

## Research

# Brachial plexopathy after prone positioning

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## Abstract

Two cases of brachial plexus injury after prone position in the intensive care unit are described. Mechanisms of brachial plexus injury are described, as are methods for prevention of this unusual complication.

**Keywords** adult respiratory distress syndrome, brachial plexopathy, prone position

## Introduction

Prone positioning has become increasingly popular as an adjunct for the treatment of hypoxia in adult respiratory distress syndrome (ARDS). Our group previously reported on the safety of prone positioning with open abdomen [1] and with high flow venous access [2]. Common complications due to prone positioning, such as pressure necrosis, are widely recognized. We now report two cases of brachial plexopathy after prone positioning in the intensive care unit (ICU).

## Case reports

### Case 1

A 34-year-old morbidly obese woman was transferred to our facility after developing a complex ischio-rectal abscess. This required multiple short (<1 hour between each procedure) debridements, which were performed in the operating room with the patient in the right lateral decubitus position. She also developed severe ARDS and underwent prone positioning for up to 12 hours/day for 6 days. In the ICU, she complained of numbness and was found to have weakness in her

entire left hand, with paresthesias of her radial forearm clinically consistent with brachial plexus stretch injury. Computed tomography ruled out a cerebrovascular event. Because the symptoms were in the nondependent arm during surgery, it was felt that they were due to prone positioning rather than operative position. Electromyelographic studies were not performed. Her symptoms improved over the next 2 weeks, and with aggressive physical therapy she had a total recovery of functional activity in the arm.

### Case 2

A 52-year-old man was transferred from another hospital after developing necrotizing fasciitis of his entire back. The patient underwent daily operative debridements in the prone position. In addition, over the course of 4 weeks, he was turned prone daily for approximately 90 min under general anesthesia in the ICU for complex dressing changes. After this time the patient was found to have numbness and weakness in his right hand and forearm, which was worse in the radial distribution but also involved the ulnar hand areas. The diagnosis of brachial

plexopathy was made and he began a course of physical therapy. After completing rehabilitation he regained normal function and equal strength in his right arm to that in his left. The patient does continue to develop transient numbness and weakness in the arm if he lies prone.

## Discussion

Prone positioning is being used with increasing frequency as a maneuver to improve oxygenation in ARDS. Complications due to turning and prone positioning are rare. The most common complication is skin pressure necrosis, which occurs with varying frequency depending on the group considered. In the largest study of prone positioning, Gattinoni and coworkers [3] found complications related to pressure in 36% of patients. In a comprehensive review conducted by Curley [4], displacement of venous lines and indwelling catheters was found to be the most common complication, occurring in 0.6% of turning cycles (supine to prone and back to supine). The group of Gattinoni also found cannula loss complications in 13.2% of all patients, although only 1.2% of these could be attributed to prone positioning. Uncommon complications attributed to prone positioning include contractures of the shoulder and hip joints, and myositis ossificans. One case of infectious corneal ulceration requiring transplantation has also been reported [4].

Although careful positioning in the operating room to prevent brachial plexus injury is standard practice, there is remarkably little recent literature on the subject. Neurologic injury due to operative positioning was found in 72 out of 50,000 operations (0.14%), the most common of which were brachial plexopathies (38%) [5]. These mostly occurred following sternotomy. Recovery occurred in 92% of patients, typically within 6 months. Patients with history of diabetes or alcoholism appear to have a slower recovery [5]. Neurologic injury is believed to occur due to compression or stretch and has been reported in as short a period as 45 min, although it is usually associated with long operative procedures [5]. Positions that appear to cause brachial plexopathy, on the basis of both clinical and cadaveric studies, are abduction with external rotation and posterior shoulder displacement [5,6]. Turning of the head to the opposite side has been suggested to increase stretch, but this was not confirmed by cadveric study [6]. The addition of general anesthesia to malpositioning increases risk for injury because there is loss of normal muscle tone as well as inability of the patient to report discomfort. Abnormal anatomy and metabolic conditions may also contribute to risk for neuropathy.

One case of brachial plexopathy due to prone position has previously been reported, and occurred following an operative procedure with longitudinal chest rolls and the arms abducted and elbows flexed [6]. This was felt to be due to unusually large chest rolls and an unsupported head, resulting in posterior shoulder displacement and anterior head displacement.

Careful positioning of prone patients both in the operating room and in the ICU is critical in preventing all of the complications mentioned above, including brachial plexopathy. Although various turning assist devices and support systems have been devised, including the Circ-O-lectric bed, the Stryker frame (both Stryker, Kalamazoo, MI, USA), and the Vollman Prone Positioner (Hill Rom, Batesville, IN, USA), most patients are manually positioned directly on a standard ICU bed, with support across the chest and pelvis with rolled blankets. The Vollman Prone Positioner also has chest and pelvic cushion support built into the structure of the device. In the case of the patients described above, patient 1 had chest and pelvic support while prone in the ICU, as did patient 2 while prone in the operating room. Patient 2 was turned prone without supports in the ICU using a Clinatron bed (a low-pressure, air-fluidizing bed; Hill Rom) in order to avoid pressure points.

Somatosensory evoked potentials have been suggested as a possible method to pre-emptively identify brachial plexus injury in prone patients. A study of awake volunteers found no correlation between changes in somatosensory evoked potentials and development of symptoms [7]. Hence, the only reliable method for prevention remains attention to detail while positioning the patient.

Prevention of brachial plexus injury due to prone positioning requires careful manipulation and positioning of the arms and chest. In our protocol the arms are rotated from the side to a 'swimming' position, with the shoulders carefully kept in the neutral position and the elbows bent at 90°, allowing the hands to lie alongside the head. Great care is taken to ensure that the shoulders are not hyperextended. Despite these precautions, we experienced two recent cases of apparent brachial plexus injury due to prone positioning (described here). It is possible that the use of a high chest roll and/or the Clinatron bed resulted in the shoulders being extended posteriorly rather than superiorly, and that this resulted in the neurologic defect.

## Conclusion

Although prone positioning is generally associated with few complications, brachial plexus injury is described in two patients attributed to ICU prone positioning. Extra care must

### Key messages

- Brachial Plexopathy is a potential complication of Prone positioning
- Proper positioning and rolling technique may decrease the risk of brachial plexopathy
- Both cases described here greatly improved with time and physical therapy

be taken with arm position and motion while patients are prone, and the positioning of the chest roll and the type of surface the patient is placed on must be evaluated in order to ensure that the shoulders are not posteriorly extended.

## Competing interests

None declared.

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