Initial UK experience with transversus abdominis muscle release for posterior components separation in abdominal wall reconstruction of large or complex ventral hernias: a combined approach by general and plastic surgeons

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ABSTRACT

INTRODUCTION Large, complicated ventral hernias are an increasingly common problem. The transversus abdominis muscle release (TAMR) is a recently described modification of posterior components separation for repair of such hernias. We describe our initial experience with TAMR and sublay mesh to facilitate abdominal wall reconstruction.

METHODS The study is a retrospective review of patients undergoing TAMR performed synchronously by gastrointestinal and plastic surgeons.

RESULTS Twelve consecutive patients had their ventral hernias repaired using the TAMR technique from June 2013 to June 2014. Median body mass index was 30.8kg/m² (range 19.0–34.4kg/m²). Four had a previous ventral hernia repair. Three had previous laparostomies. Four had previous stomas and three had stomas created at the time of the abdominal wall reconstruction. Average transverse distance between the recti was 13cm (3–20cm). Median operative time was 383 minutes (150–550 minutes) and mesh size was 950cm² (532–2400cm²). Primary midline fascial closure was possible in all cases, with no bridging. Median length of hospital stay was 7.5 days (4–17 days). Three developed minor abdominal wall wound complications. At median review of 24 months (18–37 months), there have been no significant wound problems, mesh infections or explants, and none has developed recurrence of their midline ventral hernia. Visual analogue scales revealed high patient satisfaction levels overall and with their final aesthetic appearance.

CONCLUSIONS We believe that TAMR offers significant advantages over other forms of components separation in this patient group. The technique can be adopted successfully in UK practice and combined gastrointestinal and plastic surgeon operating yields good results.

KEYWORDS

Transversus abdominis muscle – Ventral – Hernia

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Introduction

Incisional hernias are a common problem. Ventral abdominal wall hernias affect up to 50% of patients who have undergone a previous laparotomy.^{1–6} Emergency surgery, stoma formation and wound infection allied to comorbidity such as chronic lung disease, obesity, steroid therapy, diabetes, malnutrition and immunosuppressant therapy, are all recognised predisposing factors.⁷ Over and above these risk factors,

advances in the management of critically ill surgical patients in intensive care have meant that those patients who might not have previously survived their initial abdominal catastrophe are now presenting with large complex hernias, with or without laparostomies or stomas, after recovery from their critical illness. Even in the absence of intestinal failure or enterocutaneous fistulas, these patients often require further corrective abdominal wall and intestinal surgery, either with bowel resection or stoma closure. When combined with

intraoperative disease as well as underlying comorbidity including COPD and increased body mass index, these large complicated ventral hernial defects have led to new surgical challenges, even for experienced abdominal surgeons.

A new technique of posterior components separation allied to sublay mesh placement for the repair of large ventral hernias was described in 2012 by Novitsky *et al.*⁸ In this paper, we describe the initial UK experience with this technique. We emphasise the benefit of a combined gastrointestinal and plastic surgical approach and the advantages of the technique in our hands over the traditional sublay mesh augmented by anterior components separation technique as described and popularised by Ramirez *et al.*⁹

Materials and Methods

A retrospective review was performed of a prospectively maintained database of consecutive patients undergoing TAMR technique from June 2013 to June 2014. Data collected included patient demographics, comorbid factors including smoking, body mass index (BMI), previous surgical procedures, number of previous hernia repairs, size of hernias and the Ventral Hernia Working Group (VHWG)¹⁰ grading of hernia (Table 1). Intraoperative data included use of epidural analgesia, operative time and size/type of mesh. Postoperatively, details of immediate complication, length of hospital stay and follow up were additionally recorded.

Preoperatively, each patient was reviewed by both a gastrointestinal surgeon (MHS or CJW) and a plastic surgeon (KH). Computed tomography (CT) was performed to evaluate size of the abdominal wall defect(s), the remaining abdominal wall musculature and allied intra-abdominal pathology, including any existing mesh. In all cases, surgery was performed by a gastrointestinal surgeon working alongside the plastic surgeon.

At planned review, patients were assessed clinically for any recurrence of their ventral abdominal wall hernia in the

supine and standing positions (CJW, NDA, MHS or KH) and were asked to independently complete two visual analogue scales from 0 to 100: first, regarding patient overall satisfaction and second, their final aesthetic appearance.

TAMR surgical technique

A full midline incision is made and the old wound excised. In patients who have had a previous laparotomy, the skin is infiltrated with a 1:100,000 adrenaline solution. The whole scar is excised and the skin is then dissected and carefully peeled off the underlying bowel loops. Adhesiolysis is performed with complete mobilisation of bowel loops from the parietal peritoneum, to allow complete separation from the posterior abdominal wall components.

Any existing mesh from a previous repair is removed as best as possible. Any mesh fixation tacks from previous laparoscopic hernia repairs are noted because they violate inter-muscular planes and the associated scarring, making the tissue planes more difficult to separate and dissect. Whatever concomitant intraoperative surgery is required, be that colectomy, reversal of Hartmann's procedure, cystectomy and so on, is performed first. In cases requiring stoma formation (ileostomy, colostomy or ileal conduit formation), the bowel is prepared but the stoma is not matured until after abdominal wall mobilisation.

On completion of any intraoperative surgery, the abdominal wall repair is begun. The technique is as described by Novitsky *et al.*⁸ and beautifully illustrated in Rosen's atlas of abdominal wall reconstruction.¹¹ In short, the retromuscular plane is entered on both sides of the midline wound by dividing the posterior rectus sheath 0.5 cm from its medial border. This is extended for the full length of the laparotomy incision. Dissection continues laterally towards the linea semilunaris found at the lateral border of the rectus muscle. The transversus abdominis muscle is then exposed in the upper abdomen by incising the posterior rectus sheath 0.5 cm medial to the linea semilunaris, thus sparing the neurovascular bundle. The transversus muscle is then divided (TAMR) to uncover the underlying transversalis fascia/peritoneum. It is in this plane, between the transversus abdominis and the transversalis fascia/peritoneum, that the dissection is continued as far laterally as the psoas muscle, superiorly above the costal margin and inferiorly to the myopectineal orifice.

Once the TAMR is completed bilaterally, the posterior rectus sheath/transversalis can be completely medialised to permit tension-free suture in the midline. A mesh is then placed in this large retromuscular plane, being simply tacked in the cephalad, caudal and lateral extents of the wound. A variety of different meshes were used in the early experience of this new technique. In the presence of contamination, previous infection with a resistant organism or the requirement of concomitant bowel surgery, we preferred either a biological or non-biological synthetic absorbable mesh, but polypropylene mesh was used in two cases. Finally, after insertion of two closed suction drains, the anterior midline fascia or linea alba is also closed primarily with a continuous absorbable loop monofilament suture with

Table 1 Ventral Hernia Working Group grading of hernia (adapted from Breuing *et al.*)¹⁰

Grade	Definition	Description
1	Low risk	Low risk of complications No history of wound infection
2	Comorbid	Smoker Obese Diabetic Immunosuppressed Chronic obstructive pulmonary disease
3	Potentially contaminated	Previous wound infection Stoma present Violation of the gastrointestinal tract
4	Infected	Infected mesh Septic dehiscence

little or no tension. Attention is paid to careful approximation of the subcutaneous fat and the skin is closed by subcutaneous suture.

Results

Between June 2013 and June 2014, 12 consecutive patients had large or complicated ventral abdominal wall hernias repaired using the TAMR technique. Preceding operations, which had resulted in ventral hernia formation, and previous unsuccessful hernia repairs are summarised in Table 2.

The preoperative VHWG grading, defect size (measured as maximum distance between the recti (cm) on CT, concomitant surgery at time of hernia repair and mesh size are displayed in Table 3. Median age at surgery was 61.5 years (range 38–71 years) with the gender distribution revealing a predominance of men (75%) over women.

In terms of comorbid risk factors, one patient had diabetes, one had chronic lung disease and another had a history of myocardial infarction. Current smokers were not operated on and so none of the patients was a current smoker. Three were ex-smokers. Median BMI was 30.8 kg/m² (range 19–34.4 kg/m²). Five patients had previous hernia repairs with mesh, one of whom had their hernia repaired twice, both times performed laparoscopically (Table 2).

Following initial scar excision and adhesiolysis, five patients had existing mesh removed. In addition to TAMR, four patients underwent concomitant intraperitoneal surgery (Table 3). Patient 1 required a radical cystoprostatectomy, block dissection of pelvic lymph nodes and ileal conduit urostomy formation for recurrence of bladder cancer. Patient 4 required a Hartmann's procedure and formation of end colostomy for an obstructing ischaemic stricture of the sigmoid colon that had developed following a previous emergency open abdominal aortic aneurysm repair. Patient 11 underwent a concurrent completion proctectomy with reformation of his end ileostomy, following his initial emergency subtotal colectomy, end ileostomy and mucous fistula for fulminant colitis. Following this emergency surgery, the patient required reoperation for small-bowel obstruction with subsequent wound dehiscence and laparostomy. A prophylactic appendectomy was performed on patient 12 owing to the high retrocaecal position of the appendix.

In terms of size of defect, the median preoperative transverse distance between the recti was 13.0 cm (range 3.1–19.9 cm). All but one patient had a VHWG grade of 3 or 4. This grading system stratifies patients according to risk of postoperative complication following hernia repair but does not take into account size of ventral hernia, notable for patient 9, who had a ventral hernia defect size measured on

Table 2 Previous operations and hernia repairs on patients undergoing transversus abdominis muscle release

Patient	Previous operations	Previous hernia repairs
1	Laparotomy for peritonitis secondary to appendicitis	0
2	Anterior resection for colovesical fistula; Hartmann's procedure for anastomotic leak; reversal of Hartmann's with covering loop ileostomy; reversal of ileostomy	0
3	Open cholecystectomy	2 laparoscopic incisional hernia repairs
4	Emergency open abdominal aortic aneurysm (AAA) repair; laparostomy	Laparostomy wound closure with prolene mesh
5	Hartmann's procedure for perforated diverticular disease; reversal of Hartmann's	0
6	Right hemicolectomy for locally advanced cancer; emergency laparotomy for intra-abdominal abscess	0
7	2 caesarean sections, hysterectomy and laparotomy for evacuation of haematoma	0
8	Laparoscopic cholecystectomy to open midline laparotomy for haemorrhage	Midline laparotomy and mesh repair
9	Suction hysterectomy converted to midline laparotomy for haemorrhage	Midline laparotomy, adhesiolysis and onlay repair of multiple hernias
10	Polyhydramnios and divarication of recti	0
11	Subtotal colectomy, end ileostomy and mucous fistula; reoperation for small bowel obstruction, wound dehiscence and laparostomy	0
12	Perforated Meckel's diverticulum, small bowel resection; elective laparoscopic incisional hernia repair, iatrogenic bowel injury, laparotomy formation of proximal loop jejunostomy, distal loop ileostomy and laparostomy; reversal of double barrelled stomas	Laparoscopic incisional hernia repair

Table 3 Patients preoperative Ventral Hernia Working Group (VHWG) grading,¹⁰ defect size, concomitant surgery and mesh size

Patient	VHWG grading	Defect size (cm)	Concomitant surgery	Mesh size (cm)	Mesh type
1	4	14.1	Radical cystoprostatectomy and ileal conduit, block dissection of pelvic lymph nodes	40 × 50	Porcine mesh
2	4	9.6	0	20 × 30	Porcine mesh
3	3	12.6	0	45 × 30	Monofilament synthetic
4	4	13.3	Hartmann's procedure	40 × 50	Porcine mesh
5	4	15.6	0	60 × 40	Porcine mesh
6	4	19.9	0	19 × 35	Acellular dermal mesh
7	3	9.6	0	19 × 28	Acellular dermal mesh
8	4	8.0	0	25 × 20	Acellular dermal mesh
9	4	3.1	0	30 × 30	Monofilament synthetic
10	1	7.0	0	30 × 30	Polyglactin mesh
11	4	16.0	Completion proctectomy and formation of end ileostomy	40 × 25	Porcine mesh
12	3	18.0	Appendicectomy	35 × 50	Porcine mesh

CT as 3.1cm. This particular patient had an intra-abdominal complication following suction hysterectomy, a second laparotomy with onlay mesh repair of multiple small hernias followed by repeated ultrasound guided drainage of seromas. TAMR was performed for midline abdominal wall failure after recurrence of multiple small hernias following removal of mesh and debridement of seroma cavity.

Of the twelve cases, six had a porcine mesh, three had acellular dermal matrix meshes, two had monofilament synthetic meshes and one had an absorbable polyglactin mesh inserted. Median size of mesh was 950 cm² (range 500–2400cm²) and median operative time was 383 minutes (range 150–550 minutes). All patients were given antibiotics on induction and six had epidurals inserted. There were no major intraoperative complications and no patients required blood transfusion.

Postoperatively, every patient had physiotherapy and was provided with an abdominal binder to wear. One developed a superficial wound infection, which was treated with antibiotics, and one developed a small seroma, which, again, was treated conservatively. Median length of hospital stay was 7.5 days (range 4–17 days).

Two patients required readmission following their surgery. Patient 1, who underwent the concurrent cystoprostatectomy, pelvic lymph node dissection and ileal conduit, developed small bowel obstruction 1 month following discharge, which was managed conservatively. Four months later, he was diagnosed as having a pelvic collection, which had discharged via the lower aspect of the skin wound and required surgical drainage. Patient 11 (completion proctectomy and reformation of end ileostomy) required readmission twice for small bowel obstruction, which was treated conservatively on both occasions.

At median review of 24 months (18–37 months), there were no significant wound problems, mesh infections or explants. On clinical assessment in the supine and standing positions, there was no evidence of recurrence of the midline ventral abdominal wall hernias. Visual analogue scales (0–100) were used to evaluate both patients overall satisfaction and their final aesthetic results. Mean overall satisfaction was scored at 90/100 and median final aesthetic appearance was 85/100 (Fig 1).

Of those who underwent concomitant surgery, patient 1 developed a para-urostomy hernia at 28 months and patient 11 had a para-ileostomy hernia at the 31-month review. However, patient 4 showed no clinical evidence of a parastomal hernia of their end colostomy at 2 years. None of these patients had a recurrence of their ventral hernia repair.

Discussion

Large ventral hernias are being seen as an increasingly common complication following laparotomy and laparoscopy in particular. The increasing BMI in the population, allied to advances in intensive care and the management of critically ill surgical patients, including the use of laparoscopy, have led to further challenges, as patients who might otherwise not have survived their initial abdominal catastrophe are now presenting with large complex hernias.

These hernias are often found in patients who have had previous intestinal failure following abdominal catastrophe or after complicated redo surgery or aortic reconstructive surgery. The decision regarding further surgery on such an individual with a potentially hostile abdomen and high perioperative risk can be a difficult to make, particularly if they were to have a high likelihood of recurrence. Consequently,

Figure 1 Visual analogue scales; crosses represent all patient responses

many patients in the past may have been turned down for reconstructive surgery. However, these hernias can have a pronounced effect on function and quality of life, with patients having to modify their lifestyle, even changing or giving up employment.² A proportion will require emergency surgery for incarceration or obstruction¹² and others will require surgery for their intra-abdominal pathology and will need an exit strategy from the abdomen with a high likelihood of success.

Previously described reparative techniques have been associated with high failure rates, with recurrence being highest for primary suture repair, followed by open mesh and laparoscopic mesh repair.⁶ During the RICH Study,¹³ when large contaminated ventral hernias were repaired with a biological mesh using the bridging technique, recurrence rates were as high as 37.5%. Nockolds *et al*,¹⁴ after a median follow-up of 17 months (range 2–48 months), found a recurrence rate of 13% when using the anterior components separation technique to repair complex VHWG grade 3 and 4 hernias. Consequently, a dependable and durable method of repair is required for the considerable challenge that these hernias can pose.

The retro rectus Rives–Stoppa approach,^{15–17} which uses the plane between the rectus muscle and the posterior rectus fascia, was historically seen as an effective technique for open ventral abdominal herniorrhaphies. However, owing to the anatomical restriction of the lateral border of the posterior rectus sheath, this method is limited to repairing smaller abdominal wall defects. This retro rectus approach can be augmented by components separation to facilitate medialisation of the recti. The classical components

separation technique, as described and popularised by Ramirez *et al*,⁹ is an anterior components separation and, arguably according to Halvorson,¹⁸ a modification of a technique described by Young from Warrington (UK) in 1961.¹⁹

The anterior technique, which uses releasing incisions in the external oblique fascia, with or without posterior rectus sheath release, has drawbacks. The first is the need to mobilise the skin and subcutaneous fat off the fascia, interrupting skin blood supply from the perforator branches from the epigastric vessels which supply the overlying skin and subcutaneous fat. This is particularly important in patients who have had previous subcostal incisions or stoma formation. The second is the limited amount of medialisation of the recti that is possible, which is 16 cm at most (2×8 cm) in the mid-portion of the abdomen, even if posterior rectus sheath incisions as described by Ramirez⁹ in his original paper are added to the external oblique incisions.²⁰ In practice, the relative ischaemia of the subcutaneous tissues with resultant wound breakdown and infection and the restricted medialisation means that larger defects, most particularly in the upper abdomen, cannot be approximated and require bridging with a mesh. Both of these factors lead to a higher incidence of recurrence.¹⁵

In order to gain further mobility of the rectus sheath, Carbonell *et al*,²¹ introduced the concept of posterior components separation. This involved extending the retromuscular plane laterally between internal oblique and transversus abdominis. Opening this lateral intermuscular plane allowed increased mobility of the abdominal wall musculature and placement of a sublay mesh following reconstruction of the linea alba in the midline. Novitsky *et al*⁸ further modified this technique of posterior components separation using TAMR. TAMR enables significant advancement of the posterior rectus fascia with the creation of a wide lateral space for the insertion of a sublay mesh. Almost unbelievably, it is ultimately possible to achieve a primary suture of both the posterior sheath and the midline linea alba fascia anteriorly. The neurovascular bundles are preserved and there is no subcutaneous tissue undermining.

This paper does not address the vexed question of the type of mesh that should be used in the sublay position between the primary closure of the posterior and anterior sheaths. It is a retrospective review of our 'real world' practice at the time. The type of mesh was chosen on a case by case basis. In general, in the presence of contamination, previous infection with a resistant organism or the requirement of concomitant bowel surgery, we preferred the use of either a biological or non-biological synthetic absorbable mesh. That being said, two patients with VHWG grade 3–4 had polypropylene mesh inserted without any particular problem in this follow-up period.

While there are no randomised control trial data regarding TAMR, Novitsky *et al*,²² from their single specialist hernia unit in the USA, have published their outcomes of 347 patients at mean follow-up of at least 1 year, showing a recurrence rate of 3.7%. Our 2-year results appear favourable when compared with those described in the current world literature, recently reviewed by Jones *et al*,²³ who report the 2-year recurrence rate as being around 5%.

Understandably higher rates of recurrence are seen for TAMR, with simultaneous take down of enterocutaneous fistulae at 21%²⁴ and a 15% recurrence rate for those patients requiring repair following an open abdomen.²⁵

It should be noted that the TAMR technique does facilitate formation of stomas with the trephine being made through the transversalis fascia, the sublay mesh and then the anterior fascia or rectus, as appropriate for accurate stoma siting. However, in our series of the three patients requiring stomas, although there was no recurrence of their ventral hernia, two parastomal hernias were found at 28- and 31-month review (para-urostomy and para-ileostomy, respectively).

Conclusions

We have described the first UK experience of this technique, originally described in a large, tertiary, high-volume US hernia centre with recognised expertise. We have demonstrated that the technique is transferable to standard UK practice with very acceptable clinical results alongside high levels of patient overall satisfaction and final aesthetic outcomes. We believe that this technique of retromuscular mesh with posterior components separation using TAMR offers a high quality repair for patients with large, complicated ventral hernias.

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