

# Diagnosis and Management of Spinal Epidural Abscess

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**ABSTRACT:** Twenty-five patients with spinal epidural abscess were treated at the University of Western Ontario hospitals between July 1980 and July 1990. There were eighteen males (72%) and seven females (28%), with a median age of 60 years. Concurrent illness resulting in immunocompromise was present in 60%. Eleven presented with complete myelopathy, thirteen had limb weakness, and one had no neurological deficit. In twenty cases the abscess consisted of frankly purulent material, while in five the epidural collection consisted of chronic granulation tissue. *Staphylococcus aureus* was isolated in 64% of the abscesses. Twenty-seven surgical procedures were performed on 21 patients. Ten cases occurred in the cervical spine (40%), seven in the thoracic spine (28%), three in both the cervical and thoracic spine (12%) and five in the lumbosacral spine (20%). Fourteen patients (56%) retained or recovered ambulation and there were five deaths (20%). The progression from back and radicular pain to weakness and eventual paralysis continues to be characteristic of spinal epidural infection. Morbidity and mortality remain unacceptably high because of delay in diagnosis and treatment. Magnetic resonance imaging is the radiological investigation of choice for the diagnosis of spinal epidural abscess. Prompt intervention, before the development of severe neurological deficits, can improve outcome. Immediate surgical drainage combined with antibiotics remains the treatment of choice.

**RÉSUMÉ:** Diagnostic et traitement de l'abcès épidual spinal. Vingt-cinq patients avec abcès épidual spinal ont été traités dans des hôpitaux de l'Université de l'ouest de l'Ontario entre juillet 1980 et juillet 1990. Vingt-huit étaient des hommes (72%) et sept étaient des femmes (28%), l'âge médian étant de 60 ans. Une maladie coexistante responsable d'un déficit immunitaire était présente chez 60% des cas. Onze présentaient une myélopathie complète, treize avaient de la faiblesse au niveau des membres et un n'avait pas de déficit neurologique. Chez vingt cas, le contenu de l'abcès était franchement purulent, alors que chez cinq la collection était composée de tissu de granulation chronique. Du staphylocoque doré a été isolé de 64% des abcès. On a procédé à vingt-sept interventions chirurgicales chez vingt-et-un patients. Dix cas sont survenus au niveau du rachis cervical (40%), sept au niveau du rachis dorsal (28%), trois au niveau du rachis cervical et dorsal (12%) et cinq au niveau du rachis lombosacré (20%). Quatorze patients (56%) ont conservé ou recouvré la marche et il y a eu cinq décès (20%). La progression de la douleur dorsale et radiculaire à la faiblesse et à la paralysie éventuelle demeure caractéristique des infections épidurales spinales. La morbidité et la mortalité demeurent inacceptablement élevées à cause du retard à poser le diagnostic et à établir le traitement. L'imagerie par résonance magnétique est l'investigation radiologique de choix pour le diagnostic de l'abcès épidual spinal. Une intervention rapide, avant l'apparition de déficits neurologiques sévères, peut améliorer l'issue. Le drainage chirurgical immédiat combiné à l'antibiothérapie demeurent le traitement de choix.

*Can. J. Neurol. Sci. 1992; 19: 180-187*

Infection involving the spinal epidural space is a neurosurgical problem of considerable importance. Dandy<sup>1</sup> studied the anatomy of the epidural space and described the clinical features and management of pyogenic infections involving this region. Although effective surgical and antimicrobial therapy is available, delay in diagnosis and treatment continue to result in high morbidity and mortality.<sup>2-13</sup>

Twenty-five cases of spinal epidural abscess were treated at our institution between July 1980 and July 1990. The present study reviews their presentation and outcome, in order to

emphasize the importance of early recognition of this disorder and to present current epidemiological and microbiological trends. A grading scheme based on clinical status at the time of presentation is proposed, and the impact of magnetic resonance imaging (MRI) on diagnosis is discussed.

## MATERIAL AND METHODS

This study examines 25 cases of spinal epidural abscess treated by the Division of Neurosurgery at the University of

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Received August 14, 1991. Accepted in final form December 4, 1991

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Western Ontario between July 1980 and July 1990. Information was obtained from hospital records, operative and pathological reports, and review of radiographs. All cases were verified at surgery or post-mortem examination.

Note was made of the first symptom experienced and the neurologic status at the time of presentation to the Division of Neurosurgery. A clinical grade was assigned to each patient based on the degree of neurologic dysfunction and systemic illness (Table 1). Grade 1 patients were those presenting with only back or radicular pain, without limb weakness. Grade 2 patients all had pain, but in addition had evidence of weakness in a radicular distribution or an incomplete myelopathy. Grade 3 patients presented with pain and complete myelopathy. Systemic sepsis, defined as the presence of fever, elevated white blood cell count and positive blood cultures, which was severe enough to result in hypotension or multi-organ failure, resulted in placement of the patient into the next least favorable category. Grade 4 patients were therefore those presenting with pain, complete myelopathy and systemic sepsis.

The results of radiologic investigations including plain radiographs, myelograms, computerized tomograms (CT) and MRI scans were compared with surgical and pathological findings. Culture and sensitivity results were tabulated in order to determine current trends and to provide guidelines for empiric therapy. The median follow-up was 24 months, with a minimum follow-up of 3 months (range 3 to 36 months).

## RESULTS

Eighteen of the cases were male (72%) and seven were female (28%). The median age of patients was 60 years, with a range of 14 to 74 years. In 20 cases (80%) the primary finding at the time of surgery or autopsy was frankly purulent material, while in 5 cases (20%) epidural granulation tissue was found. Those patients whose epidural space contained frank pus had a median duration of symptoms prior to presentation of 11 days (range 4 days to 6 weeks), while those in which only epidural granulation tissue was found had a median duration of symptoms of 12 weeks (range 2 weeks to 6 months). Infections in which pus was identified were considered acute, while the presence of granulation tissue without pus was considered to represent a chronic infection.<sup>2</sup>

### Clinical Features

Severe back pain was the initial symptom in all cases. A consistent pattern of clinical progression was found, characterized by back and radicular pain leading to weakness and eventual paralysis. At the time of presentation to the Division of Neurosurgery, one patient was classified as Grade 1 (4%), nine

as Grade 2 (36%), nine as Grade 3 (36%) and six as Grade 4 (24%). Eleven patients (44%) presented with complete myelopathy, six of which had systemic sepsis and by definition were Grade 4 patients.

In those patients with acute infection, the median temperature at presentation was 38.0°C (range 35.3 to 40.0°C) and the median white blood cell count was 17.2 x 10<sup>9</sup>/L (range 1.8 to 28.6 x 10<sup>9</sup>/L). Cases with chronic infection had a median temperature of 37.0°C (range 36.4 to 37.9°C) and a median white blood cell count of 9.9 x 10<sup>9</sup>/L (range 6.5 to 15.5 x 10<sup>9</sup>/L). Acute and chronic abscesses did not have any apparent difference in the percentage of patients presenting in each clinical grade, although there were only five chronic cases (Table 2).

### Source of Infection

A source of infection was identified in 22 of the 25 patients (88%) (Table 3). Cellulitis or cutaneous abscesses were present in five, respiratory infections in four and oropharyngeal infections in four. A history of previously diagnosed vertebral osteomyelitis was obtained in two cases. There was one post-operative wound infection and one case occurred following a cervical discogram.

### Predisposing Factors

In 15 patients (60%) there was a concurrent illness which was felt to significantly impair immunocompetence (Table 4). Five patients had diabetes mellitus and four had metastatic malignancy. There were no patients with AIDS or HIV seropositivity. Recent spine trauma was noted in three cases and a history of previous vertebral compression fracture at the involved spinal segment was found in three others.

### Radiographic Findings

Plain radiographs were obtained in 24 of the 25 patients. One patient presented with overwhelming sepsis and died without any radiological investigation. These studies showed vertebral

**Table 2: Grade at Presentation in Acute and Chronic Cases**

Clinical Grade	Acute (n = 20)	Chronic (n = 5)
1	1 (5%)	0 (0%)
2	6 (30%)	3 (60%)
3	8 (40%)	1 (20%)
4	5 (25%)	1 (20%)

**Table 3: Source of Infection**

Source	Number of Cases	Percent of Total
Cellulitis/Cutaneous abscess	5	20%
Pneumonia	4	16%
Oropharyngeal abscess	4	16%
Septic joint	2	8%
Vertebral osteomyelitis	2	8%
Gastrointestinal tract	2	8%
Wound infection	1	4%
Psoas abscess	1	4%
Cervical discogram	1	4%
No source identified	3	12%

**Table 1: Clinical Grade of Spinal Epidural Abscess**

Grade 1	Back or radicular pain
Grade 2	Weakness
Grade 3	Paralysis
Grade 4	Paralysis and systemic sepsis

Systemic sepsis, defined as the presence of an elevated WBC, fever, positive blood cultures and hypotension or multi-organ failure, results in placement into the next least favorable grade.

body destruction in 5 cases (20%) and disc space erosion in 3 cases (15%). Purulent discitis in addition to epidural abscess was found in 7 cases; thus, plain radiographs were predictive of purulent disc space infection in 3 of 7 cases (43%). Bone was not examined pathologically in all cases; therefore the incidence of concurrent vertebral osteomyelitis could not be determined.

Myelography was performed in 19 cases. Complete block suggestive of epidural compression was seen in 14 (74%) and incomplete block seen in 5 (26%). Of those with complete block, satisfactory visualization above and below the lesion was provided in only one (7%). Five patients with complete block (36%) required multiple surgical procedures due to inadequate demonstration of the extent of the compression by the myelogram. Two patients who initially underwent anterior cervical decompression subsequently required posterior laminectomy. Three patients had initial procedures which were insufficient in their rostrocaudal extent and were subjected to a second myelogram and further surgical decompression. One patient required three surgical procedures.

CT scans were obtained in 10 cases, usually following myelography. Although epidural compressive lesions were easily appreciated, the upper and lower extent could be reliably determined in only 4 patients (40%).

Six patients underwent MRI examination, consisting of T1 and T2 weighted images obtained in sagittal planes and T1 weighted images obtained in axial planes. Disc space and soft tissue infection was associated with increased signal intensity on T2 weighted images (TR 2500 ms, TE 70 ms), with spinal cord displacement and compression seen best on T1 weighted images (TR 600 ms, TE 20 ms) (Figure 1). Vertebral osteomyelitis was recognized by reduced signal intensity on T1 weighted images and increased signal intensity on T2 weighted images (Figure 2).<sup>14-16</sup> In all six cases there was excellent demonstration of the bone and soft tissue infection. Post-operative images confirmed the satisfactory decompression of the epidural space (Figure 3).

### Surgical Procedures

Twenty-seven surgical procedures were performed on 21 patients. In four cases, only post-mortem information was available. Epidural abscess tissue was found posteriorly in 20 cases and anteriorly in 8 cases. Three patients had both anterior and posterior abscess extension. The cervical spine was involved in 10 cases (40%), thoracic spine in 7 (28%) and lumbosacral spine in 5 (20%). Three cases (12%) involved both the cervical and thoracic spine. The rostrocaudal extent of surgical decompression ranged from 2 to 15 vertebral levels (median = 5 levels).

**Table 4: Factors Predisposing to Infection**

Predisposing Factor	Number of Cases	Percent of Total
Diabetes mellitus	5	20%
Malignancy	4	16%
Alcohol or drug abuse	3	12%
Chronic steroid use	1	4%
Malaria	1	4%
Ulcerative colitis	1	4%
Recent trauma	3	12%
Previous compression fracture	3	12%
No predisposing factors	10	40%

### Microbiology

Positive cultures were obtained in 24 cases (96%). *Staphylococcus aureus* was the sole infectious agent in 16 individuals (64%), and in each case was sensitive to cloxacillin (Table 5). *Streptococcus pyogenes* was cultured in 3 cases (12%); multiple organisms were found in two patients (8%).

### Outcome

Outcome was classified as excellent, good, poor or death (Table 6). Fourteen patients retained or recovered ambulation. There were 4 excellent results (16%), 10 good (40%), 6 poor (24%) and 5 deaths (20%). Long-term outcome results were calculated for each clinical grade at presentation (Table 7). There was clearly a trend to better results in those who presented in a lower clinical grade. All five patients who died had systemic sepsis at the time of presentation. This represents a mortality rate of 42% among the 12 patients presenting with sepsis. Neither age nor sex affected outcome for a particular grade. There were no differences in the proportion of good or excellent results obtained in those with acute and chronic abscesses. However, all five deaths occurred in the acute group (Table 8).

### DISCUSSION

The incidence of spinal epidural abscess remains approximately 1 to 2 per 10,000 hospital admissions.<sup>2,6,7</sup> In the present series, two cases (8%) occurred in patients less than 20 years of age, consistent with the low reported incidence of this illness in the pediatric population.<sup>17</sup> We classified the cases as acute or chronic based on the duration of symptoms and the pathological findings of pus or granulation tissue, as has been described previously.<sup>2,4-6,8,9,11,12,18</sup> Although the chronic abscesses presented with a lower temperature and white blood cell count, there was

**Table 5: Microbiology**

Infectious Agent	Number of Cases	Percent of Total
<i>Staphylococcus aureus</i>	16	64%
<i>Streptococcus pyogenes</i>	3	12%
<i>Escherichia coli</i>	1	4%
<i>Bacteroides melaninogenicus</i>	2	8%
Multiple organisms:	2	8%
<i>Eikenella corrodens</i> , <i>Bacteroides melaninogenicus</i> , <i>Streptococcus viridans</i> <i>Staphylococcus aureus</i> , <i>Fusobacterium</i> , <i>Peptostreptococcus</i>		
No organism cultured	1	4%

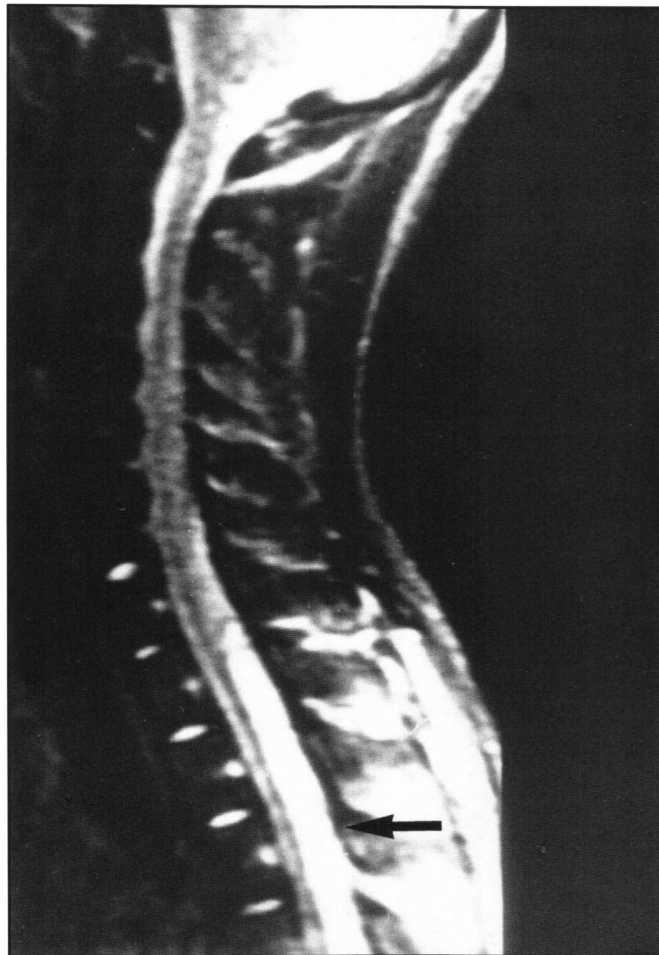
**Table 6: Outcome**

Result	Criteria	Number of Cases	Percent of Total
Excellent	No residual deficit	4	16%
Good	Ambulatory but with residual weakness or neurogenic bladder	10	40%
Poor	Non-ambulatory	6	24%
Death		5	20%

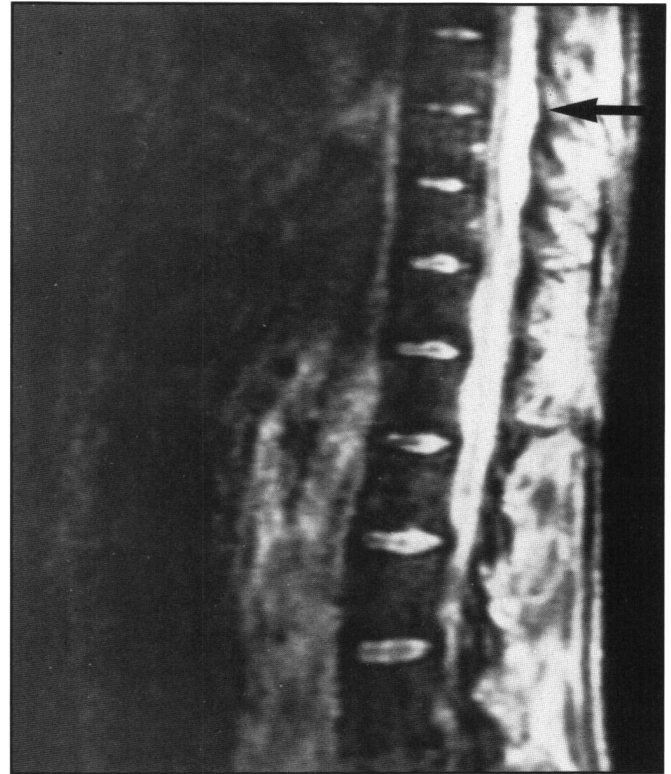
no difference between acute and chronic cases in terms of clinical grade at presentation or functional recovery. Curling et al.<sup>3</sup> and Hlavín et al.<sup>7</sup> have reported similar observations, suggesting that the distinction between acute and chronic cases is arbitrary and not of clinical importance. Heusner<sup>6</sup> felt that the chronicity of infection does not reliably predict whether pus or granulation tissue will be found. In this series, there was a shorter median duration of symptoms prior to presentation in the group with frankly purulent abscesses, but the number of cases was too small for meaningful statistical analysis.

Infection reaches the epidural space by direct extension from an established infection or by a hematogenous route. Although vertebral osteomyelitis is the most common source of contiguous infection,<sup>19-24</sup> retropharyngeal, psoas, pulmonary and perinephric abscesses have also been implicated.<sup>25</sup> Epidural abscess has been reported as a complication of gastrointestinal surgery,<sup>26</sup> epidural anesthesia,<sup>27</sup> local anesthetic injection,<sup>28</sup> chemonucleolysis,<sup>29</sup> and serial lumbar punctures.<sup>30</sup> One of our cases, with epidural and subdural empyema, has previously been reported as a complication of cervical discography.<sup>31</sup> Hematogenous

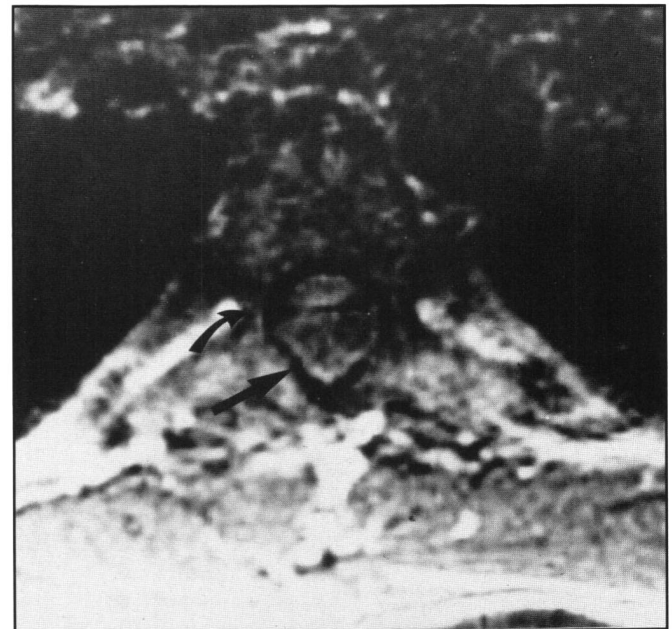
spread has most commonly resulted from cutaneous infections, pneumonia, dental abscesses and urinary tract infections.<sup>24</sup> In



A

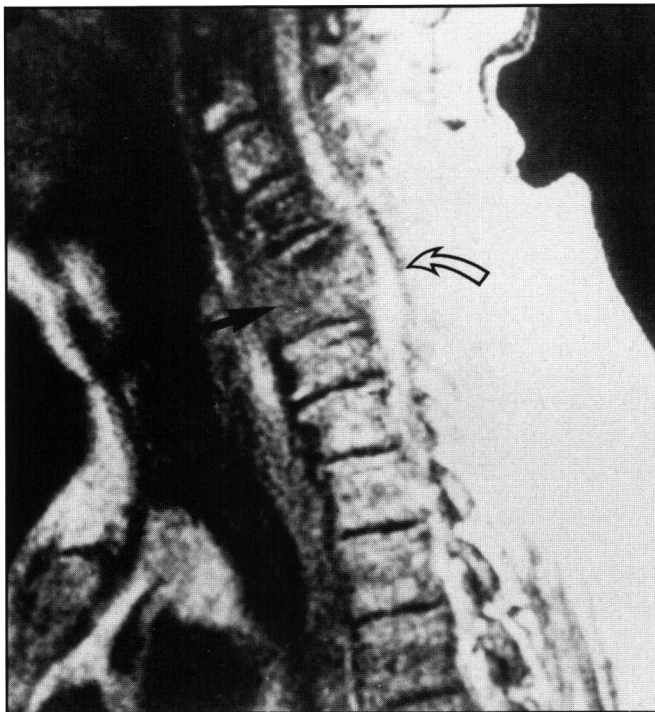


B



C

**Figure 1** – MRI scans of a 21-year-old male with a posterior spinal epidural abscess from C6 to T10. (A) Sagittal T2 weighted image (TR 2500 ms, TE 70 ms) of the cervical and upper thoracic spine demonstrating a focal area of high signal intensity in the posterior epidural space (arrow), resulting in displacement and compression of the spinal cord. (B) Sagittal T2 weighted image of the lower thoracic spine, showing the posterior epidural mass (arrow). (C) Axial T1 weighted image (TR 600 ms, TE 20 ms) of the thoracic spine demonstrating a multi-loculated posterior epidural mass (straight arrow), compressing the spinal cord anteriorly (curved arrow).



**A** **B**  
 Figure 2 – Sagittal MRI scans of a 68-year-old male with vertebral osteomyelitis of C5 and C6, associated with an anterior epidural abscess. (A) T1 weighted image (TR 600 ms, TE 20 ms) showing reduced signal intensity and collapse of C5 and C6 (solid arrow), with an anterior epidural mass compressing the spinal cord posteriorly (open, curved arrow). (B) T2 weighted image (TR 2000 ms, TE 30 ms) showing increased signal from the vertebral bodies of C5 and C6 (arrow). This pattern of signal change is consistent with vertebral osteomyelitis.

**Table 7: Outcome as a Function of Clinical Grade**

Clinical Grade	Number of Cases	Outcome	Percent Ambulatory
1	1	Excellent	100%
		Good	100%
		Poor	
		Death	
2	9	Excellent	22%
		Good	56%
		Poor	11%
		Death	11%
3	9	Excellent	11%
		Good	45%
		Poor	11%
		Death	33%
4	6	Excellent	0%
		Good	17%
		Poor	66%
		Death	17%

**Table 8: Outcome in Acute and Chronic Cases**

Outcome	Acute (n = 20)	Chronic (n = 5)
Excellent	2 (10%)	2 (40%)
Good	9 (45%)	1 (20%)
Poor	4 (20%)	2 (40%)
Death	5 (25%)	0 (0%)

the cases reported in the present series, hematogenous spread may have accounted for up to 80% of infections (Table 3). Antecedent trauma has been suggested as a predisposing factor by creating a “locus minoris resistentiae”.<sup>20,21</sup>

All reported series have emphasized the importance of *Staphylococcus aureus* as an etiologic agent in this infection.<sup>2,4-6,8-13,20,21</sup> However, recent series<sup>3,7</sup> have shown that the spectrum of organisms is becoming more diverse, with gram negative infections assuming a prominent role.<sup>3,9</sup> In this series, *S. aureus* alone was isolated in 16 patients (64%) and *S. pyogenes* in 3 (12%), while gram negative, anaerobic and mixed infections were found in 5 (20%).

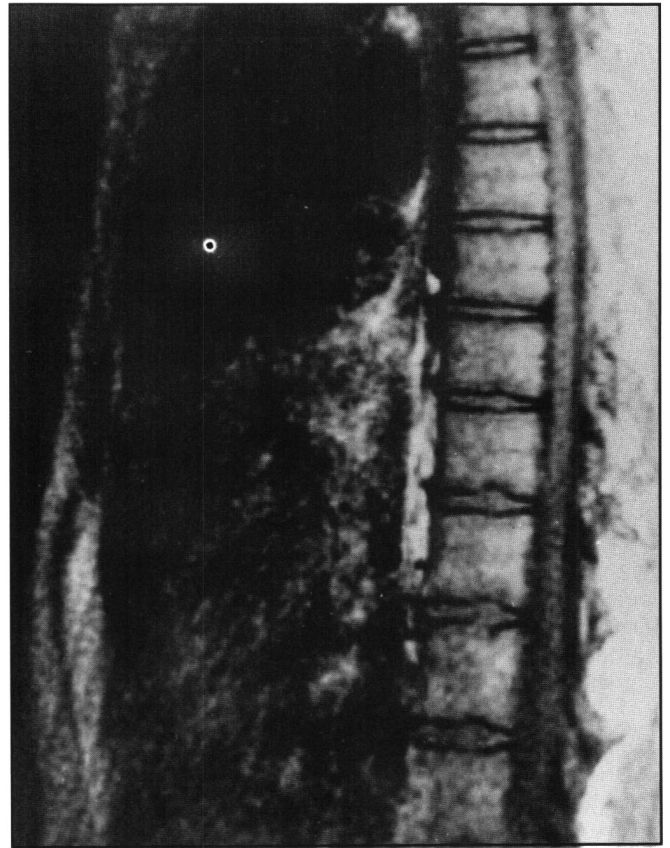
Spinal epidural abscess continues to be an affliction of the elderly and those with compromised immune status. Diabetes, malignancy, chronic renal failure, alcoholism and IV drug abuse have been identified as significant risk factors.<sup>4,7,9</sup> The median age of our patients was 60 years, and in 60% there was a predisposition to infection due to chronic illness or substance abuse. Similar observations have been presented in other large series.<sup>3,4,7</sup>

In most previously reported series, the most common location for epidural abscess has been the thoracic or lumbar area. The cervical spine has been the rarest site of involvement<sup>23,32</sup> presumably because the epidural space is merely potential at the cervical level, becoming more substantial caudally.<sup>1</sup> This series is the first to report an increased incidence in the cervical region (52%).

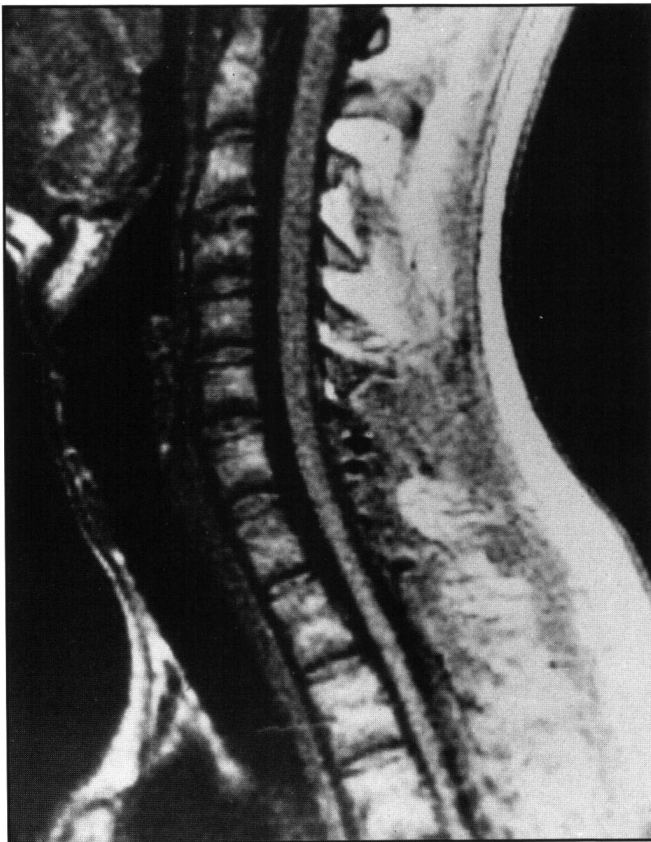
There has been debate in the literature as to the relative importance of vascular thrombosis and mechanical cord compression in the pathogenesis of neurological deficits resulting

from spinal epidural abscess.<sup>2,20,21,33</sup> In autopsied patients, Russell et al.<sup>12</sup> observed no arterial compromise but did find venous compression and thrombosis, thrombophlebitis of the epidural space, venous infarction and edema. Feldenzer et al.,<sup>34,35</sup> using a rabbit model, have demonstrated that a mechanical, compressive effect is the early cause of neurological impairment, with progressive ischemia and thrombosis in addition to compression adding to the severity and permanence of the lesion. Recognition of the importance of mechanical compression as the initial pathological factor suggests that, in extensive abscesses, the thoracic spine with its limited space may be the earliest and most severely affected level.

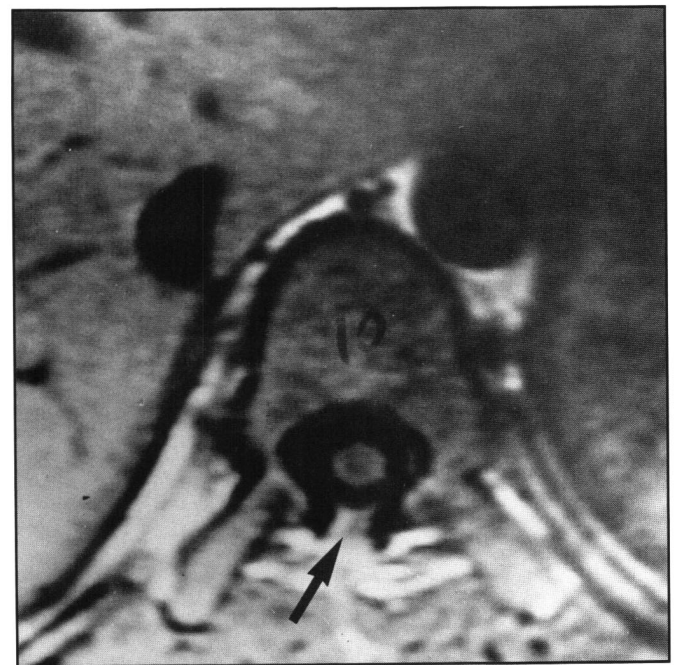
We have classified patients into four categories based on their clinical presentation and degree of neurological dysfunction (Table 1). Clearly, those with the least neurological deficit at the time of diagnosis and treatment have the best chance for recovery (Table 7). In addition to the severity of pre-existing deficits, the duration of symptoms prior to surgery has been shown to be a significant predictive factor by Baker et al.<sup>2</sup> and Danner and Hartman.<sup>4</sup> In their series, Danner and Hartman<sup>4</sup> found that only two of eleven patients with weakness or paralysis for greater than 36 hours improved, while all seven patients with neurologic impairment for less than 36 hours had some recovery following surgery. In the present series, of five Grade 3 patients who had complete myelopathy without systemic sepsis,



B



A



C

*Figure 3 – Post-operative T1 weighted MRI scans (TR 600 ms, TE 20 ms) of the same patient as in Figure 1. (A) Sagittal image of the cervical and upper thoracic spine. (B) Sagittal image of the lower thoracic spine. (C) Axial image of the lower thoracic spine, showing satisfactory decompression following laminectomy (arrow). Compare to Figure 1(C).*

four recovered ambulation, while only one of six Grade 4 patients improved to this level. Generalized sepsis thus appears to significantly reduce the probability of functional recovery, but even patients with complete myelopathy can improve following appropriate management. These results emphasize the importance of early recognition and prompt treatment of patients with this illness.

Before the advent of computerized imaging, the recommended investigation of patients with back pain, fever and spine tenderness included radiographs of the spine, lumbar puncture and myelography.<sup>2,4,9,10,13</sup> Emphasis was placed on finding an elevated CSF protein concentration together with a pleocytosis, as well as myelographic evidence of epidural compression. However, this diagnostic strategy exposed patients to the risks associated with lumbar puncture, including purulent meningitis, while obtaining only limited information in the majority of cases. In this series, only one of fourteen (7%) myelographic studies demonstrating a complete block adequately confirmed the upper and lower extent of the abscess. By definition, a complete myelogram in this setting requires puncture both above and below the block, further increasing the risks. Magnetic resonance imaging has become increasingly available as a non-invasive means to accurately identify the nature and extent of spinal pathology, and compares favorably with plain radiography, myelography and CT scanning.<sup>14-16, 36-38</sup> A prospective study has demonstrated the superiority of MRI to conventional and CT myelography in the evaluation of cervical myelopathy.<sup>37</sup> Our results in six patients evaluated with MRI have been superior to all other modalities in demonstrating the rostrocaudal extent and anteroposterior spread of infection, as well as bone, disc and paraspinous involvement.

Although there have been isolated case reports<sup>39,40</sup> and small series<sup>41,42</sup> of spinal epidural abscess managed conservatively, the fundamental surgical principle of drainage of pus has not been diminished by the early use of antibiotics. This premise is supported by the demonstration of the importance of mechanical compression in causing the early neurological deficit associated with spinal epidural abscess.<sup>34,35</sup> In the series of Hlavin et al.,<sup>7</sup> eleven patients with initially normal neurological examinations deteriorated in the hospital before surgical intervention. Eight of those patients were being treated with appropriate antibiotics. Two became paralyzed despite more than three weeks of antibiotic therapy, and only three of the eleven recovered fully. They observed that patients who are initially neurologically normal and who then deteriorate while receiving antibiotic therapy have a significantly worse prognosis after operation than those operated upon while neurologically intact. Aggressive surgical management remains the key to successful treatment, with nonoperative therapy limited to a select group with high operative risk, no evidence of neural compression and in whom positive cultures have been obtained.

Appropriate treatment includes the immediate institution of empiric intravenous antibiotics as soon as blood cultures have been drawn. Because of the changing microbiology of this disease, broad spectrum antimicrobial coverage, including an anti-staphylococcal penicillin, is recommended as the initial therapeutic regimen, until the results of culture and sensitivity testing are known. Intravenous medication should be continued for at least two weeks, with oral agents administered for another four weeks.<sup>3,24</sup> Prolonged administration, for up to 8 weeks, has been

suggested for those patients with concurrent vertebral osteomyelitis.<sup>2,3,24</sup>

## CONCLUSIONS

The progression from back and radicular pain to weakness and eventual paralysis remains characteristic of spinal epidural abscess. The distinction between acute and chronic forms of this illness does not appear to have clinical significance. We have noted an increased frequency of occurrence in the cervical spine, and found MRI to be the imaging modality of choice. A therapeutic protocol of early operative drainage and appropriate antibiotics seems to be justified by our experience and that of others.<sup>3,7</sup> Early diagnosis is vital to the improvement of overall patient outcome, since the presence of systemic sepsis or severe neurological deficit is associated with a poor chance of functional recovery. Improvement in therapeutic results is dependent on a high index of suspicion, early diagnosis, and prompt intervention with surgical drainage and antibiotics.

## ACKNOWLEDGEMENT

Dr. Del Maestro is the recipient of an Ontario Ministry of Health Career Scientist Award.

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