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Case Report

Botulinum toxin and fasciotens in the management of complex ventral hernia: a case report

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ABSTRACT

The field of Abdominal wall reconstruction (AWR) has become globally popular in recent years due to various advancement in techniques. However, the management of complex ventral hernias (CVH) with loss of domain demands more attention and the learning curve for even experienced surgeons can be very high. The component separation techniques are widely used for complex ventral hernia repairs. Loss of domain hernias may require the necessity of combining component separation with other newer techniques such as Botulinum toxin A(BTA) administration and Fasciotens device. In this paper we highlight an interesting case of LOD hernia utilizing these techniques.

Keywords: Complex ventral hernia, Loss of domain, Component separation, Botulinum toxin A, Intraoperative fascial tension

INTRODUCTION

A hernia is a weakness or bulge in which organs or tissues from the abdomen may become trapped, resulting in discomfort and symptoms like pain. The prevalence of abdominal wall hernias is 1.7% for all ages and 4% for those over 45 years, making them a relatively common condition. Worldwide, an estimated 20 million patients with hernias are treated each year.[1] The incidence of ventral hernia disease is increasing.

This is due to an ageing population, the obesity epidemic, and an increasing number of open abdominal surgeries being performed. The CVH contains a significant proportion of the abdominal viscera outside the abdominopelvic compartment and their repair presents the sternest surgical challenge. ‘‘Loss of domain’’ (LOD) is a term used commonly in the hernia literature to describe the distribution of abdominal contents between the hernia and residual abdominopelvic cavity. After repairing hernias with significant LOD i.e., large hernias with most of the abdominal viscera outside the abdominal compartment.[2] An incisional hernia is a common complication following abdominal surgery, with a 5-year incidence of 33.0% in patients undergoing open rectal cancer resection and 13.0% in laparoscopic resection. Chronic contraction of abdominal muscles reduces the volume of abdominal cavity and increases the difficulty of fascial closure, resulting in abdominal compartment syndrome, ventilatory restrictions and increased risk of hernia recurrence.[3]

According to European hernia society classification, the localization of the hernia of the abdominal wall divided into median (M1–M5) and lateral (L1–L4) hernias. Secondly, the size of the hernia it was postulated that the width of the hernia defect is the most important parameter (greater than hernia defect surface, length of the hernia or size of the hernia sac), which was divided into four groups (W1–W4). As a third parameter were made for incisional hernias and recurrences: the number of previous hernia repairs was recorded as (R0, R1, R2, R3).[4] Preoperative computed tomography scan assesses defect size, loss of domain, and the likely need for component separation. Prehabilitation, frailty assessment, and risk stratification are beneficial in complex cases. Minimally invasive component separation techniques, Botox injection and fasciotens represent novel techniques to promote closure of large fascial defects.[5]

CASE REPORT

Our patient is a 60-year-old woman, presented to us with a history of large swelling over umbilical region for years. Associated with a history of irreducibility and also had respiratory issues, low back pain, and difficulty in walking for the past few months. She had undergone lower segment caesarean section (LSCS) and a total abdominal hysterectomy (TAH) in the past. On examination, a large irreducible swelling of size around 8×8 cm present over umbilical region with extensive divarication of recti (Figure 1). The Computerized tomography (CT) scan was done and the pre-operative inter-rectus distance was more than 10 cm due to the size of hernia (M3W2 hernia) and extensive divarication (W3).

Figure 1: Our patient presented with ventral hernia with LOD.

Preoperative distances between rectus abdominis muscles as well as hernia sac/peritoneal volumes were radiologically calculated, the ratio of volume of incisional hernia to the volume of abdominal cavity (VIH/VAC) was more than 20%. Hence it was planned to utilize supplementary methods to increase the length of the abdominal muscles and thereby the abdominal cavity volume.

The patient was preoperatively optimized and planned for botox injection 4 weeks prior to surgery. The abdomen was prepared and draped in a sterile fashion. Under ultrasonic guidance, the surface markings were done and each injection site was anesthetized with 1% lidocaine prior to the administration of botox.

Figure 2: Surface marking of BOTOX injection sites.

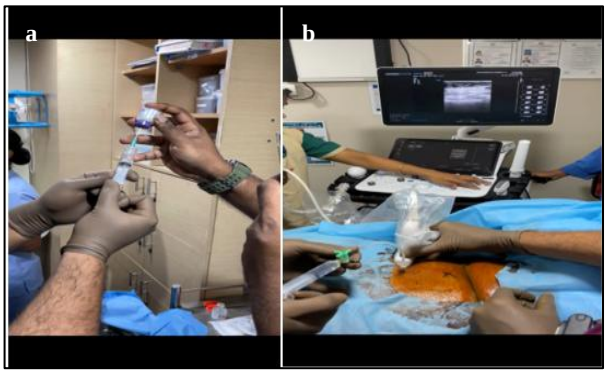

Figure 3 (a and b): Preparation and injection of BOTOX under ultrasound guidance done at our centre.

A total of 300 IU of botulinum toxin was injected, 150 IU on each side at 3 sites of lateral abdominal muscles (transverse abdominis, internal oblique and external oblique) of both sides (Figure 2,3). A CT scan was done post botox injection and a total gain of more than 10 cm was achieved. This results in rejuvenation and elongation

of the oblique abdominal muscles with a simultaneous reduction of the horizontal hernia diameter. This significantly increases the fascial closure rate. During the surgery the novel fascial traction device (FASCIOTENS) was used (Figure 4). These supplementary techniques enabled us to perform a successful abdominal wall reconstruction procedure in our patient.

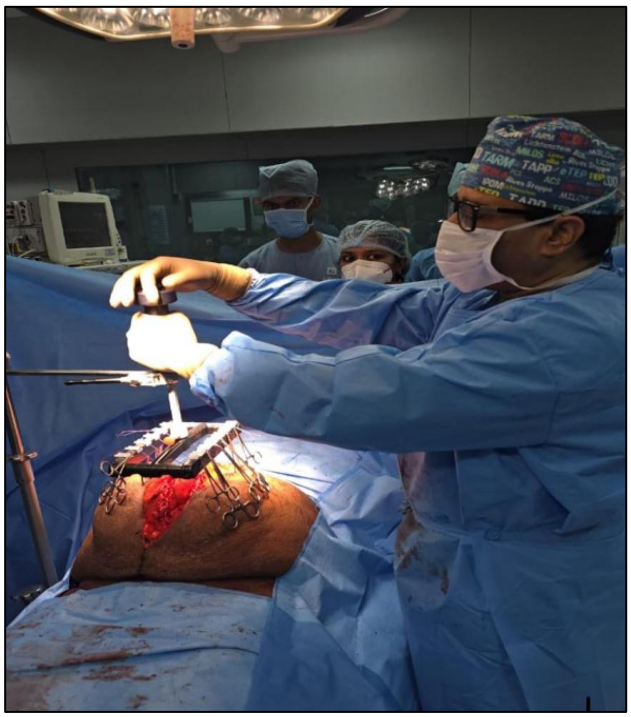

Figure 4: Anterior rectus sheath attached to fasciotens grid by continuous traction.

DISCUSSION

Ventral hernia is defined as a protrusion of the abdominal viscera through a non-hiatal, non-inguinal defect in the fascia of the abdominal wall.[6] Loss of domain hernia (LODH) represents a challenge for the abdominal wall surgeon. Continuous persistence of the intestinal contents in the hernia sac may cause respiratory disorders, physiological alterations, and abdominal compartment syndrome in these patients.[7] The VIH/VAC ratio was calculated. If this ratio was <20%, the procedure of choice depended on the location and size of the hernia such as (CST, TAR, Rives-Stoppa repair, etc). However, if the VIH/VAC ratio was higher or equal to 20%, these patients require supplementary techniques like botox, progressive preoperative pneumoperitoneum (PPP) and fasciotens.[7]

The loss of domain hernia risk is assessed by the Tanaka and Sabbagh method. The Tanaka index is a radiology calculation to determine the ratio of the hernia sac volume (HSV) to the ratio of abdominal cavity volume (ACV), LOD=HSV/ACV >0.25. The Sabbagh method is the ratio of hernia sac volume (HSV) to the ratio of total peritoneal volume (TPV), LOD=HSV/TPV >20%.[8]

Botulinum toxin A

BTA is a neurotoxin that acts selectively on presynaptic cholinergic nerve terminals, blocking the release of acetylcholine resulting in temporary flaccid muscle paralysis of the lateral muscle complex (Internal oblique, External oblique and Transversus Abdominis) and subsequently elongate the muscle complex; facilitating medialization of the rectus muscles and abdominal wall closure (Whitehead-Clarke and Windsor).[9] Preoperative distances between rectus abdominis muscles as well as hernia sac/peritoneal volumes for patients with LOD were measured based on preoperative computerized tomography (CT) scan. Most commonly, BTA is administered 3-4 weeks before surgery. The amount of BTA used and number of injection sites also vary according to each patient.

Usually, at least 200 Units (100 units per side) diluted in 30 ml of normal saline are injected.[9] Around 3-5 ml of BTA injected over three points on each side of the abdominal wall along the anterior axillary line equidistant from the costal margin at the level of ninth rib and a point anterior to anterior superior iliac spine and injected at 3 sites of lateral oblique muscles (transverse abdominis, internal oblique and external oblique).[10] Chemical components separation technique using botulinum toxin results in a significant gain in abdominal wall muscle length that can facilitate achievement of fascial closure at the future repair. The maximum effect reaches in 3 weeks and lasting up to 3-6 months after injection.[11]

In 2009 the European hernia society (EHS) developed a classification scheme for primary and incisional abdominal hernias, which describes what constitutes a large hernia defect as well as loss of domain hernia (LOD). As described by Tanaka et al, a computed tomography-facilitated measurement of the ratio of the volume of incisional hernia sac and the volume of abdominal cavity over 25% constitutes loss of domain and is predictive of a traumatic reduction of the hernia contents inside abdominal cavity. This concept is further elaborated by the Sabbagh et al, report in 2011, where it was concluded that a ratio of (incisional hernia volume) divided by the (peritoneal volume) resulting in less than 20% predicts a tension-free primary fascial closure.[11]

Lledo et al, published in 2020 their experience from a comparative study on 80 patients with midline incisional hernias, in which chemical components separation down-staged the required hernia repair type from components separation to a Rives-Stoppa repair with a 100% primary fascial closure achievement rate in the chemical components group and no complications from the injection of botulinum per se. Interestingly, large midline incisional hernias (hernia W3 according to EHS classification) with defects of 12-18 cm in diameter were only included in this study.[11]

Elstner et al, reported 32 patients of which 23 and 9 patients presented with midline and lateral hernia defects, respectively. A total dose of 300 U of BTA was applied 1–4 weeks before scheduled laparoscopic or laparoscopic-assisted open hernia repair with mesh implantation. A total of 26 patients (81%) achieved primary fascial closure with the application of BTA, whereas 6 patients (19%) required additional unilateral or bilateral endoscopic CST with division of the external oblique.[12] Ibarra-Hurtado et al, showed significant reductions of the transverse hernia defect (mean decrease, 4.79 cm; 95% confidence interval (CI), 3.63–6.31; p<0.001 and 5.25 cm; 95% CI, 3.59–6.91; p<0.001) secondary to administrations of 500 U of BTA. In a comparable study, administration of 100 U of BTA resulted in a small and statistically nonsignificant transverse reduction of the hernia defect after 4 weeks. They found no major postoperative complications except for coughing and sneezing.[12] An unenhanced abdomino-pelvic CT scan is the reference imaging study to analyze the morphology of the hernia neck, the anterolateral abdominal wall muscles, the anatomical changes (muscle retraction) and thus to confirm the feasibility of BTA injections (Figure 5,6).

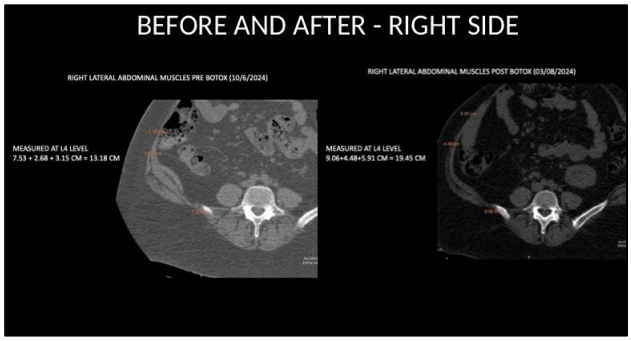

Figure 5: Pre- and post- botox measurement of right lateral abdominal muscles in our patient.

Figure 6: Pre- and post- botox measurement of left lateral abdominal muscles in our patient.

Injection of BTA is contra-indicated in patients with myasthenia gravis, severe coagulation disorders, sepsis at the site of injection and in patients who take aminoglycosides.[13] BTA does not diffuse beyond two cm around the injection point, attesting to its purely local pharmacokinetic action. The injection is made on either side of the line between the anterosuperior iliac spine and the costal margin, half-way between the anterior axillary line and the midclavicular line. Three injection points are chosen at equal distance from the bony landmarks. In patients where muscular retraction is moderate, two additional injection points may be envisioned on the posterior axillary line. The injection points may have to be modified to adapt to the parietal consequences of the incisional hernia. The goal is to instill BTA along the entire height of the abdominal wall muscles, to ensure adequate muscle paralysis.[13] CT scan is essential in preoperative planning of the LVH and the BTA management. This method has been improved by more accurate radiologic images, which can obtain the length and thickness of the lateral muscles in order to compare the effect of BTA.[14]

Table 1: Total gain in length of the both lateral abdominal muscles in our patient is 11.31 cm.

Abdominal wall muscles	Pre-botox	Post - botox	Gain in length
Left lateral abdominal muscles	10.11 cm	15.15 cm	+5.04 cm
Right lateral abdominal muscles	13.18 cm	19.45 cm	+6.27 cm

Another use of BTA allows getting a successful down-staging of the surgical repair in cases of LVH, especially with hernia transverse diameters over 11 cm and elimination of muscular lateral traction (Table 1). These results contribute to minimise disadvantages associated to techniques like component separation technique in terms of the surgical site occurrences, as well as the possibility of tension-free closure, decreasing the length of hospital stay and hernia recurrence rate.[14]

Intraoperative fascial tension

In 2017, Euchre et al. described the Abdominal Wall expander system (AWEX). The AWEX stretches the fascia anteriorly, enabling fascial closure. The first Fasciotens abdominal device was published by Niebuhr et al.[15] A device specially developed for IFT, which has shown promising results in open surgery of major midline hernias.[16] The VTD (fasciotens® Abdomen, Fasciotens GmbH, Essen, Germany) primarily applies dynamic vertical directed traction force along both facial margins via an external support system. The system comprises a scaffolding, a suture retention frame for suture clamping and two cushioned support bases that evenly distribute weight over the thorax and the anterior pelvic ring (Figure 7). The fasciotens device allows quantification of the traction forces approximately up to 20 kg.[17]

Preoperatively the diameter of hernia above measured either by CT or MRI scan. The rectus sheath was opened and the space prepared for a sub lay mesh augmentation (retro rectus) using PVDF mesh. The epifascial dissection

was limited 2-3 cm each side. For preparation of IFT, 12 polyfilament surgical sutures are placed (6 U-stitch sutures placed on each side along fascia with depth 1.5 cm and width 2-3 cm). Sutures clamped diagonally and anterior rectus sheath included in sutures and hernial sac left intact. Sutures locked into a holding device, colour indicator on the device top indicates the traction force. Tension applied continuously adjusted by pulling and reattaching each suture to increase the traction force.[17] This procedure demands 30 minutes continuous traction of muscles for myofascial advancement.

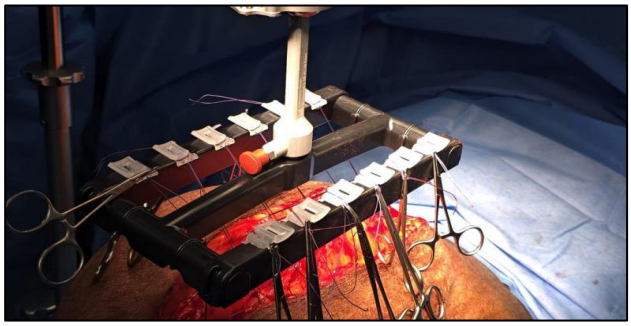

Figure 7: Application of traction to anterior rectus sheath by sequential application of weight.

Figure 8: Mesh placement in retro rectus plane.

The maximal fascial distance measured using sterile tape ruler under full relaxation. Measurements were taken before and after traction. The intra-abdominal pressure (IAP) is determined with indirect intravesical measurement, then PVDF mesh placed in the retro rectus plane (Figure 8). If midline restoration was not obtained, additional component separation should be done to achieve closure of anterior rectus sheath or placement of second PVDF mesh. The follow up was done clinically and sonographically 2-4 weeks after discharge and further follow-up was done 3,6 and 12th months.[15,17] The technique involves the implementation of intraoperative fascial traction (IFT), which reaches 120–140 N of force over 30 minutes intraoperatively and results in the approximation of displaced fascial edges of the hernia defect (Figure 9).[18]

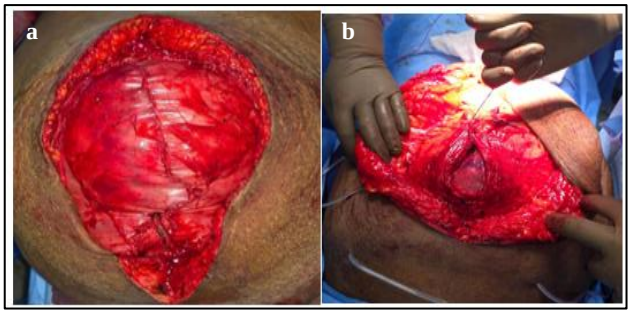

Figure 9 (a and b): Closure of PRS-peritoneal complex and tension free fascial closure.

The literature shows IFT to have best results in midline defects, although transverse defects are not an absolute contraindication for its use. The patient was observed for 24 hours postoperatively in the intensive care unit (ICU) and the intra-abdominal pressure (IAP) was measured through a urinary catheter.[19] Combined BTA injection and IFT, we noted increased lateral abdominal muscle length and simultaneously decreased muscle thickness after the combination approach. There was a significant increase in the mean abdominal muscle length from 13.1±2.6 cm/side (range 9.1–17.7 cm/side) before the combination approach to 17.2 ± 2.6 cm/side (range 12.3–23.2 cm/side) after the combination approach ($p<0.01$), indicating a gain in the mean transverse length of the lateral abdominal muscles of 4.1 cm/side (range 1.5–7.2 cm/side).[18,19]

CONCLUSION

The combined use of BTA and IFT increased the abdominal volume capacity, lengthened the lateral abdominal wall muscles over 11.31 cm by BTA and 4cm fascial length gain by IFT. This facilitated laparoscopic closure of large ventral hernia. These techniques significantly reduce the VIH/VAC ratio, allowing the reduction of the hernia contents into the abdominal cavity, which represents a key factor in the management of these hernias. These techniques play a vital role in abdominal wall reconstruction and reduce overall morbidity by aiding the possibility of tension-free closure, decreasing the duration of hospital stay and hernia recurrence rate in complex ventral hernia patients with loss of domain.

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