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Case Report

Pre-operative Preparation with Botulinum Toxin A as a Component Separation Technique in Incisional Hernia with Loss of Domain: A Clinical Case Report

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Abstract

Giant incisional hernia with loss of abdominal wall capacity is a condition that significantly impacts patients' quality of life, with high rates of morbidity, mortality and recurrence. Its history is notable for its progression from an anatomical defect to a complex "abdominal wall disease," characterized by the permanent displacement of viscera into the hernial sac. Classic research by Rives, Stoppa and Carbonell has established the basis for the use of retromuscular prostheses and the Component Separation Technique (CRT) to restore respiratory dynamics and abdominal cavity volume. Contemporary studies emphasize the importance of preoperative management with progressive pneumoperitoneum or botulinum toxin to prevent postoperative abdominal compartment syndrome. This scientific basis allows the current approach not only to close the defect but also to functionally reintegrate the abdominal contents with a significantly lower recurrence rate. Chronic abdominal wall defects grow and progressively alter the physiology of the abdominal wall, making it difficult to return the contents of the sac to the abdominal cavity. In operational terms, a loss-of-compartment hernia is classified as one with a defect of 10 cm or greater or whose volume represents at least 25% of the abdominal cavity volume. Repair of these defects can lead to several serious pathophysiological problems, such as abdominal compartment syndrome with acute respiratory compromise secondary to a sudden increase in intra-abdominal pressure. Managing these hernias remains a challenge for the surgeon; however, proper preoperative planning will improve the conditions for surgery.

Keywords: Incisional Hernia; Hernia with Loss of Domain; Hernioplasty; Preoperative Preparation with Botulinum Toxin; Component Separation

Introduction

The criteria for establishing a complex hernia include a hernia larger than 10 cm with loss of more than 20% of its surface area, which may be accompanied by infection or another condition and a hernia in which primary closure is not possible without prior separation of its components [1]. Repair of these defects can lead to several serious pathophysiological problems, such as abdominal compartment syndrome with acute respiratory compromise secondary to the sudden increase in intra-abdominal pressure. Managing these hernias remains a challenge for the surgeon; however, proper preoperative planning will improve the conditions for surgery.

Both the application of botulinum toxin type A and preoperative progressive pneumoperitoneum have proven to be effective for the treatment of giant ventral hernias with loss of dominance, as they facilitate the closure of large defects [2]. The integration of prehabilitation with Botulinum Toxin Type A (BTX-A) as an adjunct to the component separation technique represents a paradigm shift in the management of loss-of-skin hernias, transforming the abdominal wall architecture before surgery. In discussing these results, it is observed that chemodenervation of the lateral muscle complexes not only facilitates primary midline closure with less tension, but also optimizes the retromuscular space for prosthesis placement, mimicking the benefits of preoperative pneumoperitoneum but with a significantly lower complication profile [3-5].

This technical synergy allows component separation whether via an anterior or posterior approach (TAR) to be performed on pre-elongated tissue, which decreases postoperative intra-abdominal pressure and, consequently, reduces the risk of respiratory failure and suture dehiscence. Ultimately, the evidence suggests that combining TBA and reconstructive surgery not only simplifies the technical challenge for the surgeon but also results in a more predictable functional recovery and a substantial reduction in long-term recurrence rates [6].

Component separation is a technique introduced for abdominal wall reconstruction in cases of large and complex hernias. Its aim is to facilitate closure of the hernial defect without creating tension. An anterior separation involves cutting the aponeurosis of the external oblique muscle to access the plane between it and the internal oblique muscle; or a posterior separation involves releasing the transversus abdominis muscle to access the space between it and the transversalis fascia. Endoscopic techniques also exist, adhering to the same principles but with the advantage of being minimally invasive [7-10]. It is advisable to use prosthetic material in all cases and to avoid closure under tension [3].

Ethical Statement

The project did not meet the definition of human subject research under the Purview of the IRB according to federal regulations and therefore, was exempt.

Case Report

A 90-year-old male, who underwent surgery on three occasions, approximately 3 years ago, including transurethral prostatectomy plus bilateral orchiectomy in 2022, right inguinal hernioplasty in 2015 and exploratory laparotomy plus privative cholecystectomy plus incidental appendectomy in 2024, subsequently developed a mass in the surgical scar that increased in size, associated with colicky pain, early fullness and a feeling of bulging in the abdominal wall, with negative implications for his quality of life. Physical examination reveals a large protrusion of a mass at the level of the mid-supra-infraumbilical scar (Fig. 1), measuring 30x20 cm. The contents are soft, with minimal reduction, no changes in skin color and the presence of bowel sounds in the hernial sac associated with mild pain upon mobilization of the contents, without muscular resistance.

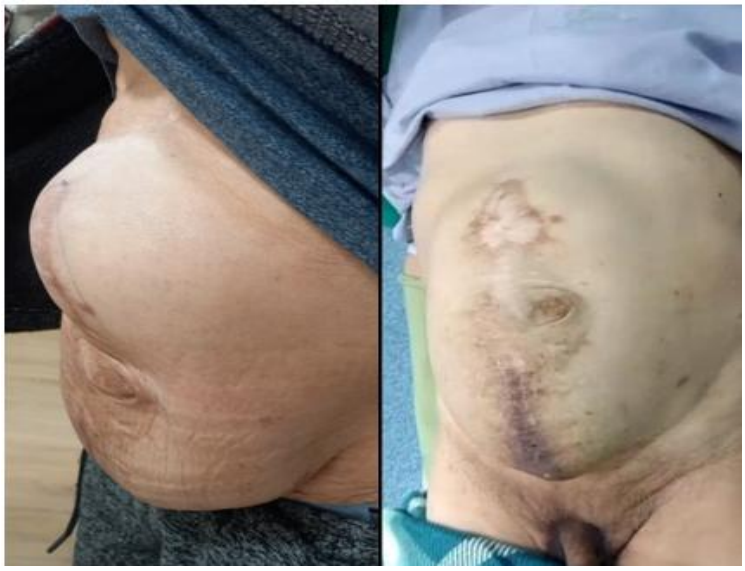

Figure 1: Abdomen in first consultation.

Preoperative laboratory tests were normal. Abdominal CT showed a 20x17 mm defect in the anterior abdominal wall (Fig. 2), with protrusion of loops of small and large intestine and omentum within a hernial sac with a maximum diameter of 237 mm (Fig. 3), in addition to scant small bowel loops within the abdominal cavity. Based on the patient's clinical and CT characteristics, the hernia was classified as loss of domain; therefore, a therapeutic intervention combined with the application of botulinum toxin was chosen.

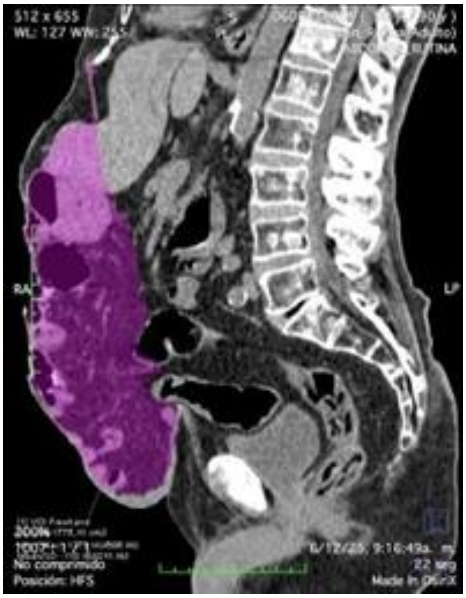

Figure 2: Size of the hernia defect.

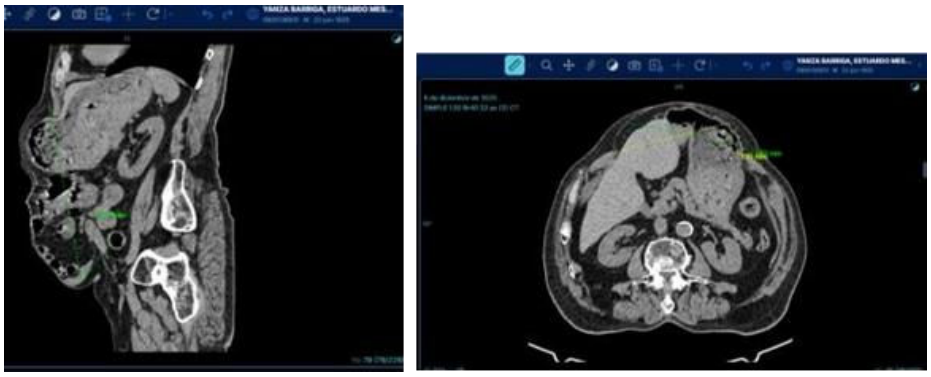

Figure 3: Dimensions of the hernial sac. A:135 mm, B:140 mm, C:237 mm.

The percentage of hernia volume of the patient under study is calculated in relation to the abdominal volume, for which we must consider the hernia sac and the abdominal cavity as ellipsoids, taking into account its three dimensions (Fig. 3,4) which for this purpose we will call by the letters a, b and c, applying the following formula, according to Tanaka, et al. [6].

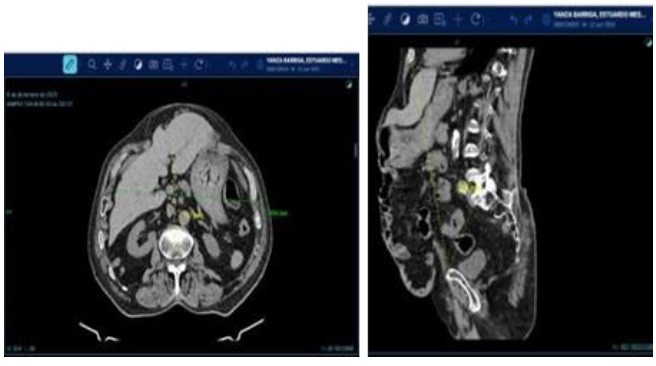

Figure 4: Dimensions of the abdominal cavity. A: 147 mm, B: 264 mm, C: 295 mm.

Volume	Calculation	Result
Hernia	0.52 x 135 x 140 x 237	2317cc
Cavity	0.52 x 147 x 264 x 295	5894cc

Table 1: Percentage of hernia volume.

As can be seen in the table, we obtain a hernia volume of 2317 cm^3 and an abdominal cavity volume of 5894 cm^3 , so the percentage of hernia volume is 39%. Tanaka, et al. [6]. They propose that an index greater than 25% in this measurement is a predictor of the need for abdominal wall prehabilitation.

Due to a hernia condition with loss of control, it was decided to perform abdominal wall prehabilitation with botulinum toxin type A.

Under aseptic and antiseptic conditions and with prior ultrasound visualization and continuous monitoring, the external oblique, internal oblique and bilateral transversus abdominis muscles are identified that Botulinum toxin type a (Dysport 500 IU vial of 500 IU) is administered to the abdominal wall muscles: external oblique, internal oblique and bilateral transverse abdominis. 50 IU per muscle with a total dosage of 300 IU resulted in no complications (Fig. 5).

She was discharged with a prescription for 500 mg of paracetamol as needed for pain. The patient was scheduled for a follow-up appointment in the outpatient clinic for surgical planning. Subsequently, a surgical intervention was scheduled, consisting of a repair with polypropylene mesh in the pre-aponeurotic space. To avoid closure under tension and its complications such as respiratory failure or intra-abdominal hypertension, alternatives such as anterior component separation or the Ramírez technique were considered. The patient was hospitalized 2 days before the procedure, for updated tests and to perform a pre-anesthetic evaluation for the surgical procedure.

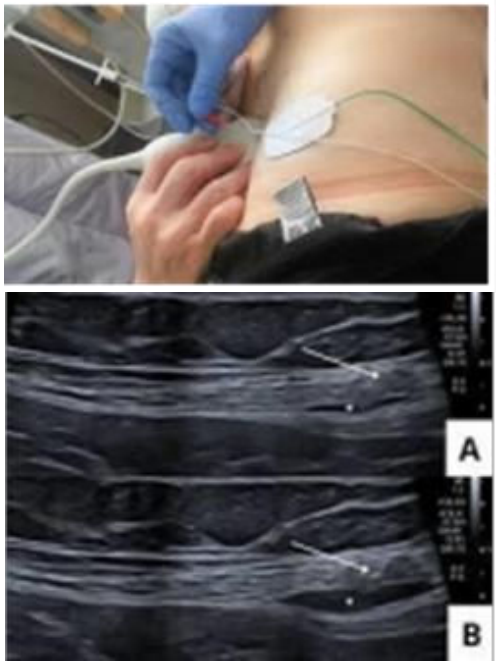

Figure 5: Application of Botulinum Toxin type A.

Figure 6: Incision and dermopilpectomy of surgical scar.

Supra-media-infraumbilical incision is made to individualize the hernial sac to its base (Fig. 6), then the preperitoneal space is released along the entire xiphopubic line with partial release of the bilateral posterior component with closure of the parietal peritone with polyglactin 2-0 (Fig. 7,8). Marlex mesh is then installed. preperitoneal area of approximately 20x30 cm and fixation of the same with transfactual sutures towards muscles Lateral abdominal incisions were closed with 1-0 polypropylene sutures (Fig. 9). Due to tension during closure of this defect, separation of the anterior component at level 1 was performed (Fig. 10), with posterior closure of the aponeurosis in the plane created between the external and internal oblique muscles (Fig. 11), with tubular drainage in the subcutaneous space. The procedure was uneventful (Fig. 12,13).

Figure 7: Preperitoneal space release.

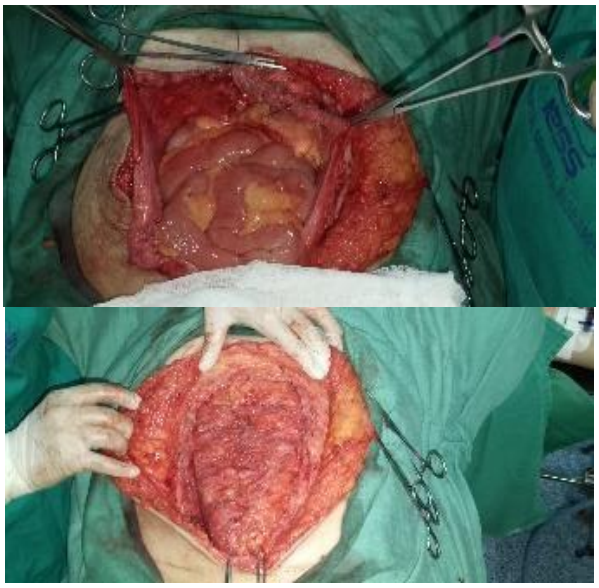

Figure 8: Parietal peritoneum closure.

Figure 9: Placement of polypropylene mesh.

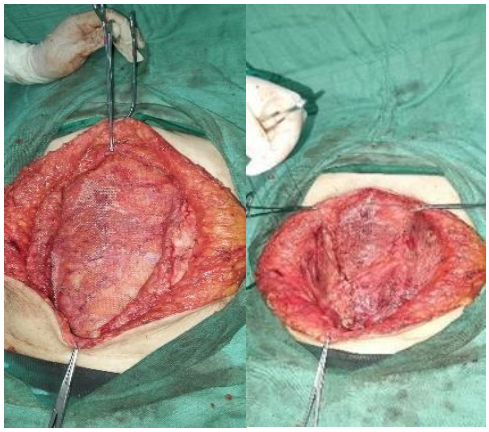

Figure 10: Surgical intervention. A. Separation of components, Ramírez technique, Level I.

Figure 11: Abdominal wall closure and placement of syringovag type suction drains.

Figure 12: Abdomen of a patient in postoperative control of the patient (immediate post-surgical).

Figure 13: Abdomen of a patient under postoperative control (immediate post-surgical).

Discussion

Among the systemic effects produced by this type of hernia are ventilatory compromise due to dissociation between intrathoracic and intra-abdominal pressure, a condition that alters the normal shape of the diaphragm. There is also dysfunction in bowel movements due to alteration of the abdominal wall musculature, which loses its ability to increase intra-abdominal pressure, as well as an obstructive effect when bowel loops are included within the hernial sac. Finally, there is difficulty urinating due to damage to the detrusor muscle of the bladder [1].

Regarding local effects: The muscles of the lateral abdominal complex undergo permanent retraction and shortening, leading to secondary dysfunction and loss of the ability to increase intra-abdominal pressure. The mesentery and intestinal loops, due to constant mechanical irritation, suffer chronic inflammation, which is more severe in incisional hernias due to fibrosis of their edges. The result of chronic inflammation is the formation of bands and adhesions. In contrast, the skin and subcutaneous tissue tend to atrophy due to severe compression and distension, causing trophic ulcers [3].

In 1940, Goñi Moreno first published the technique of preoperative progressive pneumoperitoneum for the treatment of large hernias [5]. Since then, his technique has been gradually modified and improved and is used worldwide with good results [4]. Most studies describe the use of progressive pneumoperitoneum for the repair of giant incisional hernias; However, this technique can also be used to resolve giant inguinal and umbilical hernias, with good results [5].

Another alternative is the use of botulinum toxin type A, which produces flaccid paralysis of the abdominal wall muscles, allowing for their conditioning prior to the performance of a hernia repair. It reduces the lateral retraction of the oblique muscles along the midline, ensuring closure of the hernial defect without weakening its anatomical structure, thus favoring postoperative recovery [6].

Component separation is a technique introduced for abdominal wall reconstruction in cases of large and complex hernias. Its aim is to facilitate closure of the hernial defect without creating tension. An anterior separation involves cutting the aponeurosis of the external oblique muscle to access the plane between it and the internal oblique muscle; or a posterior separation involves releasing the transversus abdominis muscle to access the space between it and the transversalis fascia. Endoscopic techniques also exist, adhering to the same principles but with the advantage of being minimally invasive [10]. It is advisable to use prosthetic material in all cases and to avoid closure under tension [3].

Giant hernias with loss of domain follow the same treatment pattern as other hernias, regarding the use of mesh and the "tension-free" concept Undoubtedly ,this is one of the most challenging pathologies for general surgeons to manage. This successful example is due to the combination of patient-family collaboration, ongoing training of the surgical team and prehabilitation of the abdominal wall with botulinum toxin four weeks prior to surgery [4]. When combined with the Preoperative Progressive insufflation (PPP) technique, a fascial closure rate of 96.7% is achieved, with a recurrence rate of 6.2% at 38.5 months of follow-up and a mean reduction in the HIV/VAC index of 16.3%. This combination also reduces the need for more invasive component separation techniques [10].

The component separation technique is fundamental in hernias with loss of control because it allows for the functional restoration of the midline by mobilizing the musculofascial flaps without generating excessive tension that compromises vascularization. This approach significantly increases the volume of the abdominal cavity, preventing abdominal compartment syndrome and improving the patient's respiratory dynamics by reintegrating the viscera into their anatomical position. By expanding the retromuscular space, it facilitates the placement of large prostheses that distribute intra-abdominal pressures homogeneously [4]. Current evidence suggests that multimodal prehabilitation is superior to isolated interventions. Skořepa, et al. and Timmer, et al., demonstrate that programs integrating nutrition, respiratory physiotherapy and physical exercise achieve better results in terms of postoperative recovery and reduced complications [1]. This conclusion is reinforced by the findings of Whitehead-Clarke and Windsor and Elstner, et al., who document additional benefits from combining specific techniques, such as the use of botulinum toxin and PPP therapy [3].

Some studies question Component Stem Surgery (CSS) due to its high rates of surgical site complications, such as seromas, hematomas and skin flap ischemia caused by the extensive dissection required. Comparative research suggests that in patients with multiple comorbidities or morbid obesity, the use of biological prostheses or minimally invasive techniques (eTEP) could offer similar results with lower morbidity than the traditional open technique. Furthermore, some authors point out that CSS does not always guarantee complete functional restoration of respiratory dynamics compared to alternatives such as preoperative pneumoperitoneum. All of this together with the previous separation of components, allowed the return of the viscera to the abdominal cavity and the tension-free closure of the hernial defect, which was vital to avoid the aforementioned postoperative complications, generating a great impact not only on the aesthetics of the abdominal wall but also on the quality of life of the patient who now lives without the cramps to which she was accustomed, can eat without problems and reintegrate into society without fear of being observed or rejected [11-16].

Conclusion

Prehabilitation with Botulinum Toxin Type A (BTX-A) has become a cornerstone of preoperative optimization for patients with incisional hernias with loss of abdominal wall function. By inducing temporary and reversible flaccid paralysis of the lateral abdominal muscles, BTX-A allows for stretching and thinning of the oblique and transversus abdominis muscles, facilitating midline closure without excessive tension. This structural modification improves the surgical distribution of the hernia components, reducing the need for extensive skin dissections and minimizing the risk of flap ischemia. Furthermore, increasing the volume of the abdominal cavity before surgery prevents abdominal compartment syndrome, ensuring superior respiratory and hemodynamic stability in the immediate postoperative period. In conclusion, the application of BTX-A not only simplifies the surgeon's technique but also raises the standards of safety and efficacy in the reconstruction of complex abdominal walls.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

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Acknowledgement

None.

Data Availability Statement

Not applicable.

Ethical Statement

The project did not meet the definition of human subject research under the purview of the IRB according to federal regulations and therefore was exempt.

Informed Consent Statement

Informed consent was taken for this study.

Authors' Contributions

Authors approved the final version of this paper.

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