Arteriovenous fistula as a complication of C1–2 transarticular screw fixation

Case report and review of the literature

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A case is reported of a vertebral artery-to-epidural venous plexus fistula as a complication of posterior atlantoaxial facet screw fixation. The use of transarticular screws to stabilize the C1–2 joint has become an increasingly popular fixation technique, most notably for atlantoaxial instability due to trauma or rheumatoid disease. Despite the fact that this approach is technically challenging, there have been few reports of complications associated with C1–2 transarticular fixation. Although damage to the vertebral artery is a documented hazard of transarticular fixation at this level, a symptomatic arteriovenous fistula resulting from the procedure has not been described previously. The etiology, presentation, and treatment of this unusual complication are discussed.

KEY WORDS • atlantoaxial stabilization • arteriovenous fistula • transarticular screw fixation • cervical spine fusion

The technique of posterior transarticular facet screw fixation for atlantoaxial instability was pioneered by Magerl in the 1970s.13 Modifications to this technique and its widespread use have been reported.5,9,13,20 Transarticular screw fixation provides immediate rigid fixation of the C1–2 vertebral segment while preserving motion between the occiput and C-1. Furthermore, biomechanical testing reveals that facet screw fixation at this level is more rigid and provides more resistance to translational and rotational forces compared to both C1–2 and occipitocervical wiring techniques.8,10,15 Clinical series reveal fusion rates consistently higher than those of well-established conventional bone wire procedures.2,6,7,11,12,17,18

Atlantoaxial subluxation is a common manifestation of rheumatoid involvement of the cervical spine.16 Atlantoaxial instability is also a common sequela of cervical trauma. Posterior transarticular screw fixation has been advocated as the preferred method of stabilization in complex cases of atlantoaxial instability with a high likelihood of failure, such as rheumatoid arthritis, congenital abnormalities, odontoidectomy, incompetency of posterior elements, nonunion of Type II odontoid fracture, intolerance to halo orthosis, and salvage for atlantoaxial nonunion.1,4,5,20

Case Report

This 50-year-old woman with a history of juvenile rheumatoid arthritis presented with persistent neck pain radiating to the shoulders. She had been treated with nonsteroidal antiinflammatory agents, prednisone, and methotrexate. She complained of progressively severe neck pain but denied any motor or sensory changes in the upper or lower extremities or any bladder or bowel dysfunction.

Examination. The patient’s hands and wrists showed stigmata of rheumatoid arthritis and mild motor weakness (4–5/5 strength) of bilateral upper extremities. She was diffusely hyperreflexive bilaterally and symmetrically. Magnetic resonance (MR) imaging showed an anterior pannus at C1–2 (Fig. 1 left) as well as the relationship between C-2 and the vertebral artery (Fig. 1 right). Plain
radiographs for flexion and extension showed a 12-mm predental space and 4 mm of anterior subluxation of C-1 on C-2.

First Operation. A transoral resection of the rheumatoid pannus and the odontoid process was followed by posterior stabilization with C1–2 transarticular screws and fusion with cadaveric iliac crest allograft using the Sonntag interspinous process technique. Under fluoroscopic guidance, the operative procedures were completed without apparent complications. Follow-up anteroposterior (Fig. 2 left) and lateral (Fig. 2 right) cervical spine radiographs showed good screw position 2 days after the operation. The patient was extubated and transferred in stable condition from the intensive care unit to the main floor. The remainder of the patient’s 1-week hospital course was uneventful. She was discharged home and instructed to wear a Philadelphia cervical collar at all times.

Postoperative Course. At routine follow-up examination 4 weeks after operation, the patient presented without neurological deficit; her neck pain was improving. She was instructed to continue wearing the hard cervical collar. At 12-week follow up, she stated that her neck pain had resolved but that her right arm was weak. Physical examination revealed moderate weakness (3/5) of the right deltoid and biceps muscles. Plain radiographs showed evidence of bone fusion at C1–2 and no cervical movement on flexion and extension. Further workup included myelography with postmyelography computerized tomography (CT) scans which showed a circumferential extradural mass compressing the thecal sac and extending from C5–6 to the foramen magnum (Fig. 3).

Second Operation. The patient then underwent posterior cervical exploration. On exposure of the cervical spinal canal there was brisk bleeding from the interlaminar space. A small amount of C-4 lamina was removed to expose a large epidural vessel under arterial pressure. At this point, the procedure was aborted and the patient was taken directly to the arteriography suite. A selective left vertebral digital subtraction arteriogram revealed an abnormal arteriovenous communication at the level of the C-2 vertebral body (Fig. 4 left), multiple enlarged draining veins within the soft tissues of the neck, and a large anterior epidural vein within the spinal canal. A selective right vertebral digital subtraction arteriogram revealed a similar arteriovenous communication. A guide catheter was then selectively placed in the left vertebral artery just proximal to the arteriovenous fistula, and a detachable permanent occlusion balloon was positioned in the left arteriovenous fistula. Follow-up arteriography revealed occlusion of the left vertebral artery, and two helical coils were placed just proximal to the occlusion balloon to ensure its stable positioning. A similar procedure was completed on the opposite side to occlude the

FIG. 1. Left: Preoperative magnetic resonance (MR) image showing pannus at C-1 and erosion of the dens with anterior spinal cord compression (arrow). Right: Preoperative MR imaging showing relationship of C-2 to vertebral artery (arrows).

FIG. 2. Postoperative anteroposterior (left) and lateral (right) radiographs demonstrating apparently satisfactory C1–2 transarticular screw placement and cable and bone fixation of the C1–2 spinous process.
right vertebral artery. After this procedure, arteriography showed good collateral filling of the posterior fossa circulation through the posterior communicating arteries and an incidental persistent right otic artery (Fig. 4 right).

Second Postoperative Course. The patient had some residual right upper-extremity weakness (4/5) but was otherwise neurologically intact. She received a course of intravenously administered heparin (partial prothrombin time 50–70 seconds) for 3 days and was then discharged home on postoperative Day 4 receiving a course of aspirin as the only medication.

On follow-up examination 4 weeks later, the patient showed only mild residual right upper-extremity weakness (5/5). When seen 3 months later, she had returned to full-time work and complained only of occasional dysesthetic pain in her hands. Plain radiographs for flexion and extension confirmed that the fixation at C1–2 was stable.

Discussion

The anatomy of the cervicocranium makes proper posterior transarticular screw placement technically demanding. In 1991, Grob, et al.,9 reported a series of 161 consecutive patients operated on by several different surgeons at four different Swiss hospitals. They reported no damage to the vertebral artery or to the spinal cord and concluded that this procedure did not result in serious complications. Stillerman and Wilson20 presented 22 cases of posterior transarticular screw fixation without incidence of vertebral artery or spinal cord damage. However, Apfelbaum1 reported one instance of bilateral vertebral artery injury leading to a fatal complication among 40 patients treated. Marcotte, et al.,14 reported two instances of dural tears in a series of 18 patients.

It must be emphasized that certain tenets have become generally accepted to minimize the risks associated with posterior transarticular screw fixation. Preoperatively, every patient should undergo thin-slice (2-mm) CT scanning through C1–2, with sagittal and coronal reconstructions, to determine the course of the vertebral artery and its relation to the bone anatomy of the pars interarticularis of C-2. During the standard posterior dissection, the C-2 pars interarticularis should be exposed so that screw placement across the C1–2 facet joint toward the lateral mass of C-1 can be visualized. Fluoroscopic guidance should be used intraoperatively to achieve the proper screw trajectory. If brisk, pulsatile bleeding indicative of vertebral artery damage is encountered while a fixation screw is being placed, that screw can be placed but no attempt should be made to place a contralateral screw. It should be noted that in the case reported here, despite intraoperative adherence to these principles, the vertebral artery had been compromised and this had not been apparent at the time.

In conclusion, C1–2 posterior transarticular screw fixation is a biomechanically superior fixation technique, which provides immediate rigid stability without the use of external orthosis. This technique is especially useful in cases of complex atlantoaxial instability. The procedure is technically demanding and places the vertebral artery at risk for complications ranging from occult arteriovenous fistula presenting as an epidural mass lesion to frank arterial compromise resulting in brainstem infarction.

References

Atlantoaxial screw fixation–induced AVF


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