

Anesthetic Management of Elderly High-Risk Patients with Left Ventricular Outflow Tract Obstruction: A Case Series

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Abstract

Elderly patients with Left Ventricular Outflow Tract Obstruction (LVOTO) present considerable anesthetic challenges due to their compromised cardiovascular status, age-related physiological changes, and multiple coexisting comorbidities such as hypertension, diabetes, and ischemic heart disease. These patients are particularly vulnerable to fluctuations in preload, afterload, and myocardial contractility, making precise hemodynamic management essential to prevent complications such as hypotension, arrhythmias, or myocardial ischemia. This case series emphasizes the tailored anesthetic strategies adopted for elderly high-risk LVOTO patients undergoing various surgical procedures, focusing on maintaining cardiovascular stability and minimizing perioperative risk. Fractional spinal anesthesia was administered in all cases, using small incremental doses of local anesthetic to achieve adequate sensory blockade with minimal hemodynamic disturbance. This approach proved highly effective in maintaining stable blood pressure and heart rate, providing sufficient and prolonged anesthesia, and reducing the need for pharmacologic intervention. The findings highlight the importance of individualized anesthetic planning, meticulous perioperative monitoring, and gradual titration of anesthesia to ensure optimal outcomes in this fragile group of patients.

Keywords: Anesthetic management, elderly high-risk patients, Left Ventricular Outflow Tract Obstruction, fractional spinal anesthesia

Introduction

Left Ventricular Outflow Tract Obstruction (LVOTO) is a complex cardiovascular condition that occurs when the left ventricular outflow tract is partially obstructed, impeding blood ejection from the left ventricle to the aorta. It is commonly associated with hypertrophic cardiomyopathy (HCM) but can also be seen in conditions such as aortic stenosis and systolic anterior motion of the mitral valve [1,2]. Hemodynamically, LVOTO leads to increased left ventricular pressure, reduced cardiac output, and a heightened risk of intraoperative cardiovascular collapse, particularly in elderly patients with multiple comorbidities [3,4].

The severity of LVOTO is often defined by an intraventricular pressure gradient exceeding 30 mmHg at rest or provoked by factors such as hypovolemia, vasodilation, tachycardia, and increased myocardial contractility. Elderly patients with LVOTO frequently present with additional challenges such as systemic hypertension, diabetes mellitus, atrial fibrillation, and chronic pulmonary disease, all of which contribute to increased perioperative morbidity and mortality [5,6]. The fragility of this patient population, combined

with reduced cardiopulmonary reserve, necessitates a meticulous anesthetic approach tailored to maintain hemodynamic stability [7,8]. Neuraxial anesthesia, particularly spinal anesthesia, is widely used for lower-limb and abdominal surgeries in elderly patients. However, traditional spinal anesthesia carries the risk of profound hypotension due to sympathetic blockade, which can be detrimental in patients with LVOTO. Fractional spinal anesthesia, a technique involving the administration of a lower dose of local anesthetic in a controlled manner, has emerged as a safer alternative. This technique minimizes abrupt hemodynamic changes while providing effective anesthesia [9,10]. This case series explores the anesthetic management of five high-risk elderly patients with LVOTO who underwent various surgical procedures under fractional spinal anesthesia. Our objective is to highlight the perioperative strategies that ensured hemodynamic stability and successful surgical outcomes.

Case Descriptions

Case 1

A 75-year-old female patient presented to the emergency department with pain and immobility of the right lower limb following a fall at home. Radiographic evaluation confirmed a right supracondylar femur fracture. Her medical history revealed long-standing hypertension and type 2 diabetes mellitus, with poor adherence to prescribed medications. On admission, her random blood glucose levels were markedly elevated, and coagulation studies indicated a mild coagulopathy with a prothrombin time (PT) of 17 seconds and an international normalized ratio (INR) of 1.5. Comprehensive preoperative cardiac evaluation was performed due to her advanced age and known cardiovascular risk factors. Transthoracic echocardiography demonstrated concentric left ventricular hypertrophy (LVH) with mid-cavity turbulence and a significant left ventricular outflow tract (LVOT) resting gradient of 47 mmHg, consistent with dynamic obstruction. The left ventricular ejection fraction (LVEF) was preserved at 62%, and grade 2 diastolic dysfunction was noted, indicating impaired ventricular relaxation. The electrocardiogram (ECG) showed sinus rhythm with biphasic T-waves in leads V4, V5, and V6, suggestive of left ventricular strain pattern.

Preoperative optimization was carried out meticulously, focusing on achieving glycemic control through insulin therapy and correcting coagulation abnormalities with vitamin K and fresh frozen plasma as required. The anesthetic plan was carefully designed to minimize hemodynamic fluctuations, considering the presence of LVOTO and diastolic dysfunction. The patient was taken up for open reduction and internal fixation (ORIF) of the right supracondylar femur fracture under spinal anesthesia using a fractional dosing technique. Small incremental doses of local anesthetic were administered to achieve a controlled block, thereby preventing sudden decreases in systemic vascular resistance and maintaining stable hemodynamics. Invasive arterial blood pressure monitoring was instituted to enable continuous and precise monitoring throughout the procedure.

The intraoperative course remained stable, with heart rate and blood pressure maintained within safe limits. No episodes of hypotension, bradycardia, or arrhythmia were observed. Adequate analgesia and muscle relaxation were achieved, and the surgery was completed successfully without complications. Postoperatively, the patient was monitored in the high-dependency unit, where glycemic control and hemodynamic parameters remained stable. She recovered well and was mobilized gradually under physiotherapy supervision. The overall perioperative period was uneventful, reflecting the effectiveness of individualized anesthetic management and vigilant perioperative monitoring in a high-risk elderly patient with LVOTO and multiple comorbidities.

Case 2

A 90-year-old female presented with a right subtrochanteric femur fracture following a domestic fall. She appeared frail, with poor functional capacity and markedly reduced effort tolerance, estimated at approximately 2 metabolic equivalents (METs). Her breath-holding capacity was limited to 10 seconds, suggesting compromised cardiopulmonary reserve. Given her advanced age and diminished physiological resilience, a thorough preoperative evaluation was undertaken. Transthoracic echocardiography revealed septal hypertrophy, an ejection fraction (EF) of 48%, and hypokinesia involving the basal inferolateral and septal wall segments, consistent with ischemic myocardial changes. Additionally, the aortic valve appeared sclerotic, and there was evidence of mild left ventricular systolic and diastolic dysfunction, indicating a globally compromised cardiac function.

In light of her frailty and significant cardiac risk, meticulous preoperative optimization was undertaken, focusing on fluid balance, oxygenation, and stabilization of hemodynamic parameters. A multidisciplinary team involving anesthesiology, cardiology, and orthopedics coordinated her perioperative management to minimize physiological stress. Considering her limited cardiac reserve, a regional anesthesia technique was preferred over general anesthesia to reduce myocardial depression and maintain stable hemodynamics. Spinal anesthesia was administered using a fractional dosing technique to achieve an adequate sensory block while avoiding abrupt decreases in systemic vascular resistance. Invasive arterial blood pressure monitoring was employed to enable continuous and accurate hemodynamic assessment throughout the procedure.

The patient underwent proximal femoral nailing under stable intraoperative conditions. Blood pressure and heart rate remained within optimal limits, with no significant episodes of hypotension or arrhythmia. Intraoperative oxygenation was well maintained, and fluid administration was carefully titrated to avoid volume overload. The postoperative course was uneventful, with smooth recovery and gradual mobilization under supervision. This case highlights the importance of individualized anesthetic planning, vigilant intraoperative monitoring, and gentle perioperative management in elderly high-risk patients with compromised cardiac function undergoing major orthopedic surgery.

Case 3

A 76-year-old male with a known history of benign prostatic hyperplasia (BPH) was evaluated for transurethral resection of the prostate (TURP). His medical history revealed hypertrophic obstructive cardiomyopathy (HOCM) and poorly controlled hypertension. Preoperative electrocardiography showed sinus rhythm with evidence of left ventricular hypertrophy (LVH), while transthoracic echocardiography demonstrated concentric LVH with a preserved ejection fraction (EF) of 65% and features of diastolic dysfunction, indicating impaired ventricular relaxation. These findings placed him at a high cardiac risk, necessitating careful preoperative optimization. His antihypertensive regimen was reviewed and adjusted to achieve adequate blood pressure control before surgery.

Given his underlying cardiac condition, anaesthetic management focused on maintaining stable hemodynamic and avoiding factors that could exacerbate left ventricular outflow tract obstruction, such as tachycardia, hypovolemia, or sudden decreases in systemic vascular resistance. The patient underwent TURP under spinal anaesthesia using a carefully titrated dose of local anaesthetic to achieve an adequate sensory block without compromising cardiovascular stability. Continuous invasive blood pressure and ECG monitoring were instituted throughout the procedure to detect and manage any hemodynamic variations promptly.

The intraoperative course remained stable, with heart rate and blood pressure maintained within the

target range. Adequate anaesthesia and muscle relaxation were achieved, and the surgical procedure proceeded smoothly without complications. Postoperatively, the patient was monitored closely in the recovery unit, where hemodynamic remained stable, and no adverse cardiac events were noted. His recovery was uneventful, and he was discharged after satisfactory postoperative progress. This case underscores the importance of meticulous preoperative optimization, vigilant intraoperative monitoring, and a carefully tailored anesthetic approach in patients with HOCM undergoing urological surgery.

Case 4

A 71-year-old male with a known history of systemic hypertension, type 2 diabetes mellitus, and an untreated atrial septal defect (ASD) was scheduled for open mesh hernioplasty for a right inguinal hernia. He also reported a history of chronic dry cough and exertional dyspnea, suggestive of underlying cardiopulmonary compromise. Preoperative chest radiography revealed bilateral hilar prominence, raising suspicion of pulmonary hypertension. Transthoracic echocardiography demonstrated a D-shaped interventricular septum indicative of right ventricular pressure overload, with preserved left ventricular systolic function (ejection fraction 59%), grade 2 diastolic dysfunction, moderate pulmonary artery hypertension (pulmonary artery systolic pressure 55 mmHg), and mild-to-moderate tricuspid regurgitation. No regional wall motion abnormalities were detected.

In view of his pulmonary hypertension and diastolic dysfunction, thorough preoperative optimization was undertaken to ensure adequate respiratory and hemodynamic stability. The patient received nebulization with a combination of Formoterol and Glycopyrrolate to improve bronchodilation, along with intravenous hydrocortisone to reduce airway inflammation and optimize lung function before surgery. Considering his comorbidities and hemodynamic vulnerability, a regional anesthesia technique was preferred to minimize cardiac stress and avoid the risks associated with general anesthesia. Spinal anesthesia was administered using fractional dosing to achieve a controlled and gradual block while maintaining stable hemodynamics. Continuous invasive arterial blood pressure monitoring was implemented for precise intraoperative assessment and early detection of any hemodynamic changes.

The intraoperative course was stable, with satisfactory maintenance of blood pressure, oxygen saturation, and heart rate. Adequate anesthesia and muscle relaxation were achieved, allowing for smooth surgical progress without complications. The patient's recovery in the postoperative period was uneventful, with no signs of respiratory distress or hemodynamic instability. This case highlights the importance of meticulous preoperative pulmonary optimization, careful anesthetic planning, and vigilant intraoperative monitoring in managing elderly patients with uncorrected congenital cardiac defects and pulmonary hypertension undergoing non-cardiac surgery.

Case 5

A 75-year-old female with a known history of systemic hypertension presented with a right femoral neck fracture following a fall. She had been experiencing dyspnea for the past month. On examination, her heart rate was 110 beats per minute, blood pressure was 110/90 mmHg, and oxygen saturation (SpO₂) was 95% on room air. Respiratory examination revealed bilateral wheezing and basal crepitations predominantly in the left lower lobe, suggesting an element of underlying airway obstruction and possible pulmonary congestion. Transthoracic echocardiography demonstrated concentric left ventricular hypertrophy (LVH) with moderate aortic stenosis, mild mitral and tricuspid regurgitation, fair left ventricular systolic function, and the presence of a small pericardial effusion, indicating a compromised yet compensated cardiac status. High-resolution computed tomography (HRCT) of the chest revealed focal ground-glass opacity in the right upper lobe with subpleural consolidation and mediastinal lymphadenopathy, findings suggestive of an inflammatory or early fibrotic process.

Given her cardiopulmonary findings and advanced age, careful preoperative optimization was undertaken. The patient was administered nebulization therapy to relieve bronchospasm and improve oxygenation, along with close monitoring of fluid and electrolyte balance to avoid precipitating cardiac decompensation. The anaesthetic plan prioritized hemodynamic stability, oxygenation, and avoidance of excessive myocardial depression. The patient underwent incremented bipolar hemiarthroplasty under spinal anaesthesia, using small, titrated doses of local anaesthetic to achieve a gradual and controlled sensory block. Invasive arterial blood pressure monitoring was employed to enable continuous hemodynamic assessment throughout the procedure.

The intraoperative period remained stable, with no significant episodes of hypotension, arrhythmia, or desaturation. Adequate analgesia and anaesthesia were achieved, and the surgical procedure proceeded uneventfully. Postoperatively, the patient was monitored in a high-dependency setting, where oxygen saturation, blood pressure, and heart rate remained within normal limits. Her recovery was smooth, with no respiratory or cardiac complications. This case highlights the importance of comprehensive preoperative evaluation, judicious optimization, and individualized anaesthetic management in elderly patients with complex cardiac and pulmonary comorbidities undergoing orthopaedic surgery.

Discussion

The Management of left ventricular outflow tract obstruction in elderly surgical patients requires meticulous anesthetic planning to avoid hemodynamic instability. In the present study, fractional spinal anesthesia was selected to preserve preload and systemic vascular resistance, thereby reducing the risk of severe hypotension and dynamic outflow obstruction.

Several studies support the use of fractional spinal anesthesia in high-risk elderly patients. Kaniyil et al. [1] demonstrated that fractional spinal anesthesia provided superior hemodynamic stability and prolonged anesthetic duration compared to conventional spinal techniques in elderly orthopedic patients. Similar findings were reported by Olsen et al. [3], who observed improved systemic hemodynamics and a reduction in perioperative complications among frail elderly patients undergoing hip fracture surgery.

Comparative principles of anesthetic management in obstructive cardiomyopathies have been discussed by Bhalerao et al. [2], who emphasized preload maintenance and avoidance of vasodilation during emergency cesarean section in patients with hypertrophic obstructive cardiomyopathy. Although their study focused on obstetric emergencies, similar hemodynamic strategies were applied in our study across a wider range of non-cardiac surgical procedures, resulting in consistent intraoperative stability.

The importance of minimizing sympathetic stimulation in cardiomyopathy patients has been highlighted by Ibrahim et al. [4]. Our anesthetic technique, which included slow intrathecal drug administration and careful titration of sensory blockade, aligns with these recommendations. Additionally, Hensley et al. [5] stressed the need to maintain sinus rhythm and avoid tachycardia in patients with hypertrophic cardiomyopathy, principles that were strictly followed during perioperative management in our cases.

Patients with coexisting valvular and cardiopulmonary conditions are at increased risk of perioperative complications. Kertai et al. [6] identified aortic stenosis as an underestimated risk factor in non-cardiac surgery, reinforcing the need for cautious anesthetic approaches in obstructive cardiac pathologies. Earlier work by Maggi et al. [7] further supports fractional spinal dosing in elderly patients to limit abrupt hemodynamic changes.

Comorbid respiratory conditions also influence anesthetic outcomes in elderly patients. Arai et al. [8] and Licker et al. [9] emphasized the importance of careful anesthetic management in patients with pulmonary hypertension and chronic obstructive pulmonary disease, respectively, to reduce perioperative morbidity. Comprehensive perioperative risk assessment and optimization, as outlined by Hines et al. [10], remain essential in managing patients with complex coexisting diseases.

Overall, the findings of this study add to the growing evidence that fractional spinal anesthesia is a safe and effective technique for elderly patients with left ventricular outflow tract obstruction undergoing non-cardiac surgery. Careful patient selection, optimization of comorbidities, and precise anesthetic techniques play a crucial role in minimizing perioperative complications and improving surgical outcomes.

Conclusion

The management of elderly high-risk patients with LVOTO undergoing surgery requires a meticulous and individualized anesthetic approach. This case series demonstrates that fractional spinal anesthesia, when carefully planned and executed, is a safe and effective technique for maintaining hemodynamic stability in this vulnerable population. The success of anesthesia in LVOTO patients hinges on several critical factors, including preoperative optimization of cardiovascular status, judicious intraoperative fluid management, and continuous hemodynamic monitoring. Fractional spinal anesthesia provides a controlled, gradual onset of sympathetic blockade, reducing the risk of abrupt hypotension while ensuring adequate analgesia and muscle relaxation. Our findings align with existing literature that advocates for the use of fractional spinal anesthesia in frail elderly patients with cardiac comorbidities. Compared to conventional spinal anesthesia, this technique reduces perioperative complications and enhances patient outcomes by preserving systemic vascular resistance and preload, which are crucial in LVOTO cases.

While our study successfully demonstrated the feasibility and benefits of fractional spinal anesthesia in this patient population, larger-scale studies are required to further validate its efficacy and establish standardized anesthetic protocols. Future research should focus on comparative studies assessing different anesthetic techniques and their long-term outcomes in patients with LVOTO.

In conclusion, our experience highlights the importance of a comprehensive, patient-specific anesthetic strategy in elderly individuals with LVOTO. By prioritizing hemodynamic stability through careful preoperative assessment, intraoperative vigilance, and the use of fractional spinal anesthesia, anesthesiologists can significantly enhance the safety and success of surgical procedures in this high-risk group.

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