Basilar artery thrombosis after reduction of cervical spondyloptosis: a cautionary report

Case report

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Although a limited number of reports in the literature document preservation of neurological function in patients with a cervical spondyloptosis, this injury is typically associated with complete neurological deficit. The inherent mechanics of this fracture-dislocation pattern contorts the vertebral arteries in such a way that it may result in dissection or compromised flow through those vessels. Thus, intimal injury or thrombus from stasis of flow may result. Reduction of the spondyloptosis restores flow to the vertebral arteries, but it also may mobilize thrombus or propagate an intimal dissection within the previously contorted vessel.

The authors review their experience in the care of a 43-year-old man who sustained C4–5 spondyloptosis while riding an all-terrain vehicle. On arrival, the patient demonstrated no motor function below C-4 but had sensation to the nipple line (American Spinal Injury Association Spinal Cord Injury Classification B). The patient’s cranial nerve examination was unremarkable. Computed tomography of the cervical spine demonstrated complete spondyloptosis at C4–5. The patient was immediately placed in cervical traction and taken to the operating room for open reduction of the fracture dislocation, decompression of the spinal cord, and stabilization with an interbody graft and cervical plate. Preoperative cervical traction was successful in only partial reduction of the fracture dislocation. Open reduction was achieved with exposure of the C-4 and C-5 bodies and sequential distraction. After anatomical alignment was achieved, an interbody graft was placed and a cervical plate secured. A subsequent decline in the patient’s level of consciousness prompted CT of the head, which showed evidence of a basilar artery thrombosis. A CT angiographic study demonstrated patency of the vertebral arteries, but a mid–basilar artery thrombosis. The patient progressed to brain death 24 hours after reduction of the fracture dislocation.

The degree of contortion of the vertebral arteries in cervical spondyloptosis in the upper cervical spine may result in stasis of flow with subsequent formation of thrombus or intimal injury. After anatomical reduction, restoration of flow within the vertebral arteries may mobilize the thrombus or propagate an intimal dissection and result in subsequent embolic events. Endovascular evaluation may be warranted immediately after anatomical reduction of a high cervical spondyloptosis for evaluation of the vertebral arteries and possible thrombus dissolution or retrieval.

The authors present their experience in the management of a patient with a traumatic C4–5 spondyloptosis. Although the patient had no motor function below the level of the injury, there was no preoperative evidence of vertebrobasilar insufficiency. Anatomical reduction was achieved, but the patient’s condition subsequently declined. Imaging demonstrated a basilar artery thrombosis. The patient progressed to brain death over the next 24 hours after anatomical reduction. While complications associated with cervical traction have been reported, to our knowledge, this is the first report of basilar artery thrombosis resulting from restoration of anatomical alignment in a patient with cervical spondyloptosis.

Abbreviations used in this paper: CTA = CT angiography; MAP = mean arterial pressure.
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History and Neurological Examination. A 43-year-old man presented to our institution after a rollover accident that occurred while riding an all-terrain vehicle. The patient arrived awake, alert, and talking. He was adequately protecting his airway. He had no cranial nerve deficits nor did he demonstrate clinical evidence of vertebrobasilar insufficiency on examination. The patient had no motor function below C-4 and had a thoracic sensory dissociation level at T-4 (American Spinal Injury Association Spinal Cord Injury Classification B). A CT scan of his brain showed no abnormalities; specifically, there was no evidence of hyperintensity within the basilar artery. A CT scan of his cervical spine demonstrated a complete fracture dislocation at C4–5 (Fig. 1).

Intervention. Because of his incomplete spinal cord injury, the patient was immediately placed in cervical traction and taken to the operating room for stabilization. Anatomical alignment was achieved. Initially under conscious sedation, cervical traction was commenced at 10 pounds, with an additional 10 pounds added every 10–15 minutes until 40 pounds was reached. Intermittent fluoroscopic images were obtained with addition of the weight. Throughout the cervical traction, the patient was awake and responsive. Partial reduction was achieved with cervical traction, but a unilateral locked facet precluded anatomical reduction. The decision was made to proceed with open reduction.

An awake fiber-optically guided intubation was then performed, and the patient was placed under general endotracheal anesthesia. His MAP was maintained above 80 mm Hg with both fluid resuscitation and dopamine. A Smith-Robinson approach was used to expose the C-4 and C-5 bodies in their entirety. The fracture dislocation was evident once the exposure was completed. Distraction posts were placed into the vertebral bodies of C-4 and C-5, and partial reduction was achieved in this manner (Figs. 2 and 3). Sequential interbody spacers were used to dislodge the perched facet and to achieve anatomical alignment (Fig. 3). Once anatomical alignment was achieved, a cortical cancellous interbody graft was placed and secured with a cervical plate.

Postoperative Course. Immediately after the procedure, the patient was opening his eyes and grimacing in response to stimuli. His pupillary response was brisk and reactive. He had spontaneous breaths with an intact gag reflex. Because of his high spinal cord injury, there was no expectation of extubation. The patient was maintained on light sedation and on a dopamine infusion to maintain MAP above 80 mm Hg.

On subsequent evaluation 2 hours after the procedure,
the patient no longer demonstrated eye opening or grimacing in response to stimuli, but all of his brainstem reflexes were intact. A CT scan of the head was immediately performed and demonstrated thrombus within the basilar artery (Fig. 4). A CTA study was then performed to rule out a dissection or thrombosis within the vertebral arteries (Fig. 5). Evidence of infarction on CT precluded the endovascular options of thrombus dissolution or retrieval. A complete laboratory evaluation showed no evidence of a primary or secondary hypercoagulable state. The patient progressed to brain death 24 hours after reduction of his spondyloptosis.

Discussion

Cervical spondyloptosis is a catastrophic injury to both the neural and vascular elements of the cervical spine. This fracture-dislocation pattern contorts both the spinal cord and vertebral artery and may result in irreversible spinal cord injury and compromise of flow through the arteries.6,9 The primary objectives of intervention in a patient with this injury are to restore anatomical alignment and to stabilize the cervical spine. We have previously reported our experience in the management of a neurologically intact patient with cervical spondyloptosis at C7–T1. In that patient, preservation of neurological function was the main concern before reduction because the vertebral arteries are not a factor at this level.8 In our management of the patient described in the present article, who lacked motor function and who had a fracture dislocation at C4–5, the vertebral arteries become a central point of concern. Nevertheless, the possibility of vertebral artery injury does not change the need for cervical traction and operative reduction and stabilization.

The patient described in this report presented with an incomplete spinal cord injury with no evidence of vertebrobasilar insufficiency. His condition indicated that if the vertebral arteries were completely occluded, the posterior circulation was being perfused adequately through the collateral circulation through the circle of Willis. In fact, the postoperative CT angiogram demonstrated generous posterior communicating arteries and the capacity for adequate collateral flow. Whether there was partial flow through the vertebral arteries or perfusion of the posterior circulation through collateral flow, the patient demonstrated no evidence of vertebrobasilar insufficiency at arrival or during cervical traction. Consequently, his blood flow was adequate, which further underscores the importance of maintaining MAP parameters in a patient with a spinal cord injury.

Partial anatomical alignment was achieved with cervical traction with the patient awake but sedated. The configuration of the vertebral arteries at the time of partial reduction (seen on Fig. 2) would be expected, at minimum, to lessen the contortion of the vertebral arteries and probably to restore flow if it was compromised. Although lightly sedated, the patient remained awake and responsive at this time, indicating the absence of an embolic event to the brainstem. This point argues against an instant embolic event from stasis within the vertebral arteries inasmuch as flow would have been returned by partial reduction. However, the possibility that a thrombus was present within one or both of the vertebral arteries and may have been dislodged in a delayed fashion cannot be dispelled entirely. The awake fiber-optically guided intubation elicited a strong gag reflex, further indicating adequate perfusion of the posterior circulation before general anesthesia.

Soon after the vertebral bodies were exposed, anatomical alignment was achieved with sequential distraction and the cervical spine was stabilized with an interbody graft and cervical plate. Considerable distraction was required to reduce the fracture (Fig. 3). It remains possible that the degree of distraction may have caused an injury to the vertebral artery. A posterior approach to reduce the fracture...
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dislocation would have lessened the need for this degree of distraction. However, the patient showed no signs of neurological decline immediately after surgery, which suggests that the degree of distraction did not result in injury. The patient was initially awakened from anesthesia and was able to open his eyes and to breathe spontaneously with an intact gag reflex, but there was no return of motor function. Again, at this time, there was no clinical evidence of vertebrobasilar insufficiency. A high cervical spinal cord injury and the risk of spinal shock prompted the decision to keep the patient intubated. His precipitous neurological decline 2 hours after surgery prompted further imaging, which ultimately showed the basilar artery thrombosis.

The origin of the thrombus remains unclear; the timing of the thrombus, however, is not. The patient's precipitous neurological decline hours after surgery indicates that the event did not occur during cervical traction or the operative procedure. The absence of a dissection on CTA dispels the possibility of an intimal flap showering the posterior circulation. Furthermore, the basilar artery thrombosis in the absence of an intimal flap suggests that a thrombus was dislodged or propagated from one of the vertebral arteries in the hours after the surgery, as suggested earlier. This unifying hypothesis reconciles the patient's preoperative and postoperative imaging with the timing of the neurological decline and with his findings on CTA.

This case raises the issue of preoperative CTA, which was not performed. Whether there was flow through these vessels or a thrombus had formed from the contortion of the vertebral arteries is unknown. Regardless of what the findings may have been on preoperative CTA, such information would not change the need to reduce the fracture dislocation and to stabilize the cervical spine. Conversely, immediate postoperative CTA may have guided his immediate postoperative management. We can only speculate about what immediate postoperative CTA may have shown. Consequently, it is difficult to conjecture whether any intervention would have altered the patient's outcome. It is only from the certainty of hindsight that we can even introduce the possibility of clot retrieval or dissolution versus systemic heparinization. On a broader scale, however, the outcome in this case demonstrates the severe nature of this injury and the morbidity and potential for death associated with the treatment of cervical spondyloptosis.

Conclusions

The degree of contortion of the vertebral arteries in cervical spondyloptosis in the upper cervical spine may result in stasis of flow and formation of thrombus. After anatomical reduction, restoration of flow within the vertebral arteries may mobilize the thrombus and result in subsequent embolic events. Angiographic evaluation of the vertebral arteries and the posterior circulation may be warranted immediately after anatomical reduction of cervical spondyloptosis. Endovascular thrombus dissolution or retrieval or systemic heparinization are considerations that must be weighed carefully after anatomical reduction and stabilization are achieved. Regardless of such preemptive actions, this injury and its treatment are associated with a significant risk of morbidity and mortality.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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