Dear Sir,

Preoperative knowledge of the highly variable vascular anatomy of the abdominal wall via computed tomographic angiography (CTA) has revolutionized surgical planning,1–4 reducing operating times, complications and improving outcomes.5,6 Our group has been highly influential in the elucidation of this method of imaging, however in the constant search for optimal outcomes and increased patient safety, we have trialled the infrared camera (Thermo Tracer TH 7800, NEC Avio Infrared Technologies, Tokyo). In this correspondence, we describe the first case, to our knowledge, in the literature using this device in surgical planning of deep inferior epigastric artery perforator flaps in comparison to CTA and discuss the potential advantages and limitations compared to contemporary imaging techniques.

Figure 1 Preoperative computed tomographic angiogram (CTA) showing one suitable single medial row perforator supplying the right hemiabdomen, with a diameter of 2 mm. The other perforators were felt to be insufficient to supply a flap. This image shows one small perforator to the right of the umbilicus and two small perforators just to the left of the midline.

Figure 2 Thermal image after 10 min of cold challenge using a water pack at 5 °C showing the presence of one ‘hot spot’ confirming the presence of the dominant perforator on the right and the lack of visible hot spots on the left.

Figure 3 Preoperative thermal image overlaying the preoperative computed tomographic angiogram (CTA), showing the correlation between the findings of the two modalities (black arrows).


A 41-year-old Caucasian female was booked for bilateral deep interior epigastric artery perforator flap reconstructions following a left mastectomy 8 years previously. Her other previous medical history of note included postoperative chemotherapy and radiotherapy. There were scars present on the lower abdomen following three previous caesarean sections.

The preoperative CTA showed one suitable single medial row perforator supplying the right hemiabdomen, with a diameter of 2 mm. The other perforators were felt to be insufficient to supply a flap. There was one small perforator to the right of the umbilicus and two small perforators just to the left of the midline (see Figure 1). The thermal image after 10 min of cold challenge using a water pack at 5°C showed the presence of one 'hot spot' confirming the presence of the dominant perforator on the right (see Figure 2), and the lack of visible hot spots on the left. We include Figure 3 which superimposes the thermal image over the CTA for direct comparison. In view of the results of these scans, the operation plan was changed to a unilateral DIEP flap based on the right hemiabdomen, and a planned right sided breast implant for symmetrisation at a later date.

The intra-operative photograph (see Figure 4) demonstrates the large perforator in the right hemiabdomen, and the absence of significant perforators on the left. The operation was completed without complication and the patient discharged on day 5 post-op.

Although CT angiography has revolutionised preoperative imaging, as a modality it has a number of drawbacks which we believe thermography can address. The attributes of CTA and DIRT are shown in Table 1. Thermal imaging has been described in the past, with varying success,7,8 but these papers predate CTA, precluding its direct comparison.

DIRT can be performed repeatedly on the same patient, allowing intra- and post-operative monitoring of flap health. This information has the potential to aid in surgical decision making, particularly in the context of assessing flap viability and the need to trim and reshape a flap intraoperatively. With refinements in technique, it may also have a future role in post-operative monitoring. Thermography records temperature changes which are a direct result of rates of blood flow to a volume of tissue and in theory should provide insight into the functional characteristics of individual vessels. Although CTA can provide us with data about the size and course of perforator vessels, we currently have limited means by which to determine the precise watershed boundaries between areas supplied by neighbouring vessels, particularly in the context of changing vascular tone intraoperatively which can affect blood flow significantly.

Concerning future research avenues, the haemodynamic information that thermography provides can also be utilized to detect the effects of various interventions on blood flow. One such intervention we are investigating is remote ischaemic preconditioning. Transient ischaemia in an isolated, remote location causes the release of soluble cytokines9,10 into the blood which promotes a systemic increase in blood flow. In multiple published studies in cardiothoracic surgery, such simple intervention preoperatively has been shown to measurably improve blood flow to the heart and result in statistically significant improvements in clinical outcomes. Although there have been no reports investigating the use of this phenomenon in reconstructive flap surgery, the basic science behind the concept is well proven and sound, and we believe that

<table>
<thead>
<tr>
<th>Computerised tomographic angiography (CTA)</th>
<th>Dynamic infrared thermography (DIRT)</th>
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<tbody>
<tr>
<td>Detects 100% of perforators</td>
<td>Detects clinically significant perforators &gt;1 mm diameter</td>
</tr>
<tr>
<td>Locates to &lt;1 mm</td>
<td>Locates to &lt;1 cm</td>
</tr>
<tr>
<td>Associated with radiation exposure</td>
<td>Radiation free</td>
</tr>
<tr>
<td>Uses intravenous contrast — anaphylactic risk</td>
<td>Non-invasive, repeatable</td>
</tr>
<tr>
<td>Separate hospital visit</td>
<td>Single visit — performed in clinic</td>
</tr>
<tr>
<td>30 min CT appointment with technician</td>
<td>10 min procedure</td>
</tr>
<tr>
<td>3D recon and report by specialist</td>
<td>Image reported by surgeon</td>
</tr>
<tr>
<td>Delay between scan and report</td>
<td>Immediate report in clinic</td>
</tr>
<tr>
<td>Static images</td>
<td>Temporal information regarding perfusion</td>
</tr>
<tr>
<td>Cost of scanner &gt;£1 million</td>
<td>Cost of camera &gt;£20,000</td>
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thermography provides us the perfect tool to test if the same technique can help us improve free flap surgery.

This case supports the case for further research into dynamic thermography to preoperatively image the abdominal wall. It allowed us to non-invasively assess the vasculature, plan surgery, and prepare the patient for a modified operation.

One challenge which we currently are investigating solutions for is a reliable method of providing a calibrated scale on the thermographic images so as to allow easy correlation visually, as well as with other imaging modalities such as CT angiography.

Conflicts of interest

None.

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References


Iain S. Whitaker
Kwok H. Lie
Warren M. Rozen
Daniel Chubb
Mark W. Ashton
Royal Melbourne Hospital & Taylor Lab., Department of Plastic Surgery, Grattan Street, Parkville, Melbourne, Australia
E-mail address: iainwhitaker@fastmail.fm

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Primary reconstruction of the umbilicus, using two rectangular subcutaneous pedicle flaps

Introduction

Generally, the umbilicus provides an important function as the only landmark of the abdomen. When it is lost, it should be reconstructed regardless of age or sex. Despite many operative techniques for reconstruction of congenital umbilical diseases, there were few reports for the reconstruction along the large defect with entire umbilicus and surrounding skin after tumor removal.

Here we describe the primary reconstruction technique for umbilicus after wide excision of the abdominal wall tumor.

Technique

We can use our technique for both benign and malignant tumor, but the size of defect include umbilicus is required to be enough for closing primarily.

After tumor removal, we design the spindle shape area in same width of skin defect. We make the major axis of the design vertical for the body and locate on the midline of the abdomen even if the skin defect is shifted in any way from the midline.

Then we make two subcutaneous pedicle flaps upon rectangular shaped skin incision on cranial and caudal skin areas around defect (Figure 1, above, left). These flaps are made inside the spindle area, which should be removed as a dog-ear when it closed primarily without umbilicus, to form the reconstructed umbilical wall. Because of thick fibrofatty tissue below the flaps, we can easily elevate and rotate by incise perpendicularly just around the flaps. The blood supply for the flaps is safe because the penetrating vessels from abdominal fascia can be preserved. With this...