Journal of Infection (2014) 69, 42—50

BIAM British Infection Association

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Clinical characteristics and outcomes of hematogenous vertebral osteomyelitis caused by gram-negative bacteria

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Accepted 13 February 2014
Available online 20 February 2014

KEYWORDS
Vertebral osteomyelitis;
Spondylitis;
Spondylodiscitis;
Gram-negative bacteria;
Outcome

Summary *Objective:* To evaluate the clinical characteristics and outcomes of patients with hematogenous vertebral osteomyelitis (HVO) caused by gram-negative bacteria (GNB).
Methods: We conducted a retrospective chart review of adult patients with HVO from three tertiary-care hospitals over a 7-year period.
Results: Of the 313 microbiologically diagnosed HVO cases, GNB was responsible for 65 (20.8%) cases. Compared with patients with MSSA HVO, patients with GNB HVO were more likely to be female ($P = 0.03$) and have diabetes ($P = 0.03$), but less likely to have epidural abscess ($P = 0.02$) and paravertebral abscess ($P = 0.003$). Clinical outcomes were similar between the GNB and MSSA groups, including in-hospital mortality (4.6% vs. 7.8%; $P = 0.53$), recurrence (9.7% vs. 4.3%; $P = 0.20$), and sequelae (31.7% vs. 32.2%; $P = 0.95$). Among GNB-infected

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http://dx.doi.org/10.1016/j.jinf.2014.02.009

patients, recurrence rates differed according to the total duration of antibiotic treatment: 40.0% (4—6 weeks), 33.3% (6—8 weeks), and 2.1% (≥8 weeks) ($P = 0.002$).
Conclusions: GNB HVO was responsible for 20.8% of adult cases of HVO. Despite some differences in clinical and radiological presentation, clinical outcomes were similar between GNB and MSSA HVO. Antibiotic therapy for ≥8 weeks may benefit patients with GNB HVO.

Introduction

Hematogenous vertebral osteomyelitis has increased in recent years, likely due to longer life expectancies, higher prevalence of chronic disease, better diagnostic techniques, and more frequent use of indwelling intravascular catheters and immunosuppressive therapy.[1—5] It is associated with significant morbidity, including prolonged antimicrobial therapy, risk of recurrence, and decreased functional status.[6,7]

Staphylococcus aureus is among the most common organisms causing hematogenous vertebral osteomyelitis, but gram-negative bacteria (GNB) are responsible for a substantial proportion, constituting 10.5—39.0% of all episodes.[5,8—13] Although GNB infection constitutes a relatively minor proportion of all cases, it is of considerable clinical importance because treatment is considered more complicated as a result of the increasing prevalence of resistance to antimicrobial agents and the comorbid conditions of patients.[13] Numerous studies have evaluated the clinical characteristics and outcomes of hematogenous vertebral osteomyelitis, but little information is available regarding the clinical characteristics and outcomes of GNB hematogenous vertebral osteomyelitis. Therefore, the aim of the present study was to evaluate the clinical characteristics and outcomes of hematogenous vertebral osteomyelitis caused by GNB.

Patients and methods

Study design and setting

This observational cohort study was undertaken in three Korean tertiary-care hospitals (two in Seoul and one in Jinju). The study included all adult patients diagnosed with hematogenous vertebral osteomyelitis from January 2005 through December 2011. We identified all discharge using the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes for osteomyelitis of the vertebral disk (M46.2), pyogenic infection of intervertebral disk (M46.3), unspecified discitis (M46.4), other infective spondylopathy (M46.5), other specified inflammatory spondylopathy (M46.8), unspecified spondylopathy (M48.9), and epidural abscess (G06). Discharges containing these ICD-10-CM codes were reviewed to determine whether they met the study criteria defined below.

Inclusion and exclusion criteria

Adult patients (≥16 years of age) who presented with hematogenous vertebral osteomyelitis were included. Hematogenous vertebral osteomyelitis was defined as both radiographic evidence of vertebral osteomyelitis and microbiologic demonstration of bacterial pathogens either from the site of infection itself (e.g., abscess, intervertebral disc, or vertebral bone) or the blood. Culture-negative hematogenous vertebral osteomyelitis was not included. Cases were excluded if there was a non-hematogenous source of vertebral infection, which included (1) penetrating trauma, (2) previously placed hardware, (3) laminectomy within 1 year prior to the vertebral osteomyelitis diagnosis, or (4) the presence of a stage 3—4 decubitus ulcer at the time of diagnosis.[14] Cases of tuberculous, brucellar, and fungal vertebral osteomyelitis were also excluded. Other reasons for exclusion were polymicrobial infection and incomplete medical records. Patients were required to have received at least 4 weeks of antibiotics and to have follow-up data for at least 12 months after completing all antibiotic treatments. We compared GNB infections with methicillin-susceptible *S. aureus* (MSSA) infections specifically, rather than all *S. aureus* infection (MSSA and methicillin-resistant *S. aureus* [MRSA]) because the therapeutic outcomes of MRSA vertebral osteomyelitis may differ from those of MSSA vertebral osteomyelitis.[15—17]

Data collection

Medical records were reviewed retrospectively for demographic information, underlying illness/conditions, presumed source of infection, other concurrent metastatic infection, diagnostic work-up, clinical presentation, laboratory and radiological data, medical and surgical treatments, and clinical outcomes. Medical and surgical therapies were performed at the discretion of the treating physicians.

Definitions

Based on MRI findings, epidural, paravertebral, and psoas involvement were classified as simple soft tissue edema or abscesses. Simple soft tissue edema was diagnosed when there was diffuse hypointensity on T1-weighted images, hyperintensity on T2-weighted images, and contrast enhancement. The criteria for abscess were well-defined masses with fluid-equivalent signal intensity of T2-weighted images and rim enhancement with hypointense liquefactive center.[18,19]

Outcomes were evaluated using the following measures: in-hospital mortality, duration of hospital stay, recurrence, and sequelae. Recurrence was defined as subjects with recurrent symptoms and signs within 12 months after the completion of antibiotics. Patients were considered to have microbiological recurrence if diagnostic biopsy or blood cultures revealed the same organism that caused the initial infection. Patients were considered to have clinical