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Knee Osteoarthritis Treated by Ultrasound-guided Genicular Nerve Block Combined with IPACK Block: Case Report

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Background: The prevalence rate of knee osteoarthritis (KOA) in China ranks first among all types of OA. A nerve block is a crucial intervention method for treating the pain of KOA patients in the early and middle stages. This paper aims to analyze the mechanism of ultrasound-guided genicular nerve block (GNB) combined with infiltration between the popliteal artery and capsule of the knee (IPACK) block in treating KOA pain by reporting the diagnosis and treatment of a KOA patient.

Case Report: The patient, a 71-year-old woman, complained of "intermittent knee joint pain for several years, aggravated and with limited mobility for one month" and was treated in the outpatient department of the Yanbian University Hospital. After a physical and auxiliary examination, it was diagnosed as bilateral KOA, Kellgren-Lawrence level II, and GNB combined with IPACK block was proposed.

Conclusion: GNB can achieve analgesia in front of the knee joint, eliminate aseptic inflammation and edema of patella medial plica (PMP), and assist with postoperative rehabilitation exercise, which is conducive to early improvement of lower limb function. IPACK block has a good analgesic effect behind the knee joint. The combination of GNB and IPACK block may play an essential role in future KOA pain treatment.

Key words: Case report, genicular nerve block, IPACK block, knee, osteoarthritis, ultrasound-guided

BACKGROUND

Osteoarthritis (OA) is a chronic degenerative joint disease commonly seen in middle-aged and elderly patients. It is reported that the prevalence of knee osteoarthritis (KOA) in China is as high as 8.1% (1). The progressive, irreversible loss of articular cartilage induces aseptic synovitis and leads to knee joint pain and functional limitation (2). This paper reports the diagnosis and treatment of a patient with KOA. It analyzes the mechanism of genicular nerve block (GNB) combined with infiltration between the popliteal artery and capsule of the knee (IPACK) block in treating KOA pain through a literature review, intending to provide a reference for the diagnosis and treatment of such patients.

CASE

The patient, a 71-year-old woman, was admitted to the outpatient department of the Yanbian University Hospital on July 19, 2022, with the chief complaint of "intermittent pain at the knee for several years, aggravation and limited mobility for one month." There is no apparent cause of the disease. Her symptoms were aggravated by standing and climbing stairs for a long time and she could not sleep well at night. It was relieved by taking oral ibuprofen or resting. One month

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before admission, the patient had increased pain with limited activity, and only oral medicine could reduce it. Three days before admission to the hospital, the symptoms worsened, and the drugs could not relieve it; she even lost the ability to move. The family members accompanied her to our hospital for treatment. Physical examination revealed positive tenderness around both knees, positive floating patella test on both sides, Visual Analog Scale (VAS) scores of 6 (at rest) and 8 (active state), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score of 67 points, Lysholm score of 36 points, range of motion 90°, and Self-Rating Scores of Sleep (SRSS) score of 40 points. Auxiliary examination with magnetic resonance imaging (MRI) of the knee joint showed degeneration of knee joint cartilage, obvious edema of the subchondral bone marrow at the lower end of the femur (Fig. 1), and formation of patellar osteophyte (Fig. 2). To sum up, the clinical diagnosis was bilateral KOA, Kellgren-Lawrence level II, and GNB combined with IPACK block was proposed.

The patient was instructed to lie in a supine position; the knee joints of the affected side were slightly flexed, and the whole knee joint was fully exposed. Disinfection and spreading of a sterile towel around the knee were followed by an intraarticular injection of 20 mg of hyaluronic acid. An ultrasound scan of the medial epicondyle of the femur was displayed using a 5-12 MHz high-frequency linear probe and slowly moved towards the proximal end of the femur to find the pulse of the superior medial genicular artery (Fig.3); the probe then scanned the medial epicondyle of the tibia along the tibial body to the tail end to find the pulse of the inferior medial genicular artery (Fig. 4); finally, the probe scanned the lateral epicondyle of the femur along the femoral body toward the head end to find the pulse of the superior lateral genicular artery (Fig. 5). The needle was inserted from the medial end of the probe into the superior medial genicular nerve (SMGN) and the inferior medial genicular nerve (IMGN) and then into the superior lateral genicular nerve (SLGN), respectively. After the needle reached the nerves, 2 mL of local anesthetics was injected (0.2% ropivacaine + betamethasone + normal saline). After the procedure, the punctured site was covered by a sterile dressing paste.

The patient was changed to the prone position. The popliteal artery was identified under ultrasound guidance (Fig. 6), 2 mL of blocking liquid was injected under the popliteal artery with the puncture needle, the puncture needle was pulled out and sterile plaster applied.

We planned to give her 3 rounds of nerve block treatment, with a one-week interval between each intervention. We evaluated the VAS score, WOMAC score,

Fig. 1. Edema of subchondral bone marrow at lower end of femur.

Fig. 2. Formation of patellar osteophyte.

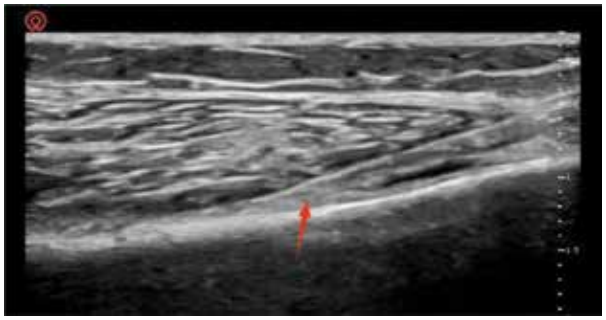

Fig. 3. Superior medial genicular artery.

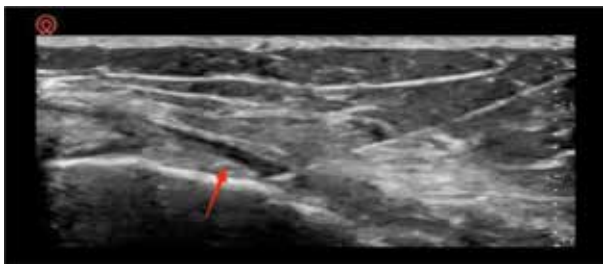

Fig.4. Inferior medial genicular artery.

Lysholm score, ROM, and SRSS sleep score at one hour and 24 hours after each intervention and at one, 4, and 12 weeks after the last intervention, and we instructed the patient to perform necessary rehabilitation exercises to strengthen the muscles of her lower limbs to stabilize the knee joint. See Table 1 for specific evaluation scores.

According to the patient's statement, her symptoms of osteoarthritis have disappeared after treatment and no longer affect her daily life, and symptoms have not recurred.

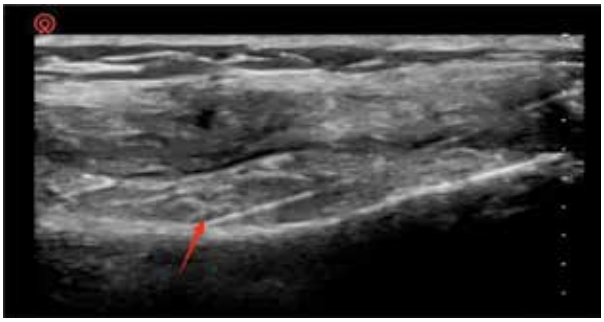

Fig. 5. Superior lateral genicular artery.

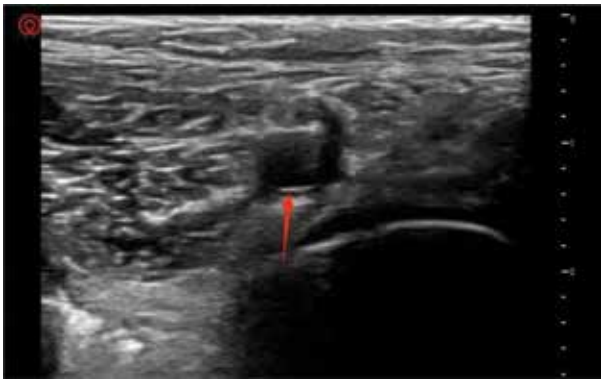

Fig. 6. Popliteal artery.

DISCUSSION

Patella medial plica (PMP) originates from the medial side of the suprapatellar plica, passes through the medial side of the patella and obliquely to the medial edge, and inserts into the synovial layer of the infrapatellar fat. Repetitive mechanical injury or direct trauma can lead to chronic inflammation, fibrosis, and thickening of the PMP, accompanied by edema changes, lymphoplasmacytic cell infiltration, and proliferation of capillaries in the synovial stoma. With the friction of the synovial fold, the synovial papilla becomes thinner. The synovial stroma has obvious fibrosis, and even the synovial papilla has completely fallen off. The incidence rate of pathological PMP of the knee joint in patients with advanced KOA is very high. The PMP is also closely

Table 1. Evaluation indexes.

	VAS score	WOMAC score	Lysholm score	ROM	SRSS sleep score
2022/7/19 Before intervention	At rest 6 Active 8	67	36	90°	40
2022/7/19 After intervention 1h	At rest 3 Active 6	62	39	95°	--
2022/7/19 After intervention 24h	At rest 2 Active 5	55	45	110°	22
2022/7/25 After intervention 1h	At rest 1 Active 3	47	48	115°	--
2022/7/25 After intervention 24h	At rest 1 Active 2	35	52	120°	18
2022/8/3 After intervention 1h	At rest 0 Active 2	28	68	120°	--
2022/8/3 After intervention 24h	At rest 0 Active 0	19	75	125°	10
2022/8/10 After intervention 1w	At rest 0 Active 1	16	81	125°	10
2022/8/31 After intervention 4w	At rest 0 Active 1	16	79	120°	10
2022/10/26 After intervention 12w	At rest 0 Active 1	18	79	120°	10

Abbreviations: ROM, range of motion; SRSS, Self-Rating Scores of Sleep; VAS, Visual Analog Scale; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index

related to the gracilis tendon sheath, and muscle contractures cause knee pain (3).

Hyaluronic acid injection into the joint cavity can lubricate the joint and reduce the friction of PMP. A nerve block can block the upward transmission of abnormal signals, improve the microcirculation blood perfusion of the knee joint, promote the absorption of aseptic inflammation of PMP, eliminate edema, promote functional recovery, and delay the course of KOA. Ultrasound technology has no radiation and is noninvasive, and makes the nerve, muscle, blood vessels, and other structures in the blocked area visible to enable determination of the direction and depth of needle insertion and thereby reduce complications.

Based on intraarticular injection of hyaluronic acid, this patient used GNB combined with IPACK block to treat bilateral KOA pain. The target nerves pointed out by Sari et al (4) include the joint branches of the femoral nerve, saphenous nerve, common peroneal nerve, obturator nerve, and tibial nerve, which constitute the "genicular nerve" that controls the knee joint. The joint branches of the tibial nerve send out the SMGN and the IMGN. The joint branch of the common peroneal nerve sends out the SLGN, and the tibial and knee recurrent nerve, among which the SMGN, the IMGN nerve, and the SLGN are suitable for blocking because of their easy positioning. As the components of the "genicular nerve," blocking these three nerves (SLGN, SMGN, and IMGN) can achieve analgesia in front of the knee joint. Sankineani et al (5) and Ochroch et al (6) pointed out that the IPACK block can effectively relieve the pain behind the knee joint. The combination of the 2 treatment approaches can achieve all-around analgesia of the knee joint. In addition, regular therapeutic exercise is beneficial in reducing knee joint pain and improving the quality of life and can improve the symptoms related to KOA in the short term (7).

It is reported that ropivacaine has little inhibitory effect on motor fibers, and 0.257% ropivacaine can provide a satisfactory brachial plexus block (8). The other study shows that when 0.2% ropivacaine 2.5 mL is used for a common peroneal nerve block, the average duration of sensory block is about 9.2 hours, and the average duration of the motor block is about 3.3 hours (9). Considering safety and effectiveness, we chose 0.2% ropivacaine 2 mL, as the block solution is injected at each target point, and no adverse reaction occurred after 3 interventions.

This case report was carried out after obtaining informed consent of the patient. In clinical practice, attention should be paid to the summary of such diseases, and early diagnosis and intervention should be carried out to improve these patients' prognosis and quality of life.

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