Case Report

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Fatal abdominal compartment syndrome following reduction of long-standing diaphragmatic hernia: Expanding the concept of loss of domain beyond ventral hernias—A case report

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Abstract

Loss of domain (LOD) is a recognized concept in complex ventral hernia surgery but has received limited attention in the context of diaphragmatic hernia repair. Failure to recognize this physiology may precipitate catastrophic intra-abdominal hypertension and abdominal compartment syndrome (ACS). Here, we report a case of a 21-year-old male with a long-standing left-sided diaphragmatic hernia who presented for elective surgical repair. Diagnostic laparoscopy revealed a left diaphragmatic hernia containing the stomach, transverse colon, and omentum. Notable abdominal wall rigidity noted during insufflation suggested reduced abdominal compliance and possible functional LOD. Due to technical difficulties, the procedure was converted to an open bilateral subcostal approach. Following the reduction of herniated contents, the diaphragmatic defect was repaired primarily and reinforced with prosthetic mesh. However, primary abdominal closure was not feasible because of a markedly contracted and noncompliant abdominal cavity. Temporary abdominal closure using a Bogota bag was performed. Following postoperative failure of the Bogota bag, re-exploration and negative pressure-assisted abdominal closure were attempted. The patient developed progressive bowel edema and persistent abdominal compartment physiology despite intensive care support and repeated closure attempts. The condition remained refractory to intervention, and the patient expired on postoperative day 21. This case represents an extreme form of functional LOD in diaphragmatic hernia, where reintegration of chronically displaced viscera exceeds abdominal cavity compliance. Preoperative volumetric assessment, progressive pneumoperitoneum, botulinum toxin A, and staged reconstruction may be valuable in selected cases. Recognition of LOD physiology and adoption of a physiology-based rather than purely anatomical approach may help prevent fatal ACS following diaphragmatic hernia repair.

Keywords:

Abdominal compartment syndrome, Bogota bag, diaphragmatic hernia, loss of domain, open abdomen, progressive pneumoperitoneum

Introduction

Loss of domain (LOD) refers to a condition in which a significant proportion of abdominal viscera resides outside the abdominal cavity, leading to a mismatch between visceral volume and available intra-abdominal space upon reintegration.[1] While this concept is well established in the

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management of large ventral hernias, its relevance in diaphragmatic hernias has not been adequately explored. Reduction of long-standing diaphragmatic hernias may precipitate intra-abdominal hypertension and abdominal compartment syndrome (ACS), both of which are associated with significant morbidity and mortality.[2] Current surgical approaches to diaphragmatic hernia repair largely focus on anatomical correction and rarely incorporate preoperative assessment of the abdominal domain compliance.

Here, we present a case that highlights the consequences of unrecognized LOD physiology and underscores the need to integrate functional and volumetric considerations into preoperative planning.

Case Report

A 21-year-old male presented with a long-standing left-sided diaphragmatic hernia. Preoperative imaging demonstrated herniation of abdominal viscera into the thoracic cavity [Figure 1]. The patient was planned for elective surgical repair. A diagnostic laparoscopy was done, which revealed a left-sided diaphragmatic hernia with stomach, transverse colon, and omentum as content. The abdominal wall was noted to be rigid during insufflation. Due to technical difficulties, the procedure was converted to an open approach. A bilateral subcostal incision was made. Intraoperatively, the herniated abdominal contents were reduced into the peritoneal cavity, and the diaphragmatic defect was repaired primarily and reinforced using prosthetic mesh. However, following the reduction, primary abdominal closure could not be achieved due to a markedly contracted and noncompliant abdominal cavity, with significant tension on attempted closure. Options for abdominal closure were then considered. A bilateral tranversus abdominis release was considered but could not be performed due to the existing bilateral subcostal incision. A Bogota bag was therefore applied to facilitate temporary abdominal closure [Figure 2]. The patient was electively kept under mechanical ventilation.

In the postoperative period, the patient developed progressive bowel edema, and the Bogota bag closure failed [Figure 3]. A re-exploration was performed, and an AbThera™ Abdominal Closure System (KCI USA, San Antonio, TX, USA) was used in an attempt to achieve

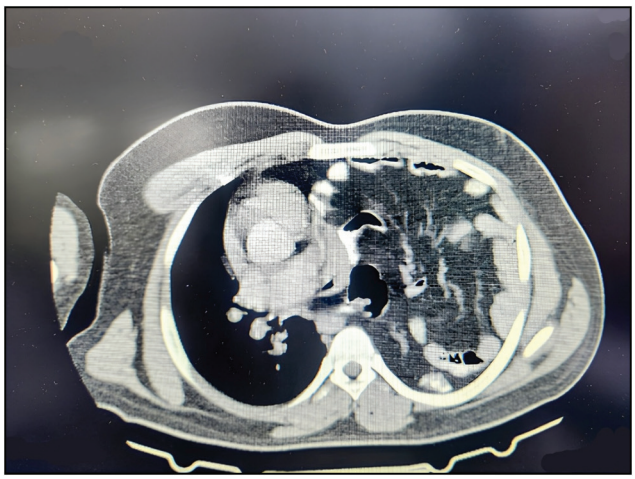


Figure 1: Preoperative computed tomography scan showing a large left diaphragmatic hernia containing the stomach, transverse colon, and omentum within the thoracic cavity

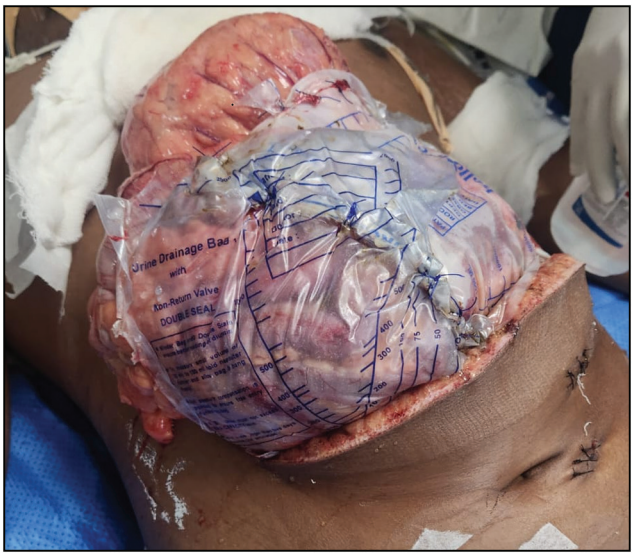


Figure 2: Application of the Bogota bag for temporary abdominal closure after failure of primary fascial approximation, illustrating an open abdomen strategy in the setting of domain mismatch

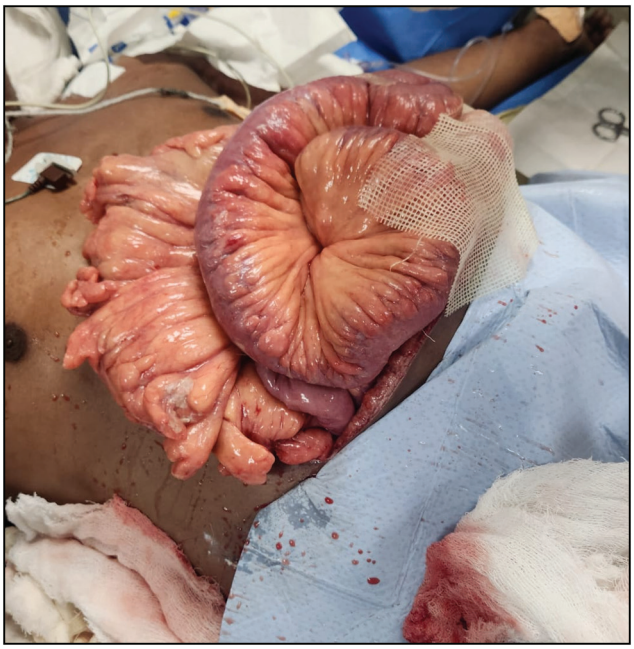


Figure 3: Failed Bogota bag in the postoperative period

fascial closure; [Figure 4]; however, this approach was also unsuccessful. Despite intensive care management, the patient continued to exhibit features of abdominal compartment physiology, including persistent bowel edema and progressive clinical deterioration. The condition remained refractory to all interventions, and the patient expired on postoperative day 21 [Table 1].

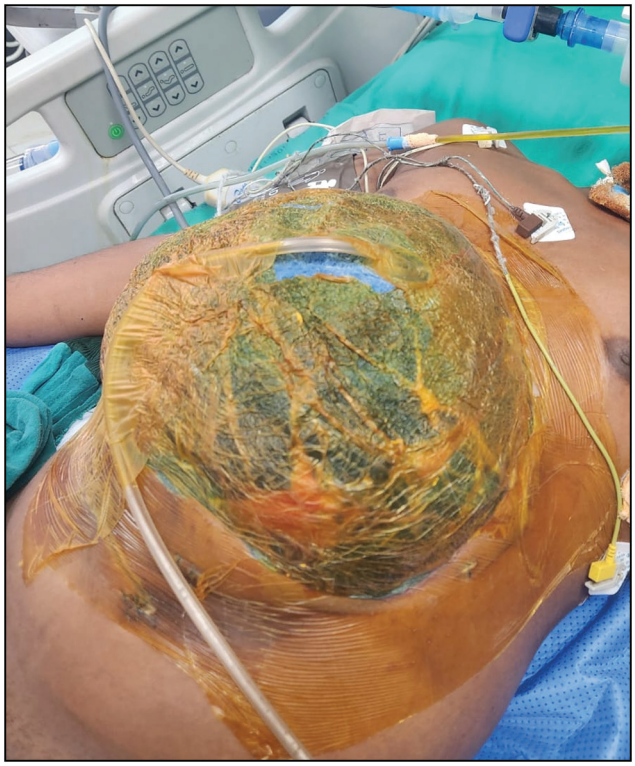


Figure 4: Re-exploration showing attempted abdominal closure using the AbThera™ negative pressure abdominal therapy system following failure of Bogota bag closure

Discussion

This case highlights a critical and under-recognized phenomenon: LOD physiology in diaphragmatic hernia, a condition traditionally associated with ventral abdominal wall defects. The fundamental issue in this case was a conceptual misclassification of the pathology. The operative approach was based on the assumption that the hernia was reducible with an adequately accommodating abdominal cavity, whereas, in reality, the patient had a long-standing displacement of viscera into the thoracic cavity, resulting in a chronically underutilized and likely contracted abdominal domain with reduced compliance. Reintegration of these contents into a restricted abdominal space resulted in a rapid rise in intra-abdominal pressure, initiating a cascade of venous congestion, bowel edema, and further pressure elevation, ultimately culminating in ACS. This pathophysiological sequence is well described in the ventral hernia literature but is seldom considered in diaphragmatic hernia repair.[2]

From a predictive standpoint, it is plausible that this complication could have been anticipated preoperatively. In ventral hernia surgery, indices such as the Tanaka index,[3] which measures the ratio of hernia sac volume to abdominal cavity volume, and the Sabbagh index,[4] which relates hernia sac volume to total peritoneal volume, are used to assess the feasibility of closure and predict the risk of postoperative ACS. Although these indices have not been validated in diaphragmatic hernias, the underlying principle of volume mismatch is conceptually the same. Therefore, their application in this context represents a logical extension rather than an unsupported extrapolation. The absence of formal

Table 1: Clinical timeline of events

Day/stage	Event	Details
Preoperative	Presentation	A 21-year-old male with long-standing left-sided diaphragmatic hernia
Preoperative	Imaging	Herniation of abdominal viscera into the thoracic cavity
Day 0 (surgery)	Diagnostic laparoscopy	Revealed stomach, transverse colon, and omentum as hernia contents; abdominal wall noted to be relatively rigid during insufflation
Day 0 (surgery)	Conversion to open	Due to technical difficulties
Day 0 (surgery)	Open procedure	Bilateral subcostal (chevron) incision performed
Day 0 (surgery)	Hernia repair	Contents reduced; diaphragmatic defect primarily repaired and reinforced with mesh
Day 0 (surgery)	Closure attempt	Primary abdominal closure not possible due to contracted, noncompliant abdominal cavity (high tension)
Day 0 (surgery)	Intraoperative decision	Component separation (TAR) was considered but not feasible due to the incision
Day 0 (surgery)	Temporary closure	Bogota bag applied
Day 0 onward	Postoperative care	Patient electively ventilated
POD 2	Early postoperative period	Progressive bowel edema noted
POD 5	Complication	Failure of the Bogota bag closure
POD 6	Re-exploration	Attempted abdominal closure using AbThera™ System
POD 6 onward	ICU course	Persistent abdominal compartment physiology; worsening bowel edema
POD 21	Outcome	Patient expired due to refractory abdominal compartment syndrome

POD: postoperative day, ICU: intensive care unit, TAR: transversus abdominis release

validation should be viewed as a gap in the literature rather than a limitation of the concept itself.

Several preoperative strategies could potentially have altered the outcome in this patient. Progressive preoperative pneumoperitoneum has been shown to gradually expand the abdominal cavity and improve compliance, thereby facilitating safe reintegration of herniated contents.[5] Similarly, administration of botulinum toxin A into the lateral abdominal wall musculature can induce temporary flaccid paralysis, increasing abdominal wall compliance and reducing closure tension.[6] These interventions, when used in combination, have demonstrated significant success in managing large ventral hernias with LOD and may have been beneficial in this case. Intraoperatively, a staged reduction approach or a planned open abdomen strategy might have been preferable to attempting definitive repair in a single sitting.[7] The use of component separation techniques[8] or the acceptance of a planned ventral hernia could have mitigated the risk of excessive intra-abdominal pressure. For this, an initial planning with a midline abdominal incision would have been beneficial. In situations where safe abdominal closure remains impossible despite complete reduction, additional strategies such as omentectomy, selective visceral debulking, acceptance of a planned ventral hernia, or staged reconstruction may need to be considered. Although such approaches are associated with their own morbidity, they may be preferable to uncontrolled ACS in carefully selected patients.

Postoperatively, repeated attempts at closure, first with a Bogota bag and subsequently with dual mesh, may have inadvertently worsened the underlying pathophysiology by perpetuating elevated intra-abdominal pressure and bowel edema.[9] Early recognition of the irreversible nature of this process and adoption of a damage-control approach might have improved the chances of survival, although it is acknowledged that once established, ACS often becomes refractory to intervention.[2] Following temporary abdominal closure, effectiveness should ideally be assessed through serial measurements of intra-abdominal pressure, abdominal perfusion pressure, ventilatory parameters, urine output, hemodynamic status, and evidence of organ dysfunction. Persistent elevations in intra-abdominal pressure (> 20 mmHg) associated with new organ dysfunction are diagnostic of ACS and should guide subsequent management. In retrospect, a more physiology-driven strategy focused on prolonged decompression and serial objective assessment rather than repeated closure attempts may have been advantageous.

An additional noteworthy finding in this case was the presence of a rigid and noncompliant abdominal wall. This may represent an acquired phenomenon resulting from chronic disuse, adaptive shortening of musculature, and fibrosis, rather than a primary syndromic association.[10] Unlike connective tissue disorders, which are typically associated with increased laxity, this scenario likely reflects a form of functional stiffness secondary to prolonged LOD.[11] This observation raises the possibility of an "acquired abdominal wall contracture" phenotype, which has not been well described in existing literature and warrants further investigation.[12]

The existing literature extensively documents LOD in the context of ventral hernias, and ACS following diaphragmatic hernia repair has been reported, albeit rarely. However, there is a lack of a unified framework to predict and manage domain mismatch in diaphragmatic hernias. This case contributes to the literature by demonstrating that the principles governing LOD are not confined to abdominal wall defects and should be applied more broadly based on underlying physiology rather than anatomical classification. It emphasizes the need for a paradigm shift toward preoperative functional assessment and individualized surgical planning in such cases.

A limitation of this report is the absence of preoperative volumetric analysis and the lack of serial postoperative intra-abdominal pressure measurements. These data would have allowed objective quantification of domain mismatch and abdominal compartment physiology. Nevertheless, the clinical course strongly supports the presence of severe functional LOD resulting in refractory ACS.

Learning Points

The learning points from this study are as follows:

(1) LOD physiology is not limited to ventral hernias and should be considered in long-standing diaphragmatic hernias with significant visceral displacement.
(2) Failure of abdominal closure after reduction is predictable, and preoperative volumetric assessment (e.g., Tanaka or Sabbagh indices) may help identify high-risk patients.
(3) Rigid or noncompliant abdominal wall during laparoscopy is an early intraoperative warning sign of potential domain mismatch.
(4) Single-stage complete reduction may be hazardous in patients with chronic herniation; staged reduction or planned open abdomen strategies should be considered.
(5) Preoperative conditioning techniques such as progressive pneumoperitoneum and botulinum toxin A may improve abdominal compliance and facilitate safer closure.
(6) Repeated attempts at forced abdominal closure can worsen ACS and should be avoided once tension is prohibitive.
(7) Early recognition and management of ACS is crucial, as delayed intervention often leads to irreversible bowel edema and mortality.
(8) This case highlights the need for a shift from anatomy-based to physiology-based surgical planning in complex hernia scenarios.

Conclusion

Diaphragmatic hernia repair in long-standing cases should not be approached as a purely anatomical problem. LOD physiology must be considered, as failure to recognize it can lead to fatal ACS. Preoperative volumetric assessment and staged abdominal conditioning strategies may play a crucial role in improving outcomes and should be considered in selected patients.

Author contributions

NG conceptualized and supervised the study and was involved in surgical management and manuscript review. NK contributed to patient management, data collection, and manuscript drafting. HA contributed to the literature review, manuscript writing, and critical revision of the intellectual content. ADS contributed to surgical management and manuscript review. DS contributed to data interpretation and final manuscript editing. All authors reviewed and approved the final manuscript.

Ethical policy and Institutional Review Board statement

Ethical approval was not required for this case report according to the policy of the Institutional Ethics Committee (IEC), Atal Bihari Vajpayee Institute of Medical Sciences and Dr. Ram Manohar Lohia Hospital, New Delhi, India. This policy exempts individual case reports from formal ethics committee review when no experimental intervention is performed and patient confidentiality is maintained. This study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Declaration of patient consent

Written informed consent for publication of clinical details and images was obtained from the patient's relatives.

Data availability statement

The data supporting the findings of this study are included within the article. Additional details are available from the corresponding author upon reasonable request, subject to patient confidentiality and institutional regulations.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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References

1. 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 2019;43:396-404.
2. Papavramidis TS, Marinis AD, Pliakos I, Kesisoglou I, Papavramidou N. Abdominal compartment syndrome – intra-abdominal hypertension: Defining, diagnosing, and managing. J Emerg Trauma Shock 2011;4:279-91.
3. Girieasen MS, Lakshmanan A, Farook M. A preoperative algorithm for loss of domain hernia repair: Stratified management using the Tanaka index in 50 cases. J Abdom Wall Surg 2025;4:14769.
4. Barbosa CA, Faria MHS, Messias BA. Predictive factors for complexity in abdominal wall hernias: A literature scope review. Rev Col Bras Cir 2024;51:e20243670.
5. Elstner KE, Moollan Y, Chen E, Jacombs ASW, Rodriguez-Acevedo O, Ibrahim N, *et al*. Preoperative progressive pneumoperitoneum revisited. Front Surg 2021;8:754543.
6. Soltanizadeh S, Helgstrand F, Jorgensen LN. Botulinum toxin A as an adjunct to abdominal wall reconstruction for incisional hernia. Plast Reconstr Surg Glob Open 2017;5:e1358.
7. Fernández LG. Management of the open abdomen: Clinical recommendations for the trauma/acute care surgeon and general surgeon. Int Wound J 2016;13:25-34.
8. Heller L, McNichols CH, Ramirez OM. Component separations. Semin Plast Surg 2012;26:25-8.
9. Zahid MJ, Hussain M, Kumar D, Hamza M, Zeb Jan SA, Safdar H, *et al*. A descriptive analysis of skin-only closure and Bogota bag techniques for achieving complete fascial closure in damage control abdominal surgery. BMC Surg 2024;24:192.
10. DuBay DA, Choi W, Urbanchek MG, Wang X, Adamson B, Dennis RG, *et al*. Incisional herniation induces decreased abdominal wall compliance via oblique muscle atrophy and fibrosis. Ann Surg 2007;245:140-6.
11. Nakamura K, Tajima Y, Takai O. Generalized laxity of connective tissue as a possible syndrome in systemic lupus erythematosus. Mod Rheumatol 2010;20:522-7.
12. Pechriggl E, Blumer M, Tubbs RS, Olewnik L, Konschake M, Fortélny R, *et al*. Embryology of the abdominal wall and associated malformations—A review. Front Surg 2022;9:891896.