

# Tension capnothorax during laparoscopic transhiatal oesophagectomy – A case report

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## ABSTRACT

Minimally invasive transhiatal oesophagectomy (THE) is a common operative procedure for carcinoma of the oesophagus. This technique has many advantages over other surgical approaches to oesophagectomy. Common complications associated with THE are pulmonary in nature and can lead to increased morbidity and mortality. We present a case where a tension capnothorax developed during laparoscopic THE.

## Introduction

Laparoscopic surgery has gained widespread popularity since its introduction early in the 20th century and transhiatal oesophagectomy has been included in its domain. However, associated pathophysiological changes, massive bleeding from injury to either the aorta or azygos vein, damage to recurrent laryngeal nerve or tracheobronchial tree during dissection make it a high risk procedure. Laparoscopic THE facilitates better mediastinal dissection and decreases blood loss and is a less traumatic procedure with a quicker postoperative recovery when compared to open oesophagectomy.<sup>1</sup> In the presenting case the patient developed a tension capnothorax following a diaphragmatic and pleural tear during laparoscopic THE.

**Case Report:** A 65 year old male weighing 37 kg was scheduled for a laparoscopic transhiatal oesophagectomy for carcinoma of the oesophagus. He was a chronic smoker and a known case of chronic obstructive airway disease (COAD). Computerised tomography (CT) of the thorax revealed a tumour in the lower and middle segments of the oesophagus. Premedication included alprazolam 0.25 mg administered at bedtime and two hours preoperatively via a nasogastric tube. In the operating room, routine monitoring was started and intravenous access was established. A rapid sequence induction was performed using a standard anaesthesia technique and orotracheal intubation was performed with 7.5 mm internal diameter flexometallic endotracheal tube (ETT). Anaesthesia was maintained with oxygen and nitrous oxide (40:60) in 0.5% isoflurane, pethidine and intermittent vecuronium. Other monitoring included central venous pressure, end tidal carbon dioxide (EtCO<sub>2</sub>), rectal temperature and urine output. Peak airway pressure ranged between 20–25 mmHg and EtCO<sub>2</sub> 32–35 mmHg.

After mobilisation of the stomach and oesophagus and while laparoscopic resection of the mediastinal part was in progress, airway pressure increased suddenly to 35 mm Hg and EtCO<sub>2</sub> to 52 mm Hg. Other possible causes of increased airway pressure such as endobronchial intubation, obstruction of the ETT or anaesthetic breathing circuit were excluded. Intra-abdominal pressure at this time was 12 mm Hg. The surgeons were asked to stop gas insufflation and the patient was ventilated with 100% O<sub>2</sub>. EtCO<sub>2</sub> continued to rise to 60 mmHg with the patient developed tachycardia (heart rate [HR] 132 bpm), hypotension (NIBP 84/60 mmHg) and desaturation (SpO<sub>2</sub> 80%). Chest movements were noticed only on the right and the trachea was found to be deviated to the right side. The left side of the chest was hyper resonant to percussion accompanied by absence of air entry on auscultation. Tension pneumothorax was suspected and a 20 gauge hypodermic needle connected to an underwater seal through an intravenous set was placed in the second intercostal space in the midclavicular line. A continuous release of air was observed. To determine the cause for this catastrophe, the surgeon quickly opened the abdomen through a midline incision. A tear was detected in the left hemidiaphragm and a pleural tear with an associated left lung collapse. A left sided intercostal drain was inserted resulting in a gush of air. The patient was ventilated with 400 ml tidal volume and 5cm H<sub>2</sub>O of positive end expiratory pressure (PEEP). Within minutes the patient began to show signs of gradual improvement in SpO<sub>2</sub> (95%), NIBP (110/70) mmHg and HR (92) bpm. At the time of repair of the diaphragm and pleural tear it was presumed that this tear had been acting as a one way valve leading to continuous entrapment of CO<sub>2</sub>. After completion of surgery and repair of the diaphragm and pleural tear it was found that only the upper lobe of the left lung was inflated whereas the lower lobe remained collapsed. On chest auscultation air entry was markedly decreased

on the left side. Fiberoptic bronchoscopy was performed which confirmed the correct placement of ETT. A mucus plug in the left lower lobe bronchus blocking its lumen was removed by bronchoscopic suction. Positive pressure ventilation expanded the left lung and bilateral air entry became equal and adequate. Surgery lasted for five hours and the approximate blood loss was 400 ml. The patient was extubated successfully after reversing the residual neuromuscular blockade. The postoperative period was uneventful.

### Discussion

THE is a widely used technique for carcinoma, benign strictures and motility disorders of the oesophagus.<sup>2</sup> Though considered to be a safe and expeditious technique, it is accompanied by complications such as massive bleeding, tracheobronchial disruptions, pneumothorax, dysrhythmia and chylothorax. Laparoscopic THE is less traumatic, promotes earlier recovery and fewer pulmonary complications than open oesophagectomy. It is especially beneficial in older, malnourished patients or those patients having associated comorbidities.<sup>3</sup> It enables direct visualisation of the mediastinum with an accurate and meticulous dissection of the mediastinal oesophagus and lymph nodes which is an important aspect in cancer patients.<sup>4</sup>

This technique is performed in three stages: firstly laparoscopic mobilisation of the oesophagus and stomach, secondly cervical dissection and finally resection of the specimen, gastric conduit formation and cervical anastomosis.

In the first stage while mobilising the oesophagus within the mediastinum, a pleural tear can occur and peritoneal gas may enter the pleural space through a pathway formed by diaphragmatic tear and break in parietal pleura. This, as happened in our case, is the leading cause of intra-operative capnothorax during laparoscopic surgery.<sup>5</sup> Carbon dioxide gas which was used for insufflation for laparoscopy kept on accumulating from the peritoneal cavity into the pleural cavity through a tear in the diaphragm and pleura causing a capnothorax followed by left lung collapse and mediastinal shift to the right.

The incidence of pleural tears during laparoscopic THE is as high as 93%.<sup>5</sup> Despite the frequent occurrence of pleural tears, tension capnothorax has not been previously reported in any series. Since tension pneumothorax is an infrequent occurrence, no surgical technique favours the prophylactic placement of chest tubes. This will rather lead to a CO<sub>2</sub> leak and loss of pneumomediastinum. However, it is recommended that during laparoscopic surgeries the intra-abdominal pressure should be 12–15 mm of Hg. With oesophageal surgery the dissection extends above the crura and always carries a high potential for pleural injury.

The opening of pleuroperitoneal ducts due to increased intra-abdominal pressure could also be a cause of capnothorax but this is usually right sided.<sup>6</sup> In our case it was left sided. In such surgery and as happened in our case, a situation of tension capnothorax endangering the haemodynamics may result.<sup>7</sup> Hypercarbia causes hypertension but in our case the

tension capnothorax compromised cardio-respiratory function leading to hypotension, tachycardia and arterial desaturation. Bleeding as a cause of hypotension was ruled out as it was minimal.

Gillinov and Heitmiller reported a 10% incidence of major pulmonary complications in elderly patients having COAD who were subjected to THE.<sup>7</sup> Respiratory changes during laparoscopy in such patients can produce deleterious effects. Similarly in our case despite the resolution of the capnothorax and all other measures taken, the lower lobe of the left lung remained collapsed. Bronchoscopy was performed which revealed a mucus plug blocking the left lower lobe bronchus and following its aspiration the lung re-expanded. Mucus plugs requiring bronchoscopy or intubation during open THE have been reported earlier.<sup>8</sup>

In summary, although laparoscopic THE is considered a relatively safe surgical procedure, it is imperative for the anaesthesiologist to be vigilant for potential complications by maintaining a high index of suspicion. Immediate recognition and early timely intervention is of the utmost importance for successful patient outcome.

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### References:

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