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A SUCCESSFUL LOW-DOSE SPINAL ANESTHESIA IN A PATIENT WITH SEVERE MITRAL VALVE STENOSIS FOR PARTIAL HIP REPLACEMENT SURGERY: A CASE REPORT

Nguyen Duy Anh✉[1], Tran Dac Tiep[1], Nguyen Ngoc Thach[1], Nguyen Tien Duc[2]

[1]Military Hospital 103
[2]Vietnam National Cancer Hospital

SUMMARY

Anesthesia for patients with mitral valve stenosis presents a great challenge for anesthesiologists. The choice of spinal anesthesia or general anesthesia for these patients is still controversial, each method has its own advantages and disadvantages. We describe the anaesthetic management for a 73-year-old female patient with a left closed intertrochanteric fracture of the femur with many concomitant diseases: atrial fibrillation, severe mitral valve stenosis, and previous cerebral stroke.

The patient had successful partial hip replacement surgery under spinal anesthesia. In the preoperative period, the patient had no difficulty breathing, no chest pain, echocardiography showed severe mitral stenosis due to rheumatism with valve orifice area 0.9 cm^2, left atrial enlargement, systolic pulmonary artery pressure 46 mmHg, normal ejection fraction 59% and electrocardiogram showed atrial fibrillation with ventricular response of 93 beats/minute.

Left partial hip replacement surgery was successfully performed under spinal anesthesia using 5 mg 0.5% hyperbaric bupivacaine. Loss of sensation reaching the umbilicus provides adequate anesthesia for the surgery. The patient recovered without any complications and was discharged on the 14th day after surgery.

***Keywords**: Severe mitral valve stenosis, hip replacement surgery, spinal anesthesia*

1. INTRODUCTION

Rheumatic heart disease is still the primary cause of mitral stenosis in most developing countries. A study of rheumatic heart disease (RHD) cases estimated that in 2015, there were globally 33.4 million cases of RHD, 10.5 million disability-adjusted life-years due to RHD, and 319400 deaths due to RHD. The incidence of rheumatic heart disease is highest in Oceania, central sub-Saharan Africa, and South Asia [1].

Mitral valve stenosis reduces left ventricular filling due to reduced blood flow from the left atrium to the left ventricle. Blood pooling in the left atrial blood in the long term causes left atrial dilation, atrial fibrillation, and pulmonary hypertension. Selecting spinal anesthesia in patients with

[1]Chịu trách nhiệm: Nguyễn Duy Anh, Bệnh viện Quân y 103
Email: anhngoc1397@gmail.com
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severe mitral stenosis requires extreme caution because it causes sympathetic blockage, reduces preload, thereby reducing cardiac output, causing severe hypotension.

In addition, in patients with severe mitral valve stenosis due to blood pooling in the left atrium, it is necessary to avoid fluid overload during surgery because it can lead to pulmonary edema. Heart rate should be maintained between 70 - 80 beats/minute because a fast rate further reduces blood flow from the left atrium to the left ventricle during diastole.

Therefore, patients with severe mitral valve stenosis need to be evaluated and well-controlled in heart rate, blood pressure, and circulating volume before, during, and after surgery [2]. In this case, a 72-year-old female patient was diagnosed with a left closed intertrochanteric femoral fracture with severe mitral valve stenosis, atrial fibrillation, and a previous stroke. The patient had performed partial left hip replacement surgery under spinal anesthesia without any complications.

2. CASE REPORT

A 73-year-old female patient (height 154 cm, weight 55 kg) with a known history of atrial fibrillation, mitral valve stenosis and she was treated with Vitamin K antagonists (Sintrom 4 mg x 1/4 pill per day), left hemiplegia due to a previous stroke (2022). The patient was diagnosed with a left femoral intertrochanteric fracture and was scheduled for left partial hip replacement surgery. At the time of admission (November 16, 2023), the patient was fully conscious, with no edema, no fever, no chest pain, no difficulty breathing, no bleeding on the skin or mucous membranes. Irregular pulse 93 beats/min, blood pressure 130/80 mmHg, no rales in lungs, SpO_2 98 - 99% breathing air. Left arm muscle strength was 1/5, left leg muscle strength was difficult to assess due to left intertrochanteric fracture of the femur.

Complete blood count and blood chemistry tests were in a normal range. Coagulation tests: Prothrombin time 15%, INR 5.1, APTT 50.6 s, Fibrinogen 4.21 g/L. An electrocardiogram indicated atrial fibrillation with a ventricular rate response of 90 beats/min (figure 1).

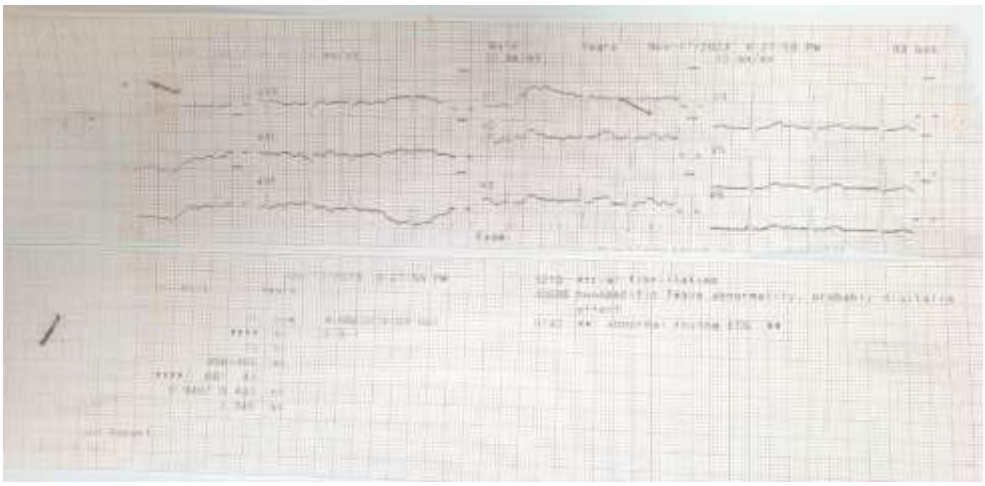

Figure 1. Preoperative electrocardiogram (November 17, 2023)

Chest X-ray (November 17, 2023): Enlarged heart silhouette, no signs of pulmonary edema.

Echocardiogram (November 27, 2023): Severe mitral valve stenosis due to rheumatism with valve orifice area 0.9 cm^2, left atrial dilatation, no thrombus, high systolic pulmonary artery pressure (46 mmHg), normal ejection fraction (EF 59%), moderate tricuspid regurgitation (figure 2).

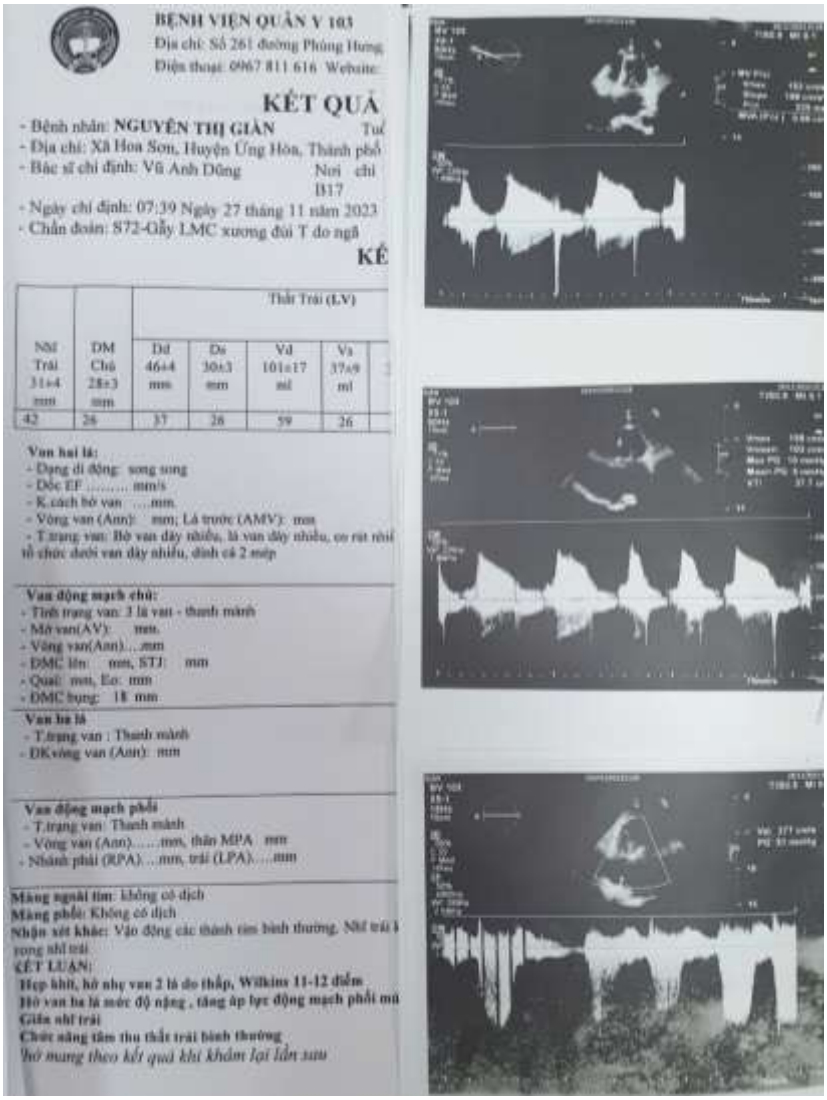

Figure 2. Preoperative echocardiography

The patient was consulted by a cardiologist and neurologist, she was advised to stop taking oral anticoagulants and switch to low-molecular-weight heparin (LMWH) subcutaneously injection. The preoperative INR test was 1.2 (November 27, 2023).

November 30, 2023, the patient was transferred to the operating room. She was inserted and monitored invasive blood pressure on the right radial artery, central venous catheter (CVC) was inserted in the right internal jugular vein, continuously monitored ECG, heart rate, SpO_2. 500 mL

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red blood cells (A group) were prepared in advance. Before anesthesia: blood pressure was 104/65 mmHg, ECG showed atrial fibrillation heart rate with ventricular response 100 - 104 beats/min, SpO_2 98% with 3 L/min oxygen support via nostril, central venous pressure (CVP) = 6 mmHg.

Spinal anesthesia was performed in the sitting position, using hyperbaric Bupivacaine 0.5% with a low dose 5 mg and 20 mcg Fentanyl, needle insertion at the L2-3 level. After removing the spinal needle, the patient was laid down immediately and the table was rotated 15 degrees to the left.

The level blockage was tested using cold sensation (alcohol cotton was used), reaching T10 level after 5 minutes of spinal anesthesia, blood pressure 100/61 mmHg, ECG atrial fibrillation with ventricular response 136 b/m. After 13 minutes, the surgeon began to incise the skin, blood pressure was 111/60 mmHg, pulse was 120 b/m. The surgery time from skin incision until skin closure was 45 minutes, no complications occurred during surgery, hemodynamics minimally fluctuated in the range (blood pressure 100/67 - 104/65 mmHg, pulse rate of 130 - 135 L/min), intraoperative fluid infusion was 100 ml of normal saline, CVP after skin closure was 8 mmHg. Blood loss during surgery was approximately 50 ml, so there was no need for blood transfusion. During the surgery, the patient did not complain of any pain, discomfort, or other abnormalities.

At the end of surgery, the patient was transferred to the post-anesthesia care unit (PACU). After 1 hour, the blockage level had decreased to L1 dermatome and she could move his knee (Bromage grade 2). The patient was infused with continuous intravenous fentanyl at a dose of 15 mcg/h in combination with paracetamol x 1 g intravenous infusion twice daily for postoperative pain management. She was then transferred to the Orthopaedic Surgery department for continued monitoring and treatment.

Table 1. Perioperative hemodynamic changes

Parameter \ Time		Before anesthesia	5 mins after spinal anesthesia	Skin incision	Skin closure
HR (b/m)		104	136	130	118
BP (mmHg)	Systolic	104	100	100	110
	Diastolic	65	61	67	70
CVP (mmHg)		6	5	5	8

On the 1st day after surgery, the total blood count tests, coagulation tests, electrocardiogram, and chest x-ray were made and the results were within normal limits. On the 2nd day after surgery, the patient continued to use LMWH x 4000 IU subcutaneous injection at the time of 8 and 20 o'clock. The patient was discharged on the 14th day after surgery without any other complications.

3. DISCUSSION

Rheumatic heart disease remains the leading cause of mitral valve stenosis in

developing countries. In addition, other causes such as valve degeneration with age or congenital heart abnormalities. According to the American Society of Echocardiography, the grading of mitral valve stenosis is based on echocardiography, when the mitral valve orifice area is less than 1 cm^2, it is considered severe stenosis [3]. Anesthesia for patients with severe mitral stenosis requires focusing on the maintenance of heart rate, blood pressure, preload, and avoiding hypoxia or hypercarbia. Because tachycardia will reduce left ventricular diastolic filling time, hypoxia causes pulmonary hypertension, causing acute right ventricular failure. High blood pressure and fluid overload can promote pulmonary edema.

Our patient was scheduled for partial hip replacement surgery. This was a major surgery, carrying a high risk of blood loss, causing severe pain after surgery. In addition, hip replacement surgery in elderly patients also carries a potential risk of pulmonary embolism. In particular, this patient has many concomitant diseases: Atrial fibrillation, severe mitral valve stenosis, left hemiplegia due to stroke. Possible risks during and after surgery include: Acute right heart failure, hemodynamic disorders, pulmonary edema, venous thromboembolism (Caprini DVT risk score 11 points), and recurrent stroke [4]. Therefore, it is necessary to optimize the patient prior to the surgery.

Blood coagulation test at the time of admission showed PT 15%, INR 5.1 due to vitamin K antagonists treatment. Our patient was asked to stop taking vitamin K antagonists. After the INR ratio reached 0.8 - 1.2, the patient was given subcutaneous injection of LMWH and stopped 24 hours before surgery. INR result (November 27, 2023) 3 days before surgery was 1.2. Additionally, another issue needs to be considered, whether a mitral valve replacement surgery should proceed first and be followed by a hip replacement surgery afterward. Our patient was diagnosed with severe mitral valve stenosis without any symptoms. Besides, the systolic pulmonary artery pressure was 48 mmHg, which was not very high. According to the guidelines of AHA for the management of patients with Valluvar disease, there was no indication for mitral valve replacement surgery in this situation [5]. However, it is necessary to optimize heart rate, blood pressure, circulatory volume and correct coagulation disorders prior to the surgery.

Many authors recommend that neuraxial anaesthesia should be considered cautiously and titrated to effect in patients with severe aortic stenosis or mitral stenosis. The main concern is that neuraxial anaesthesia can dilate blood vessels, reduce preload, and reduce left ventricular filling, causing reduced cardiac output and severe hypotension [2].

However, no studies are available to inform clinical practice on the risk of spinal anaesthesia in patients with severe mitral valve stenosis. There are no controlled studies examining the best anaesthesia technique. Besides, general anaesthesia also has many risks, especially hemodynamic disorders at induction of general anaesthesia and acute pulmonary edema at intubation and extubation. Because our patient has severe mitral stenosis with valve orifice area 0.9 cm^2, moderate pulmonary hypertension (PAPs =

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46 mmHg), preserved EF (59%), the patient had no other cardiovascular symptoms, no rales on lung auscultation, chest X-ray showed no pulmonary edema. Therefore, low-dose spinal anesthesia can be applied safely in our patients.

There have been many reports on the successful application of neuraxial anesthesia in patients with severe mitral stenosis. Gai B., (2009) successfully performed low-dose spinal anesthesia combined with epidural anesthesia for cesarean section for pregnant women with severe mitral valve stenosis and severe pulmonary hypertension [6].

The patient was a 36-week pregnant woman scheduled for a planned cesarean section. The echocardiogram showed mitral valve stenosis (valve area 0.8 - 1 cm^2), systolic pulmonary artery pressure 51 mmHg, EF 56%, the patient had no difficulty breathing, no signs of pulmonary edema on x-rays. This patient was given spinal anesthesia with 0.5% Bupivacaine at a dose of 5 mg with 25 mcg Fentanyl at L3-L4, combined with 3 ml of 2% Lidocaine via epidural catheter. The surgery was preceded uneventfully with hemodynamic stability throughout the surgery, with no complications occurring after surgery.

Manish Kela (2017) also performed labor epidural analgesia on pregnant women with severe mitral stenosis (valve area: 0.6 cm^2) and severe aortic valve stenosis (aortic area: 0.8 cm^2) without any complications [7]. The epidural catheter was inserted at the L2 - L3 interspace, a carefully titrated mixture of Fentany 1 - 2 µg/mL and 0.125% Bupivacaine was given through the epidural catheter, a total of 16 ml was given to ensure the patient had analgesia up to T10 dermatomal level without motor blockade. The patient remained pain-free and hemodynamically stable throughout the procedure. The above two cases show that choosing neuraxial anesthesia helps reduce pain during and after surgery, reduces blood loss, and also avoids unnecessary endotracheal anesthesia.

In our patient, in addition to severe mitral valve stenosis, the patient also had combined atrial fibrillation. Atrial fibrillation in patients with mitral valve stenosis is the result of blood pooling in the left atrium, causing atrial dilatation, long-term dilated atrial muscle causing atrial arrhythmias, the most common of which is atrial fibrillation. Patients with atrial fibrillation are often prescribed anticoagulants to prevent thrombosis, but sometimes non-compliance with treatment can lead to bleeding disorders.

Therefore, it is necessary to optimize coagulation disorders before surgery. In addition, patients with atrial fibrillation should be careful to avoid risk factors that can cause paroxysmal tachycardia such as hypoxia, sympathetic stimulation such as pain, anxiety, fluid overload, etc. In the case of atrial fibrillation, atrial contractions that eject blood from the left atrium to the left ventricle are less effective in diastole, so anesthesia requires maintaining preload to avoid hypotension. We use low-dose spinal anesthesia with 5 mg of 0.5% Bupivacaine, thus minimizing vasodilation and ensuring preload to help maintain relatively stable hemodynamics throughout the surgery.

In fact, after performing spinal anesthesia technique and during surgery, hemodynamic changes were minimal, the level of blockage was T10 which was

sufficient for surgery. The total amount of intraoperative fluid infusion was 100 mL of normal saline. CVP at the end of surgery was 8 mmHg, no vasopressor bolus or continuous infusion was needed. Optimization of circulatory volume, use of low doses of Bupivacaine, and minimal blood loss during surgery (50 ml of blood loss) are the reasons for hemodynamic stability during the surgery.

During the postoperative period, our patient may still be at risk of pulmonary edema due to tachycardia, hypertension due to pain, and pulmonary embolism. Our patient received multimodal pain relief including Paracetamol x 1 g intravenous infusion twice daily and continuous intravenous infusion of Fentanyl at a rate of 15 mcg/h. The patient had little pain and maintained stable hemodynamics in the postoperative period.

4. CONCLUSION

Although patients with severe mitral stenosis are considered a relative contraindication of spinal anesthesia, our case showed that applying low-dose spinal anesthesia for surgery in patients with severe mitral stenosis is safe and efficient.

However, anesthesia for this group of patients requires close coordination between surgeons, anesthesiologists and cardiologists to optimize the patient before surgery, prepare appropriate anesthesia strategies and limit maximize blood loss as well as ensure good pain relief in the postoperative period. Low-dose spinal anesthesia in patients with severe mitral valve stenosis needs to be studied further to evaluate the safety, effectiveness and benefits of this method.

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