Developing preoperative planning of DIEP flaps with multislice-CT angiography

Poster No.: C-1030
Congress: ECR 2013
Type: Scientific Exhibit
Authors: M. Casares Santiago¹, L. Gijón de la Santa¹, E. García Tutor¹, G. Rodriguez Caravaca², J. del Cerro Gonzalez¹, J. Hernanz Padial²; ¹Guadalajara/ES, ²Madrid/ES
Keywords: Grafts, Outcomes analysis, CT-Angiography, Breast, Arteries / Aorta, Abdomen
DOI: 10.1594/ecr2013/C-1030

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method ist strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Purpose

**WHAT IS A DIEP FLAP?**

Breast reconstruction is an essential component of the overall treatment plan of breast cancer patients.

Reconstruction can be achieved with prosthesis or autologous tissue (flaps).

The deep inferior epigastric artery (DIEA) perforator flap (DIEP), is the most used perforator flap in breast reconstruction surgery:

- Obtained from abdominal fat, its plasticity facilitates getting good breast symmetry and can be used to cover the bloodiest and more retractable scars, including those with post radiotherapy ulcerations.
- Has demonstrated fewer complications, including abdominal wall weakness and functional impairment of the rectus muscles.
- The abdominal scar is similar to that of an aesthetic eventroplasty, easily hidden with clothing or even with a bikini, and it produces a remodeling of the abdominal fat which tends to be appreciated by the patient.

However, there is a huge interindividual variability in the DIEA branching pattern and the location of its perforators, this is why a preoperative mapping of the anatomy of these perforators is needed.

**WHY SHOULD I KNOW THIS?**

Preoperative planning of DIEP flap has a growing presence Radiology Services, since multidetector CT angiography (MDCT) has proved to be the technique of choice. Most of the papers in the literature establish a complete map of all the perforating arteries of the deep inferior epigastric artery or a marking based on their own criteria, performing volumetric reconstructions of each perforant, which implies a very significant time involvement for the radiologist.

We aim to reduce the time spent in report and workstation for the radiologist, optimizing the process, so we issue a report most useful for the surgeon, without long time commitments to the radiologist.

**PURPOSE**
Check the value of the "criteria of Navarre" in the preoperative planning of DIEP flap breast reconstruction using multislice CT angiography, assessing radiological and surgical concordance. The hypothesis is that the perforator chosen based on these "criteria of Navarre" will be the same used by the surgeon in the flap design.

**Methods and Materials**

**Population:** The study included all patients scheduled for DIEP flap breast reconstruction from March 2009 to July 2011.

**Image acquisition:** a preoperative MDCT angiography was performed using a sixtyfour-row multi-detector CT scanner Toshiba Aquilion. Scan parameters are summarised in Table 1.

**IMAGE ACQUISITION PARAMETERS**
MDCT Aquilion 64, Toshiba
Tube voltage: 120kV
Managed Amperage: 100-180mA
Rotation time: 0.4s
Total shot time: 6-7s
Image Thickness: 0.5mm
Reconstruction interval: 0.4mm
Pitch: 0.8
Table1: Image acquisition parameters

The exploration should be carried out with the patient in the decubitus supine position, in the same position that he or she would be on the operating table. It is important to remove the underwear to avoid markings over the abdominal fat which may modify the trajectory or the markings over the skin by the perforating arteries.

**Preoperative planning:** The preoperative study was performed by two radiologists and one plastic surgeon. Only one or two perforating arteries "ideal in each case" were chosen, applying "the Navarra criteria", modified to fit the image, summarized in Table 2.

**Navarra criteria applied to the image**
1) DIEA heavier gauge
2) larger gauge piercing (both artery and vein)
3) located 2 cm above the umbilicus as maximum cranial limit
4) intramuscular shorter course
5) extensive communication with the superficial venous system
6) broad ramifications subcutaneous
7) long subfascial course
8) avoid tendinous intersections

Table 2: Change in the "criteria of Navarre" on the vascular pedicle "ideal", for application to the choice of the perforator "ideal" in CT imaging.

- We use MIP and MPR images for anatomic assessment of DIEA and its perforators (Figures 1-4).
- Applying these criteria, we make a marking on a VR image of the anterior abdominal wall, so that the surgeon may have a correlation as accurate as possible at the operating table (Figure 5).
- We use orthogonal axes from the umbilicus; that the surgeon will use to perform a marking on the skin of the patient on the operating table (Figure 6). It could be useful for the surgeon to superimpose a grid.
- Marked perforators were correlated with those finally chosen for the flap surgery (Figure 7), performing the statistical evaluation using the correlation Cohen's Kappa index.

Images for this section:
**Fig. 1:** Fig 1: VR Reconstruction of the anterior abdominal wall, showing the anatomy of the DIEA

**Fig. 2:** Fig 2: VR Reconstruction of the anterior abdominal wall, showing segmental anatomy of the perforator DIEA
Fig. 3: MIP Reconstruction of the anterior abdominal wall showing the segmental anatomy of the DIEA and its perforators
**Fig. 4:** Fig 4: MIP Reconstruction of the anterior abdominal wall, showing segmental anatomy of DIEA and its perforators, detailing the superficial venous system.
Fig. 5: Fig 5: A and B: Axial MIP image, showing a right perforating artery of good caliber, which perforates by rounding the muscle mass internally, facilitating the dissection, and which presents various subcutaneous branches. The communications with the venous system are visible in the lateral margin. C: VR image of the anterior abdominal wall, using the umbilicus as a reference, orthogonal measurements are performed to facilitate the location of the origin of the perforating artery on the operating table.
**Fig. 6:** A and B: Axial MIP image, showing a right perforating artery of good caliber, which perforates by rounding the muscle mass internally, facilitating the dissection, and which presents various subcutaneous branches. The communications with the venous system are visible in the lateral margin. C: VR image of the anterior abdominal wall, using the umbilicus as a reference, orthogonal measurements are performed to facilitate the location of the origin of the perforating artery on the operating table.
Fig. 7: A: Preoperative image of delayed breast reconstruction with DIEP flap. B: Image of everted flap, the blue arrow marks the beginning of the perforator. C: Image of the reconstruction result. The nipple and areola can be reconstructed in a second time if the patient requests it.
Results

A total of 43 patients have been studied (43 multi sliceCT angiography images prior to breast reconstruction using the DIEP flap performed on 43 consecutive patients at the University Hospital of Guadalajara). The mean age of the patients was 47.6 years (SD = 9.8). Nineteen of the patients (43.2 %) had a deferred intervention and 25 (56.8 %) had an immediate intervention.

In 38 of the 43 patients (88 % of the cases) the perforating arteries chosen in the multislice CT preoperative planning were the same ones that were ultimately used to raise the flap. In 5 of these patients, additional small perforating arteries close to the marked perforating artery were identified during the course of the surgery. These additional perforating arteries can be dissected and help to improve the vascularization of the flap, but they were not previously identified, or they presented slight relevance, in the multisliceCT angiography images.

In 5 of the 43 patients, the perforating arteries that had been previously chosen in the multislice CT planning were not ultimately used in the final creation of the flap.

- In 1 patient, the perforating artery that was chosen was located in area of fibrosis within the subcutaneous cellular tissue. This finding was not identified in the CT angiographic images, but it presents enormous difficulties for the dissection of the artery, and thus an alternative perforating artery was chosen in the contralateral half of the abdomen.

- In 2 patients, the DIEP flap surgery had to be converted into an anterior superficial epigastric artery (SIEA) flap surgery. The reason for this change was the small caliber of the perforating arteries that had been marked. This finding was suspected in the CT angiographic images, and thus the path of the superficial epigastric arteries had also been marked. The SIEA flap is based on the SIEA and vein, which arise from the common femoral artery and saphenous bulb. Provides the same abdominal tissue for breast reconstruction as the DIEP flap and causes the least donor-site morbidity as no incision must be made in the abdominal fascia and no vessel dissection performed through the rectus abdominis muscle. However it is limited by variability in its vascular anatomy and skin territory.

- In 1 patient, the two perforating arteries that were marked presented an origin that was located too far from the umbilicus in the cranial direction, and the skin and underlying subcutaneous adipose tissue at this level were not sufficient to design a flap in accordance with the expectations of
breast symmetry for this patient, and for this reason, more caudally located alternatives were looked for once in the operating room.

- In 1 patient, the perforating artery that had been marked presented scarce relation with the superficial venous system. As has been previously mentioned, this finding is important for the longterm survival of the flap, since it may result in postimplantation venous congestion. An alternative perforating artery was chosen in the operating room.

- In 1 patient, the perforating artery that had been previously marked as the first option was damaged during the dissection of the flap, and thus the alternative that had been marked was the perforating artery that was ultimately used.

The global concordance was moderate - to - high, with a Kappa index of 0.64 (95 % CI: 0.45 - 0.83).

The stratified concordance according to the type of surgery was high - to - very high for the deferred surgery, with a Kappa index of 0.78 (95 % CI: 0.60 - 0.90) and moderate - to - high for the immediate surgery, with a Kappa index of 0.6 (95 % CI: 0.39 - 0.80).

The exploration times in the performance of the CT angiographies in no case exceeded 12 minutes. The location of the perforating arteries in the workstation and the emission of the report, including the sending of the images described, can be done in a mean of 10 minutes. In some cases, clarifications may be required on the part of the surgeon concerning the images issued; this time is very variable and is not included in the results of this study.

**Conclusion**

The marking of 1 or 2 perforating arteries on each side of the abdominal wall over the CT angiographic images, determining which one is the first and which is the second choice, is possible through the application of the modified "Navarre criteria".

It is simple and quick to perform a marking over the axial MIP reconstructions and to transfer the orthogonal measurements onto a VR reconstruction of the abdominal wall, just as was previously described. Over the perforating arteries that are chosen, a trained radiologist can "dissect" in just a few minutes, the image of the perforating artery,
producing images of high quality and concordance so that the surgeon can perform a "preoperative virtual surgery".

All of the images obtained constitute the "true report" from the radiologist, and thus a small clarifying note is sufficient in these cases, avoiding the need for long reports which describe the path and the anatomical relations of the deep inferior epigastric artery and its perforating branches.

It has been widely demonstrated in the literature that the multislice CT angiography allows the radiologist and the surgeon to perform a pre-operative virtual surgery together, reducing the times of the actual surgical procedures, as well as the incidence of complications.

The authors conclude that the application of the "Navarre criteria" reduce the radiologist's workstation time and the time needed to generate the report, in the sense that there is no need to map and perform reconstructions of all the perforating arteries in the abdominal wall, but rather it is sufficient to mark and reconstruct just one or two "ideal" perforating arteries in each case.

References


Personal Information