Quadriplegia in a patient who underwent posterior fossa surgery in the prone position

Case report

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Quadriplegia is a well-known complication of posterior fossa surgery performed while the patient is in the sitting position but is rarely associated with the prone position. A case of an 18-year-old man with a cerebellar medulloblastoma is described. There was no evidence of previous cervical disease. The patient suffered quadriplegia after undergoing surgery in the prone position. Postoperative magnetic resonance imaging demonstrated a long hyperintense C2–T1 lesion on T2-weighted sequences. The authors speculate that, during the prolonged period in which the neck was in hyperflexion, overstretching of the cervical spinal cord and compromise of its blood supply might have caused this devastating complication.

KEY WORDS • posterior fossa surgery • quadriplegia • prone position

Many cases of quadriplegia following posterior fossa surgery have been reported since 1980.1-3,12 In most of these reports, however, the authors have assessed the morphological or pathological changes of the cervical cord associated with the surgery performed with patients in the sitting position. Little has been reported about the changes that occur with patients undergoing surgery in a prone position. We have recently treated a young man with a cerebellar medulloblastoma and no history of cervical disease in whom quadriplegia developed after surgery was performed while he was in the prone position.

Case Report

History. This 18-year-old man was referred to us because of headache, vomiting, and unstable gait of 3 days’ duration. He had a 6-month history of headache and dizziness. There were no remarkable personal or familial antecedents.

Examination. General admission physical examination demonstrated no remarkable results. Neurological examination revealed normal consciousness and isocoric pupil size. He suffered no facial or lower cranial nerve palsy. Except for impaired tandem gait, cerebellar signs, as assessed using the finger-to-nose and heel-to-knee tests, were absent. Otherwise, no other neurological abnormalities were demonstrated. The results of a routine laboratory evaluation were within the normal range. A computerized tomography scan of the brain revealed a homogeneously enhancing mass in the cerebellum with obstructive hydrocephalus. An MR imaging study demonstrated a mass lesion in the vermis that was shown to be isointense on T1-weighted sequences and hyperintense on T2-weighted sequences (Fig. 1).

Operation. After induction of general tracheal anesthesia, an external ventricular drain was inserted via right frontal ventriculostomy, with the patient in a supine position. The patient was then positioned prone with hyperflexion of the neck (that is, a modified Concorde position10). The chin was positioned approximately one finger’s breadth from the sternum. The axis of the trunk was approximately 10° above the horizontal line and the head 5 cm higher than the heart. A suboccipital craniectomy was performed. On opening the dura mater and arachnoid, the tumor, which was soft and dark reddish in color, was identified between the cerebellar tonsils. Gross-total removal was achieved. The entire operation took 8.5 hours. Intraoperatively, arterial blood pressure was continuously monitored via the right radial artery. Intraoperative monitoring for emboli was not conducted. No episode of hypotension was demonstrated. The operation was generally uneventful. There was no injury of major vessels. The tonsillar segments of the posterior cerebellar arteries were well protected and preserved. The vertebral arteries were not encountered. The estimated total blood loss during...
the operation was 300 ml. The histological diagnosis was medulloblastoma.

**Postoperative Course.** Two hours postoperatively, the patient awakened from the state of anesthesia. Complete motor and sensory deficits, including proprioceptive sensibility, were demonstrated below the C5–6 level. Emergency brain computerized tomography demonstrated only postoperative changes. The following morning, MR imaging of the cervical spine revealed the presence of a long hyperintense lesion within the cervical cord from C-2 to T-1 on T2-weighted sequences (Fig. 2 left). No dislocation or subluxation was demonstrated on flexion–extension cervical spine x-ray films. High-dose methylprednisolone (30 mg/kg in the first 15 minutes and 5.4 mg/kg during the following 23 hours) was administered intravenously approximately 10 hours after surgery. During his hospitalization, unfortunately, no recovery of neurological functions was noted. A follow-up T2-weighted MR imaging study obtained 1 month after surgery revealed a hyperintense area at C5–6 (Fig. 2 right).

**Outcome.** The patient exhibited some neurological improvement 1 year after the event. His status had progressed to quadriparesis (Grade 3/5 muscle power in upper limbs, and Grade 1/5 muscle power in lower limbs).

**Discussion**

Quadriplegia, a disastrous complication, is associated with a number of operations including those involving neurosurgical, cardio-surgical, and tracheal resection procedures. A variety of postures, including the sitting, prone, and lateral oblique positions, have been used for posterior fossa surgery. Each position has advantages and disadvantages. For instance, the sitting position provides a good operative field but is associated with the risk of air embolism. On the other hand, although air embolism is an unlikely complication of the prone position, blood tends to accumulate in the operative field. There have been reports of several cases of quadriplegia developing after posterior fossa surgery, in all of which the patient was placed the sitting position.

Although some mechanisms for this complication have been proposed, the pathogenesis remains uncertain. The causes for flexion myelopathy vary widely and include such conditions as subluxation, excessive kyphosis, overstretching mechanism, and tight dural canal mechanism. Wilder has hypothesized that acute flexion of the cervical spine, which occurs when the patient is in the sitting position after induction of general anesthesia, may produce sufficient stretching of the spinal cord to alter autoregulation by affecting mechanically the spinal cord vasculature. Dominguez, et al., have reported a case in which irreversible quadriplegia developed after an operation for tracheal stenosis. In their case, the patient underwent cervicotomy, resection of three cartilaginous rings of the trachea, and end-to-end anastomosis while in a supine position. To keep the neck in flexion, the chin was sutured to the anterior chest wall. The patient was extubated 1 hour after the operation. Full range movement of the four limbs was recorded. Unfortunately, complete motor deficit developed after the patient was placed in a sitting position. It was presumed that the combination of relative arterial hypotension secondary to the sitting position and the disturbed autoregulation caused by extreme neck flexion resulted in ischemic spinal cord injury. Because our patient did not experience any episode of hypotension intra- and postoperatively, hyperflexion of the neck may have played an important role in causing the quadriplegia. Bridg has shown that the cervical spinal cord increases in length up to 2.8 cm when the neck moves from full extension to full flexion and that the location of the maximum change in length is at approximately the C-5 level. The term tight dural canal mechanism was used by Iwasaki, et al., to refer to the condition in which deformity of the cervical cord is radiographically demonstrated with the neck in the flexed position but absent in the neutral and extended positions.

Based on the aforementioned theories, we speculate that the underlying pathophysiology of the cervical my-
elopathy observed in our case is as follows. With the paraspinal muscles paralyzed during general anesthesia, the hyperflexed neck caused overstretching of the cervical spinal cord. This prolonged overstretching of the cord, combined with the relatively narrow spinal canal and the slightly bulging C5–6 intervertebral disc, both of which were made worse by neck flexion, resulted in ischemic injury of the cervical spinal cord. The hyperintense area within the cervical cord demonstrated on T2-weighted MR imaging may well have been infarction surrounded by edema. The residual lesion at the C5–6 level observed 1 month later may have been a reflection of the epicenter of cord lesion where a hinge with greatest flexibility of the cervical spine was located. It also might have been a fulcrum in a flexed cervical vertebral column, where posterior or bulging of the disc might have caused the most severe mechanical impact on the spinal cord.

In retrospect, we believe several maneuvers might have prevented this devastating complication. First, although neck flexion is indispensible for posterior fossa surgery, it should be done with caution so as to allow surgical procedures but not to induce extreme hyperflexion. Second, the use of intraoperative SSEP monitoring might have alerted us of the occurrence of cervical myelopathy. Unfortunately, it had not been our routine practice to use SSEP in posterior fossa surgery. Epstein, et al., have indicated that SSEP monitoring helps reduce the incidence of devastating neurological injury during cervical procedures and should be considered as an adjunct to surgery. We agree with this notion and propose that SSEP be considered in posterior fossa surgery in cases in which prolonged neck flexion is necessary.

In conclusion, although the theory of position-associated cord lesion remains hypothetical in our case, we would recommend avoidance of hyperflexion of the neck during surgery. Neurosurgeons should keep in mind this serious complication while performing posterior fossa surgery, regardless of whether the patient is in sitting or prone position.

References


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