

Monday, January 13, 2014 - Extremities Scientific Paper Session - 6:45am - 8:15am

6:45am - 6:49am

Microvascular Considerations and Complications for 235 Foot and Ankle Free Flaps

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Purpose: Foot and ankle wounds are notoriously difficult to manage. Free flap reconstruction for these wounds remains an option, but is thought to be challenging and associated with high rates of complications. We have previously published our approach to this problem using a subunit based strategy. In this study we sought to evaluate the specific microvascular issues associated with foot and ankle free flaps in our large cohort.

Methods: This study is an IRB approved retrospective review of foot and ankle free flaps performed at a single institution between 1997 and 2013. All patients that had foot and ankle free flaps performed or attempted were included.

Results: A total of 229 patients underwent 235 free flaps to the foot and ankle during this time. Seventy-three percent of patients (n=167) were treated for acute traumatic injuries (within 30 days). Sixty-seven percent (n=153) of patients were male. The mean age was 40 (range: 1 – 83 years). Thirty-six percent (n=82) of patients had a pre-operative vascular study. The posterior tibial / plantar artery was used as the recipient vessel in 52% (n=123) of cases while the anterior tibial / dorsalis pedis artery was used in 41% (n=96) of cases. Vein grafts were used in 4.3% of cases (n=10). Venae comitantes were used alone or in combination with the saphenous vein as outflow in 94% (n=222) of cases. In the remaining cases, the saphenous vein was used as the sole venous outflow. There was no significant difference in complications associated with recipient vessel choice, the use of pre-operative vascular studies, or the use of vein grafts (p>0.05). Following the free flap procedure, 1.7% (n=4) of patients developed some degree of extremity ischemia. There was a 13.2% (n=31) rate of acute return (5 days)

to the operating room for flap evaluation. Complete flap loss occurred in 9.8% (n=23) of patients. Partial flap loss rate was 3% (n=7). The rate of post flap extremity amputation was 9.2% (n=21), most commonly a below knee amputation (6.5%, n=15). Anticoagulation strategy was highly variable.

Conclusion: Free flaps for foot and ankle wounds were commonly performed for traumatic injuries. Pre-operative vascular studies are not routinely performed but may help guide the surgeon in vessel selection. The rate of flap loss in our series (and others) is higher than that reported in the literature for breast flaps and head and neck flaps indicating the unique complexity associated with these cases.

6:49am – 6:53am

Upper and Lower Limb Salvage with Omental Free Flaps: A Long-term Functional Outcome Analysis

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Institution where the work was prepared: University Plastic Surgery, Chicago Medical School, Chicago, Morton Grove, IL, USA

BACKGROUND: The omentum is one of the oldest, but often overlooked options for extremity reconstruction. Due to the large amount of pliable tissue, long vascular pedicle, associated lymphoid tissue, and angiogenic properties, the omentum should be considered when reconstructing complex extremity defects. We report the largest series of free omental transfers for reconstruction of complex extremity defects.

MATERIALS AND METHODS: A retrospective analysis of 27 omental free tissue transfers in 24 patients with complex upper and lower extremity defects between 1999 and 2013 was performed. Indications, operative technique, and outcomes were evaluated. Functional outcomes were analyzed using clinical examination, TESS scores/functional scales and patient satisfaction scores.

RESULTS: Patient age ranged from 12-71 years with 19 males and 5 females. Mean follow-up was 4.5 years. Indications included defects due to crush-degloving injuries, IIIB/IIIC fractures, pitbull mauling, infection or debilitating scar contracture. Eleven omental flaps were for upper and sixteen for lower extremity defects, with bilateral coverage using split omentum performed in three patients. Mean defect size was 780 cm² and all patients achieved wound coverage. Complications included total flap loss (1), partial flap loss (4) partial skin graft loss (4), and donor site infection (1). One patient chose to undergo revision amputation after one year due to poor function. Laparoscopic-assisted harvest was performed in three cases. The long-term clinical outcomes, TESS scores/functional scales and patient satisfaction are discussed.

CONCLUSION: The long vascular pedicle, the vascular anatomy within the omentum and large amount of pliable tissue allow the omentum to be aggressively contoured for complex defects and is especially valuable in bilateral or multi-site injuries. By maintaining its unique physiology, including omental stromal cells and lymphoreticular bodies, the omentum may facilitate healing by reducing edema and fighting infection. The long-term clinical and functional outcomes are promising in limbs, which are often deemed unsalvageable.

6:53am - 6:57am

Twisted Wrap-Around Flap for Nail Reconstruction of Finger

Yuichi Hirase, MD

Institution where the work was prepared: Yotsuya Medical Cube, Tokyo, Japan

In the case which the nail matrix is lost, the most adequate reconstructive method is combination of two flaps for nail reconstruction in order to minimize the donor defect in toes. We have combined the partial toe transfer including nail with the finger arterial flap which is made in the recipient site. We have performed this procedure in more than 90 cases and gained the satisfactory results. However, in the case which the finger flap is difficult to elevate in the recipient site, we have used the twisted wrap-around (TWA) flap for degloved finger nail reconstruction.

Operative method

The TWA flap is made of two wrap-around flaps harvested from the great toe and second toe. This flap can be extended by combining the TWA flap with a dorsal pedis flap (E-TWA flap). The vascular pedicle is the 1st. metatarsal artery or dorsal pedis artery, and a few subcutaneous veins are included. In each flap, the digital nerve is included and sutured to digital nerves in the recipient site. In most cases, the donor defect is covered by artificial dermis and skin grafted a few weeks later.

Clinical cases

Over the past ten years we have experienced 26 cases of TWA flap and E-TWA flap. Especially in 14 cases, E-TWA flap was used for coverage of degloved fingers. Two cases of finger hemangioma were included. All flaps survived except one case of partial necrosis.

Discussion

This method has some advantages. A large skin flap with nail can be harvested. Damage of the foot is very small because the sole of the great toe and second toe are left intact in spite of harvesting flaps. The function of the PIP joint remains and recovery of sensation is also very good. Reconstruction of the fingertip with an excellent aesthetic result can be achieved.

6:57am - 7:01am

The Torsional Stability of the Femur After Harvest of the Medial Femoral Condyle Corticocancellous Flap: A Biomechanical Study of Cadaveric Models
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Institution where the work was prepared: Union Memorial Hospital, Baltimore, MD, USA

Background:

As the indications and implementation of the medial femoral condyle corticocancellous flap expand, so to have the sizes of bone harvested. The donor site morbidity, however, has yet to be fully defined. Though biomechanical evaluations have demonstrated no impairment in boney stability under axial loading regardless of flap size harvested, the effects of torsional forces have not been studied.

Methods:

Sixteen pairs of cadaver legs (32 total knees) were obtained following power analysis for requisite sample size. Following DEXA scanning the soft-tissues were dissected off the legs while leaving the knee ligaments intact. The specimens were then randomly assigned to one of four groups: a control group defined by soft tissue dissection without flap harvest and three flap groups with bone harvests measuring 2cm in width, 1cm in depth and either 3, 5, or 7cm in length. Biomechanical MTS testing was performed on the specimens in extension with the application of torsional load until failure of either bone or ligaments occurred. Failure torque (Nm) as well as the locations of failure (bone vs. ligament) were recorded. Statistical analyses including a two tailed t-test and analysis of variance (ANOVA) were performed with p values < 0.05 considered significant.

Results:

The rate of bone failure for each group was 1 of 8 (12.5%), 1 of 8 (12.5%), 2 of 7 (28.6%) and 5 of 9 (55.6%) for the control, 3, 5, and 7cm harvest groups respectively. Although an increased rate of bone failure was seen with increasing bone harvest size this failed to reach statistical significance (p=0.15). The amount of torque needed to reach failure decreased with any amount of bone harvest (0=45.5NM, 3=29.35NM, 5=27.4NM, 7=30.83NM) but did not reach statistical significance (p=0.11). There was no difference in

bone mineral density and Z-scores amongst groups ($p=0.79$ and 0.59 respectively) indicating that specimens were indeed comparable. Although there was a direct relationship identified between bone mineral density ($p=0.02$) and Z-scores ($p=0.05$) with torque failure there was no relationship between BMD ($p=0.09$) and Z-scores ($p=0.94$) with failure location.

Conclusions:

Regardless of bone graft size harvested, the occurrence of bone failure in our specimens suggests that the mechanism of iatrogenic fracture following MFC harvest is likely torsional load and patients should be cautioned regarding this activity. Though not statistically significant 7cm segments appear to result in considerable bony instability and should be avoided. Finally routine preoperative DEXA scans do not appear to be warranted.

7:09am - 7:13am

Emergency Posttraumatic Finger Reconstruction with Toe-to-Hand Transfer
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Introduction: Emergency free flap reconstruction is a well established method in reconstructive surgery. Many authors stated as the immediate restoration of all damaged structures is the goal whenever possible. Absolute indications of emergency free flaps are represented by an exposed vital structure, high risk of infection, flow-through flaps and salvage flaps; relative indications are represented by finger reconstruction with toes. It is well known as in the mutilated hand microsurgical toe-to-hand transplantation provides thumb and fingers reconstruction that is superior to conventional techniques in appearance and function. We will report a retrospective series of 31 cases of emergency and early toe-to-hand transfers for the reconstruction of mutilated hand.

Material and Methods: The overall results of 31 consecutive procedures performed as emergency or early reconstruction of mutilated hand with loss of thumb and/or fingers over a 10 years period in our institutions is presented. We review 20 thumb reconstructions and 11 reconstructions of long fingers. The transfer was performed at a mean time from the admission in hospital to surgery of 8 hours. We evaluated retrospectively the results with regard to kind of lesions and reconstruction, function, length of hospital stay, complications (e.g., infection, reexploration, reoperation), donor site morbidity. The mean follow-up was 3 years (range, 18 months to 7 years). Tip and tricks and rationale of these reconstructions are described.

Results: The success rate of these series was 100%. The rate of reexploration was 10% (venous thrombosis). The recuperation of mobility was between 70-90% (bigger for the thumb) of the ROM of transferred digit; the sensibility was 60% of a normal finger (mean mTPD 12mm). About the donor site morbidity we did not reported problems doing sports or normal activity, only morphological dysfunction. About the satisfaction of patients we report a rate of 70% of very satisfied patients, 24% of satisfied and 6% of unsatisfied patients from aesthetic point of view.

Conclusions: The data reported suggest that finger reconstruction using toes can be safely and reliably performed during the initial presentation in selected patients; cooperative and interested young patients are the ideal

candidate for toe transplantation. Emergency and early toe transfer provide some advantages over the elective procedures in acute hand injuries, such as psychological benefit, single stage reconstruction, short hospital stay without any significant differences in the success rate, functional results and frequencies of complications if compared to other elective case series.

7:13am - 7:17am

Interpositional vein grafts in microsurgery: an examination of efficacy and utility

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Institution where the work was prepared: Jonas A Nelson, Philadelphia, PA, USA

Introduction:

The use of interpositional vein grafts (IVG) in microsurgery is often viewed with hesitancy. The purpose of this study was to critically examine outcomes following interpositional vein grafting to determine the true utility of this microsurgical technique.

Methods

We performed a retrospective review of all microsurgery cases performed at a single institution from 2005 to 2011. Cases utilizing IVGs in the primary procedure, as well as cases which required an IVF during takeback or salvage attempts were included. Additional data was collected regarding flap type, indications for the IVG, microsurgery case type, need for heparin or thrombolytics, graft origin and outcome. We examined the cohort overall and performed a subgroup analysis by timing of initial IVG (at the primary procedure or as a salvage attempt).

Results

Overall, 1718 patients underwent 2368 free flaps during the study period. We determined that 51 IVGs were utilized in 38 patients (2.2%) and 38 flaps (1.6%). Nineteen (50%) were utilized in the primary free tissue transfer, while 19 (50%) were utilized during a flap salvage. IVGs were most commonly utilized for venous anastomosis (n=14, 37%), although IVG were also utilized for arterial anastomosis (34%), AV loop formation (16%) and both arterial and venous anastomosis (18%). A higher percentage of lower extremity cases overall utilized IVG as compared to breast reconstruction cases (8% vs 1%, $p < 0.001$), although IVG utilized in salvage were more common for breast reconstruction ($p = 0.002$). Ninety five percent of flaps were systemically heparinized. Overall, 9 total flap losses (24%) occurred when IVGs were utilized, 89% of which occurred in the takeback cohort ($p = 0.02$). Subgroup analysis revealed that IVG utilized in the primary

procedure had a 95% success rate, while the rate for salvage procedures dropped to 58%. Four primary procedure IVGs(21%) experienced intraoperative thrombosis and were revised, while 1(5%) experienced a delayed arterial thrombosis. We found a significantly higher rate of thrombotic events in all primary cases where IVGs were utilized($p=0.005$).

Conclusions

This study demonstrates that IVGs can be utilized in primary reconstructions with success rates upwards of 95%. However, their use requires care and attention to the technical aspects of graft use as this may be responsible for higher rates of intraoperative thrombosis. In takeback procedures, IVG use is a more clouded picture. We suggest that when utilized appropriately with thrombectomy and resection of the thrombosed vessel to healthy intima, IVGs can offer a flap a fighting chance.

7:17am - 7:21am

Heterotopic vascularized joints transfer in mutilated hand injury

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Author: Nai-Jen Chang, Chung-Chen Hsu, Cheng-Hung Lin, Johnny Chang,
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Background: For a mutilated hand injury, the prehensile function
reconstruction is the first consideration and to achieve tripod pinch is our
goal. Heterotopic vascularized transfer is a brilliant procedure to employ any
salvageable tissues for reconstruction. This technique is indicated when the
candidate replanted digit has a destroyed or missing joint.

Material and method: From 2003 to 2012, seven cases suffered from
mutilated hand injury and resulted in joint defect. There were all male with
an average of 34.7 years old. All the patients had a damaged or missing MPJ
or PIPJ which significantly compromised the hand function. All the medical
details of patients including sex, age, the origin of donor and recipient joint,
survival, complications, secondary procedure related to vascularized joint,
ROM and follow up period were all collected and analyzed.

Results: Seven patients received heterotopic vascularized joint transfer,
three from the functionless in situ stump and four from the amputated part,
including five free joints and two pedicle joints. All the joints transplanted
succeeded except one that failed due to vasospasm. As for the active ROM
after reconstruction, the cases with homo-joint transfer (MPJ to MPJ, PIPJ to
PIPJ) achieved 68.3% of active ROM. The case underwent hetero-joint (DIPJ
to PIPJ or MPJ) transfer had only 35% of ROM in average. All the patients
could use their reconstructed hands to achieve tripod pinch except one who
had only pinch to pinch.

Conclusion: Heterotopic vascularized joint transfer is a practical method to
reconstruct the injured digit for tripod pinch reconstruction. The donor joint
can harvest from either amputated part or the joint which is functionless in
situ, either pedicle or free type, immediate or second stage, and even

combined transfer with other tissues. With the proper design, successful microvascular reconstruction, adequate education and rehabilitation program, the regain the prehensile function of the hand is still possible.









7:21am – 7:25am

Analysis of Extremity Venous Arterialization by Indocyanine Green (ICG) Fluorescent-Dye Angiography

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Loss of adequate limb perfusion can result in pain, ulceration and possibly amputation. Intravascular techniques such as thrombolysis, dilatation, or stenting as well as extravascular techniques such as excision and vessel repair or bypass grafting have been used to restore distal arterial flow. However, these traditional techniques are not useful when the lesion extends throughout the distal system. In this situation, surgeons have employed venous arterialization, a technique which repairs a proximal artery to a distal vein, bypassing the diseased arterial system and providing distal perfusion through a "ramifying" venous plexus. Although there are sporadic case reports that support the efficacy of this approach none offer details as to the physiology or timing of this unconventional revascularization. In this study we utilize Indocyanine green (ICG) fluorescent-dye angiography with the SPY (Novadaq Technologies Inc) system to demonstrate real-time surface fluorescence and track reemergence of tissue perfusion.

Between 2004 and 2008, six cases of terminal limb ischemia caused by arterial lesions that could not be treated by traditional techniques underwent venous arterialization. In all cases surgical exploration ruled out a viable distal arterial target for bypass grafting. Prior to venous arterialization, valves precluding retrograde flow throughout the distal venous plexus were lysed. Branches to normally perfused areas were ligated. One-minute duration ICG fluorescent-dye angiography with the SPY system was performed to document pre-operative base-line flow, immediate post-bypass flow, and the evolution of flow recorded on POD1, POD3, and long-term (> 3 months). ICG fluorescence curves were analyzed for inflow/outflow rate and completeness of perfusion. Neighboring unaffected digits were used for control.

Cases included 6 upper extremities in 6 patients. We treated extensive thromboembolism that resulted from DVT of the lower extremity which traveled presumably through a documented patent foramen ovale (2), ulnar hammer syndrome (2), and Berger's disease (1), and Raynaud's syndrome (1). Immediate post-bypass angiography revealed an improved rate of inflow but incomplete distal perfusion compared to the pre-bypass study. There was immediate resolution of pain on POD1. POD1 was also

characterized by improved arterial insufficiency and venous insufficiency. POD3 revealed improving venous insufficiency. Long-term evaluation revealed normalization of arterial inflow and venous outflow.

This series further supports the efficacy of venous arterialization in salvaging distal extremity terminal ischemia. In addition, ICG fluorescent-dye angiography documented progressive skin surface perfusion characterized by normalization of the arterial inflow phase followed by venous outflow approximating that of the control digit by three months.

7:33am - 7:37am

Demystifying Axillary Lymph Node Harvest: A Systematic Approach to Facilitate Flap Design and Minimize the Risk of Donor Site Lymphedema in Vascularized Lymph Node Transfer

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Institution where the work was prepared: Beth Israel Medical Center, New York, NY, USA

Introduction

Vascularized lymph node transfer (VLNT) has become an increasingly accepted treatment for extremity lymphedema. The axilla is unique among lymph node donor sites in its ability to providing lymph node-bearing flaps with long pedicle lengths, large caliber vessels and abundant skin and soft tissue. In patients with hostile and contracted recipients sites due to lymphadenectomy and radiation, it is often the only lymph node donor site capable of replacing the composite skin, nodal and soft tissue deficits. However, a recent report by Vignes et al noted a 28% incidence of lymphedema (4/14 patients) after axillary lymph node harvest for VLNT. This risk remains a major concern for surgeons and is a deterrent to the use of the axilla as a donor site. We describe a multi-modal approach to access the vascular anatomy and nodal drainage patterns in the axilla to facilitate safe harvest of axillary nodes for VLNT. Technical considerations regarding pedicle selection, incision location and flap design are discussed and representative cases are shown.

Methods

Thirteen patients underwent fourteen vascularized axillary lymph node transfer. Five VLNTs included skin paddles based on thoracodorsal artery perforators. Preoperative imaging of the axilla and recipient site were performed using magnetic resonance angiography (MRA) The anatomic relationship of donor vessels to lymph nodes was determined and recipient vessels evaluated. Intraoperative navigation and lymph node selection was done using Reverse Lymphatic Mapping. This technique involves injection of filtered technetium in the upper extremity to identify lymph nodes draining the arm followed by Indocyanine green (ICG) injection of the lateral chest wall and near-infrared fluoroscopy (SPY imaging) to visualize axillary lymph nodes that drain the chest wall. Lymph nodes were selected based on fluorescence and lack of radioactivity on gamma probe examination. The choice of incision and pedicle selection were based on the location and blood supply of the desired lymph nodes, skin and soft tissue requirements, and

recipient vessel configuration. Nodal perfusion was confirmed by intravenous ICG injection and SPY imaging after flap transfer.

Results

Using this multi-modal approach, we successfully transferred 14 lymph node-bearing flaps from the axilla without causing donor site lymphedema. Representative examples are shown to demonstrate the diverse utility of the axillary donor site in VLNT.

Conclusion

The axilla represents a versatile donor site for VLNT. Preoperative MRA, intraoperative navigation using lymph node mapping techniques and algorithmic decision-making facilitate the safe design and harvest of lymph node-bearing flaps from the axilla.

7:37am - 7:41am

Microsurgical Treatment of Peripheral Lymphedema: a Systematic Meta-analysis

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BACKGROUND: Lymphedema represents a complex physiological consequence of acquired or congenital disruption of the lymphatic system. Advances in technology and experience have led to a variety of operative treatments for those who fail conservative management, including derivative microsurgical lymphovenous shunt (LV-shunt) and vascularized lymph node transplant (LN-T). Our purpose was to quantify the efficacy and safety of surgery through a systematic meta-analysis, which has yet to be described.

METHODS: A literature search was conducted to identify all articles involving microsurgical treatment of lymphedema. Ovid MEDLINE was searched using the keyword terms: "lymphedema," "microsurgery," "lymphovenous," "lympholymphatic," "shunt," and "anastomosis." Studies were rated on methodological quality based upon the American Society of Plastic Surgery's (ASPS) Levels of Evidence for Therapeutic studies. Baseline demographic information, cause of lymphedema, and surgical technique were recorded. Outcomes included objective and subjective change in lymphedema and complications related to surgery. Data was analyzed via RevMan 5.2 (The Cochrane Collaboration, Copenhagen), and results expressed as mean differences with 95% confidence intervals. Heterogeneity was assessed using the I^2 statistic with values < 50% judged as acceptable.

RESULTS: 27 studies were included, 24 offering level-IV evidence and 3 level-III evidence. LV-shunt procedures were performed in 22 studies and LN-T in five. Regarding primary outcomes, excess circumference was reduced by 48.8%+/-6.0% relative to the contralateral limb, absolute circumference was reduced by 3.31 cm+/-0.73cm. For studies reporting change in volume, excess volume was reduced by 56.6%+/-9.1%, while absolute volume was reduced by 23.6%+/-2.1%. These results were similar for upper vs. lower extremity lymphedema and for LV-shunt vs. LN-T. The incidence of no quantitative improvement in lymphedema postoperatively was 11.8%, and 91.2% of patients subjectively reported improvement. On average, 64.8% of patients were able to discontinue compression garments at long-term follow up (LN-T: 78.0%, LV-shunt: 56.3%, $p=0.04$). Complications included operative-site infection (4.7%), lymphorrhea (7.7%),

re-exploration for LN-T flap venous congestion (2.7%), and rate of additional elective procedures (22.6%).

CONCLUSIONS: While most studies were of low methodological quality and utilized heterogeneous methods of assessment, operative intervention demonstrated consistent quantitative benefit in the treatment of lymphedema. Outcomes were similar regardless of surgical technique employed; however, LN-T led to more patients discontinuing compression therapy. Complication rates were low, but LN-T procedures had slightly higher rates of infection, lymphorrhea, and additional procedures. The clinical significance of these quantitative findings, while promising, remains unclear. Future studies should employ consistent assessment modalities and validated subjective patient evaluations.

7:41am - 7:45am

Lymphatic Drainage of Mammary Gland and Upper Extremities: from Anatomy to Surgery to Microsurgery

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Institution where the work was prepared: IRCCS University Hospital San Martino - IST, Genova, , Italy

INTRODUCTION

The incidence of secondary arm lymphedema varies from 7 to 77% in patients following axillary lymph nodal dissection (ALND). On the other hand, the incidence of arm lymphedema after sentinel lymph node biopsy (SLNB) varies from 0 to 13%. The objective of this study is to carry out a detailed description of breast lymphatic drainage, remarking the correlation between upper limb derivative lymphatic pathways and the onset of secondary lymphedema after ALND/SLNB, underlining the role of lymphatic microsurgery regarding primary prevention of secondary lymphedema following breast cancer treatment.

MATERIAL AND METHODS

In this study, 350 mammary glands and upper limbs together with 80 sections of anterior pectoral skin of deceased fetuses and of 20 adults were injected. The injection was performed with the modified Gerota's mass. Dissection was carried out after appropriate fixation of the specimens in 40% formaldehyde for 6 days, then immersed in a 100-volume hydrogen peroxide solution for 24 hours. In 90 fetus specimens the Spalteholz technique for diaphanization was performed.

RESULTS

Breast lymph flows through the perilobular lymphatics and the interlobular spaces which initiate the lymphatic capillaries and thus give origin to secondary pedicles. These lymphatic vessels exit the mammary gland at specific sites (external, internal and posterior), constituting the following draining pedicles: external or axillary pedicle (95.33%), internal or mediastinal pedicle (36.6%) and posterior or retromammary pedicle (17.1%). Regarding breast skin lymphatic drainage, there are two main lymphatic pathways, the ipsilateral and the contralateral. In addition, we can

observe three different derivative lymphatic pathways of the upper limb: anterior external superficial pathway, posterior external superficial pathway and anterior internal deep pathway.

CONCLUSIONS

Lymphatic microsurgery at the same time of ALND/SLNB has a key role regarding primary prevention of secondary lymphedema. Planning breast cancer surgery, patients should undergo an appropriate clinical assessment together with lymphoscintigraphy to evaluate their lymphedema low-moderate-high risk. A prospective randomized group control trial is ongoing at the University of Genoa – IRCCS University Hospital San Martino – IST National Institute for Cancer Research, evaluating the effect of such microsurgical prevention of lymphatic complications after breast cancer treatment.

7:45am - 7:49am

The Long-Term Outcome and Complications of Vascularized Submental Lymph Node Flap Transfer for Lower Limb Lymphedema

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Background: The vascularized submental lymph node flap transfer was reported as a promising procedure to improve the lower limb lymphedema. The study was to investigate the long-term outcome of vascularized submental lymph node flap transfer for the lower limb lymphedema.

Methods: Between 2007 to 2013, there were 34 patients with lower limb lymphedema post cervical and ovarian cancer ablation surgery, pelvic lymph nodes dissection and subsequent radiotherapy undergoing vascularized submental lymph node flap transfer. The patients were divided into two groups regarding to the follow-up more than 12 months as group 1, and less than 12 months as group 2. The circumferential difference and reduction rate were used for the evaluation of the outcome at 10 cm above-knee, below-knee, above ankle and average of three levels. The donor site complications including the facial nerve palsy and lymphedema were assessed.

Results: All 34 flaps survived. At a mean follow-up of 11 ± 9.4 months, no facial nerve palsy or other donor site complications were found. The average improvement of circumferential differentiation was 10.4 ± 6.6 cm in group 1 at a mean follow-up of 20.2 ± 8.4 months and 7.3 ± 12.2 cm at a mean follow-up of 5.3 ± 4 months ($p < 0.02$). The mean reduction rate was $52.2 \pm 20.2\%$ in-group 1, and $32 \pm 16.4\%$ in group 2 ($p < 0.01$).

Conclusions: The improvement of the vascularized submental lymph node flap transfer for the lower limb lymphedema is time-sensitive. The longer follow-up, the better improvement. There was no major donor site morbidity.

7:57am - 8:01am

Combination of Charles' Procedure and Microsurgical Transfer of Lymph Nodes to the Foot for Advanced Lymphedema with Severe Fibrosis

Hung-chi Chen, MD, PhD, FACS; China Medical University; Shih-Heng Chen, MD; National Taiwan University Hospital; Phoebe Tang, MD, PhD; National Taiwan University; Samir Mardini; Mayo Clinic

Institution where the work was prepared: Hung-chi Chen, Taichung, , Taiwan

BACKGROUND: The advanced cases of chronic lymphedema with severe fibrosis has many complications including repetitive episodes of infection which should be treated eventually with Charles' procedure. In some cases even the second and fourth toes have to be amputated in order to provide large enough web space to improve foot hygiene. However, the soft tissue behind Achilles' tendon and the foot sole can not be excised. Therefore after Charles' procedure the patients may still have recurrent infection.

PATIENTS AND METHODS: From 1993 to 2013, 33 cases of advanced lymphedema had been treated with Charles procedure either without microsurgical transfer of lymph nodes (group 1, n=15) or with lymph node transfer (group 2, n= 18). The Charles' procedure was done from dorsum of foot to proximal thigh level. The lymph nodes harvested from rt supra-clavicular area were transferred to medial ankle. After surgery the following parameters were evaluated: (1) circumference, (2) tonicity of skin, (3) scanning lymphangiogram, (4) episodes of infection, (5) ICG test.

RESULTS: The mean follow-up time was 15 months. The circumference was dramatically reduced in both groups. Without lymph node transfer the patients may still have recurrence of infection and formation of verrucous hyperkeratosis at the foot and distal leg (11/15). With lymph node transfer the infection was much less (2/18), and ICG showed the collection of nucleotides into the transferred lymph nodes. The subsequent flow was deep and was demonstrated by scanning lymphangiogram. In the second group the scanning lymphangiogram showed no stasis of Tc99 at the foot.

CONCLUSION: Charles' procedure reduced the lymphatic load, and the transferred lymph nodes improved the lymphatic circulation of foot to prevent recurrent infection. The combination of these two procedures helps to control infection for advanced lower limb lymphedema.

8:01am – 8:05am

The Donor Site Morbidity of Vascularized Groin lymph Nodes Flap Transfer to the Wrist/Elbow

Nidal AlDeek, MD; Jung-Ju Huang, MD; Jerry Chih-Wei Wu; Miffy Chia-Yu Lin; Ming-Huei Cheng; Chang Gung Memorial Hospital

Institution where the work was prepared: Chang Gung Memorial Hospital, Tao-Yuan, Taiwan

Background: The dreadful upper extremity lymphedema continues to occur in 5-30 percent of the women following breast cancer treatment. A multitude of treatment modalities are in practice, of them microsurgical transplantation of vascularized lymph nodes flap is a rapidly evolving and promising therapy. The vascularized groin lymph nodes flaps have been successfully transferred to the wrist or the elbow, as a recipient site, in a novel approach. Thereof, the aim of this study is to investigate the long- term results after vascularized groin lymph nodes flap transfer together with donor site morbidity.

Methods: Between 2007-2013, twenty-one female patients diagnosed with upper limb lymphedema of stage two (n: 4), stage three (n: 13), and stage four (n: 4) underwent free groin lymph nodes flap transfer after conservative therapy failure or to enhance their quality of life. The flaps were harvested from the groin region below the inguinal ligament and medial to the femoral artery utilizing the medial column group. Results were assessed based on improvement of lymphedema (by measurements), donor site lymphedema incidence, subsidence of lymphedema related complications, lymphoscintigraphy, Doppler ultrasound, and indocyanine green injection (ICG) studies, and the need for touch-up procedures.

Results: All flaps survived well and were functional by ICG injection studies. At a mean follow-up of 24.9 months, a reduction rate of $40.9 \pm 28.1\%$ above elbow and $30.1 \pm 21.3\%$ below the elbow together with circumferential difference reduction of 8.2 ± 6.5 cm above elbow, and 8.2 ± 5.5 cm below elbow were achieved with significant lymphedema improvement and enhanced quality of life. All patients had cellulites before surgery, and in seventeen of them cellulites never occurred again postoperatively. Three patients developed upper thigh swelling one month after surgery and resolved within three month by physiotherapy (ultrasound showed intact superficial lymph nodes, and lymphoscintigraphy demonstrated patent lymphatic channels). Nine patients underwent flap debulky procedure, as well as seven had concurrent liposuction of arm.

Conclusion: The superficial, medial groin lymphnodes harvest and free transfer to the wrist or elbow is safe and efficient procedure. Constant and noteworthy improvement over long- term follow-up can be achieved by this surgery. A marked easiness in touch-ups with enhanced cosmesis is noted when touch-ups are carried out one year after the vascularized lymph nodes transfer.

CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, IV.

8:05am - 8:09am

A Safe Approach to Vascularized Groin Lymph Node Transfer Using Reverse Lymphatic Mapping and Magnetic Resonance Angiography: Combining Anatomic and Physiologic Imaging to Minimize the Risk of Donor Site Lymphedema

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Institution where the work was prepared: Beth Israel Medical Center, New York, NY, USA

Introduction

A detailed understanding of both the anatomy and physiologic drainage patterns of the inguinal region is critical in safely harvesting vascularized groin lymph nodes and minimizing the risk of lymphedema. Previously described harvest techniques are based on anatomic landmarks that do not address the variable lymphatic drainage pathways from the lower extremity or groin. As our technique for lymph node harvest has evolved by using magnetic resonance angiography (MRA), indocyanine green lymphangiography, and technetium, we have gained a deeper insight into where the lymph nodes draining the abdomen are located and how to avoid lymph nodes draining the lower extremity. The purpose of this study was to describe vascularized groin lymph node harvest based on a combined physiologic/anatomic approach and evaluate the donor site in our clinical series.

Methods

MRA was used preoperatively to localize superficial circumflex iliac-based lymph nodes. Using reverse lymphatic mapping, technetium was injected into the foot and indocyanine green was injected into the lower abdomen to differentiate target lymph nodes draining the abdomen from critical nodes draining the lower extremity. Technical details and video illustrating the harvest are provided. Location of the target and sentinel lymph nodes were evaluated as well as donor site lymphedema.

Results

A total of 12 patients underwent vascularized groin lymph node transfer using this multimodal approach. Follow up ranged from 6 to 36 months. All lymph nodes draining the lower abdomen were based on the superficial circumflex iliac artery. They were consistently located at or slightly below the

inguinal ligament, but always above the groin crease at the junction of the SCIV and SIEV. The sentinel lymph node draining the lower extremity was always located below the groin crease and along the femoral vessels. None of the patients in this series have developed donor site lymphedema.

Conclusion

Using combined physiologic and anatomic modalities when harvesting inguinal lymph nodes affords the surgeon greater certainty and safety which is critical in avoiding iatrogenic lymphedema. The results in this study provide practical guidelines for avoiding critical lymph nodes draining the lower extremity. Further long-term study is needed to fully assess this technique.