LYMPHOVENOUS ANASTOMOSIS TECHNIQUE  
( LVA / MLVA / MLVLA ).
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1. Speaer’s agreement

2. Title.

The aim of our communication is to describe and compare the various surgical derivative techniques for lymphedema: the lympho-venous anastomoses.

We will try to understand: the rationale that justifies these techniques, the differences that distinguish them, the strong and weak points of each of them, the results.

Finally we will talk about our experience, although still limited, which represents the evolution story of a Department that has undertaken this adventure in recent times, starting from the base.

3. Logo.

This is what we are now, and the “Logo” of the Venice Lymphology

4. WHY a Lymphovenous anastomosis can be indicated in Lymphedema?

Let us remember that the same thing happens at the Thoracic Duct Exit, thas is a central LV connection

5. And in normal subjects there are numerous other examples of LV shunts, also peripheral.

6. Besides this, spontaneous LV shunts are formed in the lymphedema.

Therefore: it becomes logical to consider the LVA as a rationale solution for lymphedema.

7. Now: how can we keep the LVA patent?

Two steps:

a) providing adequate flow through the anastomosis, as happens at the thoracic duct exit: this can be achieved by collecting as many lymphatics as possible into a single vein

b) avoiding venous reflux into the anastomosis by making the venous pressure less than the lymphatic pressure.

and here there are two possible choices: you can use low pressure veins (like subdermal venules) or if you decide to use normal pressure veins (subcutaneous or subfascial ones) their valves must absolutely be continent.

8. Let’s talk about the currently available techniques to perform a surgical L-V Shunt.

They are derivative techniques: Lymphatico-Venular Anastomosis (LVA), Multiple Lymphatico-
Venous Anastomosis (MLVA) and Multiple Lymphatic-Venous-Lymphatic Anastomosis (MLVLA)

9. Lymphatico-Venular Anastomosis: LVA (by Koshima)
the surgical procedure includes:
- multiple incisions (up to 10), with 3 cm length, preferentially at the extremity of the limb (where lymphatics remain contractile and venules have low pressure and/or continent valves)
- Supermicroscopy: 20-30x, nylon stitches (11-0 or 12-0), needle 50-30 microns
- Dye injected subcutaneously in the peripheral extremities (ICG or BPV)
- Each incision: isolation of a single lymphatic vessel (Subdermal, 0.3-0.8 millimeters caliber)
- End to end anastomosis (by multiple circumferential stitches) between lymphatic and subdermal venule (0.6-1.0 millimeters caliber)

10. Anastomosis can have many variants:
Octopus, Side to End, Bidirectional, End to side

11. Here some examples of Indocyanine Green Lymphangiography
With Dermal Back Flow (DBF) and a single functional lymphatic vessel; with diffuse DBF and no functional lymphatics

12. The surgical plan with the first incision. The operatory field with subdermal venules

13. The various steps of anastomosis

14. The LVA results
First let's remember that the outcomes are difficult to assess. As you know there are various techniques: limb volume or circumference measurements (that can be easily manipulated post-operatively by aggressive compression and physiotherapy), postoperative interview, ICG Lymphography, Lymphoscintigraphy, MRI-L.

15. The LVA results
-Koshima reported:
Lymphedema decrease of more than 4 cm in 62% of cases, with an average follow-up of 4.6 years
-Mihara:
limb circumference improved in 48%; stable in 27% and worse in 25%
Post-op interview: improved in 61.5%; no change 35%; worse 3.5%
Significant reduction of cellulitis occurrence

16. LVA: summary
The advantages are:
-LVA are minimally invasive: small incisions
- Apparently have low risk: only superficial structures involved; no damage to deep structures
- Are feasible under local anesthesia: 2-3 anastomoses each operating session
- The mean operative time is 4 hours

**Question marks:**
- Are more effective in early stages (I-II) and in upper extremities
- They can only treat superficial lymphatics: and the deep ones?
- Only 1 anastomosis each incision: the caliber is small, will it be effective?
- The lymphatic flow through the anastomosis is low: thrombotic risk? Long term patency?
- Therefore many anastomoses must be performed: 5-10, at various sites of the limb
- The procedure is technically demanding: supermicrosurgery; not easily found healthy lymphatics/venules.
- Requires special instrumentation (supermicroscope, surgical instruments designed for supermicrosurgery, ICG lymphography device), with high cost

17. **Now let’s talk about the Multiple Lymphatic-Venous Anastomosis (MLVA by Campisi)**

Surgical technique: single site access, in the middle third of the volar surface of the arm or in the sub-inguinal area

- The dye (BPV and/or ICG) must be injected at three levels of depth: subdermal, subcutaneous and subfascial
- Standard microscopy: no supermicrosurgery
- Many lymphatics are isolated: both superficial and deep
- All together are introduced in a single vein (not a venule), with continent venous valve
- E-E “telescoping” anastomosis: all lymphatics are inserted into the vein by a single” U” (9/0) shaped stitch; after that multiple circumferential stitches are added, between vein border and perilymphatic tissue, for fixation and lymphostasis
- Initial” U” stitch is removed at the end of the anastomosis
- Fasciotomy is also performed

18. **Some example images**
19. **Single site access**
For the arm and leg
20. **Not only superficial but also deep lymphatics are used**
These are deep
21. And here the deep anastomosis

22. To quantify the flow through the anastomosis we use a flowmeter

It was interesting to see that even some non-blue colored lymphatics (those called "sclerosis type"), when properly checked with flowmeter show a slight flow and can be suitable for the anastomosis.

In our early experience an anastomosis can be considered sufficiently valid if it has a flow rate greater than 1 mL per minute

23. MLVA is also effective in Lymphedema prevention

According to the experience of prof. Boccardo, during lymphadenectomy it’s possible to preserve the limb lymphatics by performing MLVA with an adjacent vein

24. When venous disfunction is associated

You can try to repair it with external valvuloplasty

25. Even when valvular correction is not achievable

There is a way to overcome the problem: a venous graft between lymph collectors below and above the obstruction site.

This is: Multiple Lymphatic Venous Lymphatic Anastomosis, by Campisi.

26. Multiple Lymphatic Venous Lymphatic Anastomosis

Surgical technique: it’s a double MLVA with standard microscopy.

Several lymphatics below and above the obstruction site (both superficial and deep) are gathered into a vein segment (length 7-15 cm) with competent valves.

It can be harvested from the same operative site or from the forearm (cephalic vein).

The anastomosis is standard E-E “telescoping”

Below: lymphatic-venous

Above: venous-lymphatic

Advantage:

No contact between lymph and blood: no thrombotic risk

Question marks:

Multiple site access: below and above the obstruction site ± forearm

In which lymphatic collectors the graft drains?

Arm: supraclavicular

Limb: lateral supra inguinal

Will they be really able to drain lymph in the right direction?
27. Representative illustrations:
BPV injections into the lower limb and abdomen, incisions and isolation of lymphatics, interposition graft, and the same in the upper limb

28. Representative fotos

29. And the results of MLVLA (follow-up over 5 years):
Marked edema reduction in 62.5% of cases
Moderate: 28%
Mild: 9.5%
Poor: 0.0%

30. Here the overall results of MLVA
In this article dated 2010 Campisi reported Objective volume improvement in 83% of cases, with an average reduction of 67% of the excess volume and a follow-up of more than 10 years

31. In 2014
more than 3000 cases, previous results are confirmed: success rate above 85% of cases

32. MLVA-MLVLA: summary
These are the advantages:
-effective not only in early (1A+B and 2A+B) but also in advanced stages (3A+B)
-Single site incision (MLVA only)
-Intervention customized: based on the type of mainly involved lymphatics (superficial or deep)
-No trouble in finding suitable lymphatics (in early stages)
-Not technically demanding: no supermicrosurgery/special instrumentation
-High lymphatic flow: low thrombotic risk (if no venous reflux)
-Mean operative time: 3 hours
-Also effective in venous disorders (MLVLA) and in lymphedema prevention (LYMPHA)

Question marks:
-Potential damage to the deep structures: principally nerves and vessels
-Several lymphatics (chiefly deep) are handled: should lymphedema worsen?
  In this regard: deep ones are often the sickest and It is always possible to perform an LVA in the distal sites
-Superficial lymphatics not always reach the deep anastomosis:
  Anastomosis with a side branch of the deep vein or with additional superficial vein
33. MLVA: our results

We are presenting our early experience:
- With Managerial difficulties in a Hospital focused on acute diseases
- The learning curve (at least the first 30 cases)
- The interventions were performed in advanced Lymphedema stages
- And it is a retrospective study

Between March 2014 - March 2018: 38 patients (1 surgical procedure for each patient)
- In 2014: 4 surgical procedures (all preventive)
  - 2015: stop
  - 2016: 3 procedures (all curative)
  - 2017: 26 procedures (mixed)
  - 2018: 5 procedures (mixed)

Indications:
- 8 Preventive procedures: 2 Lymph Sparing, 6 LYMPHA
- 30 Curative procedures: MLVA, all in Lymphedema stage 2B (Campisi)

34. MLVA: our results

Overall results: 38 pts…

Results centred on indications…

35. MLVA: our results

How did we measured our results?

-Intraoperative : FLOW METER
  - Good flow: > 1 mL/min
  - Poor: 0.6-1 mL/min
  - Insufficient: < 0.6 mL/ min

-Circumference pre and post-op: in all cases
-Lymphoscintigraphy pre-op: in all cases
-Lymphoscintigraphy post-op:
  - Preventive: 4 cases
    - Normal: 3 cases (has confirmed clinical absence of lymphedema)
Pathological: 1 case (no superficial/deep lymph pathways detectable)

Curative: 6 cases

MLVA detectable: 4 cases

MLVA not detectable: 2 cases

36. MLVA: our results

Analysis of cases with no/worse results:

Preventive: 1 case
Flux < 0.6 mL/min; MLVA within the field of radiotherapy; acute lymphangitis during radiotherapy. Deduction: the anastomosis must be positioned outside of the RT field!

Curative: 2 cases
1. Advanced 2B lymphedema, only 2 deep collectors found and anastomosed, Flux < 0.6 mL/min, breast cancer recurrence: early good reduction of arm circumferences but edema reappeared during chemotherapy.
Deduction: carefully rule out oncological problems before surgery!

Patient coming from Senologists/Oncologists of another Hospital

2. Advanced 2B lymphedema in patient who forced surgical indication, not constant in following physiotherapy: Flow around 0.6 mL/min, discrete initial volumetric reduction, lymphedema resumption after 6 months, dubious postoperative lymphoscintigraphy (MLVA not identifiable with certainty)
Deduction: carefully ponder the extent of lymphedema and complexity of the surgical procedures vs patient compliance for physical treatments

37. Conclusions: also in our limited experience

LVA/MLVA/MLVLA are effective surgical options for lymphedema:

At least 65% of patients report good relief from symptoms and a steady reduction in the intensity of physical care …Remember that L-V shunts occur spontaneously as a natural treatment for lymphedema.

But results remain difficult to validate:

- A universally accepted lymphedema measuring system of is still missing (Perometer? Water displacement volumeter? NMR? Lymphography?) … Keeping the budget in mind.

- It’s however possible to assess the anastomosis patency with the flowmeter

A prospective study is required, where surgical results are evaluated also in an Institution other than the one providing surgery
37. What objectives have we achieved to date?

1. Precise reproduction of the MLVA technique:
   The goal has been reached, even if results are not yet overlapping with those of the Prof. Campisi

2. Find a system to validate the proper functioning of the anastomosis:
   In our experience flowmeter works well

3. Overcome the learning curve:
   Now we can set up a prospective study