Effective Management of Giant Ventral Hernias: A Comprehensive Approach Combining Preoperative Botulinum Toxin Application, Modified Ramirez’s Component Separation, and Rives-Stoppa Hernioplasty

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Abstract

Introduction

Giant ventral hernias are a surgical challenge due to their size and the need for a specialized approach during repair. Over the decades, abdominal wall surgery has evolved into a sophisticated field with a wide range of techniques aimed at improving patient outcomes. However, there is no universally accepted method suitable for repairing all giant ventral hernias. Surgeons must rely on a combination of techniques, choosing the approach that best matches their expertise, available resources, and the individual patient’s specific needs. This article explores the effective use of a combination of techniques, including Preoperative Botulinum Toxin Application, Modified Ramirez’s Component Separation, and Rives-Stoppa Hernioplasty, yielding excellent results and minimizing recurrences.

Objective

To provide a comprehensive literature review of giant ventral hernias. Additionally, we aim to share our experience in managing and repairing giant ventral hernias using a multi-modal approach, combining various surgical techniques, with a focus on patient safety, reduced recurrence rates, and improved quality of life.

Methods

Between October 1, 2019, and October 1, 2021, six patients with giant ventral hernias were enrolled at our Department of Surgery. They received preoperative Botulinum Toxin A application, underwent corrective surgery involving Modified Component Separation following Ramírez’s Method, and received Rives-Stoppa Hernioplasty. Follow-up was conducted for at least six months.

Results

Six patients were included in the study, three women and three men. They had an average age of 53.6 years and an average body mass index of 31.8 kg/m2. The most common location of the hernia defect was supra and infraumbilical among 66% of cases. The primary adverse effect associated with Botulinum Toxin A application was abdominal distension, reported in 33% of patients. No postoperative complications, such as abscesses or seromas, were observed. After the surgical procedure, the average hospital stay was 2.6 days, and no recurrences were noted within six months post-surgery.

Conclusion

The proposed method, which involves a combination of techniques, has demonstrated promising results based on our experience. However, to solidify these findings and better understand the full scope of this approach, further comprehensive statistical studies involving larger populations are essential. These studies will not only validate our results but also provide valuable insights for optimizing the management of giant ventral hernias.

Categories: General Surgery
Keywords: hernia defect, incisional hernia, rives-stoppa hernioplasty, botulinum toxin, giant ventral hernia

Introduction
Abdominal incisions often result in areas of inherent weakness. This area is often susceptible to dehiscence due to high intra-abdominal pressures, infectious complications and alterations in wound healing. The formation of incisional hernias in up to 20% of cases is attributable to the failure of the proper close of the abdominal wall as a consequence of the factors already described [1-4].

Correcting incisional hernias can be challenging, especially when there’s a loss of domain. Loss of domain occurs when the hernia defect grows to a size where the abdominal contents can’t be retained, leading to their protrusion into the hernial sac [5]. Giant ventral hernias, as defined by the European Hernia Society, encompass any ventral hernia greater than 10 cm, regardless of the presence of loss of domain [6].

The repair of giant ventral hernias carries a higher risk of postoperative morbidity compared to other hernia repair procedures. These hernias can impose a significant physical and psychological burden on patients, impacting their quality of life [7]. Achieving the best outcomes in giant ventral hernia repair involves an integrated approach that considers established principles and individual patient needs.

Despite the advancements in abdominal wall surgery over the last two decades, there is no universally standardized method for repairing giant ventral hernias. Various management approaches and component separation techniques have been described, each offering its own set of advantages and risks. In recent years, Botulinum Toxin A (BT) has emerged as a complementary therapy frequently utilized in giant ventral hernia repair [8-10].

Botulinum Toxin A is a powerful neurotoxin derived from Clostridium botulinum, when infiltrated in the abdominal wall muscles it temporarily induces flaccid muscle paralysis by inhibiting the release of acetylcholine. The reduction in the tensile strength of muscle facilitates hernia repair. The maximum effect of BT is typically achieved two to four weeks after application and gradually diminishes [10-12]. Muscle function is usually recovered within three to six months after application. Over the past four decades, BT has evolved into a therapeutic tool for an expanding array of clinical applications including dystonia, spasticity, achalasia, hyperhidrosis, bladder dysfunction, pain management, among many others [13]. In the context of ventral hernia repair, muscle relaxation facilitates the apposition of defect edges without compromising the fascial integrity of the abdominal wall. This minimizes lateral muscle traction, subsequently reducing the need for manipulation and traction during surgical repair and decreasing the post-procedural analgesic requirement [11,12,14-17].

**Materials And Methods**

This study is a retrospective and descriptive analysis of a patient series from a second-level hospital in the northwest of Mexico. Patients diagnosed with giant incisional ventral hernias with or without loss of domain, from 2019 to 2021, were selected for analysis. The analysis encompassed a comprehensive review of the patients’ medical histories, preoperative and postoperative computed tomography scans, the preoperative application technique of botulinum toxin type A, adverse effects observed after its application, as well as an assessment of the benefits and complications experienced during the hernioplasty procedure performed. Additionally, patients were monitored for a minimum of six months after the surgical intervention.

**Description of Techniques**

Before the application of BT, a simple plain computed tomography scan was performed to ascertain data regarding the size, diameter, and exact location of the hernia defects (Figure 1). Additionally, it offered insights into the characteristics of the ventral muscle blocks and delved into the depths of the abdominal wall muscles, ensuring a thorough preoperative assessment.
FIGURE 1: Preoperative Computed Tomography Scan
Simple CT scan conducted to determine information related to the hernia defects’ size, dimensions, and precise location

Application of Botulinum Toxin Type A

Hematological and coagulation profile laboratory studies were requested to exclude any coagulopathy, which represents a relative contraindication for the application of botulinum toxin. Once the CT scans and laboratory tests were completed, the application sites were meticulously selected based on the points of maximal myoelectric stimulation of the abdominal wall, as proposed by Ibarra-Hurtado et al. [14]. These points were precisely located under ultrasonographic guidance and consisted of two points in the mid-axillary line, between the costal margin and the external iliac crest, as well as three points on the external oblique muscle border on each side (Figure 2A). Strict aseptic technique was rigorously maintained throughout the entire procedure. Plain 3% Lidocaine was infiltrated into the subcutaneous space at the five marked points on each side of the aponeurotic defect. Using a 22G hypodermic needle (0.7mm x 32mm), 60 units of botulinum toxin (Botox®) were precisely injected at each of these points, resulting in a total of 300 units applied per patient. Four weeks after the BT application, once the effects had fully taken effect, the hernioplasty procedure was performed (Figure 2B).
Anatomic Component Separation Technique by Ramírez

The Ramírez technique, described in 1990, was developed as a method to expand the abdominal cavity. It involves the precise dissection of the abdominal wall between its various components. By conducting a bilateral, longitudinal dissection between both oblique muscles, it facilitates the liberation of the rectus abdominis muscle and the rotation of the posterior sheath, ultimately allowing for the reconstruction of the linea alba. The result of this procedure is a significant increase in midline overlap of up to 10 cm [18].

Modified Rives-Stoppa technique

The Rives-Stoppa technique, originally described in 1980, involves the precise placement of a mesh within the preperitoneal and retromuscular space, followed by the primary closure of the anterior fascia [19]. This approach capitalizes on the advantageous intra-abdominal pressures, which facilitate the mesh’s integration into the surrounding tissues. By leveraging the very forces that contributed to hernia formation, it effectively prevents recurrences. Over time, this technique has become the standard for addressing complex incisional ventral hernias, resulting in remarkably low recurrence rates. Furthermore, its preperitoneal location ensures seamless compatibility with potential future abdominal surgeries [20].

Integrated Approach: A Combination of Techniques for Optimal Results

The method performed on all patients, proposed by Dr. Aragón Quintana, involved the combination of three techniques already described and documented in existing literature. This approach included the preoperative application of BT four weeks before the surgical event. It also encompassed anatomical component separation following Ramírez’s method, which was further modified with the reinsertion of the rectus abdominis muscle (Figure 3). The third component of the method was Rives-Stoppa hernioplasty using a polypropylene mesh placed within the retromuscular and preperitoneal space. Mesh fixation and fascial closures were carried out with PDS® sutures (Figure 4). Umbilical reconstruction was performed, and primary skin closure was achieved using PROLENE® sutures. Additionally, all patients were fitted with a closed drainage system equipped with an anti-reflux valve and a collection system.
FIGURE 3: Anatomic Component Separation Technique by Ramírez

Anatomical component separation following Ramirez's method, which was further modified with the reinsertion of the rectus abdominis muscle.
Results
The study population and their demographic characteristics are outlined in Table I, while information regarding the procedures conducted is presented in Table II. All patients were referred to the general surgery outpatient clinic with a diagnosis of ventral hernia in the absence of complications. A total of six patients were included (three females and three males). The mean age was 53.6 years (range 36-67 years) with a mean BMI of 31.8 (range 22-41 kg/m²), and all patients had associated comorbidities, notably high blood pressure, which was present in all of them.
### TABLE 1: Demographic Characteristics of Study Participants

<table>
<thead>
<tr>
<th>Cases</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Comorbidities</th>
<th>BMI (kg/m²)</th>
<th>ASA Class</th>
<th>Previous surgical procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>51</td>
<td>Male</td>
<td>HAS</td>
<td>31</td>
<td>2</td>
<td>Exploratory laparotomy</td>
</tr>
<tr>
<td>2</td>
<td>67</td>
<td>Female</td>
<td>Smoking, HAS</td>
<td>34</td>
<td>3</td>
<td>Eight previous hernioplasties</td>
</tr>
<tr>
<td>3</td>
<td>66</td>
<td>Female</td>
<td>T2D, HAS, Morbid obesity, Hypothyroidism, Bipolar disorder</td>
<td>41</td>
<td>3</td>
<td>Cholecystectomy</td>
</tr>
<tr>
<td>4</td>
<td>36</td>
<td>Male</td>
<td>Smoking, HAS</td>
<td>22</td>
<td>2</td>
<td>Exploratory laparotomy + Loop Colostomy</td>
</tr>
<tr>
<td>5</td>
<td>55</td>
<td>Male</td>
<td>Smoking, HAS, T2D</td>
<td>33</td>
<td>3</td>
<td>Exploratory laparotomy</td>
</tr>
<tr>
<td>6</td>
<td>47</td>
<td>Female</td>
<td>HAS</td>
<td>30</td>
<td>2</td>
<td>Exploratory laparotomy</td>
</tr>
</tbody>
</table>

BMI: Body Mass Index, ASA: American Society of Anesthesiology Scale, HAS: Systemic Arterial Hypertension, T2D: Type 2 Diabetes

### TABLE 2: Preoperative and Postoperative Aspects of the Population

<table>
<thead>
<tr>
<th>Cases</th>
<th>Evolution (months)</th>
<th>Hernia defect location</th>
<th>Post-BT Complications</th>
<th>Transverse diameter of hernia defect before BT (cm)</th>
<th>Transverse diameter measured intraoperatively (cm)</th>
<th>Loss of Dominance</th>
<th>Hospital stay (days)</th>
<th>Follow-up (months)</th>
<th>Postoperative Complications</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>24</td>
<td>LM</td>
<td>-</td>
<td>15.9</td>
<td>11.6</td>
<td>No</td>
<td>3</td>
<td>11</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>SU</td>
<td>-</td>
<td>13.6</td>
<td>9.5</td>
<td>No</td>
<td>2</td>
<td>16</td>
<td>Wound Infection + Dehiscence</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>FD</td>
<td>-</td>
<td>13.8</td>
<td>8.5</td>
<td>Yes</td>
<td>3</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>LM</td>
<td>-</td>
<td>15.2</td>
<td>12.7</td>
<td>Yes</td>
<td>2</td>
<td>12</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
<td>LM</td>
<td>Abdominal distension + Cough</td>
<td>21.7</td>
<td>17.3</td>
<td>Yes</td>
<td>3</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>LM</td>
<td>-</td>
<td>13.9</td>
<td>8.9</td>
<td>No</td>
<td>3</td>
<td>9</td>
<td>-</td>
</tr>
</tbody>
</table>

ML: Midline, SU: Supraumbilical, RF: Right Flank, BT: Botulinum Toxin A

At the initial consultation, the main reason for seeking medical attention was primarily driven by cosmetic and aesthetic concerns. However, it’s noteworthy that all patients experienced symptoms of discomfort and limited mobility. Notably, none of them reported abdominal pain as their main complaint. One patient presented lumbalgia and respiratory difficulties, particularly when lying in a supine position, which prompted their visit (Figure 5).
FIGURE 5: Giant Ventral Hernia in a 55-Year-Old Male

A and B: The patient experienced lower back pain, respiratory challenges, limited mobility, and aesthetic concerns.

Every patient had a history of prior abdominal surgical interventions, with exploratory laparotomy being the most common, representing 66% of cases. As for the hernia defect, its most prevalent location was in the midline (both supra- and infraumbilical) in 66% of cases, one supraumbilical (16%), and one on the right flank (16%). The mean transverse diameter of the hernia defect was 15.6 cm, and a loss of domain was observed in 50% of the patients. Only two patients had a history of previous hernioplasties, having undergone eight procedures, with the last one performed 13 months before the start of their current treatment.

All patients received BT according to the previously described technique, and only two of them displayed additional symptoms following the administration. Abdominal distension was the most frequent, affecting one third of the patients, while only one patient reported the onset of a cough after BT administration (16.7%). The rest of the patients did not report any symptoms associated with the application.

In all cases, component separation was performed using the Ramirez technique. This was combined with Rives-Stoppa hernioplasty featuring preperitoneal mesh modifications already described (Figure 6). No intraoperative complications were encountered. The average length of hospital stay was 2.6 days. However, one patient experienced a surgical site complication (16.7%) in the early postoperative period. This complication manifested six days after the surgical procedure and was characterized by persistent abdominal pain, abdominal distension, wound dehiscence, and purulent discharge. As a result, a second surgical intervention was required.
The long-term follow-up had an average duration of 12.3 months. A minimum follow-up period of six months was established for all participants. Throughout this time, there were no instances of hernia recurrences or additional complications observed (Figure 7).
FIGURE 7: Preoperative and Postoperative Images of a Giant Ventral Hernia

A: Preoperative view of giant ventral hernia

B and C: Postoperative view of the same patient, 3 weeks after surgical procedure

Discussion

Clinical experience with BT in the treatment of ventral hernias has extended over a decade. This has provided a comprehensive understanding of its fundamental aspects. However, there is still a lack of standardization in the technique and its indications for different populations. This limitation is due to the significant variability in the methodology of current studies. While these studies have qualitatively and quantitatively demonstrated the clinical significance of using BT in ventral hernia repair, they have also unveiled a wide range of potential interventions for addressing this common issue.

Systemic arterial hypertension was the most prevalent comorbidity in the entire study population. It was closely followed by obesity. The average BMI was 31.8 kg/m², with 83% of the study population having a BMI greater than 30 kg/m², and 16.7% having a BMI exceeding 40%. These findings align with results from other studies in which obesity was the most common comorbidity among patients [21].

In this study, a preoperative dose of Botox® (300 units) was administered to six patients with giant ventral hernias, resulting in the reduction of hernia defects in all cases. The correction of the hernias was achieved through a combined approach of techniques. This approach involved the preoperative application of BT, a modified component separation technique based on the Ramírez method, and modified Rives-Stoppa hernioplasty.

The reduction in hernia defect size became evident following the application of 300 units of BT, with intraoperative measurements showing a decrease of 2-4 cm. Notably, previous studies have demonstrated significant outcomes. For instance, using 300 units resulted in a reduction of up to 58% in hernia defect diameter and an increase of up to 4 cm in bilateral muscle length [15]. Similarly, a dosage of 500 units led to a reduction of up to 4.79 cm in hernia defect size and an increase of up to 2.6 cm in bilateral muscle length [22]. Furthermore, the application of 100 units of BT resulted in a reduction of up to 50% in the total hernia sac area and a decrease in tension during the surgical repair process [18,23].

In this study, tomographic evidence indicated improved abdominal compliance following BT application. This was attributed to a decrease in content moving into the abdominal cavity due to the flaccid paralysis of lateral abdominal muscles. This facilitated the closure of musculature, especially in the cases of giant and complex hernias [17].

The most common adverse effect post-BT application was abdominal distension (33%), as reported in other studies. Particularly, one patient (16.7%) developed a cough several days after BT application. This cough could be linked to the reliance of abdominal muscles on respiration, a phenomenon observed in two other studies. This underscores the importance of exercising caution when administering BT to patients with chronic respiratory conditions [15,23].

Component separation was performed in all patients, potentially leading to an overestimation of the BT effect. However, only one study recommends a hernia transverse diameter greater than 18 cm as an indication for component separation [15,21].
The recurrence rate, after an average 12.5 month follow-up, was 0%. This aligns with results seen in studies with similar recurrence rates, even in follow-ups lasting up to 49 months [18,22,24]. However, this differs from other studies reporting a 9% recurrence rate [25].

Surgical site infection was the most common complication related to the surgical procedure, occurring in 16.7% of cases in this study. Similar incidence rates, ranging from 28% to 40%, have been reported in other studies [18,22,23,25]. However, the administration of BT did not increase the incidence of surgical site infections. It’s important to consider that the patient experiencing this complication had underlying risk factors, including Type 2 diabetes and hypothyroidism.

Lastly, several studies have reported the effectiveness of BT in decreasing the requirement for postoperative analgesia. This effect extends until the toxin’s activity at the neuromuscular junction subsides, leading to improved patient clinical outcomes and reduced consumption of opioids or postoperative analgesia [25,26].

Conclusions

Giant ventral hernias present a complex surgical dilemma due to their size and the specialized approach needed for their treatment. Since there is no universally accepted technique for repairing all giant ventral hernias, surgeons have the flexibility to use a combination of the described techniques, tailored to their expertise, available resources, and patient-specific considerations. The combination of techniques described in this article offers a viable therapeutic option for treating giant ventral hernias. These techniques include preoperative BT application, modified component separation based on Ramírez’s method, and hernioplasty using a Rives-Stoppa mesh. This approach has shown minimal adverse effects and complications, ensuring a tension-free fascial closure and reducing the risk of post-surgical recurrences. To draw more meaningful statistical comparisons with alternative techniques or combinations, it’s essential to conduct additional clinical trials involving larger populations.

Additional Information

Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. Chihuahua City General Hospital “Dr. Salvador Zubirán Anchondo” Ethics Committee issued approval N/A. This research has been conducted in accordance with the ethical standards and guidelines set by the Chihuahua City General Hospital “Dr. Salvador Zubirán-Anchondo” Ethics Committee. All necessary approvals and permissions were obtained before commencing the study. Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue. Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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