Compressive cervical pannus formation in a patient after 2-level disc arthroplasty: a rare complication treated with posterior instrumented fusion

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Cervical disc arthroplasty (CDA) has received widespread attention as an alternative to anterior fusion due to its similar neurological and functional improvement, with the advantage of preservation of segmental motion. As CDA becomes more widely implemented, the potential for unexpected device-related adverse events may be identified.

The authors report on a 48-year-old man who presented with progressive neurological deficits 3 years after 2-level CDA was performed. Imaging demonstrated periprosthetic osteolysis of the vertebral endplates at the CDA levels, with a heterogeneously enhancing ventral epidural mass compressing the spinal cord. Diagnostic workup for infectious and neoplastic processes was negative. The presumptive diagnosis was an inflammatory pannus formation secondary to abnormal motion at the CDA levels. Posterior cervical decompression and instrumented fusion was performed without removal of the arthroplasty devices or the ventral epidural mass. Postoperative imaging at 2 months demonstrated complete resolution of the compressive pannus, with associated improvement in clinical symptoms. Follow-up MRI at > 6 months showed no recurrence of the pannus. At 1 year postoperatively, CT scanning revealed improvement in periprosthetic osteolysis.

Inflammatory pannus formation may be an unexpected complication of abnormal segmental motion after CDA. This rare etiology of an epidural mass associated with an arthroplasty device should be considered, in addition to workup for other potential infectious or neoplastic mass lesions. In symptomatic individuals, compressive pannus lesions can be effectively treated with fusion across the involved segment without removal of the device.

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KEYWORDS cervical disc arthroplasty; adverse event; ventral epidural mass; compressive pannus; posterior cervical fusion; spine surgery

THE number of operations performed for degenerative disc disease of the cervical spine continues to rise. Between 2002 and 2009, cervical fusions have increased by 21%.¹³ Meanwhile, the first clinical trial for cervical disc arthroplasty (CDA) began in 2002.^{5,16} Initially, the focus of this procedure was single-level disc disease.⁵ However, improved clinical outcomes with CDA compared to traditional anterior fusion has led to expanded indications for multilevel disease.^{9,12,19} Recent randomized clinical trials comparing 2-level CDA to anterior cer-

vical discectomy and fusion have demonstrated that CDA may decrease the likelihood of major adverse events while improving upon certain outcome measures, including the need for reoperation, neurological and clinical outcome assessments, adjacent-segment degeneration, and overall success of the operation.^{2,3,6,10}

As CDA gains widespread adoption for both single- and multilevel disease and as studies include longer-term follow-up, unexpected device-related adverse events may be identified. In this case report, we describe the forma-

ABBREVIATIONS CDA = cervical disc arthroplasty; CRP = C-reactive protein; ESR = erythrocyte sedimentation rate.

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FIG. 1. **A:** Noncontrast CT sagittal reconstruction demonstrating C5–6 and C6–7 disc arthroplasty. There is osteolysis of the C5 inferior and C6 superior endplates surrounding the arthroplasty device. **B:** Coronal CT reconstruction demonstrating osteolysis surrounding the arthroplasty devices. **C:** Axial CT image at the C5 inferior endplate demonstrating bone erosion.

tion of a symptomatic compressive ventral epidural mass associated with cervical segments previously treated with arthroplasty devices.

Case Report

History

This 48-year-old man underwent C5–6 and C6–7 CDA (M6-C cervical disc; Spinal Kinetics) at a hospital in Germany in 2013 for chronic neck pain, radiculopathy, and paresthesias. Following 2-level CDA, the patient had initial resolution of his symptoms. Three years postoperatively, he presented to our institution with several months of increasing neck pain, recurrence of radiculopathy, paresthesias, and myelopathy. The patient underwent CT imaging at another facility that demonstrated chronic periprosthetic osteolysis of the vertebral endplates surrounding the artificial disc implant, which was suggestive of reactive granulomatosis or chronic infection (Fig. 1). The patient was urgently referred to our facility for further management.

Examination

At the time of presentation, the patient had progressive neck pain with radiation to the shoulders, subjective bilateral upper-extremity weakness, and paresthesias. He

also described a Lhermitte's sign, with sharp pain radiating down his back and legs with abrupt neck extension. Vital signs and the remainder of his physical examination results were normal. MRI with intravenous contrast was obtained, and demonstrated osteolytic lesions of the vertebral bodies adjacent to the CDA device with a complex, cystic, heterogeneously enhancing ventral epidural mass at C5–6 causing spinal cord compression (Fig. 2).

The patient was placed in a cervical collar and admitted to the hospital for further workup. Results of laboratory serological testing including basic metabolic panel and complete blood count were unremarkable. Inflammatory markers were slightly elevated on admission, with a C-reactive protein (CRP) value and erythrocyte sedimentation rate (ESR) of 1.1 mg/L and 17 mm/hour, respectively. A CT-guided biopsy of the cystic lesion was performed. Cultures of aspirate were negative, and the cytology was negative for neoplastic cells. CRP and ESR normalized by hospital day 8 to 0.8 mg/L and < 1 mm/hour, respectively, with no intervening antibiotics or other medical treatment other than immobilization with a cervical orthosis. The patient maintained a stable clinical and neurological examination throughout the workup.

Operation and Postoperative Course

Given a negative workup for infectious or neoplastic

FIG. 2. **A:** Sagittal T2-weighted MRI demonstrating a peri-prosthetic hyperintense epidural mass at C5–6 causing ventral spinal cord compression. **B:** Sagittal T1-weighted MRI obtained after addition of intravenous contrast demonstrating heterogeneous enhancement of the compressive epidural mass. **C:** Axial T2-weighted MRI at the C5–6 disc space demonstrating ventral compression of the spinal cord.

FIG. 3. **Left:** Postoperative lateral radiograph demonstrating laminectomy decompression and C4–T1 posterior instrumented stabilization and fusion. **Right:** Postoperative anteroposterior radiograph demonstrating the spinal fixation construct with the arthroplasty devices maintained.

etiology and the patient's otherwise nonacute clinical status, an aseptic inflammatory pannus formation secondary to abnormal motion at the CDA level was suspected. A decision was made to treat the patient for this presumptive diagnosis with a C4–6 laminectomy decompression and C4–T1 posterior instrumented fusion (Fig. 3). The previous 2-level arthroplasty devices were maintained, and no anterior approach for removal of the ventral mass was performed. The procedure and the patient's postoperative course were uncomplicated, and the patient was discharged home in normal neurological condition.

During follow-up evaluations at both 2 months and 1 year postoperatively, the patient reported resolution of his radiculopathy, paresthesias, and myelopathy. His only symptoms were moderate residual neck and shoulder girdle pain, and decreased neck range of motion. Imaging obtained at 2 months after fusion surgery demonstrated stable cervical spine alignment and instrumentation. MRI obtained at 2 months also revealed complete resolution of the ventral epidural mass, with adequate decompression of the spinal cord (Fig. 4). Repeat MRI performed 7 months postoperatively demonstrated stable resolution of the ventral epidural mass without recurrence (Fig. 5). CT performed at 1 year postoperatively demonstrated stable posterior spinal fixation, with interval improvement in the osteolytic lesions adjacent to the inflammatory pannus (Fig. 6).

Discussion

To our knowledge, this is the first report of a compressive ventral epidural mass occurring after CDA that resolved with posterior instrumented fusion without removal of the artificial disc device. A previous case report described a similar aseptic ventral epidural mass associated with an artificial disc. However, this was treated by complete explantation of the arthroplasty device, and anterior fusion of the involved segment.¹ The authors concluded that the underlying etiology in that case was related to delayed hyperreactivity to metal ions in the implant.

FIG. 4. **Left:** Sagittal T2-weighted MRI obtained at 2 months after posterior decompression and instrumented fusion demonstrating resolution of the ventral epidural mass. T2 hyperintense signal along the spinous processes represents expected postoperative changes in the surgical cavity. **Right:** Axial T2-weighted MRI at the C5–6 disc space demonstrating complete resolution of the ventral epidural mass with circumferential decompression of the spinal cord.

It is worth noting that there was periprosthetic osteolysis of the vertebral body adjacent to the CDA. Periprosthetic osteolysis is a phenomenon described extensively in the orthopedic literature for extremity joint replacement. The mechanism is presumed to be multifactorial, whereby a pathological mechanical load in concert with a foreign body response to particles extruded from the implant construct results in chronic inflammation and subsequent degeneration of the underlying bone.^{4,8} This is a well-described finding in total hip and knee arthroplasty, but has not been observed to any significant extent after CDA. This discrepancy may be due to inherent differences in the loading environment between hip and knee joints versus the cervical spine, and to the number of biologically active fragments extruded into the more mobile hip and knee joints.¹⁴

Although we cannot definitively rule out a foreign body response, the prompt resolution of the epidural mass within 2 months following instrumented stabilization across the segment strongly suggests that the compressive lesion was related to pathological motion of the affected joint—a similar process to that seen in the pathogenesis of an inflammatory pannus. In an inflammatory pannus, synovitis results in monocytes, macrophages, and fibroblasts releasing proinflammatory mediators and matrix metal-

FIG. 5. **Left:** Sagittal T2-weighted MRI obtained at 7 months after fusion surgery demonstrates no recurrence of the ventral epidural mass, with resolution of postoperative T2 hyperintense signal. **Right:** Axial T2-weighted MRI at the C5–6 disc space demonstrates stable resolution of the ventral epidural mass.

FIG. 6. **A:** Noncontrast sagittal CT obtained at 1 year after fusion surgery demonstrates interval improvement of the osteolytic lesion at C5. **B:** Coronal CT demonstrating improvement in the osteolytic lesion at C5. **C:** Axial CT image postlaminectomy at the C5 inferior endplate demonstrating stable instrumentation and interval improvement of the osteolytic lesion.

loproteinases into the joint space. This causes breakdown of ligaments and cartilage as well as bone resorption, as was seen in this case.^{15,17} Studies have demonstrated that despite the inflammatory nature of the lesion, restriction of motion (i.e., fusion) of the involved motion segment can lead to resolution of the pannus, and improvement in neurological deficits.⁷

Other possibilities include device-related debris serving as a nidus for an immunoreactivity response. Studies have indicated that polymeric and metallic fragments may be present following cervical arthroplasty.¹¹ Yet our case supports the hypothesis that mechanical instability led to the mass rather than chemical sensitivity to the device, given that the mass resolved by simple restriction of motion via surgical stabilization. Although nonspecific, the delayed improvement in inflammatory markers (ESR, CRP) and stable clinical examination results after applying a cervical orthosis may further suggest an abnormal motion-related phenomenon. Hyperreactivity to implant debris presumably would not resolve unless the device was removed, which was not performed in this case.

Conclusions

Emerging evidence demonstrates that CDA is an effective treatment for properly selected patients with symptomatic cervical degenerative disease.¹⁸ As the numbers of single- and multilevel cervical arthroplasties increase, surgeons should be aware of the potential for a compressive pannus as a rare and unexpected postoperative complication. If a diagnosis of inflammatory pannus is suspected and infection and neoplasm have been excluded, then surgical stabilization across the involved motion segment may be an effective approach for pannus resolution.

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Disclosures

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

Author Contributions

Conception and design: both authors. Acquisition of data: both authors. Analysis and interpretation of data: both authors. Drafting the article: both authors. Critically revising the article: both authors. Reviewed submitted version of manuscript: both authors. Approved the final version of the manuscript on behalf of both authors: Brophy. Administrative/technical/material support: both authors. Study supervision: Hoh.

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