G11: Should prophylactic antibiotics be altered for patients undergoing major orthopedic procedures based on their comorbidity profile?

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Response/Recommendation:

Although tailored antibiotic prophylaxis may be considered for high-risk populations, and based on regional microbial epidemiology, altering antibiotic prophylaxis based on patient comorbidity profile does not seem to make a difference to infection rate.

Strength of recommendation: Moderate

Delegate Vote:

Rationale:

Prophylactic use of systemic antibiotics remains a crucial part of the infection prevention bundle in orthopedic surgery. Yet, in major instrumented orthopaedic procedures with implants, surgical site infections (SSI), prosthetic joint infection (PJI) and osteomyelitis do occur which can be disabling, costly, and sometimes lethal (1). Failure of prophylactic antibiotics can occur and is multi-factorial, especially impacted by higher rates of β-lactams resistant bacteria, present as part of patient's skin microbiome (2).

Some patients, including those with comorbidities, are at an increased risk of infection after orthopedic implant procedures (3). The most cited comorbidities associated with postoperative infections are uncontrolled diabetes (fasting blood glucose >180 mg/dL, hemoglobin A1c >7%), malnutrition (serum albumin levels <3.50 g/dL), cardiovascular disease, chronic kidney insufficiency, obesity (BMI $\geq$ 30 kg/m^2), active smoking (tobacco use), immunosuppressive state (untreated HIV + patients, malignancy, autoimmune diseases, consumption of immunosuppressants) and prior joint surgery (3-6). Moreover, an increased score of validated risk stratification instruments, such as American Society of Anesthesiologists (ASA) score and Charlson Comorbidity Index (CCI) correlate well with increased rates of infection after orthopedic procedures (2-4).

Standardized antibiotic prophylaxis with cephalosporins is effective in preventing SSIs and PJIs in most patients (5). We assessed whether perioperative optimization of antibiotic prophylaxis according to patient comorbidity profile was needed to reduce postoperative infections in patients undergoing major orthopaedic surgeries. Optimal antibiotic selection and dosages for prophylaxis, including local antibiotic therapy, extension of antibiotic use after discharge, combination of drugs to cover cephalosporin-resistant bacteria were evaluated. Open fracture surgeries were excluded from the analysis.

Tailoring antibiotic prophylaxis towards comorbidities and site relevant microbial susceptibility patterns show promise for specific populations. A retrospective Spanish study of 657 patients, showed that adding teicoplanin prophylaxis in hip fracture surgery for MRSA prevention, reduced SSI rates. Protracted surgeries (>120 minutes, OR 4.5, p = 0.02), red blood

cell transfusions (OR 11.6, p = 0.002) and urinary tract infections (OR 4.28; p = 0.02) were significant risk factors for orthopaedic infections (7). A recent European study switched antibiotic prophylaxis from cefuroxime to teicoplanin plus gentamicin in primary TJA, targeting resistant pathogens particularly CoNS and cefuroxime-resistant *Enterobacteriaceae.* Early and delayed PJI rates were reduced by 75.2% (0.57% vs. 2.24%, HR: 0.25, p = 0.004). Increased reversible stage-1 acute kidney injury (AKI) rates (3.3% vs. 0.8%, p = 0.001) was noted (8). Conversely, Tan *et al.* analyzed 8,575 TJAs and found no significant impact in PJI rates when comparing standardized cefazolin or vancomycin prophylaxis (1.1% vs. 1.3%, p = 0.33). The incidence of PJI did not significantly differ between the cefazolin and vancomycin prophylaxis groups when stratified by comorbidities such as diabetes (1.7% vs. 2.1%, p = 0.28), rheumatoid arthritis (1.8% vs. 2.2%, p = 0.47), liver disease (2.1% vs. 2.3%, p = 0.59), or hypothyroidism (1.2% vs. 1.5%, p = 0.34). The authors concluded that tailoring antibiotics based on patient comorbidities does not significantly reduce the risk of PJI (9). Tailoring antibiotic prophylaxis protocol towards high-risk patients was effective in a paediatric population undergoing spine surgery, as cefazolin alone was insufficient for specific high-risk paediatric patients (ASA >2, sacrum/pelvic instrumentation, greater number of fused levels, surgery duration longer than 5.6 hours, non-ambulatory status, lack of sphincter control, cognitive impairment, and postoperative ICU admission. Culture yielded 72% of gram-negative bacilli (GNB), 85.5% of them susceptible to gentamicin. Authors concluded that adding gentamicin improved gram-negative bacilli (GNB) coverage, reducing SSIs (p < 0.001) (10).

Innovative approaches are also effective in specific contexts. Additional evidence underscores the importance of procedure and patient specific considerations. Successfully tailored systemic and local antibiotic prophylaxis has been used for PJI prevention after hip hemiarthroplasty surgery for patients with proximal femoral fractures, in which, rates of infection in up to 9% is expected (11,12). Most hip fracture patients at high risk of infection because of their underlying comorbidities, old age, frequent hospitalization and colonization by multidrug resistant gram-negative bacteria (11-13). In a quasi-randomized controlled clinical study of 848 patients, the rate of deep SSI was 3.5% in the standard-of-care group (cement with 0.5 g of gentamicin) and 1.1% in the intervention group (1 g clindamycin and 1g of gentamicin) (p = 0.041; logistic regression adjusting for age and gender). Systemic antibiotic prophylaxis with single doses of Gentamicin (3 mg/kg) and Teicoplanin (400 mg) were used for all patients. The number needed to treat to prevent one infection was approximately 42 (13).

Conclusion:

Standardized antibiotic prophylaxis with cephalosporins are effective in reducing infections after orthopaedic procedures. However, innovative approaches show promise for specific populations and epidemiological patterns. Tailoring antibiotic prophylaxis by local microbial resistance patterns may reduce the risk of subsequent infections. Meanwhile, correctly tailored systemic antibiotic prophylaxis in paediatric spine surgery and for patients with hip fracture shows promise. Future randomized controlled trials with sufficient follow up should explore these strategies to refine antibiotic prophylaxis protocols without driving antimicrobial resistance.

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