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Bilateral brachial plexus injury after correction of Scheuermann's disease: case report

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Abstract

Introduction The article presents a case report and a brief literature review of an adverse event of brachial plexus injury associated with prone positioning in spinal surgery. **The purpose** was to report a case of bilateral brachial plexus injury after correction of Scheuermann's kyphosis. **Material and methods** Reported is a case of brachial plexus injury in a patient with Scheuermann's kyphosis after surgical correction. **Results** The patient could completely regain motor function of the left limb at 6 months with palsy scored 3 proximally retained in the right hand. **Discussion** The literature describes three pathophysiological conditions that predispose to brachial plexus injury in the postoperative period: sprain, compression, and ischemia. The adverse event is reversible in most cases and recovery depends on the degree of neurological deficit at an early stage. Recommendations are offered for surgeons and anesthesiologists to avoid the occurrence of the complication or take timely measures to alleviate the consequences. **Conclusion** Upper-limb somatosensory evoked potentials, a part of neurophysiological monitoring can be practical for prevention of the complication. Prevention of brachioplexopathy should be part of perioperative care.

Keywords: brachioplexopathy, Scheuermann's disease, spinal deformity correction

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INTRODUCTION

Scheuermann's disease was first described as kyphosis of unknown etiology in 1920 by the Danish orthopaedist and radiologist Holger Werfel Scheuermann [1]. There is a detailed description of the clinical and radiological features of Scheuermann's disease in the literature but the etiology remains undefined. Attempts of surgical correction of the condition were first described by K. Sorensen in 1964 [2]. Over years, treatment strategy including surgical modalities has undergone transformative change. Dorsal approach is common in surgical correction of Scheuermann's disease. Different complications including neurological deficit are reported with growing number of surgical interventions offered for Scheuermann's disease [3]. The purpose was to report a rare complication resulting from the surgical correction of Scheuermann's disease and provide a non-systematic literature review. No description of such a complication could be found in the Russian literature.

A number of complications associated with patient's position on the operating table can be identified with spinal surgery from the dorsal approach. A brachial plexus injury is one of the complications. Peripheral nerve injury in the prone position occurs in 0.14 % of surgical cases [4] with brachial plexus injury accounting for 38 % [5]. The brachial plexus is surrounded by three mobile bone structures including the clavicle, the first rib and the humeral head that increases the risk of injury [6]. The occurrence of positional brachioplexopathy during spinal surgery ranges from 0.02 to 15 % [7, 8, 9, 10] and the incidence of brachyplexopathy during spinal deformity correction is 3.6–4.8 % [9, 10, 11]. The frequency of the complications has decreased in recent years due to the widespread use of neurophysiological monitoring, [12]. Literature review revealed only one publication devoted to the topic. M. Biscevic et al. [11] reported 68 cases of spinal deformity surgical correction in the prone position and suggested that kyphosis was a risk factor for brachioplexopathy.

The purpose was to report a case of bilateral brachial plexus injury after correction of Scheuermann's kyphosis and conduct a non-systematic literature review.

MATERIAL AND METHODS

A 28-year-old patient A. presented with pain and kyphotic trunk deformity at the hospital of the Novosibirsk NIITO named after Ya.L. Tsivyan on February 10, 2021. She suffered the curve from the

age of 15, progression was gradual up to 18 years. She experienced pain in the thoracic spine over the past eight years. Based on physical examination and clinical and radiological findings, the patient was diagnosed with Scheuermann's disease, pain form; hyperkyphosis of the thoracic spine (85°) and a right-sided thoracic scoliotic curve (14°); secondary degenerative changes in the thoracic and lumbar spine and thoracalgia syndrome.

Figure 1 shows the lateral radiological view of the spine in step mode. Pain and rigid kyphotic curve being resistant to conservative treatment, were indications for elective surgical treatment. The patient signed an informed consent for surgical treatment and use of her data for scientific purposes.

Fig. 1 Lateral radiograph of the spine in step mode

Surgical treatment performed for the patient included correction of spinal deformity, posterior transverse Ponte osteotomy of Th6-7, Th7-8, Th8-9, posterior fusion of Th4-L2 using local autologous bone and neurophysiologic intraoperative monitoring (lower limb SSEP). Surgical access was made to the posterior spine at the level of Th4-L2. Intervertebral joints, spinous processes were resected throughout the access. Posterior Ponte osteotomy was performed at Th6-7, Th7-8, Th8-9 levels. Transpedicular screws were placed at the Th4-L2 levels.

There was a short-term (about 5 minutes) loss of the pulse wave from the upper limb during rod placement and correction due to a changed hand position resulting from torso lengthening during the spinal deformity correction. The corrective maneuvre was terminated, the upper limb position adjusted and the pulse wave restored. The correction was completed, the rods placed and stabilization produced. Posterior spinal fusion with autobone was performed, wound drainage placed for active aspiration and control radiography produced. Active wound drainage was arranged in the intensive care unit. Intraoperative blood loss was 200 ml, the operating time was 2 hours and 30 minutes. The patient developed neurological deficit in the form of severe upper paraparesis in the early postoperative period: scored 0 proximally in the right hand, 2 distally, 1 proximally on the left and 3 distally. An additional examinations included MRI, MSCT of the cervical spine, ultrasound of the vessels of the neck, ENMG of the upper limbs. There were no malpositions of the pedicle screws in the upper thoracic spine, no traumatic injuries of the cervical spine, no impairments of blood flow seen with ultrasound. ENMG showed signs of decreased motor conduction of the left and right axillary, musculocutaneous nerves of the axonopathic type with changes being more pronounced on the right. The patient was seen by a neurologist and diagnosed with bilateral predominantly proximal brachioplexopathy of mixed origin. The complication could be caused by a change in the hand position after the corrective maneuver and lengthening of the torso. The possible reasons could be the asthenic body type and kyphotic spinal curve featuring the patient's shoulder girdle being pushed forward with the main support falling on them and not on the chest with patient's position on the operating table.

RESULTS

Vascular, neurometabolic therapy was administered postoperatively and the patient developed positive dynamics with proximally increased strength up to 4 points in the left hand, up to 2 points in the right hand and up to 5 distally in both hands. A 6-month follow-up showed a complete restoration of the motor function of the left limb and paresis persisted proximally in the right hand scoring 3.

DISCUSSION

The literature describes three pathophysiological conditions that predispose to injury to peripheral nerves in the postoperative period: sprain, compression and ischemia [14, 15]. The mechanisms can be facilitated

in the prone position in patients with an asthenic body type, in particular. D.E. Cooper et al. [7] reviewed 15,000 interventions performed for patients under general anesthesia in the prone position and reported brachioplexopathies in 0.02 % of cases. The authors suggested the mechanical effect on the branches of the brachial plexus with resultant intraneural circulation being the cause of the adverse event. They reported the risk of intraoperative malposition of the limbs due to increased effect of muscle relaxants. "Cervical rib" or a shoulder pathology increases the risk of plexopathy with appearance of sensory and motor disorders. B. Ben-David et al. reported 22 cases of brachyplexopathy after surgery in the prone position with motor disorders being common [16]. Recent publications indicate the need for neurophysiological monitoring in surgical correction of spinal deformity [10, 11, 12, 17]. I. Chung et al. [17] reported a prospective study that showed upper limb SSEP monitoring being able to prevent the development of brachioplexopathy and injury to the ulnar nerve. They observed a decreased amplitude of SSEP in 10 patients out of 230 (4.3 %) during surgery that required a change in the upper limb position. There were no signs of plexopathy in the postoperative period.

R.D. Labrom et al. [10] reported the occurrence of brachyplexopathy in a retrospective study of 434 cases of pediatric scoliosis correction using SSEP. A sharp decrease in conduction along the branches of the brachial plexus was recorded in 27 patients (6.2 %) with intraoperative electrophysiological monitoring [18].

Schwartz et al. [9] reported a retrospective analysis of 500 cases of scoliosis correction with intraoperative electrophysiological monitoring. Conduction disorders along the branches of the brachial plexus were observed in 15 patients (3 %) using SSEP. The authors conducted this study for the complication of brachioplexopathy developed after a revision intervention following the kyphosis correction. The patient had paresis in the right hand scored 1 after the operation that regressed within 3 months. Intraoperative electrophysiological monitoring was not used due to the short duration (1 hour) and the small volume of the operation (rod replacement). M.F. O'Brien [8] et al. prospective investigated the incidence of SSEP disorders of the upper extremities during surgical interventions on the thoracic and lumbar spine. Decline in SEP responses were recorded in 15 % of cases. The use of SSEPs and the response to the decline prevented the occurrence of plexopathy in the postoperative period. The complication was reversible in most cases and recovery was dependent on the extent of neurological deficit at early stage. J.S. Uribe et al. reviewed the literature on postoperative plexopathies and identified 11 papers on the topic between 1950 and 2009. Of these, only two studies reported plexopathy in the prone position. Complete recovery occurred within 3 months in 90 % of patients [6].

CONCLUSION

Proper positioning of the patient and the upper limbs, exclusion of compression on the shoulder and the axilla, control of the patient's position on the operating table during and after corrective maneuvers, duration of anesthesia, prevention of intraoperative hypotension, control of the pulse wave by the anesthesiologist can minimize the incidence of the complications. The use of intraoperative electrophysiological monitoring including upper limb somatosensory evoked potentials can prevent the complication. Prevention of brachioplexopathy should be part of the perioperative preparation.

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