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Original Research Article

Role of ultrasound in diagnostic genicular nerve block for knee osteoarthritis pain

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ABSTRACT

Objective: To evaluate the role of ultrasound in diagnostic genicular nerve block for knee osteoarthritis pain

Introduction: Radiofrequency neurotomy of the genicular nerves is a novel technique for the alleviation of knee pain in patients with advanced osteoarthritis (OA). The efficacy of radiofrequency neurotomy may be enhanced by prior positive diagnostic genicular block. To date, genicular nerve injections have been performed under fluoroscopic guidance, in which needle is placed with reference to bony landmarks. Ultrasound-guided genicular nerve injections have recently been shown to be accurate. In the present study, we have evaluated the role of ultrasound (US) to achieve successful diagnostic genicular nerve block.

Materials and Methods: 20 patients (age 50-80 years) with advanced knee osteoarthritis pain (kellgran Lawrence grade 3-4) who failed conservative treatment underwent ultrasound guided genicular nerve block. The genicular nerve block was performed on a total of 24 knees. Visual analogue scale (VAS) of pain of each was assessed before and 2 hours after the procedure.

Results: VAS scores were found to reduce from 75.23±12.89 mm to 29.52± 10.71 mm post-procedure ($P<0.05$). 22 out of 24 knees (91.7%) got >50% pain relief.

Conclusion: Ultrasound is a valuable tool for performing the diagnostic genicular block of the knee.

1. Introduction

Osteoarthritis of the knee is a chronic debilitating disease of adults, causing significant pain and functional limitation. Various pharmacological and non-pharmacological methods for pain relief in osteoarthritis have been tried in the past with only modest clinical benefits, and surgical knee replacement remains the definitive treatment of choice in advanced OA.[1] Many patients, who choose not to undergo surgery due to coexisting comorbidities or financial constraints, accept this pain and disability as inevitable corollaries of OA and ageing.[2]

Radiofrequency (RF) neurotomy of the genicular nerves is a novel approach which has been shown to ameliorate knee pain in osteoarthritis patients. Being a slightly more invasive procedure, it is reserved for OA patients who do not respond to conservative treatments. The efficacy of genicular nerve neurotomy may be enhanced by doing it in only those patients who show a positive response to the diagnostic local anaesthetic block. In most centres, both, diagnostic block and thermal RF neurotomy of the genicular nerves are performed under fluoroscopic guidance, whereby the superomedial (SMGN), superolateral (SLGN) and inferomedial (IMGN) genicular nerves supplying the knee joint are ablated. Good pain relief has been demonstrated with this procedure along with significant improvement in the functional status of patients for up to a period of 3 months.[3]

Recently, however, interventional pain practitioners have started exploring the utility of Ultrasound (US) in performing various procedures as it is simpler and allows improved visualisation of the anatomy while avoiding ionising radiations and risks associated with contrast use.[4]

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We, in the present study, aimed to evaluate the efficacy of a newer simpler technique of achieving successful diagnostic genicular nerve block using US guidance.

2. Materials and Methods

This case series included patients who visited our Pain Clinic between March 2018 and March 2019. Informed consent was taken from all the patients.

2.1. Patient selection

After a clinical and radiological assessment, the study subjects comprised elderly patients (age 50-80 years) with chronic knee pain (Visual analogue scale VAS $>$ 50mm for $>$ 3 months) and radiological tibiofemoral advanced osteoarthritis (Kellgren Lawrence grade 3-4). These were patients in whom all conservative measures for pain relief had been exhausted, including physiotherapy, oral analgesics, myofascial trigger point injections and intraarticular injection with steroid or viscosupplementation.

Patients with acute knee pain, prior knee surgery, other connective tissue diseases affecting the knee, using anticoagulant medication, and with serious neurologic or psychiatric disorders were excluded.

2.2. Technique

The diagnostic genicular block was performed in the procedure room of the pain clinic under all aseptic precautions with monitored anaesthesia care. The affected knee was placed in a slightly flexed position with a pillow underneath. A high frequency linear US probe (6-13 MHz) (M-Turbo, Fujifilm Sonosite, USA) prepared for aseptic use and placed longitudinally along the length of the femur, first on the superomedial aspect, such that the shaft of the femur, the medial femoral condyle and the irjunction were clearly visualised (Figure 1). The probe was then tilted or moved in the longitudinal plane medially to laterally to locate the superomedial genicular artery. The artery was visualised in the cross-sectional view and was seen as a pulsatile structure just at the junction of the shaft and the condyle, close to the periosteum. If multiple small arteries were visualised, the one closest to the shaft-condyle junction and lying just above the periosteum was selected (Figure 2). 26 G 1 1/2 inch hypodermic needle (Romsons, India) then inserted in an out-of-plane manner to reach the artery identified. Once the needle reached the desired target and was found to be in contact with bone, it was withdrawn by 1-2mm, and 0.5-1 ml of 0.25% bupivacaine was injected after negative aspiration for blood. The injectate was seen to spread in a lenticular fashion just superficial to the periosteum, surrounding the artery (Figure 3). The genicular nerve lies in the same neurovascular bundle close to the artery and hence it was assumed to be covered by the local anaesthetic. The superolateral nerve was blocked in a similar manner placing the probe longitudinally along the superolateral aspect of the femur. For the inferomedial genicular nerve, we placed the probe over the medial aspect of the tibia and deposited the drug around the artery located at the junction o f the tibial shaft and condyle.

Fig. 1: Placement of the US probe for (a) superomedial, (b) superolateral, (c) inferomedial genicular nerves

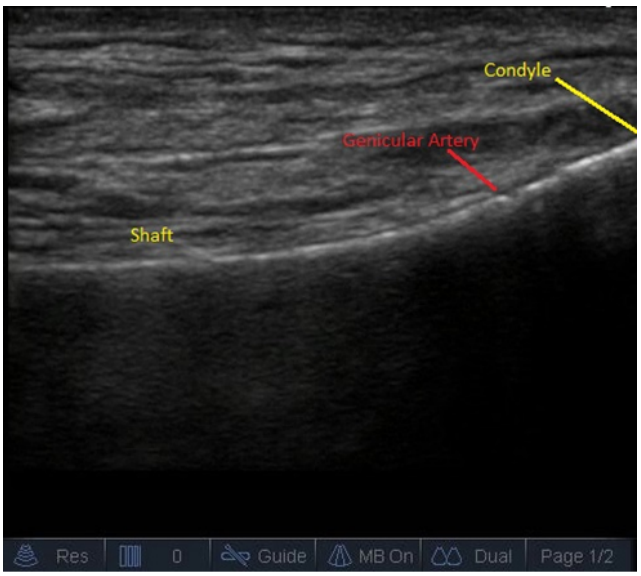

Fig. 2: Sonographic image demonstrating the medial aspect of the shaft of the femur, the femoral condyle and the superomedial genicular artery

The patients were observed for 2 hours in the recovery room and then discharged. During those 2 hours, the patients were permitted to walk and engage in their normal activities. The pain was assessed using VAS at the time of discharge. If pain relief was found to be $>$ 50%, the patients were planned for radiofrequency neurotomy at the next visit.

2.3. Evaluating parameters

Pain score of each knee was assessed separately before and after 2 hrs. of the procedure using the Visual analogue scale (VAS).

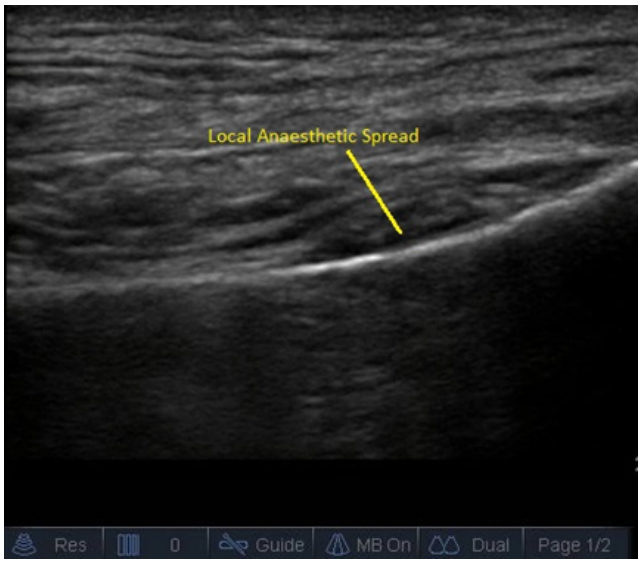

Fig. 3: Sonographic image demonstrating the appropriate spread of local anaesthetic agent for the successful blockade of the superomedial genicular nerve

2.4. Statistical Analysis

Demographic data were analyzed with one way ANOVA for continuous variables and chi-square test for categorical variables. VAS scores before and after the procedure were compared using Paired t-test. The package SPSS 20.0 (SPSS Inc, Chicago, IL) was used for statistical analysis. $P < 0.05$ was considered as significant.

3. Results

24 patients were selected for US-guided diagnostic genicular block in our pain clinic. On sonography, the intraarticular fluid collection was detected in 4 patients. The intra-articular steroid was administered to these patients. These patients were excluded from further analysis.

For the remaining 20 patients, demographic characteristics are described in (Table 1). With 4 patients suffering from bilateral advanced OA, the procedure was performed on a total of 24 knees. Satisfactory drug spread was observed at all points, and the diagnostic genicular block was performed successfully and uneventfully. Patients were discharged after 2 hours.

The mean pre-procedure VAS score was 75.23 $\pm$1.28 mm which got reduced to 29.52$\pm$10.71 mm post-procedure ($p<0.05$). At the time of discharge, pain relief of $>$ 50% was documented in 22 out of the 24 knees. This was considered as a positive response and these patients were subsequently planned for RF neurotomy.

Mild pain at the site of needle injection was reported which resolved spontaneously. No other complications were reported. None of the patients was given any additional analgesics for the first 24 hours after the block.

4. Discussion

Ultrasound -guided diagnostic genicular block provided $>$ 50% pain relief in 22 out 24 knees using the above-described technique. This simple technique permitted successful blockade of all three genicular nerves. When performing the block, it was found that the inferomedial genicular artery was identified more easily than the superomedial and superolateral arteries. This could be explained because the tibia is a superficial bone and hence the inferomedial artery was found to be more superficial than the two superior ones. The technical difficulty was experienced in patients with advanced OA with large osteophytes which sometimes obscured the shaft-condyle junction. However, it could be successfully performed in all patients.

Before the performance of the block, all the knees were scanned for any fluid collection which could have been missed or may not have been obvious on clinical examination. So all patients who showed fluid collection on ultrasound scanning were deferred from the further genicular nerve block. Thus, no inflammatory arthritic knees were missed. These patients were given intraarticular steroid[5] and called for follow up. This advantage is not seen with the fluoroscopic technique.

Yasar et al[6] have attempted to determine the accuracy of US -guided genicular nerve block on cadavers concerning the anatomical landmarks for the two medial (superomedial and inferomedial) genicular nerves. They suggest that the adductor tubercle of the femur should be taken as the landmark for SMGN, with the target point being the bony cortex 1 cm anterior to the tubercle. For the IMGN, the midpoint between the peak of the medial tibial epicondyle and the initial tibial fibres of the medial collateral ligament has been suggested as the target point for injection. The authors have not commented upon the landmark for the superolateral genicular nerve. They proposed that medial compartment OA is more common, and blockade of these two medial nerves can be sufficient in achieving adequate pain relief in the knee. Based on these landmarks, a preliminary report has been published, demonstrating the efficacy of pulsed RF of the superomedial and inferomedial genicular nerves leading to adequate pain relief in patients with medial compartment OA. It has demonstrated encouraging results.[7]

In another case report, precise US-guided location of the genicular nerves has been described using a high-resolution US.[8] However, identification of such small nerves may not be possible every time due to possible technical issues regarding the low performance of ultrasound systems and thick subcutaneous fat tissue in obese patients.

Arteries, on the other hand, are easier to locate due to their pulsatility. It is well known that the genicular arteries and nerves lie in close proximity, with the nerves curving around the femoral/tibial shafts. Franco et al studied cadavers and revealed that although nerves show variable

Table 1: Demographic characteristics of study patients

Age (years)	**Mean ± SD**	**67.7± 7.8**
Gender	Male n (%)	10 (50)
	Female n (%)	10 (50)
Symptomatic knee side	Right only n (%)	12 (60)
	Left only n (%)	4 (20)
	Bilateral n (%)	4 (20)
Kellgren- Lawrence Grade	Grade 3 n (%)	13 (54.2)
	Grade 4 n (%)	11 (45.8)

course proximally but had a constant distal contact on the femur and tibia within the neurovascular bundle.[9] Thus in our technique, we have used the arteries to identify the endpoints, and have found encouraging results. Techniques used in previous studies have described the landmarks for the blockade of only the two medial nerves, whereas by our USG artery location technique, all three genicular nerves, including the superolateral nerve, could be successfully blocked.

The genicular nerve block is not bereft of complications. As arteries travel with nerves in a neurovascular bundle, ablating nerves using a bony landmark, as under fluoroscopy, may not effectively target the nerves of interest and has been shown to lead to undesired vascular complications.[9] Most often, these vascular injuries result in the formation of the pseudoaneurysm, arteriovenous fistula (AVF), hemarthrosis, and/or osteonecrosis of the patella. Although rare, these complications carry significant morbidity.[10] These could be averted when using the US-guided technique as it allows precise visualisation of the nearby blood vessels. Among minor complications, mild pain at the injection site is most commonly reported, but it may resolve spontaneously or can be managed easily with a short course of NSAIDs. Being a completely extra-articular procedure, there is no risk of intraarticular complications.

The technique of US-guided diagnostic genicular block described in this study is technically simpler than the previous two techniques described. However, this technique is not suitable for doing thermal radiofrequency neurotomy because in this technique the tip of the needle is placed perpendicular to the target nerve, whereas for best results in thermal RF, the RF probe ought to be placed parallel to the target nerve. Probably, this technique could prove to be useful for performing pulsed RF where perpendicular needle placement is desirable; however, there is no evidence to support the same at present. Concerning the study design, we aimed to deposit local anaesthetic near the nerves, and select patients who would subsequently benefit from an RF neurotomy of the nerves. Since we were focussing on only the diagnostic block, a longer follow-up period was not kept, and no functional improvement scales have been incorporated in the study. This is only a case series with no controls, and further studies with a larger population and arandomised controlled study design are warranted to confirm the positive findings of this technique.

5. Conclusion

The ultrasound is an extremely useful tool for performing diagnostic genicular block, as it can be performed as an OPD procedure, is devoid of exposure toionising radiations and risks associated with the use of contrast, and allows precise visualisation of the associated blood vessels thus minimising vascular complications. The technique described in this study demonstrates promising results when used for performing diagnostic genicular block. However, further studies with a larger population and a randomised controlled study design are warranted to confirm the positive findings of this technique, and its utility in performing US-guided RF neurotomy of the genicular nerves.

6. Source of Funding

None.

7. Conflict of Interest /Disclosure

None.

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