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1.5. PREVENTION: OPERATING ROOM ENVIRONMENT

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QUESTION 1: Does performing a primary total joint arthroplasty (TJA) after a dirty case (infection or open abdomen) in the same operating room increase the risk of surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: The little data on this subject suggests that the risk of PJIs may be higher when an elective arthroplasty follows a contaminated case. The risk may be reduced if terminal cleaning of the operating room can be done after the dirty case. Further studies are necessary to elucidate this connection.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 93%, Disagree: 4%, Abstain: 3% (Super Majority, Strong Consensus)

RATIONALE

A comprehensive literature review was performed in order to identify all studies on the effect of infection risks in primary TJA following a contaminated case. Searches for the terms "total joint arthroplasty," "infection risk," and "infected case" with different Boolean operators were performed using the search engines Medline, Embase and Cochrane that were searched through February 2018. Inclusion criteria for our systematic review were all English studies (Level I-IV evidence) that reported on infection risk for primary TJA following a contaminated case. Exclusion criteria were non-English language articles, studies > 10 years old, 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. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) criteria were followed. The initial search resulted in 921 papers. After removal of duplicates and evaluation of titles, 170 titles were evaluated, 24 full text papers were read and 4 studies met full inclusion and exclusion criteria to allow for analysis.

There is limited data in literature specific to infection risk when performing primary TJA after a contaminated case, as the number of studies is limited and the number of TJAs performed after an infected case is also restricted. A systematic review was performed specifically evaluating whether nosocomial pathogens persist on inanimate surfaces, such as pathogens from infected surgical cases remaining on surfaces in the operating room [1]. Almost all pathogens including respiratory and gastrointestinal viruses persisted for days on inanimate surfaces, with many gram-positive, gram-negative and fungal pathogens remaining for months. However, pathogen persistence was disrupted if preventative surface disinfection was performed and this was corroborated in a study of 31,499 TJAs where terminal cleaning was effective at reducing bioburden after an infected case and did not increase the likelihood of infection when a case was performed the next day [2]. On the other hand, this same study also demonstrated that infection risk increased by 2.4 times if a TJA case followed an infected case in the same room on the same operative day. Another study

demonstrated this similar finding, as one patient of 39 TJA patients (2.6%) developed an infection after a contaminated case and the organism *Cutibacterium acnes* was the same as the one isolated from the previous infected case [3]. Of note, the sample size was small in this study, although this study encompassed a 5-year study period, indicating that few TJAs were performed after infected cases. On the other hand, a previous study examining 85 TJAs performed immediately after an infected case demonstrated no difference in deep or superficial infection risk at 12 months when compared to a matched cohort of 354 TJAs that did not follow a contaminated case [4]. The pathogen from the TJA infection that followed a contaminated case was due to a different organism than the pathogen present in the preceding infected case. Further research is needed to determine whether infection risk is increased when a primary TJA is performed after a contaminated surgical case.

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QUESTION 2: Does the use of sterile surgical vests decrease the risk of contamination or incidence of infection following total joint arthroplasty (TJA)?

RECOMMENDATION: The use of sterile surgical vests has no bearing on the incidence of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs) following orthopaedic procedures.

LEVEL OF EVIDENCE: Consensus

DELEGATE VOTE: Agree: 85%, Disagree: 6%, Abstain: 9% (Super Majority, Strong Consensus)

RATIONALE

The optimal choice of gown material, type of surgical attire and method of donning operating room personal protective equipment has long been debated. Despite the current era of evidence-based medicine, surgical clothing remains steeped in historic practices based on literature over 30 years old and the notion of "what we have always done." Overall, the evidence surrounding surgical gowning/vests is poor. On systematic review, using PubMed, Ovid-MEDLINE®, Embase, PEDro, Cochrane Library, Scopus, Web of Science, ERIC and CINAHL Plus, we identified 1,356 articles using search terms related to surgical vests, gowns or suits; orthopaedic vests, gowns, suits, exhaust, helmet and surgical textiles. Of these, only 25 were pertinent to our study and represented a heterogeneous group.

It is an issue of significant socioeconomic value given the risk of exposure to contaminants and SSI following TJA. Guidelines from various bodies (World Health Organization, Association of Perioperative Registered Nurses, National Institute for Health and Care Excellence) appear to be based more in "expert opinion" and pragmatic approach rather than scientific evidence. On occasion, these guidelines appear contradictory and incomplete [1,2]. Many papers had major methodological flaws in study design and severe observer bias such that they would not merit inclusion in the study. Of those studies included, several use unproven links such as the reduction of bacterial counts and skin squamous cells as a proxy for infection.

The part of the surgical gown below the level of the operating table and above the chest level appears to be more contaminated [3]. Gowning and gloving appear to generate air particles in an operating room environment, although this appears less so at the level of the operating table under laminar airflow [4].

Exhaust suits have been thought to contribute to reduction of SSI for many years [5]. In addition, it is advocated that they protect the surgical team from contamination during orthopaedic procedures [6]. In a randomly allocated study of different surgical attires used for total knee arthroplasty, body exhaust suits produced less air contamination than occlusive polyester gowns, but no difference was identified in wound contamination [7]. In a combination of hip and knee arthroplasty series, filtered exhaust helmets provided no increased protection against bacterial contamination in the area of the surgical field versus conventional hoods and masks [8]. In comparison to established occlusive polyester gowns, more modern liquid-proof fabric gowns have received criticism that they produce increased air contamination [9]. Disposable non-sterile hoods appear to be equally efficient to helmet systems in containing bacteria in air and surgical site surface [10]. In another study, space suits appear to cause more particle counts in the operating room with surgeon motion compared to standard surgical gowns [11]. Space suits do seem to offer protection in bacterial air contamination at the surgical site compared to conventional surgical suits [12]. Disposable polypropylene clean air suits with cuffs at the sleeves and legs appear to reduce air contamination compared to other suits [13,14]. Reusable surgical gowns show more bacterial penetration compared to disposable spun-bonded gowns [15,16]. Tightly woven special scrub suits do not seem to reduce air or wound contamination with methicillin-resistant *Staphylococcus epidermidis* (MRSE) and the most common source of MRSE remains the patient [17].

Modern positive-pressure surgical helmet systems differ from the earlier negative-pressure body exhaust systems, which were noted to reduce surgical site infection [18]. Furthermore, not all surgical helmet systems compare similarly as far as the contamination of the glove-gown interface is concerned. Specifically, positive pressure systems show more contamination in this area, even compared to conventional sterile gowns [19]. This has been attributed to contamination at the glove-gown interface [20,21]. A randomized study of standard surgical gowns and positive-pressure surgical helmet systems, with and without cuff/glove taping, found