cement in managing aseptic loosening with a one-stage prosthesis exchange. However, in the management of PJI, the role of antibiotic loaded cement choice may be dependent upon the type of operative revision: debridement and implant retention, one-stage revision, two-stage revision and resection arthroplasty.

Two publications [4,5] do report a series in which no recurrence of infection was noted following the use of antibiotic impregnated cement during one-stage revision of infected shoulder arthroplasty; however, the sample sizes were small with 16 patients in one cohort and 32 in the other. There was no comparative control group using plain cement, and, as all patients also underwent debridement and postoperative antibiotic therapy, no firm conclusions can be drawn regarding the independent relevance of the cement due to the presence of multiple confounding variables.

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QUESTION 2: What is the role of topical intrawound antiseptics (dilute betadine lavage, acetic acid or antibiotics added to the irrigation solution) and antibiotic powder (such as vancomycin) during primary or revision shoulder arthroplasty?

RECOMMENDATION: Dilute povidone-iodine and/or vancomycin powder may have a role in patients considered at high-risk for periprosthetic joint infection (PJI) after primary or revision shoulder arthroplasty based on data extrapolated from other orthopaedic specialties.

LEVEL OF EVIDENCE: Limited

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

RATIONALE

There is no data in the shoulder literature specific to the use of specific intrawound antiseptic agents, irrigation solutions or antibiotic powders. Because of this, expert recommendations will have to be inferred from data from spine surgery [1,2], elbow surgery [3] and lower extremity arthroplasty [4]. There are two randomized single-blinded studies that demonstrated the efficacy and safety of dilute betadine irrigation at reducing the risk of infection in spinal surgery [5,6]. Based on a review of this literature, there appear to be advantages associated with the utilization of dilute betadine and vancomycin powder in cases of primary surgery for prevention of surgical site infection and in cases of PJI treatment for prevention of recurrent PJI. However, the data does not consider the risks of development of antimicrobial resistance with use of vancomycin powder. Betadine may have a negative influence on osteoblast proliferation in vitro [7], and so utilization in cases of fracture may not be recommended. While data is lacking specifically for the shoulder, consensus from the hip/knee, trauma and spine groups provide the ability to make some generalized recommendations for primary and revision shoulder surgery.

TABLE 1. Characteristics of studies assessing intrawound agents, irrigation solutions or antiobiotic powders*

Study	Methods	Intrawound Product/Joint	Site	Result
Yan et al. [3]	Retrospective	Vancomycin powder	Elbow	Positive result: 6.4% SSI vs. 0% infection SSI
Riesgo et al. [4]	Retrospective	Dilute povidone-iodine lavage plus vancomycin powder	Lower extremity PJI	Positive result: 16.7% failed vs. 37% failed
Hey et al. [1]	Retrospective cohort comparative	Vancomycin powder	Spine	Positive result: 0.9% SSI vs. 6.3% SSI
Ghobrial et al. [2]	Meta-analysis	Vancomycin powder	Spine	Systematic review: confirms safety
Tomov et al. [8]	Retrospective	Vancomycin powder, betadine	Spine	Positive result: SSI rates were reduced by 50%

* None of these studies evaluated the shoulder specifically. SSI, surgical site infection; PJI, periprosthetic joint infection

A comprehensive literature review was performed to identify all studies examining the use of intrawound antiseptics and antibiotic powder in shoulder arthroplasty. Searches for the terms "intrawound antiseptics shoulder" (0/0), "antibiotic powder shoulder" (3/0), "betadine shoulder" (8/0), "irrigation solution shoulder" (18/1) and "shoulder irrigation infection" (81/0) were performed using the search engines PubMed and Scopus, which were searched through February 2018. Inclusion criteria for our systematic review were all English language studies (Level I-IV evidence) that reported on use of intrawound antiseptics or antibiotic powder in primary or revision shoulder surgery. Exclusion criteria were non-English language articles, nonhuman studies, retracted papers, case reports, review papers, studies with less than 10 patients in the sample size, studies without clinical follow-up/infection rates and technique papers without patient data. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria were followed. We identified zero articles from PubMed and zero articles from Scopus that met all criteria. Given the limited number of articles identified with the search terms used, searches were separately performed to identify studies on intrawound antiseptic and antibiotics powder outside of the shoulder literature.

Of note, the Centers for Disease Control and Prevention released a recommendation on the use of vancomycin in 1995. Due to concerns for development of antimicrobial resistance, routine utilization of vancomycin in prophylaxis has been discouraged. Instead, use of vancomycin is believed to be acceptable for "prophylaxis for major surgical procedures involving implantation of prosthetic materials or devices at institutions that have a high rate of infections caused by methicillin-resistant *Staphylococcus aureus* or methicillin-resistant *S. epidermidis*. A single dose of vancomycin administered immediately before surgery is sufficient unless the procedure lasts greater than six hours, in which case the dose should be repeated. Prophylaxis should be discontinued after a maximum of two doses." This position statement has not been updated recently or amended to include a discussion of vancomycin powder.

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QUESTION 3: Do surgical drains influence the risk of infection in patients undergoing primary or revision shoulder arthroplasty?

RECOMMENDATION: There is no evidence to support routine use of closed-suction drains in patients undergoing shoulder arthroplasty for the prevention of periprosthetic joint infection (PJI).

LEVEL OF EVIDENCE: Limited

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

RATIONALE

We conducted literature search of PubMed for all articles published on closed surgical drains after anatomic total shoulder arthroplasty (TSA) and reverse total shoulder arthroplasty (RTSA) in the primary and revision settings. The exact search queries performed included the following keywords: "surgical drain in shoulder arthroplasty" in Medical Subject Headings (MeSH) Terms, "closed wound drainage in shoulder arthroplasty," "surgical wound drainage in shoulder arthroplasty" on Title/Abstract and in combination. The initial search produced five articles, including both shoulder and elbow arthroplasty, but after reviewing the elbow arthroplasty-related studies, all of these deemed to not provide information relevant for the purposes of this review and were excluded. This left two articles, both of which had their entire manuscripts analyzed thoroughly for relevance and inclusion.

There is a paucity of literature regarding the use of postoperative closed-suction drains and the relationship to infection and PJI after shoulder arthroplasty [1].

There are no current American Academy of Orthopaedic Surgeon (AAOS) clinical practice guidelines (CPG) which comment on the use of a postoperative drain following TSA or RTSA. While very limited literature is available regarding postoperative drain use in TSA or RTSA, there are several studies that have evaluated blood loss, change in hemoglobin, clinical outcomes and complication rates related to the use of drains after total knee arthroplasty (TKA) and total hip arthroplasty (THA) [1].

A level III, case-control study compared 64 patients who underwent TSH and RTSA without the use of a closed-suction drain to 304 patients that had a drain placed. This study found that drain usage was associated with lower postoperative hemoglobin, longer length of stay and lower postoperative simple shoulder test scores [1]. There was no clinically significant difference in the transfusion rates, superficial wound infections or deep infections. As is sometimes reported in the parallel TKA and THA literature evaluating closed suction drainage, there was no mention of hematoma