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Case Report

Proximal Femur Fracture in Elderly Patients with Severe Aortic Stenosis - Anaesthetic Considerations and Perioperative Care

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Abstract

Background: Severe senile aortic stenosis is associated with valve calcification and prevalence rates that increase with age. Similarly, proximal femur fracture also has a high incidence in the elderly population. Concomitance of these pathologies is a major challenge in decision making. Aortic stenosis is associated with the risk of cardiovascular events in the perioperative period, and delays in orthopaedic surgery increase morbidity and mortality.

Case Presentation: We report different perioperative and anaesthetic approaches and their respective outcomes in two cases of severe aortic stenosis in elderly patients undergoing surgical procedures for proximal femur fractures. In the first case, an 86-year-old woman initially approached with general anesthesia for hemiarthroplasty. There were many complications in the postoperative period and early hospital readmission after discharge. Eight months later the same patient suffered a periprosthetic fracture and underwent a successful surgical procedure only with peripheral block and sedation despite severe aortic stenosis and older age. In the second case, a 90-year-old woman with a proximal femur fracture was submitted to total hip arthroplasty with spinal anesthesia. Although less instability was expected, there was great difficulty in hemodynamic control in the intraoperative. The patient was observed in a longer postoperative period, being able to finally be discharged for outpatient rehabilitation.

Conclusion: Elderly patients with proximal femoral fractures and severe aortic stenosis demand an interdisciplinary medical team where cardiologists, anaesthesiologists and orthopaedists need to make decisions case-by-case. The perioperative care strategy, including anaesthetic-surgical planning, requires extensive knowledge and immense team involvement. We recommend shared decision making that presupposes the involvement of patients and their families.

Keywords: *Aortic Stenosis; Proximal Femur Fracture; Perioperative Care; Anaesthesia in Orthopaedic Surgery; Case Report*

Introduction

Severe aortic stenosis (AS), generally defined as a valve area < 1.0 cm^2, is classically described as a risk factor for mortality and cardiac complications in the postoperative period for patients undergoing noncardiac surgery [1-3]. Senile AS is associated with valve calcification, and consequently, its prevalence increases with age [4]. Similarly, proximal femur fracture has a high incidence and high morbidity

and mortality in elderly patients, with 30% mortality in the first year after surgery, reaching 50% in patients who remain under conservative treatment [5,6]. With the prospect of population ageing, it is reasonable to predict that these two pathologies will occur concomitantly in an increasing number of elderly people, which will make this combination an increasingly frequent challenge. We present clinical cases referring to two patients admitted for a proximal fracture of the femur who were subsequently diagnosed with severe AS, asymptomatic until then, who underwent orthopaedic surgical procedures with different anaesthetic approaches and perioperative care. Our main objective was to discuss aspects related to clinical perioperative monitoring, highlighting points regarding the preoperative evaluation, anaesthetic plans and postoperative care until hospital discharge. The reported cases were managed by the same team of staff, including the cardiologist and anaesthetists, in an institution specializing in orthopaedic surgery. We observed the current recommendations for case reports [7]. All patients involved provided consent, and this report was approved by the Research Ethics Committee of the Traumatology and Orthopedics Institute Jamil Haddad.

Cases Description

Case # 1: An 86-year-old woman was admitted with a fractured right femoral neck related to fall from the own height. The physical examination showed a systolic murmur in the aortic area, +4/+6, with cervical irradiation; blood pressure (BP) 160/80 mmHg without pulmonary congestion. She denied symptoms when carrying out daily activities, including self-care. No previous complaints of syncope, dyspnoea or chest pain were reported. Electrocardiogram (EKG) showed sinus rhythm and left ventricular hypertrophy (LVH). Echocardiogram demonstrated a calcified aortic valve, an ejection fraction (EF) of 67%, a mean pressure gradient between the left ventricle and aorta (LV/AO) of 58 mmHg, a valve area of approximately 0.6 cm^2 and an aortic jet velocity of 4.6 m/sec, confirming severe AS. At admission, haemoglobin (Hb) level was (11.2 g/dl), electrolytes, renal function and coagulation test results were stable. In view of her clinical stability and absence of symptoms of heart failure (HF) and considering that femur surgery is an urgent procedure, orthopaedic surgical planning was continued for partial right hip arthroplasty (hemiarthroplasty). General anaesthesia was chosen by the anaesthetic team. The patient was monitored with EKG and pulse oximetry (SO_2). After venoclysis in the left upper limb with a 16G catheter and insertion of a catheter in the left radial artery by the Seldinger technique, pre-oxygenation with O_2 was started under a mask for 5 minutes. Induction was achieved with fentanyl plus etomidate, and 50 mg rocuronium, supplemented, according to the anaesthetic plan, through a face mask with sevoflurane; orotracheal intubation with a 7.5 mm tube was performed uneventfully, followed by ultrasound-guided (US) puncture of the right internal jugular vein. There was great haemodynamic instability during the intraoperative period with a significant drop in systolic blood pressure (SBP) to below 80 mmHg, requiring the use of amines (norepinephrine) throughout the surgery at a dose of 0.5 mcg/kg/min; a good response was obtained. Hydration with 1500 ml of crystalloid and transfusion of a unit of red blood cells was necessary. At the end of the procedure, the patient was referred to the intensive care unit (ICU) and extubated; she was haemodynamically stable and breathing spontaneously with oxygen supplementation. EKG did not show acute changes. There was no record of troponin in this period. The patient had several postoperative complications, including recurrent atrial fibrillation and pulmonary congestion. Clinical recovery occurred after 6 days in the ICU, and then she was referred to the floor. Hospital discharge occurred on the eighth postoperative day. The patient was readmitted 2 weeks later with pulmonary congestion associated with hypertensive crisis and sinus tachycardia. Her EKG and echocardiogram were similar, with no detectable troponin I increase. HF symptoms were treated with furosemide and spironolactone. The patient was referred for outpatient cardiology follow-up and considered to have indications for percutaneous aortic valve replacement (TAVR).

After a few months, she suffered another fall and presented with a periprosthetic fracture in the right femur. She had orthopaedic limitations with progressive functional worsening that prevented her from making greater efforts, but she had no dyspnoea when performing small tasks. During regular cardiology follow-up, there were no new hospitalizations for HF since the previous surgery. She had been referred for TAVR; however, the procedure had not yet been carried out. A new echocardiogram was performed confirming previous parameters of critical valve stenosis. She had a large haematoma on the right thigh, and a Hb level of 7.9 g/dL was attributed to the fracture. After further discussion with the anaesthetic and surgical team, all anaesthetic-surgical risks were presented to the patient and

her family, who shared in decision making regarding the surgery. In the context of this type of fracture, the surgical proposal was different and may be considered to be less complex than that for arthroplasty. Blood transfusion was performed in preoperative period. The anaesthetic strategy was based on peripheral nerve blocks associated with sedation. The patient was monitored with EKG, pulse oximetry (SO_2) and non-invasive blood pressure. Deep access was achieved in the right subclavian vein; sedation was started with midazolam 5 mg in intermittent doses and fentanyl 50 mcg. After insertion of a catheter in the left femoral artery by the Seldinger technique, anesthetic procedure was performed with femoral nerve block (ropivacaine 0.75% 150 mg), lateral femoral cutaneous thigh (ropivacaine 0.5% 50 mg), obturator (ropivacaine 0.5% 50 mg) and sciatic nerve block (ropivacaine 0.5% 75 mg) by subgluteal approach, under US guidance and confirmed by electrostimulation. In the intraoperative record, SBP varied between 160 and 120 mmHg, remaining stable with minimal variation in HR (60 to 80 bpm) following administration of 700 ml of crystalloid during the operation. The patient was referred to the ICU and was haemodynamically stable. In the postoperative period, the patient required volume control with furosemide but did not require amines or ventilatory support. She left the ICU 72 hours after surgery. The patient opted for hospital rehabilitation with a longer clinical observation period. Hospital discharge occurred on the 10th day after surgery, with home visit support by a nurse and physiotherapist. In addition, there was cardiological monitoring and strict recommendations for osteoporosis treatment. There were no cardiovascular (CV) complications in the first six months after surgery.

Case # 2: A 90-year-old woman was admitted with a fractured left femoral neck. Physical examination showed a severe systolic murmur in the aortic area indicating AS. BP 140/90 mmHg, HR 68 bpm and none HF symptoms at rest. EKG showed sinus rhythm. Echocardiogram showed a mean VE/AO gradient of 83 mmHg, an aortic valve area of approximately 0.6 cm^2 and an aortic jet velocity of 5.4 m/sec. There were no complaints of chest pain, syncope or dyspnoea. The patient lived alone and did not need help to perform small household tasks. Although she denied symptoms, given the degree of valve stenosis, conservative treatment of the fracture was considered; however, this possibility was strongly refused by the patient. The possibility of preoperative percutaneous aortic valvuloplasty was considered, but the logistical conditions were unfavourable. Surgical planning followed. Although the best indication orthopaedically was hemiarthroplasty, due to the non-availability of the ideal prosthesis, hybrid total hip arthroplasty (THA) was performed. The patient was informed of the risks in the presence of her family members. Medical staff, including cardiologists, anaesthetists and surgeons, were extensively involved in the planning. Preoperative laboratory tests showed a Hb level (13.0 g/dL), a creatinine level (1.1 mg/dL) and stable electrolytes and coagulation tests. Optimized blood volume parameters were obtained via US assessment of the inferior vena cava. Venoclysis was performed in the left upper limb with a 16G catheter, and sedation was performed with 6 mg midazolam in intermittent doses, followed by deep venous puncture in the right internal jugular vein guided by US. Spinal anesthesia associated with peripheral nerve block was performed. Initially, a femoral nerve block (ropivacaine 0.75% 150 mg) and lateral femoral cutaneous thigh block (ropivacaine 0.5% 50 mg) was performed under US guidance and confirmed by electrostimulation with a peripheral nerve stimulator; afterwards, the patient was positioned in the right lateral decubitus position to perform a subarachnoid block using only 5 mg of isobaric bupivacaine, and prophylactic infusion of phenylephrine was initiated at a dose of 0.1 mcg/kg/min. A catheter was inserted in the right radial artery using the Seldinger technique for invasive monitoring. After surgical exploration and placement of the cementless acetabular component of the prosthesis, there was hypotension associated with bradycardia, which was initially corrected volumetrically followed by phenylephrine bolus (50 mcg) and 0.5 mg atropine with a good response. Subsequently, a new episode of hypotension occurred during cemented implantation of the femoral component, which was treated with an infusion of norepinephrine (0.2 to 0.3 mcg/kg/min) for a short period with SBP and heart rate (HR) stability. The patient was admitted in ICU awake and without clinical signs of hypoperfusion. The patient remained in the ICU for eight days, where she had some complications: renal dysfunction with metabolic acidosis (improvement without dialysis support); anaemia (received blood transfusion); and atrial fibrillation (reversed with amiodarone). She was transferred to the floor, where she stayed for another 7 days, with physiotherapy support and monitoring by cardiology. She was discharged on the 15th day after surgery, walking with the aid of a walker. There were no new hospitalizations or complications reported until the third month after surgery.

Discussion and Conclusion

In the preoperative evaluation, we initially could consider that in both cases, the patients did not present classic symptoms of AS and therefore, despite the increased risk, we followed the recommendations for urgent surgery [1-3]. Patients with severe AS that were classified as asymptomatic had no worse clinical outcomes than controls with mild or moderate AS when undergoing non-cardiac procedures of low or medium complexity, including knee and hip arthroplasty [8]. On the other hand, in the reintervention described in Case 1, there was a history of pulmonary congestion associated to many complications after the first surgery. In this case, there is a lack of consistent studies to serve as references. Patients with symptomatic severe aortic stenosis represent a high-risk group for postoperative complications [9]; however, under conditions with indications for urgent non-cardiac procedures, including proximal femur fracture, we need to design procedures that minimize patient risk. In Case 2, despite the absence of classic symptoms, there were severe haemodynamic circumstances (aortic jet velocity > 5 m/sec). Here, we consider that there is a "gray zone". The current guidelines [1-3] can help us; however, they do not clearly consider situations of severe AS in frail elderly people with previous functional limitations, resulting in underestimation of their heart condition and making the concept of asymptomatic rather meaningless.

Studies specifically targeting the two associated diseases are still sparse. Most of the data come from retrospective and observational studies involving a small number of patients undergoing other non-cardiac surgical procedures. A multicentre observational study involving 147 patients showed that in emergency surgeries, previous symptoms attributable to AS and aortic valve area were associated with a worse outcome [10]. A case-control study involving 65 patients with femoral fractures demonstrated a higher risk of mortality at 30 days and 1 year for patients with moderate/severe AS than for patients in the control group [11]. In a retrospective evaluation, there was a higher rate of complications and hospital death in patients with severe AS, but there was no difference after 1 year [12]. Another retrospective study, with approximately 30% orthopaedic surgeries, showed no difference in mortality at 30 days between patients with severe AS (symptomatic and asymptomatic) and controls, but there was an increase in adverse CV events (18.8% vs 10.5%, P = 0.01), mainly related to HF [13]. In a meta-analysis published in 2017, severe AS did not determine an increase in mortality related to non-cardiac surgery (RR: 1.49, 95% CI: 0.85 - 2.61; P = 0.16); however, it confirms the increase in perioperative CV events (RR: 2.30, 95% CI: 1.33 - 3.97, P = 0.003). Similarly, if only asymptomatic patients with severe AS were evaluated, there was an increased risk of cardiac complications (RR: 1.59, 95% CI: 1.19 - 2.12, P = 0.002) but not mortality [14]. Patients with very severe or critical AS (aortic jet velocity > 5 m/sec) have a worse prognosis regardless of symptoms [15], which in fact leads us to consider a valve intervention before noncardiac surgery, especially after the advent of TAVI [16]. However, in a practical and realistic way, we have to consider the logistical difficulties of performing TAVI in patients with femoral fractures. In this context, percutaneous balloon aortic valvuloplasty may be a faster and less costly option. A recent study conducted by Japanese researchers demonstrated success with this procedure when it was performed an average of 8 days before non-cardiac surgery. The study involved a total of 13 cases, including 4 undergoing hip arthroplasty associated with fracture [17]. In addition to preoperative clinical optimization or performing a valve procedure first, conservative orthopaedic treatment can be chosen in view of the high risk of cardiac complications. However, we must not disregard the morbidity and limitations related to this type of fracture. Shared decision making consists of a bidirectional exchange of information between doctors and patients and must be carried out in a way that respects patient autonomy and is in accordance with patient beliefs, values and preferences [18]. Especially in the second surgery of Case 1, which involved symptomatic AS, the patient was too fragile to receive any treatment of the aortic valve but did not have signs of congestion on admission, and the fracture was corrected after clear exposure of the risks to the patient and her family and extensive participation of the experts involved.

In anaesthetic planning, there was great variation between interventions. The main anaesthetic considerations are maintaining sinus rhythm and maintaining a normal HR and intravascular volume to avoid hypotension. In the first case, the surgery consisted of hemiarthroplasty to treat femoral neck fractures, and general anaesthesia was chosen in combination with a peripheral femoral nerve block with the aid of US. In the subsequent surgery to correct the periprosthetic fracture, considering the history of complications and according to the procedure proposed, the lateral cutaneous nerves of the thigh, obturator and sciatic were blocked and patient appropriately sedated.

We took care to minimize the use of hypotensive drugs without a spinal block. There was invasive full-time BP monitoring of intraoperative and immediate postoperative periods. In Case 2, involving a patient with greater fragility and haemodynamically more severe AS, the team of anaesthetists decided on a spinal block using a lower dose of opioid in combination with a peripheral block performed with US. Nevertheless, in both cases there was a great BP instability. As we reported, phenylephrine can be preferable to noradrenaline due to its ability to rapidly restore vascular tone without beta-adrenergic stimulation.

There is no consensus about the best anaesthetic strategy in these cases. Although controversial, there is no evidence for absolute contraindications to spinal or epidural blocks [19] but concerns about sympathetic blocks and the risk of hypotension make general anaesthesia preferable [20] to neuraxial access. However, general anaesthesia can also cause hypotension, often initiated during anaesthetic induction, a decrease in vascular tone and a negative inotropic effect. In addition, the need for muscle relaxant drugs and the use of positive airway pressure, which can also cause haemodynamic changes, can be quite harmful to AS patients. On the other hand, epidural and spinal anaesthesia approaches allow vasodilation below the level of the block, commonly resulting in hypotension, which can be exacerbated and negative in patients with severe AS. The use of a spinal block using a continuous infusion catheter may be an alternative for these patients [21]. Blocking the lumbar plexus and sciatic nerve has also been described as an interesting alternative for minimizing haemodynamic complications in patients with femoral fractures [22].

A peripheral nerve block, including the femoral and lateral femoral cutaneous nerves of the thigh, that also involves sedation, is a useful alternative and previously described in the correction of femur fractures. There may be muscle weakness in the quadriceps impairing rehabilitation, but in retrospective data, an increase in hospital stay has not been shown when compared to other techniques such as spinal blocks or general anaesthesia [23]. Regardless, the use of a higher dose of local anaesthetic with multiple nerve blocks increases the risk of systemic toxicity [24]. Among the three cases described, the best evolution with a shorter hospital stay occurred in the surgery to correct periprosthetic fractures where there was no general anaesthesia or use of the neuroaxis.

In postoperative care, it is necessary to emphasize that cardiac patients must be followed up in the ICU, with electrocardiogram and high-sensitivity troponin assessments in series, preferably until the third day after the intervention [3]. Regarding rehabilitation after discharge from the ICU, it is generally understood that the total hospitalization time, including postoperative recovery, should be as short as possible. An observational study with orthopaedic surgeries, including THA, showed that reduction of the length of stay (LOS) is feasible in most patients over 85 years old, while an LOS of more than 4 days was associated with blood transfusions and the need for assistance to walk [25]. In elderly patients with fractures, the LOS tends to be obviously longer, on average 12 days, as previously reported [23]. Our understanding of the cases presented is that although the postoperative period was prolonged, the patients were fragile and recovering from for non-elective surgeries, susceptible to cardiac complications, especially pulmonary congestion. In such cases, early discharge can lead to an increased risk of readmission for CV events. However, this involves several variables, including social issues, family support and access to home care in the postoperative period. In the first described surgery, the patient was discharged just 2 days after discharge from the ICU and was readmitted after a short period due to pulmonary congestion. In subsequent interventions, we opted for a longer period of clinical observation and hospital rehabilitation followed by outpatient cardiological monitoring.

In conclusion, with the ageing of the population, there will be an increase in fractures in elderly individuals with severe AS, often asymptomatic. Considering the advent of new therapeutic technologies and after so many advances in the understanding of valvular heart disease, the maximum surgical contraindication for these patients, especially in the context of femoral fracture, does not seem adequate. For symptomatic patients or those with signs of decompensated HF, balloon valvuloplasty may be indicated, but it still requires a minimum of logistics, with a haemodynamics laboratory and trained professionals. These patients demand an interdisciplinary medical team where cardiologists, anaesthesiologists and orthopaedists need to make decisions case-by-case. The perioperative care strategy, including anaesthetic-surgical planning, requires extensive knowledge and immense team involvement. We recommend shared decision making that presupposes the involvement of patients and their families. The main topics discussed were highlighted in table 1.

What do we know?
• Both aortic stenosis and proximal femur fracture are conditions associated with ageing, and their incidence will increase in the coming years.
• Severe aortic stenosis increases the risk of cardiovascular complications in non-cardiac surgery, including that for fracture of the femur.
What does this article argue?
• Many elderly people are diagnosed with severe aortic stenosis only in the preoperative period for fracture of a femur.
• It does not seem feasible to routinely indicate treatment for valvular heart disease before correction of the femoral fracture. At the same time, orthopaedic surgery becomes a challenge for these patients.
• We need to practice patient-centred care with shared decision making and discuss strategies to minimize surgical risk, including strict perioperative haemodynamic monitoring.
• Formation of a multidisciplinary team with trained specialists, discussing specific anaesthetic strategies and improving access to aortic valve intervention procedures for selected cases.

Table 1: *Summary of the main topics (take-away messages).*

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Conflicts of Interest

The authors declare that they have no conflict of interest.

Ethics Approval

This report was approved by the Research Ethics Committee of the Traumatology and Orthopedics Institute Jamil Haddad (# 36880720.7.0000.5273)

Authors' Contributions

All authors were directly involved in the reported cases. FS reviewed the medical records. FS, MK and SPS wrote the manuscript. FS, KBGB and OSK contributed to the literature review and wrote the discussion section.

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