



## CASE REPORT

# Spinal cord ischemia as intraoperative complication in shoulder surgery positioned in beach chair: case report

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**Abstract** Spinal cord infarction is an uncommon phenomenon, which can be caused by different etiologies, constituting a real diagnostic challenge which can lead to devastating consequences. General anesthesia in beach chair positioning with intraoperative hypotension in order to avoid surgical bleeding are associated with hypoperfusion and potential neurological ischemia-related complications. We present a case of spinal cord ischemia in the context of shoulder surgery in a beach chair position.

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## Introduction

Spinal cord infarction is a rare disorder, characterized by bilateral flaccid paralysis in the acute phase, caused by reduced perfusion of a nutritional artery, or even the aorta. Depending on the topography of the infarction, patients may suffer different types transverse spinal cord syndromes with several types of sensation deficits and bladder and bowel dysfunctions.

The beach chair surgical position has been widely used in shoulder surgery, mainly in arthroscopy. However, this ver-

tical position is associated with a series of hemodynamic variations worsened by general anesthesia, which contribute to a series of physiological conditions that can cause hypoperfusion leading to intraoperative ischemic events further aggravated by permissive hypotension, frequently demanded by the surgeon to operate on a bloodless surgical field. In the last decade, there have been reports of catastrophic neurological sequelae secondary to neurological ischemia<sup>1</sup> during shoulder surgery in patients positioned in a beach chair and operated under general anesthesia. Spinal cord ischemia, unlike cerebral infarction (more frequently reported in the medical literature after shoulder surgery), accounts for less than 1% of all strokes,<sup>2</sup> one of the reasons being the extensive network of vascular collaterals of the spinal cord. However, it should be kept in mind that occlusion of a single spinal artery can also affect border-

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ing territories, which are sensitive to sudden hypoperfusion, and not only the directly irrigated tissues.

It is likely that the occurrence of ischemic neurological complications in this surgical population is multifactorial, however, we must know that sitting a patient under general anesthesia is not entirely harmless.<sup>3</sup>

We present the case of a middle-aged patient with cardiovascular risk factors, who presented spinal ischemia during a shoulder surgery intervention which underwent in beach chair position.

Written consent was obtained from the patient's son after the patient deceased.

This manuscript adheres to the applicable EQUATOR guideline.

## Clinical case

We present a 56-year-old male (weight 90 kg and height 187 cm) with medical history of dyslipidemia and hypertension, with poor treatment adherence, former smoker, former alcohol abuse until the previous 4 months, former consumer of benzodiazepines for 10 years and former cannabis consumer for 9 months, that requires elective surgery to treat a proximal humerus fracture.

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An uneventful ultrasound-guided regional blockade of the brachial plexus was performed, using an interscalenic approach with bupivacaine 0.25% (20 ml) and mepivacaine 1.5% (8 mL). After confirming the blockade and the absence of complications, anesthesia was induced with 3 mcg/kg of fentanyl, 2.5 mg.kg<sup>-1</sup> of propofol, and 0.6 mg.kg<sup>-1</sup> of rocuronium. A number 8 flexometallic endotracheal tube was placed, and the patient was placed in beach chair surgical position with the corresponding abdominal, cranial, cervical, and limb fixations. The anesthetic maintenance was carried out with sevoflurane ensuring a minimum alveolar concentration (CAM) of 1. The patient remained hemodynamically stable with mean arterial pressures around 70 mmHg, without the need for intraoperative vasopressors, being extubated after reversal of the neuromuscular blockade. Blood loss was less than 300 milliliters. The procedure was performed without surgical or anesthetic complications.

During his stay in the Postanesthetic Recovery Unit, the patient reported inability to mobilize lower limbs. On examination he was conscious, oriented, and with stable blood pressure, neurologically the presence of flaccid paraplegia without movement in the horizontal plane and absence of both patellar and aquilear reflexes in both lower limbs but with preserved sensitivity, as well as hypotonia of the anal sphincter with abolished bulbocavernosus reflex. With the suspicion of spinal infarction, an urgent magnetic resonance imaging (MRI) was requested. The main findings in the spinal cord included a signal alteration of probable ischemic origin in the thoracic segments that fundamentally affected the grey substance (Figs. 1 and 2), therefore diagnosed as



**Figure 1** T2-weighted thoracolumbar spine MRI sagittal section showing hyperintense image in the lower segments of the dorsal medulla compatible with ischemic vascular process.



**Figure 2** T2-weighted dorsal spine MRI axial section demonstrating signal alteration in the anterior horns of the medullary gray matter, which produces an "owl eyes" image. Finding compatible with acute spinal cord ischemic injury.

acute arreflexic flaccid paraplegia of probable ischemic origin without confirmed etiology.

During his 23-day admission, the patient presented clinical improvement of distal muscle tone, recovered achilles reflexes and both anal sensibility and sphincter tone, but did not recover proximal muscle function. The patient was transferred to a paraplegic center, with no improvement in the neurological examination. Finally, the patient died of cardiovascular causes two years after the intervention.

## Discussion and conclusions

Beach chair surgical positioning provides advantages in shoulder surgery; however, in relation with general anesthesia, it can lead to ischemic neurological events. The vertical position entails a series of hemodynamic changes that, in non-anesthetic conditions or in an awake patient under regional anesthesia, are compensated by an increase in sympathetic activity.<sup>3</sup> In patients under general anesthesia, the sympathetic response is inhibited, to which is added the vasodilator and myocardial depressant effect of anesthetics; causing a redistribution of venous flow, especially affecting the lower extremities, it causes a drop in preload, cardiac output, systemic blood pressure, and cerebral perfusion pressure.<sup>4</sup> Moreover, we must add another factor that accentuates the decrease in venous return, which is the increase in intrathoracic pressure caused by mechanical ventilation.<sup>1</sup>

We must bear in mind that shoulder surgery includes a rather heterogeneous group of patients, which ranges from young healthy athletes to elderly patients with varying degrees of limitation of their physiological reserve. With this last group we must have special consideration when positioning them, being rigorous in hemodynamic monitoring and less tolerant with hypotension. This is also valid for healthy patients, since among the reported cases there are patients without risk factors.<sup>5</sup>

In this case, the necessary tests (brain MRI, computed aortic angiogram, eye fundus, and transthoracic echocardiogram) were performed to clarify the etiology by making a differential diagnosis that allowed to rule out fat embolism, air embolism, cholesterol embolism, and aortic pathology among other pathologies. It is interesting to find in the MRI a diffuse microangiopathy of the central nervous system and four older lagoon strokes that suggested a chronic arteriopathy background. No spinal cord angiographic study was carried out given the high risk of this technique and the low therapeutic profitability. After ruling out different medical causes and specifically anesthetic complications derived from interscalenic blockade; the most plausible explanation for this clinical case is that the decrease in systemic blood pressure (underestimated by its measurement in the lower limb) may have significantly compromised perfusion in the circulation of the spine this hypertensive, dyslipidemic patient with radiological findings suggestive of chronic vascular disease. All this added to other hypoperfusion factors (such as the increase in intra-abdominal pressure causing

an increase in cerebrospinal fluid pressure and the ulterior compromise of circulation in the Adamkiewicz artery in which – we assume – there were some previous vascular injuries as well as possible phenomena of associated theft) could justify spinal ischemia.

Given the possible complications associated with the beach chair surgical position under general anesthesia, it is recommended, whenever possible, to advocate for a regional anesthetic technique based on interscalenic block and sedation. Although the protective role of general anesthesia is not fully established, its lower systemic hemodynamic impact may be associated with better results.<sup>1,5</sup> Similarly, whenever general anesthesia cannot be performed, invasive monitoring of systemic blood pressure is recommended, especially in patients with cardiovascular risk factors, without forgetting that neurological adverse effects have been described in patients without cardiovascular risk factors. It is difficult to establish a lower limit of mean arterial pressure to maintain cerebral self-regulation, since there is a significant interindividual variability, but it is suggested to aim for mean arterial pressures of at least 70 mmHg, avoiding BP drops greater than 20% of baseline values,<sup>1,5</sup> treating them immediately with the use of ephedrine as the first choice drug or in conjunction with atropine, since it reverses hypotension and induces peripheral vasoconstriction by raising blood pressure.

## Conflicts of interest

The authors declare no conflicts of interest.

## References

1. Bollini C. Anestesia para la Cirugía de Hombro en Posición Sentada. *Arthroscopy*. 2015;22:63–70.
2. Rubin MN, Rabinstein AA. Vascular diseases of the spinal cord. *Neurol Clin*. 2013;31:153–81.
3. Marshall W, Bedford R, Miller E. Cardiovascular responses in the seated position-impact of four anesthetic techniques. *Anesth Analg*. 1983;62:648–53.
4. Cullen D, Kirby R. Beach chair position may decrease cerebral perfusion: Catastrophic outcomes have occurred. *APSF Newslett*. 2007;22:25–7.
5. Ugarte AME, Bollini C. Cirugía de hombro en posición en silla de playa: prevención de complicaciones isquémicas. *Rev Chil Ortop Traumatol*. 2016;57:26–33.