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Spinal epidural abscesses: risk factors, medical versus surgical management, a retrospective review of 128 cases

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Abstract

BACKGROUND CONTEXT: Spinal epidural abscess (SEA) is a rare, serious and increasingly frequent diagnosis. Ideal management (medical vs. surgical) remains controversial.

PURPOSE: The purpose of this study is to assess the impact of risk factors, organisms, location and extent of SEA on neurologic outcome after medical management or surgery in combination with medical management.

STUDY DESIGN: Retrospective electronic medical record (EMR) review.

PATIENT SAMPLE: We included 128 consecutive, spontaneous SEA from a single tertiary medical center, from January 2005 to September 11. There were 79 male and 49 female with a mean age of 52.9 years (range, 22–83).

OUTCOME MEASURES: Patient demographics, presenting complaints, radiographic features, pre/post-treatment neurologic status (ASIA motor score [MS] 0–100), treatment (medical vs. surgical) and clinical follow-up were recorded. Neurologic status was determined before treatment and at last available clinical encounter. Imaging studies reviewed location/extent of pathology.

METHODS: Inclusion criteria were a diagnosis of a bacterial SEA based on radiographs and/or intraoperative findings, age greater than 18 years, and adequate EMR. Exclusion criteria were post-interventional infections, Pott’s disease, isolated discitis/osteomyelitis, treatment initiated at an outside facility, and imaging suggestive of a SEA but negative intraoperative findings/cultures.

RESULTS: The mean follow-up was 241 days. The presenting chief complaint was site-specific pain (100%), subjective fevers (50%), and weakness (47%). In this cohort, 54.7% had lumbar, 39.1% thoracic, 35.9% cervical, and 23.4% sacral involvement spanning an average of 3.85 disc levels. There were 36% ventral, 41% dorsal, and 23% circumferential infections. Risk factors included a history of IV drug abuse (39.1%), diabetes mellitus (21.9%), and no risk factors (22.7%). Pathogens were methicillin-sensitive Staphylococcus aureus (40%) and methicillin-resistant S. aureus (30%). Location, SEA extent, and pathogen did not impact MS recovery.

Fifty-one patients were treated with antibiotics alone (group 1), 77 with surgery and antibiotics (group 2). Within group 1, 21 patients (41%) failed medical management (progressive MS loss or worsening pain) requiring delayed surgery (group 3). Irrespective of treatment, MS improved by 3.37 points. Thirty patients had successful medical management (MS: pretreatment, 96.5; post-treatment, 96.8). Twenty-one patients failed medical therapy (41%; MS: pretreatment, 99.86, decreasing to 76.2 [mean change, 23.67 points], postoperative improvement to 85.0; net deterioration, 14.86 points). This is significantly worse than the mean improvement of immediate surgery (group 2; MS: pretreatment, 80.32; post-treatment, 89.84; recovery, 9.52 points). Diabetes

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mellitus, C-reactive protein greater than 115, white blood count greater than 12.5, and positive blood cultures predict medical failure: None of four parameters, 8.3% failure; one parameter, 35.4% failure; two parameters, 40.2% failure; and three or more parameters, 76.9% failure.

CONCLUSION: Early surgery improves neurologic outcomes compared with surgical treatment delayed by a trial of medical management. More than 41% of patients treated medically failed management and required surgical decompression. Diabetes, C-reactive protein greater than 115, white blood count greater than 12.5, and bacteremia predict failure of medical management. If a SEA is to be treated medically, great caution and vigilance must be maintained. Otherwise, early surgical decompression, irrigation, and debridement should be the mainstay of treatment. © 2014 Elsevier Inc. All rights reserved.

Keywords: Epidural abscess; Medical; Surgical; Motor score; Outcomes; Risk factors; Management

Introduction

Spinal epidural abscess (SEA) is a rare condition with potentially devastating consequences. Historical rates of SEA range from 0.2 to 1.2 cases per 10,000 hospital admissions [1]. Rates are expectedly higher at referral centers, 12.5 cases per 10,000 [2], and are increasing, having doubled in the past 20 years [3]. Approximately 50% of patients are initially misdiagnosed at time of presentation (range, 11%–75%) [4,5].

Spinal epidural abscess results from purulent material collecting between the spinal dural covering and osseous-ligamentous structures of the spine. This condition was first described by Morgagai in 1761 [6] and clearly defined by Bergamaschi in 1820 [7]. Barth performed the first known surgical intervention for SEA in 1901 [1] and most of the early reported cases were fatal [2].

Bacteria gain entrance to the epidural space via hematogenous spread (half of cases), contiguous spread (one third of cases), and no identifiable source in the rest [3]. The primary reason for spinal cord injury is unknown. Leading theories include ischemia from direct compression or disruption of vascular supply from septic thrombophlebitis [3]. Clinical improvement after decompression and various animal studies supports the direct compression model [8], whereas others have shown the combination of direct compression and septic thrombophlebitis to be synergistically worse for outcomes [3].

Although urgent/emergent surgical decompression and IV antibiotic therapy is the cornerstone of therapy for SEA, ideal management of this condition remains controversial. Neurologic function at the time of presentation is a key predictor of clinical outcome, but it is difficult to predict who will experience neurologic deterioration, leading many groups to endorse early operative decompression combined with IV antibiotics therapy as the treatment of choice [4,9–11]. Still others have reported similar outcomes for those treated with surgery and IV antibiotics and those with IV antibiotics alone [12–15], supporting the notion that some SEA may be managed successfully medically [16]. Thus, the literature is plagued with contradictory arguments stemming from small studies.

In 2005, 52 cases of medically managed SEA were reported. All patients were neurologically intact at presentation with three patients crossing over to surgery after their neurologic function declined. This group proposed that medical management is reasonable in neurologically intact patients with SEA, but requires close monitoring and urgent surgical decompression when neurologic changes occur [12]. In 1992, 37 cases from 1970 to 1990 of medically managed SEA were reviewed [17]. All SEA successful managed medically presented without neurologic dysfunction [12,13], with smaller abscess size [14] and required closed monitoring for neurologic deterioration [5,18]. Failed medical management of SEA has been reported in with minimal explanation for the failures [9,13,17,19,20].

Although it is largely accepted that decline in neurologic function is an indication for surgical decompression of epidural abscess, the majority of clinical decisions for medical versus surgical management of this condition are based on anecdotal evidence. Risk factors have been identified for development of SEA (elevated erythrocyte sedimentation rate, leukocytosis, intravenous drug use, diabetes mellitus, prior spine surgery) but the prognostic value of these risk factors is unknown [2,21–23]. It is not known which patient will respond favorably to medical management and who will require surgical intervention. Owing to the occurrence of severe neurologic deficits after failed medical management of SEA, it is unethical to perform randomized controlled trials to determine the best treatment for this condition [3].

Hypothesis

By studying the demographics, motor scores, and medical comorbidities of patients at our institution with SEA, we can identify risk factors to predict who will acquire SEA and prognosticate regarding the therapeutic efficacy of medical versus surgical management.

Materials and methods

We retrospectively reviewed the records of patients diagnosed with spontaneous SEA from a single quaternary referral medical center composed of two major hospitals from January 2005 to December 2011. The electronic medical record was accessed to obtain patient demographics,

presenting complaints, radiographic features, pretreatment and post-treatment neurologic status, type of treatment (medical vs. surgical), and clinical follow-up. The pretreatment neurologic status was determined by using the ASIA motor score (0 to 100) before the initiation of treatment; the post-treatment neurologic status was calculated from the last available clinical encounter that was documented. Motor scores were the primary outcome measure for this study. Imaging data were also reviewed to assess the location and extent of the pathology.

The inclusion criteria included a formal diagnosis of a bacterial SEA in patients greater than 18 years of age based on radiographic analysis and/or intraoperative findings and the availability of adequate electronic medical records. The exclusion criteria included postoperative or postinterventional infections, Pott’s disease, isolated discitis, isolated osteomyelitis, and patients who had imaging data suggestive of a SEA but negative intraoperative findings and negative cultures. Risk factors (eg, diabetes, hepatitis) were considered present if the electronic medical record indicated the patient carried a diagnosis of these conditions as documented by a physician (MD or DO). We did not specifically evaluate laboratory data or ancillary tests to confirm/refute these diagnoses or grade the severity of the diagnoses.

Our groups were defined as follows. Group 1 were patients managed surgically. Patients underwent surgery as the primary chosen intervention after their diagnosis of SEA. The time to the operating room was occasionally lengthened owing to operating room availability or optimization of medical status but intention from time of diagnosis was surgical intervention. Group 2 were patients managed medically and underwent IV antibiotic therapy for their SEA without intention of surgical management. Within this group, there was a subset of patients who failed medical management (decline in neurologic function or increased/intolerable pain) requiring surgical intervention. This cross-over group is group 3. The attending surgeon decided the appropriate surgical intervention on a case-by-case basis. There were a multitude of surgical procedures performed including laminectomies, laminotomies, anterior cervical discectomy and fusion, corpectomy and posterior spinal instrumented fusion based. Surgical decisions were based on the severity and location of pathology. Pathogens were identified based on blood culture results or intra-operative cultures. The administration of IV antibiotics was not routinely delayed for culture sample acquisition and in some cases was given before blood culture samples were taken and before surgical specimens were obtained, likely decreasing the number of positive cultures obtained in these patients.

Results

Over an 81-month-period, 128 consecutive patients were diagnosed with a spontaneous SEA. There were 79 males and 49 females with an age range of 22 to 83 years (mean, 52.9). The average follow-up was 241.1 days.

The most common presenting chief complaint was site-specific pain (100%), subjective fevers (50%), and extremity weakness (47%). The lumbar spine was the most commonly involved region; 54.7% patients had some lumbar involvement. The thoracic spine was involved in 39.1% of patients, the cervical spine was involved in 35.9% of patients, and the sacral spine was involved in 23.4% of patients (Fig. 1).

The SEA spanned on average 3.85 disc levels. Ventrally based abscess comprised 36% of the cases and dorsally, 41%; circumferential abscesses were not uncommon and occurred in 23% of patients. The dorsal/ventral location and extent of the abscess did not have a significant impact motor recovery.

The most common risk factors were a history of intravenous drug abuse (39.1% of patients) followed by diabetes mellitus (21.9% of patients). There was a sizable population of patients (22.7%) that had no discernable risk factors commonly associated with SEA (Fig. 2).

The most frequently encountered pathogen was methicillin-sensitive Staphylococcus aureus (40%), both in blood cultures and operating room specimen cultures, followed by methicillin-resistant S aureus (30%). This, too, had no impact on motor recovery (Fig. 3).

Of the 128 patients, 51 were treated with antibiotics alone (group 1) and 77 patients were treated with surgery alone (group 2). Of the patients in group 1, 21 patients failed medical management and converted to a late/delayed surgical intervention (group 3).

Irrespective of treatment, there was a 3.37 mean improvement (95% confidence interval [CI], 0.23–6.51). When comparing medically treated versus surgically treated patients, there was no significance in post-treatment motor scores (91.94 vs. 89.84), but the medically treated group had a higher average pretreatment motor score (97.86) and had lower recovery (−5.92 [95% CI, −10.1 to −1.76]) whereas the surgically treated group had a lower average pretreatment motor score (80.32) and had higher recovery (9.52 [95% CI, 5.5–13.4]). These statistically

Fig. 1. Location of spinal involvement in patients presenting with epidural abscess.
significant differences indicate that surgical intervention yields a higher return of motor function.

When analyzing the medically treated group (group 1), 41% of patients (21 patients) failed treatment and necessitated a late or delayed surgical intervention. Of the 30 patients who had successful medical intervention, the average pretreatment motor score was 96.5 and post-treatment motor score was 96.8, leading to an insignificant improvement. The 21 patients who failed medical therapy started with a mean pretreatment motor score of 99.86 and dropped significantly to an average of 76.2 with a mean difference of 23.67 (95% CI, 9.8–28.9). When patients from group 3 then underwent a delayed/late surgical intervention, their mean score improved to 85. The mean deterioration of (95% CI, −23.9 to −5.) of delayed/late surgery is significantly worse than the mean improvement of immediate surgery (group 2).

When examining various risk factors, radiographic findings, and laboratory values, we found four significant predictors of failure of medical management and eventual need for a surgical intervention. We found that patients with diabetes (odds ratio [OR], 3.8; p = .057), C-reactive protein greater than 115 (OR, 4.7; p = .045), white blood cell count greater than 12.5 (OR, 3.3; p = .045), and positive blood cultures (OR, 3.5; p = .035) were more likely to fail antibiotic treatment alone. Using a regression analysis, we were able to develop a prediction model of medical failure using these parameters: None of four parameters led to 8.3% failure; one of four parameters led to 35.4% failure; two of four parameters led to 40.2% failure; and three or more of four parameters led to 76.9% failure.

Discussion

Approximately 50% of patients with SEA are initially misdiagnosed at time of presentation (range, 11%–75%) [4,5]. This can have devastating consequences, because early diagnosis leading to prompt surgical intervention is regularly rewarded by better recovery [24]. Common problems associated with the diagnosis of SEA include ordering imaging of the wrong site where the SEA is not located, identifying only one of many epidural abscesses, ascribing all clinical findings to osteomyelitis, an inability to perform neurologic and motor examinations on patients with altered mental status, asking non-physicians to know enough to consult the proper services to adequately diagnose and treat this condition, needing to remove the spine stimulator when SEA present, and medically treating *S. aureus* without identification of the source [14].

Recommendations to alleviate some of these diagnostic problems include performing a quality neurologic and motor examination to identify levels of disease including reflexes and bowel and bladder dysfunction, suspecting an undrained SEA or possible osteomyelitis if neurologic deficits continues postoperatively, and having excellent communication between consulting teams [3]. Magnetic resonance imaging is the most sensitive way to make the diagnosis and, if a patient has risk factors for SEA and they develop back pain, then they need magnetic resonance imaging immediately [22,23].

Once a diagnosis of SEA is made, clinicians must decide between medical and surgical management. In our study, comparing medical with surgical management using an intent-to-treat analysis, we find that medically managed patients presented with higher starting motor scores than surgically managed patients (97.86 vs. 80.32). Medically managed patients incurred an average motor score decrease of −5.92 points (range, −1.76 to −10.1), whereas the motor scores of surgically managed patients increased 9.52 points (range, 5.5–13.4). Although both groups have similar post-treatment motor scores (medical, 91.94; surgical, 89.84), medically managed patients deteriorated to reach this endpoint, whereas surgically managed patients improved.

Surgical intervention is best completed as early after diagnosis as possible. If surgical intervention occurs after a course of failed medical management, as occurred in 21 of our 51 medically managed patients, the ability to recover motor function is significantly impaired. Early surgery (77/98 surgical cases) results in an increase in motor score of 9.52 (range, 5.6–13.4), whereas delayed surgery leads to a decrease of −14.86 points (range, −5.8 to −23.9).

Not all patients who began medical treatment were successful with a failure rate of 41.2% (21/51 patients).
Successful medical management resulted in an increased motor score of 0.33 points (range, −0.7 to 1.36), whereas failure of medical management was catastrophic with an average motor score decrease of −23.67 points (range, −9.8 to −28.67).

The four risk factors that predict failure of medical management of SEA are diabetes mellitus, leukocytosis greater than 12.5, positive blood cultures, and C-reactive protein greater than 115. There is a baseline rate of failure of medical management of 8.3% with no risk factors present. If one risk factor is present, the risk of failure increases to 35.4%; with two risk factors, it increases the risk to 40.2% and three or more risk factors indicates a failure rate of medical management of 76.9%.

The consequences of failure of medical management are devastating and this line of treatment should be reserved for exceptional cases where surgical intervention is associated with significant risk of death as the results of failed medical management are unacceptable. If medical management is undertaken, clinicians need to appreciate the baseline 8.3% risk of failure, the cumulative increased risk of failure based on the presence of these risk factors and understand that delayed operative intervention after failed medical management may result in poor outcomes.

Conclusion

Surgical intervention for SEA results in improved motor scores compared with medical management. Surgical intervention should be undertaken as early after diagnosis of SEA as possible as delayed surgical interventions results in lower postoperative motor scores than early surgery. There is a baseline failure rate of 8.3% for medical management of SEA. Diabetes mellitus, leukocytosis greater than 12.5, positive blood cultures, and C-reactive protein greater than 115 are risk factors for failure of medical management. One risk factor increases failure rates for medical management to 35.4%, two risk factors increases failure to 40.2%, and three or more risk factors increases failure rates to 76.9%.

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