PYOGENIC INFECTION OF THE SPINE
A Review of Twenty-eight Cases

H. E. D. GRIFFITHS and D. M. JONES, BRISTOL, ENGLAND

Since Kulowski (1936) drew attention to the more benign forms of the disease, pyogenic infection of the spine has been discussed on a number of occasions. Further accounts must inevitably cover much familiar ground. In this review we have paid most attention to any new feature to emerge and to those aspects that appear to us to merit special consideration. Details made familiar by past descriptions are dealt with more briefly.

The review is based on the case histories of twenty-eight patients treated by orthopaedic surgeons in the Bristol area over the last twenty years. Eighteen of the series are personal cases treated by one or other of us during some stage of the illness. The remaining ten case histories are from the records of colleagues. In many cases the diagnosis of a pyogenic origin was based on clinical and radiological findings alone, and, when these were equivocal, on the recovery of the causative organism from the lesion. Doubtful cases were excluded from the series, as also were infants and young children.

### TABLE I
DISTRIBUTION OF INFECTIONS OF THE SPINE ACCORDING TO AGE

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 20</td>
<td>5</td>
</tr>
<tr>
<td>20 to 49</td>
<td>8</td>
</tr>
<tr>
<td>50 and over</td>
<td>15</td>
</tr>
</tbody>
</table>

### TABLE II
DISTRIBUTION OF INFECTIONS OF THE SPINE ACCORDING TO LEVEL OF LESION

<table>
<thead>
<tr>
<th></th>
<th>Cervical</th>
<th>Thoracic</th>
<th>Twelfth thoracic and first lumbar</th>
<th>Lumbar</th>
<th>Fifth lumbar and first sacral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of cases</td>
<td>4</td>
<td>9</td>
<td>4</td>
<td>9</td>
<td>2</td>
</tr>
</tbody>
</table>

The disease involved the bodies of the vertebrae in every case. During the same twenty years' period we have met with only one case with involvement of the posterior elements, an example of the rarity of this form of the disease. The patient concerned, a young woman with infection of the laminae and paraplegia (Stammers 1938), was referred to a neurosurgical unit for treatment, so her case is not included in the series.

### GENERAL FEATURES
The main features in our series correspond to those previously described (Wilensky 1929, Kulowski 1936, Guri 1946, Garcia and Grantham 1960, Robinson and Lessof 1961, Pritchard
and Robinson 1961). The distribution of the lesions according to age and site is shown in Tables I and II. Of the twenty-eight patients, fifteen were males and thirteen females, their ages ranging from ten to seventy-eight years. Rather more than half the patients were over the age of fifty, the highest incidence, nine cases in all, falling into the sixty-seventy age group. The overall picture was that of a subacute infection in half the patients, the remainder being more or less equally divided between the acute disease and those patients who ran a comparatively mild course with very slight evidence of systemic reaction. None suffered from diabetes at the time of treatment, though one is known to have suffered from it subsequently.

The interval between the first symptom and admission to hospital varied from a few days to more than five months, with an average period of about two months. The onset was sudden in half the series, starting with a febrile illness of varying intensity, followed within a day or so by pain in the spine. In a few patients this initial febrile stage was severe; in most it was brief and described as little more than a chill. A short period of malaise often preceded the onset. In at least seven patients pain developed gradually. Local pain in the spine was present in all patients, though sometimes overshadowed by root pain. An absence of systemic reaction was noted in some. The omission of four-hourly temperature readings, or antibiotics administered before admission to hospital, may have been responsible for an apparently afebrile course in some of these cases.

**Blood examination**—Leucocyte counts of over 12,000 cells per millilitre were returned in only three of the more acute cases, the highest count reaching 17,400 cells per millilitre. The sedimentation rate ranged from 22 to 80 millimetres per hour in twenty-two patients, with an average reading of 43 millimetres per hour. Though it is a useful guide to healing, the sedimentation rate proved of little value in differentiating between the more insidious forms of pyogenic infection and tuberculous disease. A sharp rise to 80 millimetres per hour coincided with the appearance of a palpable abscess in one case.

**Serological tests** for brucellosis and for antibodies of the typhoid and paratyphoid group were done in all doubtful cases. These established procedures, though rarely informative, cannot be omitted, as the following case history shows.

**Case 1**—A boy aged fifteen was admitted with a history of four months' backache. He had a rigid lumbar spine, a sedimentation rate of 38 millimetres per hour and a positive Mantoux test. Radiographs revealed a narrow fourth lumbar disc interval with a small paravertebral shadow to the left of the spine. He was treated initially for suspected tuberculous spondylitis. He made good progress at first, the sedimentation rate settling to 10 millimetres per hour four months after admission. Two months later the rate rose to 80 millimetres per hour and a palpable abscess appeared in the flank. Pus aspirated from the abscess grew streptococcus viridans. Agglutination tests were now found to be positive for salmonella paratyphoid B, and the organism was recovered from the stools. At no time either before or during the course of the disease was there a history of any disturbance of the alimentary tract.

**Radiology**—There were few opportunities for studying radiological changes within a month of onset. Oedema of the paravertebral tissues (Figs. 1 to 3) and narrowing of a disc interval were the only signs seen during this period. Later films revealed the usual changes of bone destruction, collapse of softened vertebrae and bone proliferation. Evidence of healing, sclerosis and new bone formation was seen from the eighth week onwards (Figs. 4 to 6) and was present in twenty-two cases within two to eight months of onset. Eleven patients went on to spontaneous fusion and seven healed without fusion. The result as regards ultimate fusion is not known in seven others.

One of our patients with a staphylococcal infection of the eighth and ninth thoracic vertebrae failed to show fusion within two years. When he was seen by chance some years later, radiographs revealed solid fusion. Guri (1946) pointed out that fusion may be delayed for upwards of two to three years, the healing process continuing over a long period. In tuberculous disease fusion is sometimes seen in the lumbar spine, but its occurrence appears to be very uncommon in the cervical and thoracic regions. Pyogenic infection is a more likely cause of fusion at the latter sites.

**THE JOURNAL OF BONE AND JOINT SURGERY**
Case 1—A woman of 54 had sudden onset of severe occipital pain and fever. The radiograph one week after the onset (Fig. 1) shows swelling of the prevertebral tissues because of oedema. Six weeks later (Fig. 2) there is subluxation of the atlas on the axis with a lesion involving the bodies of the second and third cervical vertebrae. One year later (Fig. 3) there is fusion of the same two vertebrae.

Case 3—Figure 4—Acute staphylococcal osteomyelitis of the twelfth thoracic and first lumbar vertebrae in a man aged 24. Subligamentous calcification bridges the intervening disc space in this radiograph eight weeks after onset. Case 13—Figure 5—The radiograph of a woman of 64 taken eight weeks after the onset of low back pain. The infection has started in the metaphysial area of the fourth lumbar vertebra and passed upwards beneath the longitudinal ligament to involve the anterior margin of the third. A little new bone is already appearing; later the patient developed a staphylococcal sepsicaemia. Ten weeks later another radiograph (Fig. 6) shows advance of the disease. The destroyed area is becoming filled by new bone, suggesting that solid buttressing could develop; but the patient died of heart failure soon afterwards.
Bacteriology—Organisms were recovered from the blood-stream or spinal lesion in twelve patients. The staphylococcus was identified on nine occasions, the pneumococcus, bacillus coli and streptococcus viridans once each. Seven patients had positive blood cultures. In four

<table>
<thead>
<tr>
<th>Case number</th>
<th>Age</th>
<th>Sex</th>
<th>Site of lesion</th>
<th>Primary focus</th>
<th>Interval between primary focus and onset</th>
<th>Organism</th>
<th>Connection between primary focus and spinal lesion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
<td>Male</td>
<td>L.4-5</td>
<td>Bowel</td>
<td>Not known</td>
<td>Streptococcus viridans from spinal lesion. Sal. parathyroid B from stools</td>
<td>Probable</td>
</tr>
<tr>
<td>2</td>
<td>56</td>
<td>Male</td>
<td>D.7-8</td>
<td>Boils on neck</td>
<td>1-2 months</td>
<td>Staphylococcus aureus recovered in repeated cultures of urine</td>
<td>Probable</td>
</tr>
<tr>
<td>3</td>
<td>24</td>
<td>Male</td>
<td>D.12-L.1</td>
<td>Carbuncle of temporal region</td>
<td>2-3 weeks</td>
<td>Staphylococcus aureus from blood and spinal lesion</td>
<td>Probable</td>
</tr>
<tr>
<td>4</td>
<td>26</td>
<td>Female</td>
<td>D.12-L.1</td>
<td>Uterus. Curettage for miscarriage</td>
<td>Within 1 week</td>
<td>Not recorded</td>
<td>Probable</td>
</tr>
<tr>
<td>5</td>
<td>67</td>
<td>Female</td>
<td>D.10-11</td>
<td>? Respiratory tract. Acute bronchitis</td>
<td>Within few days</td>
<td>Not recorded</td>
<td>Possible</td>
</tr>
<tr>
<td>6</td>
<td>64</td>
<td>Male</td>
<td>D.8-9</td>
<td>Urinary. Post-dilatation for urethral stricture</td>
<td>3 days</td>
<td>B. coli from blood</td>
<td>Probable</td>
</tr>
<tr>
<td>7</td>
<td>36</td>
<td>Female</td>
<td>C.3-4</td>
<td>Genital tract. Delivery of infant followed 1 month later by operation to tie tubes. Severe neck pain persisted following recovery from anaesthetic for the latter operation</td>
<td>1 month</td>
<td>Pneumococci from blood</td>
<td>Possible</td>
</tr>
<tr>
<td>8</td>
<td>64</td>
<td>Male</td>
<td>L.5-S.1</td>
<td>Urinary. Septicaemia following transurethral resection for low grade carcinoma of bladder</td>
<td>2 weeks</td>
<td>Staphylococcus aureus recovered from blood and urine</td>
<td>Probable</td>
</tr>
<tr>
<td>9</td>
<td>34</td>
<td>Male</td>
<td>C.6-7</td>
<td>Urinary. Stricture bladder neck with infection and vesical calculi</td>
<td>Bladder condition present from childhood</td>
<td>Not recorded</td>
<td>Probable</td>
</tr>
<tr>
<td>10</td>
<td>67</td>
<td>Female</td>
<td>L.4-5</td>
<td>Urinary. Partial nephrectomy for calculus</td>
<td>4 months</td>
<td>B. coli in urine</td>
<td>Probable</td>
</tr>
<tr>
<td>11</td>
<td>47</td>
<td>Male</td>
<td>L.3-4</td>
<td>Haemophilia. Operation for strangulated hernia. Infection of wound</td>
<td>1 month</td>
<td>Staphylococcus aureus recovered from abdominal wound</td>
<td>Probable</td>
</tr>
</tbody>
</table>

of the series the course of the disease and the radiological appearances raised the question of tuberculous spondylitis. In each case the nature of the infection was finally settled only after recovery of the causative organisms from the lesion: the staphylococcus was responsible for three of these cases, the streptococcus viridans for the fourth.

SOURCE OF INFECTION

A connection between the spinal lesion and a primary focus of infection is believed to have been present in eleven patients (Table III), the urinary system, female genitalia and bowel.
accounting for seven of the number. Three were secondary to superficial sepsis, and one other developed backache within a few days of acute respiratory infection. Four cases followed surgical operations, three on the urinary tract and one for incomplete abortion. Parturition or a later operation carried out for ligature of the tubes may have been responsible for the fifth case.

Urinary sepsis has provided the bulk of the now numerous examples of vertebral osteomyelitis secondary to infection within the body cavity (Henson and Coventry 1956, Henriques 1958, Wiley and Trueta 1959, Garcia and Grantham 1960, Beddow and Weisl 1961). This high incidence has attracted attention and the frequency with which organisms reach the blood-stream from the urinary tract has been shown on a number of occasions. Mitchell, Slade and Linton (1962) obtained positive blood cultures in 39 per cent of cases following instrumentation of the urethra and bladder carried out with the additional safeguard of antiseptic measures. The risk to the spine from this system is thus abundantly clear. Uncommon examples of the disease have also been described following septic abortion (Sherman and Schneider 1955) and operations on the colon and rectum (Lame 1956).

VERTEBRAL OSTEOMYELITIS IN THE ADOLESCENT

Although the often benign course of the disease in older subjects has been generally recognised following Kulowski’s publication (1936), the frequency with which low grade infection of the spine may occur in young patients has not perhaps been equally appreciated. The high proportion of such examples was an unexpected finding in this series. Of the five patients in the under twenty age group, the youngest of whom was ten years old, only one presented the classical picture of acute disease. One patient ran a subacute course, and the remaining three were examples of low grade infections. Differentiation from tuberculous spondylitis was not possible on clinical and radiological grounds alone in these three patients, and was made only after recovery of the organisms from the lesion. The streptococcus viridans was responsible for one case, the staphylococcus for the two others.

Our experience suggests that in young patients with insidious spinal infection the first consideration should be a pyogenic origin as tuberculosis is becoming more uncommon, with an incidence not as high in the young as in the older age groups. The series indicates that few, if any, patients with insidious infection enter hospital within two to three months of acquiring their disease, by which time radiology may point to the diagnosis. In the absence of such evidence, there seems little purpose in delaying steps to establish the nature of the infection, by open operation if necessary.

DIAGNOSIS IN RELATION TO THE SITE OF THE LESION

A noticeable feature to emerge from the series was the ease or otherwise experienced in recognising a spinal condition, depending on the level of the lesion. In the cervical, thoraco-lumbar and lumbar regions, pain, spasm and rigidity were usually sufficiently pronounced to attract attention. Two-thirds of the patients with such lesions were referred direct to orthopaedic departments with the diagnosis of a spinal condition, the remaining patients being first in the care of other specialities. In most of the latter the diagnosis was quickly rectified but two patients had an emergency laparotomy for a suspected abdominal condition.

In contrast, the more fixed thoracic spine proved a comparatively silent area. Back pain was never as incapacitating in this region as elsewhere and was tolerated for longer periods. In consequence, a spinal origin was more often overlooked in the early stages of the disease and there was a high proportion of diagnostic errors in this group. Of seven patients with lesions above the level of the tenth thoracic vertebra, no less than five were first suspected to have respiratory infections or cardiac, renal and digestive disorders.
COMPlications

Subluxation of the atlanto-axial joint occurred in one patient with acute disease of the second and third cervical vertebrae. Recovery followed appropriate treatment (Figs. 1 to 3).

Clinical abscesses requiring drainage were present in four patients. One patient, a haemophiliac with a large psoas abscess which needed drainage for relief of pain, discharged large quantities of pus up to the time of death. The other three patients healed satisfactorily.

Paraplegia occurred in three patients. These cases are of interest as all three exemplify the dangers of late diagnosis and were found to have considerable bone destruction and deformity at the time their lesions were discovered. One, a schizophrenic man aged forty-one, had weakness of both legs and a destructive lesion of the fifth and sixth thoracic vertebrae (Fig. 7) three months after treatment for a staphylococcal infection of the knee. The second patient, a robust man of fifty-four, had backache for some three months before taking to his bed with a chest infection. Within two weeks he became paraplegic. Radiographs showed an inflammatory lesion at the fifth and sixth thoracic vertebrae. Both these patients recovered. The third was a man aged sixty-four, who developed a staphylococcal septicemia after transurethral resection for a carcinoma of the bladder. The infection was brought under control with antibiotics and the patient left hospital. Weakness of the legs was discovered five months later at routine follow-up for his bladder condition. The condition progressed and the patient died. At necropsy an extensive inflammatory lesion at the lower end of the spine with complete destruction of the body of the fifth lumbar vertebra was found.

Respiratory infection—The sequence of events in three patients suggests that disease of the thoracic spine may occasionally predispose to respiratory infection and collapse of a lung base. In two patients an appreciable interval elapsed between the onset of back pain and the respiratory symptoms. In the third a spinal lesion came to light towards the end of a prolonged illness. Admitted originally on account of severe haematemesis, the patient developed a septicemia, and later a chest infection with collapse of the base of the left lung. In each patient the disease involved the mid-thoracic spine and all patients were men over the age of fifty. Radiographs revealed basal collapse in two of the cases.

Case 2—A man aged fifty-six had suffered a succession of boils on the neck during the months of October and November 1960. Towards the end of the period he became aware of vague backache but paid little attention to the symptom at first. The pain later radiated round the lower chest and into the upper abdomen, also from the level of the thoraco-lumbar region to the umbilicus. In the middle of January 1961 he developed an acute chest infection and was admitted to hospital where he was found to have collapse of the left base. Treated with antibiotics, he returned home after three weeks but never felt really well. In March 1961 he was readmitted with increased back pain which radiated into the chest and abdomen. Further investigations revealed a healing lesion involving the seventh and eighth thoracic vertebrae. Tomography also showed a small circumscribed lesion in the metaphysis of the eleventh thoracic vertebra.

TREATMENT

Most of the patients recovered with rest and antibiotic treatment, the duration depending on the clinical condition, radiological changes and sedimentation rate. Skull traction was used for six to eight weeks in three of the four patients with disease of the cervical spine, plaster beds for an average period of three months in sixteen other patients. In uncomplicated
cases the period of antibiotic treatment averaged two months, the choice of drug depending on the sensitivity of the organism if known, and the particular antibiotic in favour at the time of treatment. Some form of collar, jacket or brace was usually worn for upwards of six months after leaving hospital.

Operations to evacuate abscesses or to establish the diagnosis were done on five patients. In one with suspected tuberculosis of the thoracic spine, the resected rib was used to graft a cavity: fusion occurred without complication. Two other patients were readmitted at a later date, one for further drainage of an abscess, and the other, a woman with disease of the fourth and fifth cervical vertebrae (Figs. 8 to 10), was readmitted after a year because of persistent neck pain, which was fused.

![Fig. 8](image1)
![Fig. 9](image2)
![Fig. 10](image3)

Case 7—A woman aged 36 with erosion of the fourth and fifth cervical vertebrae and a large prevertebral abscess from a pneumococcal infection. Figure 8 shows the radiograph probably taken between seven and eleven weeks after the onset. Ten weeks later (Fig. 9) after eight weeks' skull traction, and (Fig. 10) after a further three months there is very slight deformity but spontaneous fusion had not occurred a year later. Because the patient still complained of pain, a posterior graft was done.

RESULTS

Three patients died. One of the deaths was connected with haemophilia and another resulted from a combination of paraplegia and urinary sepsis. The cause of the third death is not clear, but is thought to have been caused by left ventricular failure in a woman of sixty-four after septicaemia which had been controlled with antibiotics.

With the exception of one patient who discharged intermittently through a small sinus for a number of years before final healing, and the one patient with posterior grafting, none of the patients needed further treatment after leaving hospital. Seven are known to have remained well over periods ranging from five to fifteen years, and a further seven for two to five years. Eleven other patients were reported fit one year after leaving hospital.

CONCLUSIONS

The eighteen personal cases are from the records of one hospital, an incidence of almost one case per year that probably approximates to the experience of most large general hospitals. Though uncommon, pyogenic infection of the spine has to be constantly borne in mind if it is not to be overlooked.

Local pain in the spine was a feature common to all cases and most errors in diagnosis could be traced to a failure to pay proper attention to the symptom. The possibility of spinal
infection must be remembered especially during the convalescent phase of a septicaemia, as lesser degrees of backache might well be overlooked in the concern aroused by a serious illness. There is a strong argument in favour of routine radiography of the spine in such cases. Because of the relative immobility of the dorsal spine, lesions situated above the level of the tenth thoracic vertebra tend to be comparatively silent and may be overlooked for a long period, and the supervention of respiratory infection can be particularly misleading.

Case 15—A woman of 63 fell one month previously, since when she had complained of neck pain. The radiograph (Fig. 11) suggests that the disease of the sixth and seventh cervical vertebrae had been present for longer. The sclerosed appearance of the fifth and sixth cervical vertebrae is caused by Paget’s disease. Fourteen weeks later (Fig. 12) and after six weeks skull traction fusion is taking place. Eighteen months after onset (Fig. 13) fusion has occurred with very slight deformity.

Exactly half the patients came direct into orthopaedic hands with the diagnosis of a spinal condition, the remainder being referred from consultant sources after other causes for the illness had been eliminated. From a purely orthopaedic standpoint, the problem was therefore usually reduced to differentiating between pyogenic and tuberculous infection. The course of the disease and the radiological signs were sufficient to determine the nature of the infection in all but four patients.

The series produced no clear evidence that operation helps to produce a better result than conservative management alone. Antibiotic therapy, administered in high dosage for at least six to eight weeks, is of paramount importance, but the rapidity with which bone healing appears in radiographs may throw doubt on the need for prolonged immobilisation in some cases. This may be a helpful matter when the more elderly patient is considered, who may not tolerate a long period in a plaster bed. In cervical lesions we found skull calipers to be of great value. It helped to prevent gross collapse of vertebrae and it was impressive how recalcification of the apparently destroyed structures took place beyond what one would have expected from the original films (Figs. 8 to 13).

SUMMARY
1. Twenty-eight patients with pyogenic infection of the spine are reported.
2. Diagnosis was by clinical, radiological and bacteriological means. Investigations of the spinal lesions by needle aspiration or open operation was needed in four patients.
3. Treatment consisted primarily of antibiotics and rest.
4. Twenty-five patients were fit and well after follow-up of one to fifteen years. Three deaths occurred, but only one was directly connected with the infection; urinary infection with paraplegia and haemophilia were the cause in two others.

5. The relatively benign course is stressed, as are some of the diagnostic pitfalls in the early stages, particularly with thoracic lesions.

We have pleasure in thanking our colleagues in the Bristol area for permission to examine their case records.

REFERENCES


