European Journal of Plastic Surgery (2019) 42:309–312
https://doi.org/10.1007/s00238-018-1485-1

CASE REPORT

Management of abnormal deep inferior epigastric vessels in microsurgical breast reconstruction: a report of 3 complex cases

Georgios Orfaniotis, FRCS(Plast)[1] · Toby Ivor Vinycomb[1] · Simon Overstall, FRACS[1] · Eldon Mah, FRACS[1] · Vachara Niumsawatt[1] · Dean Trotter, FRACS[1]

Received: 30 August 2018 / Accepted: 27 November 2018 / Published online: 12 December 2018
© Springer-Verlag GmbH Germany, part of Springer Nature 2018

Abstract
The deep inferior epigastric artery perforator flap is the gold standard in microsurgical breast reconstruction. It is now increasingly offered in patients with previous abdominal scars and in such cases, computed tomography angiography (CTA) is routinely implemented. However, previous injury of the deep inferior epigastric vessels may be difficult to detect with CTA. We report three cases of successful bilateral breast reconstruction, in which a unilateral DIEA was found to be abnormal. In the first two cases, the unilateral DIE vessels were found to be damaged and the flaps salvaged based on the deep superior epigastric artery. In the third patient, previous DIEA injury resulted in vessel recanalization, which was only evident following initial anastomotic failure. In this case, the damaged DIEA segment was subsequently removed and the flap successfully revascularized. All three patients had an uneventful post-operative recovery and all flaps survived with no complications. Based on our experience, we believe that awareness of the potential pitfalls and careful planning for lifeboats are essential to avoid flap loss in such circumstances.
Level of Evidence: Level V, therapeutic study.

Keywords Microsurgery · DIEP flaps · Computed tomography angiography · Epigastric vessels · Abdominal scars

Introduction

The deep inferior epigastric artery perforator (DIEP) flap has been the gold standard in autologous breast reconstruction, and computed tomography angiography (CTA) is now routinely performed in the pre-operative assessment of patients undergoing DIEP flap surgery. With the use of CTA, plastic surgeons are able to assess the location, calibre and course of perforators and formulate a safer operative plan that reduces operative time and donor site morbidity [1, 2]. The use of pre-operative CTA has also assisted in identifying those cases with abnormal deep inferior epigastric arteries (DIEA), caused by previous surgery or anomalous anatomy [3]. Herein, we report three cases of successful bilateral breast reconstruction with abdominal based flaps, in which a unilateral DIEA was found to be abnormal. In the first case, the anatomical abnormality of the DIEA was suspected pre-operatively on the CTA. In contrast, the other two cases, the aberrant DIEA was only recognised intra-operatively due to an incorrectly reported CTA.

✉ Georgios Orfaniotis, FRCS(Plast)
orfaniotis@doctors.org.uk

[1] Department of Plastic and Reconstructive Surgery, Royal Melbourne Hospital, Grattan Street, Parkville, Victoria 3051, Australia

Cases

Case 1

A 56-year-old female who had previously undergone bilateral implant-based reconstruction and radiotherapy opted for removal of her implants and salvage reconstruction with bilateral DIEP flaps. She had previously had a hysterectomy via a Pfannenstiel incision. A pre-operative CTA has revealed a normal right side DIEA anatomy with suitable perforators. However, the left DIEA appeared of very small calibre and the single large, left paraumbilical perforator was likely supplied from the deep superior epigastric artery (DSEA) (Fig. 1). Intra-operatively, the left DIEA and SIEA were found to be injured, possibly during the previous hysterectomy. As a result, the left hemi-flap was raised as a pedicled muscle-sparing transverse rectus-abdominis muscle (MS-TRAM) flap based on the left DSEA. The right side was raised as a conventional DIEP but required venous supercharging with the superficial-inferior epigastric vein (SIEV) due to either

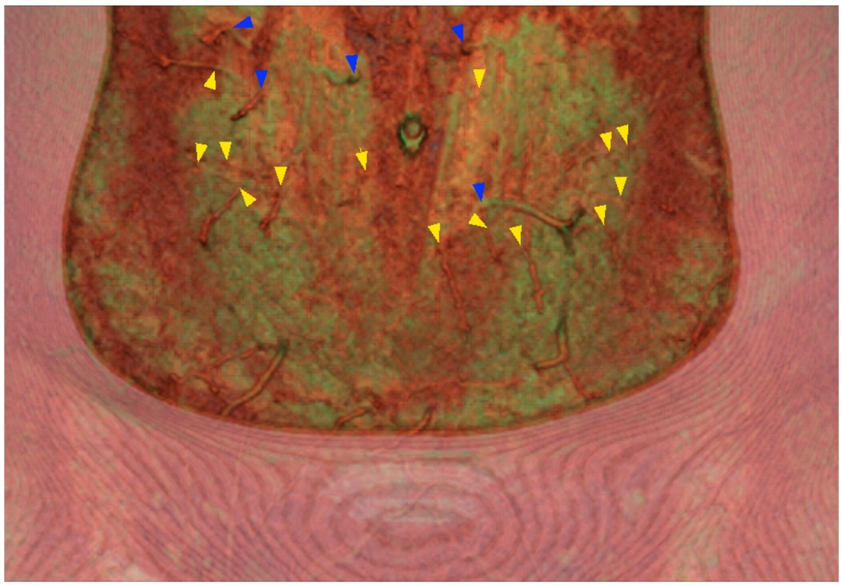

Fig. 1 Volume-rendered CTA from case 1 (blue arrows are major perforators; yellow arrows are minor perforators) demonstrating the utilised perforator at a 4 o'clock position from the umbilicus

previous injury to the DIEV or to idiopathic superficial venous dominance. Both flaps survived with no complications and the patient was discharged day 6 post-operatively. At her 5-month follow-up, both breasts demonstrated good shape (Fig. 2) and symmetry and no donor site complications were recorded.

Case 2

A 64-year-old female BRCA-2 gene carrier underwent bilateral skin sparing mastectomy and immediate reconstruction with DIEP flaps. From her past history, she had a Pfannenstiel incision for a previous caesarean section, which was complicated by post-operative bleeding, and scars from an open appendectomy and a splenectomy. Pre-operative CTA showed a large middle-row perforator on the right, and two middle-row perforators on the left side. Intra-operatively, it was noted that the right SIEA and SIEV were absent but an adequately sized superficial-circumflex iliac vein (SCIV) was preserved. During flap dissection, the right DIEA appeared fibrotic with a very weak pulse. The CTA had been incorrectly interpreted, and although the labelled perforator was continuous with the right DIEA, intra-operatively, it was determined that the perforator had the Deep Superior Epigastric Artery (DSEA) as its main source artery as the DIEA was possibly reconstituted as a result of previous vascular injury (Fig. 3a–c). Subsequently, the decision was made to raise a free right hemi-flap based on the DSEA pedicle. A 6-cm length of artery was obtained but the accompanied venae comitantes were very small and the flap showed signs of venous congestion, with a very full SCIV. A suitable size perforator from the internal mammary artery along with a 2-mm accompanied vein was identified at the third intercostal space and used as recipient vessels for flap revascularization with anastomosis to the DSEA and SCIV. The left hemi-flap was raised as a conventional DIEP and revascularization occurred uneventfully. Both flaps survived and the patient was discharged on day six post-operatively. At 3-month follow-up, there were no reported complications (Fig. 3d) and the patient proceeded with bilateral nipple reconstruction.

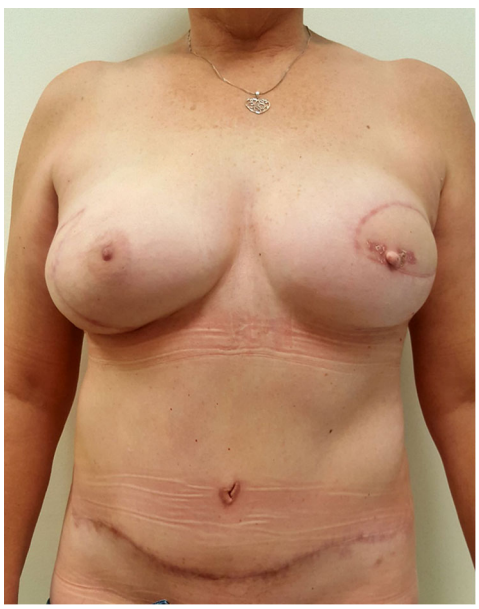

Fig. 2 Five-month clinical outcome of case 1

Case 3

A 53-year-old female with bilateral breast cancer underwent bilateral mastectomy and DIEP flap reconstruction. She had a history of an open appendectomy. A pre-operative CT scan revealed at least two suitable perforators in each hemi-abdomen arising from patent and intact deep inferior epigastric vessels. The left hemi-abdomen was raised as a DIEP flap in a routine fashion. When raising the right flap significant scarring was noted around the deep inferior epigastric pedicle at the site of the

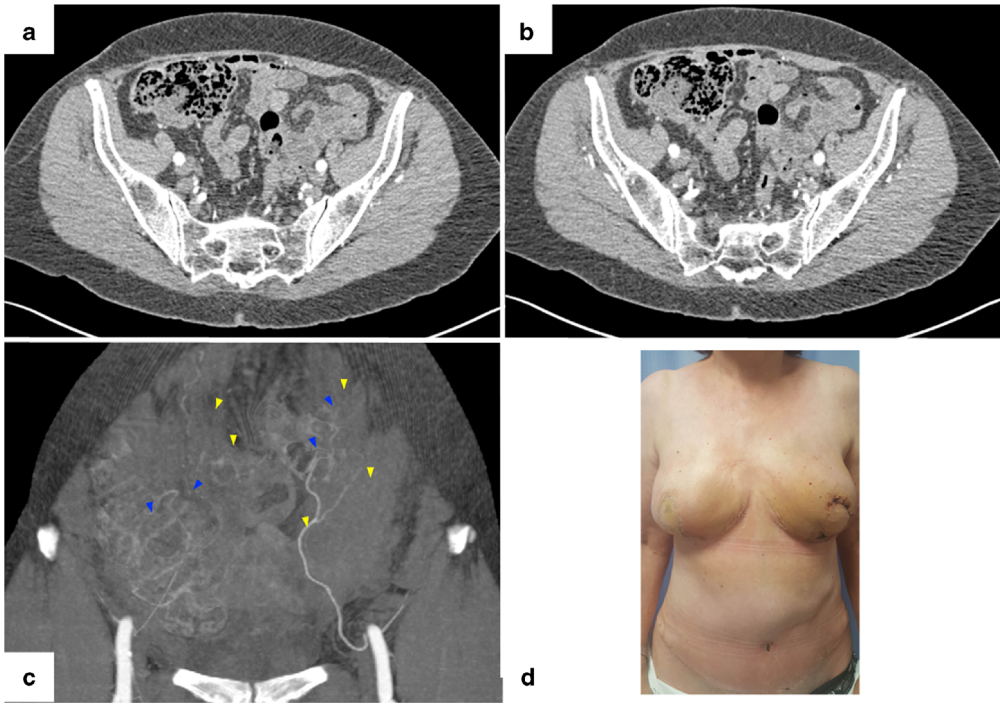

Fig. 3 Axial CTA of case 2 (**a**, **b**) demonstrating a large left-sided DIEA and a small right-sided DIEA. Coronal maximal intensive projection (MIP) of CTA (**c**, blue arrows are large perforators; yellow arrows are small perforators) demonstrating large left-sided DIEA and small right-sided DIEA. Two-month clinical outcome of case 2 (**d**)

appendectomy scar. The flap was raised with difficulty and the parietal peritoneum was required to be harvested over a short distance to avoid damaging the pedicle. Ultimately, a short pedicle to region of the scar was harvested with the flap. Upon revascularization, after initial good flow, the DIEA thrombosed. The artery was inspected and found to have multiple lumens (Fig. 4), presumably due to previous injury. The vessel was shorted and a successful micro arterial anastomosis performed. The DIEV was also anastomosed but despite anastomotic patency the flap was venously compromised, requiring supercharging with anastomosis of the SIEV to the lateral thoracic vein. The patient has an uneventful post-operative recovery, was discharged day five post-operatively, and on long-term review has two well-vascularized flaps with no significant fat necrosis.

Discussion

The abdomen remains the best donor site for autologous breast reconstruction and the presence of abdominal scars is no longer considered a contraindication in choosing abdominal-based flaps. With the assistance of the CTA and careful planning by experienced teams, DIEP flap surgery could still be a viable option in patients who have undergone previous abdominal surgery [4–6]. However, when the extent of previous surgery is unknown, awareness of the potential challenges in perforator selection and dissection is of paramount importance to minimise the risk of flap failure. DIEA irregularities may be difficult to detect pre-operatively on CTA, especially when recanalization had occurred and/or only the blood flow is affected. Conventional CTA depicts a structural image of the arteries without quantitative information on blood flow dynamics and therefore can be misleading [7]. When the course of the deep inferior epigastric vessels is within scar tissue, previous vascular injury cannot be excluded. Damaged vascular segments could be a potential source of thrombus formation and eventual anastomotic failure. If identified, as it happened in our third case, these abnormal segments should be removed, even at the expense of a shorter

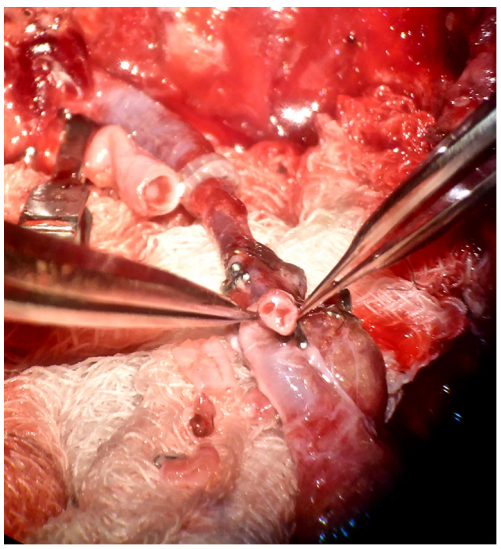

Fig. 4 A multi-lumen artery: likely, the consequence of previous injury and subsequent recanalization

pedicle and a technically more challenging anastomosis. However, scar tissue and vessel damage may be so significant as to render the DIEA or DIEV unsuitable for use as the main flap pedicle. Intra-operative assessment is key in these circumstances and flap pedicle final selection should not be based on CTA findings.

In the first case, the left DIEA was of small calibre and the SIEA was absent; hence, we raised a pedicled MS-TRAM based on the ipsilateral DSEA. In the second and third cases, although the right DIEA was reported as normal on CTA, intra-operatively, it was discovered to be abnormal. This abnormality was probably the result of previous injury, with subsequent reconstitution of the perforator distal to the zone of trauma (Fig. 5).

In the first two patients, previous disruption to the DIEA resulted in flap "delay" and ischaemic preconditioning. This delay contributed to vascular changes and an increase in diameter of the DSEA, which enabled complete flap survival. It has been reported that clinically a delay procedure reduces complications to 6% when performing pedicled TRAM flaps [8]. Moreover, patient satisfaction with unilateral pedicled TRAM reconstruction is not inferior to free abdominal flap patients [9]; however, the risk of hernia remains higher compared to DIEP surgery [10].

Suspected abnormalities of DIEA anatomy should be carefully evaluated pre-operatively and alternative donor sites should be considered. Donor site selection should be in line with the breast volume desired and patient's aspirations. Based on our experience, we believe that abdomen could still be considered as a valuable option in bilateral breast reconstruction even when a unilateral DIEA may have been previously damaged. In this situation, one should look out for other potential pedicles starting with the SIEA and SCIA and also preserve all the superficial veins encountered.

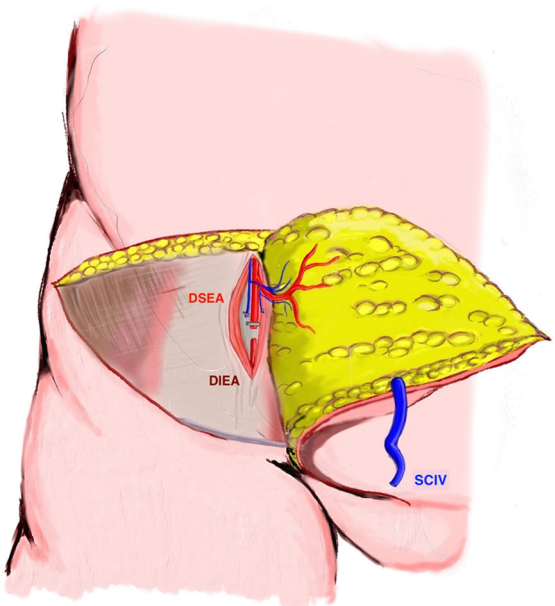

Fig. 5 Case 2: raising of the right hemi-flap with DSEA providing supply to the arterial perforator and SCIV harvested for venous anastomosis

If the DIEA and SIEA are inadequate or absent, then a free DSEA flap can be raised [7]. The limitations of this include challenging dissection, short pedicle and smaller calibre vessels. Alternatively, a pedicled MS-TRAM flap can be a reliable lifeboat option, having the benefits of previous surgical delay.

Compliance with ethical standards

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study, formal consent is not required.

Patient consent Informed written consent was obtained from all participants whose potentially identifying photographs have been used in this manuscript.

Conflict of interest Georgios Orfaniotis, Toby Vinycomb, Simon Overstall, Eldon Mah, Vachara Niumsawatt, and Dean Trotter declare that they have no conflict of interest.

References

1. Rozen WM, Ashton MW (2009) Modifying techniques in deep inferior epigastric artery perforator flap harvest with the use of preoperative imaging. ANZ J Surg 79(9):598–603
2. Rozen WM, Ashton MW, Grinsell D, Stella DL, Phillips TJ, Taylor GI (2008) Establishing the case for CT angiography in the preoperative imaging of abdominal wall perforators. Microsurgery 28(5): 306–313
3. Rozen WM, Houseman ND, Ashton MW (2009) The absent inferior epigastric artery: a unique anomaly and implications for deep inferior epigastric artery perforator flaps. J Reconstr Microsurg 25(5):289–293
4. Parrett BM, Caterson SA, Tobias AM, Lee BT (2008) DIEP flaps in women with abdominal scars: are complication rates affected? Plast Reconstr Surg 121(5):1527–1531
5. Rozen WM, Garcia-Tutor E, Alonso-Burgos A, Corlett RJ, Taylor GI, Ashton MW (2009) The effect of anterior abdominal wall scars on the vascular anatomy of the abdominal wall: a cadaveric and clinical study with clinical implications. Clin Anat 22(7):815–822
6. Kim SY, Lee K-T, Mun G-H (2017) The influence of Pfannenstiel scar on venous anatomy of the lower abdominal wall and implications for deep inferior epigastric artery perforator flap breast reconstruction. Plast Reconstr Surg 193:540–548
7. Hansen KS, Gutwein LG, Hartman BC, Sood R, Socas J (2016) Immediate bilateral breast reconstruction with unilateral deep superior epigastric artery and superficial circumflex iliac artery flaps. Arch Plast Surg 43(5):457–460
8. Atisha D, Alderman AK, Janiga T, Singal B, Wilkins EG (2009) The efficacy of the surgical delay procedure in pedicle TRAM breast reconstruction. Ann Plast Surg 63(4):383–388
9. Schwitzer JA, Miller HC, Pusic AL, Matros E, Mehrara BJ, McCarthy CM, Lennox PA, Van Laeken N, Disa JJ (2015) Satisfaction following unilateral breast reconstruction: a comparison of pedicled TRAM and free abdominal flaps. Plast Reconstr Surg Glob Open 3(8):e482
10. Mennie JC, Mohanna PN, O'Donoghue JM, Rainsbury R, Cromwell DA (2015) Donor-site hernia repair in abdominal flap breast reconstruction: a population-based cohort study of 7929 patients. Plast Reconstr Surg 136(1):1–9