

Case Report

Controlling intraoperative laparoscopy-induced pneumothorax using a novel technique

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ABSTRACT

Pneumothorax (PTX) is defined as an abnormal accumulation of gas in the pleural space. There is a potential development of PTX during laparoscopy since gas insufflation is used. Management options are available to control PTX intraoperatively, and herein we describe a new technique that can be implemented with unique features. A 32-year-old patient with morbid obesity was scheduled for laparoscopic adjustable gastric band (AGB) removal and laparoscopic sleeve gastrectomy (LSG). During the removal of AGB, a hiatal hernia was noticed. Dissection of the hernia led to PTX. Images were collected from the procedure video to describe our technique in controlling laparoscopy-induced PTX. Upon noticing PTX, actions were taken promptly using our technique. The anesthesia team was alerted, the abdomen was deflated, and the table was positioned to Trendelenburg. The PTX was controlled using a 14fr feeding tube advanced through the dissected esophageal hiatus, with the external end submerged under saline. The procedure was completed with no complications. Our technique in controlling laparoscopy-induced PTX is effective in certain situations. The technique assures completing the procedure without hindrance with minimal morbidity.

Keywords: Laparoscopy, Hiatal hernia, Pneumothorax, Bariatric surgery

INTRODUCTION

Pneumothorax (PTX) is a complication potentially occurring during laparoscopy. Several mechanisms can cause PTX, including iatrogenic tear of the parietal pleura during hiatal hernia repair or gas flowing through congenital defects in the diaphragm.¹ The literature mentioned the rate of intraoperative PTX to range between 1% to 22 %.^{2,3} In one retrospective study, the incidence of PTX was significantly higher with laparoscopic procedures at the esophageal hiatus (10%) compared to other types of laparoscopic procedures (1%).⁴ Upon the development of PTX, reports mentioned different options aiming to control and manage PTX. This study aims to describe our technique managing

intraoperative laparoscopically induced PTX that can be added to the surgeon's arsenal, in addition to reviewing the literature.

CASE REPORT

A 32-year-old female with morbid obesity was admitted electively for revisional surgery because of weight regain after insertion of AGB. The procedure planned was removing AGB followed by LSG. The abdomen was accessed through an incision located at 5 cm cranial and lateral to the umbilicus using a 5 mm vesiport under camera guidance. Intrabdominal pressure was set to 15 mmHg and the flow to 20 L/min. The other ports inserted as follows: 5 mm port at left upper quadrant, 12 mm port

5 cm lateral to umbilicus, 5 mm port at right upper quadrant, and liver retractor (Nathanson retractor) applied through a subxiphoid incision.

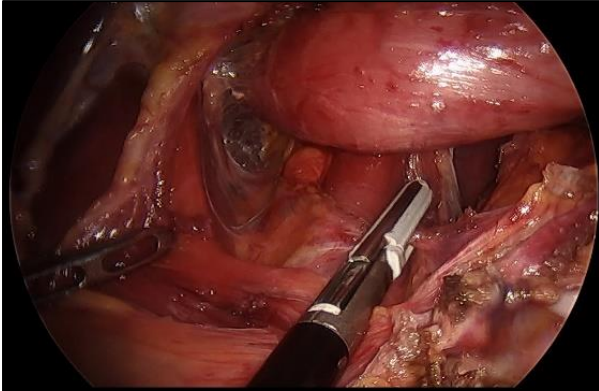


Figure 1: Dissection of the hiatal hernia.

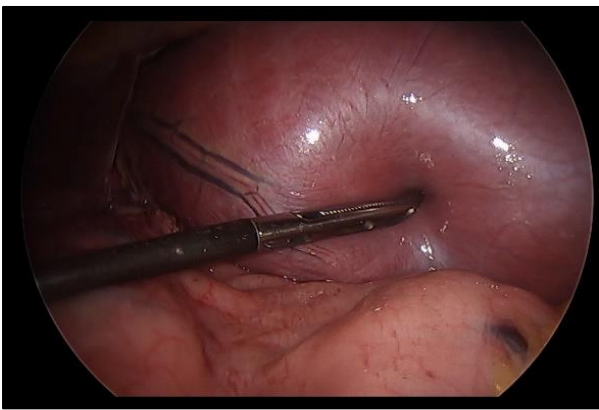


Figure 2: The floppy diaphragm.

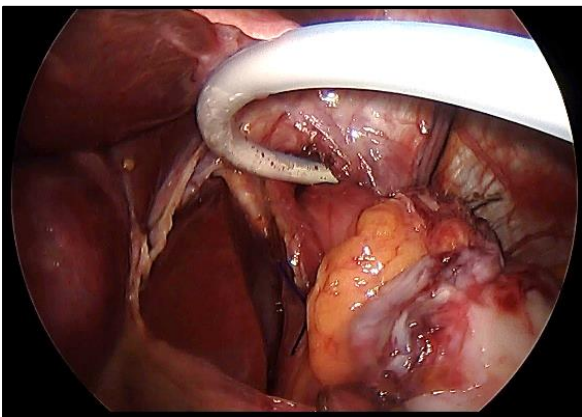


Figure 3: Drain insertion through the esophageal hiatus.

The liver is pushed up till visualizing the esophageal hiatus. After dissecting the AGB freely from the stomach, a hiatal hernia was identified. Dissection at the esophageal hiatus continued freeing adhesions and preparing for repair with nonabsorbable monofilament sutures applied anterior and posterior. (Figure 1) A

bulging of the left diaphragm was noticed (Figure 2), and the anesthesia was informed about the potential of PTX development. The changes in the ventilatory parameters were as follows: airway pressure increased from 25 mmHg to 40 mm Hg, endotracheal CO₂ (ETCO₂) decreased from 32 mmHg to 20 mmHg, Oxygen saturation decreased from 100 to 88, the blood pressure and the heart rate did not change.

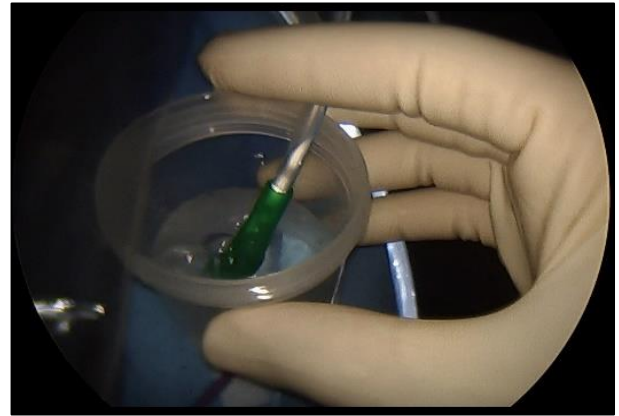


Figure 4: The distal end of the drain submerged under saline, bubbles can be seen.

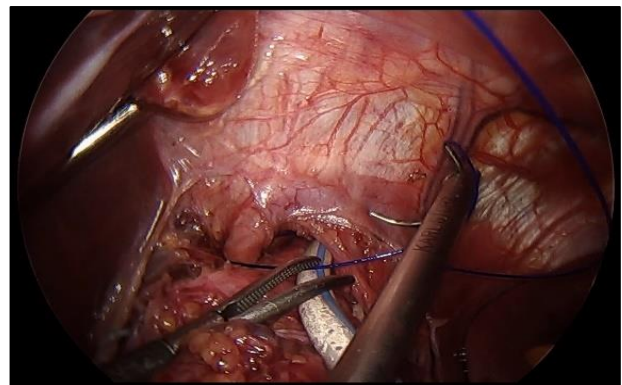


Figure 5: Repair of the hernia while the drain is in place.

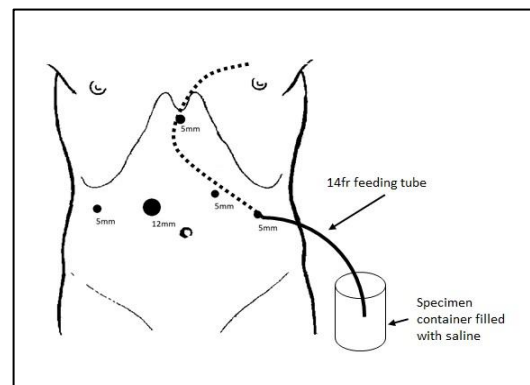


Figure 6: The dotted line is the intrabdominal tube going through the 5 mm port and entering the left thorax through the esophageal hiatus.

The anesthetist increased the fraction of inspired oxygen to 100%. The abdomen was partially deflated, intraabdominal pressure reduced to 8 mmHg, and the gas flow was set to 5 l/min. A 14fr nasogastric tube (Ryles tube) was inserted using the left upper quadrant port and inserted through the hiatus directed to the left hemithorax. (Figure 3) The external end of the tube was submerged in a deep specimen bottle full of saline, acting as an underwater seal; if the insertion is successful, continuous bubbling should be noted. (Figure 4) all the ventilatory parameters normalized, the gas insufflator setting was put back to the previous setting, and the patient was hemodynamically stable during the whole procedure. The procedure was continued and completed while the tube is in place. (Figure 5) After concluding the procedure, the 12 mm port was closed using multifilament suture with endoclose, ports were removed under vision, except for the one with the feeding tube. The anesthesia team was asked to perform a Valsalva maneuver while observing the tube for any remnant air coming through the tube. After confirming the absence of remnant air, the Valsalva maneuver was continued while withdrawing the tube slowly. The patient was extubated and shifted to the recovery room, and was monitored regularly for any chest pain, shortness of breath, respiratory distress, or hypoxia. Chest x-ray showed no residual PTX. She was discharged the next day with no complaints and seen in the clinic two weeks later and reported no postoperative concern.

DISCUSSION

Pneumothorax (PTX) is a possible intraoperative complication during laparoscopy, especially when dissection at esophageal hiatus is needed, like in Nissen fundoplication or hiatal hernia repair. Mrudock et al suggested that the reason for higher PTX during laparoscopic Nissen fundoplication is the length of surgery, although the procedure itself did not appear as a risk factor.⁴ Others suggested that dissection near the pleura, especially of the left lung, is probably the main reason PTX develops in these procedures due to breaching the pleura.³ The same concept applies to hiatal hernia repair, where dissection near the pleura is inevitable, and the risk for PTX is highly anticipated.⁵

When PTX occurs to an extent where it exhibits manifestations, it can present in different ways. The most commonly reported signs are the increased end-tidal CO₂ (ETCO₂), increased airway pressure, decreased oxygen saturation, decreased breath sound by auscultation, and hemodynamic instability if a significant PTX developed, leading to tension PTX.^{3,6} Other signs that the surgeon might notice during laparoscopy is the “floppy diaphragm”, where the diaphragm loses its concavity and bulges toward the abdomen as CO₂ fills up the pleural cavity. Using transthoracic ultrasonography is an appealing and fast way to confirm the presence of PTX compared to the conventional x-ray.⁷

The management of PTX developing during laparoscopy ranged from conservative management such as the evacuation of the pneumoperitoneum, using positive end-expiratory pressure (PEEP) intercostal cannulas, to chest tube insertion other options. Include attempting to repair the pleural injury if accessible.^{3,9-14} the chance of residual PTX after pleural repair and concluding the surgery should not be neglected and might need further management by placing a chest tube.¹⁵

The literature mentioned different option on how to manage PTX developing during laparoscopy, which ranged from conservative management such as the evacuation of the pneumoperitoneum to inserting chest tubes. Our proposed technique was implemented on several patients during laparoscopy who developed PTX intraoperatively. We believe that this technique has several appealing advantages. Firstly, it can control the PTX from progressing by taking advantage of the already available esophageal hiatus as a route to access the PTX and achieve evacuation of the gas, thus avoiding the need to insert an intercostal needle or chest tubes. If PTX developed due to pleural breach and the abdomen deflated to prevent progression or achieve stabilization, attempting to repair might be challenging and would add more time to the procedure. Additionally, the residual PTX discovered after the procedure will necessitate drain insertion or a chest tube for evacuation. The technique allows continuing the procedure with no hindrance, i.e. deflating the abdomen multiple times or conducting the procedure on a low insufflator setting. The chance of residual PTX can be nullified at the end of the procedure by doing the Valsalva maneuver. We used this technique in all similar cases encountered in our practice of around 16 patients, and none had any residual pneumothorax or needed chest tube or drain insertion postoperatively. Chest x-ray following the procedure and after 6 hours from the surgery, and all patients who had the image showed no residual PTX.

Of course, this technique cannot be applied to all incidents of PTX during laparoscopy, i.e. PTX developing due to reasons other than breaching the pleura and having the esophageal hiatus ready as a port for drainage insertion (e.g. diaphragmatic injury or congenital defects). Also, this technique might necessitate inserting another port to complete the procedure due to utilizing one of the existing ports for the drain insertion.

CONCLUSION

PTX is not an uncommon complication during laparoscopy, and if not noticed and resolved quickly, it could lead to significant morbidity. If pleural is breached and PTX developed, different management options are available. Our quick and straightforward technique can be utilized to cease PTX progression, complete the procedure with no interruptions, and assures evacuation of residual PTX.

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