Review Article

Infection Prevention in Total Knee Arthroplasty

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Abstract

Periprosthetic joint infections are devastating complications that are difficult and expensive to treat and have a substantial mortality rate. A major goal of modern joint arthroplasty is to minimize these infections. Preoperative factors associated with increased risk of infection include malnutrition, diabetes mellitus, obesity (body mass index >40 kg/m^2), and rheumatoid arthritis. Administration of appropriate antibiotics before the surgical incision is made is essential to minimize infection. The use of laminar flow rooms, proper skin preparation, limiting operating room traffic, and the use of various wound closure techniques can help to decrease infection rates. Postoperatively, optimal management of indwelling urinary catheters, blood transfusions, and wound drainage also may decrease infection rates.

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The individual morbidity and societal cost associated with periprosthethic joint infections make them devastating postoperative complications.[1] Total knee arthroplasty (TKA) infection rates range from 1.1% to 2.20%.[2,3] Despite this relatively low incidence, infections remain a significant cause of reoperation. A review of 60,355 revision TKA cases from the National Inpatient Sample database demonstrated that infection was the leading indication for revision TKA (25.2%).[4] Hanssen and Rand[5] noted that, at the Mayo Clinic between 1969 and 1996, the prevalence of infection after total hip arthroplasty (THA) and TKA was 1.7 % and 2.5%, respectively (30,680 THAs, 18,749 TKAs). Despite the use of different antibiotic prophylactic regimens, operating room (OR) configurations, surgical techniques, and modes of fixation, the authors noted that the rate of infection was remarkably constant at their institution.[5] Here, we describe the risk factors associated with periprosthetic joint infection and strategies for preventing infection.

Preoperative Risk Factors

Preoperative factors associated with an increased risk of infection include nutritional deficiencies,[6,7] uncontrolled diabetes mellitus,[8,9] obesity,[6-8,10] male sex,[2,11,12] longer surgical time,[12] and rheumatoid arthritis[11] (Table 1).

Nutritional Deficiency

Assessing the patient's nutritional status before elective surgery is essential. Greene et al[13] reviewed the records of 217 patients who underwent a primary THA or TKA. The risk of developing a major wound complication was five times greater in patients with a preoperative lymphocyte count of <1,500 cells/mm^3. The risk of wound complications was seven times greater in patients with an albumin level of <5 g/dL. Jaberi et al[14] retrospectively reviewed 300 patients who underwent total joint arthroplasty and developed persistent wound drainage. Of the 83 patients who required surgical débridement, those suffering from malnutrition (albumin levels <3.5 mg/dL, an absolute neutrophil count <1,500 cells/mm^3, or transferrin levels <200 mg/dL) had an increased risk of developing an infection. Although it is unclear whether nutritional status should be universally screened, the data suggest that patients at risk of infection may benefit from preoperative nutritional screening, education, and nutritional supplementation.

Table 1

Risk Factors for Periprosthetic Infection

Surgical Stage	Risk Factor
Preoperative	Malnutrition
	Diabetes mellitus
	Obesity (BMI >40 kg/m^2)
	Male sex
	Longer surgical time
	Posttraumatic arthritis
	Inflammatory arthritis
	Colonization with MRSA
Intraoperative	Skin preparation
	Surgical gowns and gloves
	AB-impregnated cement
	OR configuration and traffic
	Wound closure
Postoperative	Retention of the Foley catheter for >1 day
	Blood transfusions
	Prolonged wound drainage
	Dental procedures

AB = antibiotic, BMI = body mass index, MRSA = methicillin-resistant *Staphylococcus aureus*, OR = operating room

Diabetes Mellitus

Uncontrolled diabetes mellitus (glucose >200 mg/L or hemoglobin [Hb] A1c >7%) increases the risk of infection following total joint arthroplasty. Although changes in blood glucose concentration can acutely affect physiologic stability, HbA1c level, which is the average blood glucose concentration over a 1- to 3-month period, has not been shown to consistently predict infection risk when used exclusively.[15] In a retrospective study of total joint arthroplasty outcomes from the Nationwide Inpatient Sample database, Marchant et al[9] compared 3,973 patients with uncontrolled diabetes mellitus, 105,485 patients with controlled diabetes mellitus, and 920,555 patients without diabetes mellitus. The authors evaluated differences in common surgical and systemic complications, mortality, and hospital course alterations. Glycemic control was determined by physician assessments based on guidelines by the American Diabetes Association as well as patient self-monitoring of blood-glucose levels, HbA1c levels, and related comorbidities. The odds of wound infection in patients with uncontrolled diabetes mellitus were significantly increased (adjusted odds ratio = 2.28; 95% CI = 1.36 to 3.81; P = 0.002).

Obesity

Obesity may lead to increased rates of periprosthetic infection. In a prospective study of 1,214 patients who underwent TKA, Dowsey and Choong[8] compared the rates of deep prosthetic infection in patients who were obese and those who had a healthy weight at 12 months postoperatively. A body mass index (BMI) <30 kg/m^2 was classified as a healthy weight, with weight ranging from 30 kg/m^2 to 39 kg/m^2 classified as obese and weight ≥40 kg/m^2 classified as morbidly obese. Of the 18 postoperative infections reported, the incidence was greater in patients who were morbidly obese (odds ratio, 8.96; 95% CI, 1.59 to 50.63) and in those with diabetes mellitus (odds ratio, 6.87; 95% CI, 2.42 to 19.56). Jämsen et al[6] analyzed 7,181 primary hip and knee arthroplasties performed for osteoarthritis at a single center and found that the infection rate increased from 0.37% in patients with a normal BMI to 4.66% in those who were morbidly obese. Malinzak et al[7] demonstrated that, in patients treated with THA or TKA, a BMI >50 kg/m^2 increased the odds ratio of infection to 21.3. A workgroup of the American Association of Hip and Knee Surgeons evidence-based committee found that morbid obesity was associated with a considerably increased risk of infection and recommended discussing this risk factor with patients before surgery.[10]

Surgical Time

Longer surgical times and lower socioeconomic status also influence infection rates. Kurtz et al[2] reviewed 69,663 TKA patients from the 5% Medicare national sample administrative data set and identified 1,400 infections. Male sex, longer surgical time (adjusted hazard ratio for

210+ minutes compared with >120 minutes = 1.59), and lower socioeconomic status were associated with increased infection rates. Willis-Owen et al[12] reviewed 5,277 THAs and TKAs using generalized linear modeling and demonstrated that prolonged surgical time ($z = 4.325$, $P < 0.001$) was associated with increased infection rates.

Rheumatoid Arthritis

Rheumatoid arthritis[16,17] and previous knee surgery[18] may be associated with increased infection rates. Jämsen et al[11] evaluated 43,149 primary and revision TKAs from the Finnish Arthroplasty Register and noted that 387 revision TKAs were performed for periprosthetic joint infection. Increased rates of infections were found in men, those with seropositive rheumatoid arthritis, and those who had a previous fracture about the knee. Schrama et al[17] found that the infection rate among patients with rheumatoid arthritis who underwent TKA was 1.6 times greater than that of patients with osteoarthritis who underwent the same procedure.

Disease-modifying antirheumatic drugs such as methotrexate, leflunomide, and infliximab reduce the rate of damage to bone and cartilage associated with rheumatoid arthritis through various immunomodulatory mechanisms. Although there is little evidence regarding management of these medications in the perioperative period, expert opinion suggests that most of these medications should be stopped 1 to 2 weeks before surgery and restarted 1 to 2 weeks postoperatively.[19] The Canadian Rheumatology Association recommends that these drugs be stopped for as long as 3 to 5 times the half-life of each individual drug.[20] Infliximab, etanercept, leflunomide, and adalimumab should be stopped at 3 weeks, 1.5 weeks, 6 weeks, and 1 month before surgery, respectively.

Controversy exists regarding the perioperative management of medications such as methotrexate. Methotrexate is a folate analogue that has anti-inflammatory properties associated with the inhibition of neovascularization and decreased production of cytokines.[19] Some studies have shown an increased risk of infection with continued use of methotrexate during the perioperative period,[21,22] and other studies have shown no difference in the incidence of infection regardless of whether the medication is stopped.[23,24] In a prospective study, Grennan et al[23] randomized 388 patients who were taking methotrexate into two groups. The first group continued methotrexate and the second group discontinued the drug 2 weeks preoperatively and restarted the medication 2 weeks after the procedure. The group that continued methotrexate therapy had significantly fewer infections and complications ($P < 0.003$). Consultation with the patient's rheumatologist or internist regarding perioperative management of these medications is essential.

Other Risk Factors

Intra-articular corticosteroid injections are commonly used to alleviate pain and swelling in the arthritic joint. Some reports have suggested that the incidence of infection is increased when arthroplasty is performed in a joint that has previously received an intra-articular injection.[25,26] In a study of 144 patients who underwent TKA, Papavasiliou et al[26] divided them into two groups; 54 patients received an intra-articular corticosteroid injection in the 11 months before the procedure and 90 patients did not receive an injection. All three postoperative deep infections occurred in patients who received a corticosteroid injection before surgery. Desai et al[27] retrospectively reviewed 90 patients who had received an intra-articular corticosteroid injection before TKA and compared them with a matched cohort of 180 patients who had TKA without a prior corticosteroid injection. The authors found no increase in the incidence of infection in TKA patients who received a corticosteroid injection before surgery. However, little to no evidence exists to indicate when joint arthroplasty can be safely performed after administration of a corticosteroid injection.

Asymptomatic colonization with methicillin-resistant *Staphylococcus aureus* (MRSA) may be a risk factor for subsequent MRSA infection. Because of cost, time, and compliance issues, there is no current consensus on the management of MRSA colonization. Several studies have demonstrated an increased risk of infection in patients colonized with MRSA. In a prospective study of 758 patients whose nares were cultured at admission, Davis et al[28] reported that 3.4% were colonized with MRSA, and 21% were colonized with methicillin-sensitive *S aureus* (MSSA). The authors found that the risk of developing a MRSA infection was increased with MRSA colonization at admission compared with MSSA colonization (relative risk, 13; CI, 2.7 to 64) or no staphylococcal colonization (relative risk, 9.5; 95% CI, 3.6 to 25).

Identification of patients who are carriers of antibiotic-resistant bacteria and preoperative treatment to eradicate bacterial colonization can potentially decrease the rates of subsequent periprosthetic joint infection. Protocols used in decolonization programs may include the use of intranasal mupirocin ointment and/or chlorhexidine baths.[29-31] In a prospective study of 636 total joint arthroplasty patients who were screened preoperatively for *S aureus* with nasal swab cultures, Rao et al[31] found that 164 patients had positive nasal cultures (23% MSSA and 3% MRSA).

Carriers were treated preoperatively with intranasal mupirocin ointment twice daily and chlorhexidine baths of the surgical site for 5 days preoperatively. None of the treated patients developed a deep infection. In a control group of 1,330 patients who were not screened preoperatively, 12 *S aureus* infections (0.9%) were reported. Kim et al[30] also reported that infection rates were successfully decreased following mandatory preoperative testing and treatment for MRSA in all patients who were undergoing elective orthopaedic procedures. Patients who were found to be carriers of *S aureus* were treated with intranasal mupirocin and chlorhexidine baths. Following implementation of the testing and treatment program, the infection rate decreased from 0.45% to 0.19% (P = 0.0093).

Kalmeijer et al[29] compared the use of intranasal mupirocin ointment alone with that of a placebo in 614 patients who underwent orthopaedic surgery. In the mupirocin group, the eradication of nasal carriage was markedly more effective than in the placebo group (eradication rate, 83.5% versus 27.8%). However, the use of mupirocin nasal ointment did not reduce the rate of surgical site infection or the length of hospital stay. More prospective, randomized, controlled studies are needed to determine the efficacy and cost-effectiveness of preoperative intervention.

Intraoperative Prevention of Infection

Intraoperative strategies for preventing infection include perioperative administration of intravenous antibiotics;[32-34] adequate skin preparation;[35-38] appropriate use of gowns,[39-41] gloves,[42,43] and antibiotic cement;[11,44-48] limiting OR traffic,[40,49] and selection of the optimal method of wound closure[50,51] (Table 2). Preoperative antibiotic administration decreases the rate of infection following surgical procedures.[20] As part of the National Surgical Infection Prevention Project, Bratzler et al[33] recommend the use of either cefazolin or cefuroxime as preoperative prophylactic antibiotics. In the case of MRSA colonization or a recent MRSA outbreak, the use of vancomycin is recommended. Clindamycin or vancomycin is recommended for patients with a confirmed β-lactam allergy. In a meta-analysis of perioperative administration of prophylactic antibiotics to patients who underwent primary or revision hip and knee arthroplasty, AlBuhairan et al[32] reported an 8% decrease in the overall infection rate and an 81% decrease in relative risk of infection ($P < 0.00001$) associated with the use of antibiotic prophylaxis.

The Surgical Infection Prevention Guideline Writers Workgroup recommended initiating the first antimicrobial dose within 60 minutes before the surgical incision is made.[33] Discontinuation of the prophylactic antimicrobial within 24 hours after the end of surgery was also recommended. Rosenberg et al[34] demonstrated that including verification of antibiotic administration during the preoperative surgical timeout protocol greatly increased compliance in the timing of antibiotic prophylaxis from 65% to 99.1% ($P < 0.0001$).

Table 2

Intraoperative Methods of Infection Prevention
Perioperative administration of antibiotics
Shorter surgical time
Appropriate skin preparation before surgical incision
Frequent glove changes
Use of antibiotic-impregnated cement
Limiting operating room traffic
Wound closure with sutures or staples

Skin Preparation

Skin preparation reduces bacterial skin counts before surgery. However, few randomized controlled trials exist to guide preoperative skin preparation protocol. The use of mechanical razors, which may cause injury to the skin and subsequent bacterial colonization, must be avoided. Hair should be removed close to the time of incision. Gilliam and Nelson[35] compared bacterial skin counts before and after skin preparation for primary joint arthroplasty with iodophor paint and scrub (30 patients) or an iodophor and alcohol preparation (30 patients). The authors found that both methods provided a similar reduction in bacterial colony counts. However, the one-step, water-insoluble iodophor and alcohol solution improved drape adhesion.

Drape lift-off has been shown to provide a means for bacterial entry into wounds, with subsequent risk of infection. In a single-center, randomized trial, Jacobsen et al[36] compared the use of DuraPrep (3M) or an iodine scrub and paint for preoperative skin preparation in 176 patients. Both groups received an iodine-impregnated drape. They observed similar wound contamination rates (DuraPrep, 28.0%; povidone-iodine, 36.4%) but found that the iodine scrub and paint group had an increased amount of drape lift-off (9.9 cm versus 1.5 cm), potentially leading to subsequent entry of bacteria into wounds.

Chlorhexidine and alcohol can also significantly reduce the bacterial load present on the skin.[37,38] Although several studies have demonstrated that the use of chlorhexidine resulted in a greater reduction in skin bacterial counts, these studies were small and did not demonstrate a difference in infection rates. Given the lack of evidence, it is unclear whether chlorhexidine or iodine-based solutions should be used for skin preparation before TKA. However, Darouiche et al[52] demonstrated that, in clean-contaminated cases, chlorhexidine solutions were superior to iodine in limiting infection.

Surgical Gowns and Gloves

Surgical exhaust suits are frequently used when performing total joint arthroplasty. Whether these suits decrease infection risk is debatable.[39-41] Ritter[40] evaluated the effectiveness of exhaust gowns in limiting the level of airborne bacterial contamination. In a mock OR, exhaust gowns were compared with standard gowns, and the exhaust gowns provided a 38% decrease in colony forming units ([CFU]; 325 and 201 CFU, respectively). However, during actual procedures, there was no difference noted between the two types of gowns. Der Tavitian et al[39] used air and wound bacterial counts to compare the effectiveness of exhaust and occlusive gowns in preventing contamination. The number of CFUs decreased from 1.0 to 0.5 CFU/m^3 when exhaust gowns were used (P = 0.012). However, evidence of wound contamination was seen in 64% of cases when exhaust gowns were used and in 60% when standard occlusive gowns were used.

Surgical gloves can be another source of wound contamination. McCue et al[43] cultured 275 outer and inner gloves following 10 THAs. The gloves most frequently contaminated (44% of the bacterial colonies grown) were those used exclusively for draping. The authors suggested changing outer gloves after draping and periodically during the procedure to minimize contamination. Al-Maiyah et al[42] conducted a randomized controlled trial in which gloves were changed every 20 minutes or only before cementation in 50 THAs. The gloves that remained in place until cementation demonstrated significantly more bacterial contamination than those that were changed frequently (76% versus 44%, P = 0.02). Therefore, changing gloves after draping or when the case is prolonged can potentially decrease bacterial contamination.

Antibiotic-impregnated Cement

Antibiotic prophylaxis can be delivered intravenously or through antibiotic-impregnated bone cement. Josefsson and Kolmert[47] performed a prospective randomized controlled study of 1,688 THAs performed with either systemic antibiotics or gentamicin bone cement. After 10 years, there were 13 deep infections in the systemic antibiotic group versus 9 infections in the bone cement group. In a review of the Finnish Arthroplasty Register, Jämsen et al[11] found that the combined use of systemic antibiotic prophylaxis and antibiotic-impregnated bone cement lowered the rate of infection (0.68% of 32,918 knees) more than the use of systemic antibiotics alone (1.05% of 6,550 knees). In a prospective, randomized study, Chiu et al[44] found that cefuroxime-impregnated cement was effective in preventing deep infection after primary TKA was performed using perioperative systemic antibiotic prophylaxis without so-called clean air measures. No infections were reported in the group treated with cefuroxime-impregnated cement and intravenous antibiotics. In the group treated with cement without antibiotics, the infection rate was 3.1% (5 of 162, P = 0.0238). In a separate study, Chiu et al[45] prospectively evaluated 78 TKAs performed in patients with diabetes mellitus. After a mean follow-up of 50 months, there was no deep infection found in 41 knees treated with cefuroxime-impregnated cement, whereas 5 infections were reported in the 37 knees (infection rate, 13.5%) that did not receive the antibiotic-impregnated cement. We typically use antibiotic-impregnated cement in joint arthroplasties.

Concerns exist about the increased cost of antibiotic cement and the potential for secondary development of antibiotic-resistant bacteria. Using an animal model, Thomes et al[48] compared the rates of infection and antibiotic resistance in an orthopaedic procedure that was contaminated with *S epidermidis*. Standard or gentamicin-containing cement beads were implanted subcutaneously in 44 rats. A lower incidence of infection was seen in the group treated with gentamicin-containing cement beads. However, there was a significantly higher rate of infection with gentamicin-resistant organisms in this group than in the standard cement bead group (78% versus 19%; $P < 0.01$).

Operating Room Configuration and Traffic

Controversy exists regarding the efficacy of ultra-clean air and laminar air flow in the OR to decrease deep surgical site infections.[40,49] Ritter[40] demonstrated a 93% reduction in airborne bacteria in the vicinity of the wound and a 97% reduction in bacteria at the instrument table when laminar flow was used ($P < 0.005$). The author also reported that 30% of unused instruments were contaminated with bacteria in a standard OR compared with only 1% of unused instruments when laminar flow was used. Knobben et al[49] observed a similar reduction in bacterial contamination of surgical instrumentation when laminar flow was used (from 32.9% to 8.6%; P = 0.001). The authors also noted a reduction in prolonged wound drainage and the incidence of superficial infection with use of laminar flow (from 14.9% to 1.4%; P = 0.004). However, Salvati et al[53] reported an increased rate of infection in TKAs when patients underwent surgery in filtered, horizontal, unidirectional laminar airflow ORs compared with those who had surgery in standard ORs. This pattern was significant, and the authors felt that the increased rate could be attributed to the position of the OR personnel and the wound in relation to the airflow. Breier et al[54] found that laminar airflow had no independent effect on surgical site infections when controlling for confounding factors in a multivariate analysis. However, in a study of infection after 51,485 THAs and 36,826 TKAs, Hooper et al[55] reported an increased rate of early infection with the use of laminar flow.

Limiting the number of personnel entering and exiting the OR decreases the level of airborne bacterial contamination.[40] Settle plates placed in an undisturbed OR overnight produced only 15 CFU/ft^2 per hour. The CFU levels increased dramatically to 300 to 400 CFU/ft^2 per hour in an OR with personnel present.

Wound Closure

Surgical wound closure techniques may affect the infection rate. Kahn et al[50] prospectively compared wound closure in 187 primary TKAs and THAs closed with either skin staples, subcuticular 3.0 suture, or 2-octylcyanoacrylate (OCA). Closure with OCA resulted in less wound discharge in the first 24 hours for both hips and knees. However, there was a tendency for prolonged wound discharge in TKAs closed with OCA. Wound closure with skin staples was significantly faster than closure with OCA or suture. There was no difference in infection rates between the groups. We typically close wounds with staples. The use of alternative techniques to close the fascia and skin, such as barbed sutures, increases time saved in the OR. Further study on the influence these techniques have on wound drainage and infection is needed.

Postoperative Risk Factors

Postoperative risk factors for infection include indwelling urinary catheters,[56] blood transfusions,[57,58] prolonged wound drainage,[59] and dental and urologic procedures.[60,61]

Indwelling Catheters

Controversy exists regarding the use of Foley catheters. Indwelling urinary catheters may increase the risk of prosthetic joint infections via hematogenous seeding of the newly placed implant. Wald et al[56] reviewed 35,904 patients undergoing a variety of major surgical procedures. Retention of urinary catheters for >48 hours was associated with a urinary tract infection rate twice that of patients who had the catheter removed within 2 days (9.4% versus 4.5%, $P = 0.004$). The authors noted that 45% of the orthopaedic patients in the study still had the catheter in place after 2 days. In a randomized, prospective study of patients treated with THA, Miller et al[62] found that patients who had spinal anesthesia appeared to be at low risk for urinary retention and felt that a routine indwelling catheter was not required for such patients. If a Foley catheter is used, it should be removed as soon as possible after the surgery. We routinely remove urinary catheters in the morning of postoperative day 1.

Blood Transfusion

Transfusion of blood products may also increase the risk of postoperative infection. Steinitz et al[58] reported a significantly higher infection rate in patients who received transfusions than in those who did not have transfusions (14% versus 8.4%, $P = 0.035$). Urinary tract infections comprised most infections. Friedman et al[63] also found that the rates of any type of infection (lower or upper respiratory tract and lung infection, wound inflammation or infection) were significantly increased after elective THA or TKA in patients receiving allogeneic blood transfusion (9.9%) compared with those receiving autologous blood transfusion or no blood transfusion (7.9%). In a study of 308 patients who underwent primary joint arthroplasty, Innerhofer et al[57] compared infection rates in patients who donated blood (mean, 2.5 units packed red blood cells) before surgery and those who did not. Of the 100 patients who received only allogeneic blood transfusions, 12 (12%) developed infections compared with 1 infection (1.2%) in 85 who received only autogenous blood ($P = 0.0053$). Newman et al[64] used a multivariable logistic regression to examine the influence of allogeneic and autologous blood transfusions on wound infections following TKAs and THAs. The authors found that the total number of units transfused and an American Society of Anesthesiologists score >2 were substantially

Figure 1

Photograph of the knee demonstrating chronic wound drainage 1 week after total knee arthroplasty.

predictive of reoperation for infection, whereas allogeneic exposure was not a significant predictor of reoperation for infection. Although we continue to use transfusion in symptomatic patients, we try to minimize these transfusions.

Wound Drainage

Prolonged wound drainage following joint arthroplasty may result in a deep periprosthetic infection (Figure 1). Subcutaneous hematomas can foster bacterial growth and place tension on the healing wound. Patel et al[59] noted a prolonged time until the wound was dry related to patient obesity, the use of low-molecular-weight heparin, and a higher drain output in patients treated with hip or knee arthroplasty. The authors found a higher rate of infection following primary THA in patients with prolonged drainage. The risk of wound infection associated with prolonged drainage increased daily by 42% and 29% following a THA and TKA, respectively. Prolonged wound drainage should be treated aggressively with irrigation and débridement to decrease the likelihood of deep infection.

Dental and Urologic Procedures

Hematogenous seeding from distant bacterial infections is a feared complication of total joint arthroplasty. The American Academy of Orthopaedic Surgeons and American Dental Association clinical practice guideline for preventing orthopaedic implant infection in patients undergoing dental procedures[65] states that the practitioner might consider discontinuing the practice of routinely prescribing prophylactic antibiotics for patients with hip and knee prosthetic joint implants who are undergoing dental procedures. The guidelines do not recommend for or against the use of topical oral antimicrobials in patients who have prosthetic joint implants or other orthopaedic implants and are undergoing dental procedures. The guidelines also state that in the absence of reliable evidence linking poor oral health to prosthetic joint infection, patients with prosthetic joint implants or other orthopaedic implants should maintain appropriate oral hygiene. The American Society for Gastrointestinal Endoscopy has recommended against giving prophylactic antibiotics for minor surgical procedures such as upper endoscopies, sigmoidoscopies, or colonoscopies.[61]

Summary

Infection following total joint arthroplasty is a devastating complication. Decreasing the incidence of infection requires identifying high-risk patients and medically optimizing these patients before surgery. Prophylactic antibiotics should be given preoperatively. Use of antibiotic-impregnated cement has been shown to reduce the incidence of infection. Blood transfusions may increase infection risk. Every effort should be made to decrease the amount of intraoperative bacterial contamination. Postoperatively, indwelling urinary catheters should be removed as soon as possible to decrease the risk of urinary tract infection and potential hematogenous seeding of the implant. Prophylaxis should be provided to high-risk patients undergoing dental and urologic procedures.

References

Evidence-based Medicine: Levels of evidence are described in the table of contents. In this article, references 23, 29, 37, 38, 42, 44, 47, 48, 50, and 52 are level I studies. References 2-4, 6, 8, 18, 22, 27, 28, 31, 32, 35, 36, 39, 45, 49, 51, and 62 are level II studies. References 1, 9, 11-17, 21, 24-26, 30, 34, 41, 53-59, 63, and 64 are level III studies. References 43 and 46 are level IV studies.

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