



Variation in the perioperative care of women undergoing abdominal-based microvascular breast reconstruction in the United Kingdom (The optiFLAPP Study)[☆]

optiFLAPP Collaborative^{1,*}

Received 16 February 2018; accepted 19 August 2018

KEYWORDS

Breast reconstruction;
Microsurgery;
Perioperative;
Deep inferior
epigastric perforator
flap

Abstract *Introduction:* Abdominal-based microvascular breast reconstruction constitutes approximately one-fifth of reconstructions following mastectomy for breast cancer. Enhanced recovery after surgery (ERAS) protocols have been implemented to improve patient care. The aim of this project was to identify variation in the perioperative care of women undergoing microvascular breast reconstruction to inform development of an ERAS protocol.

Methods: Surveys were developed for plastic surgeons, anaesthetists and the lead clinician for breast reconstruction at each unit. These assessed most aspects of perioperative care. A team of medical student collaborators was identified. This team created a list of surgeons and anaesthetists in the United Kingdom by unit. REDCap was used to record their responses.

Results: Nineteen (19/39, 49%) lead clinicians, 83 (83/134, 62%) plastic surgeons and 71 (71/100, 71%) anaesthetists from units across the UK completed the surveys. Marked variation was identified in the clinician responses when compared with the national and international guidelines. This variation covered many aspects of patient care including antibiotic and fluid prescribing, surgical technique, post-operative care and recording of patient outcomes.

[☆] Parts of this article has been presented at the BAPRAS Winter Scientific Meeting 2016, London, UK.

¹The optiFLAPP Steering Group (in alphabetical order) comprises: Matthew D. Gardiner, Victoria Giblyn, David Highton, Abhilash Jain, Ranjeet Jeevan, Shaman Jhanji, Richard M. Kwasnicki, Afshin Mosahebi, Daniel Martin, Hazim Sadideen and Joanna Skillman. The optiFLAPP Undergraduate Working Group (in alphabetical order) comprises: Frank Acquaah, Liam Cato, Daniel Coventry, Luke Geoghegan, Fahad Iqbal, Richard M. Kwasnicki (Chair), Diana Lim, Philip McCaughey (Deputy Chair), Jay Pancholi, Yashashwi Sinha, Guy Stanley and Mark Twoon. Local collaborators (in alphabetical order) of the optiFLAPP Collaborative were: Brendon Berry, Mimi Borelli, Victoria Chan, Priyesh Chauhan, Elena Conci, Rachael Coulson, Susan Dreyer, Kaitlyn Dynes, Esther Evans, Stuart Gallagher, Jessica Garner, Tajinder Kane, George Lafford, Joanna Mena, Uyen Nguyen, Maria Nowicka, Daniel Robinson, Reena Suresh, Sam P. Tarassoli, Victoria Teoh, Mark Twoon and Benjamin Way.

* Corresponding author: Matthew D. Gardiner, Kennedy Institute of Rheumatology, NDORMS, University of Oxford, Old Road Campus, Roosevelt Drive, Oxford OX3 7FY, England.

E-mail address: matthew.gardiner@kennedy.ox.ac.uk (optiFLAPP Collaborative)

Conclusions: The optiFLAPP national practice survey has demonstrated variation in the perioperative care of women undergoing abdominal-based microvascular breast reconstruction. We propose a large prospective audit to assess current protocols and support development of randomised controlled trials.

© 2018 Published by Elsevier Ltd on behalf of British Association of Plastic, Reconstructive and Aesthetic Surgeons.

Introduction

In the United Kingdom (UK), abdominal-based free tissue transfer is the most common form of microvascular breast reconstruction used following mastectomy.¹ Many of the technical challenges for flap survival have been addressed such that reported flap failure rates are below one per cent.² Increasingly, the focus has been shifted to refining the patient pathway to improve quality of care and provide a cost-effective service.

Enhanced Recovery after Surgery (ERAS) protocols are multimodal perioperative care pathways that 'fast track' patient recovery by reducing unintended variation in clinical practice. In 2012, a protocol for microvascular breast reconstruction was included in national guidelines published in the UK.³ A subsequent study highlighted variation in some aspects of perioperative care in this patient group.⁴ More recently, ERAS protocols were successfully implemented at single centres in the USA.^{5,6} In 2017, the ERAS Society published a breast reconstruction-specific protocol.⁷ The main limitation of the protocols is that many of the recommendations rely on expert opinion owing to a lack of high-quality evidence. In addition, the guidance is often general rather than specific, which results in uncertainty. This provides space for variation in clinical practice. To date, none of the ERAS protocols have been correlated with validated patient-centred or patient-reported outcomes.

Clinical variation presents a serious challenge to delivering effective healthcare. In the UK, the National Health Service (NHS) is using the 'Get It Right First Time' (GIRFT) initiative to improve patient care and reduce costs by identifying and addressing clinical variation. The pilot study investigated delivery of orthopaedic surgery in the UK. It identified wide variations in the quality of treatment and outcomes achieved by hospitals across the country.⁸ For example, surgical site infection rates were 0.2% at the best performing hospital and 5% at the worst performing hospital, representing a 20-fold difference.

The optiFLAPP (optimising FLuid And the Peri-operative Pathway in free flap surgery) study ultimately aims to develop an evidence-based ERAS protocol for use in abdominal-based microsurgical breast reconstruction. As a first step, this article reports national practice surveys used to identify clinical variation with respect to all aspects of the perioperative care provided to women undergoing surgery in the UK. This will inform the development of a prospective audit to further evaluate current practice.

Methods

Three distinct surveys were developed by a collaborative group of plastic surgeons and anaesthetists, with an interest

in microsurgical breast reconstruction, to evaluate current practice at each UK hospital undertaking such procedures (Files, Supplementary Digital Content 1, 2, 3 REDCap survey data dictionaries). The lead plastic surgeon for the breast reconstruction service for each unit completed the 'lead clinician' survey. It examined current service provision and local compliance with existing national protocols and guidelines. The 'surgeon' and 'anaesthetist' surveys given to individual consultants focused on key aspects of perioperative care including surgical technique, prescription of fluid, analgesia, antibiotics, venous thromboembolism (VTE) prophylaxis, flap monitoring and clinician and patient-reported assessment of outcomes.

The study used an innovative methodological approach, with the dual aims of improving participation and establishing a national collaborative research network as a basis for future research and trials in plastic and reconstructive surgery. A medical student working group was established and took the lead in recruitment and data collection, with guidance from the steering group. The group first identified every UK NHS hospital providing microsurgical breast reconstruction, using a number of distinct sources to ensure completeness. They then recruited local medical student collaborators through advertisements placed with medical school surgical societies, national societies and relevant plastic surgery websites in the UK.

Medical students piloted the surveys at two sites, the Royal Marsden Hospital, London and Norfolk and Norwich Hospital, Norfolk. Respondents were asked to complete the surveys and provide feedback on both the conduct of the medical student and the questionnaire content and structure. The surveys were amended based on the feedback to aid interpretability and ease of completion.

Medical student collaborators were provided with focused training on the study aims, how to communicate with and engage clinicians, and how to collect data using the survey tool. They were directed to compile a 'denominator' list of eligible clinicians from their hospital before being given the survey links. They approached each of the consultant surgeons and anaesthetists in person, providing them with electronic means with which to complete the survey (e.g. tablet, phone or laptop device).

Study data were collected and managed using REDCap electronic data capture tools hosted at the Kennedy Institute of Rheumatology.⁹ REDCap (Research Electronic Data Capture) is a secure, web-based application designed to support data capture for research studies, providing¹ an intuitive interface for validated data entry;² audit trails for tracking data manipulation and export procedures;³ automated export procedures for seamless data downloads to common statistical packages; and⁴ procedures for importing data from external sources.

Table 1 Plastic surgeon-reported closure of abdominal secondary defect ($n=83$).

Phase of closure	Product	N (%)	
Rectus sheath mesh	No mesh used	27 (34)	
	Mesh (type not reported)	15 (18)	
	Prolene mesh	4 (5)	
	Ultrapro	3 (4)	
	Vipro	2 (2)	
	Parietax	1 (1)	
	Vicryl	1 (1)	
Closure of rectus sheath	Missing	30 (36)	
	Nylon	37 (45)	
	Polydiaxanone	6 (7)	
	Barbed suture	4 (5)	
	Vicryl	2 (2)	
	Ethibond	1 (1)	
	Prolene	1 (1)	
Closure of Scarpa's fascia	Missing	32 (39)	
	Polydiaxanone	23 (28)	
	Vicryl	14 (17)	
	Monocryl	8 (10)	
	Barbed suture	6 (7)	
	Vicryl	2 (2)	
	Missing	21 (25)	
Deep dermal closure	Monocryl	34 (41)	
	Vicryl	10 (12)	
	Barbed suture	7 (8)	
	Polydiaxanone	3 (4)	
	Insorb	3 (4)	
	Missing	26 (31)	
	Monocryl	46 (55)	
Skin closure	Polydiaxanone	3 (4)	
	Barbed suture	2 (2)	
	Vicryl	1 (1)	
	Staples	1 (1)	
	Missing	30 (36)	
	Wound dressing	Tissue glue	9 (11)
		Steri-Strips	8 (10)
Tissue glue and dressing		7 (8)	
Prineo		4 (5)	
Missing		55 (66)	

Data derived from free text responses. Missing data documented where no reference to that part of closure was mentioned in the response.

Results

Collaborators collected survey data between June and December 2016. Nineteen (19/39, 49%) lead clinicians, 82 (82/134, 61%) plastic surgeons and 71 (71/100, 71%) anaesthetists from units across the UK completed the surveys (Supplementary Table 1). One of the largest units declined to take part in the project. The median estimated number of unilateral deep inferior epigastric perforator flaps performed in 2015 by a unit was 60 (IQR 20-79), and 16 (IQR 3-20) for bilateral reconstructions. Summaries of each of the surveys are in Supplementary Tables 2-4.

Pre-operative care

In addition to their clinic appointment, patients most commonly received paper-based information (89%) and the opportunity to meet with a breast care nurse (74%). There was minimal use of the Internet or App-based information provision. Thirty-two per cent of units reported providing detailed information on what a patient should expect on each post-operative day. Patients were usually seen in a nurse-led pre-assessment clinic (84%) rather than anaesthetist-led clinic (11%). Most surgeons (58%) preferred to stop tamoxifen before surgery for a median of 3 weeks before and 2 weeks after surgery. Pre-operative imaging was requested by 92% of surgeons (CTA 67%, MRA 17% and duplex ultrasound 6%). However, surgeons felt they always used the best perforator on the scan only 22% of the time, with 69% reporting using the best perforator 'most of the time.'

Patients were admitted either on the day before surgery (42%), the morning of surgery (37%), or seen on the day before and sent home overnight (16%). Mean predicted post-operative length of stay was 5 days.

On the day of surgery, 30% of surgeons always warmed patients pre-operatively with a forced-air blanket. Most anaesthetists (70%) reported not prescribing pre-emptive analgesia. Forty-one per cent of surgeons and 31% of anaesthetists reported a formal perioperative fluid protocol. Most surgeons (93%) and almost all anaesthetists (94%) did not prescribe intravenous fluids pre-operatively. Most surgeons generally encouraged to drink water (40%). Only 13% of surgeons and 23% of anaesthetists gave a specific oral fluid prescription. For pre-operative VTE prophylaxis, surgeons reported using low molecular-weight heparin (61%), thromboembolic deterrent stockings (45%) and intermittent pneumatic compression devices (16%).

Intraoperative surgical technique

Ninety-three per cent of surgeons preferred the internal mammary vessels as recipients rather than the thoracodorsal axis (7%). To access the internal mammary vessels, 52% always removed costal cartilage and 27% sometimes removed costal cartilage. Most surgeons always coupled the vein (67%) but a sizeable minority reported hand sewing (18%). When performing the anastomosis, the preferred irrigation solution was heparinised saline (87%), but topical vasodilators such as verapamil (29%) and papaverine (22%) were also used. When closing the abdomen, techniques to reduce the dead space were rarely used. Two drains were most commonly placed, and there was a large range of wound closure techniques (Table 1). There was equipoise on use of mesh for rectus sheath closure, nylon suture for rectus fascia, PDS suture for Scarpa's fascia and monocryl suture for deep dermal and subcuticular closure. Most surgeons do not apply an abdominal binder (57%). A majority of both surgeons (67%) and anaesthetists (69%) reported placing an abdominal peripheral nerve block (Supplementary Tables 3 and 4).

Intraoperative drug administration and haemodynamic optimisation

Anaesthetists reported no consensus on the type of anaesthesia used (volatile 37%; total intravenous 39% and combination 24%). Intraoperative haemodynamic assessment showed a range of views on different modalities. Total volume of fluid given was deemed important, but central venous pressure was universally deemed not important (Supplementary Table 4). Anaesthetists preferred Hartmann's solution and reported 2850 mL (min 1000 mL, max 8000 mL, stdev 1024 mL) as the mean volume of intravenous fluid prescribed during a standard case. A majority of surgeons felt vasopressors were never warranted (66%), in contrast to 84% of anaesthetists who reported using them some or all of the time. The most popular agents were metaraminol (61%) and ephedrine (38%).

Most patients had a group and save performed (75%), rather than cross match (12%) or neither (7%). Routine measurement of intraoperative blood loss was split between always (42%) and never (36%). A haemoglobin level between 60 g/L and 80 g/L was the trigger for transfusion.

Post-operative care

The preferred post-operative environment was ward-based care in a designated 'flap' bay or room with an increased nursing ratio. This environment was usually temperature controlled (90%). In addition, the surgical preference was to have direct warming of both flap and patient with a forced-air warmer (66%) rather than the flap alone (5%). A majority of surgeons preferred to discontinue antibiotics post-operatively (53%), but the rest chose to continue them in some form. VTE prophylaxis continued in the form of low molecular weight heparins (LMWH) and thromboembolic deterrent stockings (TEDS). VTE prophylaxis was usually stopped on discharge (44%), but 29% surgeons provide prolonged prophylaxis beyond discharge. Flap monitoring used clinical observation with pencil Doppler as the preferred adjunct. The frequency of flap monitoring decreased with time (Figure 1).

The majority of surgeons placed two abdominal drains and removed them once the output was below a defined volume over 24 h. One-third of surgeons kept a patient in hospital until their drains were removed.

Formal post-operative quality of life surveys were used by 30% of surgeons. Of these, the most common surveys were Breast-Q (17%) and the NHS patient satisfaction survey (30%).

Post-operative intravenous fluid management

The majority of units (60%) did not have a formal protocol for post-operative fluid management. Non-invasive blood pressure monitoring and urine output were used to guide fluid prescribing. The main choice of fluids was Hartmann's solution (80%). Intravenous fluids were stopped on the morning after surgery by 36%, but 54% continued IV fluids beyond this point. Surgeons were divided as to whether a urine output of greater than 2 mL/kg/h was of concern.

Table 2 Anaesthetists-reported preferences for post-operative analgesia (n/N%). Multiple responses allowed.

Analgesic	Regular	PRN	No	Missing
Paracetamol	67 (94)	0 (0)	2 (3)	3 (3)
Patient-controlled analgesia	40 (56)	10 (14)	19 (27)	3 (3)
NSAID (e.g. ibuprofen)	34 (48)	7 (10)	28 (39)	3 (3)
Oral morphine	16 (23)	25 (35)	28 (39)	3 (3)
Gabapentin	13 (18)	2 (3)	54 (76)	3 (3)
Compound analgesic (e.g. co-codamol)	5 (7)	7 (10)	57 (80)	3 (3)
Aspirin	1 (1)	0 (0)	68 (96)	3 (3)
COX-2 Inhibitor (e.g. Celecoxib)	1 (1)	0 (0)	68 (96)	3 (3)

NSAID, non-steroidal anti-inflammatory drug; COX, cyclooxygenase

Post-operative analgesia

Lead clinicians reported that only 31% of units always provided a pain team review for their patients, but it was available in a further 42% if required. Fifty-seven per cent of surgeons and 53% of anaesthetists preferred use of local or regional blocks. Of these, rectus sheath block was the most popular (33%) followed by the transversus abdominis plane (TAP) block (21%). Anaesthetist-reported choice of post-operative analgesia (Table 2) included paracetamol (97% regular, 0% PRN), non-steroidal anti-inflammatory drugs (NSAIDs) (49% regular, 10% PRN), oral morphine (23% regular, 36% PRN), compound analgesics (7% regular, 10% PRN) and patient-controlled analgesia (PCA) (63%).

Discussion

This study identified marked variation in the clinician-reported delivery of perioperative care for women undergoing abdominal-based microvascular breast reconstruction. Some aspects of care differed significantly from the UK Oncoplastic Breast Reconstruction Guidelines for Best Practice,³ the recent ERAS consensus guidelines⁷ and a recent systematic review.¹⁰ (Table 3).

There was variation reported amongst clinicians within units as well as between units. This was difficult to statistically analyse, but there were units in which responses from clinicians were almost entirely the same and others where they varied widely. The reported clinical variation is likely to impact quality of care, cost-effectiveness and patient outcomes. However, for many of the elements it remains unclear what constitutes best practice, owing to the lack of high-quality evidence. For instance, the ERAS consensus guidelines recommended total intravenous anaesthesia (TIVA), owing to less nausea and vomiting, yet a recent evidence-based guideline for microsurgical free-tissue transfer, recommended volatile anaesthesia.¹⁰ The surgical responses for intravenous fluid prescribing and the use of vasopressors reflected an historical view that plenty of intravenous fluid is required to maintain a

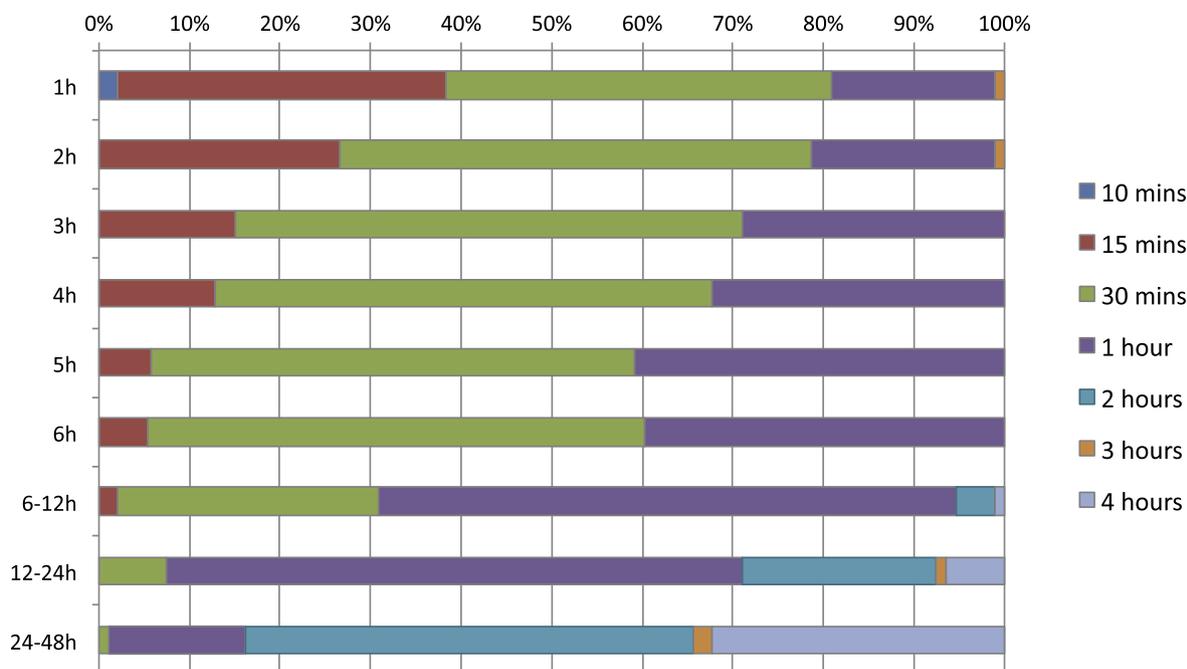


Figure 1 Plastic surgeon-reported frequency of flap monitoring over first 48 h following surgery.

'hyperdynamic' circulation and that vasopressors should be avoided because of the risk of compromising the flap blood supply. Current best evidence suggests excessive intravenous fluid is detrimental and that vasopressor use does not lead to increased flap-related complications.¹¹⁻¹³

Length of stay is often used as an outcome measure. In some ways it reflects the speed of inpatient recovery and availability of post-discharge care and support systems. Along with staffing and operating time, it represents one of the main upfront costs of the procedure. Short hospital stays are preferred by patients, and may reduce hospital-acquired complications (e.g. infections and thromboses) and save the health service money. The median reported length of stay in this study was 5 days. This is at least 2 days longer than the published ERAS protocols, which may themselves be unrealistic. The staffing costs associated with the various protocols will vary. Patients with central lines, PCA and requirement for frequent flap monitoring will consume more nursing time than those without. The direct procedure consumable costs are influenced by anaesthetist and surgical choices. For instance, the cheapest abdominal closure described entailed no use of mesh and simple suture-based closure of the rectus, Scarpa's fascia and skin, without the use of a dressing. The most expensive included routine use of mesh, multiple barbed sutures and a wound dressing device. There is little evidence to support these different closure techniques or indeed the use of dressings specifically.¹⁴ There is an increased risk of abdominal wall hernia following abdominal flap breast reconstruction,¹⁵ and the use of quilting sutures without drains results in shorter hospital stays and fewer seroma.¹⁶

Collection of patient-centred and patient-reported outcome measures (PROMs) has become central to assessing the quality of patient care. The ABS/BAPRAS guidelines recommend the routine collection of PROMs. It was striking

that only 17% of surgeons reported collecting a validated PROM for breast reconstruction. The future use of PROMs and patient-centred outcomes will be crucial for assessing the success of the ERAS protocols. Currently the UK National Flap Registry is using validated PROMs scales from the Breast-Q to address this, but the scales used are limited to breast area appearance rather than the full set of five domains, and participation rates are extremely low.¹⁷

The main limitation of this study was that, as a survey rather than prospective audit, there may have been a degree of reporting bias. However, there was no incentive for clinicians to misrepresent their own practices, and marked variation was identified. Data collection using a national network of medical student collaborators undoubtedly improved participation. However, in places their involvement had a negative impact, with clinicians reluctant to engage with them. There was a hiatus in data collection over the summer vacation period, and it was more difficult to gain responses from hospitals that were geographically remote from a medical school.

We would like to highlight some themes identified in this study that mirror areas of variation identified by previous studies and which appear to have made little progress. These include low uptake of ERAS protocols, limited use of modern multimodal analgesic regimes¹⁸ and abdominal closure with use of drains. Ideally randomised controlled trials should be undertaken within these domains, including of different ERAS protocols. The latter may be challenging, but a prospective audit of the different approaches with the subsequent introduction of a unified protocol would be feasible. A prospective audit would provide real world data on current practice and overcome the various survey-associated biases. Based on our findings and the recent literature, we are developing a proposed protocol as the starting point for a consensus meeting of clinicians and fur-

Table 3 Comparison of optiFLAPP responses with ERAS protocol and ABS/BAPRAS guidelines.

Item	ERAS Society Recommendation	ABS/BAPRAS Recommendations	optiFLAPP experience
Preadmission information, education and counselling	Patients should receive detailed pre-operative counselling.	Patients should receive information in a format and level of detail that meets their individual needs.	In addition to clinic consultation, paper-based information widely used but limited use of electronic resources.
Pre-admission optimisation	For daily smokers, 1 month of abstinence before surgery is beneficial. For patients who are obese, weight reduction to achieve a BMI ≤ 30 kg/m ² before surgery is beneficial. For alcohol abusers, 1 month of abstinence before surgery is beneficial. For appropriate groups, referral should be made to resources for these behavioural changes.	All women should undergo a pre-operative assessment process prior to admission.	All patients attend a pre-admission clinic to prepare them for surgery. BMI and smoking not examined by survey.
Perforator flap planning	If pre-operative perforator mapping is required, CTA is recommended.	No specific guidance.	Pre-operative imaging is performed in 92% patients (CTA 67%)
Perioperative fasting	Pre-operative fasting should be minimised, and patients should be allowed to drink clear fluids up to 2 h before surgery.	No specific guidance.	Most patients are encouraged to drink up to 2 h before surgery.
Pre-operative carbohydrate loading	Pre-operative maltodextrin-based drinks should be given to patients 2 h before surgery.	No specific guidance.	Only 13% of patients given a specific oral fluid prescription for carbohydrate loading.
Venous thromboembolism prophylaxis	Patients should be assessed for venous thromboembolism risk. Unless contraindicated, and balanced by the risk of bleeding, patients at a higher risk should receive low-molecular-weight heparin or unfractionated heparin until ambulatory or discharged. Mechanical methods should be added.	LMWH according to risk factors 12 h prior to surgery (night before operation). TEDS on admission. Leave flowtrons on for first 24 h post-operation. Encourage ankle dorsi/plantar flexion after flowtrons removed. No guidelines for tamoxifen	Most patients receive combined VTE prophylaxis of LMWH and TEDS. Few continue VTE prophylaxis beyond the admission. Most surgeons stop tamoxifen
Antimicrobial prophylaxis	Chlorhexidine skin preparation should be performed and intravenous antibiotics covering common skin organisms should be given within 1 h of incision.	2% chlorhexidine with 70% isopropyl alcohol with tint provides the best skin decontamination. A single intravenous dose of prophylactic antibiotic given on induction of anaesthesia. If the operation lasts longer than 4 h or there is significant blood loss, a second dose may be indicated.	All patients receive induction antibiotics. Forty-five per cent receive antibiotics beyond the procedure.
Post-operative nausea and vomiting prophylaxis	Women should receive pre-operative and intraoperative medications to mitigate post-operative nausea and vomiting.	Propofol infusions, 5HT3 antagonists and a multimodal approach to minimise retching.	Not assessed.
Pre-operative and intraoperative analgesia	Women should receive multimodal analgesia to mitigate pain.	No specific guidance.	30% anaesthetists report prescribing pre-operative analgesia
Standard anaesthetic protocol	General anaesthesia with TIVA is recommended.	No specific guidance.	39% anaesthetists use TIVA; 37% use volatile anaesthesia
Preventing intraoperative hypothermia	Pre-operative and intraoperative measures, such as forced air, to prevent hypothermia should be instituted. Temperature monitoring is required to ensure the patient's body temperature is maintained above 36 °C.	Patient temperature should be carefully monitored. No specific guidance on warming.	A range of measures were reported to prevent hypothermia. Large variation in pre-operative warming and forced-air warming devices.

(continued on next page)

Table 3 (continued)

Item	ERAS Society Recommendation	ABS/BAPRAS Recommendations	optiFLAPP experience
Perioperative intravenous fluid management	Over resuscitation or under resuscitation of fluids should be avoided, and water and electrolyte balance should be maintained. Goal-directed therapy is a useful method of achieving these goals. Balanced crystalloid solution, rather than saline, is recommended. Vasopressors are recommended to support fluid management and do not negatively affect free flaps.	Fluid balance must be carefully monitored and patients kept adequately hydrated.	Goal-directed therapy not widely used. Hartmann's solution was the preferred solution for maintenance and fluid boluses. 84% anaesthetists reported always or sometimes using vasopressors.
Post-operative analgesia	Multimodal post-operative pain management regimens are opioid-sparing and should be used.	A multi-modal approach to analgesia should be considered - options include patient-controlled analgesia, regional techniques, local anaesthetic wound infiltration and a combination of opioid and non-opioid analgesics.	Opioid patient-controlled analgesia widely used. Low use of NSAIDs. Approximately half of clinicians used regional blocks.
Early feeding	Patients should be encouraged to take fluids and food orally as soon as possible, preferably within 24 h after surgery.	No specific guidance.	Not assessed.
Post-operative flap monitoring	Flap monitoring within the first 72 h should occur frequently. Clinical evaluation is sufficient for monitoring, with implantable Doppler devices recommended in cases of buried flaps.	Monitor flap every 30 min for 24 h and hourly thereafter.	Range of flap monitoring protocols. Generally continue for 3 days and surface Doppler used as an adjunct.
Post-operative wound management	For incisional closure, conventional sutures are recommended. Complex wounds following skin necrosis are treatable with debridement and negative-pressure wound therapy.	No specific guidance other than patients should be monitored for complications.	Large variation in abdominal wound closure techniques including the use of barbed sutures and closure devices.
Early mobilisation	Patients should be mobilised within the first 24 h after surgery.	No specific guidance.	Not assessed.
Post-discharge home support and physiotherapy	Early physiotherapy, supervised exercise programs and other supportive care initiatives should be instituted after	Patients should have early access to specialist physiotherapy.	Not assessed.
Patient satisfaction	No specific guidance.	Patients' satisfaction with breast reconstruction outcome should be measured using standardised assessment tools.	Only 30% surgeons report collecting patient reported outcomes

CTA, computed tomography angiography; VTE, venous thromboembolism; LMWH, low molecular weight heparin; TEDS, thromboembolic deterrent stockings; ERAS, enhanced recovery after surgery; ABS, Association of Breast Surgeons; BAPRAS, British Association of Plastic, Reconstructive and Aesthetic Surgeons; TIVA, total intravenous anaesthesia.

ther Patient and Public Involvement (PPI). Analgesic regimes and abdominal closure would probably be amenable to randomised controlled trials. For instance, there is enough cohort data to support a trial of abdominal closure with quilting and no drains versus normal practice and drains.

Conclusions

This study highlights marked variation in the perioperative care of women undergoing abdominal-based microvascular breast reconstruction in the UK. It is likely that other countries experience similar levels of variation. The same surveys are now being completed in The Netherlands for comparison. We have made the data dictionaries freely

available to facilitate this. The optiFLAPP is an important first step in greater sharing of current practice to identify areas for further study. Greater PPI is needed to prioritise the research alongside developing a collaborative approach amongst clinicians to improve the evidence base.

Contributor statement

MDG and AM conceived the project; MDG and RMK formed the steering groups and were involved in every aspect of protocol design and delivery of the project; The optiFLAPP Steering Group developed the surveys, tested surveys and advised on delivery of the project; RMK performed the data analysis; RMK and MDG drafted the manuscript, all mem-

bers of the optiFLAPP Steering Group revised the manuscript and act as guarantors. Members of the Undergraduate Working Group identified units, recruited collaborators, provided training and managed communications. Collaborators identified clinicians and ensured completion of the surveys.

Supplementary digital content

File, Supplemental Digital Content 1, which shows the lead clinician REDCap data dictionary

File, Supplemental Digital Content 2, which shows the plastic surgeon REDCap data dictionary

File, Supplemental Digital Content 3, which shows the anaesthetist REDCap data dictionary

File, Supplemental Digital Content 4, which shows response rates and hospital caseload (not alphabetical)

Table, Supplemental Digital Content 5, which shows lead clinician survey responses

Table, Supplemental Digital Content 6, which shows plastic surgeon survey responses

Table, Supplemental Digital Content 7, which shows anaesthetist survey responses

Acknowledgements

The optiFLAPP steering group would like to thank clinicians at the following hospitals for contributing to the study (alphabetical order): Aberdeen Royal Infirmary, Addenbrooke's Hospital, Broomfield Hospital, Charing Cross Hospital, Derriford Hospital, Glasgow Royal Infirmary, James Cook University Hospital, John Radcliffe Hospital, Leicester Royal Infirmary, Morriston Hospital, Norfolk and Norwich Hospital, Nottingham City Hospital, North Tyneside General Hospital, Queen Alexandra Hospital, Queen Elizabeth Hospital, Queen Victoria Hospital, Royal Devon and Exeter Hospital, Royal Hallamshire Hospital, Royal Marsden Hospital, Royal Stoke Hospital, Royal Victoria Infirmary, Salisbury District Hospital, Southmead Hospital, St George's Hospital, St John's Hospital, Ulster Hospital, University Hospital of North Durham and University Hospital of South Manchester.

Conflict of interest

None.

Funding

None.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.bjps.2018.08.007](https://doi.org/10.1016/j.bjps.2018.08.007).

References

- Jeevan R, Cromwell DA, Browne JP, et al. Findings of a national comparative audit of mastectomy and breast reconstruction surgery in England. *J Plast Reconstr Aesthet Surg* 2014;**67**(10):1333-44.
- Lie KH, Barker AS, Ashton MW. A classification system for partial and complete DIEP flap necrosis based on a review of 17,096 DIEP flaps in 693 articles including analysis of 152 total flap failures. *Plast Reconstr Surg* 2013;**132**(6):1401-8.
- Rainsbury D, Willett A, editors. *Oncoplastic breast reconstruction: guidelines for best practice*. BAPRAS and ABS; 2012. p. 168.
- Sadideen H, Fiddes R, Birch J, Griffiths J. The national variation in peri-operative anaesthetic technique for breast free flap reconstruction in the UK: is it time to define best practice. *Euro J Plast Surg* 2014;**37**(12):653-60.
- Batdorf NJ, Lemaine V, Lovely JK, et al. Enhanced recovery after surgery in microvascular breast reconstruction. *J Plast Reconstr Aesthet Surg* 2015;**68**(3):395-402.
- Afonso A, Oskar S, Tan KS et al. Is enhanced recovery the new standard of care in microsurgical breast reconstruction? *Plast Reconstr Surg* 2017;**139**(5):1053-61.
- Temple-Oberle C, Shea-Budgell MA, Tan M, et al. Consensus review of optimal perioperative care in breast reconstruction: Enhanced Recovery After Surgery (ERAS) Society recommendations. *Plast Reconstr Surg* 2017;**139**(5) 1056e-71e.
- Briggs TW. *Getting it right first time. Improving the quality of orthopaedic care within the National Health Service in England*. Health Service in England; 2012.
- Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)-a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform* 2009;**42**(2):377-81.
- Motakef S, Mountziaris PM, Ismail IK, Agag RL, Patel A. Emerging paradigms in perioperative management for microsurgical free tissue transfer: review of the literature and evidence-based guidelines. *Plast Reconstr Surg* 2015;**135**(1):290-9.
- Brinkman JN, Derks LH, Klimek M, Mureau MAM. Perioperative fluid management and use of vasoactive and antithrombotic agents in free flap surgery: a literature review and clinical recommendations. *J Recon Microsurg* 2013;**29**(6):357-66.
- Chen C, Nguyen M-D, Bar-Meir E, et al. Effects of vasopressor administration on the outcomes of microsurgical breast reconstruction. *Ann Plast Surg* 2010;**65**(1):28-31.
- Szabo Eltorai A, Huang C-C, Lu JT, Ogura A, Caterson SA, Orgill DP. Selective Intraoperative vasopressor use is not associated with increased risk of DIEP flap complications. *Plast Reconstr Surg* 2017;**140**(1):70e-77e.
- Blazeby JBluebelle Study Group. Do dressings prevent infection of closed primary wounds after surgery. *Br Med J* 2016;**24**:353:i2270.
- Mennie JC, Mohanna P-N, O'Donoghue JM, Rainsbury R, Cromwell DA. Donor-site hernia repair in abdominal flap breast reconstruction: a population-based cohort study of 7929 patients. *Plast Reconstr Surg* 2015;**136**(1):1-9.
- Mohan AT, Rammos CK, Gaba P, et al. Modified aesthetic abdominoplasty approach in perforator free-flap breast reconstruction: impact of drain free donor site on patient outcomes. *J Plast Reconstr Aesthet Surg* 2015;**68**(6):800-9.
- Hazari A, Walton P. The UK National Flap Registry (UKNFR): A National Database for all pedicled and free flaps in the UK. *J Plast Reconstr Aesthet Surg* 2015;**68**(12):1633-6.
- Cheng GS, Ilfeld BM. An evidence-based review of the efficacy of perioperative analgesic techniques for breast cancer-related surgery. *Pain Med* 2017;**18**(7):1344-65.