CASE REPORT

Intraoperative hypercarbia and massive surgical emphysema secondary to transanal endoscopic microsurgery (TEMS)

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SUMMARY

We describe a case where full-thickness excision of a rectal lesion caused massive surgical emphysema and subsequent hypercarbia with associated difficulties with ventilation. This unique case highlights the risks of respiratory failure with extraperitoneal insufflation as in this case and as more commonly with intraperitoneal insufflation. Transanal endoscopic microsurgery (TEMS) is a technique that is being increasingly used in the management of large and early malignant rectal polyps. We reviewed the literature in order to understand the case and to highlight factors that should minimise any adverse sequelae. In the presence of ventilatory difficulties secondary to postoperative surgical emphysema, whether via extraperitoneal insufflation as described here or with intraperitoneal insufflation (as in laparoscopy), consider decreasing gas pressures, expediting the procedure, delaying extubation and prolonged close monitoring in recovery with possible admission to a high dependency unit (HDU) or intensive care unit (ICU).

BACKGROUND

We describe a case where full-thickness excision of a rectal lesion caused massive surgical emphysema and subsequent hypercarbia with associated difficulties with ventilation. Intraperitoneal insufflation of carbon dioxide (CO₂) during laparoscopy is a recognised cause of hypercarbia.¹ Extraperitoneal insufflation of CO₂ into the rectum, which occurs during transanal endoscopic microsurgery (TEMS), is known to create surgical emphysema. TEMS is a technique first described by Gerhard Buess² that is being increasingly used in the management of large and early malignant rectal polyps.³ This case is unique in that it is the only case in the published literature regarding TEMS leading to ventilatory difficulties with massive surgical emphysema. It highlights the importance of appreciating and recognising subcutaneous emphysema after surgery, which can result in hypercarbia, as well as describing subsequent management.

CASE PRESENTATION

At colonoscopy for persistent rectal bleeding in an 80-year-old man, a large 50 mm lesion lying at 3–6 o'clock at 8 cm from the anal verge was seen. Biopsies demonstrated high-grade dysplasia and multidisciplinary team (MDT) review noted a possible central depression on the photos (Paris classification: 1a+1c). The MDT was suspicious of an

early cancer, so the patient was given the option of TEMS or the more aggressive option of an abdominoperineal excision. He was unkeen on a permanent stoma in the absence of definitive cancer and opted initially for a local excision.

The patient was classified as an American Society of Anesthesiology (ASA) II patient, with a medical history of hypertension and no known chest disease. After preoxygenation, anaesthesia for the procedure was induced, using fentanyl 100 µg, propofol 150 mg and dexamethasone 6.6 mg. The airway was maintained using a laryngeal mask airway size 5.0, and the patient was ventilated using pressure-controlled ventilation with inspiratory pressure of 12–14 cm H₂O. Anaesthesia was maintained using sevoflurane in oxygen and air (ratio 1:1). Intravenous paracetamol 1 gm and morphine 5 mg were administered for analgesia during the procedure.

The patient was positioned in lithotomy with a slight Trendelenburg (head down tilt). The transanal endoscopic operative (TEO) system from Karl-Storz was used to perform the TEMS procedure. The procedure involving insertion of the 2 cm radius endoscopic operating scope was uneventful. Initially, dissection was with the diathermy hook and subsequent use of the harmonic scalpel. The rectal insufflation pressure for the TEO was 12 mm Hg and was for a short time increased to 18 mm Hg.

At this point during the procedure, the end-tidal CO₂ (ETCO₂) was noticed to increase despite adequate ventilation reaching as high as 8.5 mm Hg. This issue did not resolve with attempts to increase minute ventilation. Atracurium (40 mg) was administered in the hope that muscle relaxation might improve ventilation further and reduce ETCO₂, which did not prove to be successful.

Surgical emphysema was discovered incidentally during chest auscultation by the anaesthetist and was felt over the anterior and lateral abdominal walls and over the chest reaching up to the neck. The trachea was intubated at this point using a size 8.0 endotracheal tube and an additional dose of fentanyl 50 µg. These measures did not improve the high ETCO₂.

The procedure was completed, and it was noted that the scrotum was also enlarged. The catheter was checked and no blood was noted in the urine output. Palpation of the abdomen showed no distension; however, it became clear that there was

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significant subcutaneous emphysema, particularly in the chest and neck. A flexible sigmoidoscopy was conducted which demonstrated no perforation.

At the end of the procedure, ETCO₂ came down to 6 mm Hg, residual neuromuscular blockade was antagonised using neostigmine 2.5 mg and glycopyrrolate 0.5 mg with full recovery of the train-of-four response. The patient was generating adequate minute ventilation and was extubated.

On arrival in the recovery room, the patient was now awake but drowsy, and the ETCO₂ was still 6.0 mm Hg. The patient had a prolonged period of observation in recovery with ICU input. A chest X-ray was performed to ensure no spontaneous pneumothorax (figure 1). As the patient remained stable throughout his stay in recovery and decreasing emphysema, he was discharged to the ward.

INVESTIGATIONS

A chest X-ray was performed to ensure no spontaneous pneumothorax (figure 1).

DIFFERENTIAL DIAGNOSIS

- ▶ Spontaneous pneumothorax
- ▶ Acute respiratory failure (anaesthetic related)
- ▶ Pulmonary embolus
- ▶ Intraperitoneal perforation.

OUTCOME AND FOLLOW-UP

The patient had complete resolution of emphysema at 24 h. The patient was discharged at day 2 with oral metronidazole and stool softeners. He reattended with some rectal bleeding at day 7 and was admitted for observation for 48 h.

Histologically, the tumour was a sessile tubulovillous adenomatous neoplasm, with an area of moderately differentiated adenocarcinoma approximately 20 mm in diameter within the lesion. The tumour infiltrated almost the full thickness of the submucosa (Kikuchi level sm3). There was no evidence of muscularis propria involvement. Six lymph nodes within the adventitial tissue showed no evidence of metastatic tumour. Horizontal and deep surgical resection margins appear to be clear of the adenomatous element and invasive adenocarcinoma. The deep margin clearance for the invasive carcinoma was approximately 3 mm.

A subsequent CT scan of the thorax, abdomen and pelvis showed no residual tumour. The findings were discussed in the

colorectal MDT, and given the findings, the patient was given the option of no further treatment versus definitive surgery. He decided on expectant management.

DISCUSSION

The case presented highlights a number of issues for all clinicians, including staff that look after patients on the ward following surgery. It is important that the concept of surgery leading to subcutaneous emphysema is appreciated. During laparoscopy, intraperitoneal insufflation of CO₂ is reported to lead to subcutaneous emphysema in up to 3% of cases.⁴ Extraperitoneal insufflation of CO₂ during TEMS results in emphysema in less than 1.5% of patients.⁵ The mechanism postulated is that it is a result of raised insufflation pressures in combination with full thickness excision causing decreased tissue integrity.^{6,7}

The anaesthetic team noted the finding of emphysema in the tissues of the neck and chest, which Sumpf *et al*⁸ describe as massive subcutaneous emphysema. Their scale for subcutaneous emphysema is as follows:

- ▶ Mild: air within the skin around the port site;
- ▶ Moderate: air within the skin involving the abdomen and thighs;
- ▶ Massive: relating to the involvement of air within the skin of the chest and neck.

Kerr and Mills⁶ describe an episode of hypercapnia secondary to TEMS with a moderate degree of subcutaneous emphysema. This, however, led to delayed respiratory failure which occurred 30 min after extubation. If subcutaneous emphysema occurs, it is unclear what proportion of patients may develop subsequent hypercarbia and ventilatory difficulties. Franken *et al*⁷ describe two spontaneous cases of intraperitoneal air after TEMS with some associated surgical emphysema. In both cases, subsequent negative laparoscopies noted only a bulging peritoneum. Both patients settled without any intervention. The literature suggests that management should be expectant^{1,5-7} in the first instance as once insufflation has ceased, the CO₂ should theoretically reabsorb. Delayed hypercarbia may occur after the procedure⁶ and respiratory failure may develop. As such, prolonged monitoring of the patient in an appropriate environment should be considered.⁶ If the patient deteriorates subsequently, then a defunctioning procedure such as a Hartmann's or alternately a loop sigmoid colostomy should be considered.⁷

Figure 1 Chest X-ray of postoperative subcutaneous emphysema.

Learning points

- ▶ Transanal endoscopic operative (TEO) or transanal endoscopic microsurgery (TEMs) causing hypercarbia intraoperatively with associated massive surgical emphysema (relating to the chest and neck) and ventilatory problems has not been previously reported.
- ▶ Teams should be aware of this and, if noted, consider the following:
 - decreasing the insufflation pressure of the gas;
 - expediting the procedure;
 - delaying extubation;
 - prolonged close monitoring in recovery with possible admission to a high dependency unit or intensive care unit.
- ▶ The literature suggests that if recognised, there are no adverse sequelae and management should be expectant, but close observation is advised.

Contributors All three authors were involved in the clinical case and independently reviewed the literature. The paper was drafted by AC and revised by RC and HS.

Competing interests None.

Patient consent Obtained.

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