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CLINICAL REPORT

Anesthetic management of a patient with congenital diaphragmatic eventration

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Abstract Congenital diaphragmatic eventration is uncommon in adults and is caused by paralysis, aplasia or atrophy of the muscular fibers of the diaphragm. It may cause severe dyspnea, orthopnea and hypoxia in adult patients. Most symptomatic patients may be managed efficiently without the need for surgical correction, although any event that leads to an increase in intra-abdominal pressure puts them at the risk of spontaneous diaphragmatic rupture. This case report presents the successful anesthetic management of an adult female with congenital diaphragmatic eventration undergoing diagnostic laparoscopy and hysteroscopy using a total intravenous anesthesia technique. Essential steps to prevent any rise in intrathoracic and intra-abdominal pressures along with care to minimize intragastric volume were taken.

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Introduction

Diaphragmatic eventration is an abnormal elevation of the diaphragm resulting from aplasia, atrophy or paralysis of the muscular fibers of the diaphragm [1]. It can be either congenital (insufficient or absent muscularization of the pleuroperitoneal membrane) or acquired (phrenic nerve injury/palsy) [2, 3]. The diagnosis of most cases of diaphragmatic eventration can be confirmed by antero-posterior chest radiography and fluoroscopy together with the relevant medical history [4]. This case report presents the anesthetic management of an adult female suffering from primary infertility with diaphragmatic eventration who underwent diagnostic hysteroscopy and laparoscopy.

Case report

A 21-year-old women (weight 46 kg) was posted for elective diagnostic laparoscopy and hysteroscopy for primary infertility. During the pre-anesthetic check-up, the patient complained of discomfort and a gurgling sensation in the left side of her chest, particularly after taking meals. There were complaints of frequent chest infections since childhood which, however, responded to antibiotic treatment. There was no past history suggestive of gastric reflux, dyspnea, trauma or thoraco-abdominal surgery. Physical examination revealed deviation of the trachea to the right, a decrease in breath sounds along with apparent bowel sounds in the left axillary area and a shift of the apex beat to the right. The respiratory and cardiovascular

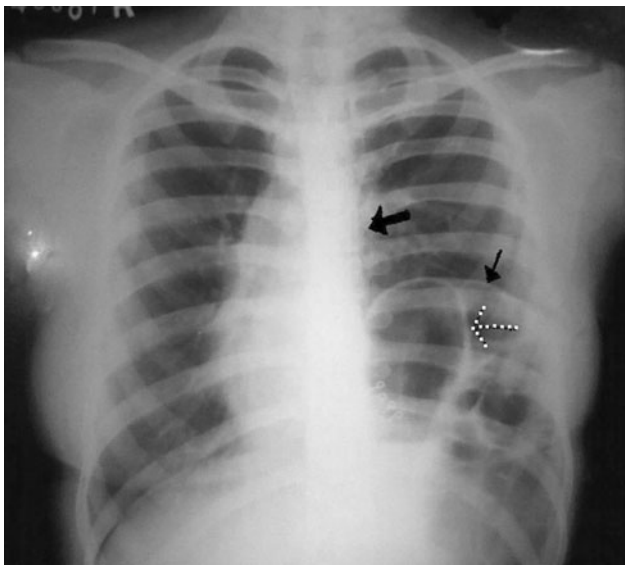

Fig. 1 Anteroposterior chest radiograph showing elevated dome of left hemidiaphragm (*black thin arrow*) with fundic bubble (*white dotted arrow*) and mediastinal shift (*black wide arrow*)

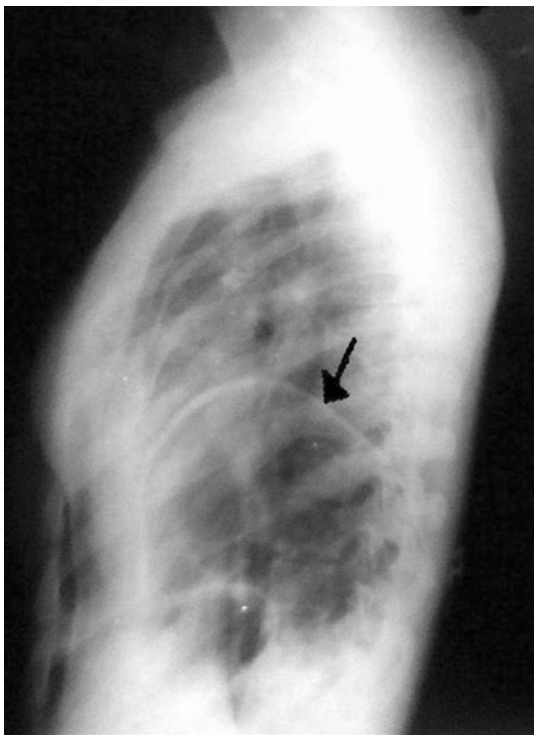

Fig. 2 Left lateral chest radiograph showing left elevated hemidiaphragm with fundic bubble (*arrow*)

examination was otherwise normal. Evaluation of the upper airway and preoperative biochemical investigations were also within normal limits. The anteroposterior and lateral chest X-rays revealed elevation of the left hemidiaphragm with a fundic bubble lying in the chest (Figs. 1, 2) along with contra-lateral mediastinal shift (Fig. 1), suggestive of either eventration or diaphragmatic palsy. There was no evidence of any chest infection. Fluoroscopy revealed eventration of the left hemidiaphragm. The results of pulmonary function tests and arterial blood gas analysis were normal.

Diagnostic laparoscopy and hysteroscopy were planned under total intravenous anesthesia (TIVA). The patient was put on antibiotics preoperatively and was advised to take a metoclopramide tablet 10 mg once daily beginning 2 days prior to surgery. She was kept on liquid diet 24 h before surgery, and mechanical bowel preparation was performed prior to the procedure. She was not allowed to consume solid food or fluid through the mouth (nil orally) from 10 p.m. on the night before surgery and was given a ranitidine tablet 150 mg and alprazolam tablet 0.25 mg the night before and 2 h prior to surgery. Inside the operation room (OR), routine monitors [electrocardiogram (ECG), non-invasive blood pressure (NIBP), pulse oximeter oxygen saturation (SpO_2)] were attached to the patient, and an 18G IV cannula was sited on the dorsum of left hand. Fentanyl 2 μg/kg along with midazolam 2 mg was given intravenously (IV) as premedication. The patient was preoxygenated with 100% oxygen for 3 min after which anesthesia was induced with propofol 2.5 mg/kg; neuromuscular blockade was achieved with succinylcholine 1.5 mg/kg. Positive pressure ventilation with a face mask was avoided, cricoid pressure was applied, and after 60 s the LMA ProSeal (LMA-PS; LMA PacMed, Burnley, Australia) size 3 supraglottic airway device was successfully inserted using a bougie-guided technique. Adequate air was inserted into the cuff of the LMA-PS to achieve an intra-cuff pressure of 60 cm H_2O, and the seal pressure was determined to be about 30 cm H_2O, which was deemed appropriate for the proposed surgical procedure. Proper placement of the LMA PS was further confirmed by flexible fiberscopy and correct and easy placement of a Ryle's tube through the drain channel of the LMA-PS. There was no aspirate upon suctioning the nasogastric tube.

General anesthesia was maintained with propofol infusion 150–300 μg/kg/min, oxygen–air mixture and a single bolus dose of atracurium, with pressure control ventilation (inspiratory pressure 18 cm H_2O, PEEP 0, respiratory rate 14 per minute). The $EtCO_2$ was maintained between 30–35 mmHg, and intra-abdominal pressures with carbon dioxide pneumoperitoneum were kept below 10 mm Hg throughout the procedure. Ryle's tube was slightly withdrawn above the lower esophageal sphincter (LES) intermittently, after gastric aspiration, to avoid any interference with the sphincter tone. The surgical procedure lasted for 30 min. The intraoperative period was uneventful. Tramadol (1 mg/kg) and ondansetron 5 mg were given 15 min prior to the end of surgery. Local anesthetic infiltration was

done at port sites for postoperative pain relief. After adequate neuromuscular recovery, as evidenced on the neuromuscular monitor, neostigmine 2.5 mg and glycopyrrolate 0.40 mg were given. Ryle's tube aspiration was done, and the LMA-PS was removed once the patient was fully awake. The total nasogastric aspirate obtained throughout the procedure was around 10 ml. The patient was observed in the OR for 1 h and had an uneventful course. Postoperative analgesia was maintained with an injection of diclofenac 75 mg intramuscularly at 8-h intervals. The patient was discharged on the fourth postoperative day without any complications.

Discussion

Diaphragmatic eventration is a rarely encountered condition. The adult patient may be asymptomatic or present with mild symptoms. These patients may complain of respiratory problems (repeated chest infections, dyspnea, orthopnea, reduction in lung volumes and hypoxia), gastrointestinal disorders and palpitation due to the mass effect [5]. The chest radiograph alone may not establish the diagnosis during preoperative evaluation, and fluoroscopy may be necessary to confirm the diagnosis.

Symptomatic adult patients who do not respond to upright positioning, antibiotic therapy and oxygen therapy may require surgical correction of diaphragmatic eventration [6]. The history of frequent but mild chest infections responsive to supportive therapy in this case obviated the need for any surgical correction prior to laparoscopy and hysteroscopy.

There is paucity of literature regarding the anesthetic management of diaphragmatic eventration in adults. The management principles resemble those involved in the management of congenital diaphragmatic hernia. Proper hydration of the patient should be ensured, and a large-bore intravenous access should be secured. Meticulous monitoring of the patient's vital signs is particularly essential. Sudden rupture of the weakened diaphragm may result from any event that leads to an increase in intra-abdominal pressure, such as coughing, straining during light anesthesia or extubation [5]. If the eventration changes into a true rupture, the relocation of the abdominal viscera into the intrathoracic cavity may cause a mass effect, leading to direct compression of the heart and further mediastinal shift and ultimately resulting in decreased cardiac output from impaired venous return to the heart due to kinking of the vena cava and pulmonary veins [7]. Thus, an adequate depth of anesthesia is required in these patients undergoing surgery, especially during the induction of anesthesia and extubation. Any coughing, bucking or straining at these times may lead to rupture of the weakened diaphragm.

Preoperative means to test the integrity/strength of the diaphragm in such patients are limited and/or unavailable and may not predict the ability of the patient to tolerate any vigorous coughing and bucking with associated unaccustomed rises in intrathoracic and intra-abdominal pressures. Also, the increases in intra-abdominal pressure during the laparoscopic procedure may place an additional stress on the weakened diaphragm. Thus, even though our patient showed normal activity in her daily life and normal lung functions, the fluoroscopic confirmation of eventration warranted that special precautions be taken during the scheduled laparoscopic procedure.

Supraglottic devices, especially the LMA-PS, have been found to be associated with a smoother emergence from anesthesia when compared to a tracheal tube [8]. The LMA Classic and LMA-PS have been successfully tested in laparoscopic surgeries and been found to have similar pulmonary ventilation parameters and gastric distension as a tracheal tube in non-obese patients [8–10]. Maltby et al. [8] compared LMA-PS with a tracheal tube in 109 patients (which also included patients with gastroesophageal reflux and hiatus hernia given a morning dose of either a H_2 receptor blocker or proton pump inhibitor) undergoing laparoscopic cholecystectomy. In all of their non-obese patients, they found that a correctly placed LMA-PS was comparable to a tracheal tube in terms of effective ventilation characteristics, without any clinically significant gastric distension or pulmonary complications.

The belief of increased risk of gastroesophageal reflux with an increase in intra-abdominal pressure during laparoscopic surgery has been found to be erroneous [11]. The laryngeal mask airway has been associated with less airway-related morbidity, such as sore throat, and may be recommended for use in short surgical procedures. Thus, it is probably both reasonable and safe to use a LMA-PS in patients with normal lung and chest wall compliance for short-duration laparoscopic procedures. A properly placed LMA-PS with the drain tube placed above the upper esophageal sphincter may protect the airway from aspiration almost as effectively as a tracheal tube with a low-pressure high-volume cuff in which aspiration along the folds in the cuff is known to be a possibility. We elected to use a properly placed LMA-PS and ensured and confirmed proper placement and adequate seal pressures in this patient in order to minimize the risks of aspiration and facilitate smooth induction and emergence from general anesthesia.

These patients may have recurrent vomiting and other gastrointestinal symptoms along with the risk of gastric volvulus [12]. We advised aspiration prophylaxis in this patient. Intermittent positive pressure ventilation was avoided until the correct placement of LMA-PS and gastric deflation.

The drain tube of the LMA-PS provides easy access for deflation of the stomach and reduction of gastric fluid volume [8]. Continuous gastric suction has been used to prevent gastric distension when nitrous oxide is used for laparoscopic surgeries [8]. We used intermittent gastric deflation with care in order to maintain the tone of LES (withdrawal of the nasogastric tube above LES), which is known to reflexly increase with an increase in intra-abdominal pressure [13].

Mask ventilation and nitrous oxide use should be avoided in these patients, as expansion of the volume of intra-abdominal viscera can impair circulation and respiration [14]. Hence, we avoided the use of nitrous oxide in this case.

The use of TIVA, which to the best of our knowledge has not been reported in published cases of diaphragmatic eventration, helped us in avoiding the use of nitrous oxide and thus protected the patient against the risk of respiratory and cardiovascular compromise. Moreover, TIVA with propofol helps in maintaining an adequate depth of anesthesia [15], decreases postoperative nausea and vomiting [15, 16] and ensures rapid and smooth recovery with no potentiation of neuromuscular blockade.

Although regional anesthesia seems to be advantageous compared to general anesthesia, high levels of regional block may cause paresis of the intercostal muscles, which can increase the workload of the diaphragm and lead to diaphragmatic fatigue or rupture [5, 17]. Titration of local anesthetic drugs should be done carefully to prevent high block levels when regional anesthetic techniques are used. However, a low level of block may not take care of shoulder-tip pain due to diaphragmatic irritation after the creation of carboperitoneum. Also, the need for the lithotomy position with the Trendelenburg tilt puts patients undergoing lower abdominal surgery at a distinct respiratory disadvantage, which may not be tolerated by such patients.

To summarize, patients with diaphragmatic eventration require special care to prevent undesirable increases of intra-abdominal and intrathoracic pressures perioperatively. Avoidance of inhalational agents and nitrous oxide contribute to a smooth course without any increase in the volume of the bowel loops. The use of TIVA with propofol may be a suitable option in such cases.

Conflict of interest No external funding and no competing interests declared.

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