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HOW-I-DO-IT

Endoscopic anterior component separation: a novel technical approach

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Abstract
Purpose Open anterior release of the external oblique fascia to enable midline closure of large abdominal wall defects is associated with relevant morbidity due to extensive subcutaneous dissection. Using endoscopic techniques, wound complications can be minimized. However, identification of the correct entry point (e.g. for balloon trocar insertion) can be challenging especially in adipose patients. We therefore present a technical modification facilitating the entire procedure.
Methods A novel technique for endoscopic anterior component separation using a trocar system allowing blunt and sharp dissection under direct vision is described. This brief communication also contains our initial experience and learning curve with this novel approach.
Results Endoscopic release of the external oblique fascia was successfully performed 29 times in a total of 15 patients. Body mass index accounted for 30.8 kg/m^2 (median; range 21.6–42.5). Transverse width of midline defect accounted for 7 cm (median; range 4–12). Subsequent hernia repair was successfully done using sublay mesh reinforcement ($n = 13$) or a laparoscopic intraperitoneal onlay mesh procedure ($n = 2$) with midline closure in all cases. One hematoma was seen at site of release managed conservatively.
Conclusions Using a trocar system allowing blunt and sharp dissection under direct vision may be a viable option for the endoscopic anterior component separation.

Keywords Endoscopic component separation · Ventral hernia repair

Introduction

Release of the external oblique fascia (EOF) to enable midline closure of ventral abdominal defects was first described by Albanese in 1966 [1]. Ramirez and colleagues popularized the technique in 1990 to cover large abdominal wall defects without prosthetic mesh reinforcement [2]. However, due to the extensive subcutaneous dissection, wound complications such as skin necrosis, infection, hematoma or seroma are seen in up to 47% of patients [3–5]. Using an endoscopically assisted approach these problems can be minimized. Commonly, an incision is made lateral to the rectus sheath and a balloon is introduced and inflated above [6, 7] or beneath [8] the EOF. On the one hand, this manoeuvre may cause diffuse bleeding or lead to rupture of anatomical planes. On the other hand, especially in adipose patients, larger incisions may be necessary in order to expose the EOF. This in turn may lead to leakage of air during later endoscopic dissection, resulting in an unstable field of operation and fogging of the lens. In addition, dissection between camera and working trocars to complete the release can be challenging due to inverse movements of instruments heading towards the camera.

We report a novel technique that reduces the aforementioned problems by using a trocar system thus permitting blunt and sharp dissection for the release of EOF under direct endoscopic vision.

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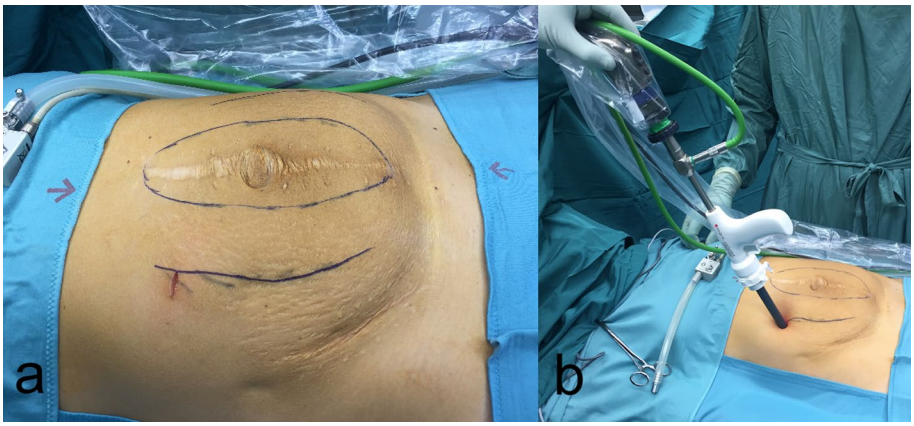

Fig. 1 The hernia site and the lateral border of the rectus sheath are marked. A 10 mm skin incision is made beneath the costal arch on patient's right side (**a**). The Visiport™ Plus containing a 10 mm 0° optic is introduced (**b**) using blunt and sharp dissection to expose the external oblique fascia

Surgical technique

The patient is placed in supine position with both arms fixed along to the table. The endoscopic unit is positioned at the patient's feet. The surgeon is standing on site of release with the assistance placed contralateral. The lateral border of the rectus sheath is preoperatively marked using ultrasound. A 10 mm long skin incision is made lateral to the marked line beneath the costal arch. The Visiport™ Plus (Medtronic plc, Dublin, Ireland) containing a 10 mm 0° optic is introduced (Fig. 1a, b). Using blunt and sharp dissection the Visiport™ Plus is advanced deep to the external oblique fascia (Fig. 2a, b). Incision of the EOF is done by pulling the trigger at the flimsy yellow shining area just medial to the muscular part of the external oblique fascia (Fig. 3a). Transection is performed a few centimetres to caudal (Fig. 3b). After removing the trocar cannula and switching to a 5 mm 30° optic using an optic adapter (Karl Storz GmbH & Co. KG, Tuttlingen, Germany), carbon dioxide is insufflated at 12 mm of mercury. A second 5 mm trocar is inserted between the already dissected edges of the EOF under direct vision. The fascia is released to the groin and up over the costal arch using monopolar scissors (Fig. 4). If necessary, a second 5 mm working trocar is inserted into the groin to facilitate complete release and dissection over and above the costal arch (Fig. 5). An additional monitor placed at the head of the patient facilitates this step of procedure. A suction drain at the lateral compartment is not used routinely.

Finally, repair of the incisional ventral hernia is done using either an open approach with sublay mesh reinforcement or a laparoscopic IPOM (IntraPeritonealOnlayMesh) procedure with laparoscopic closure of the midline defect.

Results

Between February 2015 and October 2016 in a total of 15 patients uni- ($n = 1$) or bilateral ($n = 14$) endoscopic anterior component separation was done using the aforementioned technique. Patients' demographic including ASA (American Society of Anaesthesiologists) score and perioperative characteristics are listed in Table 1. Transverse width of herniation was preoperatively measured using ultrasound or CT scan. Outcome data are presented in Table 2. Complications were classified as proposed by Dindo et al. [9].

This series contains our learning curve with the new technique. During the first eight cases we twice missed the appropriate position of first division of EOF: in one case

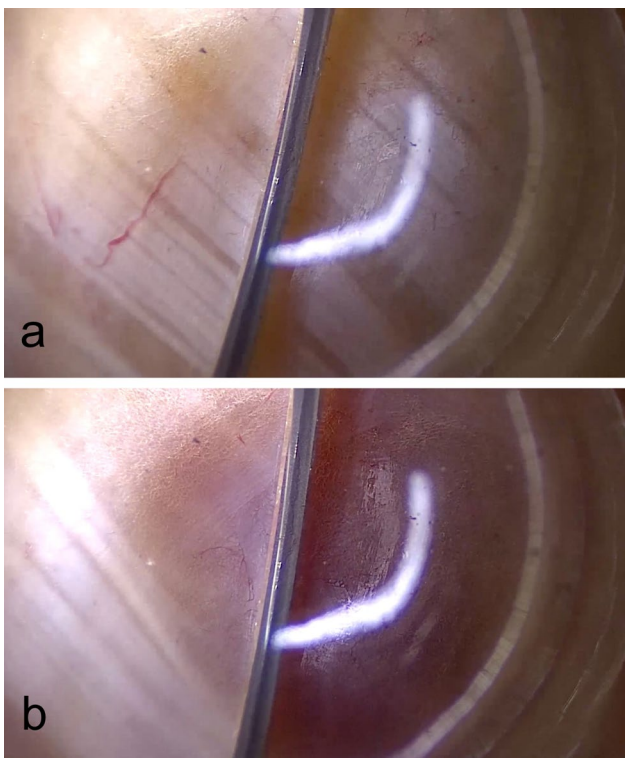

Fig. 2 A "flimsy yellow shining area" (**a**) becomes visible medial adjacent to the external oblique muscle shining through the fascia (**b**). This area is the perfect entry point for the initial cut

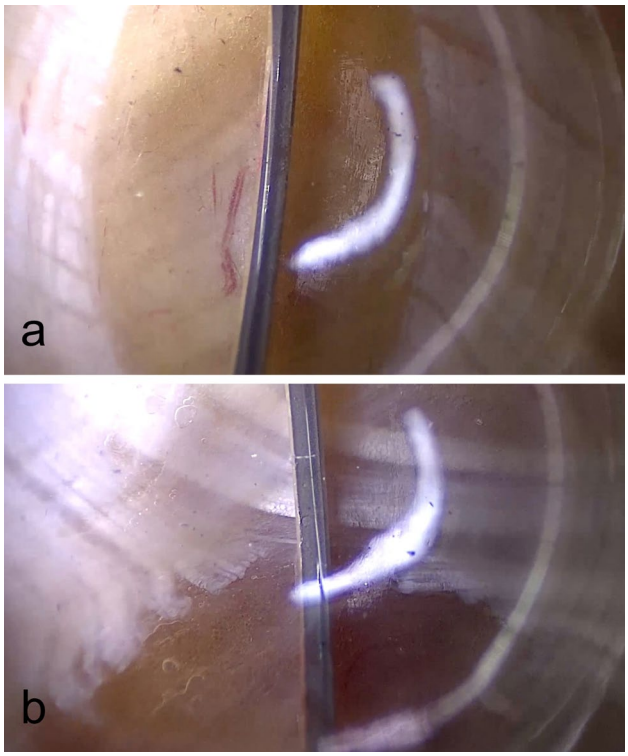

Fig. 3 The external oblique fascia is severed with the Visiport™ Plus (**a**). The fibres of the internal oblique fascia underneath (running in different direction) become visible. Next, the external oblique fascia is dissected a few centimetres to caudal (**b**)

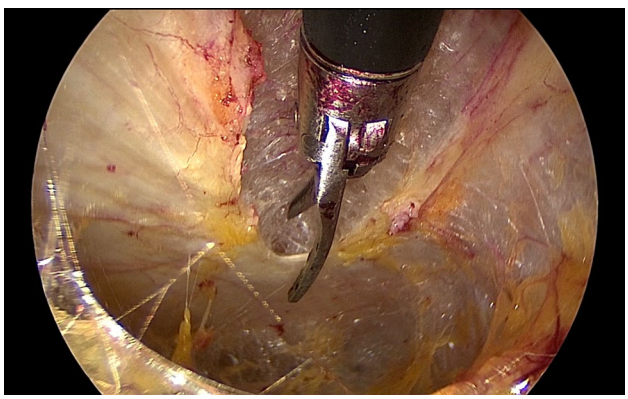

Fig. 4 Monopolar scissors are used to complete dissection of external oblique fascia and perform the release between the internal and external oblique fascia and muscle

the external oblique muscle and in one other case the rectus sheath was entered accidentally prior to correct release of the EOF a few seconds later. Upon review of all videos we recognized that medially (at the level of the rectus sheath) the fascia is whiter and dense; laterally the external

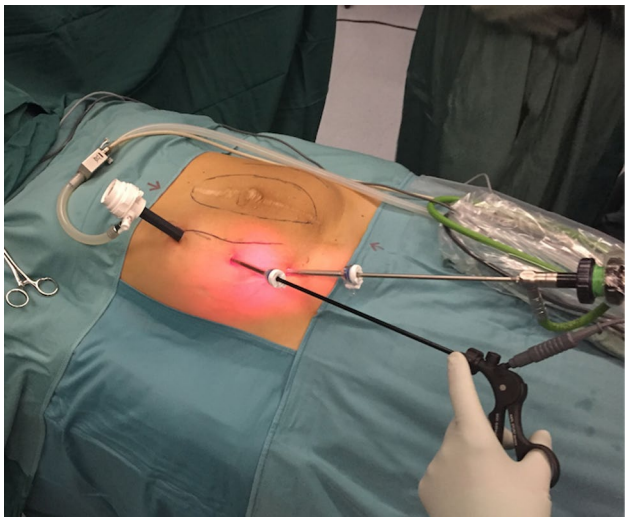

Fig. 5 If necessary, a second 5 mm working trocar can be introduced into the groin to facilitate the release over and above the costal arch

Table 1 Demographic data and perioperative characteristics of patients undergoing endoscopic anterior component separation

Demographic and perioperative data	
Male/female	12/3
Age (years)	66 (40–76)
BMI (kg/m^2)	30.8 (21.6–42.5)
ASA score	2 (1–4)
Size of defect (transverse width, cm)	7 (4–12)
Uni-/bilateral release	1/14
Sublay/IPOM	13/2
Drain (yes/no)	10/19

oblique muscle shines through in red (Fig. 2b). In between a flimsy yellow shining area becomes visible, showing the perfect entry point for the release (Fig. 2a). Identification of this area using the trocar system was possible in all remaining patients and no intraoperative adverse events were experienced since then.

Ten times (10/29; 34.5%) a suction drain was inserted at the site of release. Postoperative hematoma was observed once in a patient where a drain was present and removed on postoperative day (POD) five. This complication was managed conservatively. No surgical site infection (SSI) was recorded at the site of release. However, at the laparotomy site two SSIs and one hematoma were seen following sublay mesh repair, requiring operative revision. Finally, bowel obstruction was observed in one additional case, resulting in an overall complication rate of 33.3% (5/15). No mesh had to be removed.

Table 2 Complications and postoperative data are listed

Complications and postoperative data		Clavien–Dindo
Entry point missed initially	2/29 (6.9%)	–
Hematoma		
Site of release	1/29 (3.4%)	I
Laparotomy site (sublay)	1/13 (7.7%)	III
Trocar site (IPOM)	0/2 (0.0%)	–
SSI		
Site of release	0/29 (0.0%)	–
Laparotomy site (sublay)	2/13 (15.4%)	III
Trocar site (IPOM)	0/2 (0.0%)	–
Bowel obstruction	1/15 (6.7%)	IV
Duration of hospital stay	7 (2–22)	

Discussion

Open anterior component separation for the repair of large ventral incisional hernias is associated with relevant morbidity [3–5]. Minimally invasive assisted techniques can reduce operative trauma and preserve the vasculature of the abdominal wall, thus resulting in significantly fewer wound-healing complications [10]. Various approaches have been described: some use additional small incisions lateral to the rectus sheath for exposure and dissection of the EOF under direct [11] or endoscopic view [6–8]. Others create horizontal subcutaneous access tunnels to reach and release the EOF while preserving perforator blood supply via epigastric and intercostal arteries [12]. However, only the endoscopic approach enables excellent visualisation of anatomical planes and complete separation between the internal and external oblique fascia and muscle. Of note, using the minimally invasive approach only a shorter length of abdominal wall can be gained as compared to formal open anterior component separation. Rosen et al. performed an animal study addressing this issue [13]. An average of 86% could be gained using the endoscopic vs open anterior release. Nevertheless, the advantages of the endoscopic procedure outweigh this potential disadvantage.

We favour preoperative marking with ultrasound over median laparotomy and palpation of the rectus sheath with one's hand. With the skin and subcutaneous tissue left on the abdominal wall (as done when performing endoscopic anterior release) identification of the entry point by digital means can be difficult or even impossible. Especially in adipose patients, relative movements of ultrasound marks on skin and actual lateral border of the rectus sheath also depend on positioning of patients on the operating table. However, size matters with regard to the lateral access for exposure of the EOF and introduction of a (e.g.) space maker balloon into the correct plane [6–8]. A larger incision may lead to leakage of air causing an unstable field of operation and fogging of the lens during endoscopic release. The Visiport™ Plus allows blunt and sharp dissection, thus eliminating these problems: distinct exposure of the underlying structures is possible without soiling or fogging the lens as the 10 mm optic is protected by the acrylic glass of the port system (Fig. 2). The exact entry point of the release can easily be identified with our technique, and position correction can be done deep down at the level of the fascia without enlarging the skin incision for better exposure. Moreover, diffuse bleeding or rupture of planes or organs—a potential complication of balloon dissection—can be avoided [14]. The technique described is limited to the use of an optical trocar system making cutting under direct vision possible.

The described port system further enables dissection around the entry point (Fig. 3b). This manoeuvre facilitates insertion of additional trocars as no fascia, but only subcutaneous fatty tissue is passed. As a result, not a single trocar-associated complication was seen in this series. Thereafter, dissection between camera and working trocars is facilitated as inverse movements of instruments heading towards the camera can be avoided.

Approaching the lateral compartment first provides the advantage of ensuring a stable operating field. However, component separation is performed before evaluating whether it is necessary at all. In general, closure of the midline defect should be aimed for combined with mesh reinforcement to reduce the rate of recurrence. However, deciding which type of reconstruction should be performed depends not only on size and location of hernia but also on the patient's characteristics and compliance of abdominal wall. Taking all available information into account, reduction of tension was assessed to be beneficial in every single case in this series. Finally, there is no data suggesting that subsequent herniation at release site is an issue or function of abdominal wall deteriorates following endoscopic anterior release. In the end, it will be up to the attending surgeon to determine whether a component separation technique is necessary or not. Nonetheless, the technique described in this report can also be executed following median laparotomy in order to avoid 'overtreatment' of patients.

Conclusions

Using this novel technical approach the external oblique fascia can be exposed under direct vision via a small skin incision, thus preventing leakage of air while performing endoscopic release. Advancing the dissection of the fascia a few centimetres away from the initial port site facilitates insertion of additional trocars and demanding back-to-front dissection in between trocars can be avoided.

Compliance with ethical standards

Conflict of interest No conflict of interest to be declared by the authors.

Ethical approval This article did not require ethical approval of any kind.

Human and animal rights This article does not contain any animal studies performed by the authors.

Informed consent All subjects signed informed consent.

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