CONTINUOUS SPINAL ANAESTHESIA FOR A TOTAL HIP ARTHROPLASTY IN A PATIENT WITH AN ATRIAL SEPTAL DEFECT

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Abstract

Atrial septal defect (ASD) is often diagnosed and repaired during childhood. Nevertheless, it is the most common congenital cardiac defect seen in adults. ASD is characterized by a left-to-right intracardiac shunt and pulmonary hypertension. Pulmonary hypertension increases perioperative risks of morbidity and mortality. We report the anaesthetic management of a 68-year-old woman with an unrepaired ASD, who underwent a total hip arthroplasty under continuous spinal anaesthesia.

Key words: atrial septal defect; continuous spinal anesthesia; total hip arthroplasty.

Introduction

Atrial septal defect (ASD) represents the most common congenital cardiac defect seen in adults[1]. Most of them are repaired in childhood. Presenting symptoms in patients with untreated ASD are usually murmur, fatigue, dyspnea on exertion, palpitations (atrial arrhythmias). Stroke, caused by paradoxical emboli, are less frequent[2]. ASD is characterized by chronic pulmonary arterial hypertension (PAH), which increases the anaesthetic risk[3]. We report the anaesthetic management of a 68-year-old woman, with an ASD, who came to hospital for a total hip arthroplasty.

Case Report

A 68-year-old woman, suffering from hip arthritis, came to hospital for a total hip arthroplasty. She had been diagnosed of an ASD in her young adulthood. She also suffered from atrial fibrillation. Her daily treatment was composed by furosemide 40mg, digoxin 0.125mg and warfarin. She had no complain (no dyspnea, no chest pain, no syncope).

The cardiac auscultation revealed an irregularly irregular rhythm with a grade 3 systolic regurgitation murmur, which was increased during inspiration. Lungs were clear to auscultation. Signs of right heart failure were present: increase in jugular venous pressure, hepatomegaly (no peripheral edema was found). The patient's systemic arterial pressure was 130/75, with an irregular heart rate of 95 beats/min. Oxygen saturation by pulse oximetry (SpO2) was of 96% in room air.

The chest X-ray showed a cardiomegaly, an enlarged main pulmonary artery and enlarged hilar vessels. The electrocardiogram found an atrial fibrillation and a right axis deviation suggesting a right ventricular hypertrophy.

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The echocardiogram revealed an ostium secundum ASD at 28mm with a left-to-right shunting. The cardiac output was estimated at 1.96 L/min/m2. The left ventricular ejection fraction calculated by the Simpson's method was of 45% and the left ventricular filling was disturbed. The echocardiogram also showed dilated right areas (right ventricular diameter = 52mm; right atrium area = 66cm2) and dilated main pulmonary artery (32mm). The pulmonary artery pressures revealed PAH (Doppler studies found: systolic = 75mmHg; mean = 35mmHg; diastolic = 23mmHg).

The patient refused a surgical or transcatheter closure of her ASD. After a multidisciplinary evaluation, and a risk-benefits explanation, we decided to perform the surgery under continuous spinal anaesthesia (CSA).

Preoperative blood tests were normal (haemoglobin level at 13.2g/dl). Warfarin was changed by subcutaneous unfractionned heparin, digoxin was continued and furosemide was stopped the day of surgery.

In the operating room, arterial and central venous pressure (CVP) lines were inserted with the help of local anaesthesia. The patient received 500 ml of Ringer's lactate before the spinal anaesthesia. After antiseptic preparation of the area and a local anaesthesia, subarachnoid puncture has been performed with a 19-gauge Tuohy needle at the L4-5 interspace using a midline approach. Three cm of a 22-gauge catheter has been introduced cephalad through the needle. An initial dose of 2.5mg (0.5ml) of isobaric bupivacaine has been injected through the catheter over 10-15 s. After 20min, a second injection was made. The dermatome level of sensory blockade was yet T10. A third injection has been made to have a complete motor block on modified Bromage scale. Sensory blockade spread to T8. No modification occurred in mean arterial pressure (MAP). CVP was maintained at 13-15 mm Hg throughout the operation (basal level). Diuresis was 80ml/h. The total fluid administration was 750ml of Ringer's lactate and 500ml of hydroxyethylamidon for a surgery time of 50 min. The motor block regressed at 145th min and the sensory block at the 175th min.

There were no postoperative complications. Intravenous paracetamol and ropivacaine infusion through ilio-fascial catheter were used for postoperative analgesia. The patient had no dyspnea, chest pain, or neurologic complications. Troponin level stayed normal. She left the hospital on day 7.

Discussion

ASD is often diagnosed and repaired during childhood. If it is not, the left-to-right cardiac shunt leads to a right heart ventricular volume overload and right heart dilatation. Then patients develop PAH, right ventricular hypertrophy and congestive heart failure[4]. ASD ultimately leads to Eisenmenger's syndrome with right-to-left shunting.

Orthopedic surgery is associated with an intermediate cardiac risk[5]. Preoperatively, the patient's functional capacity must be evaluated. A complete physical examination and an electrocardiogram should be done. These patients should also have special cardiac investigations to determine perioperative risks. Echocardiography, a non invasive testing, determines the anatomic and functional features associated with the defect: type of ASD, dimension of the defect, direction of the flow, enlargement of receiving chambers, importance of the shunt[6] (Qp/Qs ratio: ratio between pulmonary flow and systemic flow). Invasive assessment by cardiac catheterization is indicated if there is evidence of PAH[7]. This technique allows a direct measurement of pressure in each chambers, assesses pulmonary vasoreactivity and calculates Qp/Qs ratio. Catheterization also confirms increased oxygen saturation in right sided cardiac chambers and pulmonary artery.

ASD closure is recommended in different cases: a defect > 10mm, an elevated shunt ratio (Qp/Qs > 1.5), right ventricular dilatation, pulmonary hypertension and an episode of paradoxical embolism[8]. Before a surgery with a potential risk of bone cement implantation syndrome, a preventive closure of an intracardiac shunting appears as a logical strategy[9].

The primary anaesthetic goal is to minimize increases in pulmonary vascular resistance (PVR) and maintain SVR[10] (systemic vascular resistance). In our case, the main risk was an inversion in the direction of the shunt (left-to-right to right-to-left shunt), resulting in major hypoxemia and possible paradoxical

embolization. The shunt direction is related to the relative pressure gradient across ASD (ratio of SVR to PVR). A decrease in SVR will favour right-to-left shunting, whereas increasing SVR will increase left-to-right shunting. PVR increases with sympathetic stimulation (pain, stress), acidosis, hypoxemia, hypercarbia, hypothermia, high intrathoracic pressure. In fact, systemic hypotension (caused by dehydration, blood loss and anaesthetic drugs) can change the direction of the shunt. Hypovolemia is also poorly tolerated in case of ASD, because a high circulating volume is needed to maintain the shunt volume[6].

The choice of anaesthetic technique is central. In patients with PAH, selected for noncardiac surgery under general anaesthesia, Ramakrishna and al. found 42% of morbid event and 7% of early death[11]. General anaesthesia and mechanical ventilation decrease SVR and increase PVR, especially with high level of PEEP (positive end-expiratory pressure). Mechanical ventilation also causes intraoperative right-to-left intracardiac shunting[12]. Spinal anaesthesia provides a sympathectomy-induced hypotension: spinal block might induce an acute and dangerous drop in venous return[13]. To avoid a rapid decrease of SVR, CSA is a valuable option. It allows incremental dosing of local anaesthetic and has the advantage to have less hemodynamic effects than a single shot spinal anaesthesia[14]. Incremental injections produce a gradual, predictable and sufficient block. Nevertheless, CSA can be associated with infectious complications, epidural hematoma and post dural puncture headache (PDPH).

De-air intravenous lines carefully is a specific management in case of ASD[10]. Monitoring of the patient is a main question. SpO2 is an essential tool: it varies with the Qp/Qs ratio. SpO2 decreases in case of shunting inversion. Artery line gives data on SVR, volemia and allows blood gas analysis[6]. CVP is not a good marker of circulating volume, because the shunt biases its value. Nevertheless, CVP monitoring is interesting to follow the preload: CVP decreases with hypovolemia. In case of ASD, measurement of thermodilution cardiac output is inaccurate, because of early recirculation[7]. A transesophageal echocardiography (TEE) is the best monitoring during surgery[5,15], but it is not an acceptable alternative in a conscious patient.

Conclusion

Our experience shows that CSA is a good alternative for the management of a total hip arthroplasty in patient with an ASD and major PAH. This technique produces a predictable anaesthesia and maintains SVR.

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