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Anterior Cervical Infection: Presentation and Incidence of an Uncommon Postoperative Complication

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Abstract

Study Design: Retrospective multi-institutional case series.

Objective: The anterior cervical discectomy and fusion (ACDF) affords the surgeon the flexibility to treat a variety of cervical pathologies, with the majority being for degenerative and traumatic indications. Limited data in the literature describe the presentation and true incidence of postoperative surgical site infections.

Methods: A retrospective multicenter case series study was conducted involving 21 high-volume surgical centers from the AOSpine North America Clinical Research Network, selected for their excellence in spine care and clinical research infrastructure and experience. Medical records for 17,625 patients who received cervical spine surgery (levels from C2 to C7) between January 1, 2005, and December 31, 2011, inclusive, were reviewed to identify the occurrence of 21 predefined treatment complications. Patients who underwent an ACDF were identified in the database and reviewed for the occurrence of postoperative anterior cervical infections.

Results: A total of 8887 patients were identified from a retrospective database analysis of 21 centers providing data for postoperative anterior cervical infections (17/21, 81% response rate). A total of 6 postoperative infections after ACDF were identified for a mean rate of 0.07% (range 0% to 0.39%). The mean age of patients identified was 57.5 (SD = 11.6, 66.7% female). The mean body mass index was 22.02. Of the total infections, half were smokers (n = 3). Two patients presented with myelopathy, and 3 patients presented with radiculopathic-type complaints. The mean length of stay was 4.7 days. All patients were treated aggressively with surgery for management of this complication, with improvement in all patients. There were no mortalities.

Conclusion: The incidence of postoperative infection in ACDF is exceedingly low. The management has historically been urgent irrigation and debridement of the surgical site. However, due to the rarity of this occurrence, guidance for management is limited to retrospective series.

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Keywords
lumbar spine, durotomy, cerebrospinal fluid leak, complications, trauma, thoracolumbar

Introduction
The anterior cervical discectomy and fusion (ACDF) is one of the most commonly performed spinal surgeries,1 affording the surgeon the flexibility to treat a variety of cervical pathologies, with a low rate of major complication.2 However, due to the nature of the anterolateral corridor of the neck, intraoperative traction on the esophagus has resulted in a dysphagia rate as high as 71%3,4. One of the most feared complications of the anterior cervical approach is esophageal perforation, which is uncommonly reported as a result of inadvertent injury due to the proximity of the esophagus to the working corridor of the sharp instruments used in cervical discectomy and fusion.2

Overall, the ACDF is well-tolerated and an ideal choice for single or multilevel degenerative disease with several surgical goals: decompression of the neural elements, restoration of cervical lordosis, the removal of anterior compressive etiologies, and arthrosis. Postoperative morbidity is relatively low, attributed to the minimal soft tissue and muscular dissection afforded by the anterolateral Smith-Robinson approach as compared to posterior midline subperiosteal dissections, which result in the elevation and retraction of posterior paraspinal musculature. As such, more and more surgeons find themselves performing a greater proportion of ACDFs in ambulatory surgery centers on a case-by-case basis.5 As such, greater attention is focused toward limiting postoperative pain and complications.

Given the limited data on this rare complication, the authors conduct a multi-institutional retrospective database review to determine the reported frequency of rare complications reported in cervical spinal surgery, namely, the incidence of postoperative infection in ACDF.

Methods
A retrospective multicenter case series study was conducted involving 21 high-volume surgical centers from the AOSpine North America Clinical Research Network, selected for their excellence in spine care and clinical research infrastructure and experience. Medical records for 17625 patients who received cervical spine surgery (levels from C2 to C7) between January 1, 2005, and December 31, 2011, inclusive, were reviewed to identify the occurrence of 21 predefined treatment complications. The complications included reintubation requiring evacuation, esophageal perforation, epidural hematoma, C5 palsy, recurrent laryngeal nerve palsy, superior laryngeal nerve palsy, hypoglossal or glossopharyngeal nerve palsy, dural tear, brachial plexopathy, blindness, graft extrusion, misplaced screws requiring reoperation, anterior cervical infection, carotid artery injury or cerebrovascular accident, vertebral artery injuries, Horner’s syndrome, thoracic duct injury, quadriplegia, intraoperative death, revision of arthroplasty, and pseudomeningocele.

Trained research staff at each site abstracted the data from medical records, surgical charts, radiology imaging, narratives, and other source documents for the patients who experienced one or more of the complications from the list. Data was transcribed into study-specific paper case report forms. Copies of case report forms were transferred to the AOSpine North America Clinical Research Network Methodological Core for processing, cleaning, and data entry.

Descriptive statistics were provided for baseline patient characteristics. Patients who had undergone an ACDF were identified in the database and reviewed for the occurrence of postoperative anterior cervical infections. A paired t test was used to analyze changes in clinical outcomes at follow-up compared to preoperative status.

Results
A total of 8887 patients were identified from a retrospective database analysis of 17 centers providing data for postoperative anterior cervical infections (17/23, 74% response rate). A total of 6 postoperative infections after ACDF were identified for a mean rate of 0.07% (range 0% to 0.39%). The mean age of patients identified was 57.5 years (SD = 11.6, 66.7% female). The mean body mass index was 22.02. Of the total infections, half were smokers (n = 3). Two patients presented with myelopathy and 3 presented with radiculopathic-type complaints. One patient presented initially prior to cervical fixation with a cervical fracture. Surgeries were performed ranging from C3 to T1, with the most common level treated being C5-C6 (n = 5). Discectomy and fusion was performed in 5 cases, whereas in 1 patient a corpectomy was performed (16.7%). The mean operative duration was 125 minutes, with a mean blood loss of 85 mL, and no transfusions were required during surgery. In none of the cases were esophageal injuries identified. The mean length of stay was 4.7 days. All patients were treated aggressively with surgery for management of this complication, with improvement in all patients. There were no mortalities.

Discussion
The incidence of postoperative infection after ACDF is exceedingly rare, with a mean incidence of 0.07% in this multi-institutional study. This complication is found to be lower than expected with previously reported rates ranging from 0.1% to 1.6% in the literature.1,6 Fountas and colleagues1 report in a retrospective series of 1015 patients only one postoperative wound infection (0.15%). In one retrospective series of anterior cervical discectomy without fusion, Bertalanffy and colleagues reported only one postoperative infection out of 450 (0.2%) presenting as an anterior cervical epidural abscess requiring reoperation.7 With so few reported infections, statistically significant risk factors were not identifiable in our study, nor in...
prior retrospective series. It is not surprising that as the size of
the population of surgical patients is retrospectively studied,
the lower the incidence of surgical site infection with ACDF.
Certainly, the retrospective design of these studies is a signif-
icant limitation as patients with a postoperative infection could
have presented for complication management elsewhere at dif-
ferent centers and not have been tracked.

Most commonly, postoperative infections occur at the
operative site,1,2,7-11 while those originating in the vertebral
bone with subsequent spread to the adjacent disc space12,13 or
adjacent levels through the epidural plexus7 occur less com-
monly. Infections of the anterior cervical spine carry several
unique concerns when compared to midline posterior spinal
exposures. Due to the adjacent location of various critical
structures in the neck to the vertebral and prevertebral com-
partments, the potential for severe inflammation, mass effect
from pyogenic abscess formation, and ultimately airway
compromise makes this complication an urgent issue to
manage (Figure 1).

Patients with postoperative infection may or may not pres-
ent with the classic triad of fever, surgical site pain, and neu-
rologic deficit. Persistent leukocytosis is particularly common
with esophageal perforation, and clinical concern is wartanted
in the case of fevers and leukocytosis unresponsive to broad-
spectrum antibiotics.14 Further diagnostic support may be pro-
vided by an elevated C-reactive protein, which would be ex-
pected to routinely normalize in approximately 6 days after
surgery.15 Clinical suspicion of a cervical spinal infection in a
stable patient should be followed by an immediate magnetic
resonance imaging of the spine to confirm abscesses. Urgent
surgical evacuation is recommended in the case of wound drai-
nage or abscess formation due to the concern for rapid neuro-
logical worsening from a space occupying abscess in the spinal
canal, or epidural abscess formation.

No study has evaluated timing for the evacuation of surgical
site infection in the neck, and clinical judgment should be
guided by the patient’s oxygenation and airway status. Regard-
ing the formation of epidural abscess from an underlying osteo-
discitis, guidance regarding urgent treatment is limited to class
III evidence in the literature and no clear statistical benefit has
been shown with early versus delayed (>24 hours) surgical
evacuation of a cervical spinal infection treatment due to very
small populations of study.16-22

**Esophageal Perforation**

Postoperative spinal infections following ACDFs are rare, with
a reported incidence in the literature ranging from 0.1% to
1.6%, with the majority of guidance in the literature derived
from retrospective studies.1,6 Factors thought to increase the
risk of postoperative infection include esophageal perforation
or Zenker’s diverticulum, 2 conditions that would provide a
coup d’oeil for gastrointestinal flora to the anterior cervical wound
bed, as well as postoperative bacteremia and systemic infec-
tions.8 It is prudent that in the event of a suspected wound
infection that an esophageal perforation is ruled out, as
irrigation and debridement of a wound infection will lead to
reaccumulation of infection. Symptoms of perforation com-
monly include increasing postoperative neck pain, erythema,
fevers, wound drainage, dysphagia, and elevated C-reactive
protein and erythrocyte sedimentation rate. Esophageal per-
foration is much more serious and could rapidly prove fatal if
not promptly diagnosed, as the swelling and infection can
expand at a much more rapid rate.1

Most commonly, postoperative infections occur in the
early period of a few weeks,1,12,23 although delayed presenta-
tions have been reported.8 An increased surgical complexity,
such as with the number of levels fused, translates into a
greater number of surgical implants and bone graft, all of
which are foreign bodies that can theoretically increase the
risk for postoperative cervical spine infections. Therefore, in
the setting of recurrent fevers in the postoperative setting after
ACDF, the authors recommend a formal evaluation of
swallowing function, which can include a direct fiber-optic
evaluation or radiographic study, to be directed by an otolar-
yngologist. Prior study has shown that leukocytosis is invariably
persistent in the postoperative setting with esophageal
perforation.14 Moreover, in the case of a suspected esophageal
perforation on clinical or direct fiber-optic evaluation, barium
esophagogram has been shown to be an effective test for the
diagnosis of esophageal leak.24

Cervical spine surgery has undergone a paradigm shift
toward a decompression of anterior compressive etiologies
while simultaneously providing a continually less invasive
surgical plan. The use of allograft bone instead of autograft
bone graft has seen increased use in a push to improve post-
operative ambulation and lower donor site pain and morbidity
from the harvest of iliac crest tricortiocancellous autograft
bone.25 Iliac crest autograft harvest sites represent an additional
source of pain and potential site of postoperative infection.10,26
Surgical technique and implantation has also undergone a gradual change in focus toward decreasing intraoperative destruction of the soft tissues as well as limiting postoperative irritation and swelling of the prevertebral tissues and esophagus by the implants.  

Inadequate fixation or pseudoarthrosis can result in eventual migration of the hardware and potentially erosion and perforation of the esophagus in extreme cases. Screw migration and esophageal perforation has even been reported to result in a delayed fusion. Arguably, the number one cause of esophageal perforation is technical error. The push behind the recent attention to limiting morbidity from the modified Smith-Robinson approach has been sparked in part by the economic benefit to perform these procedures in a low-cost center, such as an ambulatory surgery center.

**Limitations**

Postoperative anterior cervical spinal infections are rare, and conceivably could be higher than the 0.05% incidence found in this study, where data was collected prospectively. There were no cases of recurrent infection, although long-term follow-up of these patients were unavailable and additional infections could have been treated in other tertiary care centers. Postoperative tracking of complications in retrospective studies are unreliable as many patients may settle for follow-up care at local spinal care centers, particularly if symptoms due to an anterior cervical infection warranting urgent evaluation were present such as a neurologic deficit or airway compromise. When considering the fact that surgical site infections could take several weeks to manifest, well after hospital discharge, the rate of infection could be significantly higher than tracked by this inpatient analysis. The exact cause of the postoperative infections reported in the survey were not available as well as any potential risk factors for postoperative infection, which are interesting questions not fully investigated by this study.

**Conclusion**

The incidence of postoperative infection in anterior cervical discectomy and fusion is exceedingly low. The management has historically been urgent irrigation and debridement of the surgical site. However, due to the rarity of this occurrence, guidance for management is limited to retrospective series.

**Authors’ Note**

This study was ethically approved by the Institutional Ethics Committees (IEC) at all participating sites.

**Declaration of Conflicting Interests**

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**References**


