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CASE REPORT
Breast

Late-onset Total Necrosis in Deep Inferior Epigastric Perforator Flap after Contrast Enhanced Computed Tomography

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Summary: There seems to be an incessant debate regarding the duration of dependency of free flaps on pedicle vessels and the extent to which neovascularization from surrounding tissue contributes to the fortification of the free flaps. Although animal studies have suggested that pedicle vessels can be safely divided 5–8 days postoperatively without flap failure in fasciocutaneous flaps, recent clinical reports, particularly concerning the deep inferior epigastric perforator (DIEP) flap, cast doubt on this assumption. This report highlights a singular case of delayed-onset total necrosis in a DIEP flap following a contrast enhanced computed tomography (CECT) scan conducted 48 days post reconstructive surgery. The patient, a 56-year-old woman, had undergone a mastectomy for right breast cancer followed by immediate tissue expander placement. Subsequently, 6 months later, she underwent delayed reconstructive surgery with a DIEP flap. The postoperative course was uneventful, except that she had a CECT scan as part of follow-up care 48 days postoperatively and developed an abrupt yellow exudate from the right breast wound 2 days later, eventually leading to aggressive debridement of the totally necrotized flap 60 days postoperatively. This case marks the first instance of late-onset total necrosis of a DIEP flap following a CECT. The intensified endothelial damage induced by contrast media, in the context of the high dependency of the DIEP flap on the pedicle vessels with marginal blood supply from the surrounding wound bed, could be ascribed as the cause of this total loss of the flap. *(Plast Reconstr Surg Glob Open 2024; 12:e6086; doi: 10.1097/GOX.0000000000006086; Published online 22 August 2024.)*

There is ongoing debate about the duration of free flaps' dependency on pedicle vessels and the role of neovascularization from surrounding tissue in their fortification. Some clinical literature suggests muscle flaps exhibit long-term dependency on pedicle vessels due to their higher metabolic rate.[1,2] Meanwhile, fasciocutaneous flaps are hypothesized to gain autonomy through neovascularization much earlier, losing reliance on pedicle vessels 5–8 days postoperatively, according to past animal studies.[3,4] However, recent reports challenge this assumption, especially for deep inferior epigastric perforator (DIEP) flaps.[1,4,5]

This report presents a unique case of delayed-onset total necrosis in a DIEP flap following a contrast enhanced computed tomography (CECT) scan conducted 48 days after reconstructive surgery. The cytotoxicity of contrast media likely intensified in the pedicle vessels due to the DIEP flap's high dependency on them, with marginal blood supply from surrounding tissue, leading to total flap necrosis. To our knowledge, no similar cases have been reported, highlighting the need for increased caution with contrast-enhanced imaging tests for DIEP flaps even beyond 1 month postsurgery.

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A 56-year-old woman with right breast cancer underwent an inverted-T mastectomy (mastectomy weight: 528 g) and immediate tissue expander placement (Natrelle

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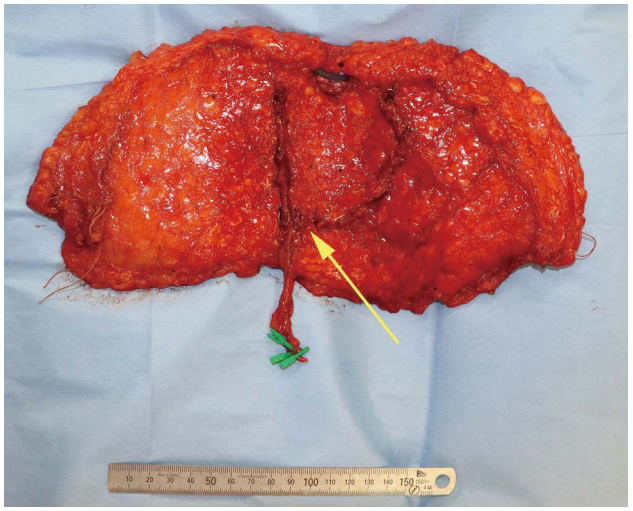

Fig. 1. After intraflap anastomoses (arrow), the unilateral deep inferior epigastric vessels were anastomosed end-to-end to the ipsilateral internal mammary artery and veins.

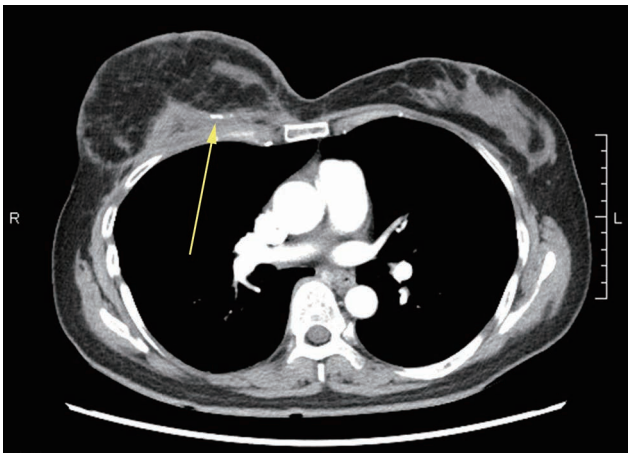

Fig. 2. In the CECT performed at 48 days postoperatively, the vascular pedicle of the flap was enhanced (arrow), and the adipose tissue of the flap appears normal.

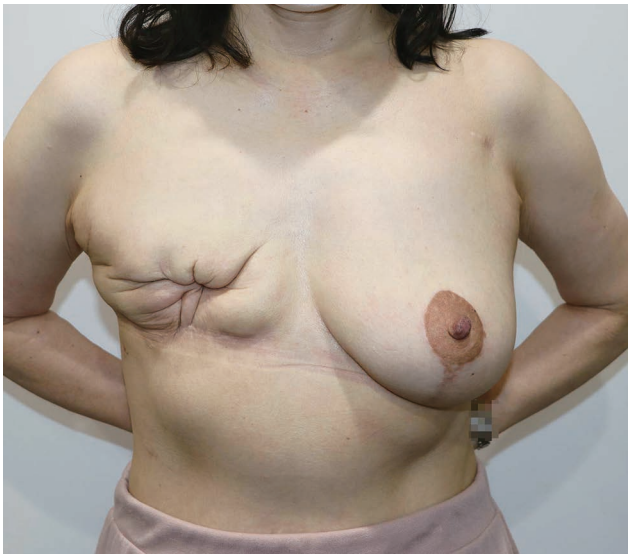

Fig. 3. Photograph after total debridement of the necrotized flap.

133S-MX13). Six months later, she had a two-stage reconstructive surgery with a bipedicled DIEP flap (**See figure, Supplemental Digital Content 1,** which displays preoperative photograph of reconstructive surgery with a bipedicled DIEP flap. **http://links.lww.com/PRSGO/D443**). After intraflap anastomoses, the unilateral deep inferior epigastric vessels were anastomosed end-to-end to the ipsilateral internal mammary artery and veins (Fig. 1). The weight of the DIEP flap was 468 g, and capsulotomy was performed only on the mastectomy flap side to increase skin elasticity (**See figure, Supplemental Digital Content 2,** which displays the photograph taken immediately after DIEP flap reconstruction. **http://links.lww.com/PRSGO/D444**). Her medical history was unremarkable, with no diabetes, nonsmoker status, a body mass index of 22.5, and no prior chemotherapy or radiotherapy.

The postoperative course after the second surgery had been uneventful until she underwent a CECT scan 48 days postoperatively for another reason, with the purpose of evaluating mediastinal lymphadenopathy (Fig. 2). In the CECT, 96 mL of Omnipaque 300 (GE Healthcare Pharma) was used. Two days after the imaging test, she returned to the hospital, presenting with slight right chest pain, accompanied by erythema and yellow exudate from the wound. Daily wound irrigation and antibiotic administration was continued, but failed to achieve stability or improvement of the flap condition. Consequently, a decision was made to perform total debridement of the necrotized flap 60 days postoperatively (Fig. 3). Intraoperative findings revealed no sign of kinking or bending of the vascular pedicles. One year later, she underwent another breast reconstruction with a fat-augmented latissimus dorsi flap (Fig. 4).

DISCUSSION

The investigation, primarily focused on determining the duration for which vascular pedicles remain crucial in sustaining blood supply after free flap transfer in humans, has faced significant technical and ethical challenges. This inquiry underscores the need to thoroughly examine previous cases and expand collective clinical knowledge to refine our understanding. Although prior animal studies suggested that fasciocutaneous flaps attain sufficient blood supply from peripheral tissue relatively early, making them autonomous, an increasing number of case reports challenge this hypothesis. A study using color duplex imaging revealed that muscle and fasciocutaneous free flaps continued to depend on the pedicle vessels, with no significant vascular flow from the peripheral tissue one year after surgery.[6] Heitland et al demonstrated the absence of reactive enhanced flow signal from the surrounding wound bed into the DIEP flaps using indocyanine green angiography 18 months postsurgery.[5] Additionally, another case report detailed

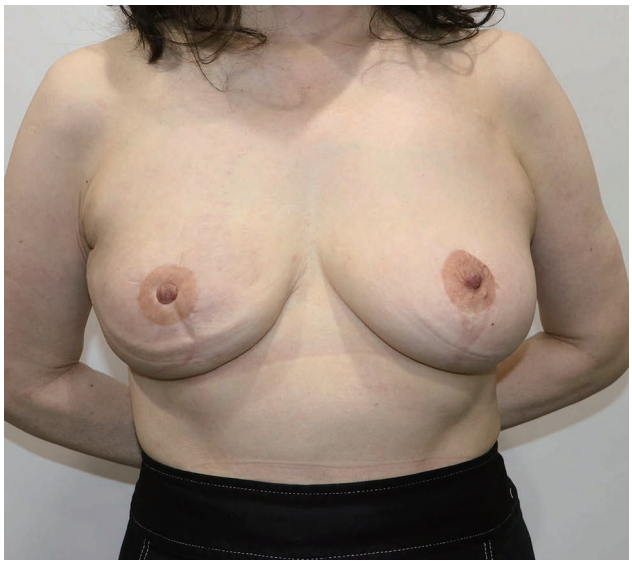

Fig. 4. Photograph 18 months after breast reconstruction with a fat-augmented latissimus dorsi flap.

a subtotal necrosis of a DIEP flap occurring after the division of the vascular pedicle during lateral breast reduction, even 3 years following the transfer.[4] It is a reasonable conjecture that the condition of the recipient site significantly influences neovascularization. Factors such as the fibrous barrier of a capsule, as seen in the present case (capsulotomy was performed only on the mastectomy flap side), could impede newly formed blood vessels from extending into free flaps. Moreover, compromised vascularity of the recipient bed due to factors like infection, trauma, diabetes mellitus, smoking habits, or chemoradiotherapy could further hinder neovascularization.[7] Even with these clinical backgrounds or comorbidities considered, DIEP flaps are increasingly recognized as having a relative paucity of neovascularization from the recipient site compared with other free flaps. This suggests that inherent attributes of the flap, such as the ratio between surface area and volume or organizational density, might contribute to its dependence on vascular pedicles.[8]

The cytotoxicity induced by iodinated contrast media (CM) has been studied previously. Sendenski et al found that CM administration significantly compromised the endothelial barrier, or the integrity of the endothelial barrier function, as shown using an electrical cell-substrate impedance system. Scanning electron microscopy further revealed CM-induced morphological changes in the endothelial lining, characterized by a ragged, irregular surface with microvilli, blebs, or small protrusions.[9] The higher osmolarity and viscosity of CM are factors contributing to endothelial retraction or injury to the cellular lining, which can lead to white blood cells adhering to vessel walls or platelet clumping.[10] Interestingly, Heitland et al demonstrated a gradual increase in vascular resistance of DIEP flaps after transfer, likely due to fibrotic changes and reduced diameter or elasticity of the pedicle vessels or the capillary flow bed.[5] In this case, the vascular pedicle, already under stress, struggled to maintain blood flow without sufficient neovascularization. The CECT scan performed 48 days postoperatively may have worsened the situation, leading to thrombus formation and vessel obliteration.

Continuous research is imperative, and until more definitive evidence is available, caution is advised against ill-considered ligation of the vascular pedicle and in performing CECT scans post DIEP flap reconstruction.

CONCLUSIONS

Our case report highlights the critical dependency of the DIEP flap on its pedicle vessels even beyond 1 month postsurgery, challenging assumptions about early neovascularization. The delayed-onset total necrosis after a CECT scan underscores the risks of iodinated CM on vascular integrity. The findings suggest that the DIEP flap's attributes and the recipient site's condition significantly impact vascular dependence. This study calls for heightened caution with contrast-enhanced imaging tests for DIEP flaps and stresses the need for further research into flap vascularization and optimal postoperative care.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

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All procedures conformed to the principles set forth in the Declaration of Helsinki. This study was approved by the Ethics Committee of Kansai Medical Hospital, and informed written consent to publish personal and medical information was obtained from the patient.

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