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QUESTION 2: Does the type of fixation of an arthroplasty component influence the incidence of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: There is no difference in the rates of SSIs/PJIs after total hip arthroplasty (THA) or total knee arthroplasty (TKA) based on fixation of the prosthesis.

LEVEL OF EVIDENCE: Moderate

DELEGATE VOTE: Agree: 93%, Disagree: 5%, Abstain: 2% (Super Majority, Strong Consensus)

RATIONALE

The type of fixation utilized for an arthroplasty gets scrutinized for its functional performance and potential to reduce the incidence of subsequent SSIs/PJIs. Below is a summary of the currently available literature on the various fixation methods for primary hip and knee arthroplasty:

Cemented, uncemented and hybrid primary THA

Several randomized control studies have compared the surgical outcomes of cemented and uncemented THA. However, most of the studies were unable to reach a conclusion on the risk of PJI based on the type of fixation due to the infrequent occurrence of SSI/PJI and low number of subjects in the cohort. Among the randomized clinical trials (RCTs) comparing cemented and uncemented THA, no difference has been observed in the rates of PJI [1-6].

Because the incidence of PJI is low, an early meta-analysis did not demonstrate a statistically significant difference in the incidence of PJI based on fixation [7]. However, a more recent meta-analysis including eight clinical studies (two RCTs and six observational studies) revealed that the incidence of PJI was 0.5% (310/67,531) in cemented group, and 0.3% (47/16,669) in uncemented group ($p = 0.008$) [8]. The use of cement in THA was associated with an increased risk of PJI (odds ratio (OR) = 1.53; 95% confidence interval (CI) 1.12 to 2.10; $p = 0.008$). The possible reasons for the higher rate of PJI in cemented THA were longer operative time and the difference in patient demographics between the two groups. However, the authors could not tell the influence of the type of cement used on the risk of PJI because five of the eight studies included did not specify whether they used antibiotic-laden bone cement or not.

The most recently published report of Phedy et al. is a meta-analysis of 27 studies attempting to show whether the infection risk is higher in cemented or uncemented prostheses. By the criteria they used, they found the current evidence is low in quality and it is hard to make a definitive conclusion based on the quality of the evidence presented [9].

Registry Data:

Evidence from large population-based studies appeared to show that the risk of revision due to PJI is roughly equal comparing uncemented with cemented fixation.

A review of this question is from the Nordic Arthroplasty Register Association for patients between 1995 and 2010 revealed no difference in infection rates for cemented vs. uncemented THA, provided antibiotic-laden cement was used (relative risk 1.5 for non-antibiotic cement) [10]. Another study using the Nordic Arthroplasty Register Association in four Nordic countries (Denmark, Finland, Norway and Sweden) observed the overall risk of revision due to infection was similar for cemented, reverse hybrid and uncemented THA [11]. Using multivariable Cox analysis, the use of cement without antibiotics and hybrid configurations were found to be risk factors for infection. Data from the Swedish Hip Arthroplasty Registry (SHAR) between 1992 and 2007 demonstrated that uncemented THA did not present a higher risk of revision due to infection compared to antibiotic-laden cemented THA [12]. Another registry study in the Finnish Arthroplasty Register observed no significant differences in the risk of early revision for infection between cemented, uncemented and hybrid THA [13]. Similar results were observed in the Danish Hip Arthroplasty Register when evaluating the rate of second revision after first-time revision of primary THA with cemented and uncemented femoral components, but did note a higher percentage of the primary THA infections were from uncemented fixation [14].

In contrast to other registry studies, the New Zealand Joint Registry on primary THA done during 1999 to 2006, found a significant increase in the risk of revision for infection in the cemented (0.36%) and hybrid group (0.32%) when compared with the uncemented group (0.22%) [15]. Importantly in New Zealand, the use of antibiotic-laden cement was uncommon during this period and 64% of the revisions for infection of cemented components were in patients who did not have antibiotic-laden cement during the primary operation. Another study of primary THA from 1987 to 2007 showed a pronounced increase in the risk of being revised due to deep infection in the subgroup of uncemented THA performed between 2003 and 2007, which had an increase of 5 times (95% CI: 2.6 – 11) compared to uncemented THA from 1987 to 1992 [16]. The authors suggested that there was a trend towards higher susceptibility to deep infection for uncemented THAs than for THAs implanted with cement-containing antibiotics.

Another study from three Norwegian health registries investigated the rate of SSI and the risk of revisions due to PJI in THA [17]. During the study period from 2005 to 2009, the rate of SSI was about 3% (167/5,540), which was not influenced by cemented or uncemented fixation. Uncemented THAs had a higher adjusted risk of revision due to PJI when compared with cemented THA (risk ratio (RR) = 1.5, 95% CI 1.0 to 2.2, $p = 0.03$). The rate of revision due to PJI for hybrid fixation was not different when compared to cemented fixation (RR = 1.1, 95% CI 1.6 to 0.7, $p = 0.7$).

A Danish Hip Arthroplasty Register found patients who had received cemented THA without antibiotics (risk ratio 1.41, 95% CI: 1.01 to 1.96) and hybrid THA (risk ratio 1.53, 95% CI: 1.19 to 1.96) had a higher risk for infection relative to uncemented implants [18]. However, the same group of researchers published contradictory results of primary THA in patients younger than 55 years of age, which found uncemented and hybrid rather than cemented implants in patients younger than 55 years had more short-term revisions associated with dislocation, periprosthetic fracture and infection [19].

The higher risk of PJI in THA using plain bone cement without antibiotics was also reported by another study from the Norwegian Arthroplasty Register Association [20]. The study directly compared

the revision rates due to infection in primary uncemented THA with those of cemented THA with antibiotic-loaded cement and to those of cemented THA without antibiotic-loaded cement. The results showed that the risk of revision due to infection was the same for uncemented and cemented arthroplasties with antibiotic-loaded cement, but higher for cemented arthroplasties without antibiotic-loaded. The authors proposed that cementation might cause bone necrosis, either by direct toxicity or by the generation of heat during the polymerization process. The necrotic bone was susceptible to the growth of bacteria, which appeared to be neutralized by adding antibiotic to the cement.

Cemented vs. Uncemented TKA

Although there are several published RCTs and systematic reviews comparing the survival of cemented versus uncemented TKA, few present PJI as the primary endpoint. A Cochrane review from 2012 comparing fixation methods in TKA was unable to report on superficial or deep infection rates due to inconsistent reporting of data in the included studies [21]. Similarly, the various retrospective studies and RCTs have not demonstrated a significant difference in the incidence of PJI between the fixation methods [22-26]. However, like the studies on THA fixation, they have low enrollments and are not appropriately powered to assess for a difference in PJI.

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QUESTION 3: Does the surface (grit-blasted, plasma-sprayed, porous metal, porous beaded and hydroxyapatite (HA) coated) of uncemented total hip arthroplasty (THA) components influence the rate of subsequent surgical site infections/periprosthetic joint infections (SSIs/PJIs)?

RECOMMENDATION: The surface roughness, including porosity size, geometry and symmetry determines biocompatibility. Several studies have shown that the surface material influences bacterial adherence, with an ideal pore size dependent on bacterial size. Too small a pore size does not allow bacterial lodging. In recent studies, nanotexture of material has been found to be important with some surfaces with nanotubules showing anti-infective properties.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 61%, Disagree: 20%, Abstain: 19% (Super Majority, Weak Consensus)