1.2. PREVENTION: RISK MITIGATION

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QUESTION 1: Is there a role for bacterial decolonization (i.e., of methicillin-resistant *Staphylococcus aureus* (*S. aureus*), or MRSA, in nares) in trauma cases?

RECOMMENDATION: It is unknown if bacterial decolonization in trauma patients reduces surgical site infection (SSI).

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

S. aureus colonization has been described since the early 1930s, and is linked to postoperative SSI in different surgical specialties, including orthopaedics. *S. aureus* resides in the nares, throat and skin surfaces in up to 30% of the population [1]. Establishing an association between bacterial carrier status and SSI in the setting of orthopaedic trauma has been challenging. The reported rate of MRSA carriers ranges from 1.8% up to 30% of hip and femur fracture patients [2–11], whereas the reported rates of MRSA-related SSI in those carrier populations ranges from 8.8% to 14.2% [6,12]. Furthermore, MRSA carriers displayed a higher incidence of other nosocomial infections and one-year mortality [4].

Although several published studies do support a connection between preoperative carrier status (for MRSA) with postoperative SSI development [13], it is uncertain whether it is due to the carrier status alone or due to other patient and disease factors [14]. One study refuted the need for widespread MRSA screening and eradication [15]. On the other hand, most literature has advocated addressing high-risk populations [6,9,16–18] for carrier status with prophylactic antibiotics against MRSA rather than decolonization preoperatively. Two main reasons have been postulated. First, one study found that in 86% of trauma cases in the setting of emergency fracture management, the results of MRSA screening would not be available before the surgical procedure commences [2]. Second, successful decolonization process will delay surgical procedures, which may not be ideal especially in hip fractures and open fractures.

With regard to decolonization, MRSA-related SSI was significantly reduced after decolonization protocol (without any reference to carrier status) from 2.3% to 0.33% [19]. However, one study demonstrated that MRSA screening and treatment policy reduced infection rates from 1.57% to 0.69% [5]. Furthermore, decolonization has been found to decrease total numbers of wound infection rather than wound infections caused by *S. aureus* [20].

For orthopaedic trauma cases, no prospective study of bacterial decolonization exists. The introduction of MRSA screening policies was evaluated in two retrospective studies including trauma patients [5,21]. Mupirocin was used for MRSA-positive patients, and both studies showed a significant reduction of postoperative MRSA infections. In a recent study on patients with lower extremity fractures, the addition of a povidone-iodine nasal swab in addition to a chlorhexidine-gluconate bath was evaluated [22]. Compared to two years before the start of the povidone-iodine intervention, the rate of SSI declined significantly.

Literature supporting decolonization in orthopaedic trauma patients only consists of low to moderate quality level 3 and 4 studies [19,20]. Literature not supporting decolonization consisted of one moderate quality level 1 study [23] and one low quality level 4 study [7]. As a result, a recommendation could not be made in favor of or against bacterial decolonization. Most importantly, screening should not delay surgical intervention in these patients, and these should be individually evaluated in a case by case scenario.

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QUESTION 2: What are the ideal strategies to prevent secondary and nosocomial contamination of open fracture wounds which are left open?

RECOMMENDATION: Data support local antibiotics and early wound closure to reduce contamination of open facture wounds.

NOTE: The recommendation above was changed from the original version so the rationale below does not completely align with this recommendation. Please see Section 3:2, Question 2 for rationale for early wound closure. The rationale below regarding negative pressure wound therapy (NPWT) applies to Section 3:2, Question 4.

LEVEL OF EVIDENCE: Moderate

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)

METHODS

Randomized controlled trials, nonrandomized trials, prospective and retrospective observational studies were eligible for inclusion. We searched Medline, Embase, CINAHL, and the Cochrane Central Register of Controlled Trials (CENTRAL) up to March 2018 for published studies without language restriction. Our search strategy, including keywords and MeSH headings, are provided in the Appendix. Eligible studies met the following criteria: (1) all patients included in the study had an open fracture, (2) infection was an outcome variable and (3) there was a comparison between patients treated with a secondary infection prevention strategy and a control group or a comparison between two or more secondary infection prevention strategies.

RATIONALE

Some high-grade open fractures are left open and return to the operating room for one or more repeat debridement surgeries. Traditionally the wound was packed with a gauze dressing, which was changed between surgeries. There is interest in using different strategies to decrease surgical site infection (SSI), which is often thought to be caused by nosocomial pathogens. The two main current treatment strategies are the use of the NPWT (wound VAC) or antibiotic bead pouches.

A systematic review of the literature reveals four randomized trials with conflicting results investigating the practice of NPWT over simple gauze dressings between surgical debridement, and there are no randomized trials examining the efficacy of antibiotic bead pouches.

Until recently, the literature investigating the use of NPWT tended to show a reduction in infection rates with its use. However, this conclusion was contradicted recently by the WOLFF trial [1] which is a well-powered (n = 460) prospective trial on open fractures requiring multiple debridements. Patients were randomized to either standard dressings or NPWT. No effect on SSI was shown (7% in negative pressure vs. 8% in standard dressing, p = 0.64) [2].

Prior to the publication of the WOLFF trial, the literature had consistently favored NPWT but in smaller or lower-quality studies as summarized in a recently-published systematic review of the literature [3]. Three of the papers included in the review assessed the effect of NPWT on reducing SSI in open fractures [4–6]. There have been two additional randomized trials published more recently [7,8] and we identified two other retrospective studies on this topic [2,9]. Two of the three prior randomized trials demonstrated reduction in infection with NPWT (28% vs. 5%, p = 0.02, n = 62 [4] and 11% vs. 5%, p < 0.05, n = 93 [7]) and the third (n = 90) had a very low event rate and revealed no difference [8]. Three more retrospective studies showed similar results with relatively large reductions in infection rates with NPWT (55% vs. 19%, p = 0.04 [8], 21% vs. 8%, p = 0.01 [3], 33% vs. 10%, p = 0.03 [2]), and a fourth identified no difference despite a potential selection bias against NPWT due to higher-risk cases in that group [8].

Despite the widespread use of this technique in North America, there are few studies investigating the use of local antibiotic beads. These are composed of polymethal methacrylate (PMMA) cement mixed with antibiotics placed into the wound in a "bead pouch" that seals off the wound between debridement surgeries. One small pilot randomized trial investigated IV antibiotics versus antibiotic beads without intravenous (IV) antibiotics and found no difference in infection rates [10]. Three similar retrospective studies by one group [11–13] should probably be considered as one study, as all the