

Diagnostic and Therapeutic Value of Surgical Biopsy of Grade IV Sacral Pressure Ulcer

ABSTRACT

BACKGROUND Surgical bone biopsy is the gold standard to diagnose osteomyelitis in pressure sores; however the true utility of this procedure is debated, as it may not offer any additional culture information beyond a swab culture taken from the surface of the exposed bone. The purpose of this retrospective study is to evaluate the diagnostic and therapeutic role of bone biopsy in patients with stage IV sacral decubitus/pressure ulcers.

METHODS Patients with stage IV pressure ulcers were retrospectively identified between August 2004 and December 2014. Only those patients who received both a bone biopsy as well as a deep tissue swab from a sacral pressure ulcer site that probed to bone were included. Progress notes and consult reports were reviewed to document the incidence and length of preoperative antibiotic courses administered. Our primary outcomes were change in antibiotic treatment plan and concordance of the bacterium isolated on culture from the surgical bone biopsy and swab.

RESULTS A total of 39 patients were identified with stage IV sacral pressure ulcers. Of these, 30 received both a bone biopsy and a deep tissue swab from a sacral pressure ulcer that probed to bone. Of the 39 patients that underwent a bone biopsy, osteomyelitis was confirmed in 59% of patients. Antibiotic management was changed postoperatively in 89.7% of patients following sacral bone biopsy findings. Antibiotic therapy was changed in 100% of patients (n=30) who underwent both pre-operative deep tissue swab and subsequent surgical bone biopsy.

CONCLUSION Surgical bone biopsy from a stage IV sacral pressure ulcer provided additional information useful in diagnosing osteomyelitis and identifying bacteria involved. In this patient cohort, biopsy changed antibiotic management in over 90% of patients.

LEVEL OF EVIDENCE Therapeutic Level IV, Case Series

KEYWORDS Osteomyelitis, stage IV pressure ulcer, sacral/decubitus ulcer

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Pressure ulcers are among the most common complications affecting bed-ridden patients with neurologic impairment following cerebrovascular accident (CVA) or spinal cord injury (SCI). The incidence of pressure ulcers in individuals who have suffered SCI has been reported in up to 40% of patients during acute rehabilitation, and there is a similar prevalence among individuals living in the community.¹⁻⁵ Various modalities have

been used to diagnose osteomyelitis in pressure sores, including clinical judgment alone, bone scan, imaging, percutaneous bone biopsy, and laboratory studies. These have yielded mixed results.^{2,6}

With the loss of overlying skin and soft tissue, bone is subjected to the external environment which predisposes the host to developing osteomyelitis. Osteomyelitis hinders healing and is associated with recurrent ulcers, septicemia, and potential death.^{7,8} Once osteomyelitis develops, it inflicts not only a higher treatment failure rate for musculocutaneous flaps but also predispose to recurrence of pressure ulcers.

Darouiuche et al. reported the incidence of osteomyelitis to be 17% in their study population of 36 patients with pressure ulcers.⁹ The incidence of osteomyelitis has been thought to correlate with the severity of the ulcer and the diagnostic modality used.^{10,11} While the standard for diagnosis is surgical bone biopsy, much debate exists around the best diagnostic modality to identify osteomyelitis in pressure ulcers.

Therefore, medical clinicians and infectious disease physicians often request an open biopsy of a sacral pressure ulcer that often probes to bone (stage IV) for definitive diagnosis of osteomyelitis and also to obtain culture data to guide antibiotic treatment. In a busy orthopaedic practice, however, bone biopsy procedures may be difficult to schedule on an urgent basis and are commonly believed by orthopaedic surgeons not to offer any additional culture information beyond a swab culture taken from the surface of the exposed bone.

The purpose of this retrospective study is to evaluate the diagnostic and therapeutic role of surgical bone biopsy in patients who have undergone bone biopsies in the context of a sacral pressure ulcer Grade IV. We hypothesized that the concordance of the microorganism and the susceptibility pattern obtained from a swab culture from the underlying exposed bone and that of the surgical bone biopsy would be high and therefore not offer additional clinical information to target appropriate antibiotic therapy.

METHODS

In an institutional review board approved study, data on stage IV pressure ulcers were identified using billing data between August 2004 and December 2014. All patients were treated at the same institution. Only those patients who received a bone biopsy, as well as a deep tissue swab, from a sacral pressure ulcer site that probed to bone (stage IV) were included. Minimum age for inclusion in the study was 18 years with sufficient follow-up to determine course of antibiotic treatment and disease management. Progress notes and consult reports were reviewed to document the incidence and length of preoperative antibiotics administered. Patients without complete medical records concerning antibiotic management were excluded. Interruption of all antibiotic therapy was at least 48 hours before specimen collection. Our primary out-

comes were change in treatment plan of antibiotic treatment and concordance of the bacterium. Swab culture was considered concordant with the bone culture when it grew the same pathogens isolated from the bone and had identical susceptibility patterns. The histopathologic or final culture report from each biopsy was used as the definitive diagnosis.

Demographics

Out of the 58 patients who obtained a surgical biopsy for grade IV sacral pressure ulcers identified between August 2004 and December 2014, 39 patients were reviewed with complete medical records. 19 patients were excluded from analyses as they failed to have complete medical records concerning antibiotic management. Thirty nine patients were found to meet all inclusion criteria and were included in this retrospective study. The average age of eligible patients was 60.5 ± 15.8 years. Of the 39 total enrolled patients, 23 were male; 16 were female; and all had a diagnosis of paraplegia due to spinal cord injury, as documented in their clinical record.

Bone biopsy

The bone biopsy was performed by two authors (P.A. and E.R.) in the operating room in a standard fashion. In all cases the wound probed down to bone. Sterile technique was used by the means of povidone-iodine solution. After inspecting the ulcer bed, a cortical window was created and a deep bone biopsy was obtained avoiding any possible contamination. The bone specimen for culture and sensitivity was taken using a sterile rongeur after osteotomy of the offending bone in the base of the ulcer.

Bone specimens were obtained for aerobic and anaerobic cultures, as well as pathology. Swabs were used to obtain aerobic and anaerobic cultures from the ulcer bed. Patients with osteomyelitis received a six week course of intravenous antibiotics and, when clinically indicated, underwent musculocutaneous flap surgery.

RESULTS

Out of the 58 patients who obtained a surgical biopsy for grade IV sacral pressure ulcer identified between August 2004 and December 2014, 39 patients were reviewed with complete medical records. Nineteen patients were excluded from analysis as they failed to have complete medical records concerning antibiotic management. Thirty nine patients were found to meet all inclusion criteria and were included in this retrospective study (**Table 1**). Of these, 30 received both

TABLE 1 Demographic and Clinical Outcome Variables

Variable	Biopsy AND Swab (n=30)	Biopsy ONLY (n=9)	Biopsy (Total) (n=39)
Age, years, mean \pm STD	-	-	60.5 \pm 15.8 years
Confirmed osteomyelitis, % (n)	-	-	59 (23/39)
Change in antibiotic course, % (n)	100 (30/30)	56 (5/9)	89.7(35/39)
"Biopsy AND Swab" corresponds to study group that underwent deep tissue swab from a sacral pressure ulcer site that probed to bone and bone biopsy; "Biopsy ONLY" corresponds to those who only underwent surgical bone biopsy; "Biopsy (Total)" corresponds to all patients inclusive of both experimental groups; "STD" denotes standard deviation.			

a bone biopsy and a deep tissue swab from a sacral pressure ulcer site that probed to bone. Nine patients had a bone biopsy only. Of the 39 patients that underwent a bone biopsy, osteomyelitis was confirmed in 23 patients (59.0%). Antibiotic management from preoperative to postoperative was changed in 35 out of the 39 (89.7%) patients following sacral bone biopsy findings.

Thirty patients underwent both pre-operative deep tissue swab and subsequent surgical bone biopsy. In all of these patients, the antibiotic therapy was changed (100%) after the bone biopsy culture data was available. The antibiotic regimen was narrowed and specifically targeted according to the sensitivities of the deep bone biopsy.

Bacterial growth was identified on culture swabs of osteomyelitis diagnosed by pathologic examination. The bacteria detected on culture swabs were mostly polymicrobial and included most commonly *Staphylococcus* spp., and *Pseudomonas aeruginosa*. Coagulase positive *Staphylococcus aureus* was identified in 11 cases, *Pseudomonas aeruginosa* in 9, group B *Streptococcus* in 4, *Escherichia coli* in 2, coagulase-negative *Staphylococcus* spp. in 1, *Corynebacterium diphtheriae* in 1, *Enterococcus* spp. in 3, *Bacteroides fragilis* in 1, and mixed bacteria types 2. The bacteriological results from the bone biopsy most commonly included *Staphylococcus aureus* and *Escherichia coli*. In all 30 patients (100%), the facultative organisms identified were not concordant (i.e. differed in part).

DISCUSSION

We found that surgical biopsy from a stage IV sacral pressure ulcer provided additional information useful in diagnosing osteomyelitis and identifying bacteria involved. In this patient cohort, biopsy proved to change antibiotic management in over 90% of patients.

As limited data are available regarding the effectiveness of ulcer swabs in identifying organisms causing osteomyelitis, it is important to review outcomes of patients who have undergone sacral bone biopsies in the context of a stage IV sacral pressure ulcer.

In addition to the diagnosis, accurate microbiologic evaluation is necessary for the treatment of osteomyelitis. The organisms infecting the bone are expected to arise from the ulcer, in which case ulcer swabs are believed to be useful in identifying the organism(s) without the need for bone biopsy. As antibiotic therapy is the mainstay of treating osteomyelitis, information regarding the organism and the culture sensitivity obtained from tissue swabs are effective ways to direct antibiotic therapy and monitor progress. Despite the utility and cost-effectiveness in tissue swabs in effectively directing antibiotic management, limited data are available regarding the effectiveness of ulcer swabs in identifying organisms causing osteomyelitis.

As posited by Livesley et al., blood cultures or cultures of deep tissue biopsy specimens generally are more clinically significant than are cultures of superficial swab specimens or aspiration of the pressure ulcer.¹² Rudensky et al. reported positive results obtained for 97% of cultures of superficial swab specimens, compared to 43% and 63% of cultures of aspirations and deep tissue biopsy specimens, respectively.^{9,13} Of note, poor consistency was observed between bacterial species identified by biopsy and swab cultures. It was concluded that swab cul-

tures reflected surface colonization and may overestimate positive results, while deep tissue biopsy specimens better estimated bacterial isolates.

To our knowledge, this is the first study to investigate whether deep tissue biopsy changed antibiotic management compared to tissue swabs related to grade IV sacral pressure ulcers. Due to the fact that antibiotic selection is based on the understanding of the microbiology of the infected pressure ulcer, one may intuit that antibiotic management may differ between methods of culture collection, particularly due to the lack of concordant bacterial species identified by biopsy and swab cultures.¹³ To complicate management, infected grade IV sacral pressure ulcers are commonly polymicrobial, so therapeutic regimens often target both gram-positive and gram-negative organisms.

In conclusion, surgical biopsy from a grade IV pressure ulcer provided additional information useful in diagnosing osteomyelitis and identifying bacteria involved. In this patient cohort, biopsy proved to change antibiotic management in over 90% of patients.

Histopathologic demonstration of inflammation in bone specimens obtained by open surgical biopsy is still considered to be the gold standard for diagnosis of osteomyelitis and ought to be considered in cases of ambiguity if prolonged antibiotic treatment is being contemplated.

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