

A Rare Intraoperative Complication: Venous Air Embolism During Laparoscopic Cholecystectomy – A Case Report

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Abstract

Background: Venous air embolism (VAE) is a rare but potentially fatal complication that may occur in laparoscopic procedures, particularly during the creation of pneumoperitoneum. Rapid diagnosis and intervention are essential for preventing severe outcomes.

Case Presentation: We report the case of a 24-year-old female patient who underwent elective laparoscopic cholecystectomy. Shortly after initiation of pneumoperitoneum, bradycardia, hypotension, hypoxemia, and a sudden decrease in end-tidal CO₂ developed. Immediate cessation of insufflation, placement of the patient in the Durant's position, and central venous catheterization for air aspiration were performed. Approximately 20 cc of air was aspirated, leading to rapid hemodynamic stabilization.

Conclusion: Prompt identification and management, including discontinuation of insufflation, Durant's positioning, and central venous aspiration, provided rapid hemodynamic stabilization. This case emphasizes the importance of intraoperative alertness and rapid interventions in the management of VAE.

Keywords

Venous air embolism, laparoscopy, anesthesia, insufflation, pneumoperitoneum.

Introduction

Laparoscopic cholecystectomy is a safe surgical method that is frequently performed today. Laparoscopic surgery is a minimally invasive procedure. The surgeon makes a small incision and uses thin, long instruments to examine the abdomen and perform surgery. It can be used for diagnostic or therapeutic purposes. Because laparoscopic surgery is performed through a smaller incision, it results in less scarring, a lower risk of complications, and a quicker recovery. Although the laparoscopic surgery is safer than open technique, complications such as infection and organ perforation may rarely occur [1].

Venous air embolism (VAE) is a very rare complication that can lead to serious morbidity and mortality. VAE usually occurs during the formation of pneumoperitoneum [2,3]. Careful intraoperative monitoring is vital for early diagnosis of this complication and reduction of morbidity [3-6].

In this report, a case of VAE occurred during laparoscopic cholecystectomy is discussed, and the diagnostic approach and management strategies are elaborated.

Case Presentation

A 24-year-old female patient was scheduled for elective laparoscopic cholecystectomy. The patient, without known systemic disease, was classified as ASA Physical Status I. The patient's body weight was 58 kg, height was 165 cm, and BMI was 21.3 kg/m².

Anesthesia Management

After the vascular access was established, she was premedicated in the preoperative period. 2 mg midazolam was administered intravenously for anxiolytic and sedation purposes. The patient, was monitored with electrocardiography (ECG), non-invasive arterial blood pressure (NIBP), and peripheral oxygen saturation (SpO₂) within the scope of standard anesthesia

monitoring in the operating room. The patient's vital signs were evaluated, and it was observed that she was hemodynamically stable.

Anesthesia induction was performed intravenously using 2 mg/kg propofol, 1-2 µg/kg fentanyl and 0.6 mg/kg rocuronium. After uneventful endotracheal intubation, correct placement of the tube was confirmed by auscultation and capnography. Intraoperative ventilator settings were adjusted as follows: the tidal volume 6-8 mL/kg of ideal body weight, the respiratory rate providing normocapnia, the fractional inspiratory oxygen concentration (FiO₂) 40-50%, and the positive end expiratory pressure (PEEP) 5 cmH₂O.

General anesthesia was maintained with desflurane, and SpO₂, end-tidal CO₂ levels, and other hemodynamic parameters were in normal range.

Surgical Intervention

Pneumoperitoneum was initiated using an intra-abdominal pressure of 15 mmHg with the patient in the supine position. Following insufflation, the end-tidal CO₂ (EtCO₂) value dropped dramatically from 34 mmHg to 20, 15, 10, and finally 8 mmHg. Simultaneously, SpO₂ decreased to 80-85%, bradycardia (HR: 39 bpm) and severe hypotension developed. Intra-arterial cannulation was promptly performed and arterial blood gas (ABG) analysis revealed significant metabolic acidosis and elevated lactate levels (**Table 1**).

The patient was administered 20 mg ephedrine and 1 mg atropine intravenously, but no significant hemodynamic improvement was observed. A norepinephrine infusion was initiated. On auscultation, bilateral breath sounds were present. However, SpO₂ remained ≤85% despite 100% oxygen administration, and EtCO₂ values remained critically low. Given the clinical picture, venous air embolism (VAE) was suspected.

Insufflation was immediately ceased. While the surgical team stopped gas insufflation, the patient was placed in the Durant's position (left lateral decubitus with head down) to prevent further embolic migration from the right ventricle to the pulmonary artery. Ventilation was

continued with 100% oxygen.

A central venous catheter was inserted into the right internal jugular vein, and approximately 20 mL of air was aspirated. Following aspiration, the patient's hemodynamic parameters improved rapidly.

Due to the VAE, the surgical procedure was postponed. Neuromuscular blockade was reversed with 4 mg/kg sugammadex. The patient regained spontaneous respiration and was oriented, cooperative, and responsive to verbal commands. Extubation was performed safely in the operating room.

Post-extubation ABG values (**Table 1**) demonstrated mild residual metabolic acidosis and moderate hypoxemia. Nasal oxygen support was initiated, and the patient was transferred to the recovery room. Neurological status remained stable, and hemodynamics normalized.

Under 3 L/min nasal oxygen, a repeat ABG (**Table 1**) showed improved oxygenation and stable metabolic status. The patient was transferred to the surgical intensive care unit (ICU) for further monitoring, where follow-up ABG confirmed full recovery of gas exchange parameters and lactate clearance (**Table 1**).

After the patient was admitted to the ICU, she was evaluated by the cardiology department using transthoracic echocardiography (TTE). No pathology was detected in the examination; no air was found in the right atrium and cardiac functions were observed to be normal. During the ICU, the patient's clinical condition remained stable without hemodynamic support.

Cardiac enzymes (troponin, CK-MB), renal function tests (BUN, creatinine), electrolyte levels (Na⁺, K⁺, Cl⁻, Ca²⁺), complete blood count, liver function tests (AST, ALT, ALP, GGT, bilirubin), and ABG were monitored at regular intervals during the postoperative period. The troponin value was determined as 250 ng/dl on the first postoperative day. In subsequent measurements, the troponin value was found to have decreased to

Table 1: Arterial blood gas analyses

ABG	pH	pCO ₂ (mmHg)	pO ₂ (mmHg)	SpO ₂ (%)	Lactate (mmol/L)	Base Deficit (mmol/L)	HCO ₃ ⁻ (mmol/L)
During Pneumoperitoneum (Crisis)	7,25	41	104	97	4,1	-8	18
After Extubation	7,3	38	67	93	2	-7	19
Recovery Room (3 L/min O ₂)	7,31	37	98	99	1,6	-7	19
ICU Monitoring	7,37	30	114	99	1,6	-5	19

ABG: Arterial Blood Gas , **ICU:** Intensive Care Unit , **SpO₂:** Peripheral Capillary Oxygen Saturation

normal limits as 125-115-64-13 ng/dl, respectively.

In the patient's laboratory controls, no significant change was detected compared to the preoperative values, except for troponin, and they remained within normal limits.

The patient was followed in the ICU for 2 days. During this period, she was found to be stable in neurological and respiratory evaluations.

The patient was then transferred to the ward. No postoperative complications were observed, and the patient was discharged uneventfully after the final evaluations on the third postoperative day.

Informed consent was obtained from the patient for the case to be presented.

Discussion

VAE is among the rare but serious complications of laparoscopic surgery. It occurs when gas enters the systemic venous circulation, especially during the creation of pneumoperitoneum, during trocar insertion or when open venous structures are encountered during insufflation [3,5,6].

In this case, the sudden EtCO₂ drop, bradycardia, hypotension and hypoxemia at the beginning of surgery constituted the classic findings of VAE. A sudden and dramatic decrease in EtCO₂, reflecting a sudden decrease in pulmonary perfusion, may be the earliest and most sensitive indicator of gas embolism. Although such a change is not highly specific, it is quite valuable for diagnosis, especially when seen during the surgical insufflation period.

One of the most reliable methods for diagnosing VAE is transesophageal echocardiography (TEE) [3,4]. It has been reported that even asymptomatic, subclinical embolism can be detected with TEE at a rate of 76-100%. However, TEE is not routinely used intraoperatively in most surgical centers. Therefore, careful monitoring of parameters such as EtCO₂, SpO₂, ECG, and arterial blood pressure is vital for the anesthesiologist.

In this case, the decrease in EtCO₂ to 8mmHg within a few seconds immediately after surgical insufflation and the development of hemodynamic instability with hypoxemia quickly suggested the diagnosis of VAE. One of the classical maneuvers that can be applied in this situation, the Durant's position (head down and left lateral position), aims to prevent the air entering the

right atrium from passing into the pulmonary circulation (6). In this patient, the surgeon's termination of insufflation and placing the patient in the head up position were sufficient to stop the progression of the air embolism. Rapid intervention with central catheter placement through the internal jugular vein and air aspiration was life-saving in this case. Air bubbles seen during aspiration supported the accuracy of the diagnosis. The normalization of the patient's hemodynamic parameters in a short time demonstrated the effectiveness of the applied treatment strategies.

In the literature, serious complications of VAE include cardiac arrest, brain damage, permanent neurological sequelae, and death [6-11]. In particular, early intubation, ventilation with 100% oxygen, immediate cessation of insufflation, and venous air aspiration are the cornerstones of effective management. In this case, rapid diagnosis and effective interventions prevented the development of severe complications.

Conclusion

A clinical presentation with a sudden decrease in EtCO₂, bradycardia, hypotension and hypoxemia should suggest VAE and immediate interventions should be initiated. Appropriate interventions including cessation of surgical insufflation, ventilation with 100% oxygen, appropriate change of patient position and central venous air aspiration might be lifesaving as in the present case.

We thought that the complication was successfully managed with timely and effective interventions without development of cardiac arrest in this case. This case report highlights the importance of intraoperative awareness and prompt interventions for rare but life-threatening complications.

Author contribution statement

All authors (ED, SK, BA, MÖC, MB, HS) participated in the planning, writing, editing, and review of this manuscript.

Conflicts of interest and funding

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Declaration of patient consent

Informed consent was obtained from the patient for the case to be presented.

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References

1. Buia A, Stockhausen F, Hanisch E. Laparoscopic surgery: A qualified systematic review. *World J Methodol.* 2015 Dec 26;5(4):238-54. doi: 10.5662/wjm.v5.i4.238.
2. Park Kwon JY, Kim KJ. Carbon dioxide embolism during laparoscopic surgery. *Yonsei Med J.* 2012 May;53(3):459-66. doi: 10.3349/ymj.2012.53.3.459.
3. Schlomp CJ, Loimer T, Rieger M, Lederer W. Venous air embolism during surgery: detection and management. *Minerva Anesthesiol.* 2020;86(2):202–211
4. Mirski MA, Lele AV, Fitzsimmons L, Toung TJK. Diagnosis and treatment of vascular air embolism. *Anesthesiology.* 2007;106(1):164–77. doi:10.1097/00000542-200701000-00026
5. Muth CM, Shank ES. Gas embolism. *N Engl J Med.* 2000;342(7):476–82. doi:10.1056/NEJM200002173420706
6. McCarthy CJ, Behraves S, Naidu SG, Oklu R. Air embolism: diagnosis, clinical management and outcomes. *Diagnostics (Basel).* 2017;7(1):5. doi:10.3390/diagnostics7010005
7. Davolio MC, Pizzirani M, Vecchio S, et al. Medico-legal implications for carbon dioxide embolism during laparoscopic surgery: Two fatal cases. *Forensic Science International: Reports.* 2023 p. 100304 . doi: 10.1016/j.fsir.2022.100304
8. Shin HY, Kim DW, Kim JD, et al. Paradoxical carbon dioxide embolism during laparoscopic cholecystectomy as a cause of cardiac arrest and neurologic sequelae: a case report. *Korean J Anesthesiol.* 2014 Dec;67(6):425-8. doi: 10.4097/kjae.2014.67.6.425. Epub 2014 Dec 29.
9. Lantz PE, Smith JD. J Fatal carbon dioxide embolism complicating attempted laparoscopic cholecystectomy-case report and literature review. *Forensic Sci.* 1994 Nov;39(6):1468-80.
10. Uchida S, Yamamoto M, Masaoka Y, Mikouchi H, Nishizaki Y. A case of acute pulmonary embolism and acute myocardial infarction with suspected paradoxical embolism after laparoscopic surgery. *Heart Vessels.* 1999;14:197–200. doi: 10.1007/BF02482307.
11. Shimizu K, Usuda M, Kakizaki Y, et al. Cerebral infarction by paradoxical gas embolism detected after laparoscopic partial hepatectomy with an insufflation management system: a case report. *surg case rep* 2023;9:34. <https://doi.org/10.1186/s40792-023-01611-0>