Pyogenic osteomyelitis of the spine in the elderly

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The authors report 10 cases of spontaneous pyogenic spinal osteomyelitis encountered within a 3-year period. There were six women and four men, ranging in age from 60 to 84 years. Six cases occurred at the thoracic level, three at the lumbar level, and one in the cervical spine. No patient was diabetic, immunocompromised, or receiving steroid therapy, and none had a history of endocarditis or intravenous drug abuse. No patient had undergone previous spinal surgery. There were no instances of coexisting tuberculosis or malignancy. Contemporaneous cases with known predisposing factors have been excluded from this report; however, three patients did have a recent history of somatic infection, one with known sepsis. All 10 patients had been previously misdiagnosed, frequently by neurosurgeons and orthopedists as well as by internists and family practitioners. Three had undergone inappropriate or unnecessary surgical procedures, and two had received inappropriate radiation therapy. Seven cases were caused by Staphylococcus species. Gram-negative bacteria, or anaerobic infections. In the other three, no bacteriological diagnosis was made, secondary to prolonged antibiotic therapy before surgery. Each patient had developed symptomatic neural element compression, spinal instability, or both by the time of their referral.

The patients with subcervical pyogenic spinal osteomyelitis underwent transthoracic or retroperitoneal decompression and corpectomy with simultaneous autologous bone grafting, followed by 6 weeks of bed rest and 6 weeks of intravenous broad-spectrum or organism-specific antibiotic therapy. They were then mobilized in orthoses for an additional 6 weeks. In no case were foreign implants employed or further stabilization procedures necessitated. One patient required an additional 6 weeks of antibiotics for recalcitrant Pseudomonas colonization.

Despite the patients’ advanced age and the extensive surgical procedures, there was no mortality and no neurological morbidity. All patients were asymptomatic or demonstrated objective improvement upon discharge from the hospital. In this subset of patients with spontaneous pyogenic vertebral osteomyelitis, the only predisposing factor was advanced age.

KEY WORDS • osteomyelitis • spinal disease • pyogenic vertebral osteomyelitis

Despite repeated warnings in the texts and journals of many specialties,5,6,8,15,16,23,26,29-34 the diagnosis of spinal osteomyelitis is still often missed, even by those who profess to specialize in spinal disease. The problem of missed diagnosis persists despite the fact that the diagnosis can usually be made on plain radiographic studies and despite the availability of computerized tomography (CT) scanning, two useful types of isotope scanning, and the virtually definitive radiographic evidence provided by magnetic resonance (MR) imaging. While the symptoms and signs of spinal osteomyelitis may well be nonspecific, the frequency with which the disease is misdiagnosed should be of much concern to the medical community.

As the incidence of tuberculous spinal osteomyelitis (Pott’s disease) has waned with improved antituberculous therapy, the occurrence of pyogenic disease has waxed.31 The literature is replete with cases of pyogenic spinal osteomyelitis reported in diabetic and immuno-compromised hosts, particularly in patients harboring malignancies on antimetabolite treatment and those receiving chronic steroid therapy or dialysis. Cases that follow elective disc or other spine surgery are also widely known and rarely missed. Over the past 10 years, there has been an alarming increase in the number of cases documented among intravenous drug abusers and others with endocarditis.18,19,24,28,33,35 Indeed, we have also seen many cases of pyogenic spinal osteomyelitis among these groups that were misdiagnosed despite the known predisposing factors. We excluded the more typical cases from this report and found a surprisingly large group of remaining patients who have no apparent predisposition beyond advanced age. All of the present cases were misdiagnosed, some for prolonged intervals, and were allowed to progress to segmental vertebral destruction, spinal instability, or neural compromise, thus necessitating major surgical procedures to decompress the spinal canal and restore stability. Several pa-
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tients underwent unnecessary or inappropriate surgical procedures before the correct diagnosis was made. Laminectomies for "degenerative stenosis" or "presumed tumor" further destabilized an already compromised canal in some cases. Two patients were even subjected to radiation therapy.

Clinical Material and Methods

Between 1986 and 1988, approximately 25 cases of pyogenic osteomyelitis of the spine were encountered at our institution. Ten of these patients had no history of diabetes mellitus, collagen vascular disease, or other immunocompromising conditions. None of the 10 had undergone previous spine surgery. There were no intravenous drug abusers, nor did any of them suffer from subacute or chronic endocarditis. There was no history of steroid therapy, malignancy, or tuberculosis among them. Pyogenic osteomyelitis occurred in the thoracic spine in six patients, the lumbar spine in three, and the cervical spine in one. There were six women and four men all of whom were elderly, with ages ranging from 60 to 84 years. All had been misdiagnosed for a prolonged period and presented to us with advanced disease.

Three patients had a history of recent somatic infection and one of these had a known sepsis. One was a 73-year-old man who had recently suffered pneumonia (not acquired during hospitalization); he had apparently responded well to antibiotics about 1 month before the onset of his presenting symptoms. The second was a 79-year-old man who had suffered a recent episode of cellulitis in the right leg which had resolved before his lumbargia began. The only serious infection among the entire group was in the third patient, a 63-year-old woman who had undergone a percutaneous liver biopsy complicated by a hepatic abscess and Pseudomonas sepsis, necessitating a laparotomy at an outlying hospital several months before transfer. Subsequently, Pseudomonas grew from her spine biopsy. In addition, a 74-year-old woman had undergone an uncomplicated and uninfected pediatric procedure 6 weeks before her symptoms began, and a 60-year-old woman had a vague history of having passed a kidney stone several weeks prior to admission. None of these cases had undergone cystoscopy or otherwise received invasive instrumentation in the recent past.

The organisms responsible for the infections in this group are the same as those responsible for the disease in more typically predisposed cases. There were three infections with Staphylococcus species, three with Gram-negative bacteria (Versinia, Klebsiella, and Pseudomonas), one case of anaerobic infection (Pectostreptococcus), and three cases in which no bacteriological diagnosis could be established, presumably secondary to prolonged preoperative antibiotic therapy.

One patient presented with spinal osteomyelitis at two noncontiguous and well-separated levels. Another patient had been successfully treated with antibiotics alone for spinal osteomyelitis at a noncontiguous level more than 10 years previously. Despite this, the diagnosis was still missed for months after the new symptoms began.

Illustrative Cases

Case 1

This 79-year-old man with a 9-month history of back pain and malaise had typical radiographic findings of L3-4 osteomyelitis on plain x-ray films and bone scans as well as a suggestive CT scan. An orthopedist diagnosed probable "tumor" and a percutaneous biopsy was interpreted as "myeloma" for which the patient began radiation therapy. Only after the pain worsened and paraparesis developed was the patient transferred to our care.

Case 2

This 74-year-old woman complained of a 4-month history of back pain which progressed such that she was in a virtually bedridden state. Her physicians obtained plain x-ray films, isotope scans, CT scans, and two MR images, all of which clearly suggested infection. Without relief, she sought help from a neurosurgeon some 800 miles distant (near her daughter's home), who performed a laminectomy for biopsy, further compromising her already damaged lumbar spine. The diagnosis was missed even then, and radiation therapy was begun for "myeloma." Symptoms and signs progressed leading to another laminectomy, this time establishing the correct diagnosis for which she was treated with 6 weeks of in-hospital bed rest and oral antibiotics. She presented to us following these events with a grossly unstable spine, paraparesis, and an elevated erythrocyte sedimentation rate.

Case 3

This 62-year-old woman developed spontaneous back pain while recuperating in a hospital following laparotomy for an iatrogenic liver abscess. Plain radiographs were normal, but a 99mTc bone scan was grossly positive for osteomyelitis at the T6-7 level (Fig. 1). Notwithstanding the normal plain x-ray films and no history of a fall or other trauma, an orthopedist and "spine surgeon" diagnosed "osteopenic compression fracture." The patient's symptoms progressively worsened and repeat plain radiographs 3½ months later showed typical changes diagnostic of osteomyelitis. The same orthopedist now diagnosed "progressive compression fracture" and prescribed a back brace. By the time of her transfer to our facility, she had developed an 80° kyphosis, almost complete destruction of the involved vertebral segments, and cord compression (Fig. 1).

Case 4

This 83-year-old woman was referred to a neurosurgeon for severe back pain and leg weakness. Apparently ignoring typical changes at L1-2 on plain x-ray films,

Fig. 2. Case 4. A: Preoperative plain radiograph is virtually diagnostic of infectious process at the L1–2 level (arrow). B: Nonetheless, the patient underwent laminectomy at L3–4 (arrows) for "stenosis" evident on computerized tomography scans which included only L3–S1 segments.

Fig. 3. Case 5. A: Anteroposterior plain radiograph demonstrating gross segmental destruction with translational dislocation at the L2–3 level (arrow) in an 81-year-old woman treated for 8 weeks for a "psoas abscess." The catheter evident in left lower quadrant was placed transperitoneally to drain the psoas abscess. B: Magnetic resonance T2-weighted image showing extensive perinephric, parapsoas, and paravertebral purulence, which appears as high-density material (arrows).

Case 5

Perhaps the grossest diagnostic error occurred in this 81-year-old woman who lay in an outlying hospital for 8 weeks while being treated by a general surgeon for a "psoas abscess" with antibiotics and transperitoneal catheter drainage. Radiographs taken upon arrival at our facility demonstrated a complete lateral translocation at L3–4 with gross destruction of both segments; the neurosurgeon diagnosed L3–4 "degenerative spinal stenosis" on the basis of a CT scan which included only L3–S1. Predictably, the subsequent L3–4 laminectomy failed to improve her condition and she was transferred to us with the disease yet to be diagnosed (Fig. 2).

Case 6

This 60-year-old woman (the youngest patient in the series) presented to our hospital initially complaining of back pain, malaise, and leg weakness. An MR study of the thoracolumbar spine was interpreted as within normal limits. During her hospitalization, the paraparesis worsened, and a myelogram followed by a CT scan demonstrated multiple epidural defects compatible with empyema. No isotope scan was obtained. An extensive thoracic laminectomy was performed and a staphylococcal infection was diagnosed, but only granulomatous...

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tissue could be obtained, without frank pus. A 6-week course of antibiotics led to little improvement, and repeat MR imaging showed changes characteristic of early osteomyelitis at T10-11. Despite further antibiotic therapy, the pain worsened and the paraparesis failed to improve. Another MR study 3 months after the original laminectomy showed progression of the early changes. Plain x-ray films revealed obvious vertebral destruction and kyphosis at T10-11, undoubtedly exacerbated by the previous surgery. Retrospectively, early evidence of spinal osteomyelitis had been evident at T10-11, even at the patient’s initial presentation (Fig. 4).

Results

In all 10 cases, late diagnosis had allowed the disease to progress to an advanced stage. All patients suffered severe vertebral segment destruction with spinal instability, neural element compromise, or both. Three cases progressed despite prolonged intravenous antibiotic therapy. Instability had been exacerbated by posterior decompression or biopsy procedures in three cases.

Surgical Procedures

In all cases, surgery was mandated to decompress spinal cord or roots, stabilize the bony spine, and debride the infection. Each patient underwent an anteriorly directed operation to accomplish all of these goals at a single procedure. The patient with cervical spine involvement underwent a standard anterior corpectomy and debridement with an autologous iliac graft and fusion, and was maintained in a halo vest and ring for 3 months postoperatively. In the six cases involving the thoracic level, thoracotomy was performed with debridement, corpectomies, and discectomies as necessary to remove all apparent granulomatous or infected tissue and to decompress the spinal canal with simultaneous autologous rib or iliac bone graft. Each of the three lumbar spine patients underwent retroperitoneal debridement and corpectomies with autologous iliac graft fusion. In no case were foreign materials or instrumentation employed. No posteriorly directed surgical procedures were necessary.

Postoperative Course

All of the subcervical patients were kept at bed rest for 6 weeks on a kinetic bed, then mobilized in a rigid orthosis for an additional 6 weeks postoperatively. During the interval of bed rest, all patients were treated with either subcutaneous mini-dose heparin or sequential compressive devices, or both. Postoperatively, every patient was placed on a 6-week course of intravenous antibiotics. The drugs chosen were either culture-specific or broad-spectrum in the cases in which no organism could be isolated. The drugs were administered via implanted subclavian vein catheters which were removed only after the postmobilization radiographs demonstrated spinal stability and the erythrocyte sedimentation rate had approached the normal range.

The post-therapy follow-up period ranged from 6 months to 3 years. No patient has required further surgery. One patient required a second 6-week course of antibiotics for a persisting Pseudomonas colonization manifested as a continued elevation of the erythrocyte
sedimentation rate, as documented via needle biopsy. This patient has been followed for 3 years since the second course of antibiotics without evidence of recurrence. At the time of this report, she was 66 years old and playing golf three times a week.

Despite the extensive nature of the surgical procedures, the use of prolonged postoperative bed rest in nine of the 10 cases, and the advanced age of the patients, there were no deaths and no neurological morbidity in this series. Four of the 10 patients were ambulatory prior to therapy, and nine patients were ambulatory post-therapy. Only the 84-year-old patient remains confined to a wheelchair despite grossly normal lower-extremity function. Despite prolonged bed rest in this patient series, there was no incidence of pneumonia or pulmonary embolism, although one patient developed deep vein thrombosis necessitating anticoagulation. In no case has an autologous bone graft served as a sequestrum or nidus despite their placement in freshly debrided spaces.

Discussion

Pathogenesis of Pyogenic Osteomyelitis

Many exhaustive reviews of pyogenic vertebral osteomyelitis have been published. 6,10,15,16,20,29,31–33 It has been well established that, in patients with no predisposing surgery or paraspinal infection, the source of the infection is hematogenous and the organism arrives in the vertebra via the end-arteriolar arcades in the subchondral plate region adjacent to the disc. In children, persisting vascular channels within the disc may allow direct disc space infection, something that may occur in adults only after the vertebral endplate is destroyed. Since the segmental arteries supplying the vertebra usually bifurcate to supply two adjacent bony segments, it is not surprising that the disease usually involves two adjacent vertebrae and the intervening disc. All of our 10 cases fit this typical pattern. Similarly, virtually all reported series, including ours, have found that the majority of cases occur in the lower thoracic or lumbar spine.

In a review of 318 reported cases, Waldvogel and Vasey found that "an unequivocal primary source for hematogenous dissemination can be found in more than 40% of cases..." Among our 10 cases, only one patient had "an unequivocal source" while two others had known recent infectious illnesses; another two had a possible source, one having had a pediatrical surgical procedure and the other having passed a ureteral stone.

Infecting Organisms

Almost all published series report Staphylococci as the most common pathogenic microbes, but simultaneously report the genitourinary tract as the most common known source of infection. This apparent contradiction is not easily explained on the basis of available data. To further confuse the issue, staphylococcal infection in one of our patients followed the passage of a ureteral stone, and two patients had Gram-negative infections neither of which followed genitourinary infection or instrumentation. Although Pseudomonas osteomyelitis of the spine is most frequently seen among intravenous drug abusers,9,18,19,26,35 and anaerobic infection is distinctly unusual,15 neither infection is unique among reported cases of this disease.

Diagnosis

As demonstrated in our patients and repeatedly documented in the literature, the symptoms of vertebral osteomyelitis usually consist of neck or back pain, malaise, stiffness, and sometimes fever. The diagnosis is frequently delayed. Sapiro and Montgomery found that the diagnosis was delayed for more than 3 months after symptom onset in 50% of 167 evaluable cases. Such was the case in each of our 10 patients. This delay is especially difficult to understand since the plain radiographic changes characteristic of vertebral osteomyelitis become evident 2 to 8 weeks after onset of disease, and isotope bone scans are positive 1 ½ to 2 weeks prior to that. In most cases, changes typical of spinal osteomyelitis were evident in every patient in our series well before the diagnosis was suspected. In each case, plain film changes were either missed entirely, misinterpreted, or ignored.

Only five of our cases had isotope 99mTc bone scanning. All five were grossly positive, in two cases before plain film changes were evident. Again, however, the evidence was misinterpreted. In two cases the misdiagnosis was because the infected vertebrae were among many abnormal areas of the scans, and in three cases it was because the area of abnormal uptake was thought to represent metastatic tumor or simple compression fracture. Although 99mTc bone scans are very sensitive in vertebral osteomyelitis (picking up at least 90% of cases according to Modic, et al.12), they are unfortunately less specific. The same authors suggested that the addition of a 67Ga bone scan to the 99mTc bone scan (not used in any of the present cases) may improve specificity to 100%.

Similar to isotope scans, CT scans are quite sensitive but not very specific. Again, CT scan evidence of osteomyelitis becomes apparent before plain film changes occur, showing early evidence of paravertebral soft tissue swelling or abscess formation as well as clear signs of bone destruction.8,12,17,21 In some cases, CT may also show encroachment on the spinal canal. Unfortunately, almost identical changes may be seen in metastatic disease or even trauma (Fig. 5). All 10 of our cases had typical CT findings, and all were misinterpreted.

Perhaps the most useful contribution of CT today is in the guidance of needle biopsy for pathological and bacteriological diagnosis. In our hands, once the diagnosis of spinal osteomyelitis is suspected, a CT-guided needle biopsy frequently establishes the organism and allows successful therapy with antibiotics and orthoses.
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Fig. 5. A: Computerized tomography (CT) scan from a patient with osteomyelitis of L-1. B: Computerized tomography scan from a patient with metastatic breast carcinoma of L-1. C: Magnetic resonance (MR) image of the patient shown in A, revealing osteomyelitis at L1-2. D: Magnetic resonance image of the patient shown in B, revealing metastatic breast carcinoma of L-1 and L-3. Note: The appearance of the CT scans is remarkably similar and therefore not specific for either diagnosis. Conversely, the MR findings are distinctive and characteristically diagnostic for an infectious process with the image in C involving two adjacent segments and the intervening disc while the image in D involves two bodies respecting the interval discs.

long before major destructive changes have occurred in the vertebrae, in most cases eliminating the need for either decompressive or stabilizing surgical procedures.

Magnetic resonance imaging is as sensitive as \(^{99m}\)Tc bone scanning and as specific as late-stage plain x-ray films. Modic, et al. found MR imaging to be as sensitive, specific, and accurate as combined \(^{99m}\)Tc and \(^{67}\)Ga isotope scanning, even with a low-powered (0.6-tesla) magnet. The multiplanar capabilities of MR imaging have largely supplanted the use of CT scanning for initial diagnosis and have almost eliminated myelography, with some exceptions (see below). The characteristic MR findings in vertebral osteomyelitis are well described and virtually diagnostic in established cases. In most cases, a diagnosis can be made from the destructive and characteristically expansile lesions involving two adjacent vertebrae across the intervening disc, frequently with high-density changes noted on T2-weighted imaging, low-density changes noted on T1-weighted imaging, and positive gadolinium enhancement. As in other disease entities, T2-weighted images generally supply more distinct anatomical detail. Paravertebral, epidural, and more distant extensions of granulation tissue or purulence are also frequently evident.

Differentiation from neoplastic and degenerative diseases is far easier with MR imaging than with any other radiographic modality. Although CT scanning offers somewhat better bone element definition and may be more useful in certain phases of surgical planning, MR imaging is a quantum leap above any other single diagnostic modality (Fig. 5). However, there are exceptions to all rules. On the basis of limited evidence, some authors have suggested that the changes in vertebral osteomyelitis seen on MR imaging predate the changes on plain x-ray films and may occur as early as those on isotope bone scans. At least one of our patients (Case 6) had early evidence of disease on plain x-ray film (admittedly noted only retrospectively) at a time when her MR image was quite normal on review. This same case illustrates another weakness of MR imaging in that, during the same interval in which the MR study was normal, a myelogram demonstrated multiple epidural defects and a complete block at T10-11 (Fig. 4). Only 6 weeks later did a repeat MR image demonstrate clear, if early, evidence of T10-11 segmental osteomyelitis, while still failing to detect the surgically proven epidural empyema. It is unclear why MR imaging fails to detect some cases of epidural infection, although a variety of explanations have been proposed. It is likely that the sensitivity of the study will improve as software is refined and gross magnetic power increases, and that even fewer myelograms and CT-myelograms will be necessary in the future. Nonetheless, failure to obtain the necessary studies on the grounds of a normal MR image may prove a lame defense in the case of the patient rendered paraplegic by an undetected epidural abscess.

Surgical Procedures

Among 153 cases reviewed by Sapico and Montgomery, 58 underwent surgical procedures. Many of these procedures accomplished little beyond a diagnosis, however. In this era in which MR imaging usually establishes pathological anatomy, and in which CT-guided needle biopsy has become a daily procedure well suited to establishing microbial diagnosis, it is likely that only 10% to 20% of all cases of pyogenic vertebral osteomyelitis require open surgery. At least three of every four patients diagnosed before neurological symptomatology ensues or before vertebral destruction destabilizes the bony spine should respond completely to antibiotics and immobilization alone. This has cer-
tainingly been our experience; the great majority of cases coming to our attention early in the course of the disease do not require any invasive procedure beyond a CT-guided needle biopsy.

Several retrospective series have been published in which the surgery of vertebral osteomyelitis is detailed.1,5,9,10,20,26,32 Abramovitz, et al.,1 Eismont, et al.,9 and others have described the many treatment options available. Traditionally, surgery has been advised for diagnosis, debridement, decompression, and stabilization in decreasing order of frequency. In the majority of cases, CT-guided needle biopsy eliminates the need for open surgical diagnosis. Debridement alone appears to be required much less frequently in cases of vertebral osteomyelitis than in cases involving the extremities or pelvis.35

Symptomatic cord compression and myelopathy occur in less than 20% of cases (reported range 3% to 45%) and are more common in cervical and upper thoracic lesions and among diabetics.3 In patients with cord compression, the surgical approach chosen must be guided by the pathological anatomy and aimed at the point of maximum impingement. In the great majority of cases, the point of maximum compression will be the kyphotic deformity and associated subligamentous granuloma or abscess anterior to the spinal cord at the level of the involved vertebral bodies. In such cases, posterior decompression procedures not only fail to attack the offending elements but also destroy the remaining relatively uninvolved and stable posterior structures, adding insult to injury. An exception to this rule may occur in patients with an associated epidural or, less commonly, subdural empyema. Even in these cases, however, the abnormality frequently surrounds the cord or dura and is not limited to the dorsal surface.3,14 As illustrated in one of our cases, the infectious material is frequently fibrotic and granulomatous, not supplicative, and hence quite difficult to remove. The laminectomy necessary for exploration may sometimes serve little useful purpose and only further complicate subsequent surgical endeavors or exacerbate the progression of kyphotic deformity.

Spontaneous osteomyelitis involves the posterior elements of the bony spine only rarely and very late in the course of the disease. Nonetheless, patients undergoing radical anterior debridement and partial or complete two-level corpectomies, with resection of anterior and posterior longitudinal ligaments, are left unstable until the fusion solidifies. In our single patient with cervical involvement, immobilization in a halo orthosis allowed early ambulation. The remaining nine patients were kept at bed rest for a full 6 weeks postoperatively. This was mandatory in the three cases with lumbar disease for lack of a satisfactory posterior instrumentation system at the time. Currently available pedicle screw-and-plate or internal fixation systems may offer an alternative in the future.

The six cases with thoracic involvement could have been mobilized earlier had we chosen to proceed with second operations for posterior (Harrington, Cotrel-Dobousset, or Texas Scottish Rite Hospital) instrumentation and fusion. We chose not to commit these elderly and fragile patients to a second major operation in which foreign bodies would have been implanted. Nonetheless, we believe a valid argument exists for either approach. Luckily, all of our 10 patients developed solid fusions without instrumentation. However, one patient did develop deep vein thrombosis necessitating anticoagulation.

Postoperative Care

Among patients not suffering neurological deficits or spinal instability, the recommendations for bed rest or immobilization have varied from none to 6 months.5,14,16,20,26,29,31,32 In all of our cases, the spine was unstable and the period of immobilization was no different from that which we employ in any other patients undergoing anterior corpectomy and fusion, and in whom no posterior stabilization procedure has been performed. The resection of all of the anterior elements over two spinal segments of the thoracic or lumbar spine produces immediate instability. In this patient series, the instability was evident preoperatively as well as postoperatively. We chose to prescribe the same length of postoperative bed rest as we would for similar procedures carried out for neoplasm or trauma. This is admittedly somewhat arbitrary, but we have been quite successful in prescribing 6 weeks of bed rest followed by 6 weeks of mobilization in a rigid orthosis. There has been no evidence of subsequent kyphotic collapse or persisting instability.

Available data offer a wide range of suggestions for the type, duration, and mode of administration of antibiotic therapy.5,6,10,13,11,15,26,27,29,31–33 It is clear that less than 4 to 6 weeks of intravenous therapy is fraught with a high rate of recurrence, irrespective of the duration of subsequent oral therapy. Some of our infectious disease consultants recommend even longer periods of antibiotic therapy, sometimes approaching 8 to 12 weeks in cases treated nonsurgically. Since one of our patients treated with 6 weeks of intravenous antibiotics postoperatively required a second 6-week course, we suggest that a minimum period of 6 weeks be considered. Since blood and bone levels of oral antibiotics differ greatly between dose schedules and between drugs, it is unclear what role oral antibiotics plays in the therapy of this disease. The literature suggests that oral antibiotics alone are frequently ineffective and that an infection persisting after an intravenous course of antibiotics is unlikely to resolve regardless of the period of oral therapy.

In those cases in which no bacteriological diagnosis can be established, drugs which cover both penicillin-resistant Staphylococcus species and Gram-negative organisms must be employed. The rare anaerobic infection will thus be cross-covered in most cases. Although the erythrocyte sedimentation rate is not a specific test, it is nonetheless quite useful in following the course of
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therapy. Both in the literature and in the present report, the erythrocyte sedimentation rate returned progressively normal as the infection subsided, and it was useful in judging both the success of therapy and the lack thereof in the one case of persisting infection. Particularly in the postoperative patient in whom radiographic and MR changes may be difficult to interpret, the erythrocyte sedimentation rate provides a simple and inexpensive means of following disease activity, noting that coexistent systemic illness such as distant somatic infections, malignancy, or trauma may invalidate the result.

Conclusions

For 30 years or more, book chapters, review articles, case reports, and editorials in the texts and journals of generalists and specialists have warned of and documented the frequent misdiagnosis of vertebral osteomyelitis. However, many of these same warnings have suggested that vertebral osteomyelitis is a disease usually seen in those predisposed by diabetes, intravenous drug abuse, endocarditis, or steroid therapy. Others suggest that most cases occur following known infections or surgical manipulations. We offer these 10 cases as evidence that this is not always so, and, although many cases are so predisposed, there is a subgroup of patients whose only predisposition may be their advanced age. In reviewing many large series of cases of pyogenic vertebral osteomyelitis reported over the past 20 years, two demographic variables stand out. First, there has been an obvious spate of cases seen in the ever-increasing population of intravenous drug abusers. Excluding these, the other changing variable is age. The more recent the series, the higher the average age of the patients afflicted. In their definitive 1980 review, Waldvogel and Vasey summarized eight previously reported series in which the average age ranged from 45 to 62 years, yet they stated that the disease “occurs mainly in adults with a mean age between 60 and 70 years.” If one excludes the one patient in our series with an “unequivocal source” of infection, the average age of the remaining nine is 74. Their age is their only common descriptor.

Based on the current evidence, we conclude the following: 1) spontaneous pyogenic osteomyelitis occurs in the elderly in the absence of any predisposing condition beyond age; 2) the diagnosis continues to be missed despite the availability of conclusive radiographic evidence such as MR imaging, plain x-ray films, and isotope scans; 3) untreated spinal osteomyelitis in the elderly may progress rapidly to vertebral destruction, multisegmental involvement, spinal instability, and neural compromise; 4) since pyogenic osteomyelitis begins in the vertebral body in the vessel-rich space adjacent to the endplate, and progresses to destroy the anterior and lateral elements of the segments, posteriorly directed surgical procedures serve only to further destabilize the spine by interrupting the less involved elements; and 5) patients presenting with advanced destructive changes, spinal instability, and symptomatic neural element compromise require radial anterior debridement and grafting which can be performed safely at one operative stage with gratifying results, even in very elderly patients.

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