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The Use of Internal Mammary Artery Perforators as Recipient Vessels in Breast Reconstruction with Free Tissue Transfer

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Abstract Breast reconstruction has been a hot topic for decades. With rapidly evolving reconstruction techniques, higher standards of quality have been achieved. One of the current gold standard breast reconstructions at the moment is autologous breast reconstruction. The choice of the recipient vessels in microsurgery reconstruction has been a topic of fierce debate. With proponents and opponents of each recipient vessels option justify their choice. One of the most debatable topics is the use of the IMA perforators as recipient vessels in microsurgery for breast reconstruction. In this article we address the pros and cons plus myths and dogma about using the IMA perforators as the recipient vessels in breast reconstruction.

Keywords: *autologous breast reconstruction, internal mammary artery perforators, internal mammary artery and recipient vessels in breast reconstruction*

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1. Introduction

Breast Cancer has been the leading cause of mortality in women worldwide for many decades. After a mastectomy the decision and choice of the reconstructive approach is influenced by many factors including the patient's wish, type and stage of the disease, logistics, need for adjuvant therapy, among others. Current practice is using either autologous breast reconstruction or implant-based breast reconstruction or a combination of both. Abdominal flaps are the most commonly used due to their reliability. However, their increasing use has generated a debate regarding the ideal recipient blood vessels.

The average Deep Inferior Epigastric artery (DIEA) diameter is around 2 mm in diameter. This limits the options of choosing a recipient vessel of a similar size. The Circumflex Scapular Artery (CSA) matches the most in size, followed by the Internal Mammary Artery (IMA) and Thoracodorsal Artery (TDA) with an average size of 1.5 mm in diameter.

In some cases TDA is not a viable option due to injury during axillary dissection whilst the CSA may be technically difficult. The IMA has thus become the recipient vessel of choice for autologous breast reconstruction. It does however come with its own disadvantages. One of which is increased co-morbidities which can occur with rib resection to facilitate anastomosis. Another major concern with using is sacrificing the main choice and gold standard vessel in Coronary Artery Bypass Graft (CABG).

In this article, we address this concern and offer a reliable alternative which achieve a good and similar outcome.

2. Methodology

A literature review was conducted through Medline, Embase, Pubmed, Google scholar and Cochrane database., limited to humans and English language.

All publications using other recipient vessels were excluded. Experimental based data on animals and cadavers were also excluded due to post-mortem vascular contraction [1,2].

3. Results

8/ 69 publications discussed using Internal Mammary Artery Perforators (IMAP) as recipient vessels for free tissue transfer during breast reconstruction.

4. Discussion

When Hamdi et al [3] performed the first breast reconstruction with free flap using the internal mammary artery perforators as recipient vessels in 1999, many believed this to be the better choice of recipient vessels. However, current practice still favours internal mammary artery and vein as recipient vessels in many centres around the world.

A study in 2013 by Haywood et al [4] found reliable internal mammary perforators in 39% of post mastectomy patients with more than 1.5 mm diameters and good blood flow. Baek et al [5] scanned a series of patient preoperatively using a Doppler to identify internal mammary artery perforators. They then examined a series of 12 patients with doppler proven perforators intraoperatively under microscopic magnification to identify the location and size of these vessels. The main aim was to determine the reliability of the vessels as recipient for breast reconstruction using free tissue transfer. A vessel diameter gauge from the coupler set was used to determine the vessel size. The second intercostal space harboured the highest number of perforators, an average of 20 perforators, compared to 4 in the 3rd intercostal space. It also contained the largest perforators, with average diameter of 1.5 mm for the arteries and 2.2 mm for the veins. From the study, it was noted that the perforators usually emerge at 20.2 mm distance from the mid-sternal line.

Park et al [6] on the other hand reported in their findings no perforators in the second intercostal spaces in 22 cadaveric dissections. This might necessitate the use of preoperative scanning, such as Doppler or CT Angiogram to select the suitable candidates for this surgery.

So how reliable is the internal mammary perforators as recipient vessels for breast reconstruction using free tissue transfer?

In 2013, Maria Cecilia Closs Ono et al in Brazil conducted a retrospective analysis over 2 years from 2005 to 2007 which included 117 patients who underwent 128 microsurgical operations for free autologous tissue transfer breast reconstruction. They noted the recipient vessels and included criteria to compare the success rate, the rate of conversion and preoperative factors such as, axillary clearance and radiotherapy.

They reported a success rate of 99% in free flaps utilizing the Internal Mammary pedicle as recipient vessels compared to 94% for the Circumflex Scapular pedicle and 87% for the perforators of the IMA.

They also found the Internal Mammary Artery/Perforators to be the artery of first choice in cases of preoperative radiotherapy. In those cases, they excluded the circumflex scapular vessels.

They also reported that these vessels were found to be reliable and only had to be converted from main IMA/IMAP to the Circumflex Scapular Artery in 11 cases due to post radiotherapy fibrosis.

A disadvantage of this study is that IMAP as a recipient vessel was only used in 8 out of 128 cases - out of which there was one total flap loss, 1 partial flap loss and 1 fat necrosis, which was more than 30% of major complications.

So, are we burning a main bridge if we use the internal mammary arteries as recipient vessels for free tissue transfer breast reconstruction?

This an old age question. The internal mammary arteries are the gold standard of revascularization in ischemic conditions which can be life-saving in CABG surgery. Until recently it was a choice between treating the cancer or a future myocardial infarction.

A retrospective, single-centre audit conducted by Amanda J Fortin et al in 2012 [7] proved this shouldn't be the case. Their study covered 81 patients who underwent an autologous free tissue transfer breast reconstruction between 2005 and 2009 in Ontario, focusing at the post-operative myocardial infarction events that required intervention.

They reported that out of 81 patients, only 2 women had myocardial infarctions, both had triple vessel disease which is an indication for CABG surgery. The women could not have CABG as the internal mammary arteries were previously used in breast reconstruction and both patients received percutaneous intervention instead, although one patient subsequently suffered repeated ischaemia necessitating future CABG using a different vessel.

The audit concluded that the overlap between the breast reconstruction group using IMA as a recipient vessel and patients with significant cardiac disease was minimal. However the implication of using IMA can have detrimental outcome in the latter group.

A previous study conducted by Nahabedian et al in 2004 [8] reviewed 520 patients who had breast reconstruction after breast cancer surgery, out of which 240 were 50 years of age or older. Two out of the 240 women (0.8%) had coronary artery disease. These 2 women had successful reperfusion using stents and were not denied high quality treatment due to sacrificing IMA in previous surgery.

The incidence of coronary artery disease was found to be related to increase in age and not related to having reconstructive breast surgery using the IMA for anastomosis. The author concluded that the use of IMA in breast reconstruction using free flaps as a recipient vessel is justified and other alternative methods for reperfusion after coronary artery disease are available, such as angioplasty and saphenous grafts.

Advantages of using the Internal Mammary Artery Perforators as recipient vessels in breast reconstruction using free tissue transfer:

- First choice in case of preoperative radiotherapy
- Excellent vessel size match (2nd best after CSA) with the Deep Inferior Epigastric Artery which is the most common vessel used in free tissue transfer for breast reconstruction in DIEP flap.
- It has a constant anatomy.
- Using IMAP avoids lateralization of the flap which is more common with the thoracodorsal and scapular pedicles, hence a better aesthetic outcome.
- It can be used reliably in case of axillary dissection in contrast to Thoracodorsal pedicle.
- It gives rise to less donor site co-morbidity as no need for rib resection, hence less post-operative pain, contour deformity and breathing difficulty.

- It spares the main Internal Mammary vessels which remain the gold standard in CABG.
- It also spares the latissimus dorsi as an option for reconstruction if needed.
- In delayed reconstruction, it is favoured over the thoracodorsal pedicle due to scarring following axillary clearance.
- More superficial plane of anastomosis not related to chest wall movements, hence a friendlier anastomosis environment compared to internal mammary vessels.

Disadvantage of using the Internal Mammary Artery Perforators in breast reconstruction with free tissue transfer:

- It can be used in selected patients only due anatomical limitations.
- There is a need for preoperative scanning either with Doppler or CT Angiography to identify suitable candidates.
- It is a challenging technique which requires more skill and theatre time for dissection.
- The vessel calibre is in most cases of a smaller size making the anastomosis more challenging.
- Relatively more liable to post radiotherapy damage compared to the internal mammary arteries.
- There is not enough data reporting the use of the internal artery perforators in the literature.
- It has a comparatively high complications rate in the available limited literature (30%) including; fat necrosis/partial flap loss/total flap loss.

5. Conclusion

The discussed literature shows that, in carefully selected patients, the use of the Internal Mammary Artery Perforators as recipient vessels can be a reliable option in autologous breast reconstruction. Preoperative scanning is essential in selecting suitable candidates and can carry a significant advantage in reducing chest wall comorbidities. Additionally, using these perforators do not impact the future management of patients with increased risk of coronary artery disease, especially when there is little overlap between the two groups of patients. If necessary, other options are available such as angioplasty and using the contralateral IMA and Saphenous vein. On the other hand, the IMA is still a reliable recipient vessel especially in delayed reconstruction when axillary scarring hinders thoracodorsal vessel dissection due to previous surgery of radiotherapy or in immediate reconstruction when the thoracodorsal pedicle is iatrogenically injured.

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