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Review Article

Botulinum toxin type A and progressive pneumoperitoneum for loss-of-domain hernia: a narrative review

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ABSTRACT

The management of incisional hernias with loss of domain (LOD) represents a significant surgical challenge. Preoperative conditioning with botulinum toxin type A (BTX-A) and preoperative progressive pneumoperitoneum (PPP) has emerged as an effective strategy in specialized centers. To synthesize the available evidence on the pathophysiological basis, clinical and volumetric indications, and outcomes of the combined use of BTX-A and PPP in hernias with LOD. A narrative review of the literature was conducted through searches in PubMed, SciELO, and Scopus, including studies related to the pathophysiological basis, indications, technical aspects, and clinical outcomes of BTX-A and PPP in hernias with LOD. The combination of BTX-A and PPP produces elongation of the lateral abdominal muscles, reduces the hernia defect, and induces adaptive volumetric expansion of the abdominal cavity through progressive insufflations. When applied 15-30 days before surgery, these interventions allow primary fascial closure rates approaching or exceeding 95%. However, adequate patient selection based on volumetric and clinical criteria, while considering potential complications, is essential. The evidence available to date suggests that the combined use of BTX-A and PPP optimizes fascial closure in complex hernias, with high efficacy in experienced centers. However, the evidence remains limited to observational studies; therefore, protocol standardization and controlled clinical trials are required to increase the level of evidence and allow this sequential therapeutic method to become a standard of care in routine clinical practice.

Keywords: Incisional hernia, Loss of domain, Botulinum toxin A, Pneumoperitoneum, Conditioning, Progressive

INTRODUCTION

The incisional hernia is one of the most frequent postoperative complications of major abdominal surgery. Its overall incidence after laparotomy is approximately 9.9%, with significantly higher rates for midline incisions than for transverse approaches (11% vs. 4.7%) and it may reach 15-20% in contemporary series that include patients with additional risk factors.[1,2] When high-risk populations are considered, such as patients with obesity, emergency surgery, postoperative surgical-site infection, and immunosuppression, the probability of incisional hernia rises to 30% at two years and may exceed 60% at five years after the index procedure.[3] This epidemiologic scenario makes incisional hernia a major public-health problem, with a direct impact on quality of life, work capacity, and health-care expenditure.[4]

Within the clinical spectrum of incisional hernia, there is a subgroup of patients in whom the hernia defect reaches a size such that contents of abdominal cavity have migrated permanently and progressively into hernia sac, exceeding capacity of the remaining abdominal cavity to safely accommodate them again. This phenomenon is known as

LOD and it represents the most complex scenario in abdominal wall surgery.[5] Absence of universally accepted operational definition has historically hindered comparison among series and development of clinical guidelines based on homogeneous evidence; the systematic review by Parker et al identified more than 10 different definitions in literature.[6] Contemporary consensus favors volumetric quantification by computed tomography (CT) as diagnostic reference standard.[7]

The pathophysiological consequences of LOD are multiple and progressive. Chronic retraction of lateral abdominal wall musculature leads to loss of the ventilatory bellows function, a restrictive respiratory pattern, and impaired quality of life.[8]

However, attempting repair without previous preparation precipitates acute intra-abdominal hypertension and abdominal compartment syndrome (ACS), with associated mortality that may exceed 50% in severe cases.[9] This risk makes severe loss-of-domain hernia a relative contraindication for direct surgical repair without preoperative conditioning.[10,11]

Preoperative conditioning of the abdominal wall aims to modify the patient's anatomy and physiology before the intervention, so that restitution of the herniated contents is safe and primary fascial closure is technically feasible. Two interventions have concentrated clinical and research attention in recent decades: i) PPP, described by Goñi Moreno in 1940 as a strategy for volumetric expansion of the peritoneal cavity; and ii) preoperative injection of BTX-A into the lateral abdominal wall musculature, introduced by Ibarra-Hurtado et al as chemical component separation.[7,11] These techniques act through distinct and complementary mechanisms: PPP acts on the peritoneal space, whereas BTX-A acts on the abdominal wall musculature. Their combined use, systematically documented since 2010 with the largest accumulated single-center experience at Hospital Universitario La Fe in Valencia, Spain, has shown promising results in observational series.[12]

Nevertheless, despite growing clinical interest, the available evidence remains scattered, with substantial heterogeneity in technical protocols, indication criteria, and outcomes evaluated. A more recent systematic review specifically addressing the combined approach, published in 2024 with searches through December 2023, identified only seven studies including 217 patients.[13] In this context, the objective of the present narrative review is to synthesize available evidence on the pathophysiological basis, clinical and imaging indications, technical aspects, and outcomes of combined BTX-A and PPP as preoperative conditioning in abdominal wall hernia with LOD, with emphasis on clinical applicability in public-health settings of intermediate and high complexity.

PATHOPHYSIOLOGY AND FOUNDATIONS OF PROGRESSIVE CONDITIONING IN ABDOMINAL WALL HERNIA WITH LOD

The pathophysiology of incisional hernia with LOD is the result of a cascade of biomechanical and adaptive events that become progressively established after fascial disruption and culminate in profound structural and functional reorganization of the abdominal wall and its viscera.

Lateral abdominal wall muscle retraction and remodeling

After opening of the linea alba, whether due to spontaneous dehiscence or as a consequence of laparotomy, the abdominal wall muscles are mechanically unloaded from their normal functional tension. This mechanical unloading triggers progressive lateral retraction of the external oblique, internal oblique, and transversus abdominis muscles.[14] At the histological level, relative functional denervation and disuse induce muscle atrophy, progressive interstitial fibrosis, and loss of tissue elasticity. Kirkpatrick et al. described that the internal oblique muscle in chronic hernias undergoes up to a 60% increase in stiffness and a 27% reduction in extensibility compared with healthy controls.[7] Retracted muscles become shorter, thicker, and less distensible, which drastically reduces the functional tissue available for midline closure at the time of repair.[7]

This retraction is not spontaneously reversible. Without active therapeutic intervention, muscular contracture becomes chronic and fascial reconstruction becomes a high-tension procedure that, in the absence of additional release techniques, may be impossible or may lead to early recurrence.[7] In this regard, BTX-A acts precisely on this component by inducing temporary flaccid paralysis, functionally reversing contracture and allowing muscle elongation before surgery.[15]

Ventilatory bellows dysfunction and respiratory consequences

The abdominal cavity and the diaphragm together form the abdominal respiratory bellows, whose integrity is essential for ventilatory mechanics. Under normal conditions, positive intra-abdominal pressure (IAP) during expiration and active movements of the abdominal muscles contribute to ventilatory function. When a significant portion of the peritoneal contents migrates into the hernia sac, IAP decreases and the diaphragm descends, altering the respiratory pattern.[16] Over time, patients with LOD develop a paradoxical respiratory pattern in which the abdomen protrudes outward instead of contracting during expiration, and accessory respiratory muscles become dominant. The clinical consequence is chronic restrictive ventilatory insufficiency, documented spirometrically by reduced forced vital capacity (FVC) and forced expiratory volume in the first second (FEV1).[17]

These abnormalities have direct surgical implications because reintroduction of the herniated contents and fascial closure under tension abruptly increase IAP, shift the diaphragm cephalad, and produce acute postoperative respiratory failure if the abdominal wall has not been previously conditioned. Therefore, measures such as PPP are required to progressively expand the peritoneal cavity during the weeks before surgery so that the diaphragm and lungs gradually adapt to the new pressure equilibrium.[18]

Digestive and vascular consequences

Portal and mesenteric venous stasis is another relevant pathophysiological consequence of LOD. Migration of the intestine into the hernia sac causes angulation and intermittent compression of the mesenteric pedicle, with resulting relative intestinal-wall ischemia, bowel-loop edema, chronic venous congestion, and bacterial translocation phenomena.[19] Edematous thickening of the intestinal loops increases the volume of herniated content, progressively hindering its reduction and increasing the risk of incarceration and strangulation. From a practical standpoint, this visceral congestion makes it necessary to plan progressive peritoneal decompression, for example with PPP, before attempting definitive surgical reduction.

Postoperative ACS

Postoperative ACS is the most concerning and potentially fatal complication of loss-of-domain hernia repair performed without previous conditioning. It is defined as sustained IAP equal to or greater than 20 mmHg associated with new-onset organ dysfunction. The incidence of ACS after abdominal wall reconstruction in large hernias has been estimated at 4.3%, with significantly high in-hospital mortality ranging from 40% to 60% in published series, and with an adjusted odds ratio of 3.84 for mortality. Elevated IAP generates a cascading effect across multiple organ systems: reduced cardiac output due to inferior vena cava compression, renal dysfunction due to decreased renal perfusion, respiratory failure due to diaphragmatic elevation, and mesenteric ischemia due to splanchnic hypoperfusion.[20]

Prevention of ACS is therefore the primary pathophysiological objective of preoperative conditioning. Both PPP and BTX-A contribute to reducing this risk: the former by expanding the capacity of the abdominal cavity to receive the reduced contents without an abrupt rise in IAP, and the latter by reducing fascial closure tension and decreasing the pressure generated by closure on the intra-abdominal contents.[21]

Volumetric quantification of the domain deficit

Characterization of LOD requires reproducible methods of quantification. The two most commonly used methods in clinical practice and research are the Tanaka index and the Sabbagh method, both based on CT volumetric measurements.[22] The Tanaka index calculates the ratio between hernia sac volume (HSV) and abdominopelvic cavity volume (APCV), considering each compartment as an ellipsoid based on its three CT dimensions; LOD is established when the HSV/APCV ratio is ≥0.25. The Sabbagh method expresses HSV as a percentage of total peritoneal volume (TPV=HSV+APCV), defining LOD when the HSV/APCV ratio is ≥20%.[23] Both methods have shown comparable clinical utility, and the choice between them depends mainly on the availability of volumetry software at each center.

INDICATIONS FOR PROGRESSIVE CONDITIONING

The indication for the preoperative conditioning protocol in hernia with LOD results from integration of three evaluation domains: i) imaging-volumetric criteria based on CT, ii) clinical patient criteria, and iii) institutional availability of the necessary resources. No single criterion is sufficient in isolation; therefore, the decision must be individualized and, whenever possible, discussed by a multidisciplinary abdominal wall team.

Volumetric criteria by computed tomography

Stratification by the Tanaka index is the objective axis of the indication. Recent studies, including the prospective study by Girieasen et al with 50 cases of LOD treated between 2021 and 2024 at a tertiary center, propose the following stratified strategy: for Tanaka indices between 0.25 and 0.30, repair by transversus abdominis release (TAR) is feasible and preoperative conditioning is usually not required; between 0.31 and 0.35, TAR may be supplemented with a reinforcing peritoneal flap, and the decision to add BTX-A is individualized when lateral muscle retraction is significant; when the index exceeds 0.35, the combined BTX-A + PPP protocol constitutes mandatory preparation before any reconstructive technique; in catastrophic hernias with an index greater than 0.50, multimodal conditioning may additionally include intensive nutritional optimization and a weight-reduction program.[24] The thresholds of HSV/APCV >25% by the Tanaka index or >20% by the Sabbagh method have been the most widely used in the literature to decide the indication for PPP.[25] In centers without access to volumetry software, a transverse defect greater than 10 cm has been used as a substitute clinical criterion.

Clinical patient criteria

Regardless of the volumetric index, the following clinical factors reinforce the indication for preoperative conditioning: i) the presence of chronic ventilatory restriction documented by spirometry (reduced FVC and FEV1), indicating that the abdominal cavity has lost its bellows function and that nonconditioned reduction will precipitate postoperative respiratory failure; ii) a chronic irreducible hernia with signs of abdominal wall adaptation (atrophic skin over the sac, multiple previous laparotomy scars, absence of cough impulse in the defect), indicating advanced muscle retraction and supporting the use of BTX-A; iii) a history of failed repair without previous conditioning in large defects, which justifies the combined protocol at reoperation; and iv) obesity (BMI >30 kg/m²), which is not a contraindication but makes BMI optimization advisable in parallel with conditioning.[26]

Specific indications by modality

BTX-A as a single conditioning modality, without PPP, is justified in hernias with moderate LOD (Tanaka 0.25-0.35) in which the dominant problem is muscle retraction rather than volumetric deficit; when peritoneal access carries high risk due to extensive adhesions documented by CT; or when the patient cannot tolerate progressive insufflation for cardiopulmonary reasons. PPP as a single strategy is mainly indicated when the dominant problem is volumetric deficit with relatively preserved lateral musculature, when BTX-A is not institutionally available, or when there is a formal contraindication to toxin use.[27]

Contraindications

Absolute contraindications for BTX-A application include known hypersensitivity to the toxin or its excipients, disorders of the neuromuscular junction (myasthenia gravis, Eaton-Lambert syndrome, amyotrophic lateral sclerosis), active infection at the injection site, and concomitant use of aminoglycosides or other neuromuscular blocking agents.[28]

For PPP, absolute contraindications include uncorrected coagulopathy, active infection of the peritoneal cavity or peritonitis, and severe decompensated respiratory failure, because peritoneal insufflation increases diaphragmatic pressure and may precipitate ventilatory crisis.[29]

Relative contraindications for both interventions include pregnancy, uncontrolled active abdominal wall infection, severely compromised nutritional status (albumin <2.5 g/dL), and urgent surgical need that does not allow the minimum four- to six-week conditioning period.[30]

Considerations in resource-limited settings

In Latin American public-health systems, such as Mexican system, BTX-A availability is not universal. The toxin is not included in the basic medication formulary of most such institutions, including IMSS, ISSSTE, and IMSS Bienestar, which frequently restricts this intervention to tertiary hospitals with specialized abdominal wall units. By contrast, PPP can be performed with standard materials available in any surgical unit (Veress needle or access trocar, medical CO_2, insufflation system) at marginal cost, making it an accessible first-line intervention in intermediate-complexity centers. The Mexican series by López-Juárez et al documented that image-guided BTX-A combined with PPP is feasible in public hospital referral centers when resources are available.[31]

Temporal sequence of the combined protocol

The optimal temporal sequence of the combined protocol has a precise pharmacological and physiological basis. BTX-A should be administered first, 28-35 days before surgery, so that its muscle-elongating effect reaches its maximum before PPP begins. PPP usually begins two weeks after BTX-A injection, when the paralytic effect is complete and the musculature offers less resistance to gas-induced distension. The systematic review by Giuffrida et al reported that, in the included studies, BTX-A was administered a mean of 29.5±1.7 days before surgery, and PPP was initiated 14.8±5.8 days before the intervention.[14]

Therefore, the combined protocol should follow this sequence: baseline CT and planning → BTX-A (approximately day -30) → initiation of PPP (approximately day -15) → post-conditioning control CT → definitive reconstructive surgery.

OUTCOMES OF THE COMBINED BTX-A AND PPP PROTOCOL

Primary fascial closure

The primary fascial closure rate is the main outcome reported in the literature on BTX-A and PPP. The systematic review and meta-analysis by van Rooijen et al which included 20 studies with 905 identified participants and reported outcomes of BTX-A alone (n=6 studies), PPP alone (n=11 studies), and the combination (n=3 studies), found an overall primary fascial closure rate of 0.94 (95% CI: 0.89-0.98).[10] Studies using BTX-A alone reported comparable rates, whereas studies using PPP alone showed greater variability. In the largest published series, by Bueno-Lledó et al which included 100 patients with LOD treated with the combined protocol at Hospital La Fe in Valencia, complete fascial closure was possible in 97% of cases, with bridging mesh required in only three patients.[11]

The most recent systematic review specifically addressing BTX-A + PPP, published by Giuffrida et al in the Journal of Abdominal Wall Surgery in 2024 with searches through December 2023, identified seven studies with a total of 217 patients. A mean reduction in the HSV/APCV ratio of 7.6% (range 0.9-15%) was documented after combined conditioning, and only 18.4% of patients required component separation (TAR or anterior separation) as an intraoperative adjunct.[14] These findings suggest that preoperative conditioning significantly reduces the need for additional reconstructive techniques.

Volumetric reduction and morphological changes

CT-documented volumetric changes before and after conditioning constitute the intermediate biomarker most commonly used to confirm treatment response and plan surgery. Bueno-Lledó et al reported a mean 15% reduction in the HSV/APCV ratio on post-conditioning control CT (p=0.001) in their 100-case series.[11] Sabbagh et al in their prospective study of 19 patients with PPP, documented that APCV increased by 2,021 cc, a value exceeding baseline HSV and indicating that the peritoneal cavity gained sufficient net capacity to accommodate the herniated contents.[9] Ibarra-Hurtado et al in the initial BTX-A series, demonstrated by comparative pre- and post-injection CT elongation of the lateral abdominal wall musculature and reduction of the transverse diameter of the defect in all included patients.[15]

Complications of conditioning

The safety profile is asymmetric between the two interventions. BTX-A has a very favorable safety profile, as shown in the systematic review by van Rooijen et al., who reported that complications related to BTX-A injection are infrequent.[10] Respiratory complications due to diaphragmatic paralysis have not been documented when injection is limited to the lateral musculature at usual therapeutic doses.[32]

PPP, in contrast, is associated with a larger number of complications, some of them severe. The systematic review by Giuffrida et al reported PPP-related complications in 25.6% of included patients, with severe complications (pneumothorax, embolism, visceral perforation) in 5 of 217 patients (2.3%).[14] The retrospective series of 162 patients by Mancini et al based on 40 years of experience at Grenoble University Hospital, documented complications in a non-negligible proportion of procedures, although most were minor (pain, pleuritic pain) and resolved with conservative management.[29] Van Rooijen et al concluded that PPP should be used with greater caution than BTX-A because of the higher number and greater severity of reported complications.[10]

Postoperative morbidity and recurrence

The rates of surgical-site infection (SSI) and surgical-site occurrences (SSO) in studies of the combined protocol are comparable to or lower than those reported for complex hernia surgery in general. Giuffrida et al. reported SSI rates of 17.5% and SSO rates of 26.2%, without significant differences among the different repair techniques used.[14] The overall recurrence rate reported in the review by van Rooijen et al was 3% (95% CI: 1-6%), with variable mean follow-up across studies.[10] Giuffrida et al found a recurrence rate of 5.9% (13/217 patients), significantly higher among patients repaired with the IPOM technique (intraperitoneal Onlay mesh bridge repair) than among those who underwent primary fascial closure with TAR (p<0.001), reinforcing the importance of fascial closure as the primary technical objective.[14]

Postoperative respiratory function

Improvement in ventilatory function after repair of hernias with LOD is one of the most clinically relevant benefits for the patient and should be an important outcome. Some studies report postoperative improvement in FVC and FEV1 compared with baseline preoperative values, attributed to restoration of the abdomino-diaphragmatic bellows function.[18] However, this outcome is poorly and inconsistently documented in the specific literature on the combined BTX-A + PPP protocol, and standardized measurement should be considered a methodological priority in future studies.

Outcomes in Latin American literature

The Mexican series by López-Juárez et al (Cirugía y Cirujanos) is one of the most relevant Latin American contributions to the literature on this topic. In this study, the authors documented the technical feasibility and outcomes of image-guided BTX-A (incobotulinumtoxinA) combined with PPP in patients with hernia and LOD, confirming that the protocol is applicable in Mexican public-health referral centers when resources are available.[31]

PERSPECTIVES

The current state of knowledge on combined BTX-A and PPP shows clear technical and clinical progress, but also structural methodological gaps that limit the strength of recommendations. The absence of randomized clinical trials, heterogeneity in technical protocols and indication criteria, and limited long-term follow-up in most series precisely define the need for further research in this field.

Need for randomized clinical trials

All available evidence on the combined protocol is observational, with a high risk of selection bias because patients receiving BTX-A + PPP are, by definition, those with the greatest complexity, preventing direct comparisons with populations with smaller hernias. The most urgent methodological question is the direct comparison among three arms: BTX-A + PPP versus BTX-A alone versus PPP alone, with standardized primary outcomes (primary fascial closure rate, postoperative IAP, clinical ACS) and a minimum follow-up of 24-36 months. Tashkandi et al noted in their analysis (Hernia) that the additional benefit of BTX-A over PPP was not statistically significant in some volumetric parameters, making this comparison a priority for study design.[33] Given the number of patients required for a trial with adequate statistical power, the design should be multicenter.

Standardization of technical protocols

Current variability in BTX-A dose, number of injection sites, commercial formulation used, volume and frequency of each PPP session, type of gas, imaging guidance for peritoneal access, and criteria for ending the protocol makes direct comparison among series and the development of high-level recommendations impossible. An international consensus of abdominal wall experts to establish a standardized technical protocol is urgently needed.

Prospective validation of indication thresholds

The Tanaka index was established using arbitrary cut-off parameters in its original 2010 description.[22] Although its clinical utility has been retrospectively validated, no study has shown that the 0.25 or 0.35 threshold is the optimal cut-off for the conditioning decision, nor that this threshold is universally applicable regardless of defect size, degree of muscle retraction, or baseline ventilatory function. The development and prospective validation of a multicriteria indication scale integrating volumetric index, defect size, degree of CT-measured muscle retraction, baseline ventilatory function, and institutional availability could allow more precise and personalized stratification than the one currently available.

Cost-effectiveness studies in public-health systems

The cost of the complete protocol, including BTX-A, imaging guidance for injection, CO_2-supervised PPP, and control CT, has not been evaluated in the context of Latin American public-health systems. Whether this cost is justified by the reduction of major complications, such as ACS, postoperative respiratory failure, and reoperation for early recurrence, is a fundamental question for health-policy decision-making in institutions such as IMSS, ISSSTE, and IMSS Bienestar. Cost-effectiveness studies should also consider the indirect cost of prolonged hospitalization and rehabilitation associated with avoided major complications.

Expansion of the protocol to minimally invasive approaches

Most available studies report definitive repair by open techniques, such as TAR or anterior component separation. However, preoperative conditioning could expand the indication for laparoscopic or robotic approaches in hernias with moderate LOD (Tanaka 0.25-0.35), taking advantage of the lower abdominal-wall morbidity and faster recovery offered by these approaches. Research on BTX-A + PPP combined with definitive minimally invasive reconstruction should be a priority area because of its relevant potential, especially in centers with established experience in robotic abdominal wall surgery.[34]

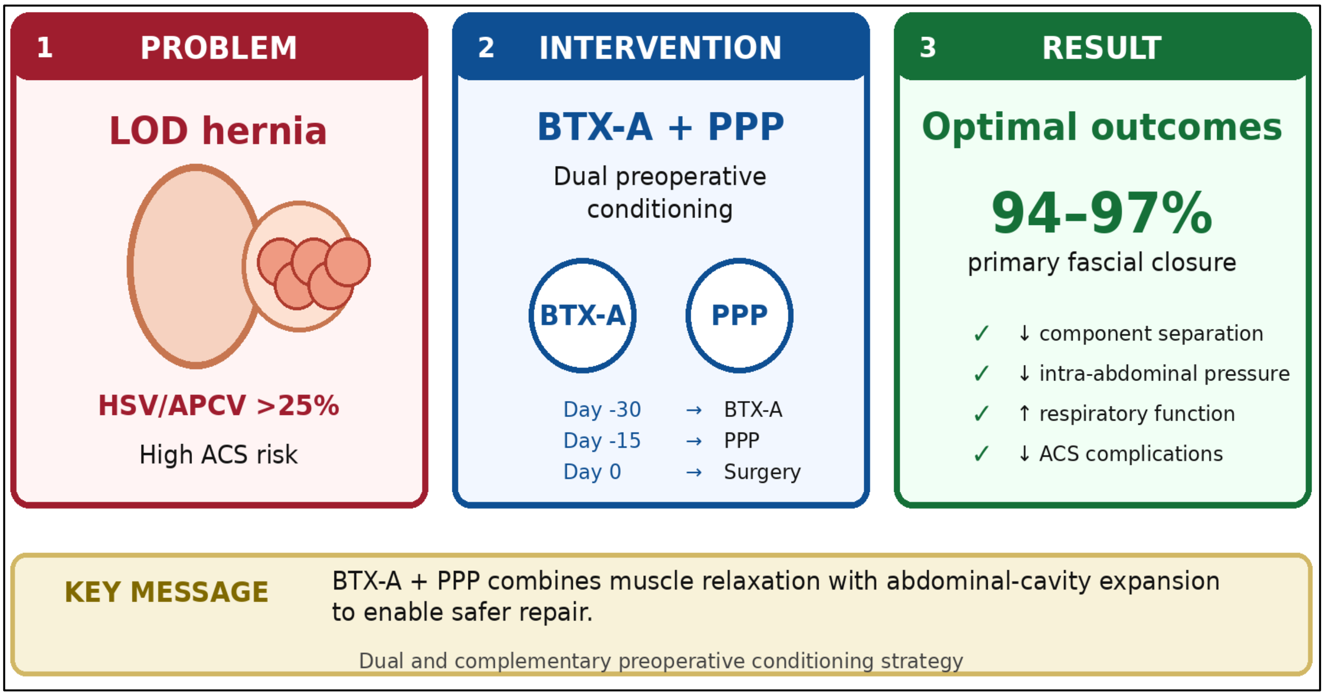

Figure 1: Graphic summary of the article.

*Abdominal wall hernia with LOD (Panel 1) is characterized by chronic retraction of the lateral musculature, reduced intra-abdominal capacity, and altered ventilatory mechanics, with permanent displacement of visceral contents into the hernia sac and a volumetric imbalance (HSV/APCV >25%) that causes difficulty in fascial closure and a high risk of postoperative ACS if repair is attempted without previous conditioning. In this context, the preoperative conditioning strategy (Panel 2) combines BTX-A and PPP, addressing the underlying pathophysiological mechanisms in a complementary manner: BTX-A induces transient flaccid paralysis of the lateral musculature, favoring elongation and increasing abdominal wall distensibility ("chemical component separation"), whereas PPP gradually expands the abdominal cavity through serial CO_2 insufflations, allowing progressive adaptation of the intra-abdominal compartments and diaphragm. The optimal temporal sequence-BTX-A administration approximately 30 days before surgery and initiation of PPP approximately 15 days before surgery-optimizes anatomic and physiological conditions for definitive reconstruction. As a result, this dual strategy (Panel 3) allows restoration of abdominal domain, facilitates high primary fascial closure rates (94-97%), reduces the need for component separation techniques, decreases IAP at the time of closure, and attenuates the risk of ACS, with favorable impact on respiratory function and overall clinical outcomes, thereby transforming an initially non-reconstructable complex hernia into a condition amenable to safe repair.

CONCLUSION

Incisional hernia with LOD represents the most complex scenario in abdominal wall surgery, characterized by chronic muscle retraction, peritoneal volumetric deficit, and risk of postoperative ACS. BTX-A and PPP act through distinct and complementary mechanisms: the former elongates the retracted lateral musculature through chemical component separation, whereas the latter progressively expands the peritoneal cavity. The available observational evidence suggests that combined BTX-A and PPP favors high primary fascial closure rates in experienced centers. The evidence is consistent but methodologically limited to observational studies; therefore, further research and advances are required for the successful implementation of progressive preoperative conditioning using BTX-A and PPP. Necessary actions include standardization of technical protocols, prospective validation of indication thresholds, and the development of multicenter Latin American registries.

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REFERENCES

1. Deerenberg EB, Henriksen NA, Antoniou GA, Antoniou SA, Bramer WM, Fischer JP, et al. Updated guideline for closure of abdominal wall incisions from the European and American Hernia Societies. BJS. 2022;109(12):1239-50.
2. Ahsan A, Nour HM, Peristeri D V., Abogabal S, Swaminathan C, Sajid MS. Systematic review with meta-analysis of transverse vs. vertical midline extraction incisional hernia risk following laparoscopic colorectal resections. Transl Gastroenterol Hepatol. 2023;8(0):NA.
3. Fortelny RH, Dietz U. [Incisional hernias: epidemiology, evidence and guidelines]. Chirurgie (Heidelberg, Germany). 2024;95(1):3-9.
4. Rhemtulla IA, Hsu JY, Broach RB, Mauch JT, Serletti JM, DeMatteo RP, et al. The incisional hernia epidemic: evaluation of outcomes, recurrence, and expenses using the healthcare cost and utilization project (HCUP) datasets. Hernia. 2021;25(6):1667-75.
5. Toma M, Oprea V, Grad ON, Pavel A, Kovacs H, Molnar C. Incisional Hernias with Loss of Abdominal Domain: A New Look to an Older Issue or the Elephant in the Living Room. Literature Review. Chirurgia (Bucur). 2022;117(1):5-13.
6. Parker SG, Halligan S, Blackburn S, Plumb AAO, Archer L, Mallett S, et al. What Exactly is Meant by “Loss of Domain” for Ventral Hernia? Systematic Review of Definitions. World J Surg. 2018;43(2):396-404.
7. Kirkpatrick AW, Nickerson D, Roberts DJ, Rosen MJ, McBeth PB, Petro CC, et al. Intra-Abdominal Hypertension and Abdominal Compartment Syndrome after Abdominal Wall Reconstruction: Quaternary Syndromes? Scand J Surg. 2017;106(2):97-106.
8. Parker SG, Halligan S, Liang MK, Muysoms FE, Adrales GL, Boutall A, et al. Definitions for Loss of Domain: An International Delphi Consensus of Expert Surgeons. World J Surg. 2019;44(4):1070-8.
9. Sabbagh C, Dumont F, Fuks D, Yzet T, Verhaeghe P, Regimbeau JM. Progressive preoperative pneumoperitoneum preparation (the Goni Moreno protocol) prior to large incisional hernia surgery: volumetric, respiratory and clinical impacts. A prospective study. Hernia. 2011;16(1):33-40.
10. van Rooijen MMJ, Yurtkap Y, Allaeys M, Ibrahim N, Berrevoet F, Lange JF. Fascial closure in giant ventral hernias after preoperative botulinum toxin a and progressive pneumoperitoneum: A systematic review and meta-analysis. Surgery (United States). 2021;170(3):769-76.
11. Bueno-Lledó J, Carreño-Saenz O, Torregrosa-Gallud A, Pous-Serrano S. Preoperative Botulinum Toxin and Progressive Pneumoperitoneum in Loss of Domain Hernias-Our First 100 Cases. Front Surg. 2020;7:3.
12. Obi M, Beffa L, Melland-Smith M, Messer N, Kanters A, Judeeba S, et al. The rate of ileostomy site incisional hernias: more common than we think? Hernia. 2024;28(6):2311-20.
13. Bueno-Lledó J, Torregrosa A, Ballester N, Carreño O, Carbonell F, Pastor PG, et al. Preoperative progressive pneumoperitoneum and botulinum toxin type A in patients with large incisional hernia. Hernia. 2017;21(2):233-43.
14. Giuffrida M, Biolchini F, Capelli P, Banchini F, Perrone G. Botulinum Toxin and Progressive Pneumoperitoneum in Loss of Domain Ventral Hernias: A Systematic Review. J Abdominal Wall Surg. 2024;3:12650.
15. Ibarra-Hurtado TR, Nuño-Guzmán CM, Miranda-Díaz AG, Troyo-Sanromán R, Navarro-Ibarra R, Bravo-Cuéllar L. Effect of botulinum toxin type A in lateral abdominal wall muscles thickness and length of patients with midline incisional hernia secondary to open abdomen management. Hernia. 2014;18(5):647-52.
16. Deerenberg EB, Elhage SA, Raible RJ, Shao JM, Augenstein VA, Heniford BT, et al. Image-guided botulinum toxin injection in the lateral abdominal wall prior to abdominal wall reconstruction surgery: review of techniques and results. Skeletal Radiol. 2021;50(1):NA.
17. Licari L, Campanella S, Carolla C, Madonia C, Canino B, Salamone G. Abdominal wall incisional hernia repair improves respiratory function: results after 3 years of follow-up. Hernia. 2020;25(4):999-1004.
18. Elstner KE, Read JW, Rodriguez-Acevedo O, Ho-Shon K, Magnussen J, Ibrahim N. Preoperative progressive pneumoperitoneum complementing

chemical component relaxation in complex ventral hernia repair. Surg Endoscopy. 2016;31(4):1914-22.

19. Renard Y, Lardière-Deguelte S, de Mestier L, Appere F, Colosio A, Kianmanesh R, et al. Management of large incisional hernias with loss of domain: A prospective series of patients prepared by progressive preoperative pneumoperitoneum. Surgery. 2016;160(2):426-35.
20. Nasa P, Wise RD, Smit M, Acosta S, D'Amours S, Beaubien-Souligny W, et al. International cross-sectional survey on current and updated definitions of intra-abdominal hypertension and abdominal compartment syndrome. World J Emerg Surg. 2024;19(1):39.
21. Petro CC, Raigani S, Fayezizadeh M, Rowbottom JR, Klick JC, Prabhu AS, et al. Permissible Intraabdominal Hypertension following Complex Abdominal Wall Reconstruction. Plast Reconstr Surg. 2015;136(4):868-81.
22. Tanaka EY, Yoo JH, Rodrigues AJ, Utiyama EM, Birolini D, Rasslan S. A computerized tomography scan method for calculating the hernia sac and abdominal cavity volume in complex large incisional hernia with loss of domain. Hernia. 2010;14(1):63-9.
23. Sabbagh C, Dumont F, Robert B, Badaoui R, Verhaeghe P, Regimbeau JM. Peritoneal volume is predictive of tension-free fascia closure of large incisional hernias with loss of domain: a prospective study. Hernia. 2011;15(5):559-65.
24. Yurtkap Y, van Rooijen MMJ, Roels S, Bosmans JML, Uyttebroek O, Lange JF, et al. Implementing preoperative Botulinum toxin A and progressive pneumoperitoneum through the use of an algorithm in giant ventral hernia repair. Hernia. 2020;25(2):389-98.
25. Van Hoef S, Dries P, Allaeys M, Eker HH, Berrevoet F. Intra-abdominal hypertension and compartment syndrome after complex hernia repair. Hernia. 2024;28(3):701-9.
26. Martínez-Hoed J, Bonafe-Diana S, Bueno-Lledó J. A systematic review of the use of progressive preoperative pneumoperitoneum since its inception. Hernia. 2021;25(6):1443-58.
27. Bueno-Lledó J, Torregrosa Gallud A, Jiménez Rosellón R, Carbonell Tatay F, García Pastor P, Bonafé Diana S, et al. Preoperative preparation of hernia with loss of domain: progressive pneumoperitoneum and botulinum toxin type A. Cir Esp. 2017;95(5):245-53.
28. Rodriguez-Acevedo O, Elstner KE, Jacombs ASW, Read JW, Martins RT, Arduini F, et al. Preoperative Botulinum toxin A enabling defect closure and laparoscopic repair of complex ventral hernia. Surg Endosc. 2018;32(2):831-9.
29. Mancini A, Mougin N, Venchiarutti V, Shen Z, Risse O, Abba J, et al. Goni Moreno progressive preoperative pneumoperitoneum for giant hernias: a monocentric retrospective study of 162 patients. Hernia. 2020;24(3):545-50.
30. Zwaans WAR, Timmer AS, Boermeester MA. Preoperative Botulinum Toxin-A Injections Prior to Abdominal Wall Reconstruction Can Lead to Cardiopulmonary Complications. J Abdominal Wall Surg. 2024;3.
31. López-Juárez SE, Medina-Benítez A, Durán-Reyes R, Bagundo-Pérez BI, Fortuna-Sandoval OI, Trejo-García MS. Botulinum toxin A (IncobotulinumtoxinA) and pneumoperitoneum image-guided for hernia repair with loss of dominance. Cir Cir. 2023;91(1):117-21.
32. Timmer AS, Claessen JJM, Atema JJ, Rutten MVH, Hompes R, Boermeester MA. A systematic review and meta-analysis of technical aspects and clinical outcomes of botulinum toxin prior to abdominal wall reconstruction. Hernia. 2021;25(6):1413.
33. Tashkandi A, Bueno-Lledó J, Durtette-Guzylack J, Cayeux A, Bukhari R, Rhaeim R, et al. Adjunct botox to preoperative progressive pneumoperitoneum for incisional hernia with loss of domain: no additional effect but may improve outcomes. Hernia. 2021;25(6):1507-17.
34. Bueno-Lledó J, Martinez-Hoed J, Torregrosa-Gallud A, Menéndez-Jiménez M, Pous-Serrano S. Botulinum toxin to avoid component separation in midline large hernias. Surgery (United States). 2020;168(3):543-9.

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