Painful knee arthroplasty: definition and overview

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Introduction

Total knee arthroplasty (TKA) is one of the most successful procedures in Orthopaedic Surgery, with good clinical results and high survival rate in more than 90% of the cases at long-term follow-up. Since the increase of population’s mean age, worsening of articular degenerative alterations, and articular sequelae related to previous fractures, there is a persistent growing of the number of knee arthroplasties in every country each year, with expected increase of complications rates. Painful TKA is considered an unusual complication, but several reports focus on this challenging clinical issue.

Common causes of painful TKA may be divided as early or late, and in referred, periauricular or intra-articular. Among the early, we recall implant instability (related to surgical and technical mistakes) and problems of extensor mechanism (patella not resurfaced, malalignment of femoral, tibial, or patellar component, tendons failure or degeneration). Late causes of painful TKA are almost related to aseptic loosening and infection, but also, even if unusual, reflex sympathetic dystrophy, synovitis, and hypersensitivity to metal implants are represented.

Hypersensitivity to metal is a clinical issue with significative increase, but to date without a specific characterization. The Authors report about incidence, clinical features, and diagnostic pathways of hypersensitivity to metal implants, focusing on the prevention of this challenging problem.

KEY WORDS: painful total knee arthroplasty; hypersensitivity to metal.

Summary

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Causes of painful total knee arthroplasty

Historically, common causes of failure of TKAs needing revision include aseptic loosening, infection, and instability (2). Majority of surgeons is familiar with classical findings associated with these conditions, and diagnosis is generally easy. Commonly, loosening represents a late mechanism of failure, leading to progressive arising of pain, functional limitation, difficult weight-bearing, gait alterations. Clinical history and periodic evaluation with x-rays are sufficient to assess this condition and usually success is reached when revision is performed.

Instability after TKA is an early cause of revision. Usually, patients complaint symptoms since the outset of a TKA, and diagnosis is made with clinical examination, x-rays evaluation (also by means of stress devices or fluoroscopy), and CT scan with study of rotational positioning of the components. Revision is mandatory, possibly substituting the only components involved in malpositioning. Occurrence of a septic involvement is quite unpredictable, and has to be always considered in differential diagnosis in painful implants: as general rule, a painful TKA has to be presumed as infected until otherwise proven. Clinical history, imaging, bone scan with marked leukocytes, repeated laboratory tests focused on erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), complete blood cell count, and in some cases knee aspiration are usually enough to prove infection. Two-stage revision with implant of an antibiotics-charged spacer is commonly considered the gold standard in these cases.

However, painful TKA may not correspond to any of the previous mechanisms of failure: thus, a symptomatic knee arthroplasty without any altered clinical, radiological, and laboratory findings represents a challenge in modern Orthopaedics.

It is useful to divide the causes of painful TKA in referred, periarticular, and articular (4). Majority of this conditions may be treated by medical and physical therapy, while others need a surgical approach, usually challenging and not free from further complications. Referred causes of painful TKA may be commonly related to spinal pathologies, as lumbar stenosis, discopathy, discal hernia with crural irradiation of pain. Moreover, an ipsilateral hip situation may presents with knee pain (arthritis, avascular necrosis of proximal femur, femoro-acetabular impingement).

Periarticular causes of pain may be principally related to iliotibial band irritation or inflammation, and pes anserinus bursitis: the latter, often present in knee arthritis before TKA, may be persistent for months after surgery.

Fibromyalgia is a rare dysfunctional disease that may overlapping or sprouting after TKA, even it is generally associated with other regional complaints by patients usually affected by behaviour disorders.

Increase in population’s mean age and related worsening of articular diseases during last decades induced a worldwide increase of the number of knee arthroplasties each year: as result, complications and failures rates also show an expected growing (1-3). Even its proven efficacy in large series, a little percentage of implants may not induce a relief from symptoms, determining patients’ complaints and surgeons’ frustration: thus, it becomes fundamental to understand the cause of the unsuccessful situation in a way to find an efficient resolution.
Among intra-articular causes of painful TKA, abnormal patellar tracking may represent one of the most frequent mechanisms. Malposition of femoral and/or tibial component, in particular concerning their rotational alignment or medial/lateral position, may alter the interaction between patella (resurfaced or native) and femoral trochlea, leading to anterior knee pain and even instability (lateral subluxation or dislocation).

A tibial component positioned too medially or larger than necessary (in lateral size) may explain an anteromedial pain over the tibial plateau, with poor response to medical or physical therapy. Even if not frequent, cementless stemmed TKA may cause persistent symptoms over the middle and distal femur or proximal and middle tibia. A not resurfaced patella with progression of degenerative changes after TKA may also produce anterior knee pain during flexion activities.

Patellar clunk is the result of a fibrous nodular structure forming between the bone and the quadriceps tendon, catching over the box generally of a posterior stabilized femoral component, and causing painful and palpable crepitus while sitting on or rising from a chair. Chronic inflammation or degenerative changes of patellar tendon can produce symptoms and lead to functional impairment after a knee replacement. Sympathetic reflex dystrophy is an uncommon disease involving joints generally after a minor trauma or immobilization: persistent pain at rest and during movement, limp, and skin alterations (dyssynchronous changes, excessive sweating, hyperalgesia). Synovitis is a not frequent cause of pain in a TKA, due generally to joint effusion or haemarthrosis and typical of patients with haematological disease, as Haemophilia or other coagulopathy. Nonetheless, it may represent the result of an abnormal response of immunologic status for hypersensitivity to metals: this represent an arising problem, still to be well understood, and leading often to a symptomatic synovitis.

Particularly, this is one of the most challenging situation recently presenting to Orthopaedic Surgeons.

Hypersensitivity to metals

Hypersensitivity to metals is thought to affect almost 10% of general population, principally determined by professional exposure or daily contact with jewelry, beauty and cleaning products. Result is a pending risk of abnormal response of joints and whole body after contact with such substances (5-10).

On the other side, some patients know themselves to be allergic, typically to Nickel, having experienced before some dermal irritation to such material. The actual challenge is to identify a sensitive patient candidate to joint replacement never suspected to be. Patch tests for metal hypersensitivity is a common tool to verify altered immunological status on these substances (Nickel, Chromium, Cobalt) (5,6); however, it is a high-sensitivity but low-specificity test, and it is clear that dermal response may not equally correspond to articular space, since synovial tissue, well represented in the knee, is particularly reactive to immunogenic stimuli (7). In vitro assessments as Limphocyte Transformation Test (LTT), Migration Inhibition Factor (MIF), and evaluation of cytokines concentration with ELISA method are investigations recently introduced, but still now there is debate on how quantify and qualify the response in terms of reproductibility (8).

On the other side, suspect sensitive patients present after replacement with well-functioning and integrated TKAs, but with large symptomatic effusion of the knee, itching on different part of their body, and important functional impairment. Treatment with anti-inflammatory drugs, steroids, physical therapy do not minimize symptoms: usually, revision with a non-allergic implant is the solution to this unpleasant issue.

Implant of a non-allergic TKA is obviously the unique way to prevent clinical issues in well-known metal-allergic patient: nowadays, it is possible to dispose of various primary knee systems with alternative bearings or coatings (Oxidized Zirconium, Zirconium Nitride, Ceramic).

Personal diagnostic protocol

In our Department, since 2007, each patient candidate to joint arthroplasty is deeply questioned on his previous occupation, eventual exposition to specific substances and about familiar allergies: in case of suspect, we perform a patch testing (Nickel, Chromium, Cobalt), blood examination to assess the concentration of specific cytokines, macrophages culture and reaction and radioimmunotesting for thymidine activated cell lines evaluated by LASER confocal microscopy. If any of these results is supposed to be positive, we proceed on knee replacement with a primary anallergic implant, in a way to prevent any future hypersensitivity (Figures 1 a-d).

Preliminary results show patient-dependent patterns of excessive immune response with altered production of specific cytokines, as Interleukin 8 (IL-8) and Macrophage Inflammatory Protein-1 (MIP1 alpha and beta), even if IL-1 and IL-2 are still well represented, demonstrating a T-cell and macrophages hyperstimulation. Future challenge will be to assess a reproducible qualitative and quantitative standard of evaluation (11-14).

On the other side, we treat also many cases of painful TKA, coming from several regions of the country, and our management is firstly concentrated on the study of the actual cause of failure. It is in fact of paramount importance before proceeding with a replacement.
vision to be sure of the real factors leading to symptoms, in order to plan as better possible any single procedure. Classical approach to the assessment of a painful TKA starts with clinical history, data concerning previous surgery and implanted components, accurate physical examination: these are basically essential to approach a painful joint after a replacement, particularly, focus on extra-articular causes and assessment of correct implant positioning, mandatory to make a differential diagnosis. Full radiographic study of the entire limb, CT scan to verify correct alignment and rotational positioning of the components, and MRI scan to rule out soft tissue pathologies are also necessary. Moreover, if these studies are not useful to define a specific clue, it is necessary to re-assess the entire examinations after a certain period, or to switch to uncommon causes, as fibromyalgia, synovitis, hypersensitivity to metals. In the latter, we use to proceed as previously mentioned, and in case of heavy suspect, we perform revision arthroplasty. Further studies will be necessary to be sure that this diagnostic pathway is correct and to reach a reproducibility in the assessment of a metal hypersensitivity, that would have an important relevance on clinical settings, and impact on population and society.

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References