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Review

Management of neuropathic pain after knee surgery

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ABSTRACT

Chronic postsurgical pain (CPSP) affects 10 to 30% of surgical patients overall and 16 to 20% of patients after knee surgery. Patients report persistent pain in the absence of infection, mechanical disorders, or complex regional pain syndrome type I. In many cases, the mechanism is neuropathic pain related to an intraoperative nerve injury or impaired pain modulation with central sensitization. The clinical risk factors and pathophysiology of CPSP are being actively investigated. Risk factors include preoperative pain; diffuse pain; severe pain during the immediate postoperative period; anxiety, depression, or cognitive distortions such as catastrophizing; and comorbidities. The diagnosis rests on clinical grounds and should be established as early as possible to optimize the chances of improvement. The management of CPSP combines a number of perioperative prophylactic strategies and the treatment of chronic neuropathic pain. Local treatments consist of transcutaneous electrical nerve stimulation and lidocaine patches combined with tramadol. When this treatment is inadequately effective, an antidepressant or anticonvulsant can be added. A capsaicin patch is the third-line treatment, and step III opioids are the last option. Rehabilitation therapy and physical exercises are beneficial. Psychological counseling and/or cognitive behavioral therapy should be offered, if indicated, by the results of the evaluation.

Chronic postsurgical pain (CPSP) is defined as pain that persists longer than 2 months after a surgical procedure, has no identified cause, does not continue from a preexisting pain problem, and is not related to a postoperative complication [1]. In patients with pain after knee surgery, the evaluation should rule out other causes of pain such as infection, loosening, instability, and complex regional pain syndrome type I. Although CPSP is multifactorial, there is often a neuropathic component related to peripheral nerve injury during surgery or impaired pain modulation with central sensitization [2–4]. Neuropathic pain is characterized by the combination of sensory loss with paradoxical oversensitivity. The incidence of CPSP is difficult to assess, because available studies used a wide variety of methodological approaches. In a recent population-based study from Norway, the incidence of CPSP was 40% overall and 18% when only moderate-to-severe pain was considered [5]. In France, longitudinal cohort studies of postsurgical patients found incidences ranging from 5 to 30% depending on the intensity of the pain and, most importantly, the type of surgery [6]. Neuropathic pain has been reported in 16% of patients after simple, commonly performed arthroscopic procedures on the knee [7]. After knee arthroplasty, over 20% of patients are dissatisfied and their main complaint is persistent pain after more than 6 months [8]. One month after knee arthroplasty, over half the patients report moderate pain and 16% severe pain, with pain during motion being far more common (78% of cases) than pain at rest. A 2012 systematic literature review showed that 20% of patients had persistent pain after knee arthroplasty [9]. During a questionnaire survey conducted 3 to 4 years after knee arthroplasty, 44% of 632 patients reported pain overall and 16% reported severe pain [10].

1. Pathophysiology

In patients undergoing knee arthroplasty or arthroscopy, the initial lesion may involve the infrapatellar branches of the saphenous nerve, the lateral femoral cutaneous nerve (medial edge of the patella), the anterior cutaneous branches of the femoral nerve, the common peroneal nerve, and/or the posterior tibial nerve [11]. The infrapatellar branches of the saphenous nerve may be injured after knee arthroplasty or arthroscopy. The saphenous nerve penetrates the fascia between the gracilis muscle and the sartorious muscle at the tip of the patella then courses in the subcutaneous tissue before dividing, typically into three branches. Anatomic variants exist regarding the number of branches (one to four) and their location between the tip of the patella and the tibial tuberosity [12]. Injury to the infrapatellar branches of the saphenous nerve

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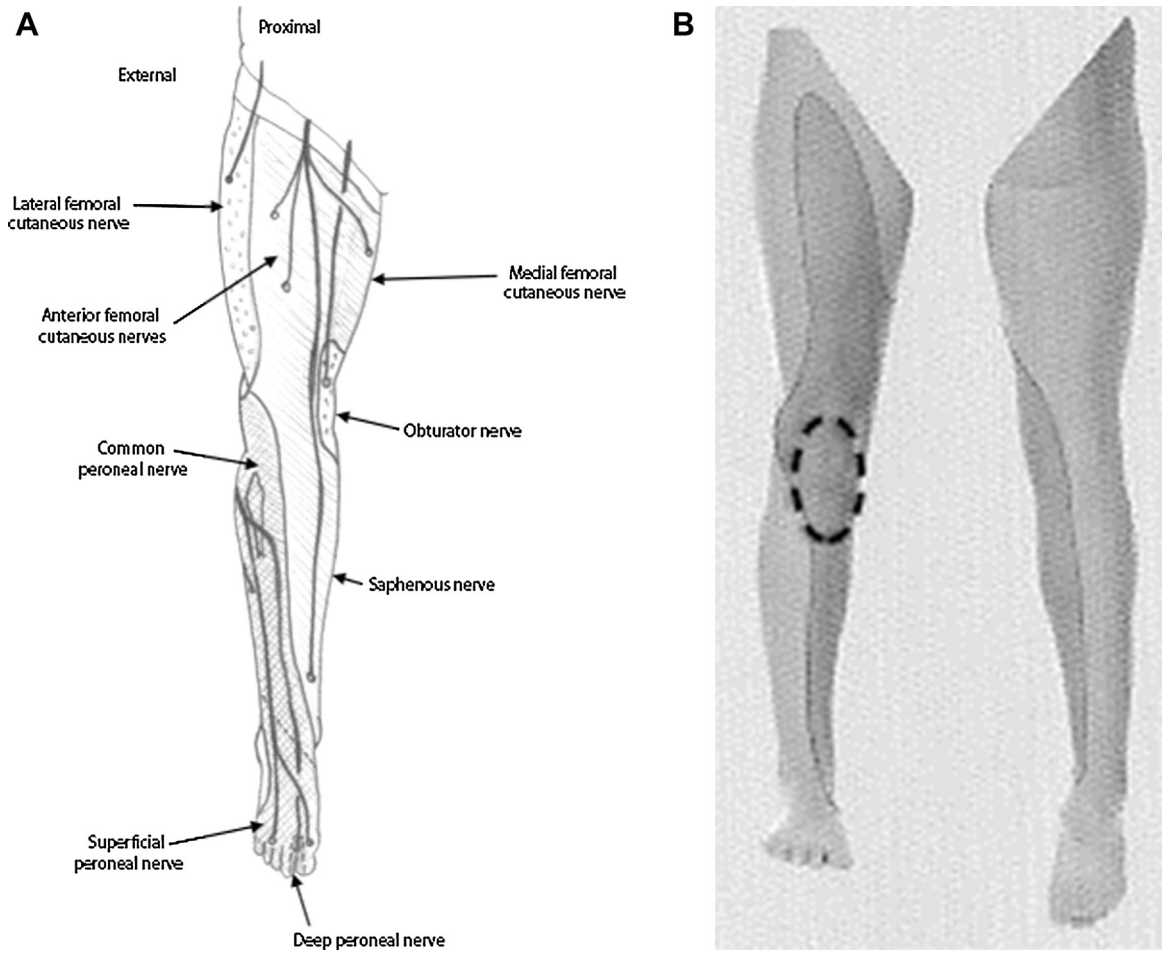

Fig. 1. A. Anterior view of the distribution of sensory nerves in the lower limb (http://coursenligne.u-picardie.fr). B. In this diagram, the shaded area approximately indicates the location of sensory impairments caused by injuries to the femoral nerve (intermediate and medial femoral cutaneous nerve and saphenous nerve). The dotted line circumscribes the area affected by injuries to the ends of the anterior cutaneous branches of the femoral nerve and to the infrapatellar branches of the saphenous nerve during surgery on the knee (from [13]).

can cause pain in the anterior knee and proximal tibia (Fig. 1A and B). In some individuals, the end of the lateral femoral cutaneous nerve communicates with the infrapatellar branch of the saphenous nerve and the anterior cutaneous branches of the femoral nerve, forming a peripatellar plexus. The pain then tends to be located at the medial knee, in the most distal part of the cutaneous distribution of the femoral nerve (Fig. 1A and B).

The common peroneal nerve may be injured during knee arthroplasty. The frequency of this event varies widely across orthopedic studies, from 0 to 9.5%. In a retrospective study of 1476 arthroplasties, 1.3% of patients experienced common peroneal nerve injury; however, only cases with combined sensory and motor involvement were included [14]. Among patients with common peroneal nerve injury, 20% also had an injury to the posterior tibial nerve. Risk factors for common peroneal nerve injury are preoperative knee valgus greater than 15°, fixed knee flexion, and a longer tourniquet time during surgery [15]. The pain tends to localize to the lateral and anterolateral aspects of the leg (Fig. 2A and B).

The risk of nerve injury depends on the approach [16]. With the anteromedial approaches used for total and medial unicompartmental knee arthroplasty, there is a theoretical but small risk of injury to the saphenous nerve or its branches. Nerve injuries are rare with the anterolateral approach used for lateral unicompartmental arthroplasty or total knee arthroplasty in a patient with valgus malalignment. The medial posterolateral approach carries a risk of injury to the branches of the saphenous nerve. This approach is indicated for excision of the posterior horn of the medial meniscus, synovectomy, and ligament reconstruction procedures. The common peroneal nerve may be injured when using the lateral posterolateral approach, which is indicated for excision of the posterior horn of the lateral meniscus, synovectomy, ligament reconstruction, and internal fixation of fractures [17]. A neuroma is a growth of Schwann cells and axons packed within fibrous tissue at a nerve ending. During the physical examination, a neuroma may be detected as a nodule whose palpation triggers the pain (trigger zone).

Intraoperative tissue damage due to inflammation and/or nerve injury (stretching, laceration, or section) induces sensitization of not only the peripheral, but also the central, nervous system. Peripheral sensitization is related to nerve damage or local inflammation induced by the surgical procedure. Damaged cells release mediators of inflammation (histamine, bradykinin, prostaglandins, and others) and attract immune cells, which produce proinflammatory cytokines. The various mediators of inflammation sensitize the peripheral nerve, whose action potentials are triggered by lower levels of stimulation [11]. In the spinal cord, the expression of the enzymes cyclooxygenase 1 and 2 increases 3 to 6 h after surgery. Spinal cord inflammation results in the production of excitatory neurotransmitters such as glutamate and substance P in the dorsal horn and in decreased production of inhibitory neurotransmitters such as glycine. Glutamate activates the N-methyl D-aspartate (NMDA) receptors, thereby inducing long-lasting