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Shoulder surgery in beach chair position causing perioperative stroke: Four cases and a review of the literature

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ABSTRACT

Perioperative stroke is a rare, but serious complication in shoulder-arthroscopy or arthroplasty. Recent literature suggests the beach chair position, widely used during shoulder surgery, might induce severe perioperative hypotension, and with this cerebral desaturation and ultimately perioperative stroke. In this article we report four cases of perioperative stroke in shoulder surgery. In all cases, patients underwent brief periods of hypotension, which might have caused perioperative stroke. Based on an analysis in our hospital, we think the prevalence of perioperative stroke during shoulder surgery is higher than reported. Surgeons should be aware of this risk when using the beach chair position.

1. Introduction

Cerebrovascular accidents (CVA) are a rare but very serious complication in shoulder surgery. There is not much literature on this topic but surgeons should be aware of the risks factors to inform their patients well and have the possibility to maybe prevent this devastating complication.

In this article we report four cases of perioperative stroke in shoulder surgery and a review of the literature. Three patients underwent shoulder arthroplasty, one patient underwent shoulder arthroscopy. The operations were performed by different surgeons in a period of four years in an orthopedic clinic specialized in shoulder surgery. As a result of advancing surgical techniques, the beach chair position is a common, increasingly used position for shoulder arthroscopy and total shoulder arthroplasty. The weight of the arm distracts the joint and therefore facilitates a better access and visualization of the shoulder joint. This position also reduces the risk for brachial plexus injury.[1]

However, this position (nearly upright, 60°–90°) can when combined with general anesthesia, induce severe hypotension, and therefore cerebral hypotension.[1,2]

Severe cerebral perioperative hypotension, causing desaturation, may result in watershed infarction and perioperative stroke.[3–5] However, a direct relationship between the beach chair position or perioperative cerebral desaturation and neurologic complications has not been demonstrated yet.[6,7]

2. Case reports

2.1. Case 1

An 80-year old, 160-cm, 86-kg woman underwent re-implantation of a total shoulder arthroplasty after an earlier infection, treated with antibiotics and placement of a temporary spacer. Her medical history included hypertension, diabetes mellitus type 2, a left bundle branch block, venous insufficiency and obesity. The patient was placed in beach chair position and received general anesthesia, an arterial line and a regional block. The surgery included debridement of the shoulder joint, creation of sufficient bone stock, neurolysis, osteosynthesis of the humerus and implantation of the prosthesis and took approximately 7 h.

Because of excessive blood loss, 3780 cc, the patient was transfused with six packets cells during surgery. During 3 h of the surgery the mean arterial pressure (MAP) was decreased, approximately 60 mmHg. The mean MAP over the whole procedure was 80 mmHg. Patient's preoperative hemoglobin count was 7.0 mmol/L, postoperative it was 6.4 mmol/L.

After surgery, the patient was transferred to the intensive care unit, because of the comorbidity and the length of the surgery. No extent of hypotension was seen. After ceasing the sedation, the patient stayed comatose. On multiple CT scans of the brain no abnormalities were seen. The clinical aspect and neurological analysis were suspect for

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brain stem infarction or post anoxic encephalopathy. In the following days there was no improvement of the clinical state. After consultation with the patient's family, the treatment was ceased and palliative sedation was started.

2.2. Case 2

A 61-year old, 171-cm, 85-kg woman underwent implantation of a total shoulder prosthesis because of severe avascular necrosis. Her medical history included two ischemic cerebrovascular accidents and a carotid endarterectomy. Because of this, a duplex of the carotid artery and a neurologic screening was done before surgery, where no abnormalities were found. Perioperative bridging of her anticoagulant was performed with acetylsalicylic acid. The patient was placed in low beach chair position (45°) and received general anesthesia, an arterial line and a regional block. There were no complications during surgery, which took almost 4 h.

The mean MAP during surgery was 87 mmHg. Patient's preoperative hemoglobin count was 8.4 mmol/L, postoperative it was 5.3 mmol/L. Because of multiple periods, of 15 min, of peri- and postoperative hypotension, with a MAP lower than 60 mmHg, the patient spent one night at the medium care department, after which she was transferred in good neurological and orthopedic condition to the orthopedic ward, with a normalized tension.

The following morning a reduction of consciousness was noticed. During neurological examination, the patient showed a right-sided hemiparesis and aphasia. CT scan of the brain showed a watershed infarction of the area between the left medial cerebral artery and anterior cerebral artery. Because of postoperative anemia the patient received two packed cells. After admission and treatment at the department of neurology, the patient started revalidation. Two months after the cerebrovascular accident there was an almost complete recovery of speech and hemiparesis.

2.3. Case 3

A 70-year old, 168-cm, 93-kg man underwent implantation of a reversed shoulder arthroplasty with bone graft of the glenoid, because of severe glenohumeral osteoarthritis. His medical history included asthma, polymyalgia rheumatica and multiple knee arthroscopies. The patient was placed in beach chair position and received general anesthesia, an arterial line and a regional block and was transfused with one packet cell during surgery. The perioperative parameters were stable, except for a period of 2 h, in which the MAP was only 60 mmHg. Patient's preoperative hemoglobin count was 8.7 mmol/L, postoperative it was 7.3 mmol/L. The operation lasted for almost 4 h, without any surgical complications.

Six hours after surgery the patient developed a paralysis of the left hand and the left facial nerve. The results of neurological examination were highly suspect for a minor stroke of the right hemisphere, which was not confirmed on the CT-brain. During postoperative examinations no underlying cause for the perioperative stroke was found. After admission and treatment at the department of neurology, the patient started revalidation. At follow-up, one year after the surgery, the patient was completely recovered, except for a mild loss of sensibility of the skin in the left arm.

2.4. Case 4

A 50-year old, 195-cm, 126-kg man underwent shoulder arthroscopy because of subacromial impingement. His medical history included hypertension, Hashimoto's disease, multiple surgeries for osteoarthritis in both hands and an repair of the shoulder's rotator cuff. The patient was placed in beach chair position and received general anesthesia, an arterial line and a regional block.

The perioperative parameters were stable, no anesthesiologic interventions were performed. No severe hypotension was seen, although there a short period in which the MAP was 66 mmHg. The MAP over the whole procedure was 86 mmHg. The surgery, without any complications, took around 1 h. In the final phase of the operation additional anesthesia was given because of bronchospasms. Patient's preoperative hemoglobin count was 9.5 mmol/L, postoperative it was 8.3 mmol/L.

After ceasing the anesthesia, the patient woke up slowly, and a hemiparesis of the right side of the body was seen. A MRI of the brain showed a significant ischemic infarction caused by ischemia (left frontal-parietal and right frontal), with matching clinical neurologic loss of function. After admission and treatment with anticoagulant at the department of neurology, the patient started rehabilitation. During postoperative examinations no underlying cause for the perioperative stroke was found, except for an incomplete circle of Willis at the right side. At follow up, one year after the surgery, the patient had recovered almost completely and had an acceptable function of both the right arm and leg.

3. Discussion

Shoulder surgery in beach chair position can induce hypotension, causing cerebral hypoperfusion and perioperative stroke.[3,5] The risk of a perioperative stroke is strongly correlated with age and cerebrovascular risk factors.[8] If it occurs, postoperative stroke has a mortality of 60%, which is much higher than the mortality of a stroke in general (15%–46%).[9] Perioperative stroke is an uncommon complication after total shoulder arthroplasty, with a 0,22% chance in the first 30 days, reported by Landercasper et al.[9] In a recent review, Salazar et al. found an incidence of perioperative neurologic complications after shoulder surgery of only 0,004%, after comparing ten studies.[7] For this review, four case reports describing cases of relatively healthy patients who developed perioperative stroke were excluded. Lovy et al. investigated risk factors and timing for complications after total shoulder arthroplasty in 5801 patients and found a prevalence of 0,17% of perioperative stroke within 30 days after surgery.[10]

Perioperative hypotension can be monitored during shoulder surgery with three different methods. The simplest technique is the traditional tourniquet, which inflates in regular intervals of a few minutes. Because of the delay between a decrease in blood pressure and the moment of registration, this is not considered a safe option anymore. Placement of an arterial line to continuously register the MAP is a better technique. It quickly shows changes in blood pressure, which enables the anesthetist to intervene rapidly. The most precise method to register cerebral perfusion is cerebral oximetry.[11,12] Using this technique it is possible to register cerebral perfusion in particular, which is not measured with the other two techniques. Unfortunately, this technique is not widely available yet. The use of cerebral oximetry as a monitor of the adequacy of cerebral perfusion in a patient undergoing shoulder surgery in the beach chair position has been proven trustworthy.[12,2]

During shoulder surgery a minimal MAP of 65 mmHg is advised.[3] Below this value auto regulation is not effective anymore and cerebral hypoperfusion could be expected.[3] The reduction of frontal lobe oxygenation have been measured up to 40% in beach chair position,[4] while normally a reduction of 20% results in syncope.[13]

In our four cases, the first two patients were on high risk for developing a perioperative stroke, regarding their medical history known before the operation. The third patient had little cerebrovascular risk factors, the fourth patient had no known relevant medical history, but it is likely that the incomplete circle of Willes was an important factor in the originate of the ischemia. In our hospital the regional cerebral oxygenation was not monitored during surgery. In the four cases discussed, it is likely that the hypotension induced by the beach chair position, which resulted in a low MAP, had a strong correlation with the cerebrovascular accidents. This combined with the high-risk profile of the majority of the patients and the length of the surgeries could have

caused severe neurological complications.

In our orthopedic center, the last four years 1077 shoulder surgeries were performed, including shoulder arthroscopies and shoulder arthroplasties. We have found four cases in which the patient suffered from severe neurological complications, which results in a prevalence of 0,37%. This is much higher than the 0,004% described in the review of Salazar,[7] but corresponds with the findings of Landercasper and Lovy.[9,10]

Thus, perioperative stroke after shoulder surgery in beach chair position might be an underreported complication.

High risk patients should be evaluated by a neurologist preoperative, followed by a duplex of the carotid artery. In patients using anticoagulation medication, which have to be ceased perioperative, bridging with acetylsalicylic acid could be considered, although this does not compensate the effects of cerebral hypotension.

After surgery, patients with high cerebral risk factors should be transferred to the intensive care unit for observation of the tension and neurological status, especially if there were multiple events of slight hypotension during the operation. Vital parameters should be checked intensively during admission for at least for 72 h, also when the patient is transferred to the orthopedic ward, to avoid hypotension.

Despite the advantages of the beach chair position, alternative positions could be considered for high-risk patients. To prevent severe complications, hypotension should be counteracted during surgery, by using ephedrine or a less upright beach chair position. Regional cerebral oxygenation should be monitored if possible using cerebral oximetry.

Summarizing, perioperative stroke is a serious and devastating complication during shoulder surgery using the beach chair position. We think this complication is underreported. Surgeons should be aware of the risks of this position and should take the measurements discussed to prevent this life-threatening event.

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Conflicts of interest

The authors declare that they have no relevant conflict of interest.

Ethical approval

This study was approved by the local institutional review board.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jor.2019.05.009.

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