tion for those without neurological recovery/improvement after chemotherapy for moderate motor weakness and surgical decompression of the cord under the cover of multi-drug chemotherapy for severe motor weakness irrespective to the duration of illness or cause, are also recommended [22].

Medical treatment is generally effective for those with or without mild neural deficit. Surgical intervention may be indicated in advanced cases with marked bony involvement, abscess formation or paraplegia, regardless of prior or active tuberculosis.

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QUESTION 2: Should routine methicillin-resistant *Staphylococcus aureus* (MRSA) screening be in place prior to spine surgery?

RECOMMENDATION: Routine MRSA screening should not be performed prior to spine surgery. However, in hospitals with a high incidence of *S. aureus* spinal surgical site infection (SSI) and particularly high rates of MRSA infections, MRSA screening might be useful.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 86%, Disagree: 7%, Abstain: 7% (Super Majority, Strong Consensus)

RATIONALE

According to a recent review of 161 studies, the pooled average of SSI in spine surgery was 1.9% (range: 0.1 to 22.6%) [1]. Instrumented spinal fusion had the highest rate (3.8%), followed by spinal decompression (1.8%) and spinal fusion (1.6%). *S. aureus* contributed to almost 50% of spinal SSIs with a range of 0.02 to 10%. Among *S. aureus* spinal SSIs, the pooled rate of MRSA infections was 38% [1]. The 30-day mortality rate among patients with SSI was 1.06%, double that of those without SSI (0.5%), with mortality increasing with the complexity of spinal surgery or with the presence of underlying diseases [2]. Moreover, SSIs increased re-admission rates (from 20–100%), reoperation rates (with a pooled average of 67%) and doubled health-care costs [1].

Preoperative nasal carriage of *S. aureus* has been shown to be a risk factor for SSI, but rates have been variable between studies [3,4]. Nasal decolonization with the use of topical mupirocin is utilized in 90% of cases, however, the impact of using this strategy on the reduction of SSIs in orthopaedic surgery have reported conflicting results [5,6]. A recent meta-analysis of all published studies in cardiac and orthopaedic surgery suggested that decolonization was associated with a significant decrease in *S. aureus* SSIs when either the intervention was applied to all patients or only to those who were nasal carriers [7]. Another meta-analysis showed that an absolute reduction in SSIs of 1% may be cost-effective, however, universal decolonization may increase the risk of mupirocin resistance [8].

In a not-yet published retrospective study of 1,749 patients scheduled for elective instrumented neurosurgery, the MRSA colonization rate was 0.74%. After decontamination, all MRSA carriage was eliminated and none of the 13 MRSA carriers developed an SSI, while only 1 MRSA-negative case developed a MRSA SSI.

In a recent retrospective study of 4,973 consecutive spine patients who were given cefazolin as prophylactic antibiotic therapy rather than topical nasal antibiotics for decolonization, 49 (1.1%) were MRSA carriers, and 94 (2.1%) developed an SSI, 11 of which were caused by MRSA [9]. The SSI rates were similar in nasal carriers compared to non-MRSA carriers (3 of 49 vs. 91 or 4,433, $p = 0.13$) and nasal carriage was not a risk factor for spinal SSIs.

In conclusion, in patients undergoing spinal surgery, the low level of MRSA carriage and MRSA SSI are arguments against routine MRSA screening. In hospitals with a high incidence of *S. aureus* spinal SSI and high rates of MRSA infections, MRSA screening could be useful.

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QUESTION 3: Is there a role for routine decolonization of patients undergoing spine surgery? If so, what is the optimal agent(s)?

RECOMMENDATION: There is evidence to support the use of institutionalized screening and decolonization programs in methicillin-resistant *Staphylococcus aureus* (MRSA) carriers to reduce the rate of surgical site infection (SSI), however the optimum agents for decolonization have not been determined.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 91%, Disagree: 0%, Abstain: 9% (Super Majority, Strong Consensus)

RATIONALE

There is evidence to support the use of institutionalized screening and decolonization programs to reduce the rate of SSI, however the optimum agents for decolonization have not been determined [1]. Preoperative nasal MRSA colonization is associated with increased risk postoperative spinal SSI. Thakkar et al. reported screening positive MRSA SSI rates of 12% compared with screening positive for MSSA (5.73%) and screening negative (1.82%) [2]. Furthermore, Ramos et al. found increased rates of SSI in hip and knee arthroplasty and spine fusions, reporting a 4.35% SSI rate in colonized (nasal MRSA and MSSA) patients versus a 2.39% rate in noncolonized patients [3].

While widely utilized preoperatively, there is minimal evidence specifically supporting the use of chlorhexidine gluconate (CHG) showers preoperatively. The 2015 Cochrane review written by Webster et al. reported minimal evidence supporting isolated use of CHG showers preoperatively. Four reviewed trials comparing CHG to placebo found no effect, and only one trial comparing CHG showers to controls reported an improvement in SSI rate [4].

The majority of reviewed literature bundles the use of nasal decolonization with other interventions (CHG wipes, CHG showers, etc.). Multiple reviews on the effectiveness of bundled interventions for decolonization in surgical patients (including orthopaedic surgery) report reduced SSI rates with nasal decolonization and CHG wipes [5,6]. Reported studies on nasal decolonization protocols have largely shown benefit in reducing SSIs. Mullen et al. used CHG wipes and alcohol-based nasal decolonization preoperatively and reported a mean reduction rate in SSI of 81% (1.76 per 100 to 0.33 per 100) [7].

Chen et al. reviewed 19 studies of decolonization protocols on orthopaedic procedures and found significant efficacy in reducing SSIs, reporting reduction of *S. aureus* SSIs ranging from 40–200% and reduction of MRSA SSI from 29–149% [8]. Bode et al. performed a randomized, double blinded trial to determine if decolonization would reduce the SSI rate. Of 6,771 general, orthopaedic and neurologic surgery patients, 18.5% tested positive for *Staphylococcus* and were decolonized with 5 days of CHG showers and mupirocin nasal ointment. SSI rates significantly reduced from 7.7 to 3.4% using eradication compared with the placebo control [9]. These interventions are likely cost-effective as well, as Slover determined that the cost-efficacy threshold for their institution's screening and decolonization protocol would be met with a spine SSI reduction of only 10% [10].

It is our recommendation that patients who screen positive for nasal MSSA and MRSA should be decolonized using 2% mupirocin ointment applied intranasally and 2% chlorhexidine gluconate (CHG) showers for five days preoperatively. Additionally, in patients positive for MRSA, intravenous vancomycin 15 mg/kg should be administered preoperatively prior to skin incision and for 24 hours postoperatively.

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