

Diagnosing pelvic osteomyelitis beneath pressure ulcers in spinal cord injured patients: a prospective study

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Abstract

There is no consensus on a diagnostic strategy for osteomyelitis underlying pressure ulcers. We conducted a prospective study to assess the accuracy of multiple bone biopsies and imaging to diagnose pelvic osteomyelitis. Patients with clinically suspected osteomyelitis beneath pelvic pressure ulcers were enrolled. Bone magnetic resonance imaging (MRI) and surgical bone biopsies (three or more for microbiology and one for histology per ulcer) were performed. Bacterial osteomyelitis diagnosis relied upon the association of positive histology and microbiology (at least one positive culture for non-commensal microorganisms or three or more for commensal microorganisms of the skin). From 2011 to 2014, 34 patients with 44 pressure ulcers were included. Bacterial osteomyelitis was diagnosed for 28 (82.3%) patients and 35 (79.5%) ulcers according to the composite criterion. Discrepancy was observed between histology and microbiology for 5 (11.4%) ulcers. Most common isolates were *Staphylococcus aureus* (77.1%), *Peptostreptococcus* (48.6%) and *Bacteroides* (40%), cultured in three or more samples in 42.9% of ulcers for *S. aureus* and $\geq 20\%$ for anaerobes. Only 2.8% of ulcers had three or more positive specimens with coagulase-negative staphylococci, group B *Streptococcus*, and nil with enterococci and *Pseudomonas aeruginosa*. *Staphylococcus aureus*, *Proteus* and group *milleri* *Streptococcus* were recovered from one sample in 22.8%, 11.4% and 11.4% of ulcers, respectively. Agreement was poor between biopsies and MRI (κ 0.2). Sensitivity of MRI was 94.3% and specificity was 22.2%. The diagnosis of pelvic osteomyelitis relies on multiple surgical bone biopsies with microbiological and histological analyses. At least three bone samples allows the detection of pathogens and exclusion of contaminants. MRI is not routinely useful for diagnosis.

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Introduction

Pressure ulcers are a serious healthcare problem with variable consequences both for patients and for the healthcare system according to the stage of ulcer: non-blanchable erythema of intact skin (Stage I), partial-thickness skin loss involving the epidermis or dermis (Stage II), full-thickness skin loss that may extend to the fascia (Stage III) or through this one into the deeper structures, such as muscle, bone or joint structures (Stage IV) [1]. Stage IV pressure ulcers are particularly

associated with considerable morbidity and mortality [2]. Indeed unrecognized osteomyelitis of underlying bone is responsible for wound chronicity [3], complications of flap reconstruction [4], increased length of stay [4] and increased cost of treating [5]. Despite a high osteomyelitis prevalence [6] and the possible impact of this complication on clinical management, there is no consensus on a diagnostic strategy of bone infection in advanced pressure ulcers.

The diagnosis of chronic osteomyelitis is challenging because the clinical evaluation is often inaccurate [7]. Standard diagnostic tools such as laboratory findings (haemoglobin, erythrocyte sedimentation rates, white blood cells, C-reactive protein) [8], computed tomography [9] and bone scintigraphy [10] are neither sensitive nor specific. These imaging techniques may not discriminate osteomyelitis from pressure-related changes in bone [11,12]. Currently, magnetic resonance imaging (MRI) is used for evaluating the presence of osteomyelitis in non-healing wounds because of a claimed high sensitivity (84–98%) and specificity (60–89%) [10,13]. However, several studies suggest that areas of healed osteomyelitis and active infection cannot be distinguished with MRI [14,15]. Bone biopsy remains the reference standard to diagnose osteomyelitis, but discrepancy between the microbiological and histological studies is frequent [7,16], leading some experts to recommend establishing the definite diagnosis based on the pathological examination [17]. Indeed, distinguishing colonization from infection is difficult in these chronic wounds colonized by commensal flora.

The primary objective of the present study was to assess agreement between biopsy-based histology and microbiology. As a secondary objective, we assessed the accuracy of bone MRI in the diagnosis of pelvic osteomyelitis.

Materials and methods

Population

We conducted a prospective study at the Montpellier University Hospital (France) from December 2011 to March 2014. Inclusion criteria were: age ≥ 18 years, stage IV or III [1] pressure ulcer(s) (ischial, sacral and/or trochanteric areas) with unfavourable evolution despite optimal treatment (i.e. stagnation or increase of the size of the wound and/or worsening of the stage of the ulcer), indication of hospitalization for surgical debridement and no contraindication to MRI. Up to three pressure ulcers per patient were included, each ulcer being considered separately. Patients were excluded if they had received antibiotic therapy within the 2 weeks before biopsies, or when biopsies were not performed according to the protocol detailed below. The study

was approved by the local Ethics Committee (South Mediterranean IV, Montpellier). All study participants gave written informed consent.

Protocol diagnostic strategy

Bone pelvic MRI was performed within the month before surgery. For each included pressure ulcer, from three to five intraoperative bone biopsies for microbiological analysis and one for pathological examination were sampled from the same site. We defined bacterial osteomyelitis using a composite microbio-histological criterion, which required:

- positive histology defined as presence of signs of osteomyelitis (see below) AND
- positive microbiology defined as at least one positive bone culture with a non-commensal bacteria OR at least three positive bone cultures with the same commensal microorganism of the cutaneous flora (e.g. coagulase-negative staphylococci, *Micrococcus*, *Corynebacterium*)

These criteria were developed from the criteria that are used to diagnose osteoarticular infections on materials [18].

The following data were collected prospectively: age, gender, comorbidities, risk factors for pressure ulcers, risk factors for multidrug-resistant organisms (MDROs), pressure ulcer characteristics and laboratory findings, all listed in Table 1. Risk factors for pressure ulcers included poor nutrition, limited mobility, sensory deficit, incontinence, increased age, skin abnormalities, previous pressure ulcer and tissue hypoxia. Risk factors for MDROs were: recent and/or repeated hospitalizations, previous MDRO carriage or infection, residence in a long-term care facility and recent antibiotic use.

Bone specimen sampling and processing

After excision of the subcutaneous tissue, the ulcer was cleaned with polyvidone iodine and washed with sterile saline solution, careful debridement of the infected bone was then performed. At the end, per-wound bone biopsies were carried out with sterile gouge pliers specifically dedicated to specimen sampling, far from the ulcer periphery, guided by the macroscopic evaluation of the surgeon.

Biopsies for culture were placed in sterile tubes (IKA, Staufen, Germany) containing stainless steel micro balls and 2 mL of sterile water, and immediately sent to the laboratory. After grinding (Ultra-turrax Tube drive; IKA), each sample was plated onto standard agars for culture of aerobes and anaerobes and into Schaedler broth for 15 days. All isolates were identified with phenotypic methods. Antimicrobial susceptibility was determined by the disk diffusion method according to the

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