

Pyogenic Vertebral Osteomyelitis: A Systematic Review of Clinical Characteristics

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Objectives: Vertebral osteomyelitis is a cause of back pain that can lead to neurologic deficits if not diagnosed in time and effectively treated. The objective of this study was to systematically review the clinical characteristics of pyogenic vertebral osteomyelitis (PVO).

Methods: The authors conducted a systematic review of the English literature. The inclusion criteria included studies with 10 or more subjects diagnosed with PVO based on the combination of clinical presentation with either a definitive bacteriologic diagnosis or pathological and/or imaging studies.

Results: The 14 studies that met selection criteria included 1008 patients with PVO. Of them, the majority (62%) were men, with back pain and fever as the most common presenting symptoms. Diabetes mellitus was the most common underlying medical illness, while the urinary tract was the commonest source of infection. *Staphylococcus aureus* was the most commonly isolated organism. Computed tomographic guided or open biopsy yielded the causative organism more often than blood cultures (77% versus 58%). Plain radiography showed abnormalities in 89% of the cases, while bone scanning and computed tomography or magnetic resonance imaging were positive in 94% of the cases, revealing lumbar as the most commonly affected area. The attributable mortality was 6%, while relapses and neurological deficits were described in the 32% and 32% of the cases, respectively.

Conclusion: PVO is an illness of middle-aged individuals with underlying medical illnesses. Although the mortality rate is low, relapses and neurological deficits are common, making early diagnosis a major challenge for the physician.

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Vertebral osteomyelitis accounts for about 1% of skeletal infections. Its incidence, however, seems to be increasing as a result of the higher life expectancy of older patients with chronic debilitating diseases, the rise in the prevalence of intravenous drug abuse, and the increase in spinal instrumentation and surgery (1). In adults, it usually presents insidiously and follows an indolent clinical course, making early diagnosis difficult. The symptoms and clinical findings of patients are often nonspecific and may vary widely, thus making imaging necessary for confirmation and localization of the infection (2,3). Bacteriological diagnosis is also difficult,

since blood cultures are often negative and bone biopsy is required. While life expectancy may not be affected, neurologic compromise can occur when diagnosis and treatment are delayed (4). Therefore, physicians must be able to recognize this entity, since its prompt and accurate diagnosis depends on a thorough knowledge of the disease along with a high index of suspicion.

In the last 20 years, several reported series have analyzed the clinical, microbiological, and radiologic features of vertebral osteomyelitis. However, some of them have focused on a particular etiologic agent (5,6), age group (7), treatment method (8), or radiologic technique (9). As a result, certain clinical, diagnostic, and therapeutic issues remain unclarified. To date, there has been no comprehensive review of the literature on pyogenic vertebral osteomyelitis (PVO) to help in clarifying the epidemiology, clinical, microbiological, and diagnostic issues as well as the outcome of PVO in the general population. We sys-

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tematically reviewed the literature on PVO. The primary objectives of this study were to review the epidemiology and the clinical and microbiological aspects of the disease, to evaluate the diagnostic methodology, and to assess the parameters related to the outcome.

METHODS

Literature Search

We collected the literature by searching the MEDLINE database starting with 1966. We also used textbooks of infectious diseases and orthopedics. The MEDLINE search string was “Discitis”[Mesh] OR “vertebral osteomyelitis” OR “spinal osteomyelitis” OR spondylodiscitis OR spondylitis NOT ankylosing NOT “case reports” [pt]. The results were limited to human studies published in the English language. Manual searches of reference lists from potentially relevant papers and book chapters were also performed to identify any additional studies that may have been missed using the computer-assisted method.

The literature search yielded 1663 articles that were imported to a database using Reference Manager Professional Edition v10 (ISI Research Software). We screened the abstracts of these articles and retrieved the full text of the ones we considered important. After detailed review, 38 items were identified as potentially relevant, but only 14 of them fulfilled the inclusion criteria.

Study Selection Criteria

Two investigators independently reviewed the titles and abstracts of all citations identified by the literature search and evaluated them for eligibility on the basis of some inclusion criteria. In the studies included in our review, the diagnosis of PVO had to be based on the combination of clinical presentation with either a definitive bacteriologic diagnosis or pathological and/or imaging studies. Moreover, they had to involve 10 or more subjects diagnosed with vertebral osteomyelitis. Studies including only patients with tuberculosis or brucellosis were excluded. Studies involving only a specific population, only a particular treatment, or only a specific pathogen were also excluded. Studies including patients with history of intravenous drug abuse and prior spinal instrumentation or surgery were included.

Data Extraction

Two reviewers extracted the data independently. Any disagreement was resolved by consensus. The reviewers extracted the following data from each study: number of subjects, age, mean time from onset to diagnosis, the prevalence of fever, neurological symptoms or deficits at presentation, source of infection, concomitant diseases/risk factors, causative organisms, material of which the microorganisms were isolated (blood, tissue), location of infection, other foci of infection, imaging studies performed

and their ability to identify vertebral defect, the outcome, and the proportion of surgically treated patients. For numerical variables we calculated means, taking into account the number of subjects in each study.

RESULTS

Study Characteristics and Limitations

Epidemiological, clinical, and microbiological aspects of PVO require careful interpretation for 2 reasons: (a) there is heterogeneity of the inclusion criteria among studies. Thus, 2 reports (10,19) excluded drug abusers and 5 (10,12,16,21,23) excluded postoperative infections. On the contrary, in 1 report (14) intravenous drug abusers constituted the majority of the included patients. (b) Almost all the studies (93%) are retrospective, in which there is a potential for error because of bias and statistical inaccuracy. For example, PVO caused by low virulence organisms may have been underestimated because such organisms could have been discarded as contaminants.

Demographic Data

One thousand eight patients were included in the 14 studies. The mean age of the patients ranged from 46 to 72 years (median value, 59 years) (10,11,15-20,22,23). The 2 studies that included many drug users reported the lowest ages (mean and median values, 46 and 35 years, respectively) (14,23). Demographic characteristics are shown in Table 1.

Underlying Medical Illnesses

All studies reviewed revealed information about the possible concomitant diseases of their patients (Table 1). However, Patzakis and coworkers focused solely on drug users (14). Most patients were reported to have more than 1 underlying medical illness, including diabetes mellitus (24%), intravenous drug abuse (11%), immunosuppression (7%), malignancy (6%), alcoholism (5%), rheumatic disease (5%), liver cirrhosis (4%), renal failure (4%), and previous deficit of the vertebrae such as radiation or osteopenic fracture (3%). Other underlying medical illnesses such as pulmonary fibrosis, predisposing heart conditions, malnutrition, myelodysplasia, sarcoidosis, septic phlebitis, or partial gastrectomy, occurred in 10% of the patients. Only 1 (17) of 14 studies states that 28% of its patients had no underlying medical illness.

Clinical Presentation

The mean time from onset of symptoms to diagnosis was reported in 5 studies and ranged from 11 to 59 days (10,11,18-20). Back pain was by far the most common presenting symptom (86%), followed by fever (axillary temperature $>37.5^{\circ}\text{C}$), found in the 60% of the cases. Neurologic deficits at presentation, such as radiculopathy,

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