Available online at www.sciencedirect.com
ScienceDirect
The Surgeon, Journal of the Royal Colleges of Surgeons of Edinburgh and Ireland
www.thesurgeon.net

Management of acute periprosthetic joint infection of the knee – Algorithms for the on call surgeon

Robert Petretta [*,a], Jonathan Phillips [b], Andrew Toms [c]

Exeter Knee Reconstruction Unit, Princess Elizabeth Orthopaedic Centre, Royal Devon and Exeter Hospital, Exeter, Devon EX2 5DW, UK

ARTICLE INFO

Article history:
Received 1 March 2016
Received in revised form
7 June 2016
Accepted 8 June 2016
Available online 23 June 2016

Keywords:
Periprosthetic joint infection
Irrigation and debridement
Acute infection
Total knee arthroplasty
One stage revision
Two stage revision

ABSTRACT

Periprosthetic joint infection (PJI) remains a serious complication following a total knee replacement. Infections rates following arthroplasty range from 0.5% to 3%. The acutely infected knee replacement often presents to the on call Orthopaedic Surgeon who can often lack the expertise or resources for the definitive management. However, obtaining an early and accurate diagnosis and potentially performing an early treatment such as irrigation and debridement may be required by the on call surgeon. Management of these patients should include a team of specialists including Medical or Intensive Care, and Infectious Disease. Management of PJI is expensive, complicated and has a high morbidity. These patients should have their definitive care by specialist multidisciplinary teams on a regional basis.

Introduction

Periprosthetic joint infection (PJI) remains a serious complication following a total knee replacement. Cumulative rates of both acute and chronic infections following arthroplasty range from 0.5% to 3%.[1–6] A two-stage revision arthroplasty is considered the gold standard for treatment in chronic PJI. Success rates for two stage revision range from 72 to 93%.[7–9] A one stage revision arthroplasty has also become a standardized treatment for chronic PJI in some specialized European centres, and has some potential benefits over a two stage revision.[8,10,11]

Treatment for the acutely infected knee replacement is broader and can vary from irrigation and debridement with exchange of modular parts, to revision arthroplasty. Acute infection can present to the Orthopaedic surgeon on-call who may not have sub-speciality training in knee arthroplasty. In this article we focus on the basic framework of knowledge, including the diagnosis and treatment options, for acute periprosthetic joint infections of the knee for the on-call surgeon. It should be noted that some of our suggested protocols

* *Corresponding author*. Tel.: +44 01392 403562.
E-mail addresses: robpetretta@hotmail.com (R. Petretta), jonphillips@nhs.net (J. Phillips), andrewtoms@nhs.net (A. Toms).
[a] Permanent address: UBC Orthopaedics 3114 - 910 West 10th Avenue, Vancouver, BC V5Z 1M9, Canada.
[b] Tel.: +44 01392 404774.
[c] Tel.: +44 01392 403562.

http://dx.doi.org/10.1016/j.surge.2016.06.001

are meant for the on-call surgeon who does not specialize in knee arthroplasty and who may not work in a tertiary referral centre, where a more definitive treatment would be performed.

Classification

In general, most guidelines distinguish prosthetic joint infections as early or late infections.[12–14] We use the definition of early (or acute) PJI, as described by Gerhke et al., as those with either a recent knee replacement or late haematogenous infections of which the onset of symptoms have been less than 3 weeks.[10] This 3 week period has been fairly well accepted and is premised on the basis of biofilm formation.

Within this group of early infections a subset of this group may present with acute sepsis and should be treated much more urgently. Based on this, acute PJI can be divided into 3 distinct groups:

1. Acute post-operative infections
2. Acute haematogenous infections (or delayed acute infections)
3. Acute infection with sepsis

The distinction between early and late (or chronic) infections (symptoms greater than 3 weeks) is important as it helps dictate the type of treatment and likely outcomes.[10,13,15–18] Some early infection may be treated with aggressive irrigation and debridement, exchange of modular components and retention of well-fixed components. However, other factors must be taken into account in addition to the timing of the infection. This includes host factors such as the patients medical and immune status, local soft tissue factors and virulence of the microorganism (See Key Factors Box).[1,3,5,8,10,11]

Key factors influencing outcome of treatment.

1. Timing of infection (Early versus Late)
2. Patient medical and immune status
3. Local soft tissues
4. Virulence of the microorganism

Pathophysiology

The importance of timing of symptoms is based on the idea of bacterial formation of a biofilm. Once a biofilm has been formed, irrigation and debridement is unlikely to be successful.[19,20] It is presumed that organisms produce this biofilm within a 3 week period, and hence the distinction between early and late infection at the 3 week mark. However, there is evidence to suggest that a biofilm may be formed much earlier than this, potentially within days or even hours.[21,22] It is therefore likely that earlier treatment and using antimicrobials with activity against biofilms, may lead to better outcomes.[4,15,16] Equally, some microorganisms are more aggressive biofilm formers than others.

Diagnosis of periprosthetic joint infection

All patients suspected for an acutely infected prosthesis should undergo the same standard diagnostic algorithm (Fig. 1). This includes history, physical examination, blood tests (including ESR and CRP) and radiographs of the prosthesis.[23] A knee aspiration and potentially blood cultures should also be performed if an acute infection is suspected. We recommend the diagnosis for PJI as defined by the International Consensus on PJI rather than using the surgical site infection (SSI) criteria defined by the Centers for Disease Control (CDC). The latter encompasses superficial infections and, therefore, by definition is not an infection of the prosthesis itself. The International Consensus on PJI have recently made some adaptations in the criteria initially made by the Musculoskeletal Infection Society (MSIS).[24] Based on their recommendations, criteria for the diagnosis for PJI exists when[14]:

1. Two positive periprosthetic cultures with phenotypically identical organisms, or
2. A sinus tract communicating with the joint, or
3. Having three of the following minor criteria:
   a. Elevated ESR and CRP
   b. Elevated synovial fluid white blood cell (WBC) count or ++change on leukocyte esterase test strip
   c. Elevated synovial fluid polymorphonuclear neutrophil percentage (PMN%)
   d. Positive histological analysis of periprosthetic tissue
   e. A single positive culture

However, patients who meet the criteria for systemic inflammatory response syndrome (SIRS) with acute onset of symptoms (such as pain, warmth, erythema and swelling) in a previously asymptomatic knee, should be treated as an acute emergency. The SIRS criteria are shown in Table 1.

History and physical examination

As for any diagnosis, a thorough history and physical examination should be performed on every patient suspected of an early PJI. History suspicious for an acute infection includes acute onset of pain, warmth, erythema and effusion surrounding a patient's prosthetic knee as well as potential systemic features of fever, chills or night sweats. In the setting of an early post-operative period, this may also include persistent drainage from the surgical wound or even the formation of a sinus tract. Symptoms of pain are highly sensitive for PJI, but non-specific.[25,26] In contrast, local features of warmth, erythema and swelling are less sensitive for infection but more specific with specificity ranging 0.77 to 1[25,27]. History should include the date of the primary procedure, past surgeries to the joint, wound healing problems, recent or ongoing wound drainage, previous infections of the joint,