Anaesthesia Management of a Patient with Severe Regurgitative Lesion and Right Heart Failure Posted for Open Cholecystectomy under Erector Spinae and Transverse Abdominis Plane Blocks

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ABSTRACT

Mitral regurgitation affects 2% of the world's population. Patients with pulmonary hypertension (PH) and right heart failure indicate a poor prognosis, which necessitates the need for early surgical intervention. The authors present a case of a patient with severe mitral regurgitation, severe tricuspid regurgitation, and severe PH who had been advised dual valve replacement three years ago, but the patient refused surgery. She was now presented with acute right hypochondrial pain and was scheduled for open cholecystectomy. Because of the risks involved, we decided to proceed with surgery under a combination of nerve blocks, paraspinal fascial plane block (erector spinae plane block), and subcostal transverse abdominis plane block, along with minimal sedation.

Key Words: *Mitral regurgitation, Pulmonary hypertension, Regional anaesthesia, Erector spinae plane block, Transverse abdominis plane block*.

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INTRODUCTION

Mitral regurgitation (MR) affects 2% of the population worldwide, with increasing prevalence with age.[1] It can present acutely or chronically, with chronic cases often remaining asymptomatic until late in the disease progression. Common clinical findings in MR include fatigue, exertional dyspnoea, orthopnoea, paroxysmal nocturnal dyspnoea, pulse pressure widening, and other symptoms, as well as specific physical examination findings such as a holosystolic murmur, dependent oedema, and raised jugular venous pressure (JVP). Advanced cases may also exhibit signs of pulmonary hypertension (PH) and right ventricular dysfunction, indicating a poor prognosis and the need for early surgical intervention.[2] The most common type of PH is due to left heart disease and valvular pathology is the leading cause. Patients with moderate-to-severe MR undergoing non-cardiac surgery are at increased risk for cardiovascular complications, especially if they have PH or right ventricular heart failure.[3]

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Surgical stress may cause worsening of ongoing PH, which may lead to potentially fatal complications such as arrhythmias, major haemodynamic instability, myocardial ischaemia, heart failure, perioperative respiratory complications, and prolonged intensive care unit (ICU) stay.[4] Anaesthesiologists caring for these patients must have a thorough understanding of the pathophysiology and should focus on optimising blood pressure (BP), oxygenation, and ventilation, as well as avoiding exacerbating factors and controlling pain, to improve perioperative outcomes.[5]

The authors chose regional anaesthesia for a patient who had severe PH and was very high risk for both general anaesthesia and central neuraxial block. The authors used a combination of nerve blocks for the surgery that had not been attempted before.

CASE REPORT

A 69-year old female (weight 50 kg, height 160 cm) with long-standing hypertension, diabetes mellitus, ischaemic heart disease, severe valvular heart disease, and hypothyroidism presented with acute right hypochondrial pain and was planned for cholecystectomy on suspicion of empyema of the gallbladder. The patient was taking a tablet of spironolactone 40 mg OD, tablet metoprolol 25 mg BD, tablet digoxin 0.25 mg OD, tablet thyroxin 50 µg OD, tablet warfarin, and oral hypoglycaemics. The patient had been advised of dual valve replacement three years ago but she refused surgery. She had a history

of multiple hospital visits due to shortness of breath and had been hospitalised earlier in the year due to congestive heart failure. Her initial labs showed leucocytosis (total leucocyte count: 24,000/mm^3), hyponatraemia (123 mEq/L), hypoalbuminaemia (albumin 3.1 g/dl), and deranged coagulation profile (activated partial thromboplastin time >2 min). Her echocardiography showed ejection fraction (EF) of 50% by modified Simpson bi-plane method with severe tricuspid regurgitation (TR), severe MR and severe PH with mean pulmonary artery systolic pressure of 100 mmHg and mild pericardial effusion (Figure 1). Her coronary arteriography showed mild-to-moderate coronary artery disease. Her electrocardiogram (ECG) showed T wave inversion in inferior-lateral leads with poor progression of the R wave. Her carotid artery Doppler showed bilateral, small fibro-fatty, and calcific non-obstructive plaques. Chest x-ray is shown in Figure 2. The abdominal ultrasound showed increased wall thickness of the gall bladder with pericholecystic fluid.

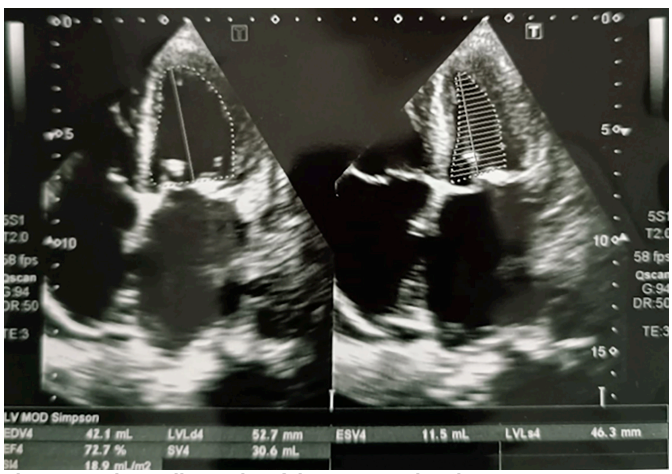

Figure 1: Echocardiography of the presented patient.

Figure 2: Chest x-ray (PA-view) showing pulmonary vessels going cranially and congested pulmonary vasculature.

On physical examination, there was a pansystolic murmur. The cardiac surgery team was taken on board, and they advised valve replacement before proceeding with any other surgical procedure, but they wanted the infection to be settled first to avoid any possible valve infection, and the general surgeon wanted to proceed with cholecystectomy as the gall bladder was thought to be the source of infection. Because of the risks involved, we decided to proceed with open cholecystectomy under nerve blocks after explaining the risks to the family and taking written informed consent.

On shifting to the operation room (OR), the patient was catheterised, an arterial line was passed and wide-bore peripheral IV lines were secured. Standard monitoring was done using an ECG, invasive BP, pulse oximetry, urine output, and temperature. The capnograph was attached to the face mask. Defibrillator and inotropic and vasopressor medicines were ready for emergency use and a cardiologist was taken on board for the case. Oxygen was attached at 5 l/min using an oxygen mask. Two units of fresh frozen plasma were transfused. Erector spinae plane block (ESPB) single shot was performed by ultrasound guidance on the right side at T8 level and 0.375% bupivacaine 20 ml with 1 µg/ml dexmedetomidine was given through it. Along with it, right-sided ultrasound-guided subcostal transverse abdominis plane (TAP) block was performed with 0.375% bupivacaine 10 ml with 1 µg/ml dexmedetomidine being given. The patient was also started on intravenous infusion of fentanyl (2 µg per ml) in combination with ketamine (2 mg/ml) and midazolam (0.1 mg/ml) @ 10 ml per hour. IV fluid normal saline was started @ 40 ml per hour. The incision was given after confirmation of the analgesic effect (almost 25 minutes) of both nerve blocks. The surgery went uneventfully. The total duration of surgery was 1 hour 15 minutes, with minimal blood loss of around 50 ml. There was no need for any inotropes intraoperatively, and the perioperative course was uneventful. The patient was shifted to the post-anaesthesia care unit (PACU) with stable vitals, no inotropic support, and maintaining saturation with minimal supplemental oxygen (2 litres *via* nasal cannula). In the PACU, ECG, BP, spO_2, and subjective monitoring were done. The defibrillator and inotropic and vasopressor support and airway trolley were kept on standby to deal with any emergency situation. A follow-up with the cardiologist was done immediately after shifting, and a bedside cardiac point-of-care ultrasound (POCUS) was done to rule out any acute changes. The patient had an uneventful stay at PACU and was shifted to a room after six hours. The patient also remained pain-free for eight hours after surgery, after which 1st dose of rescue analgesia was administered in the form of tramadol 20 mg intravenously and paracetamol 1g intravenously, and it was enough for the postoperative period. However, before shifting to the room, intravenous paracetamol 1g thrice a day, and capsule tramadol 50 mg thrice a day were added. She was discharged from the room after two days and was called for follow-up by the cardiac surgery team after two weeks. Before discharge, informed consent was signed by the patient's son for publication of the case report.

DISCUSSION

MR occurs when blood flows backwards from the left ventricle (LV) into the left atrium (LA) through the mitral valve (MV), producing a systolic murmur heard best at the heart's apex with radiation to the left axilla. MR is classified into primary (degenerative or organic) and secondary (functional or ischaemic) based on its underlying causes and can be further categorised by leaflet motion using the Carpentier classification.

Among other complications of MR, the development of atrial fibrillation or PH significantly impacts prognosis and warrants earlier surgical intervention, as per guidelines from leading cardiovascular associations such as the American Heart Association/American College of Cardiology (AHA/ACC) and European Society of Cardiology/European Association for Cardio-thoracic Surgery (ESC/EACTS).[6] Managing patients with MR and its complications presents a significant challenge for anaesthesiologists. It is crucial to possess a comprehensive understanding of the underlying pathophysiology to prevent exacerbating factors and enhance patient outcomes. The key goals of anaesthetic management are to maintain forward blood flow, reduce regurgitation, and prevent an increase in pulmonary vascular resistance to minimise right heart failure. This is achieved by optimising pre-load without causing overload, maintaining a moderate heart rate (80-100 beats per minute) to avoid bradycardia and excessive diastole (which increases regurgitation), enhancing contractility to improve forward flow and reducing regurgitation, and reducing afterload. Additionally, it is important to avoid exacerbating factors such as hypoxia, hypercarbia, acidosis, and pain to prevent an increase in pulmonary vascular resistance. There is currently no definitive conclusion in the literature regarding whether regional or general anaesthesia is more advantageous for patients with PH.[7]

Patients with PH face heightened risks during general anaesthesia due to potential acute right ventricular decompensation and cardiac arrest triggered by sympathetic nervous system activation, hypoxaemia, hypercapnia, or mechanical ventilation. Neuraxial anaesthesia must also be given cautiously to avoid systemic hypotension and haemodynamic collapse. A systematic review and expert consensus statement published by Hosseinian reported 30-day mortality ranges between 2% and 18% for non-obstetric and non-cardiac surgeries in such patients undergoing elective procedures, while mortality rate increases up to 15-50% in such patients undergoing emergency procedures.[8,9]

In this case, the patient's refusal of surgery three years ago likely exacerbated the condition, leading to severe symptoms. Opting for nerve blocks during cholecystectomy demonstrates a cautious approach to mitigate risks associated with anaesthesia, considering the patient's cardiac complications. There have been numerous studies for the comparison of spinal anaesthesia *versus* general anaesthesia for open cholecystectomies as well as laparoscopic cholecystectomies. Laparoscopic cholecystectomies have also been performed under both spinal anaesthesia and epidural anaesthesia. Single-shot regional anaesthesia techniques, including ESPB and TAP block, have been used as part of multimodal analgesia in patients undergoing laparoscopic cholecystectomies under general anaesthesia to reduce intraoperative and postoperative opioid consumption,but these blocks have not been previously used to perform open cholecystectomy with minimal sedation. Studies have shown that mini cholecystectomies can be performed under local anaesthesia by infiltrating the incision site as well as infiltrating the Calot's triangle with local anaesthetic, provided the patient is not in the acute phase.[10] This is the first case being reported in which open cholecystectomy for acute cholecystitis was performed under a combination of nerve blocks.

Postoperatively, the patient was stable in this case and after vigilant monitoring (5 minutes for the first 15 minutes and then every 15 minutes for the next 2 hours, followed by every 30 minutes for the next 4 hours) of ECG, invasive BP, spO_2, urine output, other subjective parameters such as the generalised look and systemic examination and postoperative follow-up of the cardiologist was done. A multimodal analgesic plan must be added to the treatment chart before shifting from the PACU to the ward/room.

In conclusion, patients with valvular heart diseases and their associated complications require individualised treatment and management that is tailored to their risk status. The use of a combination of nerve blocks for various surgical procedures in these patients may mitigate their morbidity and improve the anaesthetic management in such high-risk cases. Further studies and evidence are needed to make it generalised in such high-risk patients.

PATIENT'S CONSENT:
Informed consent regarding the data collection for case report publication was obtained from the patient and the family.

COMPETING INTEREST:
The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:
AK: Conception of study, analysis, and manuscript writing.
KB: Performing the nerve block in the operation theatre and proofreading of the final study.
SR: Drafting of the work for important intellectual content.
JS: Proofread the final version.
ZK: Manuscript writing.
All authors approved the final version of the manuscript to be published.

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