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Case Report

Case Report: Raised $ETCO_2$: An Early Sign of Surgical Emphysema during Laparoscopic Surgery

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Abstract

A healthy male posted for an elective laparoscopic surgery was found to develop complications intraoperatively. Soon after peritoneal insufflation, a gradual increase in $EtCO_2$ was noted. All differential diagnosis were ruled out (equipment/ventilation/medical emergencies) and attention turned to an inadequate intra-abdominal pressure with insufflation of gas intra abdominally. A suspicion of subcutaneous emphysema was made. Surgeon was alerted and pneumoperitoneum released. Diagnosis was confirmed by the presence of crepitus on the abdominal wall. $ETCO_2$ settled down soon after and the procedure was done by an open approach. The patient remained hemodynamically stable throughout the procedure. While we set our eyes on the anaesthetic variables, it is also advisable to look at the surgical field. A rising $ETCO_2$ can cause potential harm ranging from arrhythmias to cardiac arrest. Prompt diagnosis and intervention lead to better outcomes.

Keywords: *$EtCO_2$; Subcutaneous Emphysema; Laparoscopy*

Abbreviations

ASA: American Society of Anaesthesiologists; $ETCO_2$: End Tidal Carbon Dioxide; NIBP: Non Invasive Blood Pressure; SpO_2: Oxygen Saturation; ECG: Electrocardiogram

Background

Laparoscopic approach to intra and extra peritoneal procedures was developed in 1930s and gained widespread popularity in 1990s [1]. Since it is minimally invasive and takes lesser operative time, it contributes to early discharge of patients with no wide surgical scars. Carbon dioxide (CO_2) is the preferred gas for the creation of pneumo-peritoneum as it is inexpensive, highly soluble, chemically stable, rapidly eliminated, physically inert, suppresses combustion and also provides fairly good illumination. During pneumoperitoneum insufflation, CO_2 is very rapidly absorbed from the peritoneal cavity into the circulation. Absorbed CO_2 is excreted only through the lungs [2]. These procedures, however are not without potential morbidity [3]. The incidence of developing sucutaneous emphysema ranges from 0.3 to 3% during laparoscopic surgeries [4]. Incidence rates for pneumothorax and pneumomediastinum, which usually are accompanied by subcutaneous emphysema, have not been reported. Because these complications can go unrecognized, especially when they are diminished, the true incidence might be higher than expected [5]. Pneumoperitoneum also contributes to hemodynamic instabilities. Thus, the vigilance of an anesthetist to recognise and treat without delay contributes to successful outcomes.

Case History

A 45 year old male patient (BMI 25) with a diagnosis of right sided inguinal hernia and no other comorbidities (ASA1) was posted for elective laparoscopic inguinal hernia repair. Pre-operative investigations (as per hospital protocol) were done and found to be within

normal limits. The patient was fasted for 8 hours prior to the surgery. On the morning of surgery, he received Tablet Pantoprazole 40 mg and Tablet Metoclopramide 10 mg 2 hours prior to surgery with sips of water. In the operation theatre, monitors were connected (NIBP, SpO_2, ECG) and baseline readings were noted. The patient was pre oxygenated adequately and induction was done using Midazolam (1 mg), Fentanyl (100 mcg) and Propofol (160 mg). He was intubated using #8.5 cuffed endotracheal tube, 3minutes after paralysing him with Atracurium 40 mg. Placement of the tube was confirmed by auscultation and end tidal CO_2 ($ETCO_2$). Anesthesia was maintained using Oxygen - air (FiO_2 0.4 - 0.5), Sevoflurane (MAC 1 - 1.2) and boluses of Morphine and Atracurium. He was put on the ventilator on volume control mode with tidal volume of 450 ml, respiratory rate of 14/min, I:E ratio 1:2 and PEEP 5. The monitor readings then showed BP 110/80 mmHg, HR 70/min, SpO_2 100% and $ETCO_2$ 28 mmHg. Verees needle was introduced for insufflation of CO_2 in the abdomen. Gas was introduced at 4 - 6 L/min to maintain an intra abdominal pressure of 12 - 14 mmHg. Other ports were subsequently done and the surgeon proceeded with surgery. Within 5 minutes of initiating the surgery, a gradually increasing $ETCO_2$ was noted with no effect on heart rate or blood pressure. $ETCO_2$ increased from 32 to 38 and reached 48 (8 minutes). Ventilatory issues were checked and endotracheal tube displacement was ruled out. Soda lime was checked for exhaustion. Temperature probe was connected and temperature read 36.5 degrees Celsius. After checking the patient and the machine, attention was diverted to the surgical side when the surgeon insisted on increasing gas flows. It was noted that with continuous gas flows the intra abdominal pressure couldn't be maintained at even 10 mmHg. The surgeon was immediately alerted. A suspicion of subcutaneous emphysema was made with consistent level of $ETCO_2$ at 46 - 50mmHg even after increasing minute ventilation. Intra-abdominal CO_2 was released and patient ventilated with 100% oxygen at higher minute ventilation. Arterial blood gas was done which showed raised PCO_2 (46 mmHg) with normal pH. $ETCO_2$ started decreasing gradually to reach 30 mmHg in 10 minutes. The patient remained hemodynamically stable throughout. The surgery proceeded by open repair. Post completion of surgery, mild crepitus was noted around the port sites on the anterior abdominal wall. The patient was extubated after administering reversal and observed in the post-operative area with supplemental oxygen for 30 minutes. He remained hemodynamically stable and maintained Oxygen saturation at room air. No further investigations like chest X ray or arterial blood gas were done as the patient remained clinically stable.

Discussion

Laparoscopy is widely practised in all centres, big or small, for most intra abdominal pathologies. The commonly known complications of laparoscopic procedures are mainly due to creation of pneumoperitoneum - subcutaneous emphysema, pneumothorax, gas embolism and pneumopericardium. Others include visceral injuries and vascular damage due to inadequate vision or surgical in expertise. Subcutaneous emphysema is defined as the presence of gas within a tissue beneath the skin which causes bulging of the area and produces crepitus on palpation. There are 4 degrees of Subcutaneous emphysema [6]:

- 0 - No Subcutaneous emphysema
- 1 - Mild emphysema with crepitus at trocar insertion sites or groin
- 2 - Marked emphysema extending to the abdomen and thighs
- 3 - Massive emphysema extending to chest or neck and face

According to this grading, our patient at the time of recognition fell in grade 1. Even though a figure of 0.3 - 3% has been stated for incidence of subcutaneous emphysema, the true incidence of subcutaneous emphysema, pneumothorax and pneumomediastinum is believed to be significantly higher, because many such complications go undetected [7]. Subcutaneous emphysema by itself usually requires conservative treatment. On the contrary, when it is accompanied by pneumothorax, pneumomediastinum or hypercarbia, more invasive therapy is generally needed, in order to avoid increment of morbidity and mortality rates [8]. Several predisposing factors have been related with the manifestation of such complications. Length of operative procedure (> 200 minutes) [9], an increase in the number of surgical ports (6 or more) [10], obese patients with a very thick abdominal wall (where the port may not reach far enough into the abdominal cavity), displacement of port into abdominal wall and repeated dislodgement and reinsertion of the port which may enlarge the port wound or result in new tissue paths through the abdominal wall. Maintaining eucapnia during laparoscopy requires an increase in minute ventilation by 20-30%. but an increasing $ETCO_2$ level despite this should alert the anesthetist towards silent development of subcutaneous emphysema. Surgery should be stopped immediately and CO_2 insufflation ceased. A further increase in minute ventilation may

be supported for a short while with 100% Oxygen. Arterial blood gas analysis must be done in case of severe hemodynamic compromise or with decreasing saturations. Before extubation, it is crucial that the end-tidal and arterial CO_2 levels be within normal limits. In patients with severe chronic obstructive pulmonary disease or those with ventilatory dysfunction due to medications (opioids or anesthetic medications), mechanical ventilation may need to be continued postoperatively until the CO_2 levels normalize. Post operatively, a chest X ray maybe done to rule out pneumomediastinum which may have gone unnoticed.

Conclusion

Subcutaneous emphysema is an under reported complication. Any rise in $ETCO_2$ is diverted to ruling out malignant hyperthermia and other medical emergencies (thyrotoxic storm, drug reactions) among anaesthetists. Hence, it is important to remember this complication in all laparoscopic procedures. It is always better to be vigilant and prevent complications than be heroic to treat them.

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