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Preoperative CT angiography versus Doppler ultrasound mapping of abdominal perforator in DIEP breast reconstructions: A randomized prospective study

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KEYWORDS

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Summary Is there a difference in surgery time and complication rate when Doppler ultrasound (US) is used for the preoperative mapping of perforators in comparison with computer tomography angiography (CTA)?

Women who were candidates for breast reconstruction using the deep inferior epigastric perforator (DIEP) free flap were enrolled in a prospective randomized study.

The operating time was 249 ± 62 min (mean \pm SD) in the CTA group ($n = 32$) and $255 \text{ min} \pm 75$ in the US group ($n = 31$) – hence a difference of 6 min on average. No flaps were lost. Sixteen complications occurred in 15 patients: seven in the CTA group and nine in the US group. Complications were remedied without delay and all patients came through with a favorable reconstruction.

Preoperative mapping of perforators with US is satisfactory enough provided the microsurgery team has proper experience in breast reconstruction with the DIEP flap.

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Introduction

In our department, the first deep inferior epigastric perforator (DIEP) free flap for breast reconstruction was performed in 1998. The number of unilateral delayed breast reconstructions with DIEP flaps/year has risen from eighteen reconstructions in 2005 to 55 in 2013 (Figure 1).

All patients who were reconstructed in 1998–2006 had preoperative abdominal skin perforators mapping using a handheld Doppler ultrasound (US) probe.¹ In 2007, we started with preoperative computer tomography angiography (CTA). CTA shows the presence of perforators, their size, and location in the overlying fascia and their course through the rectus abdominis muscle. By predicting the patient's vascular anatomy, we were hoping to choose the "best" perforator and reduce surgery time. This has been previously reported in the literature.^{2–8} Speed is not synonymous with good surgical outcome. A good reconstruction with as few complications as possible is more important. In this study, we chose to measure surgery time and complication rate as the major advantages of CTA have been described to be reduced surgical time and fewer complications.

Indeed, our surgery time has been reduced from 7–8 h in 1998 to 4–5 h in 2012 (Figure 1). We wanted to investigate whether this reduction in surgery time was due to the preoperative examination with CTA or due to a learning curve. We therefore set up a randomized prospective study. Patients were randomized to preoperative mapping of perforators of the abdomen with either CTA or handheld Doppler US.

Material and methods

Patients

Seventy-nine consecutive patients were asked to join our study from February 2012 onwards. Sixty-five women accepted, and they were randomized to either preoperative CTA or US mapping of abdominal perforators. All 14 women who did not want to participate had preoperative

CTA. One patient, randomized for a preoperative CTA, withdrew from the study as she did not want any reconstructions anymore.

Due to the sudden illness of one surgeon during surgery, the operating time was considerably longer in that particular case of the US group. Indeed, the operating time turned out to be 103 min longer than the second slowest surgery. This patient was seen as an outlier and excluded from further analysis.

The study groups of 32 and 31 women each turned out to be very compatible with one another. However, there were some more ex-smokers in the US group and the flap weight was slightly higher. Flap weight was defined as the weight of the entire flap after harvest minus the weight of those parts that were discarded in the final breast reconstruction. Fewer patients in the US group had previous radiation therapy. The details of the groups are given in Table 1.

All patients in this study quit smoking at least 4 weeks preoperatively. One patient was diagnosed with diabetes type 2, one with rheumatoid arthritis, and one with chronic obstructive lung disease, in the US group. In total, 10 patients were treated for high blood pressure of which four were in the US group.

CTA and image analysis

Preoperative CTA was performed on a 16- or 64-channel multidetector CT (Somatom[®], Siemens Healthcare/Medical Solutions, Erlangen, Germany). Patients were examined in the supine position. Clothes that might deform the anatomical landmarks and all metal objects were removed prior to examination. Iohexol contrast medium (Omnipaque[™] 300 mg I/ml, GE Healthcare, Uppsala, Sweden) at 320 mg I/kg bodyweight was administered using a peripheral venous access and a power injector (Spectris Solaris, Medrad, Pittsburgh, PA, USA) in all patients. The contrast medium was injected for 15 s and the examination was triggered by bolus tracing in a region of interest (ROI) in the abdominal aorta at the level of the renal arteries set to 140 HU. Examination was performed in the caudocranial direction from the groin to 5 cm above the umbilical plane.

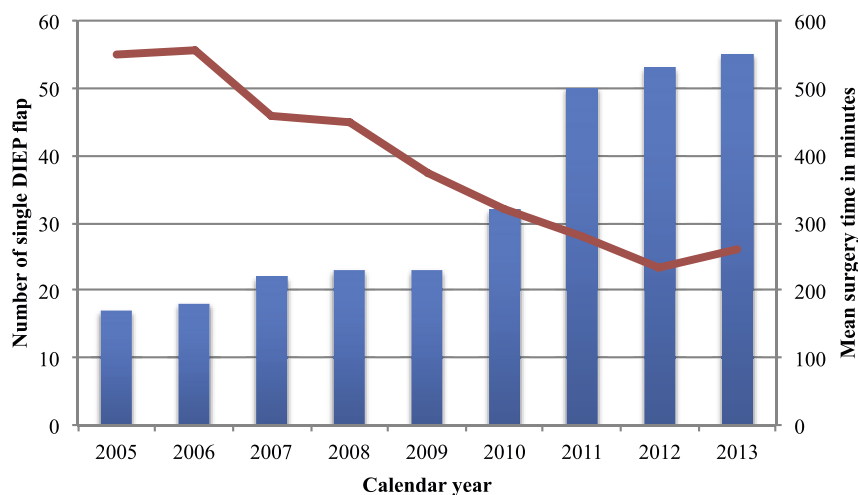


Figure 1 Single DIEP flap/year in our unit in 1998–2013. Red line (mean surgery time in minutes).

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