

# Successful resuscitation after carbon dioxide embolism during laparoscopic-assisted abdomino-perineal resection

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## ABSTRACT

We report a 67-year-old woman who underwent laparoscopic-assisted abdomino-perineal resection for rectal carcinoma. She sustained hypotension of 40/20 mmHg associated with bradycardia (heart rate 30 to 45 beats per minute) and an end-tidal carbon dioxide level of zero when she was raised to a head-up position at the end of surgery to facilitate pelvic irrigation. Pulmonary air embolism was confirmed by aspiration of 15 millilitres of foamy blood from her central venous line. Resuscitation was successful and she recovered completely with no neurological deficits.

**Keywords:** air embolism, colectomy, laparoscopic surgery, rectal cancer, surgery complications

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## INTRODUCTION

In recent years, minimally invasive surgery with laparoscopy has enjoyed increasing popularity due to improvements in instruments and techniques resulting in better safety. Patients like the shorter hospital stay, early return to normal activity, and the cosmetically more pleasing operative scar. However, some potentially serious complications can occur. We present a case of pulmonary air embolism occurring during laparoscopic-assisted abdomino-perineal resection of a rectal carcinoma with successful resuscitation.

## CASE REPORT

A 67-year-old, 46 kg Chinese woman presented with anal pain associated with fresh bleeding per rectum of one month duration. She had no history of cardiopulmonary disease or deep venous thrombosis. Rectal examination revealed a mass just above the dentate line that was confirmed to be a rectal adenocarcinoma on colonoscopy and biopsy. She was scheduled for laparoscopic-assisted abdomino-perineal resection. Routine pre-operative tests did not reveal any abnormality. Her coagulation profile, renal

function, chest radiograph and electrocardiogram (ECG) were normal.

At induction of anaesthesia, her blood pressure and heart rate were 135/70 mmHg and 78 beats per minute, respectively. Continuous ECG, pulse oximetry, end-tidal carbon dioxide and non-invasive blood pressure were monitored. She was lowered to a head-down in the Lloyds-Davis position, and her vital signs remained stable. The abdomen was entered using the open technique. Pneumoperitoneum was created by insufflation of carbon dioxide via a trocar inserted one centimetre below the umbilicus and intra-abdominal pressure was regulated to less than 15 mmHg. End-tidal carbon dioxide level was kept within the range of 30 to 35 mmHg. Anaesthesia was maintained with sevoflurane and nitrous oxide with oxygen. Atracurium besylate was used for muscle relaxation and morphine was used for analgesia.

Laparoscopic mobilisation of the colon and rectum, and ligation of the inferior mesenteric artery were performed. During open perineal resection of the rectum, some bleeding from the presacral veins was noted and haemostasis was secured with diathermy. The patient was then tilted to a head-up position to facilitate pelvic irrigation through the port sites and drainage from the perineal wound. At this point in time, there was a sudden decrease in systolic arterial pressure to 40 mmHg, associated with bradycardia (heart rate 30 to 45 beats per minute) and end-tidal carbon dioxide level of zero. Pulmonary air embolism was suspected and resuscitation commenced immediately.

The patient was returned to a head-down position, given a pre-cordial thump with external cardiac massage, and ventilation with 100% oxygen. A central venous line was inserted and 15 ml of foamy blood was aspirated. Adrenaline and ephedrine infusion were started immediately. An arterial blood gas analysis showed severe combined metabolic and respiratory acidosis. Resuscitative efforts were successful, her blood pressure and heart rate stabilised, and pulse oximetry and end-tidal carbon dioxide values returned to normal. The patient was monitored

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in the surgical intensive care unit and she regained consciousness three hours after surgery. She recovered completely with no neurological deficits.

## DISCUSSION

Possible causes for the sudden hypotension include hypovolaemia, air embolism and vagal reflex. Our patient had a total of 2000 ml of crystalloids infused, operative blood loss was less than 400 ml at the onset of hypotension and her urine output was adequate at 450 ml over three hours, making hypovolaemia an unlikely cause. At the point of drop in blood pressure, there was no traction on the bowel, making vagal reflex unlikely.

The incidence of air embolism during laparoscopy is reported to be 15 per 100,000 cases per year<sup>(1)</sup>. Although it is more common in laparoscopic hepatic resection, it has been reported in other types of laparoscopic surgery. Schmandra et al<sup>(2)</sup> recently reported that in experimental animals, gas embolism was detected in nearly all animals when monitored with two-dimensional transoesophageal echocardiography. A delayed manifestation of gas embolism may be pulmonary oedema or sudden death<sup>(3)</sup>. Pathophysiological effects of gas embolism are due to the transient accumulation of gas in the pulmonary arterioles. Besides the nature of the gas, the consequences depend on the volume as well as the rate of gas entry<sup>(1)</sup>.

Slow infusion of air is known to occlude pulmonary circulation. This may be compensated by an increase in cardiac output but when that fails, it will lead to hypotension. A large air bolus can produce a “gas lock”, meaning complete mechanical obstruction and ineffective contraction of the right heart, causing acute hypotension or even cardiac arrest<sup>(1)</sup>. It is also important to note that embolisation to the right ventricle and pulmonary circulation may be delayed by as much as one hour by passage of the gas through

the portal system<sup>(3)</sup>. Carbon dioxide embolisation must always be suspected during laparoscopic surgery whenever there is sudden deterioration of the haemodynamic status associated with decreased end-tidal carbon dioxide levels and chest compliance.

Air embolism is often over-diagnosed during laparoscopic procedures. However, in this case, definitive diagnosis of air embolism was established with the aspiration of gas bubbles from a central vein. The fact that the hypotension occurred after the patient was placed in a head-up position further supports the diagnosis. An air bolus probably entered the circulation at the time of haemorrhage from the presacral veins.

Venous laceration during laparoscopic dissection<sup>(2)</sup> is a common cause, and specifically, because of the anatomy of the presacral region, the risk of gas embolism after venous injury while dissecting the rectum under a pneumoperitoneum is increased. To reduce the incidence of gas embolism during laparoscopic surgery, we propose firstly that the patient be kept well hydrated to maintain an adequate volume of circulation at all times. Secondly, the position the patient is placed is a precipitating factor and any changes in position should be done gradually. In summary, laparoscopic-assisted abdominopelvic resection is a good choice in properly-selected patients. Careful monitoring for air embolism and early detection with adequate resuscitation can result in a favourable post-operative outcome.

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