Recent developments in the treatment of spinal epidural abscesses

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Abstract

Spinal epidural abscess (SEA) is a serious condition that can be challenging to diagnose due to nonspecific symptomology and delayed presentation. Despite this, it requires prompt recognition and management in order to prevent permanent neurologic sequelae. Several recent studies have improved our understanding of SEA. Herein, we summarize the recent literature from the past 10 years relevant to SEA diagnosis, management and outcome. While surgical care remains the mainstay of treatment, a select subset of SEA patients may be managed without operative intervention. Multidisciplinary management involves internal medicine, infectious disease, critical care, and spine surgeons in order to optimize care.

Introduction

Spinal epidural abscess (SEA), although rare, has become increasingly prevalent.[1] Potential causes for this increased rate of epidural infection include: aging of the population; increaseing numbers of spinal surgeries and minimally invasive procedures; the increasing incidence of diabetes, IV drug abuse, and use of immunosuppressive medications (*e.g.* biologicals); and increased access to better diagnostic imaging studies (MRI). SEA is typically an acute pyogenic infection within the confined space of the spinal canal, which can lead to acute and long-term neurological symptoms via compressive and neurogenic pathways. SEA often presents as nonspecific back pain, frequently in the setting of fever and elevated inflammatory markers. Patients with diabetes, IV drug users, and those who are immunocompromised or recently underwent spinal surgery are at risk. In addition to routine CBC an infectious workup consisting of blood cultures and inflammatory labs should be obtained as well as MRI imaging with contrast. Urgent spinal surgery consultation should also be obtained if diagnosis of SEA is suspected. As diagnostic and therapeutic modalities progress, there has been an increase in studies published on conservative versus surgical management, as well as timing and type of surgical intervention indicated.

For this study, the keyword *epidural abscess* was utilized to query the PubMed database of the U.S. National Library of Medicine. From the resulting list, manuscripts published between September 2005 and September 2015 in *Spine, The Spine Journal, European Spine Journal, Journal of Neurosurgery: Spine, and Neurosurgical Focus* were reviewed. Fifty seven studies were identified and are summarized and referenced in this review.[1-57]

Conservative *vs* surgical management

The optimal application of conservative versus surgical management of SEA remains controversial. To address whether intravenous (IV) antibiotics alone or in combination with surgery leads to superior outcomes, Adogwa *et al.*[1] reviewed 82 cases of SEA in patients ≥ 50 years of age with multiple comorbid conditions. For this select group of patients, it was concluded that early surgical decompression combined with IV antibiotics was not superior to IV antibiotics alone. Ziu *et al.*[2] study investigated 164 patients with spinal infections. 102 of these had history of intravenous drug abuse. 80 out of 102 patients were treated with antibiotic therapy alone, while 22 had to undergo decompressive surgery. This suggests that patients can usually be treated with antibiotics and do not always require surgery. Likewise, Smith *et al.*[5] suggested that SEA should be mainly treated with pathogen specific antibiotics.

Patel *et al.*[3] reviewed neurological outcome after medical management alone versus medical management combined with surgery in 128 cases of isolated abscesses. Neurologic outcome was improved with early surgery compared to delayed operative intervention following a failed trial of medical management with IV antimicrobial therapy. In this study conservatively treated patients failed management 41% of the time, requiring subsequent medical decompression. Furthermore, Arko *et al.*[4] stated that medical intervention (antibiotic use) alone fails if patients have certain risk factors: C-reactive protein levels >115 mg/L, age greater than 65, diabetes, methicillin-resistant *S. aureus* infection, white blood cells levels greater than 12(10^9)cells/L, and severe neurological involvement.

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Connor *et al.*[7] retrospectively compared operative and nonoperative management of 77 cases of SEA. Four patients presented with myelopathy, 22 with radiculopathy, and 43 with focal weakness. The authors concludedthat immediate surgical decompression in combination with tailored antibiotic therapy is an optimal treatment strategy for patients suffering from SEA. For 62 cervical SEAs, Alton *et al.*[8] found early surgery resulted in improved motor scores when compared to patients with failure of conservative treatment and therefore delayed surgery. Ghobrial *et al.*[9] was not able to show a statistically significant difference between the benefits of doing surgery within 24 hours or after 24 hours in patients with spinal epidural abscesses and spondylodiscitis, probably due to small sample size.

The ability to predict failure of antibiotic therapy is essential in limiting delay to the operating room. Kim *et al.*[13] reviewed 355 SEA cases and found that for patients > 65 years of age with diabetes, methicillin-resistant *S. aureus* (MRSA) infection, or neurologic compromise, antibiotic therapy alone has a higher risk for treatment failure. Patel *et al.*[3] observed that failure of medical management could be predicted by CRP>115, WBC>12.5, bacteremia, and diabetes. Studies such as these reveal the important of risk stratification and laboratory evaluation in the workup of SEA.

For pyogenic spinal infection, surgical intervention is necessary when there are neurological complications; otherwise, antibiotic therapy or spinal bracing are sufficient to treat this condition.[24] Urrutia *et al.*[25] observed that cervical spinal pyogenic infections are more dangerous and harmful in comparison to pyogenic infections in the

thoracic and lumbar regions. Of the 102, 19 patients involved the cervical region. Of these 19, 12 had c5-c6 involvement and 11 had epidural abscesses. They were more likely to have surgical intervention, neurological impairment, and mortality.

Duarte and Vaccaro *et al*.[15] described a management algorithm aimed at improving patient assessment. The diagnostic importance of routine histopathological analysis was emphasized. Emphasis was also placed on the initiation of antimicrobial therapy immediately after establishing the definitive etiological diagnosis. The authors summarized the indications for surgery to include presence of SEA with failure of conservative therapy, neurological deficit, sepsis, or spine deformity/instability. In their review article, Tuchman *et al*.[18] made two major conclusions: patients who are neurologically intact should only undergo antibiotic treatment. And, patients who are neurologically involved need to immediately get surgical treatment, because it is not known at what point of time the neurological deficits are irreversible.

Diagnosis and outcome predictors

Epidural abscess and vertebral osteomyelitis misdiagnosis has been reported to be as high as 50%.[21] Davis *et al*.[22] suggested that patients in the emergency department with spine pain can be accurately diagnosed for spinal epidural abscess via risk factor assessment with erythrocyte sedimentation rate and C-reactive protein level measurements. However, MRI is the gold standard for diagnosing SEA, since it has a sensitivity and specificity greater than or equal to 90%. If an MRI is not possible, then a CT scan be an alternative.[55-57]

Schoenfeld and Wahlquist[16] reviewed 30,274 cases with the objective of identifying risk factors for postoperative complications, mortality, and costs of care associated with SEA. The mean total charge for patient care was $159,782. Age (especially>80 years), insurance status, paralysis, and liver/renal disease were strong predictors of morbidity, mortality, and higher expense of hospitalization. Shweikeh *et al*.[17] performed a retrospective analysis and found that the major risk factors for epidural abscess were: intravenous drug abuse, diabetes mellitus, old-age, and renal disease. In descending order of frequency, the observed pathogens were methicillin-sensitive *S. aureus*. MRSA, Streptococcus, coagulase negative *Staphylococcus*, *Klebsiella*, *Candida*, *E. coli*, *Aspergillus*, and *Enterobacter*. For optimal results, the authors suggested that surgery/decompression should be performed no longer than 36-72 hours after limb weakness/paralysis/numbness. Most importantly, the authors emphasized the importance of taking into consideration the patient's health, age, and other diseases in surgical decision making.

Multifocal SEA can be challenging to diagnose as well. Ju *et al*.[19] reviewed 233 cases and found that when compared to single lesion patients, patients with multifocal SEA most commonly had delay in presentation ≥7 days, a concomitant area of infection outside the spine and paraspinal region, and an ESR of >95 mm/h at presentation. This study demonstrates the importance of whole spine imaging when evaluating SEA, especially in those with extremely elevated ESR and CRP or who have a delay in presentation.

Interesting cases

Case reports provide useful insight into the range of etiologies and presentations of SEA. Several iatrogenic etiologies are described. SEA is usually a manifestation of an underlying disease. Although the abscess may be the presenting MRI-finding, the etiology may require further investigation. In many cases, spondylodiscitis may be the underlying problem. Other causes including previous surgery and empyema of the facet joints may also be involved. The following cases highlight more exotic causes of SEA. Treatment modalities vary with the etiology of the abscess.

Radulovic and Vujotic[27] describe a case of cervical SEA caused by iatrogenic perforation of the pharyngeal wall during diagnostic esophagoscopy. Condrea *et al*.[28] describe development of latent SEA months after esophageal perforation – which typically presents early. Lee *et al*.[29] described a case of triparesis caused by an extensive, gas-containing epidural abscess secondary to *Aeromonas hydrophila* infection of a thoracic vertebroplasty. Papp *et al*.[30] detected the destruction of the C1-C2 vertebrae of 4-week-old infant with retropharyngeal abscess. This was the first reported case of retropharyngeal abscess leading to osteomyelitis and SEA. Goulart *et al*.[31] demonstrated that traumatic injury to the regions near oropharynx can cause bacteria to enter into the vertebrae and cause osteomyelitis, which can lead to epidural abscesses. A 62-year-old man[32] was the first reported case of *Lactobacillus* and *Candida* spinal epidural infection due to esophageal perforation.

Surgical intervention of SEA comes with its own risks, especially in the event of involvement of cervical nerve roots responsible for control of the diaphragm. A 35-year old[33] was the first reported patient to require intervention with extracorporeal membrane oxygenation (ECMO) support for cardiopulmonary collapse during a procedure that required a prone position for the excision of thoracic epidural abscesses.

Sterility of tools for invasive procedures is highly important to prevent post-operative infections. A 57-year old[35] patient developed C1-C4 epidural abscesses following ozone therapy for herniated cervical discs. Two patients (18 and 23) contracted *Pseudomonas aeruginosa* after a dental procedure, which caused cervical epidural abscesses. Walters *et al*.[36] indicated that neck pain after a dental procedure should be taken seriously and be checked for spinal epidural abscesses. Muzii *et al*.[37] consider dental treatment as a major risk factor for the development of SEA, since four out of the eight patients they investigated with cervical spinal epidural abscesses had dental treatment for mouth infections. In Zimmerer *et al*.'s[38] study, of the 36 patients with SEA, 16 patients had primary SEA while 20 had secondary SEA. Zimmerer et al mentioned that secondary SEA usually results from past spinal surgeries, probably because of poor sterility of instruments or physician breach in sterile technique. 16 patients in the secondary SEA group had previously undergone microsurgical discectomy. A 64-year-old patient[39] received an injection of adipose cells, plasma, and bone marrow aspirate in the L3-L4 and L5-S1 discs to stop disc degeneration and induce regeneration. This procedure resulted in the development of spinal epidural abscess. The patient had to undergo decompressive surgery.

Many different surgeries can be performed to treat spinal epidural abscess. For example, two patients underwent apical laminectomies mid-cervical, mid-thoracic, and mid-lumbar to irrigate the epidural abscesses with a feeding tube. Both patients recovered to normality. To avoid heavy blood loss and excessive exposure of patient's internal tissues to the open environment, laminectomies completed at mid-lumbar, mid-thoracic, and mid-cervical levels were successful in treating extensive epidural abscesses.[40] Tubular retractor systems used for microsurgery can be efficient for irrigation of extensive epidural abscesses.[41] A 59-year-old woman with an extensive ventral SEA in the cervical and upper thoracic region had a midline trough burred into the vertebrae and disc spaces. The major advantage of this procedure is that it allows for decompression without the need for stabilization and fusion, as this patient could not handle a very long operation. The

operation only took 2 hours and she was able to recover completely, she did however develop cervical kyphosis at 1 year followup.[42] A 38-year-old female with a history of drug abuse, back pain, and weakness in limbs underwent a thoracic laminoplasty. The major advantage of this technique was to preserve her spinal stability and structure in the midline of her body.[43] A 36 year old man had epidural abscess from C2 to sacrum. He underwent limited laminectomies and 6 weeks of antibiotic treatment.[44] The transpedicular approach can be used to drain epidural abscess and extract tissue affected with discitis in the thoracic vertebrae. This approach is safer than the anterior approach.[45]

Immunosuppressant drugs can also lead to development of SEA. A case of a 49-year old man taking infliximab for psoriasic arthritis resulted in epidural abscess from C2-T7. This is the first reported case of chronic infliximab treatment leading to the development of epidural abscesses.[46]

SEA can also be misdiagnosed. A 69-year-old male was mistakenly diagnosed with Guillain-Barre syndrome. The MRI was inconclusive, since the spinal epidural abscess was in its beginning stages. The patient had low back pain and ascending limb weakness. An L1-L2 lumbar puncture yielded 5 mL of yellowish fluid with high protein levels that grew *S. aureus*. The patient was subsequently diagnosed with an extensive cervicothoracic epidural abscess and underwent surgery.[47]

Koplay et al report a rare pediatric case of SEA. A 5 year old boy was diagnosed with an SEA from the cervical region to the lumbar region after presenting with numbness in feet, fever, and walking difficulties.[48] A 69-year-old man had extensive epidural abscess that was complicated by bilateral psoas muscle abscess. Vertebroplasty, laminectomy, drainage, and antibiotic treatment did not result in significant strength gains in limbs and he had to remain in hospital for long-term care.[49] Lin *et al*.[50] discuss a patient who has abscesses at right and left erector spinae muscles and epidural abscess at L5. Likewise, a 56-year-old woman[51] had primary erector spinae pyomyositis which led to an epidural abscess in L4/5 intervertebral foramen. The pathogen was *S. aureus*. She was treated with flucoloxacillin and recovered fully. Muscle abscess usually complicates the treatment for patients with epidural abscesses. A 15-year-old child diagnosed with extensive spinal epidural abscess also had cerebral salt wasting due to increased secretion of atrial natriuretic peptide. CSW was treated with Na-concentrated fluids. Authors do not understand or have explanation of the coincidence of these two diseases.[52]

A 61-year-old patient developed cervical epidural abscess as a result of contracting brucellosis. Authors did not perform surgery. Treatment involved three antibiotics: streptomycin, doxycycline, and rifampicin. Streptomycin was continued for two weeks while the other two continued until infection is resolved.[53] A case of two patients demonstrated that daptomycin is an effective treatment for methicillin-resistant S. aureus spinal epidural infection when vancomycin (standard antibiotic) is not working.[54]

Conclusions

Spinal epidural abscess continues to present a challenge to clinicians in terms of diagnosis and treatment. Several recent investigations have provided insight into optimal diagnostic protocols in addition to medical and surgical management strategies. Prompt diagnosis and treatment are the most critical component of care for spinal epidural abscess. Cooperative management between medical and spine surgical teams is recommended.

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