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Case Report

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Transesophageal Echocardiography-guided Anesthetic Management for Laparoscopic Cholecystectomy in a Patient with Left Ventricular Outflow Tract Obstruction: A Case Report

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Abstract

Background: Left ventricular outflow tract (LVOT) obstruction with systolic anterior motion (SAM) of the mitral valve poses significant perioperative risks during non-cardiac surgery. Transesophageal echocardiography (TEE) plays a critical role in real-time hemodynamic monitoring and management of such patients.

Case Presentation: A 76-year-old female (54 kg) with suspected hypertrophic cardiomyopathy, diagnosed with LVOT obstruction (Vmax = 3.9 m/s, PG = 59 mm Hg) and SAM, underwent laparoscopic cholecystectomy under general anesthesia. TEE-guided management included:

1. Pre-induction fluid resuscitation (500 mL succinylated gelatin) to optimize preload.
2. Anesthetic induction with midazolam, sufentanil, cisatracurium, and propofol, combined with a continuous norepinephrine infusion (0.05 μg/kg/min) to maintain systemic vascular resistance without increasing contractility.
3. Intraoperative TEE monitoring of LVOT obstruction and SAM severity during reverse Trendelenburg positioning and CO_2 pneumoperitoneum (12 cm H_2O). Fluid therapy and vasopressor titration were adjusted based on TEE findings to maintain hemodynamic stability (BP 110–140/50–90 mm Hg, HR 60–80 bpm).
4. Postoperative pain control with oxycodone and tracheal lidocaine inhalation to prevent sympathetic surges during extubation.

Conclusion: TEE-guided anesthesia management effectively mitigated the exacerbation of LVOT obstruction in this high-risk patient, highlighting its value in optimizing perioperative hemodynamics in cases of LVOT obstruction with SAM.

Keywords

Transesophageal Echocardiography, Left Ventricular Outflow Tract Obstruction, Laparoscopic Cholecystectomy, Anesthesia

Abbreviations

LVOT: Left Ventricular Outflow Tract; SAM: Systolic Anterior Motion; TEE: Transesophageal Echocardiography; HCM: Hypertrophic Cardiomyopathy; SVR: Systemic Vascular Resistance

Introduction

Left ventricular outflow tract (LVOT) obstruction accompanied by systolic anterior motion (SAM) of the mitral valve is a hallmark of hypertrophic cardiomyopathy (HCM), affecting approximately 1 in 500 adults [1]. Non-cardiac surgery in these patients carries a high risk of hemodynamic instability, as reductions in preload or systemic vascular resistance (SVR), or increases in contractility or heart rate, can exacerbate LVOT obstruction via SAM, potentially leading to cardiogenic shock or sudden cardiac death [2]. Transesophageal echocardiography (TEE) provides real-time assessment of LVOT dynamics, preload, and contractility, enabling targeted interventions to maintain hemodynamic stability. Here, we present a case of TEE-guided anesthesia for laparoscopic cholecystectomy in a patient with LVOT obstruction and SAM.

Case Presentation

Patient Evaluation:

A 76-year-old female (54 kg) presented with a one-year history of right upper quadrant pain and one-month history of jaundice. Her past medical history included undiagnosed heart disease with multiple admissions for dyspnea and cough. Baseline activity tolerance was less than 3 METs, with occasional chest tightness. Preoperative vital signs were: HR 68 bpm, SpO_2 98% (room air), and BP 135/70 mm Hg. Echocardiography revealed left atrial enlargement, asymmetric ventricular septal hypertrophy (14–17 mm in the basal segments), LVOT obstruction (Vmax = 3.9 m/s, PG = 59 mm Hg), SAM, mild-to-moderate mitral regurgitation, and reduced left ventricular diastolic function. Abdominal ultrasound confirmed cholelithiasis and a thickened gallbladder wall. She was scheduled for elective laparoscopic cholecystectomy.

Anesthetic Management:

- Intraoperative Monitoring: Upon arrival, monitoring showed sinus rhythm (70 bpm), BP 130/74 mm Hg, and SpO_2 100% (via face mask). A peripheral IV was inserted, followed by rapid infusion of 500 mL succinylated gelatin. After sedation with midazolam 1 mg and sufentanil 5 μg, left radial artery cannulation was performed under local anesthesia.

- Induction & Maintenance: Norepinephrine infusion (0.05 μg/kg/min) was initiated to maintain SVR. Anesthesia was induced with midazolam 1 mg, sufentanil 10 μg, cisatracurium 13 mg, and propofol 60 mg, followed by tracheal intubation (7.0 mm tube) and TEE probe placement. Anesthesia was maintained with 4%–6% desflurane, remifentanil 0.1–0.2 μg/kg/min, and intermittent doses of muscle relaxants.

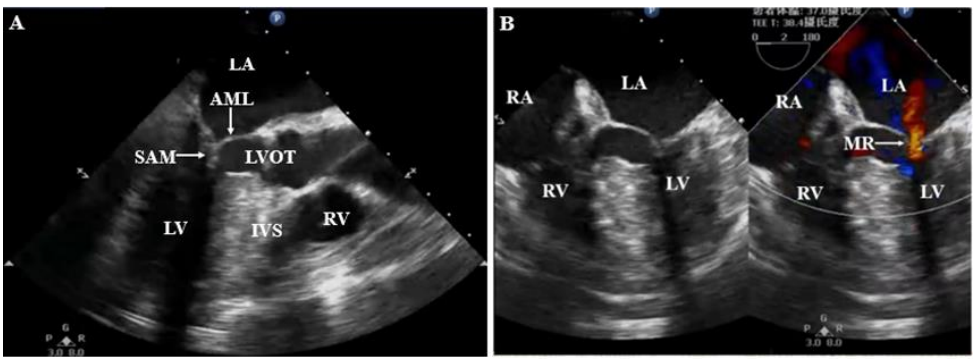

Fig-1: TEE Images After Anesthesia Induction and Before Surgery

A: Left ventricular long-axis view.

B: Four-chamber view. LA: Left atrium; LV: Left ventricle; RA: Right atrium; RV: Right ventricle; AML: Anterior mitral leaflet; SAM: Systolic anterior motion; LVOT: Left ventricular outflow tract obstruction; IVS: Interventricular septum; MR: Mitral regurgitation.

- Positioning & Pneumoperitoneum: Before skin incision, the patient was slowly tilted into the reverse Trendelenburg position. TEE (mid-esophageal aortic valve long-axis view) was used to monitor LVOT obstruction and SAM, ensuring that positioning did not exacerbate obstruction (**Fig-1**). Pneumoperitoneum was established at 12 cm H_2O with a flow rate of 6 L/min.
- Hemodynamic Management: TEE-guided adjustments of fluids (total: 850 mL crystalloid and 500 mL gelatin) and norepinephrine (0.01–0.03 μg/kg/min) maintained BP between 110–140/50–90 mm Hg and HR between 60–80 bpm. Surgery lasted 46 minutes. Postoperatively, oxycodone was administered, and 2 mL of 2% lidocaine was instilled into the trachea before extubation. The patient was discharged the next day with stable vital signs.

Discussion

The most common cause of LVOT obstruction with SAM is hypertrophic cardiomyopathy (HCM), characterized by asymmetric left ventricular hypertrophy or localized hypertrophy greater than 15 mm. LVOT obstruction can occur at rest or under provocative conditions, and in some cases, SAM arises when the mitral valve moves anteriorly during systole and contacts the interventricular septum [1]. Based on the patient's preoperative echocardiogram, HCM was suspected.

Non-cardiac surgery in patients with LVOT obstruction and SAM carries significant perioperative risks. Any factor that reduces left ventricular preload or systemic vascular resistance, or increases myocardial contractility or heart rate, can exacerbate LVOT obstruction—with or without worsening SAM—potentially leading to hemodynamic collapse or sudden cardiac death [2].

The core principles of perioperative management for patients with LVOT obstruction and SAM are to increase cardiac preload and reduce hyperdynamic cardiac function [3]. In this case report of a patient undergoing laparoscopic cholecystectomy under general anesthesia, TEE in the mid-esophageal long-axis view of the aortic valve was used to:

1. Preload Optimization: After 10 hours of fasting, rapid fluid infusion was initiated upon arrival to restore intravascular volume before anesthesia induction, aiming to maintain adequate preload [4].
2. Anesthetic Induction: A combination of propofol, opioids, and benzodiazepines was selected to ensure sufficient anesthetic depth and blunt sympathetic responses to intubation. This approach minimized tachycardia and increased contractility, which could shorten diastolic filling time, reduce preload, and worsen LVOT obstruction [4].
3. Vasopressor Management: Continuous norepinephrine infusion was initiated at induction. As a pure α-agonist, norepinephrine increases systemic vascular resistance without enhancing contractility or heart rate, thus preventing hypotension caused by anesthetic-induced vasodilation. Notably, inotropic agents are contraindicated in LVOT obstruction with SAM, as they may worsen obstruction by increasing Venturi forces [5].
4. Positioning: Reverse Trendelenburg positioning, which can reduce left ventricular end-diastolic volume by approximately 18% [6], was performed gradually under TEE guidance after adequate fluid resuscitation to mitigate preload reduction.
5. Intraoperative TEE Guidance: Real-time TEE monitoring allowed titration of vasopressors to minimize the Venturi effect and optimize hemodynamics during pneumoperitoneum and surgical manipulation.
6. Postoperative Extubation: To avoid sympathetic stimulation from pain or tracheal irritation, oxycodone was administered at the end of surgery, and 2 mL of 2% lidocaine was instilled into the trachea prior to extubation.

Conclusion

Continuous TEE monitoring is increasingly used in non-cardiac surgeries for patients with cardiovascular disease. For patients with LVOT obstruction and SAM, preventing exacerbation of outflow tract obstruction is critical in perioperative anesthesia management. Anesthesiologists should utilize TEE to dynamically

assess LVOT dynamics, preload, and contractility, guiding precise fluid and vasoactive therapy. Additionally, close collaboration with surgeons to optimize patient positioning and pneumoperitoneum pressures contributes to safer and more effective anesthesia care using advanced visualization techniques.

Consent for Publication

Written informed consent was obtained from the patient's son for the publication of this case report and related images.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of West China Hospital of Sichuan University. Written informed consent was obtained from the patient and her son for the publication of any potentially identifiable images or data included in this article.

Data Availability Statement

The original contributions presented in this study are included in the article. Further inquiries can be directed to the corresponding authors.

Conflict of Interest

The authors have read and approved the final version of the manuscript. The authors declare no conflicts of interest.

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