Spinal Epidural Abscesses: A Retrospective Analysis of Clinical Manifestations, Sources of Infection, and Outcomes

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Background: Spinal epidural abscess (SEA) is uncommon but has a potentially disastrous outcome. Its early recognition and management may lead to satisfactory results. We analyzed the clinical manifestations, sources of infection, and outcomes of patients with SEA.

Methods: Between 1997 and 2003, 17 patients in the Department of Neurosurgery at Keelung Chang Gung Memorial Hospital had SEA. We retrospectively reviewed their records to analyze their clinical presentations, image findings, laboratory data, and clinical outcomes.

Results: All 17 patients (mean age, 63 years) underwent surgery and received antibiotics. Back and/or neck pain (82%), motor deficits (70%), and elevated C-reactive protein levels or erythrocyte sedimentation rates (64%) were the most common symptoms and signs. The most common etiological organism was oxacillin-resistant *Staphylococcus aureus*. The SEA was most commonly located in the lumbar spine, anterior to the spinal canal. Outcomes were poor in 29% of the patients, fair in 18%, and good in 53%.

Conclusions: Abdominal complications in patients with spinal disease are not uncommon, especially when the thoracic level is involved. The abdominal symptoms may initially mask neurological deficits due to spinal cord involvement, however, spinal pain and motor deficits present in most cases under more thorough investigation. In a suspected SEA patient with a history of gouty arthritis, tissue biopsy should include additional crystal analysis. Although the increasing availability of MRI makes diagnosis easier and quicker, repeated neurological examination and full evaluation are essential in any patient with an unknown focus of infection and spinal pain or tenderness.
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Key words: **spinal epidural abscess, clinical manifestations, sources of infection, outcomes.**

Infection in the spinal epidural space is an unusual but potentially devastating condition. When recognized early and treated promptly, the outcome is good. Otherwise, this infection may leave the patient with severe long-term complications and disabilities. The incidence of spinal epidural abscess (SEA) is increasing.[1] Early diagnosis with improved imaging techniques, prompt surgical intervention, and effective antibiotics have led to a gradual trend toward improved mortality rates, but high mortality rates of 5-33% are still reported in some series.[2-8]

The purpose of this study was to analyze the

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clinical manifestations, prognostic indicators, sources of infection, and final outcomes in patients with SEA. To provide a comprehensive description of this entity, we discuss our findings in light of the results of other case series reported in the recent medical literature.

METHODS

Between 1997 and 2003, 17 patients in the Department of Neurosurgery at Chang Gung Memorial Hospital, Keelung, were diagnosed with SEA. Their medical records, operative notes, culture results, and magnetic resonance images (MRIs) were retrospectively analyzed. Inflammatory markers, such as white blood cell (WBC) counts, C-reactive protein (CRP) levels and/or erythrocyte sedimentation rates (ESRs), were assessed at the time of admission. All MRIs were obtained on an 0.5-T (before 2001) or 1.5-T machine. Axial and sagittal T1- and T2-weighted pulse sequences were used, and gadolinium diethylenetriaminepentaacetic acid contrast material was administrated to all patients.

All patients underwent surgery within 24 hours of the discovery of neurological deficits and nerve or cord compression on MRI. Anterior debridement and discectomy and/or corpectomy were performed for anterior compression in the cervical region. All other regions (thoracic or lumbar) were treated with posterior laminectomy and debridement. The causative pathogens were identified by isolating them in pathological tissue, including frank pus or granulation tissue, obtained from the epidural space. Muscle strength was graded on a scale of 0 (no contraction) to 5 (normal strength). The strength of the most affected muscles were recorded for analysis. Neurological deficits before surgery were graded as severe if the patient was paraplegic, moderate if the patient retained only antigravity strength, and mild to normal if the patient was able to walk with or without assistance. The therapeutic outcome was assessed at the patients' last follow-up visit in the outpatient clinic. Outcomes were considered good if recovery was complete or if the patient could ambulate independently; fair if previous neurological deficits improved, and the patient had intact bowel and bladder function but dependent ambulation; and poor if deterioration occurred or if the patient was paraplegic or had died. Patients who died were included in the poor-outcome group for statistical analysis.

Statistical analysis included Fisher's exact test and a determination of rank correlation coefficients. $p < 0.05$ indicated a statistically significant difference.

RESULTS

Epidemiological data

During the 7-year study period, 17 patients with SEA were admitted to our department, and their records were reviewed. The patients consisted of 16 men and one woman, revealing a striking male predominance. Their ages ranged from 42 to 84 years, with a mean age of 63 years. Fifteen patients had one or more underlying diseases. The likely predisposing factors are listed in Table 1. Their average hospital stay was 39 days.

Table 1. Predisposing Factors Identified for 14 of 17 Patients*

Underlying disease	No. of patients
Documented predisposing factors	
Diabetes mellitus	4
Chronic renal failure	2
Alcoholism	4
Liver cirrhosis	2
Long-term corticosteroid therapy	1
Post-procedure	6
Neoplasm	0
Intravenous drug use	0
Other underlying disease	
Pneumoconiosis	6
Gout	3
Stroke	2

* Six patients presented with more than one underlying disease

Clinical manifestations

The initial diagnoses of these 17 patients at admission are listed in Table 2. Of the 3 patients who had an initial diagnosis of intra-abdominal disease, one underwent exploratory laparotomy under the impression of peritonitis. The other two were first treated medically under the impression of cholecystitis or epigastralgia. On retrospective review, all 3 patients had variable degrees of spinal pain and motor deficits on admission. The final diagnoses of SEA were later confirmed with MRI.

The most frequent symptom was back and/or neck pain. The most common signs were motor deficits, followed by an elevated CRP level and/or ESR (Table 3). One of the three patients with an initial diagnosis of intra-abdominal disease (cholecystitis) did not have neurologic deficits; only the WBC count and CRP level were elevated. The other 2 patients had radicular pain and fever or bladder incontinence in addition to abdominal symptoms.

MRI confirmed the radiological diagnoses in all patients. The abscesses were located predominantly in the lumbar spine and anterior to the spinal canal (Table 4). Radiological findings of spondylodiskitis were observed in 11 patients; these were associated with an anterior location of the abscess in eight patients. A significant relationship was observed between spondylodiskitis and an anterior location of the abscess ($p = 0.007$, Fisher's exact test).

Table 2. Initial Diagnosis

Initial diagnosis	No. of patients
Epidural abscess	4
Lumbar herniated discs or degenerative disease	9
Cervical spinal tumor	1
Intra-abdominal lesion	
cholecystitis	1
peritonitis	1
epigastralgia	1

Table 3. Associated Signs and Symptoms

Symptoms/Signs	No. of patients (%)
Back/Neck pain	14 (82)
Motor deficits	12 (70)
Radiculopathy	10 (58)
Fever	9 (52)
Urinary incontinence	6 (35)
Elevated CRP/ESR	11 (64)
WBC > 10800 cells/microliter	8 (47)

Abbreviations: CRP: C-reactive protein; ESR: erythrocyte sedimentation rate; WBC: white blood cells.

Table 4. Abscess Location, as Determined with MRI

Location	ant or antlat	post or postlat	ant and post	total
Cervical	1	1	1	3 (18)
Thoracic	3	0	0	3 (18)
Lumbar	5	3	3	11 (64)
Total	9*(53%)	4 (24%)	4 (24%)	17

Abbreviations: ant: anterior; antlat: anterlateral; post: poster; poster; postlat: posterlateral.

* Radiological findings of spondylodiskitis were significantly ($p = 0.007$) associated with anterior located spinal epidural abscess.

Source of infection

In our series, *Staphylococcus aureus* was the predominant pathogen, identified in 7 patients including 4 who had undergone focal procedures before admission. Oxacillin-resistant *S. aureus* was found in 6 of these patients. A variety of other organisms were found in the other 10 patients, including 2 each with *Viridans streptococcus*, *E. coli*, and *Mycobacterium tuberculosis*. Three patients had polymicrobial infection, and no organism was isolated in 3 patients. The patients received broad-spectrum antibiotics initially, followed by treatment specific to the cultured organisms and microbiological sensitivities. Except for anti-TB drugs, intravenous antibiotics were administered for an average of 18.6 days, followed by oral antibiotics for another 2-4 weeks. The duration of treatment depended on the WBC counts and CRP levels.

The most likely route of infection was identified in 13 of the 17 patients, as presented in Table 5. The cases of SEA in this series were more likely caused by direct extension (59%) of infection, especially that secondary to spinal surgery, peridural anesthesia, or paraspinal acupuncture.

Table 5. Presumed Source of Infection

Source of infection	No. of patients (%)
Hematogenous spread	3 (18)
Infected vascular access	0
Lung infection (pneumonia, empyema)	2
Chronic osteomyelitis	1
Direct extension	10 (59)
Skin and soft tissue infection	1
Focal procedures (e.g. facet block, acupuncture & analgesic injection)	5
Laryngeal mass biopsy	1
Spinal surgery	3
No source identified	4 (23)

Clinical outcomes

All 17 patients underwent surgical intervention.

Improvement was noted in 12 of 17 patients, with good and fair outcomes. In the poor-outcome group, three patients died from medical complications during the early postoperative period. One died from respiratory failure related to a history of pneumoconiosis, and 2 had sepsis. Another patient had had paraplegia for more than 3 days on admission and experienced no improvement postoperatively. Another 81-year-old man was initially identified as having cholecystitis and received emergency decompression after long-term medical treatment was ineffective. Urine retention and paraparesis were still present postoperatively. Clinical outcomes related to presenting deficits are shown in Table 6. A positive relationship was observed between preoperative deficit and final outcome (rank correlation coefficient= +0.312), but statistical significance was not found ($p=0.222$). That is, a more severe preoperative deficit was possibly predictive of a worse outcome.

Table 6. Clinical Outcomes*

Preoperative deficit†	good	fair	poor‡
Mild to normal	2	0	0
Moderate	5	1	3 (2 died)
Severe	2	2	2 (1 died)

*: Good if recovery was complete or if the patient could ambulate independently; fair if the neurological deficit improved and patient had intact bowel and bladder function but dependent ambulation; poor if deterioration occurred or if the patient was paraplegic or dead.

†: Severe if the patient was paraplegic; moderate if the patient retained only antigravity strength; mild to normal if the patient was able to walk with/without assistance.

‡: Three patients died from medical complications (one respiratory failure due to history of pneumoconiosis, two with sepsis).

DISCUSSION

Epidemiological data

SEA is a disease of elderly patients, with the peak incidence in the sixth and seventh decades of life. Our data showed that most patients with SEA (10 of 17 cases) had an underlying disease that predisposed them to infection, a local condition (e.g., surgical intervention) that facilitated the settlement of bacteria in the paraspinal area, or a combination of these. Risk factors for altered immune status were identified on the patient's history at admission and included diabetes mellitus, chronic renal failure, alcoholism, liver cirrhosis, and long-term corticosteroid therapy.[2,3,5,6,8-10] Because many of the conditions that predispose an individual to SEA are more prevalent in older persons than in younger ones, it is certainly reasonable that mean age of our patients was 63 years, however this is higher than that described in earlier reports.[3,9,10] Most reports describe a slight male predominance.[3,6,8,10] We cannot explain the striking male predominance observed in our study.

Clinical manifestations

Spinal pain, motor deficits, and elevated CRP/ESR were the 3 most common clinical features of our patients. The correctly initial diagnostic rates were in our series and other reports.[2,5] Patients with lumbar SEA were more likely misdiagnosed as having lumbar herniated discs or degenerative disease. In 14 of our patients, the initial diagnosis was related to a spinal problem, but the remaining three cases involved suspected abdominal diseases. All of these cases had involvement at the level of the thoracic spine. This level of the spinal cord regulates the autonomic nervous system related to the gastrointestinal and genitourinary systems, and receives sensory inputs from the chest and abdomen. The most common gastrointestinal complications associated with spinal cord injury are gastric dilatation, paralytic ileus, stress ulcers, and metabolic disturbances. Associated clinical findings are often altered or absent as a result of the lack of sensory, motor, and reflex functions. These features create a complex differential diagnosis and require more attention, especially in patients with associated neurological deficits and spinal pain. Early detection with improved outcome is reported in most series. In our series, patients whose illnesses were initially misdiagnosed had a poorer outcome (one [33%] of 3 versus 4 [29%] of 14 patients).

In our study, the most common location of SEA was the lumbar epidural space, as in other series.[2,8] However, some series found no predominant location.[6,9] Slightly more than one-half of our cases of SEA involved an anterior location, and in the other half, the infection extended circumferentially. The high incidence of spondylodiskitis (11 of 17 cases) in our study may have contributed to this finding.

Source of infection

Pathogens gain access to the epidural space via contiguous spread or hematogenous dissemination from a remote infection. Postoperative epidural abscesses represent 16% of all epidural abscesses.[2,11] Recent series have shown that about 12-17.5%[5,8] of affected patients had undergone spinal procedures. Direct extension, primarily from a decubitus ulcer or site of a spinal procedure, was observed in 59% of our patients. Spinal procedures, including needle biopsy, facet block, epidural analgesia, local injection for pain relief, acupuncture, cupping, and surgical operations, contributed to the development of SEA in nine of our 17 patients. These causes are common in recent series and appear to play an increasing role in the pathogenesis of epidural abscess.[8,9,12-16] One possible reason may be that in the Keelung area, where our hospital is located, patients usually first seek traditional Chinese medical care, such as acupuncture and cupping, or local spinal injection. *Staphylococcus aureus* was cultured from 4 of the 5 patients who received focal procedures. We suspect lack of skin sterilization is the cause.

In our series and in published reports, most cases of SEA were caused by *S. aureus*. Oxacillin-resistant *S. aureus* was the predominant pathogen in our cases. Gram-negative rods, anaerobes, and mycobacteria were responsible for the rest of the cases. This observation reflects a trend toward a broader mix of organisms and the possibility of inappropriate use of antibiotics. No growth was found in 3 patients. Two had received antibiotic therapy for other infections (pneumonia and urinary tract infection) prior to culture of granulation tissue from the epidural space. One patient who presented with fever and leukocytosis on admission had received inappropriate empiric antibiotic treatment. Somewhat surprisingly, two of these patients had a history of gout (the so-called "great deceiver"). Although gout of the spinal column is unusual, its presentation is similar to that of infection and may include neck or back pain with various neurological symptoms. Laboratory findings of inflammatory changes and significant mass effect on MRIs are as common with gout as with SEA.[17] Although the pathologic findings were suspected too late to confirm them, our pathologist suggested that the specimens from these two patients might have been consistent with gouty arthritis. Magid et al.[18] reported that, even on gross inspection during surgery, gouty tophus can simulate purulent material. Thus, in patients with suspected infections, particularly those with a history of gout, tissue biopsy should include crystal analysis in addition to cultures.[19]

Clinical outcomes

As a result of earlier detection, neurosurgical intervention and improvement in antibiotic agents, an overall decrease in morbidity and mortality has been reported in all recent series. After a review of 168 cases from six series (1973 to 1987), 38% of patients achieved complete recovery with surgical treatment and antibiotics, 19% of patients had residual weakness, 21% of patients remained paralyzed, and 12% died (the remaining 10% did not undergo surgery).[4] In 94 cases from more recent series from 1990 to 2002,[3,8,9] the percentages, respectively, were 57%, 29%, 9%, and 5%, showing a decreasing trend. The perioperative mortality rate in our series was 18%, and the rate of postoperative deterioration was 11%. In addition to the deaths secondary to overwhelming sepsis and respiratory failure, the other two patients who died in the poor-outcome group had no improvement, supposedly as a result of a delay in treatment (paraplegia lasting for more than 3 days before admission) and diagnosis (SEA initially diagnosed as cholecystitis). Increased awareness, attention to detail, and repeated neurological examinations are mandatory, especially in patients with a bizarre presentation. MRI is now the imaging study of choice. It offers a unique advantage over computed tomography and myelography in the diagnosis and localization of SEA.[4,20] T2-weighted MRI enables a precise demonstration of the size and extent of an SEA (Fig. 1).[4]

In conclusion, abdominal complications in the patients with spinal disease are not uncommon, especially when the thoracic level is involved. The fact that abdominal symptoms can initially mask neurological deficits due to spinal cord compression should be kept in mind. Delay in the early recognition of SEA may lead to a poor outcome, and the appreciable neurological recovery seen in some patients reflects the prompt diagnosis and early treatment.[1,21,22] Although spinal gout is less common than SEA, crystal analysis and staining should be performed if intraoperative findings for a causative organism are negative in a patient with a history of

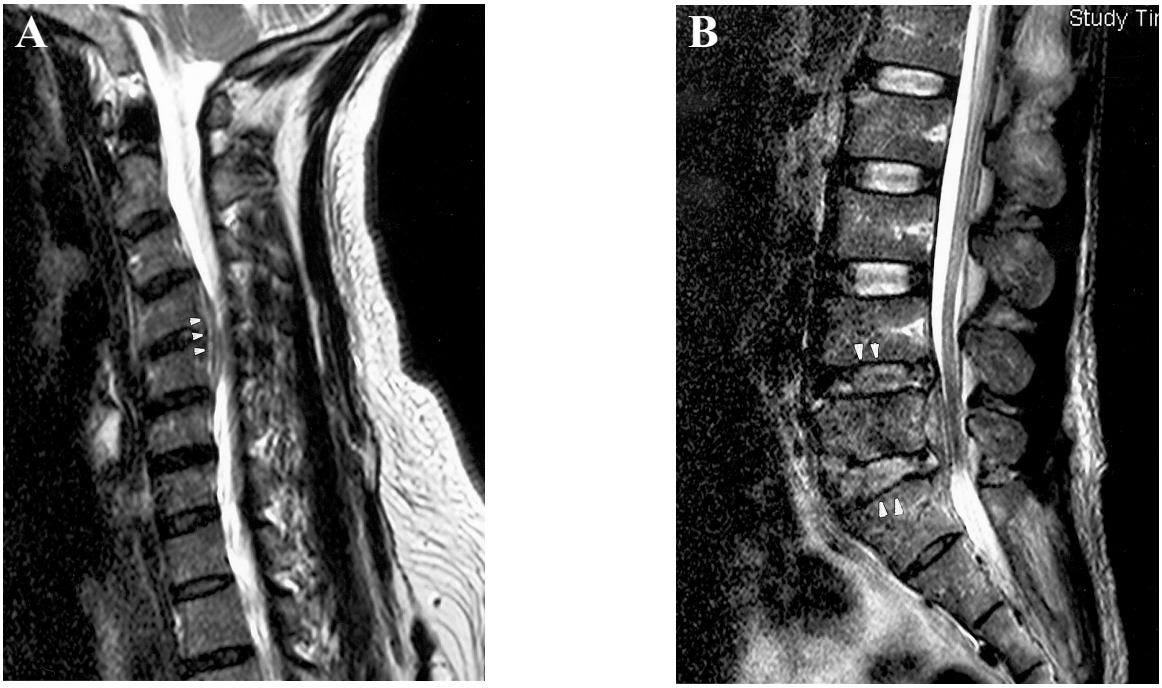

Fig. 1 T2-weighted, sagittal MRI scans enable a precise demonstration of the size and extent of a spinal epidual abscess (SEA): (A) A mass anterior to and displacing the spinal cord from C4 to C5; (B) Irregularity and destruction of the vertebral body end plates of inferior L4 to superior S1.

gouty arthritis. Although the increasing availability of MRI makes diagnosis easier and quicker, repeated neurological examination and full evaluation are essential in any patient with an unknown focus of infection and spinal pain or tenderness.

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硬脊膜上膿瘍：臨床表現、感染來源、與預後之回溯性分析

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背 景： 硬脊膜上膿瘍在臨床上並不常見，若是能早期發現及處理，多能有不錯的預後；反之，則會造成嚴重的脊髓或神經傷害。此一回溯性研究主要是收集硬脊膜上膿瘍的病例，加以分析其臨床表現，感染來源，與相關預後。

方 法： 我們回溯性收集自1997年3月至2003年4月間在本院神經外科所治療過之17例患有硬脊膜上膿瘍的病患，根據病歷資料加以分析其臨床表現、實驗室檢查、影像學發現及預後。

結 果： 全數病人都有接受外科手術及抗生素治療，平均年齡爲63歲，男性佔絕大多數。頸背部疼痛、運動障礙及升高的C-reactive protein或紅血球沉降速率 (erythrocyte sedimentation rate) 值，是最常見的臨床症狀。最常見的感染病源是oxacillin-resistant金黃色葡萄球菌；最常見的感染位置是在腰椎及椎管的前側部位。預後不佳的病人有29%，尚可的有18%，而良好的有53%。

結 論： 在脊椎疾病病人併發腹部症狀的並不少見，特別是在胸椎部位；雖然神經缺陷可能因爲脊髓壓迫而被腹部症狀所遮蔽，但是在縝密的檢查下，大多可以發現有脊椎疼痛及運動缺陷的存在。在疑似硬脊膜上感染，又有痛風病史的病人，除了檢體送檢培養之外，結晶體分析也是需要的。雖然核磁共振影像使得我們得以更早期且更容易發現硬脊膜上膿瘍，但在任何有未知感染源及脊椎疼痛的病人，仔細且頻繁的病史詢問及理學檢查，仍是不可或缺的。

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關鍵字： 硬脊膜上膿瘍，臨床徵狀，感染來源，預後。

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