Case Report

Pneumothorax during laparoscopic repair of giant paraesophageal hernia

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Abstract

Giant paraesophageal hernia is an uncommon morbid disorder which may present a risk of catastrophic complications and should be repaired electively as soon as possible. Laparoscopic fundoplication is the mainstay of surgical management of this disorder due to several advantages such as lower post-operative morbidity and pain. We report a case of a 70-year-old patient with a giant paraesophageal hernia, who developed subcutaneous emphysema with pneumothorax during laparoscopic fundoplication. Early diagnosis was possible by close clinical evaluation and simultaneous monitoring of end-tidal carbon dioxide levels and airway pressures. Although positive end-expiratory pressure application is an effective way of managing pneumothorax secondary to the passage of gas into the interpleural space, insertion of an intercostal drain may be used in an emergent situation.

Key words: Laparoscopy; paraesophageal hernia; pneumothorax; subcutaneous emphysema

Introduction

Paraesophageal hernia (PEH) is a rare condition, occurring in about 5% of all hiatal hernia. It is more common in women after the age of 60 years.[1] Various advantages, such as reduced post-operative pain, shorter hospital stay and rapid convalescence, make laparoscopy the surgical technique of choice for repair by fundoplication of the PEH, especially in high risk elderly population.[2,3]

There are high chances of complications related to carbon dioxide (CO_2) insufflation, such as subcutaneous emphysema, pneumothorax, pneumomediastinum, and pneumopericardium. Increasing airway pressures and end-tidal carbon dioxide ($EtCO_2$) and decreasing peripheral oxygen saturation (SpO_2) may indicate development of pneumothorax.[4] We report a case of laparoscopic repair of a giant PEH, in whom early diagnosis and prompt management of life-threatening subcutaneous emphysema and pneumothorax was possible because of vigilant monitoring. We discuss problems in anesthetic management and treatment strategies for managing pneumothorax during laparoscopy.

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Case Report

A 60 kg, 70 year woman presented to the hospital with complaints of post-prandial epigastric pain, occasional post-prandial dyspnea, and regurgitation of food since 4 years. Conservative anti-reflux medication had not benefited her. Oral contrast computerized tomography scan showed herniation of stomach, spleen, and pancreas into the thoracic cavity [Figure 1]. The patient was diagnosed as a case of large type IV (giant) PEH and scheduled for laparoscopic repair of the PEH with Nissen fundoplication.

Pre-operative evaluation revealed that the patient was a known hypertensive controlled on oral amlodipine 5 mg and atenolol 50 mg taken once daily. She had grade III dyspnea with a breath holding time of 14 s. Airway examination was normal but she had mild degree of thoracolumbar kyphoscoliosis. Echocardiographic evaluation was normal. Pulmonary function tests revealed a restrictive pattern of lung disease and arterial blood gas analysis on room air showed pH 7.39, PaO_2 70 mmHg and $PaCO_2$ 36 mmHg.

The patient was pre-medicated with oral alprazolam 0.25 mg and ranitidine 150 mg, the night before surgery and again 2 h prior to surgery. Antihypertensive medication was continued till the morning of surgery. On arrival in the operating room, pulse rate was 66/min, blood pressure (BP) 138/84 mmHg and SpO_2 93% on room air. An epidural catheter was placed at the T9–T10 level. Patient was given morphine 0.1 mg/kg and midazolam 1 mg intravenous (IV). After pre-oxygenation, a rapid sequence induction/intubation was performed after administration of thiopentone 4 mg/kg and suxamethonium 1.5 mg/kg IV. Anesthesia was maintained with oxygen, nitrous oxide (N_2O), isoflurane (0.5-1%), and rocuronium. Controlled ventilation was instituted with a tidal volume of 600 ml and a rate of 12/min using a Penlon A-200 SP ventilator. A right internal jugular catheter and a nasogastric tube were placed after induction. Morphine 2.5 mg in 6 ml saline was given via the epidural catheter. The vital parameters, end-tidal carbon dioxide ($EtCO_2$), and airway pressures were monitored. CO_2 pneumoperitoneum was created by using pressure-controlled high flow insufflator to an intra-abdominal pressure (IAP) of 12-15 mmHg.

The intra-operative period was uneventful for approximately 6 h but toward the end of the surgery, the patient's pulse rate and BP showed a rising trend along with an increasing airway pressures and $EtCO_2$ values. The plane of anesthesia was deepened and the anesthesia circuit and endotracheal tube checked for kinks or obstruction. We tried to decrease the peak airway pressures by decreasing the tidal volume from 600 to 550 ml and the respiratory rate was increased to 14/min. However, within a span of 7-8 min, the peak airway pressures reached 50 cmH_2O and $EtCO_2$ values approached 90 mmHg.

Chest auscultation revealed decreased air entry over the left hemithorax and arterial blood gas analysis showed an uncompensated respiratory acidosis (pH 7.25, PaO_2 102 mmHg and $PaCO_2$ 98 mmHg). A crepitus was palpable over chest and neck extending till the face. The surgeons discovered a rent in the left parietal pleura. A diagnosis of iatrogenic left pneumothorax with subcutaneous emphysema was made [Figure 2].

N_2O was discontinued and the surgeons were asked to deflate the pneumoperitoneum. An intercostal drain was inserted and within 10 min, the airway pressures and $EtCO_2$ returned to baseline values. However, to continue the procedure, surgeons had to increase the CO_2 insufflation rate from 6 to 8 L/min.

At the end of the surgery, the patient was shifted to ICU for elective ventilation. Chest X-ray showed subcutaneous emphysema in the neck and thorax and intercostal drain in situ,

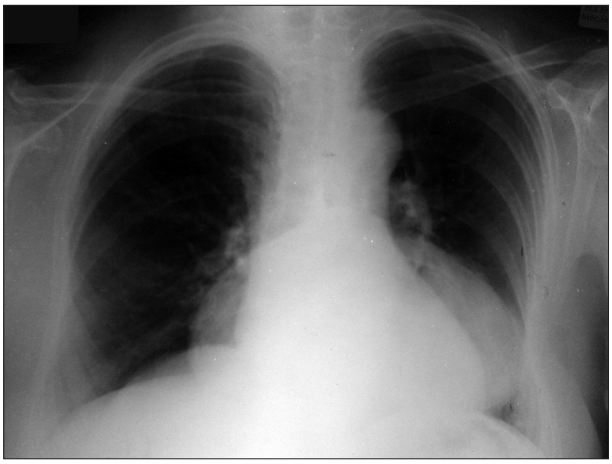

Figure 1: Chest X-ray of the patient showing a radio-opaque rounded shadow alongside the cardiac silhouette. This radio-opaque shadow is the hernial sac.

Figure 2: Iatrogenically created rent in the left parietal pleura.

without any evidence of pneumothorax or pneumomediastinum. Post-operative pain was managed with morphine 3 mg in 8 ml saline via the thoracic epidural catheter 12 hourly. Weaning from the ventilator was gradually done and trachea extubated after 48 h. The chest drain was removed after complete lung expansion, on the third post-operative day. Her ICU stay was uneventful.

Discussion

Giant PEH is a hiatal hernia in which besides the stomach and gastroesophageal junction, other viscera, such as colon, small bowel, spleen, or pancreas are present in the hernia sac.[1]Its incidence is higher in the elderly population possibly as a result of progressive weakening and enlargement of the diaphragmatic hiatus with advancing age.[2,5]It is reported to be associated with thoracolumbar kyphoscoliosis.[6] There is a associated high risk of catastrophic complications that include bleeding, strangulation, incarceration, volvulus and perforation and so it should be repaired electively soon after recognition to prevent the development of these potentially

life-threatening complications.[1,7]

Repair of PEH can be difficult for the surgeon as there is a need to resect a large sac. It presents additional challenges to an anesthesiologist too.[2] The main anesthetic considerations include geriatric age group, associated comorbidities, concomitant multiple drug therapies, presence of gastro-esophageal reflux, and low cardiopulmonary reserve due to herniation of abdominal contents into the thorax, compounded by kyphoscoliosis and old age. All these factors were found in our patient. The intra-operative concerns are related mainly to the surgical positioning and the effects of CO_2 pneumoperitoneum. The patient is placed in supine position, with slight (10-15°) reverse Trendelenberg, legs abducted and the operator standing between the legs.[1,3] In the post-operative period, pain relief and need for elective ventilation are the main concerns.

Subcutaneous emphysema and pneumothorax are known complications during laparoscopic surgeries especially around the esophagus. Left pneumothorax is one of the most common intra-operative complications since the left parietal pleura is exposed and can be torn during dissection around the diaphragmatic hiatus.[8] The incidence of pneumothorax varies from 0 to 8% depending on the surgeon's expertise.[9] Although subcutaneous emphysema itself is not a serious complication, but it may be the harbinger of pneumothorax.[10] The risk factors for the development of subcutaneous emphysema are $EtCO_2$ of 50 mmHg or greater, the use of six or more operative ports and operative time over 200 min. In addition, laparoscopic upper abdominal surgery is an independent risk factor for pneumothorax.[11] All these risk-factors were present in our patient.

Whenever surgical emphysema is detected during laparoscopic surgery, pneumothorax must be ruled out. If not associated with pneumothorax, the only treatment required is to temporarily interrupt the surgery and increase the minute ventilation to allow CO_2 elimination. Surgery may then be resumed using lower insufflation pressures. The presence of pneumothorax, on the other hand, requires urgent and aggressive management.[10] N_2O must be discontinued and pneumoperitoneum deflated. Strategies for further management include insertion of an intercostal drain, application of positive end-expiratory pressure, and plugging the pleural rent. Insertion of an intercostal drain, although the treatment of choice for pneumothorax due to other causes, is not indicated in laparoscopic surgeries, as it causes loss of pneumoperitoneum, creating suboptimal conditions for the continuation of surgery.[12]

Joris *et al*[13] used PEEP as an alternative to chest tube placement and found that PEEP largely corrected the respiratory changes associated with pneumothorax. It helps by decreasing the pressure gradient between the abdominal and pleural cavities not only during inspiration but also during expiration and subsequently inflating the lung. Re-expansion of the lung with PEEP can mechanically seal the surgically induced tear in the parietal pleura. An alternative treatment is to ask the surgeon to plug the rent in the pleura with the help of omentum. Minute ventilation is then increased to eliminate the excess $PaCO_2$. Although this may be time consuming, it has been successfully used by Singhal *et al*.[12]

In our patient, N_2O was switched off and abdomen deflated as soon as pneumothorax was detected. However, the increasing airway pressures and rising $EtCO_2$ levels made ventilation difficult, necessitating chest tube insertion before patient condition deteriorated further. Although pneumoperitoneum was lost, surgeons were able to complete the surgery with lower IAP using higher insufflation rate of CO_2.

To conclude, awareness of the risk and high index of suspicion for development of pneumothorax are needed during laparoscopic procedures around the diaphragmatic hiatus. $EtCO_2$ and airway pressures monitoring is mandatory. Any sudden and brisk increase in these parameters should prompt a search for subcutaneous emphysema or pneumothorax.

References

1. Hawasli A, Zonca S. Laparoscopic repair of Paraesophageal Hiatal Hernia. Am Surg 1998;64:703-10.
2. Gangopadhyay N, Perrone JM, Soper NJ, Matthews BD, Eagon JC, Klingensmith ME,*et al*. Outcomes of laparoscopic paraesophageal hernia repair in elderly and high-risk patients. Surgery 2006;140:491-9.
3. Leeder PC, Smith G, Dehn TC. Laparoscopic management of large paraesophageal hernia. Surg Endosc 2003;17:1372-5.
4. Rajan GR, Foroughi V. Mainstem Bronchial Obstruction during Laparoscopic Fundoplication. Anesth Analg 1999;89:252-4.
5. Grotenhuis BA, Wijnhoven BP, Bessell JR, Watson DI. Laparoscopic antireflux surgery in the elderly. Surg Endosc 2008;22:1807-12.
6. Schuchert M, Prasad A, Cook CC. Prevalence of Kyphoscoliosis among Patients with Giant Paraesophageal Hernia: Proposed Pathophysiology and Clinical Significance. Gastroenterology 2008;134:A-867.
7. Geha AS, Massad MG, Snow NJ, Baue AE. A 32-year experience in 100 patients with giant paraesophageal hernia: The case for abdominal approach and selective antireflux repair. Surgery 2000;128:623-30.
8. Coelho JC, Campos AC, Costa MA, Soares RV, Faucz RA. Complications of Laparoscopic Fundoplication in the Elderly. Surg Laparosc Endosc Percutan Tech 2003;13:6-10.
9. Kiviluoto T, Sirén J, Färkkilä M, Luukkonen P, Salo J, Kivilaakso E. Laparoscopic Nissen fundoplication: A prospective analysis of 200 consecutive patients. Surg Laparosc Endosc 1998;8:429-34.
10. Wahba RW, Tessler MJ, Kleiman SJ. Acute ventilatory complications during laparoscopic upper abdominal surgery.Can J Anaesth 1996;43:77-83.

11. Murdock CM, Wolff AJ, Van Geem T. Risk factors for hypercarbia, subcutaneous emphysema, pneumothorax, and pneumomediastinum during laparoscopy. Obstet Gynecol 2000;95:704-9.
12. Singhal T, Balakrishnan S, Hussain A, Grandy-Smith S, Paix A, El-Hasani S. Management of complications after laparoscopic Nissen's fundoplication: A surgeon's perspective. Ann Surg Innov Res 2009;3:1-9.
13. Joris JL, Chiche JD, Lamy ML. Pneumothorax During Laparoscopic Fundoplication: Diagnosis and Treatment with Positive End-Expiratory Pressure. Anesth Analg 1995;81:993-1000.

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