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Workgroup 10:

Irrigation and Debridement

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QUESTION 1A: When can irrigation and debridement (I&D) be considered?

Consensus: I&D may be performed for early postoperative infections that occur within 3 months of index primary arthroplasty with less than 3 weeks of symptoms.

Delegate Vote: Agree: 84%, Disagree: 13%, Abstain: 3% (Strong Consensus)

QUESTION 1B: Can irrigation and debridement (I&D) be considered for late hematogenous infections?

Consensus: I&D may be performed for patients with late hematogenous infection that occurred within 3 weeks of an inciting event or with symptoms not longer than 3 weeks.

Delegate Vote: Agree: 88%, Disagree: 9%, Abstain: 3% (Strong Consensus)

Justification:

I&D is a viable option to consider for patients with early postoperative or late hematogenous infections [1]. The rate of success of I&D has been stated to be between 0 and 89% [2]. What is known is that this procedure, performed for early infections or late hematogenous infections, has a higher success rate in healthier patients, infections with low virulence organisms, and in patients with short period of symptoms [1,3–25]. If I&D is to be attempted, it is imperative to ensure that the prostheses are well-fixed and well-positioned and there is a good soft tissue envelope to cover the prosthesis.

QUESTION 2: What are the contraindications for I&D?

Consensus: The inability to close a wound or the presence of a sinus tract are absolute contraindications to performing an I&D and retention of the prosthesis. Another absolute contraindication is the presence of loose prostheses.

Delegate Vote: Agree: 95%, Disagree: 4%, Abstain: 1% (Strong Consensus)

Justification:

The inability to close a wound is an absolute contraindication for retention of the prosthesis. An open wound allows for contamination and colonization of the prosthesis and will result in a chronic infection. Other relative contraindications include infection with highly virulent organisms such as methicillin-resistant *Staphylococcus aureus* (MRSA) [25,26] or polymicrobial infections [27] (often as a result of the presence of a sinus) and in patients with extensive comorbidities, in particular those with immunocompromised status [13,28]. Marculescu et al found that the presence of a sinus tract leads to an odds ratio of 2.84 for failure of I&D [29].

QUESTION 3A: When performing an I&D for hematoma after TKA, should the deep fascia be opened?

Consensus: The fascia/arthrotomy should always be opened in patients with total knee arthroplasty (TKA) and hematoma formation.

Delegate Vote: Agree: 87%, Disagree: 8%, Abstain: 5% (Strong Consensus)

QUESTION 3B: When performing an I&D for hematoma after THA, should the deep fascia be opened?

Consensus: Aspiration of the joint, either prior to surgery or at the time of I&D, should be performed. For patients with a clear fascial defect or hematoma/fluid deep to the fascia confirmed by aspiration, the fascia should be opened.

Delegate Vote: Agree: 87%, Disagree: 9%, Abstain: 4% (Strong Consensus)

Justification:

There is little to no guidance in the literature about what should be done when a surgeon encounters a draining wound and/or hematoma formation [18,30]. Although superficial hematoma formation is not infrequent, the consequences of missing a deep hematoma or infection in a patient with a prosthesis can be dire [15]. Thus, it is the opinion of this consensus group that appropriate investigations should be performed to evaluate whether a presenting hematoma is superficial or if it extends to deeper layers. The fascia should be opened and the deeper hematoma evacuated in patients in whom there is a blood or fluid collection deeper in the fascia. I&D is a different procedure compared to reoperation done for evacuation of a hematoma.

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QUESTION 4: How should I&D be performed for PJI?

Consensus: An I&D of a prosthetic joint needs to be performed meticulously and according to the detailed protocol provided. Briefly this includes:

- Preoperative optimization of the patient
- Good visualization and thorough debridement
- Obtaining multiple culture samples
- Copious irrigation (6–9 L) of the joint
- Explantation of the prosthesis if indicated.

Delegate Vote: Agree: 90%, Disagree: 6%, Abstain: 4% (Strong Consensus)

Justification:

The joint should be opened via the previously mentioned access under aseptic conditions [30]. Brush and wash all surfaces with an antiseptic solution. Copious irrigation using low-pressure pulse lavage or bulb irrigation should be performed. Reports in trauma surgery have raised concern regarding the use of high pressure lavage, which may spread the infection deeper [31,32].

QUESTION 5: Should the modular part always be exchanged during I&D?

Consensus: Yes. All modular components should be removed and exchanged, if possible, during I&D.

Delegate Vote: Agree: 92%, Disagree: 8%, Abstain: 0% (Strong Consensus)

Justification:

There is little evidence in the literature regarding the role of exchanging modular components. Although this practice results in added expenses, prolongs the surgery, and could potentially result in increased morbidity, in our opinion it is necessary in order to allow access to parts of the joint that otherwise could not be accessed without removing the modular components. The latter is particularly true for TKA. Access to the posterior capsule to perform extensive debridement is not possible without removal of the tibial polyethylene. In addition, removal of the modular components allows for removal of "slime" from the undersurface of such components leading to better reduction of bioburden. We therefore believe it is advisable to remove and exchange modular components (if possible) in all patients undergoing I&D [1,6,7,11,13,17,25,26,30,33,34].

Although removal of polyethylene is absolutely necessary for through debridement, reinsertion of a "sterilized" component may also be reasonable. In a study by Laffer et al [35] the polyethylene modular component was removed and washed with antiseptic during I&D of TKA. The authors suggest that this may be a reasonable option to exchange of components, which carries additional cost.

QUESTION 6: Do useful classification systems (such as the Tsukayama classification) exist that may guide a surgeon in deciding on the appropriateness of an I&D?

Consensus: The available classification system is inadequate in guiding a surgeon in selecting the appropriate surgical intervention for management of early PJI. There is a need for further studies to identify risk factors for failure of I&D in patients with acute PJI.

Delegate Vote: Agree: 84%, Disagree: 5%, Abstain: 11% (Strong Consensus)

Justification:

There are numerous classification systems for PJI. The Tsukayama classification has been used as a rough guide and basis for selection of surgical treatment [17,36]. It defines an early infection as one that occurs within one month of index arthroplasty and any infection beyond this point as late. Acute hematogenous infection is also included in this classification system. The Zimmerli/Trampuz classification defines an early infection as one that occurs within 3 months of index surgery. Infections with onset between 3 and 24 months are delayed infections and those occurring >24 months after index arthroplasty are classified as late [23]. These classification systems are useful in that they provide a description for pathogenesis, with the theory being that early infections may be the result of seeding during surgery, whereas late infections are likely acquired by hematogenous spread. Another classification proposed by Senneville et al relies mostly on the duration of symptoms and places less emphasis on the timing of index arthroplasty. Based on this classification, acute infection is one with less than one month of symptoms and any infection with greater than one month of symptom are considered late [37]. Less than 4 weeks of symptoms is quite common according to Garvin et al [17,38,39]. The classification proposed by McPherson considers criteria other than timing such as host factors and micro-organism factors, and looks at periods of less than 3 weeks [40]. Recent data suggest that the success of prosthesis retention depends on many factors other than the time at which infection occurs [41,42]. Thus, the decision to perform an I&D for a patient with infection must take into account many other parameters including the host type, the virulence of the infecting organism, and status of the soft tissues. Biofilm is the key factor for success or failure using irrigation and debridement [30,43]. Only with further research may we be able to identify factors that influence the outcome of surgical intervention for PJI in general and I&D in particular.

QUESTION 7: Is I&D an emergency procedure or can the patient be optimized prior to the procedure?

Consensus: No. I&D is not an emergency procedure in a patient without generalized sepsis. All efforts should be made to optimize the patients prior to surgical intervention.

Delegate Vote: Agree: 92%, Disagree: 6%, Abstain: 2% (Strong Consensus)

Justification:

Although many believe that a patient presenting with an acute infection should undergo surgery as soon as possible, there is no evidence to suggest that any delay in surgical intervention adversely affects the outcome. What is known is that patients with medical comorbidities that are not controlled may be at risk for medical complications, some of which could prove to be fatal. In addition, subjecting a patient to I&D without addressing an underlying coagulopathy that could be the result of administration of anticoagulants can result in the development of a further hematoma with all its adverse effects. Thus, it is critical that conditions such as uncontrolled hyperglycemia (>180 mg/ml), severe anemia (Hb <10 mg/dL), coagulopathy, and other reversible conditions are addressed prior to subjecting a patient to I&D. The nutritional status of any patient undergoing reoperation should also be checked and provisions implemented to reverse malnutrition, if present.

QUESTION 8: Does arthroscopy have a role in I&D?

Consensus: Arthroscopy has no role in I&D of an infected prosthetic joint.

Delegate Vote: Agree: 91%, Disagree: 7%, Abstain: 2% (Strong Consensus)

Justification:

There are some published studies demonstrating that the outcome of I&D is markedly worse when debridement was performed using arthroscopy [6,35,44]. As mentioned above, one of the main factors determining the success of surgical intervention for treatment of PJI is the ability to perform through debridement and reduce bioburden. Using arthroscopy the surgeon is not able to access all compartments and parts of the joint; therefore, thorough debridement is unlikely to be performed. However, there may be a diagnostic role for arthroscopy in knee arthroplasty.

QUESTION 9: How many I&Ds are reasonable before implant removal is considered?

Consensus: Following failure of one I&D, the surgeon should give consideration to implant removal.

Delegate Vote: Agree: 94%, Disagree: 6%, Abstain: 0% (Strong Consensus)

Justification:

Although surgical intervention needs to be individualized for each patient, it is unlikely that multiple I&D procedures can serve a patient well in the long run. If several attempts at I&D fail to control infection in a patient, consideration should be given to implant removal [13,45]. Mont et al found it reasonable to perform multiple debridements in their series of 24 acute TKA infections [46]. On the other hand, failure of a single I&D procedure is recommended to be a consideration for implant removal [47]. Another study found that a need for a second debridement is an independent risk factor for failure of treatment [19]. In the absence of conclusive evidence, we recommend that no multiple I&D procedures should be performed in patients with acute PJI. However there is evidence to perform multiple I&Ds within a specific protocol.

QUESTION 10: Should culture samples be taken during I&D? If so how many and from where?

Consensus: Representative tissue and fluid samples, between 3 and 6, from the periprosthetic region should be taken during I&D.

Delegate Vote: Agree: 98%, Disagree: 2%, Abstain: 0% (Strong Consensus)

Justification:

Despite attempts, distinction between benign hematoma and acute infection may not always be possible. Thus, during I&D of a joint, tissue or fluid samples should be sent for microbiological examination. The information obtained from culture can then be used to determine the course of treatment for the patient. Five to 6 samples should be taken from areas that macroscopically appear most clinically infected to the surgeon. These should include the superficial, deep, and periprosthetic layers and the interfaces between modular components. If definitive components are removed, the bone/prosthetic interface should also be sampled. The samples should be submitted for aerobic and anaerobic culture [48]. Some authors have shown that antibiotic prophylaxis at the time of induction does not alter the results of the microbiological cultures obtained during the surgery and should not be withheld [49].

QUESTION 11: Should extended antibiotic treatment be given to patients following I&D? If so, what are the indications, type of antibiotic, dose and duration of treatment?

Consensus: No. Extended antibiotic should only be administered to patients that meet the criteria for PJI (see workgroup 7). The type, dose and duration of antibiotic treatment for infected cases should be determined in consultation with an ID specialist.

Delegate Vote: Agree: 75%, Disagree: 20%, Abstain: 5% (Strong Consensus)

Justification:

Patients subjected to I&D should be worked up appropriately for infection, including ordering erythrocyte sedimentation rate, C-reactive protein, aspiration of the joint (either prior to or during surgery), and culture. These investigations allow the treating medical team to determine if there is high likelihood of PJI. For patients who have a high suspicion for PJI, extended antibiotic treatment should be administered. For others with normal serological and synovial parameters and no evidence of active infection during surgery, antibiotic therapy may not be indicated.

QUESTION 12: Is there a role for intra-articular local antibiotic treatment after I&D? If so, define indications.

Consensus: No. There is inadequate evidence to support administration of continuous intra-articular antibiotics for the treatment of PJI.

Delegate Vote: Agree: 89%, Disagree: 7%, Abstain: 4% (Strong Consensus)

Justification:

Although the concept of administering continuous intra-articular antibiotic appears logical in that it allows higher local concentrations of antibiotics, this procedure requires further evaluation. The practice of continuous intra-articular antibiotic administration was introduced by Whiteside et al and has been shown to be successful in a case series [50]. No multivariate analyses have been performed to demonstrate that the practice of intraarticular administration of antibiotics is an independent factor enhancing success. It is likely that a combination of factors such as meticulous surgical debridement may explain the high success rate that was observed in that case series [4,51]. There are some potential risks associated with this practice, including drug reactions, added expense, need for an additional surgery (to remove the Hickman catheter), and possibly development of antibiotic resistance. The use of continuous intra-articular antibiotics for the treatment of chronic infection, with a reported success rate of 94%, also deserves further evaluation [50]. Those and other case series need to be further evaluated [52,53].

QUESTION 13: Is there a role for the use of resorbable antibiotic-impregnated pellets (calcium sulfate, etc)? If so, define indications for use.

Consensus: No. Currently there is no conclusive evidence that the use of antibiotic-impregnated resorbable material improves the outcome of surgical intervention for I&D.

Delegate Vote: Agree: 88%, Disagree: 6%, Abstain: 6% (Strong Consensus)

Justification:

A number of case series have evaluated the role of antibiotic-impregnated resorbable material for treatment of PJI. Although initial reports of these series have been encouraging, there are no randomized, controlled studies to demonstrate that the use of these materials enhances the outcome of surgical intervention [53]. In one study evaluating the outcome of I&D in 34 patients in whom resorbable gentamicin was utilized, a success rate of 73% was described which appears to not be much higher than what one would expect with conventional I&D [54].

The use of resorbable material is not without problems. Besides the cost, which depending on the material can be substantial, local reaction to the resorbable material has been described.

Calcium sulphate pellets have been shown to increase wound exudates [55,56]. A possible cytotoxic effect of this material has also been described. Newer material such as nanoparticle hydroxyapatite has been described [57]. Future studies are desperately needed to evaluate the role of resorbable antibiotic-impregnated material, as currently no concrete evidence exists that could support their use.

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