PYOGENIC INFECTIONS OCCURRING PRIMARILY IN INTERVERTEBRAL DISCS

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Pyogenic osteomyelitis of the spine has been fully described by Wilensky (1929), Kulowski (1936), Compere and Garrison (1936), Guri (1946), Wiley and Trueta (1959), Robinson and Lessof (1961), Pritchard and Robinson (1961) and recently by Griffiths and Jones (1971). Pyogenic infection of the intervertebral disc in children has been documented by Saenger (1950), Bremner and Neligan (1953), Dupont and Andersen (1956), Mathews, Wiltse and Karbelnig (1957), Doyle (1960), Jamison, Heimlich, Miethke and O'Loughlin (1961), Milone, Bianco and Ivins (1962) and by Menelaus (1964). However, the latter condition has not been so clearly recognised in the adult, for, as Ghormley, Bickel and Dickson (1940) suggested, many authors do not differentiate between osteomyelitis and intervertebral disc infections. Ghormley and colleagues described what they considered to be an acute infectious lesion of the intervertebral disc in twenty patients ranging in age from nine to fifty-nine, basing their evidence on clinical and radiological observations.

Although it is generally accepted that the lesion is caused by pyogenic infection in childhood, Alexander (1970) suggested that infection was only an occasional cause and that most cases complicated partial dislocation of the epiphysis of the vertebral body during growth. It has been difficult to obtain evidence of the etiology of the condition in children, though Milone et al. (1962) obtained material either by needling or by open biopsy from five of their young patients and cultured Staphylococcus aureus on each occasion. Doyle (1960) and Menelaus (1964) showed that in children the infection remained within the disc, the duration of the disease was relatively short and the prognosis was excellent, provided treatment was adequate.

For the past twelve years it has been the practice at the Royal National Orthopaedic Hospital to explore nearly all inflammatory lesions of the spine in order to confirm or establish the diagnosis, to isolate and determine the antibiotic sensitivities of the organism, and to perform radical clearance of diseased tissues. Grafts have been inserted whenever the stability of the affected area was in question. This radical approach, based on the work of Hodgson and Stock (1956, 1960) was adopted in order to assess its value in the management of spinal infections and is the subject of a separate review (Kemp, Jackson, Jeremiah and Cook 1973).

The purpose of this paper is to define infections of the intervertebral disc in the late adolescent and in the adult, to compare and contrast the presentation with the condition observed in children, and to consider the management and prognosis.

CLINICAL PRESENTATION

Over the past six years fifteen patients, thirteen men and two women, between the ages of seventeen and seventy-two, have been admitted to this hospital with infections of intervertebral discs (Table I). The levels affected were similar to those in the cases reported by Menelaus (1964). The series described by Ghormley and colleagues (1940) showed a similar male preponderance, though Menelaus (1964) observed a greater frequency in the female child. Only one patient presented initially at the hospital; the remaining patients were referred from other centres. For this reason it was not possible to assess accurately the severity of the prodromal infection and the associated sepsicaemia. Ghormley and colleagues (1940) stated that most of their patients were severely ill. In contrast, only five of the patients in
the present series were similarly affected. In four of these, the systemic reaction could be
directly attributed to the primary disease. One of these patients (Case 5) had a brief undiagnosed
febrile illness associated with rigors and he was treated empirically with antibiotics and
steroids by his own practitioner.

A significant feature was the interval between the onset of symptoms and the establishment
of the diagnosis. The shortest period was three months, the longest eighteen months. The

<table>
<thead>
<tr>
<th>Level of involvement</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thoracic</td>
<td></td>
</tr>
<tr>
<td>5/6.</td>
<td>2</td>
</tr>
<tr>
<td>6/7.</td>
<td>2</td>
</tr>
<tr>
<td>7/8.</td>
<td>3</td>
</tr>
<tr>
<td>8/9.</td>
<td>1</td>
</tr>
<tr>
<td>9/10.</td>
<td>2</td>
</tr>
<tr>
<td>Thoraco-lumbar</td>
<td>1</td>
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<tr>
<td>Lumbar</td>
<td></td>
</tr>
<tr>
<td>1/2.</td>
<td>0</td>
</tr>
<tr>
<td>2/3.</td>
<td>1</td>
</tr>
<tr>
<td>3/4.</td>
<td>3</td>
</tr>
<tr>
<td>4/5.</td>
<td>2</td>
</tr>
<tr>
<td>Lumbo-sacral</td>
<td>1</td>
</tr>
</tbody>
</table>

mean average was 6.8 months. This is approximately three times as long as the period
quoted by Griffiths and Jones (1971) for pyogenic osteomyelitis of the spine.

All patients complained of back pain which they could localise accurately. With one
exception, all patients with disease in the lumbar region had referred pain of femoral or sciatic
distribution. They showed local tenderness, paravertebral muscle spasm and limitation of
movement. Patients previously treated by conservative measures such as bed rest, plaster
immobilisation and administration of antibiotics were relieved of their symptoms. However,
the symptoms recurred as soon as the patient was mobilised or treatment was stopped.

Clinico-pathological investigations (Table II)—The leucocyte count and the erythrocyte
sedimentation rate were of little value in the initial investigations, in that they did not appear
to show any relation to the severity of the disease process. In three patients (Cases 1, 10 and 11)
the erythrocyte sedimentation rate was within accepted limits of normality even though the
organism was isolated from the infected disc in two of the patients. However, as a guide to
the response to treatment, this test was conducted at monthly intervals and was a relatively
accurate indicator of the patient’s reaction.

Specific investigations included the anti-alpha haemolysin, the anti-Panton Valentine
leucocidin and the anti-streptolysin O titres as these were considered relevant in the diagnosis
of the causative lesion.

Staphylococcus pyogenes was isolated from the intervertebral discs of five patients and from
the primary source in three of the patients. In one other patient the organism was isolated only
from the primary lesion. The anti-alpha-haemolysin titre was elevated in three of these patients
and the anti-Panton Valentine leucocidin was elevated in two. In the remaining three patients
the titres were not raised, even though the organism was isolated from the affected intervertebral
disc. The anti-streptolysin O titre was performed on all but one of the patients. Streptococcus
pyogenes was not cultured in any of these patients. A titre of 750 was obtained in a youth
aged eighteen, but when the test was repeated a week later the titre was found to be normal.
TABLE II
CLINICAL DETAILS OF FIFTEEN PATIENTS WITH PYOGENIC INFECTIONS OF INTERVERTEBRAL DISCS

<table>
<thead>
<tr>
<th>Case number</th>
<th>Sex</th>
<th>Age (years)</th>
<th>Duration of symptoms (months)</th>
<th>Level</th>
<th>Site of pain</th>
<th>Paraplegia</th>
<th>Mantoux Test</th>
<th>Erythrocyte sedimentation rate</th>
<th>Anti-alpha haemolysin titre</th>
<th>Anti-P.V. leucocidin titre</th>
<th>Anti-streptolysin O titre</th>
<th>Leucocyte count</th>
<th>F18 scan</th>
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<tbody>
<tr>
<td>1</td>
<td>Male</td>
<td>61</td>
<td>4</td>
<td>T.5–6</td>
<td>Back</td>
<td>Mild Recovered</td>
<td>+</td>
<td>10</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>8,000</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Male</td>
<td>63</td>
<td>3</td>
<td>L.3–4</td>
<td>Back (right)</td>
<td>Test not done</td>
<td>–</td>
<td>50</td>
<td>Test not done</td>
<td>Test not done</td>
<td>Test not done</td>
<td>10,000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Male</td>
<td>34</td>
<td>6</td>
<td>T.9–10</td>
<td>Back</td>
<td>Complete Recovered</td>
<td>+</td>
<td>71</td>
<td>8–10</td>
<td>64</td>
<td>Normal</td>
<td>7,000</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Male</td>
<td>55</td>
<td>6</td>
<td>T.7–8</td>
<td>Back</td>
<td>Complete Recovered</td>
<td>+</td>
<td>126</td>
<td>20–32</td>
<td>64</td>
<td>Normal</td>
<td>13,000</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Male</td>
<td>46</td>
<td>6</td>
<td>T.7–8</td>
<td>Back</td>
<td>Complete Recovered</td>
<td>+</td>
<td>20</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>7,500</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Male</td>
<td>72</td>
<td>6</td>
<td>T.6–7</td>
<td>Back (right)</td>
<td>Complete Recovered</td>
<td>+</td>
<td>38</td>
<td>2–4</td>
<td>Normal</td>
<td>Normal</td>
<td>6,000</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Male</td>
<td>33</td>
<td>12</td>
<td>L.4–5 L.5–S.1</td>
<td>Back</td>
<td>Back</td>
<td>Complete Recovered</td>
<td>+</td>
<td>119</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>9,000</td>
</tr>
<tr>
<td>8</td>
<td>Male</td>
<td>61</td>
<td>6</td>
<td>T.6–7</td>
<td>Back</td>
<td>Incomplete Recovered</td>
<td>+</td>
<td>100</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>7,000</td>
<td>Test not done</td>
</tr>
<tr>
<td>9</td>
<td>Female</td>
<td>60</td>
<td>5</td>
<td>T.8–9</td>
<td>Back</td>
<td>+</td>
<td>58</td>
<td>&gt;40</td>
<td>16</td>
<td>Normal</td>
<td>Normal</td>
<td>8,000</td>
<td>+</td>
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<tr>
<td>10</td>
<td>Male</td>
<td>17</td>
<td>7</td>
<td>L.3–4</td>
<td>Back (right)</td>
<td>Complete Recovered</td>
<td>+</td>
<td>10</td>
<td>16–20</td>
<td>8</td>
<td>Normal</td>
<td>8,000</td>
<td>+</td>
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<tr>
<td>11</td>
<td>Male</td>
<td>32</td>
<td>18</td>
<td>L.4–5</td>
<td>Back (right)</td>
<td>Complete Recovered</td>
<td>–</td>
<td>8</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>8,500</td>
<td>+</td>
</tr>
<tr>
<td>12</td>
<td>Female</td>
<td>48</td>
<td>6</td>
<td>T.7–8</td>
<td>Back</td>
<td>Complete Recovered</td>
<td>–</td>
<td>88</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>9,000</td>
<td>+</td>
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<tr>
<td>13</td>
<td>Male</td>
<td>57</td>
<td>5</td>
<td>T.5–6</td>
<td>Back</td>
<td>Complete Recovered</td>
<td>+</td>
<td>130</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>10,200</td>
<td>Test not done</td>
</tr>
<tr>
<td>14</td>
<td>Male</td>
<td>46</td>
<td>10</td>
<td>T.9–10 L.3–4</td>
<td>Back</td>
<td>Back</td>
<td>Complete Recovered</td>
<td>+</td>
<td>110</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>10,000</td>
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<tr>
<td>15</td>
<td>Male</td>
<td>18</td>
<td>12</td>
<td>T.12–L.1</td>
<td>Back</td>
<td>+</td>
<td>Complete Recovered</td>
<td>–</td>
<td>59</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
<td>750</td>
</tr>
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</table>
Radiological features—Many of the radiological features observed in these patients were previously reported by Flemming (1935) as typifying chronic osteomyelitis of the spine. Ghormley and colleagues (1940) described similar changes in infectious lesions of intervertebral discs. Similar though less extensive radiological changes were reported in children by Doyle (1960) and by Menelaus (1964). The earliest radiological change observed in patients with inflammatory lesions primarily involving the intervertebral disc was a decrease in the vertical height of the affected intervertebral disc space (Figs. 1, 5, 9, 12 and 15). This feature was observed in the seven patients radiographed during the first three months of the disease. One patient, who had no apparent prodromal disease, had symptoms and signs localised to the affected disc and a persistently raised erythrocyte sedimentation rate (28-44 millimetres in the first hour) for six weeks before radiological evidence of narrowing of the disc space became apparent. The degree of narrowing was variable and did not appear to be related to the subsequent progress of the disease.

![Fig. 1](image1.png)  ![Fig. 2](image2.png)  ![Fig. 3](image3.png)  ![Fig. 4](image4.png)

The radiological features of pyogenic infection arising primarily in the intervertebral disc. The earliest radiological sign is narrowing of the affected intervertebral space (Fig. 1). It is followed by an increase in the density of the adjacent areas of the proximal and distal vertebral bodies. The increase in density is due to the deposition of new bone on existing trabeculae and to subperiosteal new bone formation (Fig. 2). After a variable period, erosion of the vertebral plates occurs. It is associated with reactive bone sclerosis (Fig. 3). Approximately 50 per cent of the lesions do not progress beyond this stage. Attempts at healing may occur by circumferential bone bridging. The remaining lesions show evidence of progression, characterised by ballooning of the affected disc space and an extension of density to involve the vertebral body remnants (Fig. 4).

Myelography in these patients shows posterior extension of the inflammatory granulations.

Within two to three months of the appearance of narrowing of the affected disc space the second radiological sign was observed, namely progressive sclerosis of the subchondral bone in association with an increase in density of the adjacent areas of the vertebral bodies on either side of the affected disc. It was also observed, in the lateral tomographs which were routinely taken of the affected area, that the increase in vertebral density was due to the deposition of new bone on existing trabeculae and that this was enhanced by associated subperiosteal new bone formation (Figs. 2, 6, 9, 13 and 16). The third radiological feature was a progressive irregularity of the adjacent vertebral plates; though in one patient these changes were not manifest until twelve months after the onset of the disease (Figs. 3, 8, 13 and 16). It was considered, and subsequently demonstrated, that these changes represented local extension of the inflammatory process and that the sclerosis of the margins of the vertebral bodies was a reactive response to the infection.

Subsequent radiological examination showed that the disease process could exhibit a variable course. The infection could remain entirely confined to the disc space, the intervertebral narrowing and the associated radiological changes becoming more pronounced.
Case 11—A 32-year-old man presented with a six-month history of low back pain and sciatica. The original radiographs showed narrowing of the intervertebral space, increased density of the adjacent vertebrae and slight evidence of periosteal new bone formation (Fig. 5). Symptoms persisted; when he returned twelve months later radiographs showed only slight progression of the lesion (Fig. 6).
In approximately half the observed lesions the disease was found to be limited in this manner. In the remaining patients there was radiological evidence of direct spread of the inflammatory process to involve the adjacent vertebrae. Relatively late in presentation, the evidence of vertebral involvement is recognised by the phenomenon of “ballooning” of the intervertebral disc space (Figs. 4, 17, 18, 20 and 21). This ballooning is associated with erosion of the vertebral bodies. Such erosions may occur equally or may preponderate in one vertebral body. Even in patients who are not seen until this stage is well established, it is still possible to recognise the initial site of the infection by the presence of ballooning and the associated density of the residual portions of the adjacent intervertebral bodies.

![Image](image.png)

**FIG. 7**
Case 11 (see Figures 5 and 6)—Lateral myelography and tomography show minimal erosion of the intervertebral plates (Figs. 7 and 8). There is slight bulging of the disc posteriorly (Fig. 7).

Attempted repair may occur at any stage of the disease and can be recognised by the circumferential formation of bone around the annulus. This appears radiologically as a bony bridge and can often be extremely bizarre in appearance (Figs. 10, 11, 13, 14 and 16). Unlike the repair process in osteomyelitis, healing does not apparently occur by intervertebral fusion, even when the affected disc space is cleared by operation. However, according to Menelaus (1964) it may occur spontaneously in childhood. These radiological features differ from those observed in tuberculous and pyogenic osteomyelitis. In both forms of osteomyelitis, narrowing and subsequent loss of the disc space is an early and relatively common feature. It can be seen in serial tomography to be due to attenuation and subsequent infractions of diseased vertebral plates. This permits the disc to herniate into the medullary region of the vertebra. In pyogenic lesions the disc is also directly destroyed by the action of exotoxins. In tuberculosis there is early destruction of bone which is recognised by the loss of definition and collapse of the affected vertebral bodies. It is observed in routine radiographs and in tomographs, and is a sequel to trabecular death. Similar changes are observed in pyogenic osteomyelitis, though they are often associated with irregular bone density. This manifestation can be seen, in serial tomographs, to be due to the deposition of new bone on trabeculae unaffected by the inflammatory process.
Case 4—A 55-year-old man with multiple lesions. The lumbar lesion was not explored. The initial radiographs (Fig. 9) show narrowing of the intervertebral space and increased density of the vertebral bodies anteriorly. Five months later, after prolonged antibiotic therapy, there was further narrowing of the disc. Unilateral bridging had occurred (Fig. 10).
It is well recognised that abscess formation in pyogenic osteomyelitis is less common than it is in tuberculous osteomyelitis. It was a feature of infections primarily involving intervertebral discs that abscess formation was not observed on radiological examination at any stage. Myelographic examination of patients with cord involvement showed filling defects in the subarachnoid space at the level of the affected disc that could be construed as being due to abscess formation (Figs. 7 and 19). It will be shown in the operative findings that the cause of these filling defects is proliferation of inflammatory granulomatous tissues extending posteriorly.

Radioactive isotope scanning—The use of scanning in the diagnosis of spinal infection is described separately (Kemp, Johns, McAlister and Godlee 1973). It was used diagnostically in seven patients. Increased isotope uptake was constantly observed at the site of the lesion. The test is regarded as a valuable adjunct to the standard radiological investigations.

Findings at operation—These showed a close correlation with the radiographic appearances, though like the radiographs they exhibited a wide variation in terms of the pathology, reflecting the stage of the disease and the activity of the infection.

In the course of exposing the affected intervertebral space, when the lesion was localised it was noted that there was no paravertebral swelling and that there was only a minimal reaction of the overlying pleura or peritoneum. It was frequently adherent and the vessels were dilated in the proximity of the intervertebral disc. When the soft tissues were divided and retracted, the level of the lesion could be recognised by the deposition of subperiosteal bone on otherwise normal vertebral bodies on either side of the affected disc. The principal pathological changes and variations were observed in the intervertebral space. In two patients (Cases 2 and 7) the disc was found to be totally sequestrated, lying free in the intervertebral space. In consequence, on manual extension of the affected area it was possible to lift out
Case 10—A 17-year-old boy originally came with back and thigh pain which had been present for seven months. The radiographs showed narrowing of the disc space and increasing density of the adjacent vertebrae (Fig. 12). One month later the lesion had progressed and radiologically there was early erosion of the vertebral plates (Fig. 13). At operation the disease was limited to the intervertebral disc, which was removed. Staphylococcus pyogenes was isolated.
the affected disc. In the first patient the disc was discoloured; in the second it was yellowish, necrotic and covered with a thin film of pus and patches of granulation tissue. On further exploration of the disc space in these two patients, it was found that erosion of the epiphysial cartilage had occurred, though the subchondral bone plates were intact.

In other cases it was necessary to fenestrate the annulus fibrosus in order to remove the affected disc contents. When the infection had been relatively recent or was known to be active, the nucleus pulposus was replaced by exuberant inflammatory tissue; occasionally, these granulations had ruptured through the annulus fibrosus. In the chronic stages of the disease such granulations had been partly replaced by fibroblastic tissue and the affected disc was found to be considerably narrowed.

Progressive lesions were technically extremely difficult to explore, because of widespread fibrous adhesions involving tissues related to the affected disc. In one patient this had caused a broncho-pleural fistula, necessitating lobectomy.

Patients with paraplegia required extensive exploration in order to decompress the spinal cord. Two of these patients had been subjected to radical laminectomy before their admission. The operation notes on the patient with a total and irreversible paraplegia (Case 13) recorded that inflammatory granulation tissues completely surrounded the cord, producing a circumscribed pachymeningitis. Of the patient (Case 8) who became paraplegic immediately after operation, it was reported that there was a localised area of pachymeningitis anteriorly. At subsequent exploration by an anterior approach, a large spherical cavity was observed filled with prolific granulation tissue. The wall consisted of sclerotic bone. The previous laminectomy had caused partial collapse and resulted in a kyphos at the level of the lesion (Figs. 20 and 21). Subsequent infolding of the ossified posterior longitudinal ligament formed a ridge which further compressed the cord. Clearance of this mechanical barrier and the removal of the inflammatory tissue which had extended to involve the meninges, coupled with
Case 15—An 18-year-old boy presented with backache (Fig. 15). The radiographs show narrowing of the disc space. Treated conservatively, he failed to respond and was referred after twelve months. At this stage all the radiological signs were present. The radiographs suggested that erosion of the vertebral plates had occurred (Fig. 16). Operatively and histologically the disease was still confined to the intervertebral space.
an iliac graft to compensate for the partial collapse of the affected vertebrae, allowed the cord to expand. The patient subsequently recovered from the paraplegia.

In the remaining four patients, anterior decompression of the cord was performed. It was a constant finding in all these patients that inflammatory granulation tissue extended backwards from the affected disc space. In three, it was possible to clear the granulation tissue from the dura. In the fourth patient, whose paraplegia was irreversible, it was found that the inflammatory granuloma had eroded the meninges to involve the cord.

The affected disc was completely removed whenever this was technically possible. Grafting was performed only if it had been necessary to explore the spinal cord. In those patients in whom clearance of the disc space had been carried out, circumferential bony bridging occurred in about twelve months.
Case 8—A 60-year-old man, previously subjected to an extensive laminectomy, as a sequel developed a slight kyphus. The lateral radiograph and tomograph, taken later, still showed ballooning of the affected disc and density of the vertebral remnants.

Case 15—Histological section shows that the disc is almost completely replaced by inflammatory tissue. Virtually all the cartilage on the vertebral plates has been destroyed. The section shows one surviving plaque of cartilage (top right). Normal bone is seen at the top of the section. (×100.)
Pathology—In addition to the removal of the affected disc, specimens were taken of the adjacent vertebral bodies. The affected discs were found to be replaced partly or entirely by inflammatory granulation tissue (Fig. 22). The adjacent vertebrae showed the deposition of new bone or osteoid on existing trabeculae—a reaction which was presumed to be a non-specific response to the generalised hyperaemia induced by the infection of the intervertebral disc. The intertrabecular spaces were filled by fibroblastic tissues. Only in those patients in whom the disease had spread to involve the adjacent vertebrae were there changes consistent with osteomyelitis. In these instances inflammatory tissue invaded the intertrabecular spaces and trabecular death and collapse were evident over a limited area. These pathological findings confirmed the radiographic appearances.

### TABLE III

<table>
<thead>
<tr>
<th>Case number</th>
<th>Primary infection and complications</th>
<th>Organism isolated from primary infections</th>
<th>Pre-operative antibiotic in therapeutic dosage</th>
<th>Organism isolated from disc at operation</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Pyelitis</td>
<td>B. proteus (urine)</td>
<td>No</td>
<td>B. proteus</td>
</tr>
<tr>
<td>2</td>
<td>Enlarged prostate: self-instrumentation knitting needle</td>
<td>E. coli: B. proteus (urine)</td>
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<tr>
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<td>Chronic dermatitis. Secondarily infected</td>
<td>Staph. pyogenes (skin)</td>
<td>No</td>
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<tr>
<td>4</td>
<td>Rh.A. (10 years). Pyogenic polyarthritis (2 years previously). Recurrent furunculosis</td>
<td>Staph. pyogenes (furuncle)</td>
<td>No</td>
<td>E. coli: B. proteus</td>
</tr>
<tr>
<td>7</td>
<td>No known infection</td>
<td>Negative</td>
<td>No</td>
<td>B. proteus</td>
</tr>
<tr>
<td>8</td>
<td>Nephrolithotomy. Recurrent pyelitis (D.M.)</td>
<td>E. coli (urine)</td>
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<td>Negative</td>
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<tr>
<td>9</td>
<td>Herpes zoster. Secondarily infected</td>
<td>Negative</td>
<td>No</td>
<td>Negative</td>
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<td>10</td>
<td>No known infection</td>
<td>Negative</td>
<td>No</td>
<td>Staph. pyogenes</td>
</tr>
<tr>
<td>12</td>
<td>Recurrent pyelitis (D.M. 10 years)</td>
<td>E. coli (urine)</td>
<td>Yes</td>
<td>Negative</td>
</tr>
<tr>
<td>13</td>
<td>Phlebitis. Septicaemia. Septic broncho-pneumonia</td>
<td>Staph. pyogenes (blood, urine, sputum)</td>
<td>No</td>
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<tr>
<td>15</td>
<td>Known drug addict. ? Intravenous administration</td>
<td>Negative</td>
<td>No</td>
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</tbody>
</table>

**Bacteriology**—In nine of the fifteen patients the causative organism was isolated from the affected disc. The commonest organism was Staphylococcus pyogenes, which was obtained from five patients. E. coli was isolated on two occasions and B. proteus on three. Culture was negative in three patients (Cases 5, 8 and 12) who had received adequate treatment with antibiotics before operation, and in three patients who had not received it (Table III).  

**Complications**—The most serious feature was the affection of the spinal cord in six patients. Three patients were partly paraplegic and three patients were totally paraplegic. The patient in Case 1 was initially paraplegic and recovered after decompression. The patient in Case 4 had multiple spinal lesions. In addition to involvement of the discs between the seventh and eighth thoracic and the second and third lumbar vertebrae he had osteomyelitis of the third and fourth cervical vertebrae. Totally paraplegic below the seventh thoracic level, he recovered
completely after anterior decompression at this level. The patient in Case 8 had had an exploratory laminectomy three months before admission. He was found to be paraplegic below the sixth thoracic level after operation, apart from limited sensory preservation. After anterior decompression and grafting he recovered progressively, regaining sphincteric control, though when he was last seen his lower limbs were still hypertonic. The patient in Case 12 was incompletely paraplegic. She recovered completely after specific antibiotic therapy and anterior decompression. The patients in Cases 13 and 14 were both totally paraplegic and have remained so. The operative findings have been described above. Three of the patients who developed paraplegia were diabetics. In Cases 8 and 14 this was discovered in the course of routine investigation. In Case 12 diabetes had been stabilised on insulin for the previous ten years.

**DISCUSSION**

**Prodromal infection**—Evidence has been presented by Hurwitz and Albertson (1950), Adelman and Duff (1952), Henson and Coventry (1956), Henriques (1958), Garcia and Grantham (1960), Beddow and Weisl (1961) and Griffiths and Jones (1971) that pyogenic osteomyelitis of the spine occurs most commonly as a sequel to urological infection or to urological procedures. In the present series only three of the thirteen patients with known prodromal lesions had urological infections.

It has been suggested that pyogenic osteomyelitis of the spine occurs by means of the vertebral venous plexus of Batson (1940). Doyle (1960) postulated that infections of intervertebral discs in children might also take place by this means. However, Wiley and Trueta (1959), supporting their observations with clinical evidence, demonstrated by vascular studies that it was extremely unlikely that the venous plexus was responsible for the spread of infection to the spine. Their belief that osteomyelitis of the spine was due to haematogenous spread was supported by Ghormley and colleagues (1940). The connection between pyogenic infections of the spine and intervertebral discs and urological procedures appears to be derived from the bacteremia which commonly follows such procedures. Barrington and Wright (1930) obtained positive blood cultures after simple procedures such as catheterisation, and Mitchell, Slade and Linton (1962) found positive cultures in 39 per cent of their series.

**Blood supply of the intervertebral disc**—Although it is generally believed that the intervertebral disc becomes avascular in adult life, Coventry, Ghormley and Kernohan (1945) showed that there was an adequate blood supply to the intervertebral disc until the age of thirty. Smith (1931) demonstrated that the intervertebral disc did not become avascular, even in the elderly. Wiley and Trueta (1959), Mineiro (1965) and Hassler (1970) subsequently showed that although the blood supply to the intervertebral disc diminished with age, from decrease in the number of vessels which enter the nucleus pulposus from the adjacent vertebrae by perforating the vertebral plates, an adequate circumferential supply was maintained from the periphery. Wiley and Trueta (1959) and Mineiro (1965) showed that the segmental vessels responsible for the blood supply of the vertebral bodies freely anastomosed and supplied the intervertebral disc around the circumference of the annulus fibrosus. Mineiro showed that these vessels penetrated as far as the junction between the annulus and the nucleus pulposus. Consequently, it would be reasonable to postulate that infections of intervertebral discs may occur in a similar manner to infections of the vertebral bodies.

**Diagnosis, prognosis and treatment**—The outlook for the patients in this series was more serious than that in the cases reported by Ghormley and colleagues (1940). Several factors contributed to this poor prognosis. First, diagnosis was delayed in most of the patients. This was due partly to failure to recognise the radiological signs of the lesion. The clinico-pathological investigations were frequently of little diagnostic assistance; the only test that was consistently helpful was the isotope scan.

Secondly, the disease exhibits a chronicity in the late adolescent and adult that is not observed in children. Several patients had been treated by the conservative methods employed
by Doyle and Menelaus. Their symptoms recurred when treatment ceased. These findings were in contrast with those observed by Flemming (1935) and Ghormley and colleagues (1940).

Thirdly, the most serious feature was the high incidence of spinal cord affection (40 per cent). Even if allowance is made for the fact that three of the patients were diabetics, the figure is still higher than that reported by Kulowski (1936) in pyogenic osteomyelitis of the spine. Further, unlike the paraplegia of early onset due to tuberculous infection, the paraplegia complicating involvement of the intervertebral disc is often rapid in development and is more frequently irreversible because of actual involvement of the cord (13.3 per cent). It seems from the operative findings that the paraplegia is mainly due to direct extension of the inflammatory granulations posteriorly to involve the meninges and occasionally the cord. The mechanisms of cord damage are probably similar to those described by Kulowski, in that compression of the cord may result from inflammatory infiltration and oedema of the meninges or it may be due to septic thrombosis of the spinal vessels.

Some of the patients in this series had healing lesions after adequate antibiotic therapy, and it is possible that closed measures could arrest the progress of the disease. Such an approach would be justified in patients with localised lesions if the causative organism could be identified by blood culture or by needle biopsy, particularly when it is recognised that exploration may be technically difficult. However, clearance of the disc space can relieve the patient of his symptoms and may reduce the morbidity of the condition. It usually permits the isolation of the infecting organism, facilitating the determination of antibiotic sensitivities. It may prevent extension of the disease and is an emergency procedure in the presence of impending paraplegia.

CONCLUSION

Pyogenic infection of the spine may present primarily as a pyogenic osteomyelitis of the vertebral body or as an infection of the intervertebral disc. The two conditions appear to share a common etiology in that they usually occur secondarily to existing or preceding infection. They differ in their site of involvement and in their clinical and radiological presentation.

It has been our intention to stress these differences because pyogenic infections of the spine arising primarily in the intervertebral disc are not so widely recognised as infections arising primarily in the intervertebral body. The failure to appreciate the nature of this lesion may lead to delay in the initiation of adequate treatment and increase the risk of complications which are common to both conditions.

SUMMARY

1. Pyogenic infection of the intervertebral disc in fifteen patients is described.
2. The importance of certain radiological signs in establishing the diagnosis is discussed.
3. Delayed diagnosis is believed to be responsible for the high incidence of paraplegia in this condition.
4. The place of operation in the management of this lesion is considered.

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REFERENCES


