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Case report

Periarticular needle-based therapies can cause periprosthetic knee infections

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ABSTRACT

Periarticular needle-based therapies such as dry needling, acupuncture, and genicular nerve radiofrequency ablation are becoming more popular for treatment of knee osteoarthritis. These therapies are also being used after total knee arthroplasty for persistent postoperative pain. Although limited published evidence exists for the risk of periprosthetic joint infection after these procedures, we describe one case of periprosthetic joint infection developing shortly after dry needling and another case developing shortly after genicular nerve blocks. We present details of these 2 cases along with a review of the literature regarding the use of periarticular needle-based therapies after total knee arthroplasty.

Introduction

Patient satisfaction after total knee arthroplasty (TKA) remains inconsistent as 20% of patients report dissatisfaction with the procedure [1]. A central portion of this dissatisfaction can be attributed to poor postoperative pain control. Attempts to alleviate pain after TKA beyond oral pain medications include physical therapy, topical creams, and cryotherapy. Treatments gaining recent popularity include dry needling and genicular nerve radiofrequency ablation (RFA). These treatments may come with more risks than previously believed.

Dry needling is a form of acupuncture used to decrease pain, reduce muscle tension, and assist with return to active rehabilitation [2]. During the procedure, the practitioner palpates the target muscle and a solid, filiform needle within a tube is positioned on the overlying skin. The top of the needle is then flicked or tapped, allowing the needle to penetrate the skin. From there, the needle is advanced toward the target area with the goal of eliciting a local twitch response. The needle can be left in place for up to 2 minutes before being redirected toward other neighboring target areas [3]. Although often focused on releasing muscular trigger points, dry needling targets have expanded to ligaments, tendons, subcutaneous fascia, scar tissue, peripheral nerves, bone, and neurovascular bundles [4].

Although limited, some evidence suggests genicular nerve RFA is effective for addressing chronic knee pain [5]. During this procedure, a radiofrequency cannula is advanced into a target nerve area often under ultrasound or fluoroscopic guidance. After insertion of the cannula, sensory and motor function is tested confirming appropriate needle location. Local anesthetic is then injected before continuous radiofrequency is administered for 90 seconds [5,6]. Before undergoing genicular nerve RFA, patients will often undergo genicular nerve blocks to determine if they will have improvement from RFA. During this separate procedure, local anesthetic is injected around periarticular nerves, namely the superomedial genicular, superolateral genicular, and inferomedial genicular nerves [6]. If a significant improvement in pain is made, the patients are then considered for RFA.

Dry needling, genicular nerve blocks, and radiofrequency ablation are not benign procedures. Acupuncture in general carries an 8.6% risk of an adverse event, which range from hematoma to pneumothorax [7]. Dry needling has been found to be the cause of a deep thigh abscess in a young athlete [8]. In addition, there has been a case report from the Netherlands that has linked an acute

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periprosthetic hip infection with postoperative dry needling [9]. Little has been reported regarding complications after genicular nerve blocks or radiofrequency ablation; however, injury to nearby vascular structures is possible [10].

We present 2 cases of periprosthetic knee infection, one after postoperative dry needling therapy and the other after postoperative genicular nerve blocks. The purpose of this report is to warn about the potentially devastating complications of invasive needle therapies after total joint arthroplasty.

Case histories

Case 1

A 79-year-old man underwent a right TKA with a vastus medialis obliquitus advancement. Before undergoing this procedure, the patient had failed conservative measures including anti-inflammatories, physical therapy, and multiple knee injections. Intraoperatively, the knee displayed signs of advanced osteoarthritis consistent with the preoperative films (Fig. 1a and 1b). A vastus medialis obliquitus advancement was performed because of the patient's inability to achieve full knee extension strength after undergoing a quadricep tendon repair 2 years before his TKA that ultimately yielded a 5-degree extensor lag. Radiographs from his first postoperative visit can be seen in Figure 2.

The patient demonstrated appropriate neurological function at his first 2 postoperative visits. However, 8 months postoperatively, he presented with a right foot drop. The patient had a history of lumbar stenosis prompting an arthrodesis at L3-4 years before his TKA. After a thorough workup that included the involvement of a neurologist, it was determined that the spontaneous foot drop was the result of peripheral neuropathy rather than a compressive source. For treatment of his neuropathy, the patient was referred to physical therapy, where he underwent dry needling at his first visit.

The patient noted that during this dry needling session, needles were placed into the lateral side of his right knee. Within 24 hours, the patient developed redness, swelling, worsening pain, and progressive inability to bear weight on the right lower extremity. Of note, at no time before this event did the patient exhibit such symptoms or require the need to rule out infection with infectious indices. He presented to an emergency department 4 days later where an aspiration of his knee was performed for presumed periprosthetic joint infection. Radiographs of the knee were normal. The aspirate yielded over 80,000 white blood cells per microliter and ultimately grew *Pseudomonas aeruginosa*. For his acute periprosthetic joint infection, the patient underwent an irrigation and debridement with poly exchange and retention of metal components. During this procedure, intraosseous antibiotics were also used. With the recommendation of the infectious disease team, the patient was discharged on 6 weeks of intravenous piperacillin-tazobactam which served as his final antibiotic treatment. His postoperative course following his irrigation and debridement was uncomplicated, and at one year, the patient was infection free and seeking treatment for osteoarthritis of his contralateral knee.

Case 2

A 59-year-old woman presented to the emergency room with 2 days of left knee redness, swelling, increased pain, and limited ability to bear weight 13 months after undergoing a left revision TKA. Before her revision, the patient underwent 2 left knee arthroscopies with partial meniscectomies and a unicompartmental knee arthroplasty before conversion to TKA that failed due to instability. Two previous knee aspirations were negative for infection. An incompetent medial collateral ligament with gross instability was encountered at the time of revision and there was no sign of infection intraoperatively or postoperatively.

Unfortunately, she continued to have pain after her revision. For this, she found only mild relief with lidocaine patches and nonsteroidal anti-inflammatory cream. She sought the advice of a physical therapist, who performed dry needling and cupping with limited efficacy for the patient. She was also being treated by a pain specialist who recommended genicular nerve radiofrequency ablation. Before undergoing this procedure, she underwent a diagnostic genicular nerve block to see if she would benefit from the ablation. During this procedure, the patient received multiple periarticular injections around the left knee including superior, medial, and lateral to the patella. Alcohol prep pads were used for sterilization before the injections.

Over the next 48 hours, the patient developed redness, swelling, and severe pain in her left knee that limited her ability to ambulate. Up to this point, she had not experienced this constellation of severe symptoms and postoperative infectious indices remained within normal limits. She presented to the emergency department where

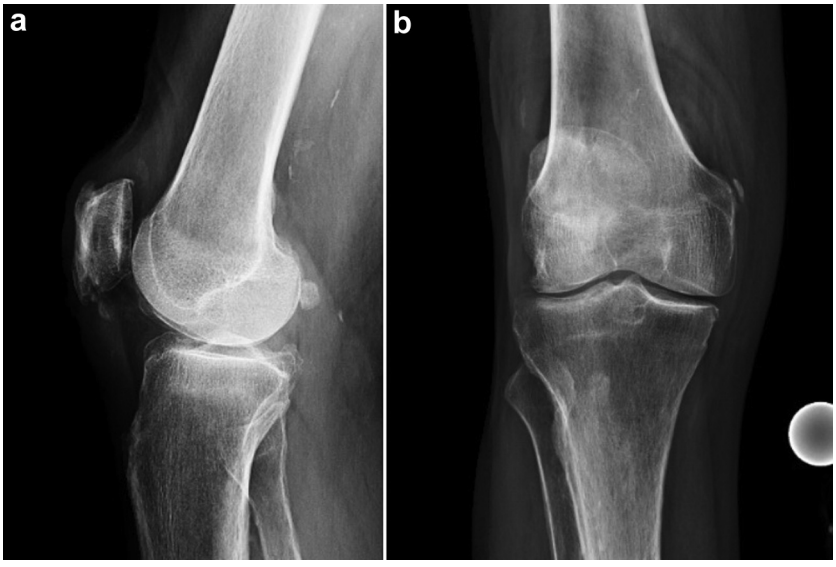

Figure 1. Preoperative AP (a) and lateral (b) radiographs from patient 1 displaying tricompartmental osteoarthritis of the right knee.

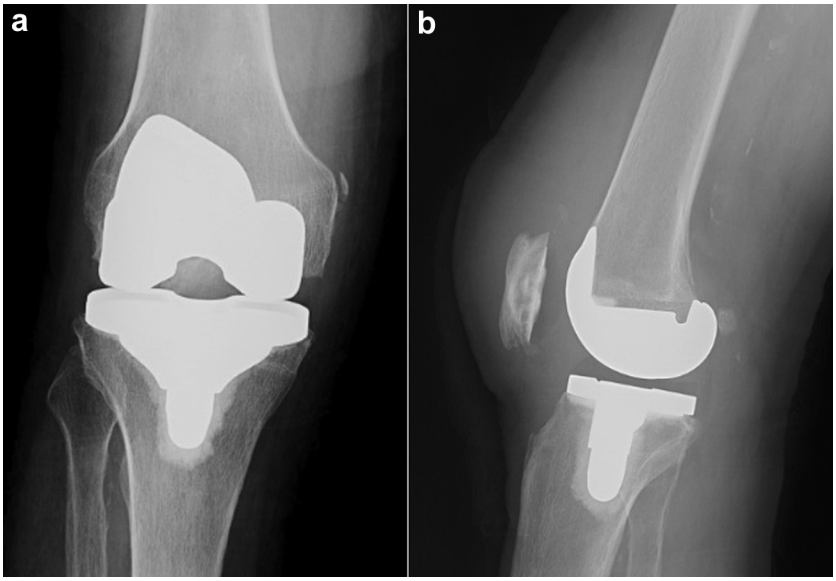

Figure 2. Postoperative AP (a) and lateral (b) radiographs 2 weeks after patient 1 underwent a right total knee arthroplasty with VMO advancement.

an aspiration was consistent with a periprosthetic joint infection with cultures that grew coagulase-negative *Staphylococcus capitis*. She subsequently underwent an irrigation and debridement, poly exchange, and placement of antibiotic beads with retention of her TKA components. Four days later, she returned to the operating room for a planned second irrigation and debridement with poly exchange, removal of the antibiotic beads, and placement of an incisional wound vacuum. She was treated with 6 weeks of intravenous cefazolin before being placed on cefalexin for chronic suppression at the recommendation of the infectious disease specialists despite no intraoperative suggestion of a chronic infection.

The patient's dilemma unfortunately continued after her initial set of debridements. Ten months after undergoing these procedures, she presented to clinic with one week of increased knee pain, swelling, instability, and general malaise. Cultures from an aspiration again grew *S. capitis*. She was taken to the operating room for irrigation, debridement, poly exchange, and retensioning of her medial collateral ligament. She was treated with another round of intravenous cefazolin for 6 weeks and placed back on cefalexin for chronic suppression. Despite these measures, she presented back to clinic 9 months later with 2 months of worsening pain and swelling. An aspiration at that time again yielded *S. capitis*. She was taken to the operating room for removal of her TKA components and placement of an articulating spacer (Fig. 3a and 3b), followed by 6 weeks of intravenous cefazolin. After normalization of inflammatory markers and a negative knee aspiration were obtained, she underwent reimplantation of her left TKA (Fig. 4a and 4b) and is currently doing well.

Discussion

Periprosthetic joint infection remains a leading cause of revision TKA [11,12]. Much research seeking to reduce the risk of periprosthetic joint infection has been aimed at what can be done preoperatively to optimize the patient as well as intraoperatively through the use of perioperative antibiotics, irrigation solutions, or antibiotic-laden bone cement [13]. Relatively little research has been directed toward preventative measures postoperatively.

Recently, dry needling has gained popularity in manual physical therapy for the treatment of multiple conditions, particularly myofascial pain [14]. Multiple practitioners can perform the technique if they are certified, including physicians, chiropractors, acupuncturists, and physical therapists. Whether dry needling lies within the professional and legal scope of practice for physical therapists has remained a debate. However, to date, dry needling is held to be within the scope of practice of physical therapists in 35 states and the District of Columbia.

The exact mechanism by which dry needling provides pain relief is unclear. However, it has been proposed that the technique provides relief via multiple factors including central and peripheral

Figure 3. AP (a) and lateral (b) radiographs following placement of an articulating spacer.

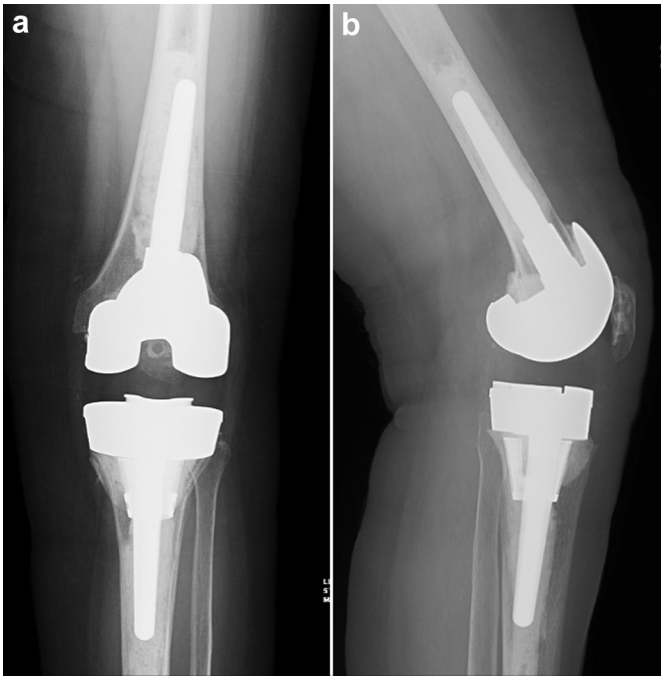

Figure 4. AP (a) and lateral (b) radiographs following second stage reimplantation of her left total knee arthroplasty.

pain modulation, hyperalgesia and allodynia disruption, and the placebo effect [2]. Regardless of the mechanism, acupuncture as a whole has been shown to improve physical function and pain relief in those with knee osteoarthritis [15,16]. However, despite finding statistically significant benefits among randomized sham-controlled trials, a Cochrane review concluded that the benefits of acupuncture in addressing peripheral joint osteoarthritis are small and likely clinically irrelevant [17].

A review of the literature reveals multiple studies that show acupuncture after total knee arthroplasty may provide significant pain relief [18-20]. With regards to dry needling specifically after total knee arthroplasty, supporting literature is limited to small trials and case series [21,22]. Mayoral et al. [22] performed a double-blinded, randomized control trial with 40 subjects in which treatment group subjects received dry needling for preoperatively identified trigger points for a painful total knee arthroplasty. Significantly better postoperative pain control was observed compared to sham controls. Notably, no adverse events were noted in this study. As mentioned previously, there has only been one report identifying dry needling as a cause for periprosthetic joint infection, occurring after a total hip arthroplasty [9].

Genicular nerve RFA and associated nerve blocks are also gaining popularity for arthritis-related chronic knee pain [23]. While nerve blocks deliver perineural local anesthesia that works more temporarily, RFA delivers thermal energy via an alternating current to neural tissue, degrading its ability to transmit pain signals [24]. Small-scale studies have shown the efficacy of genicular nerve RFA in arthritis, yet higher quality evidence is lacking [5,23]. Similarly, limited evidence supports the efficacy of genicular nerve RFA [25,26] and genicular nerve blocks [27,28] in pain control after total knee arthroplasty. In fact, Walega et al. [29] found no effect on postoperative pain when randomized patients undergoing total knee arthroplasty received genicular nerve radiofrequency 2 to 6 weeks before surgery. These studies are restricted to case reports and small clinical trials that advocate for larger studies to be performed. No adverse effects were noted in any study.

The immediacy of the periprosthetic joint infection seen in both of our cases after dry needling and genicular nerve blocks suggests the placement of needles around the knee led to development of periprosthetic joint infections. However, there is the possibility that the temporal relationship of the patients' symptoms and the invasive procedures could have been a coincidence. One could surmise that shortly after these procedures, planktonic bacteria from biofilm sitting on the implants could have been released and caused the symptoms. While possible, the authors consider it improbable as symptoms in both cases occurred within 24-48 hours, respectively.

Periarticular needle-based therapies to address postoperative pain after TKA are not limited to intentional extra-articular needle placement. Use of intra-articular corticosteroid injections after TKA has been described. A retrospective cohort study by Klement et al. [30] showed favorable results with improvement in pain, increased range of motion, and decreased swelling in patients after undergoing corticosteroid injections after TKA, with no associated infections. However, another larger retrospective cohort study by Mills et al. [31] reported an acute infection rate of 0.16% after intra-articular corticosteroid injection into a preexisting TKA, therefore recommending against its use. Because of the elevated risk of PJI and potential masking of the true etiology of the patient's problem, we recommend against use of intra-articular corticosteroids into a preexisting TKA.

Furthermore, inconsistency of sterility during the aforementioned periarticular needle-based therapies was appreciated upon a review of the literature. Although controversial, some acupuncture and dry needling literature suggests against the need for skin sterilization before needle application unless the skin is visibly soiled [32,33]. Alternatively, the World Health Organization recommends the use of a 60%-70% alcohol for skin preparation if placing needles intramuscularly for therapeutic purposes [34]. Sterile technique was recommended with use of genicular nerve RFA and intra-articular corticosteroid injections [5,30,31]. Standardization of sterile precautions is necessary for each procedure; however, it is our opinion that periarticular needle-based therapies are still not worth the risk of a PJI.

As described by our cases, the consequences of periprosthetic joint infection can be devastating and prolonged. As such, we advocate for the avoidance of needle-based therapies around the knee after total knee arthroplasty to prevent periprosthetic joint infections. We suspect complications such as these related to periarticular needle-based therapies are underreported. Large, well-designed retrospective studies evaluating the safety of specific therapies are warranted.

Summary

We present 2 cases of periprosthetic knee infection after postoperative periarticular needle-based therapies. Patient 1 developed an acute periprosthetic joint infection after dry needling that resolved after irrigation, debridement, poly exchange, and 6 weeks of intravenous antibiotics. Patient 2 developed an acute periprosthetic joint infection after genicular nerve blocks that ultimately became chronic and required a 2-stage revision arthroplasty.

Conflict of interest

The authors declare there are no conflicts of interest.

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