevention? A. Pissas (Montpellier, France)
Lecture	Present Role of Lymphatic Imaging in the Prevention of Lymphoedemas and future Perspectives P. Bourgeois (Brussels, Belgium)
	Lympho-Fluoroscopy as a helpful Tool in early Detection of subclinical Cancer Related Secondary Lymphoedema J.P. Belgrado, L. Vandermeeren, J.B. Valsamis, J.J. Moraine, R. Deraemaecker (Brussels, Belgium)
	Tissue Dielectric Constant (TDC) Measurement, Bioimpedance Spectroscopy and Arm Volume Measurement in Early Detection of BCRL T. Lahtinen, K. Johansson (Kuopio, Finland)
Lecture	Prevention and Early Management of Breast Cancer Related Lymphoedema K. Johansson (Lund, Sweden)
Lecture	LYMPHA Experience at Columbia University Medical Center S. Feldman (New York, USA)
Lecture	LYMPHA Technique: no Reasons not to Use It! F. Boccardo (Genoa, Italy)
Lecture	Lymphoedema Prevention and Treatment: State-of-the-Art from the ISL Consensus Document M. Bernas (Tucson, Arizona, USA)
	Discussion

#### 10.15-10.45 am COFFEE BREAK

10.15-10.45 am	COFFEE BREAK	Lecture	Lymphatic Supermicrosurgery
10.45-1.00 pm	SESSION IV PREVENTIVE AND THERAPEUTIC MEANING OF NON-OPERATIVE PROCEDURES		A Living Experimental Model for Research and Training in Lymphatic Microsurgery
Chairmen:	A. Leduc (Brussels, Belgium), E. Iker (Santa Monica, California, USA)		C.C. Campisi (Genoa, Italy), M. Ionac (Timisoara, Romania)
Co-Chairmen:	I. Forner Cordero (Valençia, Spain), K. Johansson (Lund, Sweden)		Lymphaticovenular Anastomosis Reduces the Risk of Cellulitis in Lymphoedema Patients M. Mihara, H. Hara, H. Taubaki, M. Kawahara
Lecture	State of the Art in Physical Treatment of Lymphoedema A. Leduc (Brussels, Belgium)		N. Murai, D. Furniss, P. Gennaro, G. Gabriele (Japan / UK / Italy)
Lecture	<b>The Role of Compression Garments</b> <b>in the Management of Lymphoedema</b> I. Forner Cordero (Valençia, Spain)		LASER Technology for Treatment of Lymphatic Diseases in Dermatology Caterina Campisi, C.C. Campisi, A. Parodi (Genoa, Italy)
Lecture	How to objectively Assess Results of Lymphoedema Treatment E. Iker, E. Glass (Santa Monica, California, USA)		Chyloperitoneum: a New Clinical Entity for "Lymphatic Surgeons" S. Dessalvi, L. Molinari, S. Spinaci, C.C. Campisi,
	Manual Lymphatic Drainage: from Imaging to Daily Practice J.P. Belgrado, L. Vandermeeren, J.B. Valsamis,		E. Nacchiero, M. Cafferata, C. Braggio, C. Cornacchia, A. Ferrari, F. Boccardo, C. Campisi (Genoa, Italy) <b>Fibro-Lipo-Lympho-Aspiration (FLLA): a Lymph</b>
	The Effects of three-years Pneumatic Compression of Postinflammatory and Post		Vessel Sparing Procedure (LVSP) C.C. Campisi, C. Campisi (Genoa, Italy)
	Traumatic Edema of Lower Limbs W.L. Olszewski (Warsaw, Poland)	Lecture	Present Role of Liposuction in the Treatment of Lymphoedema H. Brorson (Malmo, Sweden)
	Lymphology in North-East of Italy A. Busetto (Venezia - Mestre, Italy)	Lecture	<b>Combined Treatment of Filarial Lymphoedema</b> G. Manokaran (Chennai, India)
Lecture	Long Term Follow Up in the Physical Treatment of Post-Mastectomy Lymphoedema M. Andrade (São Paulo, Brazil)	Lecture	Combined Surgical Approach in Genital Lymphoedema
Lecture	Infections and Lymphoedema: the Role of Complete Decongestive Treatment E. Dimakakos (Athens, Greece)		Discussion
Lecture	Drugs in Lymphedema Treatment A. Macciò (Savona, Italy)	5.00-5.30 pm	COFFEE BREAK
	Discussion	5.30-7.00 pm	SESSION VI
1.00 pm	ISL Executive Committee Meeting		LYMPHOEDEMA CLINICAL CORRELATIONS, RISK FACTORS, AND QUALITY OF LIFE
1.00-2.00 pm		Chairmen:	M. Witte (Tucson, AZ, USA), M. Andrade (São Paulo, Brazil), S. De Franciscis (Catanzaro, Italy)
2.00 0.00 pm	WHICH IS THE PRESENT ROLE OF DIFFERENT TYPES OF SURGERY IN EARLY AND LATE STAGE LYMPHOEDEMAS?	Co-Chairmen:	J.P. Belgrado (Brussels, Belgium), M. Bernas (Tucson, Arizona, USA), M. Amore (Buenos Aires, Argentina)
Chairmen:	<ul><li>R. Baumeister (Munich, Germany),</li><li>C. Campisi (Genoa, Italy),</li><li>W.L. Olszewski (Warsaw, Poland)</li></ul>	Lecture	The Vesuvius and the Veno-Lymphatic Eruptions: the Magma Correlations S. De Franciscis (Catanzaro, Italy)
Co-Chairmen:	H. Brorson (Malmo, Sweden), G. Manokaran (Chennai, India), M. Wald (Prague, Czech Republic)		Prevention of Lymphatic Injuries in Vascular Surgery
Lecture	Pathophysiological Bases of Lymphatic Micro- surgery: how to Reach the Best Results W.L. Olszewski (Warsaw, Poland)		S. Dessalvi, F. Boccardo, C. Campisi (Genoa, Italy) Preliminary Study for a Disability Scale in Lipedema, Based on ICF Core Sets
Lecture	Multiple Lymphatic-Venous Anastomoses (MLVA): A Long Life Experience		S. Michelini, M. Cardone, F. Cappellino, A. Fiorentino, V. Sainato, A. Failla, G. Moneta (Rome, Italy)
Lecture	Role of Lymphovascular Grafting in Lymphoedema Treatment		Lipedema: Lymphoscintigraphy and Clinical Stages M. Cestari (Terni, Italy)
	R. Baumeister (Munich, Germany)		Anatomical Deformation of Tissue
Lecture	Combined Technique for Breast Reconstruction and Lymphatic Microsurgery: Indications and Results J. Masià (Barcelona, Spain)		M. Zaleska, W.L. Olszewski, M. Cakala, P. Jain (Warsaw, Poland)

Primary and Secondary Prevention of Lymphatic Complications Following Melanoma Surgical Treatment

C.C. Campisi, E. Nacchiero, M. Cafferata, L. Molinari, S. Spinaci, S. Dessalvi, Caterina Campisi, F. Boccardo, C. Campisi (Genoa, Italy)

A New Pathophysiological Approach of Inflammatory Bowel Disease: from Gut to Lymph, Lymphatics and Lymphnodes S. Spinaci, L. Molinari, S. Dessalvi, C. Braggio, C. Cornacchia, A. Ferrari, F. Boccardo, C. Campisi (Genoa, Italy)

**Chylothorax: an Interdisciplinary Approach** L. Molinari, G. Leoncini, C.C. Campisi, S. Spinaci, S. Dessalvi, E. Nacchiero, M. Cafferata, C. Braggio, A. Ferrari, C. Cornacchia, F. Boccardo, C. Campisi (Genoa, Italy)

Discussion

7.00 pm ESL Executive Committee Meeting

8.30 pm GALA DINNER AT MERIDIANA PALACE

#### September 26, 2014

#### Ionio Room

9.30-12.00 am SATELLITE WORKSHOP - CIZETA MEDICALI Linforoll: a New Medical Device for an EBM Lymphatic Drainage S. Michelini, W. Olszewski, I. Forner Cordero, E. Dimakakos, A. Pissas, R. Caldirola (Italy / Spain / Greece / France)

#### 1.00-2.00 pm LUNCH

#### 2.00-5.00 pm SATELLITE WORKSHOP – JUZO Treatment with Compression Garments for Special Lymphological Issues / Breast Lymphedema and Genital Edema

C. Hemmann-Moll (Bad Rappenau, Germany)

5.00-5.15 pm COFFEE BREAK

5.15-7.45 pm	SESSION VII NON-OPERATIVE AND OPERATIVE APPROACHES FOR PREVENTION AND TREATMENT OF LYMPHATIC DISEASES
Chairmen:	I. Forner Cordero (Valençia, Spain), E. Dimakakos (Athens, Greece)
Co-Chairmen:	O. Leduc (Brussels, Belgium), A. Macciò (Savona, Italy)
	Anatomical Effects of Axillary Nodes Dissection on Rat's Lymphatic System Model: ICG Mapping and Dissection F. Pastouret, L. Cardozo, J. Lamote, P. Lievens (Brussels, Belgium)
	Pathophysiological Arm Lymphoedema Evaluation using Indocyanine Green Lymphography A. Hayashi, N. Hayashi, T. Yamamoto (Tokyo, Japan)
	Predictive Factors of Response to Decongestive Therapy in Patients with Breast Cancer Related Lymphoedema

D. Bojinović-Rodić, D. Živanić, J. Nikolić-Pucar (Banja Luka, Bosnia and Hercegovina) Indocyanine Green Lymphography: Comparison between two different Devices G. Giacalone, J. Opheide (Hasselt, Belgium)

Acoustic Radiation Force Impulse (ARFI). Quantification for Assessment of Tissue Alterations in Upper Arm Lymphoedema A. Onorato, F. Bonutti (Udine, Italy)

High Levels of Skin Intercellular Fluid Cytokines and Chemokines may be Responsible for Hyperkeratosis and Fibrosis in Lymphoedema M. Zaleska, W. Olszewski (Warsaw, Poland)

Acute Lymphangitis Score for Early Diagnoses and Treatment

A. Macciò (Savona, Italy)

#### Physical Treatment in Lymphoedema Patients and Cardiac Implications: Preliminary Study

M. Cardone, S. Michelini, A. Fiorentino, A. Failla, G. Moneta (Rome, Italy)

### Running with Leg Lymphoedema: which Optimal Compression Garments

A. Hamadé, M.H. Diancourt, W. Younes, F. Moudni, P. Michel, G. Obringer, M. Lehn-Hogg, J.C. Stoessel, H. Metzger (Mulhouse, France)

#### Lympho-Taping to reduce Hematoma after Liposuction: A 'Double Blind' Clinical Randomized Trial

L. Vandermeeren, J.P. Belgrado, A. Lenne, J.B. Valsamis, J.J. Moraine, R. Deraemaecker (Brussels, Belgium)

#### Influence of the Autonomic Nervous System/ Vagal Nerve Activity on Secondary Breast Cancer related Lymphoedema and Health Related Quality of Life

A. Nele, Y. Gidron, E. Van Haver, J. Lamote, J. De Greve, J. Nijs, P. Lievens (Brussels, Belgium)

What Influence have Oedema on Quality of Life at Patients with Secondary Lymphoedema? T. Planinsek Rucigaj (Ljubljana, Slovenia)

#### Disability Evaluation and Treatment of Patients Suffering from Lymphedema M. Ricci (Ancona, Italy)

Discussion

#### September 26, 2014

#### **POSTER Area**

11.00 am / POSTER SESSION

1.00 pm

Chairmen: P. Bourgeois (Brussels, Belgium)

*Co-Chairmen:* T. Yamamoto (Tokyo, Japan)

#### Comparison of Manual Lymphatic Drainage and Intermittent Pneumatic Compression in the Treatment of Breast Cancer Related Lymphoedema

Y. Bakar (Bolu, Turkey)

Lymphoedema and Lipedema: Usefulness of Shock Waves

M. Bordoni, M. Cestari, E. Conti, L. Famoso (Terni, Italy)

#### Icg Fluorescence Lymphography Reveals Real-Time Lymph-Flow in the Superficial Lymph-Vessels of the Leg by Intermittent Pneumatic Compression in Health

J. Maegawa, S. Matsubara, T. Mikami, K. Hirotomi,

S. Kitayama (Yokohama, Japan)

Lymphoedema Index for Body-Type Corrected Lymphoedematous Volume Evaluation

N. Hayashi, A. Hayashi, T. Yamamoto (Tokyo, Japan)

#### Comparison of Indocyanine Green Lymphographic findings with the Conditions of collecting Lymphatic Vessels in Patients with Lymphoedema

H. Hara, M. Mihara, I. Koshima (Tokyo, Japan)

Genital Lymphoedema Severity Staging System using Indocyanine Green Lymphography N. Hayashi, A. Hayashi, T. Yamamoto (Tokyo, Japan)

#### Indocyanine Green Lymphography for Obstructive Lymphoedema

N. Yamamoto, T. Yamamoto (Tokyo, Japan)

#### Surgical Treatment of Lymphoedema

of the Scrotum: Modified Surgical Technique A. Atta, E. Eaber, M. Basiouny, S. Mostafa Abass (Cairo, Egypt)

#### The true Pathophysiology of Secondary Lymphoedema based on histological Analysis of Collecting Lymphatic Vessels

M. Mihara, H. Hara, N. Murai, M. Kawahara (Saitama, Japan)

### The Lymphoedema Quality of Life Inventory (LyQLI): test of Validity and Reliability

K. Johansson, P. Klernäs, A. Johnsson, V. Horstmann, L. Kristjanson (Lund, Sweden)

#### Influence of Microsurgical Lymph Node Transplant and/or Lymph-Venous Anastomoses on Secondary Breast Cancer related Lymphoedema and Quality of Life

A. Nele, M. Hamdi, A. Zeltzer, B. De Brucker, L. Leysen, J. Lamote, P. Lievens (Brussels, Belgium)

### Anxiety and Depression - Complicating Factors of Lymphoedema Treatment

M. Bendova, K. Benda, K. Skřivanová, L. Minář (Czech Republic)

#### The Effect of Education on Physiotherapy Students Knowledge of Lymphoedema Detection and Prevention

Y. Bakar, Ö. Özlem Cinar, Elif Zorgör (Bolu, Turkey)

#### Evaluation of Time-Distance Parameter changes in Patient with Primary Lymphoedema: a Case Report

G. Baskent, I. Yildiz, A. Kilic, E. Unuva, F. Oguz, E. Akalan, Y. Temelli, S. Kuchimov, A. Baskent (Istanbul, Turkey)

#### Effectiveness of the "Punch Tape" Application in Seroma: A Case of Seroma after Breast Reconstruction Surgery

J.D.P. Coutinho (Coimbra, Portugal)

#### Effect of combined Therapy on Colon Cancer-Related Lymphoedema: Case Report Ö. Cinar Ozdemir, Y. Bakar (Bolu, Turkey)

### Activators of Lymphatic Drainage in Overcoming Insulin Resistance

I. Kurnikova, (Moscow, Russia),

S. Zykina (Izhevsk, Russia)

#### Features Diagnosis and Treatment of Patients Tactics with Concomitant Lymph, Venous and Musculoskeletal Lower Limb

S. Katorkin, I. Losev, J. Syzonenko (Samara, Russia)

Effectiveness of the Application of Neuromuscular Taping ("Punch Tape") in Post Mastectomy Lymphedema: A Case Study Using Ultra Sound to Measure Changes in Edema Volume and Skin Thickness

C. Villarón Casales, J.D. Pinto Coutinho (Valencia, Spain - Coimbra, Portugal)

#### September 27, 2014 Atlantic Room

#### 8.00-10.20 am SESSION VIII MODERN DIAGNOSTIC INVESTIGATIONS AND CLINICAL IMPLICATIONS P. Bourgeois (Brussels, Belgium), Chairmen: S. Feldman (New York, USA), A.P. Pecking (Paris, France) Co-Chairmen: M. Cestari (Terni, Italy), J.P. Brun (Paris, France), O. Leduc (Brussels, Belgium) Lecture Lymphoscintigraphy in the Evaluation of Lymphedema Following Axillary Lymph Node **Dissection for Breast Cancer** G. Villa (Genoa, Italy) Lecture Fusion Imaging of the Lymphatic System: Therapeutic Implications A.P. Pecking, R.V. Cluzan (Paris, France) **Clinical Findings of Lymphoedema** and Lymphoscintigraphics: Our Experience S. Michelini, G. Moneta, M. Cardone, A. Fiorentino, V. Sainato, G. Ventroni, A. Semprebene, L. Mango (Rome, Italy) The Role of Stress-Lymphoscintigraphy in predicting Lymphoedema and planning the Treatment Program G. Tartaglione, R. Bartoletti, M. Pagan, G. Paone, V. Bernabucci (Rome, Italy) Where are the Functional Lymphatic Vessels in the Chronic Lymphoedema of the Lower Extremities? - A Study by the SPECT-CT Lymphoscintigraphy S. Matsubara, J. Maegawa, T. Mikami, K. Hirotomi, S. Kitayama, H. Tomoeda, Y. Yabuki, S. Kagimoto, E. Adachi (Yokohama, Japan) Lympho-Fluoroscopy in Cancer-Related Secondary Lymph Edema: from Imaging to daily Practice J.P. Belgrado, L. Vandermeeren, J.B. Valsamis, J.J. Moraine, R. Deraemaecker (Brussels, Belgium) MR Imaging: how to make Visible the Invisible Lecture N. Liu (Shanghai, China) Role of MRI in Physical Treatment Lecture of Lymphoedema J.P. Brun, C. Becker (Paris, France) Lecture Identification of the Axillary Web Syndrome (AWS) by the Correlations between Clinical Signs, MRI and Echographic Imaging O. Leduc (Brussels, Belgium) Role of Indocyanine Green Lymphography Lecture in Physical Treatment of Lymphoedema J.P. Belgrado (Brussels, Belgium) Discussion

10.20-10.50 am COFFEE BREAK

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10.50 am / 1.25 pm	SESSION IX SPECIAL ASSESSMENT, CLINICAL ASPECTS, AND THERAPEUTIC OPTIONS BEYOND ACQUIRED FORMS: AN OVERVIEW ALSO ON PRIMARY LYMPHOEDEMAS AND OTHER ASSOCIATED LYMPHATIC MALFORMATIONS	
Chairmen:	N. Liu (Shanghai, China), C. Papendieck (Buenos Aires, Argentina)	
Co-Chairmen:	C. Bellini (Genoa, Italy), J. Masià (Barcelona, Spain)	
Lecture	<b>2014 Challenges In Pediatric Lymphology</b> C. Papendieck (Buenos Aires, Argentina)	
Lecture	Brain Hyper-Lymphatic Highway Network C. Bellini (Genoa, Italy)	1.
Lecture	Growth, Overgrowth and Asymmetric Growth C. Papendieck (Buenos Aires, Argentina)	2.
	Our Diagnostic and Therapeutic Approaches to Primary Lymphoedema	
	H. Hara, M. Minara, I. Kosnima (Tokyo, Japan)	
	Dynamic Indocyanine Green Lymphography for Comprehensive Assessment for Lymphoedema	I
	N. Yamamoto, T. Yamamoto (Tokyo, Japan)	10
	Physical Treatment of Lymphoedema and Linforoll: a New Mechanical Method Operator Dependent in Line with EBM	12 C
	S. Michelini, W.L. Olszewski, R. Caldirola, A. Pissas, E. Dimakakos, I. Forner-Cordero, N. Liu, L. Michelotti, M. Ricci, M. Cestari, M. Cardone (Italy / Poland / France / Greece / Spain / China Rep.)	
	The Hydromechanics of Edema Fluid during Linforoll Device application in Lymphoedema Patients	
	W.L. Olszewski, M. Zaleska, S. Michelini (Poland / Italy)	
	Linforoll Protocol: Preliminary Results concerning 12 Patients treated in the Unit of Treatment of Lymphoedema A. Pissas (Montpellier, France)	
	Surgery and Laser Bound Together in Treatment of Vascular and Lymphatic Anomalies	
	E. Bernè, K. Arcieri, F. Balconi (Milan, Italy)	
	How to Treat Edema of Lower Limbs after Trauma, Thrombosis or Inflammation? W.L. Olszewski, M. Zaleska (Warsaw, Poland)	

Lymphatic Surgery for Generalised Lymphatic Dysplasia Patients

M. Mihara, H. Hara, J. Shibasaki (Saitama, Japan)

Lymphatico-Venous Side-to-End Anastomosis in Peripheral Lymphoedema Patients Changes Superficial Lymph Flow in ICG Fluorescence Lymphangiography J. Maegawa, S. Matsbara, T. Mikami, K. Hirotomi, S. Kitayama (Yokohama, Japan)

Acrobatic Lymphatic Supermicrosurgery A. Hayashi, N. Hayashi, T. Yamamoto (Tokyo, Japan)

Discussion

#### 1.30-2.00 pm CLOSING REMARKS

2.00 pm ESL GENERAL ASSEMBLY (Pocket Lunch)

### September 27, 2014 Ionio Room

10.50 am /	SATELLITE WORKSHOP - CTG	
12.50 pm	Compression Therapy in Lymphology	
Chairmen:	A. Macciò (Savona, Italy), E. Colombo (Como, Italy)	

#### Dogmas and Evidences

in **Compression Therapy** M. Izzo (Naples, Italy)

#### Normatives and Quality Checks To Certify Effectiveness of the Therapy with Elastic Medical Stockings N. Cartaro (Switzerland)

Materials and Characteristics in Medical Compression Therapy M. Buccalossi (Siena, Italy)

Role of Lymphatic Circulation in Venous Diseases: CEAP 3 V. Gasbarro (Ferrara, Italy)

Medical Stocking: Standard versus Custom Made G. Moneta (Roma, Italy)

#### **Questions & Discussions**

E. Colombo (Como, Italy)

#### September 25, 2014 - ATLANTIC ROOM

### SESSION I TRANSLATIONAL LYMPHOLOGY AND EPIDEMIOLOGIC STUDIES

### GENETICS, GWAS, SURGICAL GENOMICS, AND TRANSLATION: CHALLENGES A PROMISE FOR PERSONALIZED LYMPHOLOGY

MARLYS WITTE, MICHAEL BERNAS

Department of Surgery, University of Arizona (Tucson, AZ, USA)

Since 2000, there has been an explosion of interest and information about the genomics/ proteomics of familial lymphedema (LE) syndromes. Based on advancing technology including next generation exome sequencing, 10 specific gene mutations have been associated with distinctive largely autosomal dominant LE syndromes with variable penetrance, and 8 of these underlie corresponding mouse LE models. The commonest among these relatively rare syndromes are in VEGR3 (Milroy syndromes) and FOXC2 (LE-distichiasis), but each of the 10 has shed unexpected light on signalling pathways in lymphvasculogenesis/lymphangiogenesis and suggested potential therapeutic targets for more common disorders of the lymphatic and other body systems. Indeed, based on genomewide association studies (GWAS), some of these same and other genes have been proposed to increase risk of secondary lymphedema, although to a minor degree, after axillary lymphadenectomy for invasive breast cancer. Genetic and other molecular information is now being translated into patient care, i.e. contributing to "personalized lymphology" - prevention, risk assessment, genetic counseling, early diagnosis, monitoring, and treatment options (e.g. pharmaco/surgicogenomics, genetic surgery). A cautionary note: "depersonalized lymphology" can result from megadata overload in molecular/genomic prognostication if the clinical context and course of the patient is neglected as the cornerstone of "personalized lymphology".

#### GENETIC ASPECTS IN PRIMARY LYMPHEDEMA

SANDRO MICHELINI, MARCO CARDONE<sup>1</sup>, ALESSANDRO FIORENTINO<sup>1</sup>, FRANCESCO CAPPELLINO<sup>1</sup>, VINCENZO SAINATO<sup>1</sup>, ALICE BRUSON<sup>2</sup>, FRANCESCO SIROCCO<sup>2</sup>, STEFANO CECCHIN<sup>2</sup>, MARIO BERTELLI<sup>2</sup>

<sup>1</sup> Department of Vascular Rehabilitation, San Giovanni Battista Hospital, Rome, Italy

<sup>2</sup> Laboratory of Molecular Genetics, International Association of Medical Genetics, MAGI onlus, Rovereto, Italy

In advanced stage of lymphangiogenesis an incomplete development of lymphatic system can be determined by genetic mutation of genes related to the primary lymphedema disorders. The disease develops clinically in different ages with the appearance of an oedema affecting the limbs, external genitalia or other area of body which tends to progress In familial forms, it is usually inherited as an autosomal dominant disease linked to heterozygous mutations in genes involved in lymphangiogenesis, including VEGFR3 (e.g.: Milroy S.) and FOXC2 (e.g.: Lymphedema distichiasi S.) genes. Due to its rarity, exhaustive genotype-phenotype correlation studies are lacking and lymphoscintigraphy studies have never been performed on subjects with inherited mutations but without clinical presentation.

We previously reported clinical and genetic analysis of 52 Italian probands screened for VEGFR3 and FOXC2 mutations [Michelini S. et al., 2012]. Here, we focus on the nine familial cases with positive molecular diagnosis (6 with mutations in VEGFR3; 3 in FOXC2). These patients and their relatives also underwent lymphoscintigraphy. In one of the nine families we identified a clinically normal subject carrying a FOXC2 heterozygous mutation. The same variant was detected in his daughter, who has an overt phenotype. The lymphoscintigraphic patterns of affected patients in the same family proved to be very similar. The results of the FOXC2 patient without clinical manifestations indicated bilateral delay in lymphatic drainage through inguinal nodes. When major parameters (age of onset, clinically involved limbs and evolution) were considered, a genotype-phenotype correlation was observed in patients carrying the same mutations from this and previous case studies. In conclusion, lymphoscintigraphic features of the clinically normal patient with FOXC2 mutation indicate that subjects without manifestations but carrying mutations may have silent lymphatic insufficiencies. This suggests that in late forms, subclinical disease is already present at birth and only manifests after physical trauma. Primary lymphedema should therefore be regarded as having variable clinical expression and not, as currently considered, incomplete penetrance.

#### NEXT GENERATION SEQUENCING AND LYMPHATIC GENETICS

ROBERT ERICKSON University of Arizona

We have reached the "One thousand dollar" human genome sequence but the analysis of it costs tens of thousands of dollars. Exome (the coding sequences)-only sequencing is commercially available for about \$700 with a real cost of closer to \$400. Current commercial diagnostic laboratories only sequence the exons and splice donor and acceptor sites (usually at \$1,000 or more per gene—depending on its size and complexity) while sequencing and analyzing the exomes and splice donor sequences of about 50 currently known lymphatic-disorder related genes would cost about the same as analyzing 2 or 3 of the more commonly studied genes (VEGFR3, *FOXC2, CCEB1*, etc.).

In addition, somatic (non-germline) mutations in several genes are responsible for non-familial, peripheral lymphatic disorders. These mutations are likely to be present at only small levels in the usual sources of DNA (blood where the DNA is in white blood cells, saliva, or buccal swabs) but higher levels would be found in portions of any surgical biopsy or removed tissue. The arguments for, and suggested contents of, a lymphatic-disorder panel are presented here.

#### NEW MECHANISMS OF LYMPHANGIOGENESIS AND LYMPHEDEMA

MICHAEL JELTSCH<sup>1</sup>, SAWAN KUMAR JHA<sup>2</sup>, DENIS TVOROGOV<sup>2</sup>, ANDREY ANISIMOV<sup>1,2</sup>, VELI-MATTI LEPPÄNEN<sup>1</sup>, TANJA HOLOPAINEN<sup>2</sup>, RIIKKA KIVELÄ<sup>2</sup>, KARI ALITALO<sup>1,2,4</sup>

<sup>1</sup>Wihuri Research Institute, <sup>2</sup>Translational Cancer Biology Program and <sup>3</sup>Department of Biomedicine, Biomedicum Helsinki, University of Helsinki, Finland, <sup>4</sup>Helsinki University Central Hospital, Helsinki, Finland

Despite the intensive research on the lymphangiogenic VEGF-C/VEGFR-3 signaling pathway in the last two decades, new and unexpected findings do not cease to be made. Diseases that involve the lymphatic system have helped to uncover mechanisms of its normal functioning and development. A recent example of new basic knowlegde that resulted from the investigation of a human disease is Hennekam lymphangiectasia-lymphedema syndrome (OMIM 235510). It is an autosomal recessive condition, which co-segregates with mutations in the collagen- and calcium-binding EGF domains 1 (CCBE1) gene.

Both CCBE1 and the lymphangiogenic vascular endothelial growth factor C (VEGF-C) are necessary for the early lymphatic development, namely for the budding and migration of endothelial cells from the cardinal vein (CV) and for the formation of the early lymphatic structures. These processes fail in embryos deficient of either Ccbe1 or Vegfc. In Vegfc-deficient embryos pro-spective lymphatic endothelial cells fail to sprout from the CV, whereas in Ccbe1-deficient embryos, the sprouting is abnormal and does not result in the formation of discrete lymphatic structures.

Because of this close link between the phenotypes of Ccbe- and Vegfc-deficient embryos, we searched for interactions of CCBE1 with the VEGF-C growth factor signaling pathway, which is critical in embryonic and adult lymphangiogenesis. VEGF-C is synthesized as an inactive proprotein and needs to be processed by at least two distinct proteases to become fully active.

By analyzing VEGF-C produced in cell culture and by in-vivo application of VEGF-C and CCBE1, we found that the presence of CCBE1 localizes and promotes VEGF-C activity by stimulating VEGF-C activation via the protease ADAMTS3. This leads to increased VEGFR-2 and VEGFR-3 signaling and increased lymphangiogenesis and angiogenesis in-vivo.

These results show that CCBE1 modulates lymphangiogenesis by boosting the effect of VEGF-C. VEGF-C is undergoing clinical trials with the goal to enhance the integration of lymph nodes into the lymphatic vasculature after autologous transfer to treat postmastectomy lymphedema. Our data suggests that a CCBE1 could be used as a therapeutic tool for the modulation of such VEGF-C-c-induced therapeutic lymphangiogenesis in a variety of diseases that involve the lymphatic system.

#### EPIDEMIOLOGY OF LYMPHEDEMA

#### KAREL BENDA

Dept. of Radiology, University Hospital Brno, ARCUS onco-lymphocentre Brno, Czech Republic

The epidemiology of lymphedema (LE) is decisive factor for current treatment needs and preventive programmes planning. At present, the incidence and prevalency of LE on national and international scales remain in general still unknown.

The purpose of the study was to present recent relevant data to judge the epidemiology of LE in different countries and worlwidth. Because of the lack in obligatory reporting LE and absence of national registers it is difficult to judge relevant figures. The author used epidemiologic data of LE incidence from his own previous studies in 90's concerning to LE incidence and treatment needs in Czech Republic and MEDLINE in searching for published data (recent 99 records, 7 years period), but didn't obtain relevant sumarising figures. The author present investigated figures of LE incidence secondary to malignencies treatment. They are: postmastectomy and radiotherapy (20% to 42%), gynecological cancer (8% to 32%), urological cancer (21% to 50%), head and neck cancer (75%), melanoma (47%). Published incidence rates varies substationally bacause of different locoregional treatment (surgical techniques and radiation therapy parametres) in particular clinics, institutions and other facilities.

Because of lacking evidence of LE incidence in particular countries, approximation of data from comparable countries is neccessary for rough orientation. For Middle Europian countries updated data from Germany are evaluable. The incidence of LE in this country reaches 1,8% per 1 Mill. of inhabitants (women 2%, men 1,7%). The incidence of lymphedema in tropical countries and China (cause by filariasis) reaches about 200 Mill. inhabitants.

For discussion the author submit urgent problems: (1) Standardization of LE diagnosis. To diagnose LE is problematic because the criteria used to identify changes in the volume of the limbs are not standardized. (2) Diagnosis of primary LE based on clinical examination only is not accurate enough. Primary malfunctionating of lymphatic drainage is to be diagnosed using lymph-sctintigraphy (latent stage of LE!). The ratio of primary to secondary LE incidence varies in large scale (from 41% to 59% of patients) according to different specialization of workplaces and failed registration. (3) Degenerative changes in lymphatic system (both vessels and nodes) might be the cause of lymphatic drainage insufficiency of the seniors (according to Foeldi, 4,5 million Germen suffer from this typer of LE).

#### THE DEVELOPMENT OF AN INTERNATIONAL EPIDEMIOLOGY STUDY LIMPRINT

CHRISTINE MOFFATT, DR VAUGHAN KEELEY

University of Nottingham, Nottingham, UK. Royal Derby Foundation NHS Trust UK

The Epidemiology of patients suffering with chronic oedema due to different causes has been poorly studied. The International Lymphedema Framework have developed an international prevalence study to define the prevalence and impact of chronic oedema LIMPRINT. This has involved validation of the methodology and the development of an electronic data capture system. Pilot work has included the evaluation of 3250 patients within a UK Lymphedema service and a population study in Copenhagen. Roll out of the programme has commenced with Japan and France commencing large multi centre projects. This presentation will describe the validation methodology and early pilot results.

### SESSION II ANATOMIC RESEARCHES, PHYSIOLOGIC ASPECTS AND PATHOPHYSIOLOGICAL MECHANISMS

#### TECHNOLOGICAL INSTRUMENTATION AND ABSORBING LYMPHATIC VESSEL: HISTORY

#### AZZALI GIACOMO

Professor Emeritus of Anatomy, Department of Biomedical, Biotechnological and Translational Sciences (S.Bi.Bi.T), University of Parma – 43126 Parma, Italy

The knowledge of the lymphatic system (LS) began in 1621 with the accidental discovery of the chyliferous vessels by Aselli (1622) during the demonstration of the recurrent nerves; prestigious anatomical discovery that constituted a milestone in the history of medical-biological sciences. From Alcmaeon (VII century BC) to the first century BC the information concerning the presence of lymphatic vessels in humans and animals have been scarce. In the book by Galen (second century AD), it is reported that Herophilus and Erasistratus of the Alexandrian school (second century BC), described in humans the presence of arteries containing milky fluid responsible for the nutrition of the intestine which draining into small glandular bodies. Such knowledge was also found in the following centuries until the Renaissance as what had been said and done before was still copied and strictly repeated. Even in the "De Humani Corporis Fabrica" by Vesalius (1554), despite the severe critical review of the prior anatomical knowledge, there were no additional information regarding the LS except for the simple description of the "vena thoracica alba" by Bartolomeo Eustacchio (1585) in the horse and, in the liver, of vessels always full of a yellow and bitter liquid by Falloppio (1521-1562). The discovery by Aselli in dogs, accompanied by an iconography of 4 color plates of 40.5x25.5 cm, challenged by Riolano and Harvey (1628), was confirmed in humans by Peiresc (1580-1647) and Vesling (1598-1649). The posthumous publication of "De lactibus sive lacteis venis..." and the subsequent editions (Basel 1628, Leiden 1640, Amsterdam 1645), stimulated further studies in humans discovering anatomical findings by Pecquet (1622-1674) such as the "receptaculum chyli" and the "ductus thoracicus" draining into the jugular subclavian confluent. In this regard, Giovanni Guglielmo Riva (1627-1677) in "De lactice in animante" provides not only a complete description of the LS in humans but also a functional interpretation of showing it in a color painting on canvas (97x250 cm) called "Microcosmo" currently on display in the National Historical Museum of Health art in Rome. Rudbeck (1640-1702) and Bartholin (1616-1680) dealt with the distinction between chyliferous vessels and "vasa lymphatica" confirming the existence of a second circulatory system, as envisaged by Joyliffe (1621-1658). The instrumentation used for the maceration in water (Malpighi, 1628-1694) and injecting different liquids and waxes has allowed Hunter (1752) and Monro (1753) to envisage the possibility for the lymphatic vessels of an absorbing function already conceived by Glisson in his publication "Anatomica Hepatis" (1656). Mascagni (1755-1815) provided a masterly description and iconographic documentation of the lymphatic system through macroscopic and microscopic preparations of the human LVS, and also statues of wax, thus witnessing a valuable teaching skill over time. Furthermore, the injecting instrumentation through the use of particularly fluid colored substances, such as the mass of Gerota, and epoxides (Geox, Neoprene latex, etc.) has contributed to a qualitative and quantitative comparison between lymphatic and blood vessels allowing a classification of vessels as lymphatic peripheral with absorbing function (ALPA by Ottaviani) and as vessels with predominant function of conduction of the lymph (pre- and post-lymphnodal collectors, trunks, etc.). These morphofunctional features have found a definitive and unquestionable achievement thanks to electron microscopy instrumentation (SEM and TEM). In addition, the power of ultrastructural resolution, together with the reconstruction by three-dimensional models from ultrathin serial sections of the lymphatic endothelial wall, have further enabled to effectively understand the morphological mechanism responsible for the transendothelial passage of macromolecules (chylomicrons), the homing of lymphocytes to defende the organism and the metastatic spread of tumor cells (Azzali 1982-2003; Feng et al., 1991).

### LYMPHATIC DRAINAGE OF THE LUMBAR SKIN: THE PERFORATING VESSELS AND THE RELATION WITH THE ILIAC LYMPH NODES

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**Background:** Anatomical descriptions of the lymphatic drainage in the lumbar skin did not contemplate the relationship with iliac lymph nodes. After studying the conventional drainage of this region, we decide to research this important lymphatic pathway, throughout the perforating vessels. **Objectives:** Carry out a detailed description of the lymphatic drainage of the lumbar skin, remarking the connection between the superficial lymphatic drainage and the deep system with the iliac lymph nodes throughout the perforating lymph vessels and translating these anatomical findings into current clinical practice. **Methods:** In this study, 10 (n=10) lumbar skin of deceased fetuses and of 2 adults were injected. The injection had been performed with the modified Gerota's mass. Dissection had been carried out after appropriate fixation of the specimens in 40% formaldehyde for 6 days, and then immersed in a 100-volume hydrogen peroxide solution for 24 hours. In 8 fetus specimens we used the Spalteholz technique for diaphanization. **Results:** We found, after anatomical dissection and its interpretation, that the superficial lymphatic network of the lumbar región can reach the iliac lymph nodes throughout the perforating vessels in 6 (n=6) specimen; all of them have an intrinsic relationship with the psoas muscle. This connection, never before described, play a key role in the prognostic of lumbar skin melanomas.

#### REMODELING OF CARDIAC LYMPHATIC VESSELS CAUSED BY LYMPHOSTASIS

EIKICHI OKADA

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**Introduction:** This study was conducted in an attempt to elucidate the mode of remodeling of the lymphatic system of the heart induced by cardiac lymphostasis.

**Materials and Methods:** The mongrel dogs were operated on to induce cardiac lymphostasis by ligation of coronary lymphatic vessels. From the next day to 6 months after the surgery, we measured densities and total volumes of the epicardial lymphatic vessels. **Results:** The total volume, measured after 1 week  $(0.27 \pm 0.09)$ , 2 weeks  $(0.32 \pm 0.04)$ , and 6 months  $(0.23 \pm 0.05)$  continued to be higher than that on the first day  $(0.16 \pm 0.04)$  (p<0.05). The density measured after 1 week  $(2.6 \pm 0.3)$  and 2 weeks  $(3.7 \pm 0.3)$  were also higher than that on the first day  $(1.7 \pm 0.7)$  (p<0.01). However, 6 months later, the value of density  $(1.9 \pm 0.03)$  showed no statistical difference compared to that on the first day.

**Conclusions:** Cardiac lymphostasis induced by ligation of the coronary lymphatic causes continuous increase in total volume of the epicardial lymphatic vessels. In contrast, although the density increases at least until 2 weeks after surgery, it returned to the level of the first day, after 6 months after the surgery.

#### TECHNOLOGICAL INSTRUMENTATION AND ABSORBING LYMPHATIC VESSEL: HISTORY

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#### PHYSIOLOGY OF LYMPHATIC SYSTEM, SOME REMARKS

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Main function of the lymphatic system is 1) transport of interstitial fluid, which is produced by filtration of blood capillaries to and from the interstitium to lymphatic capillaries and then back to the blood circulation. 2) Lymphatics serve as a route for absorption of macromolecules-nutritiens: fat, vitamins and some proteins from bowels to the intestinal lymphatics which enter blood circulation for further processing. 3) Lymph nodes are a source of lymphocytes, forming immunology defence. 4) The right equilibrium of interstitial fluid with formation of lymph is prevention of development of lymphedema. Starling in the last century showed that the amount of fluid filtering outward from arterial capillary ends, equals almost exactly, the fluid returned by absorption to the blood circulation. Only small amount of fluid -10% is returned back to the circulation by way of the lymphatics. However this formule was recently revised – some physiologists question the mechanism of reabsoption-filtration of fluid in the venous capillary ends. Many factors influence the lymph flow. One of them are microvascular factors influencing the increase of lymph flow and edema formation. Lymph flow is increased when capillary hydrostatic pressure, capillary surface area, capillary permeability, tissue metabolism and muscle activity are increased. Edema formation is increased when plasma protein concentration decreases, arteriolar dilation, and capillary permeability increase. Other factors for the development of edema are venous and lymphatic obstruction. Lymphatic pumping increases the lymph flow by extrinsic and intrinsic factors. The extrinsic pumping relies on the cyclical, regular or irregular, compression-expansion of the lymph vessels by the activity of the surrounding tissue- skeletal muscle, smooth musle of the gastrointestinal organs, cyclic compression of concomitant arteries and by breathing. Intrinsic pumping is realized by the contractions and relaxation of smooth muscle layer in the wall of lymphatics: spontaneous contraction and pacemaker cells. Other factors - the role of nerves and development of lymphatic are discussed.

#### THE SKIN IN LYMPHATIC DISEASES FROM PATHOPHYSIOLOGY TO DISEASES

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Structure of the skin:It has a characteristic structre after the different portion of the body. The face and genitalia have rich distribution of the lymphatics whereas the back has a poor. The skin has no parasynpathetic nerve and the genitalia has no subcutaneous fatty tissue. The epidermis lack the blood vessel but there exists the nerve. Edema is difficult to be detected in histology. Diseases which the lymphatics are involved in and its management: 1. serous reflux: after physiotherapy by magnetic fields, vibration & hyperthermia, it stops permanently or temporaly. 2. a perfect prophylaxis for tinea:to reduce bacterial complication. 3. manegement of nail mycosis. 4. local elephantiasis: external application of Vit. D3 derivatives works well. 5. acute lymphangitis: its characteritics are mentioned. 6. lymphangioma: macroscopic diagnosis of superficial & dep lymphangioma. 7. peculiar finding in cheilitis granulomatosa. 8. severe ulcus: external application of basic fibroblast growth factor is an excellent treatment. **Conclusion:** If we understand characteristic structure and physiology of the skin, we can diagnose and treat many lymphatic diseases with good results.

#### EXPERIMENTAL STUDIES IN PATHOPHYSIOLOGY OF LYMPHATIC SYSTEM

#### ANDRZEJ SZUBA

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Experimental studies on lymphatic system started in early 20th century by Halstead, who tried to developed experimental model of extremity lymphedema in dogs. Successful experiments to create animal model of lymphedema were reported in 60's and 70's by Olszewski and others helped understand lymphedema pathophysiology. In the last 25 years several animal models of secondary lymphedema were created, including mouse tail, rabbit ear and rat tail and leg models enabling deeper insight into pathophysiology of lymphedema. Progress in molecular biology and discovery of Chy-mouse – an animal model of hereditary lymphedema and subsequently series of genetically modified mice with different types of lymphedema and lymphatic abnormalities deepened our knowledge on lymphatic pathophysiology. Advances in lymphatic imaging enabled further experimental studies on lymphatic system involvement in human pathology: inflammation, cancer, atherosclerosis, obesity and others. The lecture will review break-through experimental studies in the past and recently reported important experimental studies on lymphatic system pathology.

#### PATHOPHYSIOLOGICAL BASES OF LYMPHATIC DISORDERS

E. FOELDI Hinterzarten, Germany

#### PATHOPHYSIOLOGICAL MECHANISMS OF VARIOUS TYPES OF LYMPHEDEMA

GILBERT THIBAUT

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**Introduction:** Lymphedema (LE) appears when a part of Interstitial Fluid (IF) and consequently produced lymph are not entirely resorbed by the lymphatic vascular system. The medical prescriptions and the different phases of treatment vary, according to the etiologies and pathophysiological mechanisms.

**Schematic description of pathophysiological mechanisms:** A good knowledge of pathophysiological mechanisms is of great value to offer the right therapy. Various schemas can give a better view of the damaged lymphatic system.

• The pictures (1 - 1bis) are a schematic view of the vascular system of the body:

In basal conditions in case of a healthy subject

The lymph production is stable; it represents an amount whose name is Lymph Produced Volume (LPV), which reaches a basal level. Then the lymph is transported by only one of the two tubes in the right small container. The transport of the lymph is designated as "Transport Capacity" (TC). In case of increase of lymph production, TC may also increase by using the second transport connecting tube. From the right small container the lymph, which takes the name of Drained Volume (DV), is led by the thoracic duct to the venous circuit. Then in some circumstances for instance functional deficiency of lymphatic vessels, the equilibrium is lost. **Pathological events** 

• In case of an absence of lymphatic vessels (fig. 2) the usually filtered volume remains normal but the lymph cannot be transported and subsequently accumulates in the IS causing LE and swelling. Then the Lymph-Produced Volume is normal but there is no transport capacity and no drained volume. LE appears and it is rich in proteins because these proteins with no transport possibility, stay in the IS. A different case concerns situations where the number of lymphatic vessels is smaller but in the norm. Some Lymphatic Vessels (LV) are very thin, some others are dilated without intrinsic mobility.

• One may also observe nonfunctional valves partially destroyed or even, a complete absence of valves. This incapacity to propulse the lymph downstream in the venous system causes reflux in the intra-dermal micro-lymphatic vessels, accumulation in the IS and LE occurs. This LE is of functional origin (fig. 3): Filtered volume is normal, Lymph produced volume is normal, Transport capacity is reduced, Lymph drained volume is reduced, LE is rich in proteins.

#### MENTORSHIP AND SCHOLARSHIP IN LYMPHATIC SURGERY

CORRADINO CAMPISI

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**Introduction:** The aim of this Lecture is to underline the importance of Mentorship and of Scholarship in Lymphatic Surgery for Young Lymphologists of the New Generation. **Materials and Methods:** On the guide of his life experience, the Author points out the continuity from the Mentor to the Scholars, as pilaster of the cultural, research, training and of the best clinical practice in Lymphatic Surgery, which must represent, according to the Author's vision, a basic role for young surgeons to reach the highest top of best clinical practice, not only in General Surgery, but in any other specialistic branch od Surgery, above all by learning microsurgical methodology and skills. **Results:** The Author's panoramic experience shows the multiformuc and eclectic advantages of this kind of educational program to acquire the best performance statement in the surgical practice. **Conclusions:** Lymphatic Surgery represents today a solid basis for the best clinical practice in every branch of Surgery. Medical student and surgical resident educational programs would reserve a proper space to the training, research and clinical applications skills in Lymphatic Surgery and Microsurgery, to reach highest quality performance in Surgical Practice, to perform fine, conservative and functional surgery, to improve the results of minimally invasive procedures also considering Robot- Guided new Techniques, to avoid lymphatic injures and complications, to realize high quality of life long- term clinical outcomes in any type of surgery. This one must become the challenge for next generations of surgeons.

### SESSION III PRIMARY AND SECONDARY PREVENTION: DIAGNOSTIC AND OPERATIVE ISSUES

#### WHAT DO WE MEAN WHEN WE SPEAK ABOUT PRIMARY AND SECONDARY LYMPHEDEMA PREVENTION?

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The authors bring their experience on 3500 patients treated for lymphedema and beside this aspect, they add their own experience of treatment of breast cancer and on rational attitude concerning lymph nodes of the lower limb.

#### PRIMARY PREVENTION OF LYMPHEDEMA

It represents in the first step, the concept "give good recommandations, good advices" to a patient operated for axillar lymphadenectomy. In the second step primary prevention is represented by the classical treatment of edema by either physiotherapeutic intensive treatment of surgical attitude (lymphovenous or lympholymphatic anastomosis). In the second step antibioprophylaxy by benzathine penicillin is necessary when the patient had presented more than one access of acute dermatolymphangioadenitis. All those considerations represent a sort of resignation. They look like the acceptance of a defeat. All these therapeutical attitudes of primary prevention accept the idea that surgeons or radiotherapists are not able to change their indications.

#### SECONDARY PREVENTION OF LYMPHEDEMA

First of all, be carefull concerning lymphnodes of inguinofemoral region. Never practice an extensive lymphadenectomy only for diagnosis and if we are not sure of malignancy. For upper limb adopt a very conservative attitude that is the respect of the important anatomical derivative ways described by Leduc and Caplan. Limit the clearing out of axilla only to the formation so called "the axillar cellulo adipotic formation". The respect of the concept of sentinel lymph node could be interesting but does not resolve the problem. In addition, the surgeon must do a good hemostasis and a very carefull lymphostasis and put one or two little tubes to avoid the constitution of lymphocela. For the constitution of lymphocela occurs in 50% of cases, a lymphedema with many ponctions. So, in summary, our concept of efficient preventive attitude of lymphedema lies upon the constation of the real reasons of apparition of lymphedema:

- · Practice of inguinofemoral lymphadenectomy for diagnosis
- Destruction of vicariant ways by the surgeon or the radiotherapist (deltopectoral, Mascagni, Sappey's way, tricipital, posterior scapular).
- The constitution of lymphocela with many ponctions.

If we avoid those 3 detrimental attitudes, we respect secondary concept of prevention of lymphedema.

### PRESENT ROLE OF LYMPHATIC IMAGING IN THE PREVENTION OF LYMPHEDEMAS AND FUTURE PERSPECTIVES

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#### **Pre-operative approaches**

The CT, MRI, PET-CT investigations of the LN group(s) "at risk" in order to define the "pN+" cases? In cN0 patients and in patients "at low risk" (on the basis of "nomograms" ?), the US investigation of the axilla (BC, Melanoma) and/or of the groin(s) (Melanoma, Vulva, Penis...) and, if the US exam is positive and/or suspicious, with their biopsies  $\mathbb{X}$  – if pN– $\mathbb{X}$  No LN dissection?

- if pN+ $\mathbf{X}$  C(Axill-Ing)LND and/or/after pre-op NAT?

The Lymphoscintigraphic investigation of the limbs to define the patients at risk (with SPECT-CT evaluation of the LN). The Lympho-Fluoroscopic investigation of the limbs to define the patients at risk?

#### Per-operative approaches

The "Sentinel Lymph Node" investigations

The "Reverse Mapping" or the imagings of the LN draining the limb (in cN0 patients and in patients "at low risk"? on the basis of "nomograms"?)

The "Lympha" solution?

#### **Post-operative approaches**

The Lymphoscintigraphic (with SPECT-CT and/or (?) Lympho-Fluoroscopic (?) investigation-s of the limbs to define the patients at risk.

### LYMPHO-FLUOROSCOPY AS A HELPFUL TOOL IN EARLY DETECTION OF SUBCLINICAL CANCER-RELATED SECONDARY LYMPHOEDEMA

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Near infrared fluoroscopy is an emerging imaging tool in the field of lymphology. The use of Indocyanine green (ICG), and a dedicated camera (PDE<sup>®</sup>), makes it possible to visualize the superficial lymphatic network architecture and the lymph propagation in real time. Video images of this lymph propagation are analyzed, resulting in a semi-quantification of lymph flow. This imaging technique contributes to map superficial lymphatic networks. The damage to the lymphatic network after oncological surgery can be evaluated before the edema is measurable. We show video highligths based on 262 lympho fluoroscopies, realized during the evaluation of subclinical and clinical secondary lymphedema and experiences on healthy subjects.

After a subcutaneous or intradermal injection of highly diluted Indocyanine Green (ICG), we observe and record on video the tracer's progression in oncological patients at risk for the development of lymph edema, before and after their oncological treatment. These images are processed and the architecture of the superficial lymphatic network is analyzed and compared with the images of healthy subjects and edema patients.

We identify in several areas the same modifications of the lymphatic architecture in this specific series of patients (without edema), as in the series of patients with secondary lymph edema after cancer treatment.

These findings can adapt the intensity of the follow up and preventive treatment in these specific patients.

In near future, the lympho-fluoroscopy will become a helpful tool in the preclinical detection of lymph edema in oncological patients at risk for the development of lymph edema.

Intensive follow-up and preventive treatment may avoid the development of a 'full-blown' lymph edema.

### TISSUE DIELECTRIC CONSTANT (TDC) MEASUREMENT, BIOIMPEDANCE SPECTROSCOPY AND ARM VOLUME MEASUREMENT IN EARLY DETECTION OF BCRL

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**Introduction:** In dielectric measurement of skin and upper subcutis an electrical parameter, tissue dielectric constant TDC, directly related to tissue water content can be determined. If breast cancer treatment-related lymphedema (BCRL) manifests initially only in skin and upper subcutis, the TDC measurements might offer an optimum solution to detect lymphedema. Therefore, the superficial TDC measurements were compared with techniques specific to whole arm metrics such as arm volume measurement and bioimpedance spectroscopy (BIS) in patients within one year from BC treatment.

**Materials and Methods:** One hundred BC patients were investigated within one year from breast surgery, axillary dissection and related radiotherapy (RT). Clinical diagnosis of lymphedema was based on arm excess volume >5% measured by water displacement method (WDM), increased subcutaneous thickness by palpation and/or a patient's experience of arm tension. Both arms were measured and arm ratios for TDC, BIS and WDM methods between the affected or at risk arms and healthy arms were calculated.

**Results:** Thirty-eight patients were clinically diagnosed for LE (38.0%). According to the technique-specific lymphedema threshold limits the TDC technique was in accordance with clinical diagnosis in 32/38 patients (84.2%) and the BIS technique in 16/38 patients (42.1%).

In 32/38 lymphedema patients edema in skin and upper subcutis was greater than 20%, i.e. TDC ratio >1.20. In these patients the WDM and BIS ratios were elevated in 25/32 (78.1%) and 15/32 (46.9%) patients, respectively. Six of 38 lymphedema patients did not have edema in skin and upper subcutis although high WDM ratios indicated lymphedema. Three of these patients were diagnosed for lymphedema immediately after RT.

TDC measurements revealed that 14/38 lymphedema patients (36.8%) had BCRL in upper arm, 4/38 patients (10.5%) in forearm and 14/38 patients (36.8%) at both sites. In the non-lymphedematous 62 patients, 18/62 (29.0%), 4/62 (6.5%) and 4/62 (6.5%) patients had arm ratios suggesting for lymphedema with TDC, WDM and BIS methods, respectively.

**Conclusions:** TDC method was assisting diagnosis of lymphedema significantly better than BIS method, characterizing regional differences in arm lymphedema and increase of tissue water in skin and upper subcutis in patients at risk. Discrepancy with the WDM method in lymphedema patients without skin edema may indicate that lymphedema may not always initiate from skin.

#### PREVENTION AND EARLY MANAGEMENT OF BREAST CANCER RELATED LYMPHEDEMA

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**Introduction:** There are many benefits of early diagnosis and treatment within many areas and this also goes for cancers related lymphedema (LE). The LE can either be eliminated at an early stage, when still minor, or reduced to a level that minimizes the effect on activities or quality of life.

Early diagnose routine follow-up visits for all patients at risk are recommended. In a clinical survey it was found that within a year after surgery about 50% are detected already at first follow-up visit 4-5 weeks after surgery, using volume measurement and palpation of thickness in the subcutaneous tissue. Another examination 3-4 months after completion of radiotherapy detected another 30%. It is recommended that patients at risk are provided with a brief LE preventive information at surgery and more deepened at the first followed up. This information should include basic function of the lymphatic system, early signs of lymphedema and skin care. At this time the therapist measure the leg or arm and order compression garments in case there is an edema. Further follow-up once a month is recommended until the LE is considered stable, and thereafter follow-ups are individually settled.

**Material and Methods:** A retrospective 10-year follow-up of early diagnosis and treatment of arm LE in ninety-eight breast cancer patients, all with axillary surgery and radiotherapy, was performed (Johansson & Branje 2010).

**Results:** At diagnosis the mean volume difference between the arms was 8,1% and at last follow-up measurement (mean 4 years after diagnosis) the difference was 9 %, both values considered to be low. In the same study we also found that 81% of the patients had <10% difference (mild LE) already at diagnosis. At average 4 years after the diagnosis, mild LE still could be found in 69% of the patients, revealing that increase of volume to moderate LE (10-20% difference) developed only in 12% of the patients.

Conclusion: Results showed that LE can be kept on a very low level in terms of edema volume, when diagnosed at an early stage.

#### LYMPHA INITIAL EXPERIENCE AT COLUMBIA UNIVERSITY MEDICAL CENTER

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**Introduction:** We report our preliminary experience performing lymphatic-venous anastomoses (LVA) using Lymphatic Microsurgical Preventive Healing Approach (LYMPHA) at the time of surgery for the primary prevention of lymphedema in breast cancer patients undergoing ALND. This preventative microsurgical procedure was first described in ASO in 2009 by Boccardo, Campisi et al.

**Methods:** Node positive patients requiring ALND, most with locally-advanced breast cancer (13 of 25 [52%] having received neoadjuvant systemic therapy) at the highest risk of lymphedema were offered LYMPHA. Following ALND a skilled microvascular surgeon performed LVA in 21 of 25 (84%) eligible female breast cancer patients. Four patients did not undergo LYMPHA (no lymphatics were identified in 1 and no suitable vein was found in 3). Axillary reverse mapping using blue dye injected in the upper arm to identify afferent lymphatic vessels, 1-3 (mean 1.5) of which were sutured into a branch of the axillary vein distal to a competent valve. Both pre- and post-operatively evaluations performed with lymphoscintigraphy and limb volume via circumferential measurements and (L-Dex<sup>®</sup>) bio-impedance spectroscopy.

**Results:** Over 18 months (12/12 to 05/14), 21 patients successfully underwent LYMPHA. Three (11%) of these patients had breast conserving surgery while the others underwent mastectomy. The mean follow-up was 3.8 +/- 3.9 months. Nineteen of 21 (90%) patients had normal pre-operative lymphoscintigraphy (LS). Three of 21 (14%) patients developed clinically-apparent lymphedema, 2 transiently and resolved, and 1 with ongoing symptoms. Two of 3 patients had radiation. Three-month post-op LS showed patent LVA in 8 of 11 (73%) patients. Sub-clinical limb volume increases developed in 12 of 21 (57%) patients, 7 of which received radiation. LYMPHA OR time about 45 minutes. No LVA related complications.

**Conclusion:** Based on our results, LYMPHA is an important technique for the primary prevention of breast cancer-related lymphedema. In this highest risk group of breast cancer patients, our clinical lymphedema rate was 3 of 21 (14%), 2 of which were transient. Sub-clinical volume increase was identified in 12 of 21 (57%), 7 of which had received radiation. Given the strong association between radiation and secondary lymphedema/increased limb volume, modifying radiation fields may reduce lymphedema risk post LYMPHA.

#### LYMPHA TECHNIQUE: NO REASONS NOT TO USE IT!

#### FRANCESCO BOCCARDO

IRCCS S.Martino – IST National Cancer Institute - Dept of Surgery – Unit of Lymphatic Surgery (Chief: Prof. C. Campisi) - University of Genoa – Italy

Lymphedema is a consequence of cancer treatment and patients should be informed of the signs, symptoms and possibilities of prevention for lymphedema. The use of the blue dye and of LVA helps to solve the problem of preventing secondary arm and leg lymphedema even maintaining the oncological radicality.

Recent advances in the treatment of breast cancer, specifically as concerns the prevention of lymphatic complications following sentinel lymph node biopsy and axillary dissection, brought to the proposal of a new technique to primarily prevent lymphedema by microsurgical lymphatic-venous anastomoses (LYMPHA). L-V shunts have been chosen for LYMPHA technique instead of lymph node or lymph vessels transplantation because it is a faster technique and does not require lymph node or lymph vessels harvesting in sound areas. ARM technique allows to identify arm lymphatics and lymph nodes which can therefore be preserved even though there is the risk to leave undetected metastatic disease in the axilla. But, it is almost impossible to preserve efferent lymphatics from the blue nodes because they join the common axillary nodal basin draining the breast. Thus, not preserving efferent lymphatics makes practically impossible to preserve arm lymphatic flow. So, on the basis of the clinical experience in the treatment of lymphedema by microsurgical lymphatic-venous anastomoses (LVA), we thought to perform LVA immediately after finishing nodal axillary excision. The surgical technique proposed for patients with operable breast cancer requiring an axillary dissection consisted in carrying out LVA between arm lymphatics identified by injecting blue dye in the arm and an axillary vein branch simultaneously. It is almost always possible to find blue lymphatics and also to find a vein branch long enough to be connected to arm lymphatics which are usually locate very laterally. LYMPHA is used also to primarily prevent leg lymphedema in vulvar cancer and trunk melanoma. LYMPHA, therefore, might represent a rational approach to the prevention of lymphedema and reduce other lymphatic complications after axillary and groin surgery in the therapy of malignant tumors.

#### LYMPHEDEMA PREVENTION AND TREATMENT: STATE-OF-THE-ART FROM THE ISL CONSENSUS DOCUMENT MICHAEL BERNAS

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The ISL Consensus Document (CD) represents the centerpiece of current views on diagnosis and treatment of peripheral lymphedema from the broad perspective of leading lymphologists from around the world. It is the oldest Consensus Document in the field of Lymphology and its origin represents global theory, practice, and needs that coalesced into a working document in 1994 at the ISL Executive Committee meeting at the Foldiklinik and was most recently updated in 2013.

The CD, extensively cited and used throughout the world, is broad in scope - as are ISL members and practitioners and the patients with lymphedema. Because this diversity spans geographical and political boundaries, context and specifics of medical disorders, variable health care systems and resources, and patients themselves, it is a tool and not a set of strict protocols or best practice mandates with exhaustive references or metanalyses which may rigidly define the boundaries of quality care for specific forms or location of lymphedema without complications.

These specifics (often debatable, contested and of uneven quality) are readily available, but need to be tempered by clinical judgment, patient concerns, and the local environment.

All contemporary treatments and even many not widely used are addressed in the document for the reader to evaluate.

Unfortunately, even widely used methods have yet to undergo sufficient meta-analysis of multiple studies which have been rigorous, well-controlled, and with sufficient follow-up and maybe more importantly, good studies comparing different methods of treatment do not exist.

This lack of evidence is troubling, but does allow differences of expert opinion in varied circumstances to be used to determine the optimal clinical options for their specific patients. Prevention studies are found in very small numbers in the literature and no meta-analysis of any method exists.

The CD does not currently include prevention strategies, but a few ideas have been proposed for the next update and this "living document" will include some of these to offer ideas to the readers and stimulate debate among experts.

### SESSION IV PREVENTIVE AND THERAPEUTIC MEANING **OF NON-OPERATIVE PROCEDURES**

#### STATE OF THE ART IN PHYSICAL TREATMENT OF LYMPHOEDEMA

ALBERT LEDUC, O. LEDUC, P. BOURGEOIS

The Executive Committee of the International Society of Lymphology updated, in a consensus document, the practice guideliness on the diagnosis and treatment of peripheral lymphedema. This consensus document, published in Lymphology 46 (2013), informs that the first treatment of peripheral oedemais is the physical treatment consisting in:

Manual Lymphatic Drainage

Sequential Intermittent Pressotherapy

Multilayers Bandages

Compression garments

These guidelines were also updated after discussions between several treatment centers in Europe. The "Association des Physiothérapeutes de Suisse Romande", with European treatment centers, under leadership of the authors recommend to adapt the consensus and recommend new guidelines dividing the physical treatment of oedema in several steps according to the volume and the anamnesis of the oedema (Eur.J.of Lymphology 55, 2008) : 1. The limb volume is less important than 10 % difference: MLD preventive + stockings

2. The limb volume, recently increased, is between 10 to 20 % difference: MLD therapeutic + stockings

3. The limb volume is more than 20 % difference and since long time existing: ISL consensus + stockings / sleeves

Before starting with the treatment we have to remind that oedema consists in an abnormal accumulation of fluid containing macromolecules generating an inflammatory process stimulating the tissular evolution of the oedema. It is well known that "oedema" is a "symptom" resulting from a "desease" and that the desease consists in a lymphatic insufficiency.

To be efficient, the physical treatment has to treat not only the symptom but has also to treat the desease.

In a first step, the authors present several slides showing that the symptom (the volume of the oedema) is decreasing during the application of the physical treatment.

In a second step the authors present several unexpected lympho-lymphatic pathways isolated during human dissections. These unexpected lymphatic derivative pathways are numerous :

- The Mascagni pathway (direct or indirect) is draining the arm to homolateral supra clavicular lymphnodes.
- The trans-axillar derivative pathway is draining the front side of the arm to the opposite axillar lymph nodes (\*).
- The trans-subclavian pathway is draining to lymphnodes in the basis of the neck (\*).

• The Caplan or tricipital pathway is draining the posterior part of the arm to dorsal superficial lymphnodes.

(\*) These derivative pathways exist on the back and on the front side of the chest. The authors give the percentage of existence of these derivative pathways and they demonstrate how the physical treatment is also treating the desease: they demonstrate, by mean of direct lymphographic, by lympho-scintigraphic and by lympho-SPECT-CTinvestigations, that the physical treatment is opening and stimulating lympho-lymphatic derivative pathways. Finally, they demonstrate that the oedema that developes after adenectomy is drained according to unexpected directions. The authors also demonstrate that MLD initiates and increases the function of these numerous unexpected derivative pathways. They may conclude that the Physical Treatment of the oedema, in accordance to their method, is not only treating the symptom but is also treating the desease.

#### THE ROLE OF COMPRESSION GARMENTS IN THE MANAGEMENT OF LYMPHEDEMA

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Although the pathophysiology of edema varies, compression is the cornerstone of lymphedema management. However, the evidence base for the optimal application, duration and intensity of compression therapy is lacking. Compression can be used by the means of intermittent pneumatic compression, bandages or compression garments.

Compression garments can be prescribed for prevention of lymphedema, during Decongestive Lymphatic Therapy (DLT) to achieve volume reduction and during maintenance treatment.

While some authors recommend wearing a garment to prevent the appearance of lymphedema after axillary and inguinal lymphadenectomy, the study of Stuiver did not find any difference from using or not compression stockings in the prevention nor in the severity of lymphedema, after inguinal lymphadenectomy.

Concerning Post-thrombotic syndrome, a recent trial has reported that elastic compression stockings did not prevent it after a first proximal deep vein thrombosis, hence authors do not recommend routine wearing of elastic compression stockings after DVT. Compression garments have also been used as the compression method during DLT ro achieve volume reduction. While the reduction obtained with garments of the edema is less important than the reduction obtained with bandages, the upper extremity functional status (lower DASH scores) is better than with bandages.

Concerning maintenance phase, studies with follow-up periods of 6 months to 5 years indicate that compression garments are effective in maintaining the volume of the arm in BCRL. Consensus documents and systematic reviews state that:

 $\boxtimes$  A prescription for low stretch elastic garments to maintain lymphedema reduction after DLT is essential for long-term care.  $\boxtimes$  A trained practitioner should check that a newly prescribed garment fits properly and fully covers the area requiring treatment. Standards of different garments, the availability and reimbursement by public health system are not uniform between different countries. Thus the patients are wearing a wide range of products, depending on this availability rather than an accurate prescription. In our unit we performed a descriptive study to prospectively analyse the fitting of the garments in 130 patients with BCRL and the efficacy of them in maintaining the volume of the arm at long-term , .

The change of Volume was calculated as a percentage from the baseline volume at 1st, 6th and 12th months after the adaptation of the garment.

The volume calculated with the Kuhnke formula: decreased at 1st month: a mean of -1.6% from baseline; returned to baseline after 6 months: 0.0%, and increased a little after 12 months: 1.5% (95%CI:-0.4-3.5). The efficacy was found to be related to a better fitting of the garment. The fitting and satisfaction of the garment are important in predicting its efficacy in maintaining the volume and the compliance of the patients with it, thus it is necessary to check the garment always after the prescription.

Another important issue about compression garments is the patient's adherence to it. Brown et al report that a 60 % of patients for whom compression garments were prescribed as part of self-care wore their compression garment and less than 75 % of the frequency prescribed by their lymphedema clinician.

This is especially important in upper limb lymphedema, as the patients complain about the influence of the garments on hand functions in daily life. Activities that involve heavy lifting, gripping, holding, and hand dexterity are impeded by compression materials and interfere with certain job requirements in activities of daily living. Particularly, the grip strength and manual dexterity scores in patients with BCRL are influenced by the characteristics of the compression type. A wider choice of compression materials would improve on hand function in activities of daily living.

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#### HOW TO OBJECTIVELY ASSESS RESULTS OF LYMPHEDEMA TREATMENT

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Lymphedema is a symptom of failed lymph system resulting in delayed transport of the lymph fluid. Lymphedema is demonstrated by swelling of the affected tissue.

Aim of this study is to demonstrate an effective, objective and cost effective way to assess the efficacy of the lymphedema treatment measured by ultrasound. The ultrasound evaluation can assess the skin thickness, subcutaneous tissue changes and the excess of the adipose accumulation.

Methods: 20 patients with lower extremity unilateral lymphedema were evaluated 9 primary and 11 secondary.

The Measurements were taken at the medial aspect of the ankle, medial calf, medial distal thigh and medial groin. The Terason 12MgHz probe was used by one examiner only at the baseline before the MLD, after 30 minutes of MLD administration and after 30 minutes of IPC treatment.

**Results:** Reduction after MLD alone was achieved by 15.1% with additional reduction of MLD and IPC to 25.3 %. **Conclusion:** The Ultrasound is an effective, objective and cost effective tool to assess the efficacy of the LE treatment.

#### MANUAL LYMPHATIC DRAINAGE: FROM IMAGING TO DAILY PRACTICE

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Near infrared fluoroscopy is an emerging imaging tool in the field of lymphology. The use of Indocyanine green (ICG), and a dedicated camera (PDE<sup>®</sup>), makes it possible to visualize the superficial lymphatic network architecture and the lymph propagation in real time. Video images of this lymph propagation are analyzed, resulting in a semi-quantification of lymph flow. This imaging technique contributes to map superficial lymphatic networks and provides us a sensitive tool to improve physical treatment of lymphedema. We report our experience based on 262 lympho fluoroscopies, realized during the evaluation of lymphedema and experiences on healthy subjects.

After a subcutaneous or intradermal injection of highly diluted Indocyanine Green (ICG), we observe and record on video the tracer's progression, performing specific protocols. The objective of these protocols is to study the diverse physical treatment techniques such as different manual lymphatic drainage methods, intermittent compression therapy, multicomponent bandages or the wear of sleeves. At the end of the examination, when substitution pathways are identified, we trace and draw them on the patient's skin in order to map them for future physical treatment.

Showing videos, our communication will point out the main results of our experience with cases where lympho fluoroscopy carries out an added value to lymphedema evaluation and treatment.

The major advantage of this imaging technique is the possibility to observe in real-time fluid movements from the interstitial space to the lymphatics, lymph propagation velocity, contraction rate, kinesiology of the lymphangions, mapping of substitution pathways and detection of subclinical lymphedema and "ectopic" lymph nodes in lymphedema.

### THE EFFECTS OF THREE-YEARS PNEUMATIC COMPRESSION OF POSTINFLAMMATORY AND POSTTRAUMATIC EDEMA OF LOWER LIMBS

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**Background:** Chronic edema of lower limbs after trauma, venous ulcers and recurrent dermatitis is a serious disabling complication affecting millions around the world. The cause of edema are chronic inflammation and venous and lymph stasis. The only solution for therapy of these large cohorts of patients is mechanization of treatment using mechanical devices for intermittent pneumatic compression (IPC).

**Aim:** To investigate how effective is a 3 years continuous daily high pressure, long inflation time IPC therapy in decreasing limb circumference/volume, tissue elasticity, histological changes and incidental complications.

**Methods:** Twenty randomly selected patients with unilateral lower limb post inflammatory and posttraumatic edema stage II to IV were treated daily for a period of 3 years with a pneumatic device, 8 chamber sleeve, sequential inflation of chambers to 100-120mmHg for 50 sec(total 400sec) and no distal deflation, and 50 sec sleeve deflation time. The changes in limb circumference and tissue tonicity were measured at monthly intervals. Results.Treatment revealed durable decrease of limb circumference and increased elasticity .Improvement was most expressed in the calf above the ankle and mid-calf. Limb circumference was decreased or at least stabilized, elasticity of tissue was increased and maintained. No complications as thigh ring or chronic genital edema were observed. **Conclusions:** IPC takes over the transport function of stagnant tissue fluid from the insufficient veins and obliterated lymphatics by squeezing edema fluid to regions with normal drainage. Long term, high pressure IPC, long inflation timing therapy can be safely be recommended to patients with lower limb edema.

#### LYMPHOLOGY IN NORTH-EAST OF ITALY

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Lymphology is the study of lymph and lymphatic system. Among all lymphatic system diseases, certainly the best known and most represented is lymphedema.

In North-East of Italy the lymphedema incidence is similar to that found in the rest of the Country and is mainly secondary to armpit interventions for breast disease, about 90% of upper limb lymphedemas, or groin interventions for gynecological and urological cancers, about 80% of lower limb lymphedemas.

The treatment is based on three fundamental pillars:

1. Physical therapy: various techniques of lymph drainage (manual, mechanical, elastic compression);

2. Pharmacological therapy;

3. Surgical therapy: derivative and reconstructive microsurgery.

The synergism of the above listed treatments allows to achieve results not otherwise obtainable with simple implementation of a single therapeutic approach. Extremely significant is the economic and social impact of lymphedema: although precise data related to our Country are lacking, a comparison between different series of cases, in USA recorded, shows an annual cost of approximately 3000 dollars/patient (2200 euro), when treatment is late and/or incompletely administred; spending drops to about 700 dollars (520 euro) when planning is done early and properly.

Until now, in North-East of Italy only physical and pharmacological therapy was available. Recently, however, at our Institution and thanks to the teachings of Prof. Campisi (Director of the Lymphatic Surgery Unit of Genoa - S. Martino Hospital/IST), we started an intensive training and have established a partnership covering all aspects of surgical lymphology. In particular, following the guidelines of this Reference Center, we are now able to complete the clinical/instrumental evaluation of any patient requiring surgical care and, therefore, we plan his optimal therapeutic strategy by joining the specific health expertise of Mestre and Genoa.

#### LONG TERM FOLLOW UP IN THE PHYSICAL TREATMENT OF POST-MASTECTOMY LYMPHEDEMA

MAURO ANDRADE

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**Introduction:** Risk of failure of conservative treatment of lymphedema after breast cancer treatment has been reported to progressively increase during long term follow-up, reaching up to 60% failed interventions after five years. As therapeutic methods and maintenance phase strategies may vary for different treatment centers, we analyzed our long term results from our casuistry.

**Methods:** We studied arm volume reduction in 48 patients whose follow-up was at least 12 months obtained after decongestive phase, without additional MLD or bandaging. Age, initial volume, edema extension, infection and cancer recurrence were matched to final results to seek any correlation with poor prognosis.

**Results:** Considering failure as an increase of at least 10% of the measurements obtained at the end of the decongestive phase, no recurrence was observed in 75%(36/48) whereas in 25% of the patients (12/48) a new decongestive phase was indicated. Interestingly, we observed additional volume reduction in follow-up in 16 patients.

**Conclusion:** In conclusion, edema recurrence is not to be expected after a single course of complex physical therapy and indication of regular decongestive treatment should be evaluated for each individual patient.

#### INFECTIONS AND LYMPHEDEMA: THE ROLE OF COMPLETE DECONGESTIVE TREATMENT

#### EVANGELOS DIMAKAKOS

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Lymphedema has been shown in several studies to be the strongest risk factor for infections. The most frequent medical emergency associated with lymphedema is caused by a bacterial infection in the affected limb. These infections require prompt medical attention and correct treatment.

As we know, Lymph is responsible for transporting essential immune chemicals and cells. Stagnant lymph fluid contains protein and cell debris that causes swelling of affected tissues. The protein-rich lymphatic fluid serves as an excellent medium for bacteria to grow, and stagnation of the lymphatic fluid due to impaired lymph drainage with consequent reduction in lymphatic clearance creates a state of local immune deficiency, which, in turn, can increase the risk of local cellulitis. An untreated lymphedema leads to chronic inflammation and hardening of the local skin. Because of the swelling, even in minor lymphedema, the natural defense cells of the body may be too ineffective in fighting off invaders adequately. If the layer of skin is damaged or broken, it permits bacteria to get into the body causing an infection. The aim of our work was to study the effect of complete decongestive treatment in appearance of episode of infections in patients with lymphedema. In our very important study shows a statistically significant reduction (p = 0,0000 X2 Yates's correction, CI 95%) of inflammation and especially of recurrent inflammations in patients with lymphedema after the treatment with the complete decongestive therapy and the directly improvement of their quality of life. Moreover our study shows that lymphedema is a bad prognostic factor for the appearance of infection and so the earlier start his correct treatment of lymphedema the best patient prognosis.

#### DRUGS IN LYMPHEDEMA TREATMENT

ALBERTO MACCIÒ LymphoLab Onlus, Italy

The most important parts of combined therapy in lymphedema patients consist of:

- Good General Care of the skin, weight control and however a healthy lifestyle;
- Physical therapy including bandages, elastic garments and stockings, manual and mechanical lymph-drainage;

- Pharmacological therapy;

- Surgical therapy (overall microsurgery approach):

For this reason the pharmacological supports in clinical lymphology is very important in the daily activity for the treatment of primary or secondary lymhostasis in association with the other components of combined therapy.

This is particularly true in areas around the world where filariasis is endemical. In these countries, the patients have a difficult time finding the appropriate bandages, capable physical therapists or even more there is a serious lack of trained surgeons in microsurgical lympho-venous anastomoses.

The role of drugs can be to "convert a slowly worsening condition into a slowly improving one in lymphedema patients" (Casley-Smith 1992).

In this lecture, we will show you the role of drugs in the treatment of lymphedema and and we will analyze all the most substantial contributions of literature to discuss the most important therapeutic substances and their pharmacokinetics and pharmacodynamics. We would like to focus our attention on pharmacological treatment of chronic lymphostasis and acute complications and prophlaxis of lymphangitis (cellulitis in lymphedema patients) within Evidence Based Medicine.

### SESSION V WHICH IS THE PRESENT ROLE OF DIFFERENT TYPES OF SURGERY IN EARLY AND LATE STAGE LYMPHEDEMAS?

#### PATHOPHYSIOLOGICAL BASES OF LYMPHATIC MICROSURGERY: HOW TO REACH THE BEST RESULTS WALDEMAR OLSZEWSKI

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An evident progress has been made since mid of the XXth century in therapy of lymphedema. Elephanthiasis has practically been eradicated in the western hemisphere. This has been the combined effect of manual drainage, pneumatic compression, elastic garments and administration of long-term antibiotics for prevention of chronic and recurrent acute dermato-lymphangio-adenitis (DLA), as well as surgical procedures, with first of all lympho-venous shunts. The indications for surgical treatment of lymphedema, developed over time, should be diversified depending of the etiology of this condition. The majority of lymphedema cases around the world are of post-inflammatory (post-infective?) type with gradual obliteration of peripheral lymphatics. The inflammatory causative factor persists and adversely affects patency of the constructed anastomoses. The post-traumatic type of lymphedema has at least two pathological components as prolonged healing of damaged tissues like bones and muscles and wound infection. Both may gradually damage the draining lymphatics and nodes. The post-surgical oncological cases are the most favourable for early microsurgical shunts, as the peripheral lymphatic trunks are healthy and retain their contractility for years. Lymphoscintigraphic and infrared lymphographic functional pictures decide upon the site and expected effectiveness of the microsurgical shunts. The accumulated experience has allowed to formulate the detailed contemporary indications. They are:

Lymphedema at an early stage (I and II) of postinflammatory, postsurgical and hyperplastic type with at least one calf or thigh lymphatic and a single inguinal or iliac lymph node visible on the functional lymphoscintigraphy (performed during limb pneumatic massage or after standard time walking) or on near-infrared ICG lymphography with tissue massage. Surgical lympho-venous shunts should be performed as soon as obstructive lymphedema is diagnosed. Also preventive shunts at the time of inguinal or axillary and inguinal lymphadenectomy are highly recommended. Has isotope or ICG lymphography shown patent lymphatic but no their contractility (tracer stop), lymphatico-venous shunts should still be performed followed by postoperative intermittent pneumatic compression providing force for lymph flow through the anastomosis.

#### MULTIPLE LYMPHATIC- VENOUS ANASTOMOSES (MLVA): A LONG LIFE EXPERIENCE

#### CORRADINO CAMPISI

IRCCS University Hospital San Martino-IST National Institute for Cancer Research Dpt. of Surgery Lymphatic Surgery, DISC, Genoa, Italy

Author points out the 41 years research and clinical experience on Lymphatic Microsurgery, at the University Hospital San Martino, in Genoa, Italy, starting from 1973.Long-term clinical outcome is shown and discussed. Materials and Methods: Clinical Registry concerns more than 3000 cases treated by Derivative and Reconstructive Microsurgical Procedures, with a post-op follow-up from at least 5 years to more than 20 years after operation. Multiple Lymphatic-Venous or Lymphatic-Venous-Lymphatic shunts were performed, according to the lymphedema staging, both primary and secondary. Our 3 Phases Protocol of Complete Lymphedema Functional Therapy (2007) includes 1st Phase of CPT ((Combined PhysioTherapy) for 6-12 months; 2nd Phase of Microsurgery (1week), and k 3rd Phase of Post-Op-Rehabilitative CPT(at least 5 yrs). EcoColor Doppler Venous investigation is mandatory in the pre-op evaluation of cases to verify health anatomical and functional conditions of venous system and plan right surgical strategy and indication to1) MLVA, eventually combined with an External Valvuloplasty ,or the indication to 2) Multiple LVLA (Lymphatic-Venous-Lymphatic Plasty C. Campisi, 1980), for cases of serious venous disease contraindicating derivative L-V shunts. In late stages of lymphedema with excess of fibrous adipose tissue, Fibro-Lipo-Lympho-Aspiration (FLLA) can be addedd after MLVA, performing a safe liposuction - like technique by Lymph Vessel Sparing Procedure (LVSP), according to own method (C.C.Campisi, 2012). To avoid lymphatic injuries and above all secondary lymphedema after nodal dissection in oncologic surgery (Breast Cancer, Melanoma, etc.), or in other specialistic surgeries, Lymphatic Microsurgical Preventive Healing Approach (LYMPHA) represents today the best way to realize Primary Lymphedema Prevention. Results: Post-op long- term clinical outcome shows significant and effective results, with a percentage rate of volume edema reduction in >80% of cases, considering all stages, and >95% of cases, in the earliest stages. Quality of Life of patients can improve in a significant way according to the lymphedema staging. Conclusions: Today Lymphatic Microsurgery can be defined by the acronym F.I.E.R.A.E.: F = Fast, I.= Increasing, E.= Effective, R = Recovering, A = Aesthetic, E = Economic.

#### THE ROLE OF LYMPHOVASCULAR GRAFTING IN LYMPHEDEMA TREATMENT

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In the broad variety of possible surgical treatment procedures, lymphovascular grafting is a method to reconstruct an interrupted lymphovascular system bypassing the defect, using the patient's own lymphatic vessels, a method which is well established within the vascular surgery. However because of the delicate structures this kind of bypass procedure within the lymphatic vascular system became only possible with the use of advanced operating microscopes.

The direct reconstruction has several advantages. It respects the normal pressure gradient of the lymphatic flow. It shows a minimal risk of thrombosis of the anastomoses and it connects the main lymphatic channels in front and behind the interruption. Therefore a long term patency can be demonstrated by lympangiography and lymphoscintigraphy and normal values of lymphatic transport can be achieved. There are some limitations of the method. An appropriate harvesting side is necessary and only lymphedemas with a definite interruption of the lymphatic flow can be treated. This is however the case in most lymphedemas within Europe.

COMBINED TECHNIQUE FOR BREAST RECONSTRUCTION AND LYMPHATIC MICROSURGERY: INDICATIONS AND RESULTS J. MASIÀ

Barcelona, Spain

#### LYMPHATIC SUPERMICROSURGERY

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Introduction: Lymphatic supermicrosurgery, supermicrosurgical lymphaticovenular anastomosis (LVA) is becoming a useful treatment option for compression-refractory lymphedema with its effectiveness and low invasiveness. In supermicrosurgical LVA, a lymphatic vessel is anastomosed to a venule or a vein in an intima-to-intima coaptation manner to prevent anastomosis site thrombosis even when venous reflux takes place. Materials and Methods: Lymphatic supermicrosurgery was performed on compression-refractory peripheral lymphedema patients under local anesthesia without sedation. After infiltration anesthesia, an approximately 2-cm-long incision was made. Deep fat layer (below the superficial fascia) was dissected to find collecting lymphatic vessels suitable for LVA. A lymphatic vessels was anastomosed to a recipient small vein. A similar-sized vein was used to prevent venous reflux, because a small vein branched from a larger subcutaneous vein usually has an intact valve. Preoperative findings, intraoperative findings, and postoperative results were evaluated. **Results:** One LVA (skin incision, dissection, anastomosis, skin closure) took approximately 1 hour; 1 anastomosis could be completed within 5-10 min, and 1 LVA within 20-30 min by an expert lymphatic supermicrosurgeon. No postoperative complication was observed. With indocyanine green (ICG) lymphography navigation and simultaneous multisite approach, multiple LVAs (usually 10 anastomoses) could be completed via millimeter skin incisions within 2 hours. The number of bypasses positively correlated with postoperative volume reduction. Early-stage patients' daily life could be normalized after LVA; complete volume reduction could be maintained without postoperative compression. **Conclusions:** LVA is a minimally invasive and effective treatment for refractory lymphedema. ICG lymphography allows easier LVA by guiding lymph vessel location on patients with early-stage (dermal backflow stage -III) lymphedema on whom ICG lymphography shows linear pattern. In progressed-stage (dermal backflow stage IV-V), although effective, LVA alone would not be enough to obtain optimal treatment results, and it would be better to combine vascularized lymph node transfer and liposuction with LVA.

#### A LIVING EXPERIMENTAL MODEL FOR RESEARCH AND TRAINING IN LYMPHATIC MICROSURGERY

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**Introduction:** The aim of this contribution is to describe a new living experimental model, able to allow young surgeons the best training for research and clinical applications in Lymphatic Microsurgery.

**Materials and Methods:** Authors point out attention on flexibility of this original experimental living suine method, both for research and training in Lymphatic Microsurgery, able to realize Multiple Lymphatic Venous Anastomoses and Lymphnode Transfer. Surgical sites are represented by both inguino- crural regions as well.

Model is easy to be learned and to be applied for any kind of Lymphatic Microsurgery.

Suine has not to be sacrified and immediate, medium and long-term patency rate can be in this way evaluated.

**Results:** As far as EBM Literature data are concerned about experimental models of Lymphatic Microsurgery, this living model seams to be the most flexible and the easiest to be applied among the known related experiental models, both for Multiple Lymphatic-Venous o Lymphatic-Venous-Lymphatic Shunts and for Lymphnode Transplant.

**Conclusions:** The suine living experimental model hereby described represents uptoday the most suitable model to do training and research on Lymphatic Microsurgery, helpful for any kind of surgical educational program, too.

#### LYMPHATICOVENULAR ANASTOMOSIS REDUCES THE RISK OF CELLULITIS IN LYMPHEDEMA PATIENTS

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**Introduction:** We wished to determine whether lymphaticovenular anastomosis (LVA) was effective at reducing the occurrence of cellulitis in patients with lymphedema. One of the severe complications of lymphedema is repeated cellulitis. Cellulitis causes increased damage to the lymph vessels, and a stepwise worsening of the lymphedema, rendering the patient ever more susceptible to cellulitis and creating a vicious cycle of worsening cellulitis. The effect of LVA for reducing this complication has not been elucidated.

**Methods:** We compared the frequency of cellulitis before and after LVA in 95 patients with arm/leg lymphedema, who underwent LVA at University of Tokyo Hospital or Saiseikai Kawaguchi General Hospital from September 2005 to April 2012. The diagnostic criteria for cellulitis was a fever of 38.5°C or higher and warmth/redness in the affected limb(s). The occurrence of cellulitis before and after LVA was compared using Student's t-test.

**Results:** The mean number of occurrences of cellulitis in the year preceding surgery was 1.46, while that of the year following surgery was 0.18 (p < 0.0001).

Conclusions: LVA significantly reduced the occurrence of cellulitis in lymphedema patients.

#### LASER TECHNOLOGY FOR TREATMENT OF LYMPHATIC DISEASES IN DERMATOLOGY

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**Introduction:** Skin usually represents a special mirror of human health conditions, as far as Lymphatic Diseases are concerned, too. Dermatologists can interact with Internists and Surgeons and their specialistic expertise can be helpful for diagnosis and treatment, including skin manifestations of lymphatic disorders.

LASER Technology represents today a very useful and modern armamentarium in Dermatological Lymphology.

**Materials and Methods:** Different types of LASER devices are able to treat different types of skin lymphatic lesions:- papillomatous lymphostatic verrucosis, - lymphangioma circumscriptum,- lymphorrhea, - lymphatic ulcers.

**Results:** Minimally Invasive Approach of Skin Lymphatic Lesions by LASER Technology represents a safe procedure, able to avoid any risk of infection or of other related complications.

Tissue necrosis is strictly limited by low-power LASER radiation, also useful for good evaluable exeretic biopsies.

Conclusions: LASER Technology represents today a very helpful armamentarium for Dermatological Lymphology.

#### CHYLOPERITONEUM: A NEW CLINICAL ENTITY FOR "LYMPHATIC SURGEONS"

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With the term Chyloperitoneum (or Chylous Ascites) we mean the presence of chylous within the peritoneal cavity.

We distinguish idiopathic (or primary) and secondary forms. Among the secondary forms, the most frequent causes in adults are represented by iatrogenic lesions of the main afferents of the Cisterna Chyli, and malignant tumors. Other possible causes of secondary Chyloperitoneum are the abdominal trauma (open or closed), liver cirrhosis, tuberculosis, pancreatitis (acute and chronic) and filariasis.

Peritonitis due to extravasation of chylous into the peritoneal cavity is a condition often confused with other clinical conditions. In fact, the diagnosis of chylous peritonitis is rarely suspected before the intervention and almost always oriented toward the other most common surgical emergencies, including, above all, acute appendicitis.

There are several treatment options that can be taken for the treatment of Chyloperitoneum, although their effectiveness is very variable, in function of etiopathogenesis and extent of the disease. So, we cannot talk about a gold standard treatment, since the therapeutic solutions substantially vary depending on the clinical picture.

Diagnostic tests include Lymphoscintigraphy of the lower limbs , and sometimes even the upper limbs ("Whole Body Lymphoscintigraphy"), Lymphangio-MR and Lymphangiography which, associated with CT, represents the most important investigation (Lymphangio-CT).

The surgical approach includes Laparoscopic/Open surgical and Microsurgical procedures, that have shown to be effective in the treatment of Chyloperitoneum refractory to medical treatment and paracentesis.

Standard lymphangiography (LAG) uses liposoluble ultrafluid contrast (Lipiodol Ultrafluid) injected after isolation and cannulation of the lymphatics at the dorsum of the foot with microsurgical technique. If coupled with a CT scan (Lymphangio-CT, LAG-CT), LAG allows a more accurate assessment of disease extension, as well as the site of the obstacle and source of chylous leakage.

The main indications to the use of LAG-CT are represented by pre-operative assessment of patients affected by primary, post-traumatic and post-operative chylostatic disorders.

The isolation of the lymphatic collector is performed using operative microscope magnification.

Once the contrast is injected completely (20 ml), the patient undergo multi slice CT examination. LAG-CT brings about precise information about the site of chylous dysplasia and/or fistulas, since it supplies precise relations between lymphatic-lymph nodal structures and skeletal apparatus.

In the literature it is reported that lymphangiography can have also sclerosing effects on lymphatics, obtaining the closure of lymphatic fistulas in patients with chylous ascites.

LAG-CT represents presently the only diagnostic investigation that can supply precise topographic information about the site, cause and extension of chylous pathology and allow to plan proper therapeutic procedures.

#### FIBRO-LIPO-LYMPHO-ASPIRATION (FLLA): A LYMPH VESSEL SPARING PROCEDURE (LVSP).

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**Introduction:** For advanced stages of Lymphedema (IIB/ III A-B) Lymphatic Microsurgery is able to give only partial results. That is why recently C.C.Campisi developed a "Lymph Vessel Sparing Procedure", with Liposuction like technique, that he called "Fibro-Lipo-Lympho-Aspiration" (FLLA), with the aim of removing remaining excess fibroadipose tissue of the lymphedematous limb previously treated by MLVA.

**Material and Methods:** Authors show the first series of 50 cases treated by this new procedure in these last 2 years. Lymphatic Vessel Injuries can be avoided during liposuction on the guide of Lymphoscintigraphic mapping, of the Indocyanine Green Fluorescent Microlymphography (Photo-Dynamic-Eye/PDE Test), and of EchoColor Doppler Mapping of the Principal Superficial Veins in close proximity to the Lymphatic Network. Primary and Secondary Lymphedemas, both of upper and of lower limbs, were treated without age or gender limits.

FLLA-LVS procedure is performed as tumescent liposuction-like procedure (350-1250 ml of Klein's solution) without turniquet. Lenght of surgery range is from 45' to 150'.

Excess of fibro-adipose tissue removed was 500-1500 ml for upper limbs and 800-3800 ml for lower limbs.

Bleeding was minimal and only at the beginning of this experience sometimes patients needed blood transfusion.

According to the size of the affected limb and the volume excess of fibro-adipose tissue, this procedure can be performed in 2-3 steps. FLLA-LVSP is a painless procedure, that requires only one-day surgery hospital stay management.

**Results:** Results in all cases have been very significant on the clinical and QoL point of view, because FLLA-LVS Procedure is consequently able to improve not only the cosmetic aspect of the limb but, above all, to increase the functional Lymphatic-Venous output already established by previous MLVA.

**Conclusions:** The new Fibro-Lipo-Lympho-Aspiration (FLLA) is a safe Liposuction-like Lymph Vessel Sparing (LVS) Procedure able to reach best long-term results after MLVA Microsurgery in latest stage lymphedemas, too, and consequently improving in a significant way the patient's Quality of Life.

#### PRESENT ROLE OF LIPOSUCTION IN THE TREATMENT OF LYMPHEDEMA.

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In 1987 we noted an excess of adipose tissue in the lymphedematous tissues and recommended liposuction in order to remove the excess volume. This was questioned by several lymphologists. In recent years more and more information show that we now have clear evidence that lymphedema leads to deposition of adipose tissue. Thus we now know that patients with chronic, non-pitting, lymphedema develop large amounts of newly formed subcutaneous adipose tissue, which precludes complete limb reduction utilizing microsurgical reconstruction or conservative treatment. Although incompletely understood, this adipocyte proliferation has important pathophysiologic and therapeutic implications.

- 1. The findings of increased adipose tissue in intestinal segments in patients with Crohn's disease, known as "fat wrapping", have clearly shown that inflammation plays an important role (Borley NR, Mortensen NJ, Jewell DP, Warren BF. The relationship between inflammatory and serosal connective tissue changes in ileal Crohn's disease: evidence for a possible causative link. *J Pathol*, 2000; 190: 196-202).
- 2. Consecutive analyzes of the content of the aspirate removed under bloodless conditions, using a tourniquet, showed a very high content of adipose tissue in 44 women (mean 90%, range: 58-100) was found (Brorson H, Åberg M, Svensson H. Chronic lymphedema and adipocyte proliferation: Clinical therapeutic implications. *Lymphology*, 2004; 37(Suppl): 153-5).
- 3. In Graves' ophthalmopathy a major problem is an increase in the intraorbital adipose tissue volume leading to exopthalmus. Adipocyte related IEGs (immediate early genes) are overexpressed in active ophthalmopathy and CYR61 (cysteine-rich, angiogenic inducer, 61) may have a role in both orbital inflammation and adipogenesis. (Lantz M, Vondrichova T, Parikh H, Frenander C et al. Over-expression of immediate early genes in active Graves' ophthalmopathy. *J Clin Endocrinol Metab*, 2005; 90: 4784-91).
- 4. A functional inactivation of a single allele of the homeobox gene Prox1 led to adult-onset obesity due to abnormal lymph leakage from mispatterned and ruptured lymphatic vessels. Prox1 heterozygous mice are a new model for adult-onset obesity and lymphatic vascular disease. (Harvey NL, Srinivasan RS, Dillard ME, Johnson NC et al. Lymphatic vascular defects promoted by Prox1 haploinsufficiency cause adult-onset obesity. *Nat Genet*, 2005; 37:1072-81).
- 5. Tonometry can distinguish if a lymphedematous arm is harder or softer than the normal one. If a lower tissue tonicity value is recorded in the edematous arm, it indicates that there is accumulated lymph fluid in the tissue, and these patients are candidates for conservative treatment methods. In contrast, patients with a harder arm compared with the healthy one, have an adipose tissue excess that can successfully be removed by liposuction (Bagheri S, Ohlin K, Olsson G, Brorson H. Tissue tonometry before and after liposuction of arm lymphedema following breast cancer. *Lymphat Res Biol*, 2005; 3: 66-80).
- 6. Investigation with VR-CT (Volume Rendering Computer Tomography) in 8 patients also showed a significant preoperative increase of adipose tissue in the swollen arm, followed by a normalization at 3 months paralleling the complete reduction of the excess volume. (Brorson H, Ohlin K, Olsson G, Nilsson M. Adipose tissue dominates chronic arm lymphedema following breast cancer: An analysis using volume rendered CT images. *Lymphat Res Biol*, 2006; 4: 199-209)
- 7. Analyses with DXA in 18 women with postmastectomy arm lymphedema showed a significant increase of adipose tissue in the non-pitting swollen arm before surgery. Postoperative analyses showed normalization at 3 months. This effect was seen also at 12 months. These results paralleled the complete reduction of the excess volume ("edema volume") (Brorson H, Ohlin K, Olsson G, Karlsson MK. Breast cancer-related chronic arm lymphedema is associated with excess adipose and muscle tissue. *Lymphat Res Biol*, 2009; 7: 3-10).
- 8. Parathyroid hormone-like hormone (PTHLH), which can inhibit adipogenesis, is downregulated both in active and chronic ophthalmopathy, indicating the possibility of an increased risk of adipogenesis (Planck T, Parikh H, Brorson H, Mårtensson T, Åsman P, Groop L, Hallengren B, Lantz M. Gene expression in Graves' ophthalmopathy and arm lymphedema: similarities and differences. *Thyroid*, 2011; 21: 663-74).
- 9. Adipogenesis in response to lymphatic fluid stasis is associated with a marked mononuclear cell inflammatory response (Zampell JC, Aschen S, Weitman ES, Yan A, Elhadad S, De Brot M, Mehrara BJ. *Plast Reconstr Surg*, 2012; 129: 825-34).
- 10. Lymphatic fluid stasis potently up-regulates the expression of fat differentiation markers both spatially and temporally (Aschen S, Zampell JC, Elhadad S, Weitman E, De Brot M, Mehrara B. *J Plast Reconstr Surg*, 2012; 129: 838-47).

Liposuction can be performed in patients who fail to respond to conservative management or microsurgical reconstruction because the hypertrophy of the subcutaneous adipose tissue cannot be removed or reduced by these techniques.

The long-term results of liposuction for chronic large postmastectomy arm lymphedema (20 years) and primary and secondary leg lymphedema (10 years) leading to complete reduction – without recurrence – will be described.

#### COMBINED TREATMENT OF FILARIAL LYMPHEDEMA

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Lymphedema is most neglected and most difficult problem to treat.lymphatic filariasis is as old as human being itself.this has a mention in our old literature and mythology.lymphatic filariasis is classified as most neglected tropical disease by the WHO. We have been treating lymphatic filariasis for the last 30 years by various methods.

Now we found a combination of foot hygiene, non surgical conservative Manual lymph drainage and multilayer bandaging with chemotherapy for filariasis and periodic cyclical antibiotic for prevention of secondary infection which will be fallowed by micro surgical nodovenal shunt or lympho venal anastomosis fallowed by multi stage reduction surgery and sculpturing technique and maintain the reduction achieved by a pressure garment or multilayer bandaging.

This combined protocol found to be very effective in treating or managing the Lymphedema due to lymphatic filariasis. This will be given as a invited lecture with power point presentation in the session "THERAPY-OPERATIVE TREATMENT".

#### COMBINED SURGICAL APPROACH IN GENITAL LYMPHEDEMA

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Chronic genital lymphedema as the result of lymphatic insufficiency in men and women is not as frequent as the lymphedema of the other part of the body above all of extremities. Nevertheless people suffering from genital lymphedema have significant problems regarding the quality of their live above all from personal hygiene, sexual function, and mobility point of view.

In Europe, one can usually find it as a result of lymphadenectomy and/or radiotherapy of inguinal or pelvic lymphatics, or as the result of complex treatment of lymphedema of the lower extremities. Sometimes, it may follow "trivial surgeries", such as operations near the inguinal area. Primary lymphedema of the genital can occur separately or it is often found in combination with lymphedema of the lower extremities or occurs in the context of another syndromes. Both primary and secondary genital lymphedema and its progression are passed through the same stages as the lymphedema of the other parts of the body, it means from the pitting stage to the lipohypertrophy, fibrosclerosis and elephantiasis even in the case of very well done complex decongestive therapy (CDT). Regarding the problems connected with the use of compression, the CDT has only limited possibilities.

The authors demonstrate their experience with surgical treatment of chronic genital lymphedema in men and women, call attention to indications for surgery, particular steps performed during surgery and post-operative care.

Patient feedback from these surgeries has been unanimously positive from the aspect of: assisting with their personal hygiene, solving this social handicap, and from the perspective of improved sexual function; however, it is necessary to reach a better cosmetic effect, especially in the case of young individuals.

### SESSION VI LYMPHOEDEMA CLINICAL CORRELATIONS, RISK FACTORS, AND QUALITY OF LIFE

#### THE VESUVIUS AND THE VENO-LYMPHATIC ERUPTIONS: THE MAGMA CORRELATIONS

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#### PREVENTION OF LYMPHATIC INJURIES IN VASCULAR SURGERY

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**Introduction:** Vascular Surgeons can improve in a significant way immediate, medium and long- term clinical patient outcomes, by a careful dissection of veins and arteries, and seeing evidenced superficial and deep lymphatic pathways, respectively in close proximity of superficial veins and of arteries.

**Materials and Methods:** Venous surgery and arterial surgery can drastically reduce percentage rate of lymphatic injuries, like lymphorea, lymphocele and secondary lymphedema, simply by adopting preventive procedures to evidenciate lymph pathways around veins and arteries.

Lymphoscintigraphic and Echo-Color-Doppler Mapping before surgery, and BPV Dye Test, and PDE Test during surgery, are able to realize this kind of prevention.

Authors describe their clinical experience, related to the EBM literature data.

**Results:** Prevention of lymphatic injuries in Vascular Surgery shows to be a suitable and convenient procedure for QoL of patients in immediate, medium and long- term clinical outcome.

Costs/Benefits Ratio is highly significant in favour of shorter lenght of hospital stay and of post-discharge patient's shorter recovery, on the personal, social and professional performance point of view.

**Conclusions:** Preventive procedures of Lymphatic injuries in Vascular Surgery would be considered for their advantageous aspects, also by insurance companies and national health assistance system to cover costs of patient hospital stay related both to the venous and to the arterial surgery.

#### PRELIMINARY STUDY FOR A DISABILITY SCALE IN LIPEDEMA, BASED ON ICF CORE SETS

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The International Classification of Functioning, Disability and Health (ICF) offers a framework to describe functioning, disability and health in persons with all kinds of diseases or conditions, but we often need "variability" to capture the detail to describe a unique disease or health condition. It can be used key indicators of activity and participation domain, using only a small number of ICF categories. Aim of this work was to identify the best ICF indicators of the activity and participations domain that can fit for lipedema, obtaining for each item a value between 0 and 4, in order to get a disability index. This type of disability scale was compared with the results of the Nottingham Health Profile and WHODAS II, recommended by the WHO. Results showed many similarities for all the three scales used, with some differences illustrated in this study. Hopefully we could get a more complete tool for the clinical aspects definition through ICF, in describing health condition and outcome measurement in this kind of patients.

#### LIPEDEMA: LYMPHOSCINTIGRAPHY AND CLINICAL STAGES

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**Introduction:** Lipedema is a symmetrical, chronical and progressive disorder of fat distribution on the legs, and sometimes involving arms, with orthostatic edema, pain and frequent hematomas associated, which affect women above all and brings a reduction in quality of life. The diagnosis of lipedema is clinical, but further to patient evaluation, which leads to a clinical report, where clinical staging is included, lymphoscintigraphy exam was requested in order to analyze the morphological and/or functional features of the lymphatic system.

**Materials and Methods:** 34 patients affected by lipedema of the lower limbs were evaluated through a clinical examination that led to differential diagnosis vs obesity and lymphedema, and to 3 clinical stages: – stage 1-17 patients with normal skin surface, soft consistence of subcutaneous tissue with small palpable multiple nodular fatty structure; stage 2-11 patients with uneven skin surface and irregular, increased consistence of subcutaneous tissue with large palpable nodular fatty structure; stage 3-6 patients with lobular deformation of cutaneous surface due to increased fatty tissue with a difference sized nodular fatty structure.

Furthermore, a lymphoscintigraphy exam was required and carried out by the same nuclear M.D. and the results of the exams were then analyzed within every stage.

**Results:** In this study lipedema was classified in 3 clinical stages and the results of lymphoscintigraphy, previously requested, were analyzed within each stage. In stage 1 a normal radiotracer flow was noted in 23% of the cases and a morphological and/or functional abnormality in 77% of the cases, while in stages 2 and 3 the morphological and/or functional abnormality were highlighted in all cases. In all stages no lymph-nodal alteration was noted.

**Conclusions:** In this in-progress study the attention was focused on the lipedema and it was classified in 3 clinical stages. Furthermore, lymphoscintigraphy exam was required in all cases to diagnose eventual lymph flow impairment and consequently the results were analyzed in each stage. The study highlighted morphological and/or functional abnormality in 77% of the cases of stage 1 and in all stage 2 and 3. It is knows that the diagnosis of lipedema is clinical, but the use of lymphoscintigraphy exam, with eventual lymph flow impairment, is important for the detection of alteration of the lymphatic system with no current clinical evidence.

### ANATOMICAL DEFORMATION OF TISSUE IN LYMPHEDEMA- FLUID CHANNEL FORMATION, EFFECT OF INTERMITTENT PNEUMATIC COMPRESSION

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**Objectives:** We observed formation of tissue channels in advanced obstructive lymphedema increasing in density during high pressure intermittent pneumatic (IPC) therapy.

**Methods:** Twenty patients with patients with lymphedema stage II/III of lower limbs were investigated. Tissue morphology was evaluated before and after 1 year of intermittent pneumatic compression. The parameters of compression were: inflation pressure 120-100mHg, sequentially from chamber 1 to 8, inflation time of each chamber 50'', daily for 1 h. Lymphoscintigraphy with Nanocoll was performed before, after 6 and 12 months of treatment. Skin and subcutaneous tissue biopsies were taken before and after treatment. Specimens were injected with Paris Blue in chloroform and made translucent to visualize spaces filled with mobile tissue fluid.

**Results:** Lymphoscintigraphic imaging. Multiple wide irregular spaces filled with tracer could be seen in the subcutis on the internal aspect of thigh and along large blood vessels running to the groin. There were no such structures around the hip, in hypogastrium and buttocks. Immunohistochemistry of biopsies revealed presence in subcutis and around veins open spaces negative on staining with LYVE1. These spaces were then stained with Paris Blue and presented irregular interconnected spaces. Their density was measured using computer planimetry (Microimage, Olympus). After 1 year of IPC the total area occupied by depicted channels was found slightly increased in calfs but evidently more in thighs.

**Conclusions:** Increase in stagnant tissue fluid in lymphedematous subcutis is followed by formation of irregular tissue channels. Their density increases after IPC. These channels substitute obliterated lymphatic collectors. Flow in these channels requires active external compression.

### PRIMARY AND SECONDARY PREVENTION OF LYMPHATIC COMPLICATIONS FOLLOWING MELANOMA SURGICAL TREATMENT

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**Introduction:** To optimize the surgical management of melanoma patients with metastatic lymphatic involvement, it is of remarkable importance for following patient's QoL to avoid the risk of the high percentage rate incidence of Lymphatic Complications, such as Lymphorea, Lymphocele with scar infection, and Lymphedema.

**Materials and Methods:** According to oncological radical needs of melanoma best surgical management, primary or secondary prevention of lymphatic complications is today a suitable option.

Primary prevention can be realized in case of trunk melanoma with positive SLNB at level of axillar/or inguino-crural regions. Metastatic Lymphatic Involvement in these specific cases doesn't contraindicate simultaneous LYMPHA procedures, because lymph stream from related limb is not involved in metastatic spreading.

On the contrary, if melanoma site is one of the limbs, the oncological radical needs contraindicate simultaneous LYMPHA Procedures. But lymphatic complications can be limited, avoiding the risk of lymphorea, lymphocele and scar infection, and supporting patient with secondary lymphedema by careful skin care, remedial exercises, and elastic stockings, along all period needed to reach "free of disease" condition for patient.

Then, secondary lymphedema will be treated before of worsening by MLVA Microsurgery and eventually, in a 2nd step, by FLLA-LVS Procedure, to remove residual and persistant excess of fibro-adipose tissue.

A basic role is reserved to the dye evidentiation of lymph collectors during nodal dissection by BPV Test and to the preliminar US mapping of veins and of superficial lymphatic network by Green Indocyanine Fluorescent Microlymphography (PDE-Test). Lymphatics would be preferably closed by clips or ligated by non- absorbable material, to avoid in the best way the risk of lymphorea and of lymphocele.

**Results:** Clinical experience of these last 3 years shows significant advantages by the two previously described protocols of Primary and Secondary Prevention of Lymphatic Complications following Melanoma Surgical Treatment.

The main consequent advantage is represented by the remarkable improvement of QoL of patients in comparison with patients non enroled in these two optional preventive protocols.

**Conclusions:** Primary and Secondary Prevention of Lymphatic Complications, following Melanoma Surgical Treatment, represent today a valid option for patient's QoL and for the significant improvements of costs/benefits ratio.

#### A NEW PATHOPHYSIOLOGICAL APPROACH OF THE INFLAMMATORY BOWEL DISEASE: FROM GUT TO LYMPH, LYMPHATICS AND LYMPH NODES

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**Introduction:** In their original description in 1932, B. Crohn et al. distinguished cases of regional ileitis among the "benign granulomatous tumors", which clinically and histologically resembled tuberculous enteritis, but where the tubercle bacillus could not be isolated or identified on tissue section. More recently M. Witte, P. Tonelli and F. Becker developed innovative concepts on the "Lymphatic Dysregulation" as a key player in the pathogenesis defense, and progression of inflammatory bowel disease (IBD). Drawing on the explosion in "molecular lymphology" during the past 15 years, F. Becker et al. (*Lymphology*, 47, 2014, 3-27) implicate novel regulatory factors and new roles for familiar signaling pathways linked to inflammation- induced lymphatic alterations associated with lymphangiogenesis and tissue remodeling.

**Materials and Methods:** From the outset, lymphatic system abnormalities - increased lymphatic vessel density and vigorous immune system response - have provided a backdrop for Crohn's disease and other inflammatory bowel disorders.

In the context of "lymphology" the study of the integrated function of the lymphatic system (lymphatic vessels, lymph, lymph nodes, and lymphocytes acting together) - in health and disease, IBD fulfills the definition of a "lymphologic" disorder. Such lymphangiogenic expansion might enhance classic intestinal lymphatic transport, eliminating excess accumulations of fluid, inflammatory cells and mediators, and could therefore be interpreted as an "adaptive" response to acute and chronic inflammatory processes.

**Results:** Whether these new lymphatic vessels are functional, unregulated or immature, and what factors may promote "maturation" of these vessels is currently an area under intense investigation. It is still controversial whether impaired lymphatic function in IBD is a direct consequence of the intestinal inflammation, or a preceding lymphangitis- like event. Current research has uncovered novel regulatory factors as well as new roles for familiar signaling pathways, which appear to be linked to inflammation- induced lymphatic alterations. **Conclusions:** The current review summarizes mechanisms amplifying lymphatic dysregulation and remodeling in intestinal inflammation at the organ, cell and molecular levels and discusses the influence of lymphangiogenesis and intestinal lymphatic transport function as they relate to IBD pathophysiology.

#### CHYLOTHORAX: AN INTERDISCIPLINARY APPROACH

LIDIA MOLINARI, GIACOMO LEONCINI, CORRADO CESARE CAMPISI, STEFANO SPINACI, SARA DESSALVI, ELEONORA NACCHIERO, MARA CAFFERATA, CESARE BRAGGIO, ALESSANDRO FERRARI, CHIARA CORNACCHIA, FRANCESCO BOCCARDO, CORRADINO CAMPISI IRCCS – S. Martino Hospital - IST, University of Genoa, Italy

Authors report their clinical experience in the treatment of primary or secondary Chylothorax.

They report proper diagnostic investigations, including, above all, Lymphangiography associated with CT scan, and a sequential therapeutical approach is finally described including conservative procedures, thoracoscopic approach (VATS) and microsurgical methods.

From the etiopathological point of view, primary forms of Chylothorax are basically correlated with congenital dysplasic alterations of the Thoracic Duct, as well as of regional lymph nodes. These conditions account for approximately 70% of all cases. Conversely, "secondary" forms due to mechanical causes or obstructions of various types or disruptions, including trauma, are less common. It should be pointed out that from a pathophysiologic point of view, malformation-related dysplasic alterations act as actual obstacles to antigravity lymph drainage, just like mechanical obstruction. A malformation affecting the Thoracic Duct illustrates this concept and represents a significant obstacle to lymph drainage with consequent chylous stasis.

In the initial approach to this complex problem, especially in acute and sub-acute onset cases, for a rapid restoration of proper metabolic balance, total parenteral nutrition (TPN) is recommended early on in order to significantly limit the chylous leak volume. An accurate diagnostic assessment is required for proper treatment, depending on associated clinical features: Lymphoscintigraphy, Standard Lymphangiography coupled with a CT scan, Magnetic Resonance .

Surgical intervention depends on the outcome of the various conservative treatments already implemented, namely, hyperprotein and hypolipidic diet (e.g., exclusively based on medium-chain fats and triglycerides) and total parenteral nutrition (TPN); proper antibiotic protection, which is necessary to prevent and treat the not uncommon septic complications; and even serial thoracentesis, which mainly aims at gradual chylous effusion drainage. In this as well as in subsequent treatment phases, the intravenous, intramuscular, and/or subcutaneous administration of somatostatin or octreotide (the synthetic form) can be useful in reducing chylous effusion – in some cases remarkably successful – likely related to their pitressin-like effect and even as anti-proliferation agents in vascular and, more specifically, lymphatic cells and endothelium.

Therefore, surgery should be designed on a case by case basis, depending on the primary or secondary nature of chylous effusion, clinical severity, and the number of chylous leaks. The following types of surgical approaches can be performed to treat this disease depending on the specific clinical condition and prior response: Chylothoracic drainage with Pleurodesis; Identification of the site or sites of chylous leakage; Resection of lymphangiectasic - lymphangiodysplasic tissue, which can also be combined with other ad hoc solutions: closure of chylous fistulae and of lymphatic leaking areas ( non-absorbable sutures, haemo-lymphostatic materials and solutions Trémollières-like); Derivative or Reconstructive Microsurgery: when applicable, efficacy has been extensively documented. Videothoracoscopy has been particularly helpful. For better recognition of chyliferous vessels, the administration of a fatty meal (60 g of butter in a cup of milk) is useful 4-5 hours before surgery.

In conclusion, considering the etiopathogenesis as well as the nature and complexity of Chylothorax, the treatment of these difficult pictures and the outcome significantly depend on the skills of the physicians/surgeons and on the available technology and equipment. For this reason, it is highly recommended that these patients be referred to the few centers that have a specific surgical experience in the treatment of this disease.

### SESSION VII NON-OPERATIVE AND OPERATIVE APPROACHES FOR PREVENTION AND TREATMENT OF LYMPHATIC DISEASES

### ANATOMICAL EFFECTS OF AXILLARY NODES DISSECTION ON RAT'S LYMPHATIC SYSTEM MODEL: ICG MAPPING AND DISSECTION

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**Introduction:** Axillary Nodes Dissection (AND) is an important risk factor for the appearance of Breast Cancer Related Lymphedema (BCRL). However, the specific anatomy and pathophysiology that leads to the development of BCRL after AND is not completely understood. Until now, various AND techniques were tested on rats to create an "in vivo" chronic lymphedema model but none of them succeeded without additional chemical inflammatory drugs or physical technique applications (radiotherapy). The aim of this study is to analyse the specific anatomical effects of AND on the rat's front leg lymphatic system before and after surgery.

**Materials and Methods:** Superficial and deep AND were performed on seven Wistar rats with a new, less invasive, posterior surgical approach. Indocyanine Green (ICG) mapping was done before and after surgery to detect "normal and secondary superficial lymphatic pathways" of the operated rat's front legs. Volume changes were appreciated and compared to contralateral sides. After 12 months, dissections were done after subcutaneous hand blue dye injection to analyse superficial and deep lymphatic pathways.

**Results:** After AND, a post-operation acute oedema of arm and shoulder appeared and persisted during 14-21 days. However, this did not result in a front leg chronic lymphedema. In two cases, seromas appeared. In all cases, ICG mapping allowed detecting superficial lymphatic pathways and lymph leaks around the surgical sites. After euthanasia and dissections, substitution lymphatic pathways were visualised by blue dye mappings. Although no contralateral axillary lymphatic pathways were seen, functional superficial secondary lymphatic pathways were found in all cases and they connected to the deep lymph vessels by perforating lymph vessels.

**Conclusion:** This type of lymphatic substitution pathways after AND on rat has never been described in the literature before. Anatomical description of the newly developed substitution lymphatic pathways after AND helps to understand why a chronic secondary lymphedema could not be created in rats after AND without additional chemical or physical interventions. This finding permits researchers to remove specific substitutional lymphatic vessel parts that may prevent the development of a chronic secondary lymphedema on the rat's front leg after surgery without using additional techniques.

*Keywords:* Axillary nodes dissection, substitution pathways, rats, perforating vessels, ICG, Blue dye. Acknowledgements: Study was supported by the European Association for Andullation Therapy (EAAT).

#### PATHOPHYSIOLOGICAL ARM LYMPHEDEMA EVALUATION USING INDOCYANINE GREEN LYMPHOGRAPHY

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**Introduction:** Breast cancer-related arm lymphedema management is challenging, and emphasis should be put on prevention and early diagnosis/treatment of lymphedema. Indocyanine green (ICG) lymphography, which can precisely visualize superficial lymph flows, seems useful for arm lymphedema evaluation.

**Materials and Methods:** Twenty patients with breast cancer-related arm lymphedema underwent ICG lymphography. ICG lymphography findings were analyzed according to corresponding clinical stages and duration of edema. Based on changes in ICG lymphography findings with progression of lymphedema, a new severity stage, arm dermal backflow (ADB) stage was developed and compared with clinical stages.

**Results:** The ICG lymphography findings were classified into two large groups: linear pattern (LP) and dermal backflow (DB) patterns (splash, stardust, and diffuse patterns). The DB patterns were found more frequently than the LP in the proximal upper extremity. The DB patterns also increased significantly in prevalence overall as the duration of lymphedema increased. The ADB stage was linearly correlated with clinical stage.

**Conclusions:** ICG lymphography is a safe and convenient evaluation method for lymphedema, allowing pathophysiological assessment of lymphedema. The ADB stage is a simple severity staging system which demonstrates a significant correlation with clinical stage. ICG lymphography may play an important role in early diagnosis of secondary arm lymphedema.

### PREDICTIVE FACTORS OF RESPONSE TO DECONGESTIVE THERAPY IN PATIENTS WITH BREAST CANCER RELATED LYMPHEDEMA

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**Introduction:** Lymphedema is a relatively common functional complication after breast cancer treatment. Complex decongestive therapy is the "golden standard" of treatment for lymphedema, but the predictive factors of response to this therapy are still unknown. The aim of this study was to estimate efficacy of decongestive therapy in patients with breast cancer related lymphedema and to identify predictors of response to lymphedema treatment throughout the intensive phase of therapy.

**Materials and methods:** Prospective study involved patients who were taken to a 3 week program of complete decongestive therapy, once per day, 5 days per week. For each patient, the following data were recorded: patients characteristics, body mass index, duration of lymphedema, arm circumference before and at the end of the treatment, relative percentage of edema reduction, and duration of wearing bandages during the treatment. Statistical analysis includes descriptive statistics , One-Sample t-test and Pearson coefficient of correlation.

**Results:** Twenty three women, mean age  $59,65\pm6,87$  years were included. The mean size of edema before treatment was 8,52% (95%CI: 6,57-10,48), and after 5,46% (95%CI: 3,64-7,28). This reduction was statistically significant (p<0,01). The mean percentage of edema reduction was 47,0% ( $\pm 23,85$ ). The size of edema before therapy was statistically significantly correlated with percentage of edema reduction (p<0,01). Also, there was statistically significant correlation between compliance to bandage and percentage of edema reduction (p<0,05). There was no significant correlation between chronicity of lymphedema and percentage of edema reduction and between body mass index and percentage of edema reduction.

**Conclusions:** Decongestive therapy is effective treatment for breast cancer related lymphedema. Size of edema before treatment and bandage compliance are two predictors of response to this therapy which we identified in this study.

#### INDOCYANINE GREEN LYMPHOGRAPHY: COMPARISON BETWEEN TWO DIFFERENT DEVICES

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**Introduction:** Indocyanine green (ICG) lymphography is becoming an essential tool for the evaluation and staging of lymphedema patients. We examined the results in lymphedema patients with 2 different devices.

**Methods:** We tested the Photo Dynamic Eye of Hamamatsu (Japan) and Fluobeam of Fluoptics (France) devices in 21 lymphedema patients, suffering from primary and secondary lymphedema.

**Results:** Imaging of both devices is similar in macroscopic view. However, the advantage of the Fluobeam is the possibility of evaluating the microcirculation which is particularly important in patients with lymphedema secondary to recurrent infections.

**Conclusions:** The use of fluoroscopy is nowadays an essential tool to express the severity of the lymphedema. The PDE is more user friendly and less expensive in comparison with the Fluobeam. The sensibility of the 2 devices is comparable. The Fluobeam is capable to get clear enlarged pictures which is useful for studying the pathophysiology of the lymphatic microcirculation.

### ACOUSTIC RADIATION FORCE IMPULSE (ARFI) QUANTIFICATION FOR ASSESSMENT OF TISSUE ALTERATIONS IN UPPER ARM LYMPHEDEMA

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**Introduction:** Tissues affected by lymphedema undergo alterations represented by fibrosclerosis, lipoid cell proliferation and angiogenesis. The changes in thickness and elasticity can normally be assessed by palpation, ultrasonography and tonometry. ARFI quantification is an elastographic technique that allows the quantitative assessment of tissues elasticity. This technique has been used in the present study to determine the elasticity changes of lymphedematous tissues.

**Materials and Methods:** Thickness and elasticity of the epifascial tissues of both forearms (healthy and lymphedematous) of 41 people with 2<sup>nd</sup> and 3<sup>rd</sup> stage lymphedema were examined, with and without tissue compression. It was used a Siemens Acuson 2000 - Virtual Touch ultrasound equipment, with 14.5 MHz linear probe for evaluations of thickness and 9 MHz linear probe for ARFI measurements.

**Results:** The mean elastographic values without compression from lymphedematous limb were  $1.78 \pm 0.46$  m/s for superficial epifascial layer,  $1.50 \pm 0.84$  m/s for the intermediate and  $2.17 \pm 0.88$  m/s for the deep one. With tissue compression, values were respectively  $3.12 \pm 0.80$  m/s,  $3.37 \pm 1.14$  m/s and  $3.67 \pm 0.94$  m/s. In lymphedematous limb, we found significant differences between intermediate and deep layers with no compression (p = 0.005), and between superficial and intermediate level (p = 0.004) and intermediate and deep layer (p < 0.001) in the acquisition with compression.

**Conclusions:** Our study demonstrates the usefulness of ARFI quantification for the assessment of alterations in lymphedematous tissues. It also shows a lower elasticity of deep portions of epifascial tissues, explained by their fibrosis.

### HIGH LEVELS OF SKIN INTERCELLULAR FLUID CYTOKINES AND CHEMOKINES MAY BE RESPONSIBLE FOR HYPERKERATOSIS AND FIBROSIS IN LYMPHEDEMA

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**Background:** Tissue cell metabolic processes, proliferation, differentiation, senescence and apoptosis are regulated by a plethora of cytokines, chemokines, growth factors, enzymes and neurotransmitters present in tissue fluid and lymph. Knowledge of their concentration and activity can give insight into cellular and interstitial processes of the tissue.

**Methods:** Twenty randomly selected healthy individuals (ages 24–46 years) without any history of systemic or local disease of lower limbs undergoing voluntary studies of lymph lipids or antibiotic penetration were selected. A leg lymphatic lying on the fascia was exposed under the operating microscope and was cannulated in a retrograde manner. Lymph samples were taken at 12-hour intervals. Concentrations of cytokines and chemokines were measured by enzyme immunometric assays (Quantikine; R&D Systems, Abingdon, UK).

**Results:** Total protein concentration was in lymph and serum 1.66  $\pm$  0.14 g/dl and 7.30  $\pm$  0.1 g/dl, respectively (L:S ratio 0.22  $\pm$  0.1). The cytokine lymph to serum ratio (L/S) was for IL1, 3.1, IL6 3.9, TNF $\alpha$  1.9, IL15 5.0, IL8 10.0 and 1.1 for IL1R $\alpha$ , but only 0.29 for IL12, 0.4 for IL10 and 0.004 for TGF (p<0.05). The chemokine and matrix enzyme L/S was 3.4 for MIP 1 $\alpha$ , 3.0 for CCL21, 2.5 for TIMP, 1 3.5 for TIMP2 and 1.0 for MCP1 and below 1 for MMP9 (0.33) and CCL27 (0.28) (p<0.05).

**Conclusions:** High lymph concentrations cannot be explained by filtration from blood and should be attributed to local production by keratinocytes, blood and lymphatic endothelial and Langerhans' cells, fibroblasts and recirculating lymphocytes, serving tissue homeostasis. These are the first data on human tissue fluid regulatory proteins. Their effect on tissues deprived of lymphatic outflow remains largely unknown and it is the subject of our further studies.

#### ACUTE LYMPHANGITIS SCORE FOR EARLY DIAGNOSES AND TREATMENT

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The clinical approach to Acute Lymphangitis as broadly as possible.

We discuss the epidemiological, clinical and microbiological aspects of the most important in multidisciplinary lymphatic disease in a surgical department and emergency properly recognize the signs and symptoms of local and general diseases and to treat appropriately and reduce the serious complications such as septicemia

Our past personal experience speaks about above 3000 patients, they were admitted in Emergency Room, and they were evaluated by lymphologycaly trained physicians: about 1,1% of this patients were diagnosed to have a acute lymphangitis and lymphangioadenitis. after over 10 years of clinical experience and we can claim to have successfully treated over 500 patients with acute lymphatic diseases So we would like to propose a surgical clinical protocol for the correct approach to these particular affections, starting from the correct diagnosis in emergency room until the appropriate post-acute rehabilitation.

#### PHYSICAL TREATMENT IN LYMPHEDEMA PATIENTS AND CARDIAC IMPLICATIONS: PRELIMINARY STUDY

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In patients affected edema of the lower limbs, especially in elderly patients, the genesis of stasis often recognizes a dual origin: transportation difficulties of the lymphatic system, often old and not sufficiently supported by daily physical exercise, but also a state of "fragile" cardiac compensation.

In these circumstances it may happen that decongestive physical treatment, concentrated in a few sessions, with particular regard to Elastocompression, can unmask heart failure and worsen the overall clinical condition of the subject. In these cases it is appropriate to control the "capacity of ventricular response" of the patient, either by testing the state in basal conditions and during treatment, in order to determine the the response capacity and, consequently, modulate therapeutic intervention.

The authors have studied the plasma concentrations of Pro -BNP at baseline, 15 subjects (aged between 57 and 79 years old, 8 males and 7 females) suffering from edema of the lower limbs to the third clinical stage that they dated for more than 2 months. 10 subjects (Group A) showed values in the normal range (<125 pg / ml.), 4 subjects (Group B) showed values slightly higher than the maximum of the range; one Group (C) had typical values of heart failure (> 3000 pg / ml.). In all patients was performed a cycle of 8 sessions of manual lymphatic drainage, Linfotaping, multilayer inelastic bandages, breathing exercises and exercises under bandage. In none of the patients was performed pressotherapy. At the end of treatment 2 of the 10 subjects of group A showed Pro -BNP values slightly higher than the norm. In the second group there was an average increase of Pro -BNP value of 144% (from 35% to 267%). In the patient group C it was found an increase of 150% Pro -BNP. The data in this first experimental study suggest that the monitoring of the ventricular response to decongestive physical treatment should be performed in all patients with suspected unstable cardiac compensation , including for the purposes of the definition of the appropriate "dose" of physical therapy (which determines a volemy increase in relatively short times) and definitive elastic garment (especially relatively to the class of compression).

#### RUNNING WITH LEG LYMPHEDEMA: WHICH OPTIMAL COMPRESSION GARMENTS

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**Background:** The quality of life is important in patients affected by lymphedema of lower limbs (LLL). An adapted leg compression garments (CG) is necessary when these patients run regularly.

**Material and Methods:** We report the case of five men (26-44 years) with LLL who maintain regular running practise. All patients present normal transcutaneous oxygen tension (TcPO2) and ankle-brachial pressure index (ABI). Utrasuonography did not show arterial or venous anomalies of lower limbs.

**Running test:** The 5 men run three times 3 km with 7 km/h speed, the first time without CG, the second with 18 mmHg CG and the third with 32 mmHg CG.

**Results:** After each test :TcPO2 and ABI not changed.

We asked the five patients to estmate the pain , heaviness and the mobility of lowers limbs during each test.All run more easily while wearing the 32 mmHg CG.

Conclusion: The patients with lymphedema must wear CG with exercise. When running 25-30 mmHg CG is necessary.

### LYMPHO-TAPING' TO REDUCE HEMATOMA AFTER LIPOSUCTION: A "DOUBLE BLIND" CLINICAL RANDOMIZED TRIAL

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**Introduction:** Skin taping to reduce local edema is worldwide and commonly used by numerous therapists. "Lymphotaping" (LT) is derived from the kinesiotape technique, announcing drainage capacity without actual demonstration of it.

The frequent use of skin taping is in large contrast with the poverty of biophysical background and almost inexistance of scientific literature on the subject.

We would like to propose our results of a prospective randomised clinical trial in which LT was used to study the post-liposuction hematomas in reconstructive surgery patients.

**Material and Methods:** 42 reconstructive surgery patients underwent a liposuction of the buttocks using a "superwet" technique with the aim of harvesting fat for lipofilling purposes. Patients were randomised in three groups. Only one buttock was taped using one of three different taping techniques following the study protocol. The taping was performed directly after liposuction and renewed at day 5 and 10. Progressive reduction of the hematoma was semiquantitatively evaluated by spectral analysis of pictures at day 5, 10, and 15 and comparison was made between the taped and not-taped buttock.

**Results:** This study shows no significant difference in hematoma resorption time in taped and not-taped areas in the three different patient groups. It seems to us that the presence of the tape on the skin impedes the hematoma formation underneath the taped area and "pushes" the hematoma to an adjacent uncovered area.

**Discussion:** Observation of LT seems to indicate that the skin undergoes variations in tangential and perpendicular forces during motion. This variation in direction of forces can contribute to an accelerated resorption of the hematoma. On the contrary, simply placing a tape can modify mechanical properties and thus prevent edema formation.

**Conclusion:** This clinical trial is the first to study the possible vascular effects of lymphotape on humans in a randomized manner. It shows that the concept of "lymphotape" is not so clear as its marketing would like us to believe. More randomized clinical trials must be performed to better understand the working mechanism of "lymphotape".

### INFLUENCE OF THE AUTONOMIC NERVOUS SYSTEM/VAGAL NERVE ACTIVITY ON SECONDARY BREAST CANCER RELATED LYMPHEDEMA AND HEALTH RELATED QUALITY OF LIFE

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**Introduction:** Besides the evolution in (surgical) treatment of breast cancer related lymphedema (BCRL), identifying patient- and treatment related risk factors to decrease the onset and progression of BCRL stays a hot topic in our domain. Currently, at our department, research is conducted in order to study the activity of the autonomic nervous system as a potential patient-related risk factor.

Autonomic activity can be measured non-invasively through heart rate variability (HRV), which is a marker for vagal nerve activity. Previous research has already shown that low vagal nerve activity increases the risk and worsens the prognosis of Alzheimer's disease, some types of cancer and cardiovascular disease. Three basic mechanisms of these diseases are oxidative stress, inflammation and excessive sympathetic response which can also be seen in BCRL. The vagal nerve informs the brain about peripheral inflammation through IL-1. In return, vagal nerve activity decreases oxidative stress, suppresses inflammatory reactions and counteracts sympathetic nervous system. Inadequate vagal activity leads to a decrease in those moderating reactions.

Therefore, our hypothesis is that low HRV, as an index of vagal nerve activity, increases the risk and worsens the progression of BCRL. If so, patients at risk of developing BCRL could be identified and might be treated with vagal stimulation to possibly prevent or treat the BCRL.

**Materials and Methods:** Different diagnostic criteria are used to define BCRL. The evolution of BCRL is measured by arm volume changes (with a tape measure at 5 locations) and through subjective symptoms. HRQoL is measured with the EORTC-QLQ C30 and BR23 questionnaire.

The possible effects of other known patient- and treatment related risk factors of BCRL are taken into account during the statistical calculations.

Paired sample t-tests will be used to analyse the evolution of BCRL in the study population between baseline measurements and follow-up. Correlations between BCRL, HRV and HRQoL will be calculated with the Pearson correlation coefficient, as well as correlations with other patient- and treatment related risk factors.

All authors and co-authors signed a Conflict of Interest/financial disclosure statement. The ethical committee of the organising hospital approved this longitudinal cohort study.

**Results and conclusions:** At the congress, results of about 100 breast cancer patients with 3 months to 3 years follow-up will be presented.

#### WHAT INFLUENCE HAVE OEDEMA ON QUALITY OF LIFE AT PATIENTS WITH SECONDARY LYMPHEDEMA?

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Aim: Patients with secondary lymphodema after cancer therapy were more and more every day. But, do we know how oedema influence on their quality of life?

**Methodes:** 133 patients with secondary lymphedema after cancer therapy (brest cancer, melanoma, gynecologycal cancer and other) stage I, II and III on their extremitates answered the 10 questions Questionary. Questions were about influence the oedema on their work and study, choices for buying clothes, shoes, on sexual life and relationship within their family and restrictions because of therapy of oedema. They were answered the questions before therapy with short-strech bandages and after one year of wearing the compession garments. The questionaires where analysed and scored.

**Results and Discussions:** After therapy the influence of/on: 1. the pain were smaller for 66,49%; 2. the embarrassment because of oedema was smaller for 49,2%; 3. everyday life (shopping, working at home or garden) was better in 49,89%; 4. choosing the clothes were smaller for 51,35%; 5. social or leisure activities were smaller for 50,37%; 6. sport were smaller for 38,1%; 7. influence on working and studying were smaller for 44,52%; 8. problems with relatives were smaller for 37,23%; 9. sexual difficulties because of oedema were smaller for 54,55%; 10. taking time for treatment or on making home messy were smaller for 40,43%.

**Discussions:** Quality of life at patients with secondary lymhoedema was after therapy better for 45,8%. Those patients need therapy not only for better clinical condition but for better physical condition too.

#### DISABILITY EVALUATION AND TREATMENT OF PATIENTS SUFFERING FROM LYMPHEDEMA

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**Introduction:** Lymphedema is a disease which can cause disability since it may damage social relationships as well as daily life. Patients suffering from Lymphedema normally have trouble in their partnership, job and life. It is important to know degree and manifestation of disability in order to get an overall view of the person and treat the patient in a global way.

**Materials and Methods:** I published a new Scale to measure disability in Lymphedema and to use it is necessary to test a checklist of Activity Daily Living from ICF. The daily use of this scale let me highlight the characteristics of disability in lymphedema and build a personalized treatment for that patient.

**Results:** A typical woman suffering from breast cancer related Lymphedema is young and with a low disability early onset (within 2 years from the onset of the lymphedema). She normally changes her ADL: she often has difficulties in lifting and carrying objects, dressing and doing homework. No matter if the lymphedema is in a dominant limb. Housewives normally have a higher disability degree then working women. I organized a rehabilitation treatment for specific disabilities, getting a better global outcome than by using a Decongestive Treatment only.

Conclusions: Personalized treatments based on global approaches bring better outcomes and quality of life in patients.

#### Acknowledgements

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### SESSION VIII MODERN DIAGNOSTIC INVESTIGATIONS AND CLINICAL IMPLICATIONS

### LYMPHOSCINTIGRAPHY IN THE EVALUATION OF LYMPHEDEMA FOLLOWING AXILLARY LYMPH NODE DISSECTION FOR BREAST CANCER

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Aim: Arm lymphedema is a frequent complication of breast cancer therapy and axillary lymph node dissection, with an estimated frequency of 5%-30%. This incidence is based primarily on studies that use volume and circumference criteria in the first years after surgery. In the extremities, the lymphatic system consists of a superficial system that collects lymph from the skin and subcutaneous tissue, and a deeper system that drains subfascial structures such as muscle, bone, and deep blood vessels. The superficial and deep systems drain at markedly different rates: subfascial transport is slower than the superficial system and transports less lymph.

**Material and Methods:** A retrospective study of 122 patients with breast cancer-related lymphedema (from stage 1 to stage 3) was performed. The ages of the patients ranged from 36 to 81 years old with a mean of 56 years. They underwent different type of injections in order to differentiate various mechanisms of edema. In all patients, superficial system was studied injecting 15 MBq of 99mTc-Nanocoll in 0.1 mL. Injections were performed in the web space between the first and second and the second and third digits of the hands. Both arms receive injection to use one side as a control for patients with unilateral lymphedema. Deep system was studied by two different ways: in a first group of consecutives 86 subjects using a single 37 MBq dose in aponeurotic sites of the palms; in a second group of 36 subject, we injected the tracer inferiorly at the styloid process of the ulna. Time for appearance of lymph vessels and nodes and distribution pattern were scored. These scores were compiled into a modified Kleinhans transport index (TI) in order to quantitate visual findings in lymphoscintigraphy. This method designes a numeric index of transport kinetics by combining visual assessment of five criteria: temporal and spatial distribution of the radionuclide, appearance time of lymph nodes, and graded visualization of lymph nodes and vessels. For assessment, scores were used ranging from 0 to 9. Thus, the resulting transport index (TI) ranged from 0 (normal) to 45 (pathological).

**Results:** In both groups, TI of superficial systems in healthy extremities was less than 10. Only in the second group 4 patients had abnormal TI calculated in the deep system. In the first group TI of superficial system was found to be increased in 93% of the affected arms, in the second group 89%. Average TI for superficial and deep systems were respectively 22.3 and 22.9 in the first group, and 21.0 and 18.5 in the second. A significative difference was observed in the scores for appearance of deep lymph vessels, respectively 6.3 in the first group and in 5.0% in the second group.

**Conclusions:** Lymphoscintigraphic evaluation has proved to be very sensitive and able to reliably depict abnormalities in the lymphatic circulation. In our limited experience, injection in the medial carpal region allows to better distinguish the two different compartments and to recognize subclinical disease in healthy extremities.

#### FUSION IMAGING OF THE LYMPHATIC SYSTEM: THERAPEUTIC IMPLICATIONS

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As a safe, non invasive and physiological, method radionuclide lymphoscintigraphy has been developed since 40 years to generate useful clinical information on the lymphatic system status of the limbs. These functional rough images are far from the sharpness of anatomic images coming from computed tomography (CT) or magnetic resonance imaging (MRI). The diagnostic utility of the coregistered functional and anatomical images appears to have a synergistic effect which is beyond the collective utility of each modality individually. Hybrid system developed for single photon emission tomography imaging (SPET/CT) may be a potential new tool to assess the lymphatic system either in Oncology or Lymphology.

**Patients:** 106 patients were successively assessed with hybrid SPET/CT imaging - 72 patients with a lower limb lymphedema related to a superficial functional insufficiency selected at the standard radionuclide lymphocintigraphy results (type 1 and 2) 1 - 34 patients for sentinel node detection before conservative breast cancer surgery. Age was ranging from 34 to 78 years.

**Imaging:** Lymphoscintigraphic images (sentinel node and lymphedema) were obtained with nanocolloids of albumin labeled with 99m technetium. Detection was performed with a hybrid device combining a dual head gammacamera and a multislice helicoidal CT [Infinia GE, Milwaukee, USA]. Images were simultaneously and precisely registered during the same acquisition and fused together. Iteration with attenuation correction images using a new algorithm [SharpIR<sup>®</sup> algorithm GE Healthcare] was then performed on each imaging set resulting in a significant reduction in noise.

**Results:** In the 72 cases of lower limb lymphedema related to a type 1 or 2 superficial functional lymphatic insufficiency fusion images bring additional precise and accurate information: quite normal lymphatic system (3), intraductal lymphostasis without lymph nodes abnormalities (12), intraductal lymphostasis with lymph nodes abnormalities (29) and tissue lymphostasis with lymph nodes abnormalities (28). Compensatory pathways from a sub-facial lymphostasis through an effective deep lymphatic system were observed in 51 cases. In addition a precise functional lymph node mapping was obtained. According to these results the treatment protocol was modified for 45 out of 72 patients (62.5%) In the 34 patients with breast cancer fusion images were useful to clearly and precisely locate the real sentinel node particularly when more than one lymph node was detected (6). The surgical protocol was modified for 5 out of 34 patients (14.7%) resulting in a more extensive axillary dissection instead of a simple sentinel node dissection.

**Conclusion:** Limb lymphedema is mainly coming from a lymph node dysfunction resulting in a distal lymphostasis. The diagnosis is always performed too late so that we are only treating the consequence of the lymphostasis. Anatomical imaging is unable to early detect any functional abnormality inside a lymph node before its anatomical visualization. Because of its poor resolution molecular imaging using radionuclide may fail to differentiate between functional and non functional lymph nodes. Hybrid systems are an answer to these problems and are providing clinically relevant information not detected on separate imaging method. An early diagnosis of a lymph node dysfunction seems now possible and could really impact the choice between surgical or medical therapeutic approach. 1. A.P. Pecking, J.L. Albérini, M. Wartski, V. Edeline, R.V. Cluzan. Relationship between lymphoscintigraphy and clinical findings in lower limb lymphedema (LO): toward a comprehensive staging. *Lymphology*, 2008; 41: 1-10.

#### CLINICAL FINDINGS OF LYMPHEDEMA AND LYMPHOSCINTIGRAPHICS: OUR EXPERIENCE

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In primary and secondary lymphedema it's very important an early diagnosis and, above all, to performe a primary prevention. The lymphoscintigraphy represents, still today, the diagnostic "gold-standard" in this way.

In our experience of over 700 clinical cases studied by lymphoscintigraphy we observed the following aspects :

- In subjects with blood relation with patients suffering from primary lymphedema, or in subjects with subclinical secondary lymphedema (i.d.: coinciding arms after matectomy for breast cancer) can be observe some aspects of increased lymph-stasis.
- In secondary lymphedema is more frequent to observe an important dermal back flow on the proximal area of the limb, corresponding to the clinical finding.
- In secondary lymphedema of the upper limb the most frequent aspects are the presence of the dermal back flow on the external area of the forearm (corresponding to the fibrotic concentration on the suprafascial tissue and the stop of the tracer in epitroclear area (this last aspect is frequently bilateral) (87% of cases).
- A low dermal back flow on thigh or on the arm can demonstrate an early secondary lymphedema. Very important signs of reduction of lymph-transport capacity is the appearance of lymph-nods along the limb (as for the upper and for the lower limb), not displayed in normal subjects (42% of cases); to consider in these cases the choice of the proper lymphatic ways to stimulate to drain the lymph without negative collateral effects on the contralateral limb.
- In cases (especially in primary forms) lymph nodes at the root of the limbs do not appear with the standard injection of the tracer, the AA. perform a second inoculation most proximal (lower third of the thigh to the lower leg, above the elbow to the 'upper limb), and in these cases, in 52% of cases appear after the second injection of one or more nodes, not shown in standard conditions.
- A particular development of the lymphatic alternative ways (Mascagni's, sovrapubic, axillo-axillar anterior or posterior) can also demonstrate a vicariant capability of local lymphatic system.

The lymphoscintigraphy is, in our experience, a very useful technique to evaluate the early diagnosis of lymphedema, the prognosis and also the physical and surgical tailored indications for the treatment.

### THE ROLE OF STRESS-LYMPHOSCINTIGRAPHY IN PREDICTING LYMPHEDEMA AND PLANNING THE TREATMENT PROGRAM

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**Introduction:** We investigated the role of Stress-Lymphoscintigraphy to evaluate the effects of muscular exercise on lymph drainage for planning a treatment program in lymphedema patients.

**Material and Methods:** 252 consecutive patients (204 females, 48 males, age range 14-75). 50.4% of patients had a primary lymphedema, 46% had a lymphedema secondary to lymph nodes dissection for breast or melanoma cancer, and 3,6% had a congenital lymphedema. 65% of patients had a lymphedema of lower limbs, 35% of upper limbs. In 55% of patients the lymphedema was bilateral. Two doses of the 99mTc-HSA-nanocolloid, 50-80 MBq, 0.3-0.4 mL, were injected intradermally at the first interdigital area. Two planar static rest scans were acquired immediately after injection (5 mins, 128x128, Ant / Post views, LEGP collimator). If the lymph drainage was delayed, the patient performed an isotonic exercise (stepping or weight training) for 2 minutes and then the stress scans were newly acquired until visualization of regional lymph nodes. The Tracer Appearance Time (TAT) in the regional lymphnodes was estimated (NV <10 mins).

**Results:** In contra lateral normal limb we observed the main lymph collector along the great saphenous vein or basilic vein, usually in less than 10 mins. Abnormal scan findings were divided into minor (72.3%) and major criteria (27.7%). Minor findings were: a normal lymph pathway with a delayed lymph drainage and visualization of regional lymph nodes following stress in 19.8% of limbs; a diversion of main lymphatic vessel in 14%; an incomplete obstruction in 8.7%; collateral lymphatic vessels (<3) in 20.1%; lymphangectasia in 9.7%. Major findings were: a lymph drainage towards the deeper subfascial lymphatic compartment (with an unusual uptake of the popliteal or elbow lymph nodes) in 12.6%; "dermal backflow" in 10%; and a lymph drainage failure in 5.1%. The TAT in limbs with lymphedema was  $16 \pm 4$  mins ranging from 12 mins to 46 mins, whereas in contralateral normal limbs was 5  $\pm 72$  mins, ranging from 1 to 12 mins (P<0.001).

**Conclusions:** Stress lymphoscintigraphy may help to better predict which patient is at greater risk for swelling limb, and plan a personalised exercise program in subjects with a recent lymph node dissection. Pts with minor stress-scan findings may be safely perform a personalised exercise program as a first-line treatment. Pts with major stress-scan findings can start earlier a CPT program to prevent subsequent damages.

### WHERE ARE THE FUNCTIONAL LYMPHATIC VESSELS IN THE CHRONIC LYMPHEDEMA OF THE LOWER EXTREMITIES? - A STUDY BY THE SPECT-CT LYMPHOSCINTIGRAPHY

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**Introduction:** The lymphoscintigraphy (LS) and ICG fluorescence lymphography (ICG-LG) are commonly used for lymphedema patients. However, the distribution of the functional lymphatic vessels in the whole limb is unclear. This is a preliminary study to understand the dynamics of lymphatic flow in lower limb lymphedema, using SPECT-CT lymphoscintigraphy (SPECT-LG).

**Materials and Methods:** In 2013, 238 limbs of 119 patients who were examined their lymphedema of the lower extremities by SPECT-LG were evaluated. In two-dimensional images of LS, we define co-lateral lymphatic flow as unusual linear uptake of isotope on the out of medial side of the lower extremities. In SPECT-LG, the uptake of isotope was colored by gradation and fused with CT images. We define deep lymphatic flow as uptake of isotope under the fascia in axial images. The percentage of co-lateral lymphatic flow and deep one were investigated.

**Results:** There is co-lateral lymphatic flow in 157 limbs (66%) on the lateral superficial area or deep area. 65 limbs (71%) In 92 limbs, in which there is no symptom of lymphedema, have co-lateral lymphatic flow. Especially in the primary lymphedema patient, it was detected in 23 limbs (77%). In axial images of SPECT-LG, 194 limbs (82%) of 238 limbs have the deep lymphatic flow. There are 21 limbs (9%) without superficial lymphatic flow and 44limbs(19%) without deep one.

**Discussion:** It is important to detect the functional lymphatic vessels to treat lymphedema. In this study, many lymphedema patients have the co-lateral flow (66%) and deep lymphatic flow (82%). It suggested two things. One is that the manual lymph drainage (MLD) only to medial side of the lower extremities might not use the functional lymph vessels effectively, though such a MLD is described as a standard procedure in many textbooks. Another is that, surgery of the superficial area such as LVA or lymphatic node transplantation do not make an enough lymphatic flow for the patient have main flow in deep layer.

**Conclusions:** Our LS and SPECT-LG are useful to detect the functional lymphatic vessels. To understand their correct location makes it possible to improve both the conservative and surgical treatment of the lymphedema

#### LYMPHO-FLUOROSCOPY IN CANCER-RELATED SECONDARY LYMPH EDEMA: FROM IMAGING TO DAILY PRACTICE

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Near infrared fluoroscopy is an emerging imaging tool in the field of lymphology. The use of Indocyanine green (ICG), and a dedicated camera (PDE®), makes it possible to visualize the superficial lymphatic network architecture and the lymph propagation in real time. Video images of this lymph propagation are analyzed, resulting in a semi-quantification of lymph flow. This imaging technique contributes to map superficial lymphatic networks. The damage to the lymphatic network after oncological surgery can be evaluated. We show video highlights based on 262 lympho fluoroscopies, realized during the evaluation of clinical secondary lymphedema and experiences on healthy subjects.

After a subcutaneous or intradermal injection of highly diluted Indocyanine Green (ICG), we observe and record on video the tracer's progression in each specific patient.

At the end of the examination, when substitution pathways are identified, we trace and draw them on the patient's skin in order to map them for future surgical and physical treatment.

Showing videos, our communication will point out the main results of our experience with cases where lympho fluoroscopy carries out an added value to lymphedema evaluation and treatment.

The major advantage of this imaging technique is the possibility to observe in real-time fluid movements from the interstitial space to the lymphatics, lymph propagation velocity, contraction rate, kinesiology of the lymphangions, mapping of substitution pathways and detection of subclinical lymphedema and "ectopic" lymph nodes in lymphedema.

#### MR IMAGING: HOW TO MAKE VISIBLE THE INVISIBLE

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Peripheral lymphostatic diseases may be primary or secondary origin and caused by lymphatic system dysplasia, dysfunction, or obliteration. It is essential to have sensitive and accurate diagnostic modality which can provide comprehensive information of individual patient for both the treatment and etiological research purpose. The image results of more than 1200 cases in author's clinic showed that MR lymphangiography is superior to the previously used image modality for providing high quality imaging to outline the detailed structural and anatomical abnormalities of both lymphatic vessels and draining lymph nodes. In the meant time MR lymphagiography can make real-time monitoring of lymph flow in the lymphatics and nodes and make quantitative judgment of the functional state of the lymph system. So far MR lymphangiography is the only image modality that is able to localize the edema fluid in the tissue and visualize the lymphatic system anomalies and assess its functional state in a single acquisition. It is also helpful in differential diagnosis of lymphedema and venous edema or lipedema. The comprehensive information provided by contrast MR lymphangiography is useful in staging and classification of primary and secondary lymphostatic diseases and promote the development of rational therapeutics.

#### **ROLE OF MRI IN PHYSICAL TREATMENT OF LYMPHEDEMA**

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In the past the exploration of limb lymphedema was dominated by direct lymphography then abandoned cause it's morbidity.

Lymphoscintigraphy has been largely used but this exam shows only the function of lymphatics with a poor anatomical approach.

Recently Lymphatic RMI allows a very good analysis of lymphatic vessels and nodes for an anatomical point of view without any contrast media. The most, this exam is simply reproductive without morbidity.

Finally we have so a positive diagnosis (collection around muscular area, subcutaneous infiltration and dermal thickening), an estimation of the severity of lymphedema and controlateral evaluation.

More estimation of hypoplasia or hyperplasia, obstruction of lymphatics and nodes is possible.

In case of lymphatic surgery we see directly the result of collector or nodes transplantation and in the same way the apparition of new vessels.

In case of physical treatment of lymphedema this exam allows to show the condition of oedematous tissues (fat and/or fibrosis), condition of lymphatics collectors and nodes (appearance/lack).

All this is important to apply correctly manual lymphatic drainage particulary choice and intensity of calling or resorption manoeuvres. What is the interest of applying pumping manoeuvre on an aria without lymphatic nodes? The aim is to avoid a blind MLD and practice. This is the same in case of a post surgical treatment.

After all Lymphatic RMI avoid a blind MLD locked up in a perpetual routine.

If the exam is doing again we can evaluate the efficiency of the manual technics before introducing multi layer bandaging to reduce the volume of edema.

The authors show all these arguments through example of Lymphatic IRM images.

### IDENTIFICATION OF THE AXILLARY WEB SYNDROME (AWS) BY THE CORRELATION BETWEEN CLINICAL SIGNS, MRI AND ECHOGRAPHIC IMAGING

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**Introduction:** The Axillary Web Syndrome (AWS) follows surgery for breast neoplasia and consists in the appearance of one or more frequently two or three cords of subcutaneous tissue. Strings originate from the axilla, spread to the antero-medial surface of the arm down to the elbow and then move into the antero-medial aspect of the forearm and sometimes into the root of the thumb. The purpose of this study was to compare two techniques, echography and Magnetic Resonance Imaging (MRI), with regard to their respective sensitivity and accuracy with which they could identify AWS strings and provide hints as to the origin of this pathology. Images of the cords with lymphoscintigraphy before and after treatment are presented in preview by the 41th congress of the ESL.

**Methods:** The examinations were performed in fifteen patients using a Philips iU22 ultrasound device with a high frequency probe (17MHz). We first palpated and marked the cord. To properly locate the cord on the screen, it was tensioned through maximum abduction. To identify the rope, with magnetic resonance imaging (MRI), a catheter filled with a gel detectable under MRI was placed on the skin at the site of the cord. The equipment used was a 1.5 Tesla AVANTO (SIEMENS) MRI.

**Results:** In some cases, analyzed with ultrasound, the dynamic abduction maneuver proved to be essential to facilitate the detection of the cord. This dynamic method on ultrasound confirmed the precise location of the cord even if this one was located deeper in the hypodermis fascia junction; Ultrasound and MRI images have revealed several features of the cords.

**Conclusions:** Displaying the strings was difficult with either of the two imaging modalities. However, echography seemed to be more efficient than MRI and allowed dynamic evaluation. The results of the study support a lymphatic origin of the AWS.

Keywords: Axillary web syndrome, Lymphatic, Cords, echography, Magnetic Resonance Imaging (MRI).

#### ROLE OF INDOCYANINE GREEN LYMPHOGRAPHY IN PHYSICAL TREATMENT OF LYMPHOEDEMA

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### SESSION IX SPECIAL ASSESSMENT, CLINICAL ASPECTS, AND THERAPEUTIC OPTIONS BEYOND ACQUIRED FORMS: AN OVERVIEW ALSO ON PRIMARY LYMPHEDEMAS AND OTHER ASSOCIATED LYMPHATIC MALFORMATIONS

#### 2014 CHALLENGES IN PEDIATRIC LYMPHOLOGY

CRISTOBAL PAPENDIECK

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All pediatric lymphology topics deserve special considerations. In the second decade of the 21st Century, the secondary disease is quantitative, a minor chapter, but with great social and medical implications as are filariasis, podoconiosis, as a regional disorder, and bacterial infections resulting from the growing resistance to traditional antibiotics. The prevention and therapy of erysipelas have been the subject of medical protocols but they are difficult to access and are not applied by consensus. With a life expectancy of 80 years, children pay a high price for acute and chronic infections. A significant issue is the oncologic risk in primary and secondary lymphedemas in particular due to interstitial hypertension. In adults, the risk is known in 5 to 10 years of evolution, but not in children possibly because there are oncologic but not lymphologic records. The acknowledgment, diagnosis and valuation of lymphedema in pediatrics allow a correct vascular rehabilitation, but this is a temporary aspect. In pediatrics, over 140 syndromes have a primary lymphedema, but there are no vascular rehabilitation wards in children's hospitals. Eighteen types of lymphatic malformations (lymphangiodysplasias LAD I and lymphadenodysplasias LAD II) may be identified, but not all of them are the cause of primary lymphedemas; what is more, some never are. Many lymph hemi-circuit distribution anomalies of the right and left systemic lymph and of the chyle may be identified and corrected in their physiopathological expression; for example, the systemic lymph and chyle reflux. Age and malformation determine any access to available surgical procedures. Nothing can be done with local anesthesia; everything requires a longer time. Continuous post-operative compressive therapy is unacceptable as a lifelong situation. Vascular anastomosis of abnormal lymph vessel ends is not the same as of selected normal lymph vessel ends. Big Angiodysplastic Syndromes (BAS) (e.g.: Klippel Trenaunay Weber, Servelle, Maffucci, among others), many of them with LAD I, LAD II, and LAAD, and primary lymphedema are Combined Vascular Syndromes where the presence of truncular venous hypertension determines bypass techniques, even with optical digitalization. Today, interstitial lymphography with gadobutrol allows performing Palma's cross- venolymphatic shunts provided the disorder if it is unilateral. All primary lymphedemas require a genetic evaluation through molecular biology and at least an anatomical pathology examination of lymph nodes in general. This is possible; however, less than 5% of patients have access to it. Therefore, treatments are generic and non-specific. Possibly 70 million children are involved in this problem. Malformations are not biologic tumors. But some malformations, i.e. lymphangiomatosis and lymphangiomas (cystic hygromas) are treated with local or systemic cytostatic drugs (rapamycin, bleomycin, vincristine and other agents) with the purpose of causing a sclerosis. Also with identical aims, Picibanil (OK-432) allows reducing the cyst in one, two or five sessions under general anesthesia, which possibly requires the same control and has the same risk as surgery. Like LAMs, microcystic lymphangiomatoses are highly aggressive disorders that condition many life aspects. Twenty-one syndromes are known, but the antilymphangio or antilymphangio tumorigenic agents have not been identified --an important issue considering the frequency of the disorder. Hemolymphangiomas may respond to propranolol due to their hemangioma component, and venolymphatic malformations to sildenafil. Neither is specific of the lymphatic system. To date there are no images of the chyle hemi-circuit. Chyle reflux points to a malformation in both chyle and systemic lymph circuits, which produces a valve failure that promotes reflux. Pulmonary and intestinal lymphangiomatosis are severe disorders. In Waldmann and Hennekam syndromes in general, they express themselves as an exudative disease and for its association with chyle collection. Chyle should be bypassed but there is a limited choice of valves due to vessel diameter incompatibility, which overrules potential indications in small children. Lipodysplasia, dystrophia and blastoma are frequent in pediatrics (after Dercum, Madelung, CLOVEs, Klippel Trenaunay Servelle and Proteus among other syndromes). Certainly lipedema too. But the term lipedema is wrong because it is not a collection of lipids. The subject is not exhausted in pediatrics and it has been classified generically as an overgrowth. Thus, we have summarized the challenge of lymphology for the second decade of 2014.

#### **BRAIN HYPER-LYMPHATIC HIGHWAY NETWORK**

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Our purpose is to discuss the role of lymphatic system in the complex mechanism that regulates volume in the fetus and newborn as well as the regulation of fluid distribution between the plasma and interstitial fluid, while placing special emphasis on the role the lymphatic system plays in mediating and maintaining this distribution, both during the fetal life, and during the changes occuriring in the newborn at birth to allow the infant to survive outside the womb and adapt to life in a new environment. In particular, we focus special attention on relationship between lymphatics and brain. Although scientists have believed for years that the cerebrospinal fluid (CSF) acts as the brain's highly refined lymphatic system, two statements are traditionally very difficult to tie together: there are no lymphatic vessels in the brain parenchyma and there is a hyghly specialized system that allows the CSF to move into the brain, thus exchanging with fluid inside the brain. We would like to discuss briefly what is now known in this faschinating field, then concluding that CSF runs into the brain just like since a long time scientists thinked indeed, but that an incredible advanced network of anatomical structures, we can define it as a sort of marvellous and hyper-developed brain lymphatic system, a "brain hyper-lymphatic highway network", allows CSF circulation and brain cellular waste filtering.

#### GROWTH, OVERGROWTH, ASYMETRICAL GROWTH

CRISTOBAL PAPENDIECK

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Biological growth means trophia and plasia with a tendency to a genetically predetermined size that depends on multiple factors, namely growth hormone (GH), intracellular growth (GF), insulin (IGF 1-2), steroids and thyroid hormone. More or less asymmetrical growth and overgrowth, and in particular anomalous growth of body segments that can involve 50% of total body weight in just one limb in children, may or may not relate to a vascular anomaly, a fact that has much clinical and angiological interest by itself in pediatrics. The growing and progressive acquisition of involved tissue function leads to development. The adequate (or inadequate) balance between trophia and plasia provokes harmonic, or disharmonic, or disproportionate growth, which we identify as dysmorphia. In general, greater or lesser deviation induces dwarfism or gigantism. In 1850, the term overgrowth appears in the literature (Debusey) as well as (non parasitic) elephantiasic shapes (Kulenkampf y Esmarch); in 1900, the concept of hypertrophy is created, with the classical Klippel Trenaunay syndrome. Hypertrophy always involves the skeleton; conversely, pseudohypertrophy refers to soft tissue involvement alone. In this context, direct or crossed hypertrophies (and eventually hypotrophies) are added to the list, which affect half of the body and sometimes the same body segment (a hand, for example). Thus, several syndromes have been identified since then: Wiedemann Beckwith, Silver Rujssel, Prader Willi, Banayan Riley Ruvalcava; later the Proteus syndrome, N1 (von Recklinghausen) and N2 (e.g., plexiform neurofibromatosis) and 24 syndromes with a dominant vascular pattern such as Klippel Trenaunay Weber, Servelle, Proteus, F.P. Weber, Maffucci, Cobb, Sotos, Weaver, Costello, Cowden, Simpson-Golabi-Behmel-Rosen or Bulldog syndrome, Denys Drash, Perlman and other; and a group where pseudohypertrophy prevails due to fat tissue overgrowth, or lipomatous overgrowth, like CLOVE, Dercum, Madelung and other related disorders; lipomatoses like lipoblastoma/tosis, and lipedema and -why not?- the consequence of interstitial hypertension of primary and secondary lymphedema with fat tissue overgrowth as well. Regional truncular venous hypertension leads to distal body segment hypertrophy; conversely, extratruncular venous hypertension induces skeleton hypotrophy and only apparent pseudohypertrophy due to vascular proliferation. Interstitial hypertension does not cause hypertrophy (skeleton asymmetry), this being an interesting consideration in diagnosis and differential diagnosis of edemas in pediatrics; in addition, it suggests that the vascular factor of growth is not the result of hypertension but humoral in nature (e.g., due to O2 or PO2 saturation and its effect at a metaphysial level). Possibly, the so-called lipedema -an incorrect semantic term- exists in pediatrics too, in the context of other syndromes (e.g., Klippel Trenaunay Servelle), also as a prenatal condition. Other syndromes, i.e. Turner Ullrich and Noonan, are characterized by short stature and frequently by lymphangiodysplasia, which becomes clinically evident in the course of life. Secondary osteoskeletal dysmorphias are a constant in Gorham Stout disease, or phantom bone disease as it is known due to the intra-osseous chylous cysts; in addition they are associated with hemangioblastomas, such as in the Haferkamp syndrome, which is malignant. Children with complex or chronic vascular accesses may reproduce, as a secondary syndrome, exactly that which is listed as congenital, which is relevant as a disorder and for therapeutic purposes.

#### OUR DIAGNOSTIC AND THERAPEUTIC APPROACHES TO PRIMARY LYMPHEDEMA

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**Introductions:** Primary lymphedema is said to be caused by malformations or hypoplasia of the lymphatic vessels. We consider that primary lymphedema patients have various degree of generalized lymphatic dysplasia and the effect of surgery is dependent on it. **Patients and Methods:** We used magnetic resonance thoracic ductography (MRTD) on 10 patients with primary lymphedema to assess the morphology of the thoracic duct in patients with primary lymphedema, and we performed lymphatico-venous anastomosis (LVA) for 9 of them. Also, we performed indocyanine green (ICG) lymphography for 8 babies who had idiopathic lymphatic pleural effusion and ascites (LPEA) and performed LVA for 5 of them. We examined their collecting lymphatic vessels pathologically if possible. **Results:** MRTD showed various kinds of abnormalities in thoracic duct. There was relationship between the findings of MRTD and the onset of lymphedema, and the effect of LVA. We found lymphatic stasis in the limbs of LPEA patients with ICG lymphography **Conclusions:** MRTD and ICG lymphography showed that there were various degree and extent of lymphatic dysplasia in the patients, even if they do not have symptoms.

#### DYNAMIC INDOCYANINE GREEN LYMPHOGRAPHY FOR COMPREHENSIVE ASSESSMENT FOR LYMPHEDEMA

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**Introduction:** Lymph pump function is a critical function maintaining fluid circulation. After cancer treatments, lymph obstruction leads to abnormal lymph circulation, resulting in lymph pump dysfunction. As well as lymph pathological circulation (dermal backflow), lymph pump function is important for lymphedema evaluation.

**Materials and Methods:** We assessed and analyzed lymphatic contractility of 12 secondary leg lymphedema patients and 15 arm lymphedema patients using dynamic indocyanine green (ICG) lymphography according to corresponding severity stage.

**Results:** ICG velocity and transit time could evaluate lymph pump function; ICG velocity decreases and transit time increases as the lymphedema severity stage progresses. Measurement of ICG velocity required 5 minutes after the dye injection, whereas that of transit time took more than 1 hour in severe cases. With progression of lymphedema, ICG velocity significantly decreased (P < 0.05), and transit time increased (P < 0.05).

**Conclusions:** ICG velocity can be easily obtained, and is recommended for evaluation of lymphatic contractility compared with transit time. Dynamic ICG lymphography, which evaluates both lymph pump function and circulation, plays an important role in comprehensive assessment of lymphedema pathophysiology.

### PHYSICAL TREATMENT OF LYMPHEDEMA AND LINFOROLL: A NEW MECHANICAL METHOD OPERATOR DEPENDENT IN LINE WITH EBM

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The techniques of manual lymphatic drainage commonly used today, are too subjective and operator dependent: so not universally standardized. The need to use therapeutic methods scientifically correct and reproducible led them to manufacture this equipment dedicated to the lymph drainage in which the physical parameters to be used, operator dependent, can be universally standardized. This fact in the view of compliance with the current concepts of EBM. Linforoll consists of a roller magnetically applied to a handpiece connected to a computerized system containing a program that transmits in real time the pressures exerted by the roller on the same underlying tissues. The device is calibrated so that the ideal pressure to be exerted is positioned about 60 millimeters of mercury, and provides, through lighting systems of "alarm", any reduction or excess pressure. For each clinical case must be performed at least 10 sessions (with a variable time per session variable between 20' and 45'). At the end of the treatment is performed a inelastic multilayer bandage on the anatomical area concerned. In the study were enrolled 120 patients suffering from primary and secondary lymphedema, 46 males and 74 females, age ranging from 2 to 81 years old. Before the drainage must be carried out maneuvers "emptying" of the lymph nodes that are encountered in the individual anatomical areas (as by manual tehcnique). The pressure exerted by the operator that rotates the roller on the skin surface of the patient must be constant. The study aims to examine the volume of the anatomical region affected by oedema and the tissular consistency. The values are noticed at baseline and after 10 sessions of drainage. The volume is calculated automatically by means of a computerized processing based on the formula for the volume of a truncated cone, based on the detection of the circumferences of limbs affected by oedema. The tissue texture should be detected at the same levels of the measurements of the circumferences of the limb (by means tonometry) with the foresight to detect mainly in correspondence of the anatomical areas in which clinically is more increased the local consistency. After the treatment the Aa. observed a medium decrease of 23% of circumference of limbs and a medium decrease of 25% respect to the tonometric basal parameters. The study, still in progress, testify the effectiveness of the device and the availability according to the EBM.

### THE HYDROMECHANICS OF EDEMA FLUID DURING LINFOROLL DEVICE APPLICATION IN LYMPHEDEMA PATIENTS

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Compression therapy for lymphedematous tissues is based on application of force per area of the affected limb. This applies to manual drainage, bandaging, stockings and intermittent pneumatic compression. The knowledge of hydromechanics of the edema fluid in tissues under compression is required for an efficient protocol of application of all these methods. The physical laws of tissue fluid movement are the same irrespective of the used methods. The conditions to be met for proximal movement of edema fluid are: level of exerted force to generate flow, timing sufficient to evacuate excess fluid, tonicity of skin and subcutaneous tissue (hydraulic conductivity). Moreover, sites of accumulation of edema fluid in the limb (distribution of soft tissues, subplantar and popliteal space, inguinal crease resistance) should be taken into account when applying local compression.

The Linforoll device is the first ever construction for manual edema fluid drainage allowing standardization of applied force depending on the local anatomy of soft tissues and their tonicity, timing of applied force, unidirectional fluid movement, detecting sites of increased tissue hydraulic resistance already during the first run of the device (mapping).

We compared the Linforoll applied force (pressure) with the device-skin interface and subcutaneous edema fluid pressures during first and sequential compressions at various levels of lower limb, observed increase of circumference of limb during compression proximally to the device (using strain gauge plethysmography), decrease in deep tissues tonicity (using high force tonometer), and movement of edema fluid by the device under gamma-camera during lymphoscintigraphy.

The obtained results showed that tissue fluid pressures generated manually ranged between 50 and 120 mmHg. Using Linforoll we could regulate them at the range of 50 to 80mmHg. Higher force could be applied in hard tissues and lower below the knee or in the thigh, depending on pressure recordings seen by therapist on the screen. Proximal direction movement of edema fluid could be recorded on plethysmography and correlated with the applied pressure.

The novelty of the device is 1. Regulation of the applied force depending on hydromechanic conditions of the massaged tissues, 2. Standardization of the massage method based on the device properties and not the therapist' hand. 3. Possibility of comparing results in cohorts of patients treated with exactly same force.

### LINFOROLL PROTOCOL: PRELIMINARY RESULTS CONCERNING 12 PATIENTS TREATED IN THE UNIT OF TREATMENT OF EDEMA

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Linforoll consits in a roller magnetically applied to a hand piece connected with computerized system with a programm which transmits the pressures exerced by the roller (60mm of mercury in general).

We excluded patients with cardiac, hepatic, renal failure or very severe disease. We applied this protocoll to twelve income patients, because all of our patients are treated in the unit of treatment of edema. The twelve patients were women from 41 to 84 years old: 5 presented an edema of lower limb (4 right, 1 left); 7 presented an edema of upper limb (4 right, 3 left). Those patients were in hospitalization two weeks and treated 5 days the week; so ten sessions of 45 minutes. At the end of the treatmenteach day a multilayer bandage was applied. A very precise follow up was done: blood pressure, urinary debit... No complication was observed. On those 12 patients, 5 were treated in the past in our unit by classical technic (LMD, soft pneumatic drainage that is pressotherapy).

On the other hand 7 were treated in opur unit for edema the first time by linforoll protocol.

On those first results we can think that there is no significative difference in efficiency between classical and linforoll treatment. So we consider that the good application is that linforoll can be used by any operator (physiotherapist) without important experience of treatment of edema; so it is NO operator dependent!!! and universally standardized... with respect of concepts of E.B.M.

#### SURGERY AND LASER BOUND TOGETHER IN TREATMENT OF VASCULAR AND LYMPHATIC ANOMALIES

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Lymphatic displasias also for their origin can involve every areas of body.

The complexity of clinical square, often different to the commons classification are in grade to reflect only in parts the clinical condition of the patient.

This difformity put the Specialist in front of more of crossroads in the choose of the therapeutic approach, adapt to permit better quality of life to the patient and with an adequate balance between cost and duration of the medical care.

The therapeutic choose is conditioned by more factors:

Age of the patient, perspective of spontaneous remission of the lesion, the extension of the lesion and, naturally, the clinical presentation. The instinctual approach is in several cases with sclerosant substances or alcohol, while the lymphatic surgery came in game in cases in which is build an insistent or compromise "lymphodinamic".

In more recent age, from the employ of optical fiber on diode laser for the treatment of the venous insufficiency started the use the same method for the lysis of the localized adiposity of the lipedema and PEFS alone or associated to the lymphedema.

So is proper on and adaptability of laser technologies that we put the future fondaments for the care of part of lymphatic displasias, that have variable characters from district to district like are varying the laser devices employed.

Any lymphatic presentation are so superficial and with an equivocal presentation under microvescicolar forms to permit only with difficulty the differential diagnosis with HHV1 infections.

This condition can benefit in definitive time of the treatment with CO2 laser, that permits a superficial dermoabrasion and seals forever the ectatic lymphatic vessels .

A pair efficacy and radicality is obtained on removal of verrucous components that caratherize

the lymphedema of declive district.

On soft tissue and mucosae the employ and in more recent time of diode laser 980 nm with optical fiber have shown the same efficacy than in vascular pathologies but the effects of physical interaction with the tissue is more linked to the thermal damage of the protein than to the phototermolysis.

The phototermolysis is the end point for all vascular laser, with some significant differences between transdermal vascular wavelength and diode laser, because, for example, when we speak about 1470 nm, the selectivity switched from blood of 810-980 nm to water and tissue fat.

The endocavity approach with optical fiber with the use of diode laser 980 nm the 1470 nm is a perspective is evaluating the real carrying, of a method well known for the treatment of certain vascular anomalies but of more recent employ, the preliminary results well hope around the attitude to procude endolesional proteic agglomerate, that can obliterate in "quasi" physiological mode the cavity in question. Other prospective potentially interesting is the new surgical wavelength, the diode 2100 nm that have shown an high incisional quality and a controlled impact on the tissue.

Still in embrional time are the application of transdermal vascular laser, like the 532 i.p. and the Dye laser 595 NM, for whom the caratheristic peak of absorbtion to the hemoglobin can represent a limit.

Less closed is this aspect reffered to transdermal Nd-YAG 1064 nm but in limited fiel of application and also in a narrow way of definition.

#### HOW TO TREAT EDEMA OF LOWER LIMBS AFTER TRAUMA, THROMBOSIS OR INFLAMMATION?

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Background: Edema of limb soft tissues develops after mechanical injury of soft tissues, bone fracture, venous thrombosis and infection. All these conditions are characterized by increased capillary filtration, excess mobile tissue fluid, and insufficiency of lymphatics in evacuating edema tissue fluid (TF). Under normal conditions lymphatics transport away TF and intercellular environment is maintained. In the above listed pathological conditions lymphatics are either mechanically damaged or their transport capacity is insufficient. External force is needed to propel TF and lymph to the region they can be absorbed. This can be done with use of pneumatic compression devices and bandages. Aim: To measure the hydromechanic parameters of TF in order to apply effective pressure and compression time of pneumatic devices and bandages. Material and methods: Fifty patients with various types of edema of lower limbs stage II to IV were investigated. We used 8 chamber sleeve inflated to 50, 80 and 120 mmHg and timing 5, 20 and 50 sec/ chamber, no distal deflation (Biocompression Systems, Moonachie, NJ, USA). Short stretch bandages 40-60 mmHg were applied after pneumatic compression.TF pressure was measured with sensors placed subdermally and flow with plethysmographs. Tissue tonometry was performed. Decrease in limb circumference was correlated with compression generated tissue fluid pressure and flow. Results: a)TF head pressures lower than those in inflated chambers, b) inflation time of 5 and 20 sec not long enough to generate TF head pressures above 30 mmHg, c) the 50 sec timing allowed to reach head pressures above 30mmHg, however, they remained lower than in compression chambers, d) bandages 40-60mmHg generated pressures only around 40mmHg and gradually decreased. Conclusions: Our observations point to the necessity of applying high pressures and compression times over 50 sec, to generate effective TF pressures and provide enough time for creating TF flow.

#### LYMPHATIC SURGERY FOR GENERALISED LYMPHATIC DYSPLASIA PATIENTS

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**Introduction:** Generalised lymphatic dysplasia disease (GLD) a rare disease, but when it persists over a prolonged period, the fatality rate is particularly high. The purpose of this study was to determine the utility of indocyanine green (ICG) lymphography and lymphtico-venous anastomosis (LVA) in these cases. There are no established examinations or therapeutic methods for GLD. **Methods:** We tested the lymphatic function in the four extremities for 8 GLD patients by using ICG lymphography and confirmed that the pleural effusion and ascites consisted of lymphatic fluid from the four extremities; on the basis of the results, we performed a LVA for 5 of them. LVA was performed at the extremities in 1~2 cm incisions under general anesthesia. **Results:** In most cases, ICG lymphography showed a linear pattern, which indicates normal, in the four limbs in the early phase; however, in the limbs with lymphostasis, the lymph demonstrated dermal backflow. In 2 patients, LVA was effective and effusion stopped completely after the operatin. In 1 patient, the pleural effusion decreased but did not disappear; after surgery, its volume increased again. In two patients, the LVA had no effect. There were some relationships between ICG lymphography findings and the LVA effect. **Conclusions:** The application of ICG and LVA in the diagnosis and treatment of lymphedema is believed to make it possible to diagnose and treat idiopathic lymphatic lymphatic ascites, the cause of which remains unknown.

### LYMPHATICO-VENOUS SIDE-TO-END ANASTOMOSIS IN PERIPHERAL LYMPHEDEMA PATIENTS CHANGES SUPERFICIAL LYMPH FLOW IN ICG FLUORESCENCE LYMPHANGIOGRAPHY

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**Background:** We have reported outcomes of lymphatico-venous side-to-end anastomosis (LVSEA) in peripheral lymphedema patients. Patency of LVSEA has been evaluated by postoperative ICG lymphangiography in our series. Through the ICG lymphangiography we recognized changes of superficial lymph flow after surgery. In this paper we report some patterns of ICG lymphangiography observed after LVSEA. **Methods:** Between June 2007 and June 2012 143 patients with cancer related lymphedema who had undergone preoperative lymphoscintigraphy and LVSEA by one surgeon using dual dye method under general anesthesia were included in this study. Out of those 95 were lower limb and 48 upper limb. We evaluated postoperative patency of LVSEA and patterns of lymph flow by ICG lymphangiography. **Results:** In the lower limb cases 240 anastomoses were performed and out of them 79 anastomoses could be evaluated by ICG lymphangiography with follow up of 6-36 months. The anastomoses of 32(41%; 32/79) were patent and 47 no patent. In the upper limb cases 114 anastomoses were performed and out of them 56 anastomoses could be evaluated with follow up of 5-34 months. The anastomoses of 25(38%; 25/56) were patent and 31 no patent. We observed decreased dermal back-flow in the patients with patency and new formation of dermal back-flow in the anastomosed sites in the patients with no patency. **Conclusions:** LVSEA can change lymph flow locally in ICG fluorescence lymphangiography. If LVSEA is successful local lymph stasis can be improved and if it is not patent new dermal back-flow can be created in some patients, which suggests that surgical stimulations create new pathway of the lymph.

#### ACROBATIC LYMPHATIC SUPERMICROSURGERY

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**Introduction:** Lymphatic supermicrosurgery, supermicrosurgical lymphaticovenular anastomosis (LVA), is a useful treatment for refractory lymphedema with its effectiveness and minimal invasiveness. It seems reasonable to create as many bypasses as possible to increase lymph flow bypass.

**Materials and Methods:** We performed LVAs on peripheral lymphedema patients refractory to conservative treatments. Postoperative volume reduction and intraoperative findings such as diameter of vessels, vessels' location, the number of vessels in a surgical field, and vessels' sclerosis were evaluated. When there were multiple lymphatic vessels and veins in a surgical field, complex anastomoses were performed in the field.

**Results:** Volume reduction correlated with the number of bypasses. Multi-configuration LVAs were performed to increase the number of LVAs using end-to-end (E-E), end-to-side (E-S), side-to-end (S-E), and side-to-side (S-S) anastomoses. When there were multiple lymphatic vessels and veins in a surgical field, multiple complex LVAs were performed; E-E + E-S (lambda), S-S + S-E (sequential), triple S-E, combination of sequential + double E-E (flow-through) + S-E, etc.

**Conclusions:** It is recommended for an experienced lymphatic supermicrosurgeon to combine the basic 4 types of LVA to maximize the number of bypasses according to vessels available in a surgical field. This acrobatic lymphatic supermicrosurgery leads to better treatment results.

### **POSTER SESSION**

### COMPARISON OF MANUAL LYMPHATIC DRAINAGE AND INTERMITTENT PNEUMATIC COMPRESSION IN THE TREATMENT OF BREAST CANCER RELATED LYMPHEDEMA

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**Purpose:** The purpose of the present study was to compare manual lymphatic drainage (MLD) and intermittent pneumatic compression (IPC) in the treatment of patients with breast cancer related lymphedema.

**Methods:** 60 patients with unilateral breast cancer related lymphedema were randomly allocated into two groups, Manual Lymphatic Drainage (MLD) (n=31) group and Intermittent Pneumatic Compression (IPC) (n=29) groups. Both groups received skin care, short-stretch compression bandage and decongestive exercises as well. Both treatment programs continoued for four weeks and five days a week. After the fourth week, a compression garment was fabricated according to each subject's current edema measurement. Cases were instructed to continue skin care applications and exercise with their compressions garments on during the follow-up period. Volume and circumference were measured at six levels (metacarpal, wrist, mid forearm, elbow, mid arm, upper arm/axilla) on the upper limbs, before the treatment, at the 10th and 20th (end of the theatment) treatment sessions and one month after the discharge using a Leg-O-Meter.

**Results:** The results indicate that both treatment programs reduced lymphedema but in MLD group edema was significantly reduced compared to IPC group (p<0.05). At the end of the treatment, while edema was accumulated in the shoulder region of the cases in IPC group, no accumulation was observed in MLD group.

**Conclusions:** These findings lead us to think that MLD is a safe method for treatment of breast cancer related lymphedema and IPC can be applied if MLD application is not possible.

Key words: manual lymphatic drainage, complex decongestive physiotherapy, lymphedema, intermittent pneumatic compression.

#### LYMPHEDEMA AND LIPEDEMA: USEFULNESS OF SHOCK WAVES

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**Introduction:** Pneumatically-generated radial shockwaves have interesting effects on tissue in the region of application: they stimulate metabolism and vasodilation, as well as speeding up neoangiogenesis, having an anti-inflammatory effect and increasing transport of interstitial fluid.

This study in progress aims to highlight the usefulness of shock waves both in lipedema, as a monotherapy, and in fibrotic areas in lymphedema, either as an isolated technique or as part of a combined treatment.

**Materials and Methods:** After the lymphological assessment, with morphological analysis of the tissue by ultrasound, and a measurement/photographic assessment, 31 patients were treated with shock waves (EMS Swiss DolorClast): 19 with lipedema (1 upper limb, 18 lower limbs) and 12 with lymphedema (3 primary lower limb and 9 secondary: 5 lower limbs and 4 upper).

- Lipedema: number of sessions 10- pulses from 4000 to 6000, for each application, with variable intensity from 3 to 4 bars depending on the subjective tolerability and area treated, while the frequency used was equivalent to 8-10 Hz
- Lymphedema (fibrotic area): number of applications 4/6- pulses from 2000 to 6000, for each application according to the size of the area being treated, with variable intensity from 2.5 to 4 bars depending on the subjective tolerability, while the frequency used was equivalent to 8-10 Hz

The exclusion criteria were the presence of inflammation in the area of application and coagulopathies.

**Results:** At the end of the treatment, tissue texture and morphology were assessed with ultrasound, and a comparative

measurement/photographic assessment of the limbs was performed. In the case of lipedema, the subjective data of the patients were taken into account.

- Lipedema: a reduction in tissue texture, on palpation, with a centimetric decrease in limb size, while ultrasound examination showed a reduction in the epifascial thickness.
- All patients reported less pain and heaviness, which they had initially reported in the limbs.
- Lymphedema: a reduction in the tissue texture was found in the fibrotic area on palpation, with a centimetric decrease in the treated region. Ultrasound examination showed a reduction in the epifascial thickness, with a reduction in tissue hyperechogenicity.

**Conclusions:** In view of the results achieved in this study in progress, shock waves, which are easy for a physical therapist to apply, are useful both as monotherapy in the treatment of lipedem

### ICG FLUORESCENCE LYMPHOGRAPHY REVEALS REAL-TIME LYMPH-FLOW IN THE SUPERFICIAL LYMPH-VESSELS OF THE LEG BY INTERMITTENT PNEUMATIC COMPRESSION IN HEALTH

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**Background:** It has been still unknown how lymph flows by intermittent pneumatic compression (IPC). Aims of this study were to reveal real-time lymph-flow and lymph-flow patters in the superficial lymphatics of the leg by ICG fluorescence lymphography during IPC in the healthy volunteers.

**Materials:** Thirteen healthy volunteers participated in this study. After subcutaneous injection of Indocyanine Green lymph-flow in the leg was observed by PDE system (Hamamatsu Photonics, Japan) and a transparent garment with 6 chambers connected to a pneumatic pump, Physical Medomer (Medor Inc., Japan) was then put on the leg. Each chamber inflates with a maximum pressure of 90 mmHg in sequence or at the same time and deflates according to some orders we set. During the inflation and deflation the lymph-flow in the mid lower leg was recorded through the PDE system and brightness of the recorded images was calculated by software.

**Results:** Real-time lymph-flow could be observed through the transparent garment during IPC by ICG fluorescence lymphography. The brightness in the images in the mid lower leg changed more quickly in the deflation period we set than in the inflation period, which means the lymph flowed faster in the deflation period than the inflation.

**Discussions:** IPC accelerates lymph-flow in the superficial lymphatic vessels of the leg in the healthy volunteers with faster flow in the deflation period than inflation. Timing of deflation seems to be important to obtain effective lymph-flow in IPC. We have to study a relationship between lymph-flow and clinical improvement in patients with lymphedema in the future. In addition, appropriate pressures for lymph-flow in IPC should be studied.

#### LYMPHEDEMA INDEX FOR BODY-TYPE CORRECTED LYMPHEDEMATOUS VOLUME EVALUATION

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**Introduction:** Measurement of limb volume is one of the most commonly employed methods for evaluating extremity lymphedematous volume. However, comparison between different patients is difficult with volumetry. For example, 6000ml-leg of a BMI-20 patient should be evaluated as more severe than 6000ml-leg of a BMI-30 patient. To overcome this problem, we have formulated new indices, lower extremity lymphedema (LEL) index and upper extremity lymphedema (UEL) index.

**Materials and Methods:** Lymphedema index is calculated using the formula; (C12 + C22 + C32 + C42 + C52) / BMI, where C1-5 indicate extremity circumferences (PMID: 21734534 & 21407058). We compared lymphedema index with extremity volumetry in volunteers' non-edematous limbs to validate that lymphedema index is body-type corrected. We also evaluated correlation between LEL index, UEL index and clinical stage in patients with extremity lymphedema.

**Results:** As BMI increased, extremity volumetry increased, while lymphedema index stayed constant. The LEL index and the UEL index were significantly correlated with clinical stages and could be used as a severity scale.

**Conclusions:** The lymphedema indices, LEL index and UEL index, make objective assessment of the severity of lymphedema through a numerical rating, regardless of the body type. This numerical rating makes the indices useful for evaluation of peripheral lymphedema severities between different cases.

### COMPARISON OF INDOCYANINE GREEN LYMPHOGRAPHIC FINDINGS WITH THE CONDITIONS OF COLLECTING LYMPHATIC VESSELS IN PATIENTS WITH LYMPHEDEMA

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**Introductions:** We investigated the relationship between findings from indocyanine green (ICG) lymphography and the condition of lymphatics according to the NECST classifications observed during surgery.

**Patients and Methods:** We examined a total of 43 limbs of 25 patients who had undergone lymphatico-venous anastomosis (LVA). After the injection of ICG, linear, splash, stardust, and diffuse patterns were determined. Visual findings of the collecting lymph vessels during the LVA at each incision site were evaluated on the basis of the NECST classifications.

**Results:** LVA was conducted on 164 collecting lymph vessels within 25 patients. Of these, Normal type lymph vessels were observed in 36, Ectasis type in 43, Contraction type in 52, and Sclerosis type in 33. Many normal type vessels were found in the linear region, while the proportion of this type declined in the more severe stardust and diffuse regions. In contrast, no sclerosis type vessels were found in the linear region, while the proportion of this type increased with lymphedema severity.

Conclusions: ICG lymphography findings and the NECST classification of collecting lymph vessels seem to have a relationship.

#### GENITAL LYMPHEDEMA SEVERITY STAGING SYSTEM USING INDOCYANINE GREEN LYMPHOGRAPHY

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**Introduction:** Treatment of genital lymphedema (GL) is challenging, and early diagnosis and intervention is important. However, early treatment of GL is difficult due to a lack of appropriate evaluation methods allowing early diagnosis. Indocyanine green (ICG) lymphography, which allows precise visualization of superficial lymph flows, seems useful for genital lymphedema evaluation.

**Materials and Methods:** Patient characteristics and ICG lymphography findings of 68 secondary leg lymphedema patients were reviewed. The clinical data and dermal backflow (DB) stages based on ICG lymphography findings, leg DB (LDB) stage for leg lymphedema and genital DB (GDB) stage for genital lymphedema, were analyzed to compare between regions with and without symptomatic GL.

**Results:** Twenty-two of 136 regions had symptomatic GL. There were statistically significant differences between regions with and without GL in duration of leg edema, International Society of Lymphology stage, LDB stage, and GDB stage.

**Conclusions:** ICG lymphography can clearly visualize abnormal lymph circulation in the lower abdominal and genital region. GDB stage is based on the concept of lower abdomen-to-genitalia (LAG) sequence, in which genital lymphedema follows lower abdominal lymphedema, allows early diagnosis of GL before symptom manifestation. ICG genital lymphography can be a key evaluation for prevention and early intervention of GL.

#### INDOCYANINE GREEN LYMPHOGRAPHY FOR OBSTRUCTIVE LYMPHEDEMA

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**Introduction:** Management of lymphedema secondary to cancer treatment is challenging, and emphasis should be put on early diagnosis and prevention of secondary lymphedema. Indocyanine green (ICG) lymphography is becoming a method of choice for evaluation of lymphedema and for navigation for lymphatic surgery.

**Materials and Methods:** ICG lymphography was performed on patients with obstructive lymphedema such as leg, arm, facial, and genital lymphedema. Clinical findings, ICG lymphography findings, intraoperative lymphatic conditions, and postoperative results were evaluated.

**Results:** With progression of obstructive lymphedema, ICG velocity decreased, and ICG lymphography findings changed from linear, to splash, to stardust, and finally to diffuse pattern. Based on dermal backflow (DB) patterns, pathophysiological severity staging systems (DB stages) were developed. As ICG lymphography findings change from linear to stardust and diffuse pattern, detection of lymphatic vessels became more difficult, and lymphatic vessels became smaller and more sclerotic.

**Conclusions:** Although impossible to visualize deep lymph flows, ICG lymphography is a safe, and convenient evaluation method for lymphedema. Dynamic (dual-phase) ICG lymphography allows comprehensive assessment of lymphedema; ICG velocity in an early transient-phase, and DB stages in a late plateau-phase. One injection is enough for dynamic ICG lymphography and navigation lymphatic surgery. DB stage would play an important role in strategy of lymphedema management, since splash/stardust pattern (DB stage I/II) represents a reversible/irreversible change, respectively.

#### SURGICAL TREATMENT OF LYMPHEDEMA OF THE SCROTUM; MODIFIED SURGICAL TECHNIQUE

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**Introduction:** Lymphedema of the scrotum is categorized in the literature as rare condition. Scrotal lymphedema can be a functional and psychological incapacitating problem. In the absence of effective procedures that restore physiologic function, surgical resection and scrotal reconstruction is the preferred treatment of cases with severe scrotal lymphedema. The aim of the of the present study is evaluation of the results of surgical treatment of stage III, moderate and severe cases of scrotal lymphedema in twenty patients using reconstruction with local scrotal flaps following excision.

**Material and Methods:** The three flaps surgical technique introduced in the present study was in twenty patients suffering from moderate to severe cases of lymphedema of the scrotum in the period between September 2009 till September 2013. The technique includes elevation of two inguino-scrotal flaps and one perineo-scrotal flap. The base of the flaps is limited to the neck of the scrotum & perineum and the base to length of the flaps measures one to two. They are used to reconstruct of the scrotum after excision.

**Results:** The clinical results showed excellent improvement as regards scrotum size, sexual and voiding functions and acceptable cosmetic result, even in cases with recurrence (20%) within follow up period (average 23 months), where they did not exceed upper third of the thigh.The clinical Evaluation of the results in the follow up period showed wound infection in 80% of the cases that was controlled on conservative measures, 80% of the patients had good satisfaction while 20% were unsatisfied ,recurrent infections were controlled .

**Conclusion:** The results are presented and discussed and it was concluded that the adpted technique is a simple, easy and proved satisfactory for the treatment of moderat and severe disabling and persistent cases of scrotal lymphedema after failure of conservative measures.

### THE TRUE PATHOPHYSIOLOGY OF SECONDARY LYMPHEDEMA BASED ON HISTOLOGICAL ANALYSIS OF COLLECTING LYMPHATIC VESSELS

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**Introduction:** To date, an electron microscopy study of the collecting lymphatic vessels has not been conducted to examine the early stages of lymphedema. However, such histological studies could be useful for elucidating the mechanism of lymphedema onset. The aim of this study was to clarify the changes occurring in collecting lymphatic vessels after lymphadenectomy.

**Methods:** The study was conducted on 114 specimens from 37 patients who developed lymphedema of the lower limbs after receiving surgical treatment for gynecologic cancers and who consulted the University of Tokyo Hospital and affiliated hospitals from April 2009 to March 2011. Lymphatic vessels that were not needed for lymphatico venous anastomosis surgery were trimmed and subsequently examined using electron microscopy and light microscopy.

**Results:** Based on macroscopic findings, the histochemical changes in the collecting lymphatic vessels were defined as follows: normal, ectasis, contraction, and sclerosis type (NECST). In the ectasis type, an increase in endolymphatic pressure was accompanied by a flattening of the lymphatic vessel endothelial cells. In the contraction type, smooth muscle cells were transformed into synthetic cells and promoted the growth of collagen fibers. In the sclerosis type, fibrous elements accounted for the majority of the components, the lymphatic vessels lost their transport and concentrating abilities, and the lumen was either narrowed or completely obstructed. **Conclusions:** The increase in pressure inside the collecting lymphatic vessels after lymphadenectomy was accompanied by

histological changes that began before the onset of lymphedema.

#### THE LYMPHEDEMA QUALITY OF LIFE INVENTORY (LYQLI) - TEST OF VALIDITY AND RELIABILITY

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**Introduction:** Lymphedema has a significant impact on quality of life and several questionnaires have been developed for either upper or lower limbs. However, there has been a lack of instruments designed for measuring Health related quality of life (HRQOL) in patients with all kinds of lymphedema. Recently a general questionnaire; Lymphedema Quality of Life Inventory (LyQLI) has been developed. The LyQLI is vertically arranged on an A4, including five pages. The first page has a short description of the questionnaire and how to answer it related to the past four weeks. The next part contains three pages with 41 items divided into three dimensions; physical (12 items), psychosocial (16 items) and practical (13 items). The last page consists of two questions whether the past four weeks had been as usual or not and one question about over all impact on HRQOL related to lymphedema and one about general quality of life.

Purpose: The aim of present study was to test LyQLI for reliability and validity in Sweden.

**Method:** Two-hundred patients with different kinds of lymphedema were included and LyQLI was sent to the patients twice, together with SF-36 for measurement of general health.

**Results:** One-hundred twenty-six patients (lymphedema of the lower limbs/upper limbs/others 55/40/5%) completed the test-retest. Median respondent time for test-retest was 10 days. Reliability: ICC in the physical and psychosocial dimension were 0.88 (P < 0.01) and in practical the 0.87 (P < 0.01).Cronbach's alpha was 0.88/0.92/0.88 for each of the three dimensions respectively. Criterion validity: The correlations were low or moderate for the mean score in the three dimensions in the LyQLI and the eight domains in the SF-36. Floor-ceiling: The skewness characteristics show that there is a tendency to a small floor effect.

**Conclusion:** The new questionnaire, LyQLI, is valid and has a good reliability. It can be used in clinic and for cross-sectional studies. Further studies of LyQLI is needed to investigate the responsiveness in interventional and longitudinal studies.

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### INFLUENCE OF MICROSURGICAL LYMPH NODE TRANSPLANT AND/OR LYMPH-VENOUS ANASTOMOSES ON SECONDARY BREAST CANCER RELATED LYMPHEDEMA AND QUALITY OF LIFE

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**Introduction:** Breast cancer related lymphedema (BCRL) is one of the most common complications following breast cancer treatment and can induce significant decrease in health related quality of life (HRQoL) of breast cancer survivors. Due to the fact that complex physical therapy (CPT) does not always offer a satisfying result, plastic surgeons developed promising microsurgical methods, offering a long-term solution for BCRL.

In January 2013 our research group, a cooperation between the Plastic Surgery Department and the Physical Therapy Department of the Breast Cancer Center started this study, as part of a bigger BCRL prevention and curation project, to give an answer to CPT failure in breast cancer survivors with BCRL.

The primary aim of this research is to study the influence of microsurgical lymph node transplant (LNT) and/or lymph-venous anastomoses (LVA) with a standard CPT protocol in patients with secondary BCRL on degree of BCRL and HRQoL of breast cancer survivors. A secondary aim of this study is to analyse the evolution of episodes of inflammation in the edematous arm and the need to wear compression stockings.

**Materials and Methods:** The evolution of BCRL is measured by arm volume changes (with a Perometer), changes in edematous tissue (echogenicity at US echography) and changes in skin thickness (with US echography). HRQoL is measured with the ULL-27 questionnaire. CPT treatment pre- and post-operative is registered through content, frequency, intensity and duration of each treatment. The possible effects of patient- and treatment related risk factors of BCRL are also calculated.

Paired sample t-tests will be used to analyse the evolution of BCRL and HRQoL in the study population between baseline measurements (prior to the surgical intervention) and 3, 6, 9 and 12 months follow-up. Correlations between degree of BCRL and HRQoL will be calculated with the Pearson correlation coefficient, as well as correlations with CPT and patient- and treatment related risk factors.

All authors and co-authors signed a Conflict of Interest/financial disclosure statement. The ethical committee of the organising hospital approved this longitudinal cohort study.

**Results and conclusions:** At the congress, preliminary results of about 10 to 15 patients with 3 months to 1 year follow-up will be presented as well as the protocol of the bigger BCRL project.

#### ANXIETY AND DEPRESSION - COMPLICATING FACTORS OF LYMPHEDEMA TREATMENT

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Lymphedema is generally accepted as chronic, progressive, life-long disease affecting the patients both physically and psychologically. Therefore, lymphedema requires, from psychosomatic point of view, standing adaptation on the disease. Since 10/205 till 12/2013 in general 746 lymphedema patients underwent complex treatment. Collected knowledge evoked consequential cognitions. The lymphedema patients are influenced by a planty of psychosocial factors as breaked body- image, limitations in dressing, problems in family and partner's relation (incl. sexual life), limited social interactions and other factors decreasing pts' quality of life. The onset of anxiety and depression causes a lack of pt's self-care and worsening of lymphedema. This situation needs a special treatment. Conventional psychotherapy on it's own is insufficient. Rational psychopharmacological approach (antidepressive and anxiolytic drugs) must be integrated into pt's complex treatment (in cooperation with psycho- specialist). The onset of depression seems to be very often unrecognized by "somatic" doctors from specific reasons: at first – signals of early signs of depression are often qualified as a lack of will, lazyness, hypersensibility or hysteric reaction and, at second – lymphologist might underestimate the fact, that depressive symtoms may manifest themselves not only in "verbal sphere", but also "nonverbally" and, therefore, might be easilly overlooked. Depression strikes the patient, he becomes passive, apathetic and ignores the treatment daily-régime. So, a "vitious circle" starts: depression ... increasing pt's pasivity ... decreasing treatment effort ... progression of lymphedema ... worsening of depression. Summary. Nowadays, complex decongestive therapy (CDT) of lymphedema is based on psychosomatic conception of the disease and needs interdisciplinary cooperation.

This study was supported by grant P407/12/0602 of the Grant Agency of the Czech Republic.

### THE EFFECT OF EDUCATION ON PHYSIOTHERAPY STUDENTS KNOWLEDGE OF LYMPHEDEMA DETECTION AND PREVENTION

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Breast cancer-related lymphedema (BCRL) is an accumulation of lymphatic fluid in the interstitial tissue that causes swelling, most often in the arm (s), and occasionally in the chest. Studies have reported that approximately twenty to fourty percent of patients who have undergone axillary surgery for breast cancer will develop BCRL at some point during their lives.

The purpose of this study was to evaluate the effectiveness of an education program on Physiotherapy students knowledge of the risk of and preventive measures for upper limb lymphedema in breast cancer patients.

A sample of physiotherapy students (n = 38) included both studied the 3th semester at the Abant Izzet Baysal University, School of Physiotherapy and Rehabilitation. Nineteen physiotherapy students who attended an educational program on lymphedema detection and prevention and nineteen physiotherapy students who did not attend were randomly selected to participate in the study. Although there was little variation in the scores between the educated versus the uneducated group, the educated group did better. Among the groups, the highest score was found in the educated group (92%). The group that did not receive the education received a lower score (81%).

This knowledge has the potential to improve the ability of physiotherapy students to deliver effective patient education, provide quality care and improve health outcomes for those at risk for lymphedema.

This study makes a significant contribution to physiotherapy students knowledge by describing and documenting the effect of an education program on physiotherapy students knowledge of the risk and prevention of lymphedema for women who have had breast cancer treatment.

Physiotherapy students need continuing education about definition, assessment, intervention, and prevention of lymphedema. With this accomplished, patients will benefit with patient education and high quality care.

#### EVALUATION OF TIME-DISTANCE PARAMETER CHANGES IN PATIENT WITH PRIMARY LYMPHEDEMA -A CASE REPORT

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**Introduction:** Lymphedema is a chronic disease. The patient has to use the garment during his life. The aim of this case report is to evaluate walking ability with gait analysis for the patient with bilateral primary lymphedema. Data obtained with the gait assessment at the motion analysis laboratory. This case report describes the differences of walking with the barefoot and garments.

**Materials and Methods:** Our subject was a 13 years old child with bilateral lower limb primary lymphedema. The patient was measured walking on barefoot and with garments. The measurements were taken in Istanbul Faculty of Medicine, Motion Analysis Laboratory by using gait analysis laboratory (Elite System, BTS S.p.a., Milan, Italy) which has six high speed cameras (100 m/s) and two force plates. Step width (mm), cadence (step/min) and mean velocity (m/sec) were analyzed as system program.

**Results:** Time-distance parameters were evaluated. There was %16.91 difference for step width parameter between barefoot and garment. There was %0.90 difference for cadence and %3.84 difference for mean velocity parameter between barefoot and garment. By comparing barefoot and walking with garments on gait, step width decreased but there was not seen any noticeable difference between cadence and mean velocity.

**Conclusions:** Our findings can explain that walking with garments can increase balance. Because step with is associated with balance and its decreased as the patient walking with garments. But as there wasn't any noticeable difference between cadence and mean velocity. We need more clinical researches with more patient outside of only one case report.

Keywords: Lymphedema, gait analysis.

### EFFECTIVENESS OF THE "PUNCH TAPE" APPLICATION IN SEROMA: A CASE OF SEROMA AFTER BREAST RECONSTRUCTION SURGERY

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**Introduction:** Common complications of breast surgery include bleeding, infection, lymph oedema and nerve damage. The most common complication following breast surgery is seroma formation. Punch-Tape is a type of tape riddled with holes in an asymmetric pattern that creates different tension lines within the same piece of tape. This has a major effect on the superficial fascia, neuro-lymphatic system and analgesic response (endorphins), draining haematoma and edema. Punch-Tape is a type of tape riddled with holes in an asymmetric pattern that creates different tension lines within the same piece of tape. This has a major effect on the superficial fascia, neuro-lymphatic system and analgesic response (endorphins), draining haematoma and edema. Punch-Tape is a type of tape riddled with holes in an asymmetric pattern that creates different tension lines within the same piece of tape. This has a major effect on the superficial fascia, neuro-lymphatic system and analgesic response (endorphins), draining haematoma and edema. A case of using Punch Tape to reduce a four weeks seroma after breast reconstruction surgery in a woman with 45 years old.

Material and Method: A 45 years old woman, with seroma in the right lateral face of the trunk at the level of the 4,5, 6 and 7 ribs.

Before applying the Punch Tape we realized the perimetry of superior trunk in the maximum of inspiration and exhalation. The same procedure was performed after 2 hours of the first application and after 4, 8, 12 and 16 days after each application, and 1 month after stopping the taping.

The tape was applied applied over the watershed between the posterior thoracic skin territories and from spine to axilla. The patient was positioned so that the skin was slightly stretched before the application of the tape. Once the skin returned to its normal position, it was drawn up to create an underlying negative pressure.

**Results:** After 16 days, there was a significant decrease in the measure that was maintained 1 month after stop the use of Punch Tape. When applied properly the tapes allow for 24 hours of lymphatic drainage system.

**Conclusion:** In a case seroma after breast reconstruction surgery the use of Punch Tape helping the drainage to the thoracic skin territories e was effective in is reduction in 16 days.

Keywords: Seroma, breast surgery, Punch-Tape, Physiotherapy.

#### EFFECT OF COMBINED THERAPY ON COLON CANCER-RELATED LYMPHEDEMA: CASE REPORT

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**Introduction:** Lymphedema is a complication that commonly been observed in cancer patients. Complex decongestive physiotherapy (CDP) is used as a treatment method for lymphedema and includes skin care, manual lymphatic drainage, compression garments, and selected used of pneumatic compression (PC) devices. Postulated mechanisms of PC ef?cacy include simulating the calf muscle pump, decreased capillary ?ltration, and reduced venous re?ux. Kinesio Taping (KT) for lymphatic drainage is a new choice in the field of physical and alternative therapy. The material used for the KT and the original concept of the taping technique were introduced by Dr. Kenso Kase in 1973. KT had been designed to allow 30–40% longitudinal stretch. The aim of the study was to assess the efficacy of CDP, KT and PC therapy for treating colon cancer-related unilateral seconder leg lymphedema.

**Materials and Methods:** Female patient at the age of 39 applied to our unit by lymphedema complaints. The patient has been operated in 2002 and 2009 due to metastatic rectum neoplasm yet there is still a metastatic mass in iliopsoas muscle. Firstly manual lymph drainage was applied to axilla-inguinal anastomosis pathway. Then PC was performed 30 minutes and patient was provided skin care-compression bandage and exercise. Also KT was applied twice a week. The procedures were applied 5 days a week for a period of 4 weeks. The amount of patient's right leg edema was evaluated with Leg Q Meter. Edema evaluation was repeated after 10 days and after the treatment. Beck Depression Scale (BDS) was used to assess psychological status, and Nottingham Health Profile (NHP) was applied to assess quality of life

**Results:** According to circumference measurement results decrease of 2.2cm at metatarsophalangeal joint, 2.7cm at ankle, 2.9cm at achilles tendon, 3.8cm at gastrosoleus muscle, 3.3cm at head of fibula, 4.2 cm at middle of knee, 2,8 cm at thigh and 2.7 cm at thigh?(most swollen region) was determined. BDS and NHP total scores of the patient respectively was measured as 50 and 569,1 points at the first assessment and 34 and 549,1 points at the second assessment.

Conclusion: The patient was using a wheelchair at the beginning of treatment. After treatment she began to walk with a cane. Combined therapy is effective for reducing edema and improving the quality of life.

Key Words: Lymphedema, Kinesio Taping, Pneumatic Compression, Complex Decongestive Physiotherapy.

#### ACTIVATORS OF LYMPHATIC DRAINAGE IN OVERCOMING INSULIN RESISTANCE

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**Introduction:** Diabetes (DT 2) is chronic endotoxemia. The new direction - antihomotoxicology therapy (AHT), methods of activating interstitial humoral transport (IHT) and lymphatic drainage (LD).

**Object:** Examine the effectiveness of methods AHT, IHT, LD correction mechanisms of primary insulin resistance (IR) in patients DT 2.

**Subject and Methods:** Were examined 74 patients with DT 2. Criterion for selection: satisfactory compensating for DT2, disease duration less than 10 years, body mass index (IMB)> 28. Monitoring Group (1): 24 patients DT2, age  $53 \pm 6.4$  g, rehabilitation complex which included AHT and IHT. Comparison group: 34 people. Age  $51 \pm 7.1$  g, matched by sex, age and characteristics of the DT 2 (2a) and 2b group (16 pers.), in which patients given metformin in a therapeutic dose. Controlled: glycemic profile, HbA1c, cholesterol, lipoprotein fractions, triglycerides (TG). Assessed the state of the cell membrane - (cell microelectrophoresis) for rapid diagnosis endotoxicosis (patent RU ? 2249214). Functional reserves of the body assessed indicator adaptation of conformity (IAC) (patent RU 2342900 C1).

Treatment – Lymphomyosot (10 drops 3 times a day to 4 weeks). As supporting detoxification drugs - Hepar compositum (2 times weekly 1 ampoule intramuscularly 6 weeks), Ubichinon compositum (2 times weekly 1 ampoule intramuscularly within 6 weeks). Appointments were made in accordance with published protocols firm Heel.

**Results:** In group 2a there were no changes. In group 1 and 2b marked improvement in metabolic parameters (reducing HbA1c with 9,91 ± 1,2% to 6,72 ± 1,8%, p < 0,001; triglycerides with 2,8 ± 0,4 g / 1 to 1,5±0,5 g/l, p < 0,001), but a significant and sustained improvement in IAC noted under the influence of AHT+LD. In group 2a and 2b through IAC 6 months corresponded to the beginning of observation. Amplitude of the oscillations of the cell walls determines the membrane potential, which characterizes the level of viability and metabolic processes in the cell (normal 3-5 mM). The number of viable cells in group 1 increased ( from 4,72±7,9 to 12,8 6,1%; normal 5-15%) due to the increased sensitivity of tissue receptors and the action of insulin , blood glucose levels returned to normal, the indicator decreased HbA1c to the level of metabolic compensation . After a course of AHT+LD TG decreased 2,4 ± 0,11 mmol/l to 1,77±0,8 mmol/l (p < 0,05) and at 3 months was 1,56 ± 0,1 mmol/l (p < 0.01). In the comparison group TG 3 months increased to 2,65±0,9 mmol/l (p > 0,5) after the patient returns to habitual way of life. In group 1, the number of patients with good compensation DT2 and high IAC increased from 11% to 40%.

**Conclusion:** In the body of the patient DT2 accumulate toxic substances of exogenous and endogenous origin, lowered defenses. Promising use AHT+LD in DT2 therapy is associated with the effect of reducing IR and increasing organism functional reserves.

### FEATURES DIAGNOSIS AND TREATMENT OF PATIENTS TACTICS WITH CONCOMITANT LYMPH, VENOUS AND MUSCULOSKELETAL LOWER LIMB

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**Introduction:** In clinical practice, a combination of various congenital and acquired abnormalities of the foot with chronic venous and lymphatic vessels of the lower extremities is a common occurrence. This is due, primarily, a common cause - congenital systemic connective tissue dysplasia, as well as locomotor flawed relationship that causes progressive mutual burdening these diseases. **Objectives:** Improve the results of treatment of patients with combined pathology of the lymphatic, venous and musculoskeletal lower limb through a comprehensive multidisciplinary approach to choice of the optimal treatment strategy.

**Materials and Methods:** The results of the survey 568 patients with combined pathology of the lymph, the veins of the lower extremities and musculoskeletal system. Underwent clinical, instrumental and functional examination (ultrasonodopplerografiya, volumetry, computed tomography, plantography, podometrics, goniometry, functional electromyography). Patients with disorders of the musculoskeletal system and associated chronic venous diseases C3-C6 class performs the combined surgery (n = 401), aimed at correcting violations of peripheral venous circulation and lymphatic drainage. When I-II stages of lymphedema conducted

lymphove inous shunting (n = 54). At stage III-IV lymphedema conducted operations resection character (n = 62).

Assessment of the quality of life of patients was performed using a questionnaire "SF- 36 Healf Status Survey". Rating long-term results of surgical treatment (up to 3 years) is made using the criteria of evidence-based medicine.

**Results:** Secondary lymphedema stages I-II was detected in 154 and III-IV - 62 patients. C3 class at 168, C4 - in 124, C5 - C6 and in 102 - in 58 patients. Nontraumatic pathology still detected in 506 (89%), and the phenomenon of foot joints arthrosis in 255 (45%) patients. Clinical analysis of movements revealed pathological changes in step cycle and functional insufficiency of the lower limbs. Increased density of the skin and subcutaneous tissue to  $-19,1 \pm 0,2$  HU, muscle compartments of the tibia - to  $4,3 \pm 0,18$  HU. Combined pathology of the musculoskeletal, lymphatic and venous systems leads to the development of congestive arthrogenic syndrome. At C5-C6 classes formed chronic compartment syndrome . In the late postoperative period showed a reduction in the functional failure of the affected limb and quality of life.

**Conclusions:** With medical rehabilitation of patients with combined lesions of the lymphatic and venous and musculoskeletal lower limb needs a multidisciplinary approach. Criteria developed systemic functional approach to the diagnosis and treatment can help you avoid many of the pitfalls in the treatment of patients in this category.

#### EFFECTIVENESS OF THE APPLICATION OF NEUROMUSCULAR TAPING ("PUNCH TAPE") IN POST MASTECTOMY LYMPHEDEMA: A CASE STUDY USING ULTRA SOUND TO MEASURE CHANGES IN EDEMA VOLUME AND SKIN THICKNESS

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**Introduction:** Common complications in breast cancer surgery include bleeding, infection, nerve damage and lymphedema. The most common complication is lymphedema. Breast cancer surgery requires the recession of select lymph nodes causing damage to lymphatic vessels responsible for the complicated transport of high-particle proteins from the lymphatic tissue and their subsequent circulation in the body. This damage causes elevation of the colloidal osmotic pressure and water retention in intertissular spaces; leading to loss of lymphatic vessel tone and decrease in the hydrostatic pressure. In this case study, ultra sound measurements demonstrate a decrease in lymphedema volume and skin thickness within 5 minutes of the correct application of neuromuscular taping (Punch Tape).

**Material and Method:** A 56 year old, post-mastectomy breast cancer patient (women) developed lymphedema in her arm. An ultrasound study was performed on the forearm of the affected limb, to measure the size of the edema and the thickness of the skin, then the treatment with Punch Tape was applied and the same measurement protocol used previously is re-used. The ultrasound machine used to carry out our measurements is the Logic E BT11 (General Electric). The neuromuscular tape used was Punch Tape (a registered EU Class I Medical Device).

**Results:** In the first measurement (before application of Punch Tape) the results were: forearm edema = 1.18 cm and the skin thickness = 0.23 cm. Five minutes after application of the Punch Tape, the results recorded were 0.51 cm and 0, 08 cm respectively.

**Conclusion:** The use of neuromuscular tape (Punch Tape) in the treatment of lymphedema in post-mastectomy patients may significantly reduce both the edema and the thickness of the skin within five (5) minutes. Further clinical studies with a larger sample size are required to confirm these results.

Keywords: Punch-Tape, Physiotherapy, Neuromuscular Taping (NMT), Medical Taping Concept (MTC).

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