Top 10 tips to avoid periprosthetic joint infection

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Total joint arthroplasty (TJA) is one of the most common elective surgical procedures across the globe. The annual volume in the United States is projected to exceed two million procedures over the next decade[1]. Periprosthetic Joint Infection (PJI) is a rare but devastating complication that has been suggested to be the main cause of failure in modern TJA[2].

Recently, several evidence-based guidelines were introduced to standardise the approach to a patient with a suspected PJI, including the American Academy of Orthopaedic Surgeons (AAOS) Clinical Practice Guidelines on Diagnosis of Periprosthetic Joint Infection[3] as well as the Proceedings of the 2018 International Consensus Meeting (ICM) on Periprosthetic Joint Infection[4]. While these comprehensive documents should be familiar to all orthopaedic surgeons, this article provides a brief overview on the top 10 ways to reduce the risk of PJI.

1. Pre-operative optimisation

While it is well established that elective TJA should be contraindicated in any patient with an infectious lesion in their extremity until the infection is resolved, it is also important to search for other niduses of infection including the genitourinary tract, skin, nails or oral cavity[5].

TJA should also be deferred in patients with uncontrolled medical conditions, such as uncontrolled diabetes, malnutrition, anaemia, and other immunocompromised states[6]. In particular, good glycaemic control remains an important modifiable factor in elective TJA, since a high proportion of patients undergoing TJA are diabetic (8–25%) and up to 50% of presumably non-diabetic patients have glucose levels in the diabetic or pre-diabetic range[7,8]. Although glycated haemoglobin (HbA1c) is the gold standard test for monitoring glycaemic control, it remains unclear whether HbA1c is the most appropriate marker for glycaemic optimisation and perioperative risk stratification[5,9]. A recent multicentre study demonstrated that fructosamine, an intermediate-term glycaemic marker, was a better predictor of adverse events following TKA[10] and THA[11] compared to HbA1c.

2. Reducing bioburden

This step involves pre-operative skin decontamination through the administration of pre-operative cleansing agents and removal of hair on the day of surgery. Pre-operative skin cleansing at home prior to the elective procedure has an important role in the reduction of surgical site infections (SSI) and PJI[12]. Specifically, chlorhexidine gluconate (CHG) has been shown to be an effective agent in previous randomised controlled trials[13] and retrospective cohort studies[14,15]. The relatively high rate of hypersensitivity to CHG and bacterial resistance to CHG has made CHG based wipes and soaps lose popularity in recent

years. One recent trial also suggested that iodine-based antiseptic solutions may be equally effective[16]. Overall, current Centers for Disease Control and Prevention (CDC) guidelines recommend showering or bathing with either soap or an antiseptic agent on the night before the operative day[12].

3. Perioperative antimicrobial prophylaxis

Perioperative antibiotic prophylaxis prior to TJA is considered the standard of care[17], and has been shown to reduce the rates of SSI and PJI[18]. The American Academy of Orthopaedic Surgeons (AAOS) as well as other official guidelines recommend the use of first- or second-generation cephalosporin antibiotics as a means for prophylaxis prior to TJA due to their favourable side effect profiles and efficacy against the broad array of organisms[19,20]. This should be administered intravenously within 30 to 60 minutes before incision as a single and weight-adjusted dose. Allergy labels have been shown to drive arthroplasty surgeons to use alternative antibiotics[21], which have been associated with a higher rate of infection[22-25]. As majority of allergies to penicillin are minor and non-anaphylactic, and the fact that cross-reaction between cephalosporin and penicillin is rare, it is reasonable to administer test dose of cefazolin to patients with non-anaphylactic allergy to penicillin[26]. Some patients with anaphylactic reaction to penicillin may benefit from seeing an allergist[22]. Dual antibiotic prophylaxis using a cephalosporin in combination with vancomycin should be reserved for patients at a high-risk of infection, such as those undergoing revision surgery and those at a high-risk of MRSA infection (e.g. known MRSA carriers, healthcare workers, nursing home residents)[19]. This is recommended as the addition of vancomycin to the prophylactic antibiotic regimen has not been shown to decrease the rate of SSIs when compared with cefazolin alone, and could increase the risks of adverse events[27]. Vancomycin should be started two-hours before incision due to the extended infusion time.

4. Respect for soft tissues

This particular strategy and its importance in minimisation of SSI is often overlooked. It is important to respect the soft tissues during the surgical procedure by not being overly forceful, tearing the skin, or continuously touching the incision. Incision size should kept as small as possible, but large enough to allow adequate exposure and visualisation. The use of non-absorbable sutures, foreign bodies and copious use of subcutaneous electrocautery have also been correlated with an increased risk of SSI[28].

5. Expeditious surgery

Prolonged operative time is another independent risk factor for SSI and PJI following TJA. It was previously shown that a 20-minute increase in operative time was associated with approximately 25% increased risk of PJI[29]. The explanation for this association is likely multifactorial. A longer operative time would increase the risk of tissue desiccation as well as the duration of exposure to microorganisms within the operative environment, hence increasing the risk of wound contamination[30,31]. Prolonged operative time may also be associated with a prolonged tourniquet time, which has been shown to induce wound hypoxia[32]. In addition, local tissue concentrations of systematic antibiotics could fall below therapeutic levels if not promptly re-dosed during longer surgical procedures[33]. Common factors known to influence the operative time include the surgical complexity of the case, experience and fatigue of the surgeon, experience of the surgical team, implant type, and use of cemented components[34]. Although these factors may not be modifiable, it is nonetheless important to ensure optimal pre-operative planning, procedural efficiency and surgeon education whenever possible[35]. Coordinated efforts to reduce the operative time without technically compromising the procedure may help to prevent infection.

6. Blood conservation

There is wealth of evidence demonstrating that both pre-operative anaemia[36] and the need for subsequent allogeneic blood transfusion[37] are associated with an increased the risk of SSI or PJI[6]. As such, in addition to correcting pre-operative anaemia, strategies to minimise blood loss during surgery have been implemented to reduce the need for allogeneic blood transfusion. One such strategy has been the administration of tranexamic acid (TXA) during TJA, which has been proven to reduce blood loss and the need for allogeneic blood transfusion[38]. This likely accounts for its association with a reduced incidence of PJI after joint replacement[39]. Another strategy to manage perioperative blood loss pertains to post-operative venous thromboembolism (VTE) prophylaxis, since less aggressive agents such as aspirin have been shown to reduce the incidence of bleeding[40,41] and infection[42] after TJA.

7. Reduce operative room traffic

The primary source of bacteria in the operating room (OR) is the OR personnel. Multiple studies have shown that unnecessary OR traffic increases the risk of surgical site infection (SSI)[43,44]. This has been attributed to the turbulence in airflow caused by the opening of doors, which may predisposed to increased wound contamination during the procedure[45]. Since all individuals shed bacteria, an increased number of people in the OR would also lead to a higher bacterial count in the air and greater the likelihood for SSI.

8. Antiseptic irrigation solution

The wound is a possible point of entry for bacteria residing on the skin or in the environment. Once the number of pathogens in the wound exceeds the host immune threshold, an infection can arise. Different ways to mitigate this risk during wound closure have been proposed[46], one of which is wound irrigation with antiseptics. While a myriad of antiseptic solutions have been proposed, no consensus on the optimal irrigation fluid has been reached due to a lack of robust data[47]. Dilute povidone-iodine is one option that has been endorsed by the Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO)[48,49].

9. Clean implants and instruments

All instruments used during the procedure should be thoroughly sterilisation to prevent orthopaedic device-related infections. Bacterial adhesion to the implant occurs as a result of biofilm formation on the surface[50]. Contamination of these implants during surgery can be avoided by minimising touching and preventing them from coming into contact with the skin during implantation.

10. Proper wound management

It is vital to ensure that the wound is properly closed and appropriate occlusive dressing is applied. Wound closure with a running subcuticular suture and skin adhesive has garnered interest for its capacity to reduce superficial drainage and potentially deep infection. A running subcuticular suture may enable more robust wound perfusion compared to skin staples[51]. However, meta-analyses have reported mixed results with respect to SSI prevention[52,53]. The use of an occlusive silver-impregnated dressing rather than a simple gauze dressing has been proven effective in reducing infection rates in multiple studies on TJA[54,55]. As mentioned above, avoiding aggressive anticoagulation could also help to minimise wound drainage[56].

Summary

As new strategies for PJI prevention are developed, it is imperative that the orthopaedic community continues to test these strategies rigorously in a clinical setting in order to provide the best evidence for PJI prevention. Notwithstanding, a multimodal approach and attention to detail remain paramount. This 10-step approach entails simple measures that should be considered by any surgeon performing total joint replacement. ■

References

References can be found online at: www.boa.ac.uk/publications/JTO.