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The utility of CT angiography in planning perineal flap reconstruction following radical pelvic surgery

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ABSTRACT

Introduction: Closure of the perineum following radical excision of pelvic tumours can prove to be a complex surgical problem. A number of pedicled flaps have been used for perineal reconstruction in order to reduce post-operative complications such as infection and abscess formation. The aim of this case series was to analyse the use of pre-operative computer tomography (CT) angiography to guide flap selection for perineal reconstruction following radical excision of pelvic tumours.
Methods: We conducted a retrospective review to identify all patients who underwent CT angiography prior to radical excision of pelvic tumours and planned flap reconstruction over an 18 month period. Six patients were identified and are presented in this case series. Patients' medical records, histology reports, pre-operative investigations and CT angiograms, complications and follow-up were reviewed.
Results: The mean patient age was 58.3 years, with a male to female ratio of 1:2. Four out of six patients (66.6%) underwent pre-operative radiotherapy. The deep inferior epigastric arteries (DIEA) were visualised in all six cases (100%) and the pre-operative CT angiography helped guide flap choice in all cases (100%). In one case, narrowing of the DIEA vessels was noted precluding the use of a DIEA-based flap. One patient had a minor superficial wound dehiscence.
Conclusion: Pre-operative CT angiography allows accurate visualisation of the DIEA system including perforator vessels. CT angiography is a useful tool, providing the surgical team with significant additional information to aid pre-operative planning and optimise reconstructive choice and outcome.

1. Introduction

Extensive surgical resections, such as pelvic exenteration or abdomino-perineal excision of the rectum (APER), are often required to treat certain carcinomas of the anal canal, rectum, bladder, vulva and vagina. Closure of the perineal wound following such radical surgery is frequently complex. Such procedures leave a large deadspace within the perineum and pelvis, and full thickness defect of the skin and subcutaneous tissue. A number of options are available to close the deadspace and skin defect, ranging from primary closure to a wide variety of flap reconstructions. However, primary closure has consistently been shown to be associated with a high rate of wound complications such as infection and perineal wound dehiscence (25%–60%), particularly following neo-adjuvant radiotherapy.[1–4] Common complications include prolonged and often painful wound healing, haemorrhage, infection, perineal hernia, pelvic abscess and fistula formation.

Perineal reconstruction using local flaps is being performed more frequently, and as such plastic surgeons have become core members of the colorectal, anal, urological and gynaecological multidisciplinary teams. The most commonly used flaps are the pedicled myocutaneous flaps (vertical rectus abdominis myocutaneous (VRAM) flap and the gracilis myocutaneous flap) and the fasciocutaneous flaps (gluteal fold fasciocutaneous flap). Such flaps are particularly effective in reducing perineal complications and shortening hospital stay.[2,4–6] In addition, free tissue transfer may also be an option, although it is technically more demanding.

Of the three pedicled flaps above mentioned, the VRAM flap has been shown to result in significantly fewer major complications compared to thigh flaps.[7,8] However, VRAM flaps are associated

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with a risk of abdominal wall bulge, weakness and hernia formation[9,10] and may not always be the optimum choice for certain patients. Consideration must also be given to: stoma placement, the possibility of damage to the main pedicle due to previous intra-abdominal and pelvic dissection, and the position of the associated cutaneous surgical scars which could disrupt perforator blood supply to the overlying skin paddle. In cases where a VRAM is contraindicated, gracilis and gluteal fold flaps are useful alternatives. The use of pre-operative computer tomography (CT) angiography for autologous breast reconstruction is considered a routine, non-invasive investigation which provides useful information regarding the location, diameter and anatomic course of the perforator vessels in relation to the abdominal rectus muscles.[11] The aim of this study was to analyse the use of CT angiography as a novel strategy in the pre-operative planning of flap selection for perineal reconstruction following radical excision of anorectal and urogynaecological tumours, especially in the presence of previous radical radiotherapy.

2. Methods

A retrospective review of the electronic, password protected databases at Addenbrooke's Hospital, Cambridge (a tertiary referral centre), was conducted in order to identify all consecutive patients who were planned to undergo radical excision of pelvic tumours and flap reconstruction and who underwent pre-operative CT angiography over an 18 month period from May 2010 to November 2011. All reconstructions in this case series were conducted by the same Plastic Surgeon (AD). Patients' medical records, multidisciplinary team meetings, adjuvant therapy, pre-operative investigations including CT angiograms, choice of flap used for the reconstruction, complications and follow-up were evaluated.

3. Results

Pre-operative CT angiography has been used to guide perineal reconstruction in six patients who required radical excision of pelvic tumours in the past 18 months (Table 1). The mean patient age was 58.3 (range 27–80) years, with a male to female ratio of 1:2. Four patients had anorectal malignancy (three anal squamous cell carcinoma (SCC) and one anorectal carcinosarcoma) and two had bladder malignancy (Table 1). All patients were discussed at the multidisciplinary team meeting prior to surgery. Four patients (66.6%) had undergone pre-operative radiotherapy and one patient (16.7%) had undergone pre-operative chemotherapy. One of the patients did not have neo-adjuvant therapy and was found to be suitable for direct closure intra-operatively. Four of the six patients (66.7%) (patients 2, 3, 4, 5) had no evidence of metastatic disease on pre-operative staging. One patient found to have involvement of the inguinal nodes on pre-operative staging underwent synchronous bilateral inguinal node clearance with APER and VRAM flap reconstruction. One patient was found to have metastatic disease and underwent surgery as palliative treatment for symptom relief. Therefore, five of the six (83.3%) patients were treated with potentially curative intent.

All six patients underwent pre-operative CT angiography in order to aid reconstruction planning pre-operatively and the deep inferior epigastric arteries (DIEA) were visualised in all six (100%) patients. In one case, narrowing of the DIEA vessels was noted (Fig. 2), precluding the use of a DIEA-based flap. Two patients (33.3%) had a VRAM flap reconstruction, two (33.3%) had a gracilis myocutaneous flap, one (16.7%) had bilateral gluteal fold fasciocutaneous flaps, and one (16.7%) was found not to require reconstruction intra-operatively.

One of the six patients had a superficial wound dehiscence affecting the distal aspect of the flap that healed with conservative measures. No other intra- or post-operative complications were noted. Three of the patients (50%) remain disease-free with a mean follow-up period of 11.7 months (range 11–13 months). One patient (16.7%) with bladder leiomyosarcoma developed inoperable liver metastases which were noted on follow-up CT scan 10 months after surgery and is currently receiving palliative treatment. The remaining two patients died; one was a planned palliative resection and died four months following surgery, and the other developed aggressive local recurrence (despite clear resection margins) and died seven months after surgery.

4. Discussion

We describe the use of pre-operative CT angiography in perineal reconstruction in patients with differing pelvic pathologies, namely anal SCC, bladder leiomyosarcoma and the exceedingly rare anorectal carcinosarcoma, of which there have only been three previous cases reported in the literature.[12–14] All six patients in this case series required radical surgery (either APER or pelvic exenteration). Five patients underwent neo-adjuvant therapy in order to remove the tumours with adequate clear margins, resulting in large dead spaces within the pelvis and perineum. Deciding on the type of flap to reconstruct a particular defect is complex and requires extensive knowledge of individual patient factors.

When planning radical pelvic surgery, a decision must be made as to whether the defect should be closed primarily or whether flap reconstruction would offer a superior outcome. The literature suggests that primary closure is associated with a higher incidence of post-operative complications, particularly when performed after radiotherapy to the region.[1–4] In fact, the risks of post-operative complications are 2–10 times greater in patients undergoing pre-operative radiotherapy.[4,15,16] The use of flaps can reduce the

Table 1
Patient demographics, management and outcomes.

	Age	Gender	Histology	Pre-operative radiotherapy	CT angiogram findings	Surgery	Complications	Follow up (months = m)
Patient 1	79	Male	Anorectal carcinosarcoma	Yes	Patent DIEA	APER & VRAM flap (Fig. 1)	None	Disease-free 11 m
Patient 2	59	Male	Anal SCC	Yes	Patent DIEA	APER & gracilis flap	None	Died 7 m
Patient 3	80	Female	Anal SCC	Yes[a]	Patent DIEA	APER & bilateral gluteal fold flaps	Superficial wound dehiscence	Disease-free 13 m
Patient 4	45	Female	Anal SCC	Yes	Patent DIEA	APER & VRAM flap	None	Disease-free 11 m
Patient 5	60	Female	Bladder leiomyosarcoma	No	Patent DIEA	Total cystectomy, ileal conduit, no reconstruction	None	Liver metastases 10 m
Patient 6	27	Female	Bladder TCC	No	Obliterated L EIA, patent R DIEA	Pelvic exenteration & gracilis flap	None	Died 4 m

SCC = squamous cell carcinoma, TCC–transitional cell carcinoma, CT = computer tomography, DIEA = deep inferior epigastric artery, L = left, EIA = external iliac artery, R = right, APER = abdomino-perineal excision of the rectum, VRAM = vertical rectus abdominis myocutaneous.

[a] Patient 3 had a past medical history of vulval SCC which had been treated with wide local excision and left gluteal fold V-Y advancement flap followed by radiotherapy to the perineum.