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Original Article

The relationship between meniscal tear and neuropathic pain in patients with knee pain

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Abstract

Aim: To determine whether the presence of meniscal tear, bone marrow edema, synovitis and effusions in the knee joint present a risk factor for neuropathic pain.

Material and Methods: A total of 103 patients (66 females, 37 males) with knee pain were included in the study. Meniscal tear, bone marrow edema, effusion and synovitis in the knee joint were determined using magnetic resonance imaging. The neuropathic pain level of the patients were evaluated according to the Leeds Assessment of Neuropathic Symptoms & Signs (LANSS). The visual analogue scale (VAS) used for the evaluation of pain.

Results: Neuropathic pain was found in 14.6% of patients according to the LANSS scale. Night pain was higher in patients with neuropathic pain compared with those without neuropathic pain (P=0.014). Rest pain was higher in patients with neuropathic pain compared with those without neuropathic pain (P=0.026).Movement pain was higher in patients with neuropathic pain compared to those without neuropathic pain (P=0.004).Meniscal tear was present in 76.7% of the patients. Neuropathic pain was identified in 16.45% of meniscal tears, and the ratios of bone marrow edema, synovitis and effusion were 22.3%, 43.7% and 64.1%, respectively. The relative risk ratios of meniscal tear, bone marrow edema, effusion in the knee and synovitis in the development of neuropathic pain (with 95% confidence interval) were 1.9 (0.4–8.1), 0.9 (0.3–2.8), 0.8 (0.3–2.2) and 0.5 (0.2–1.4), respectively

Conclusion: Based on our study findings, meniscal tears, bone marrow edema, knee effusion and synovitis lesions did not have an effect on neuropathic pain development.

Keywords: Neuropathic pain; meniscal tear; bone marrow edema; synovitis; effusion.

INTRODUCTION

The menisci consist of two half-moon-shaped (c-shaped or crescent shaped) fibrous cartilage structures that are attached to the tibial intercondylar area and both menisci are connected to each other from the front by the transverse ligament. As a result, they move together when the femur slides over the tibia (1). The menisci play a role in shock absorption, load transfer, nutrition of the articular cartilage, limitation of excessive flexion and extension and stability maintenance (2). Traumatic, degenerative and congenital pathologies are some of the causes of meniscal tears. These tears may occur because of overloading in a normal meniscus or normal loading in a degenerative meniscus. Traumatic tears are typically observed in individuals aged 10–40 years, whereas degenerative tears are typically observed in those aged >40 years. Traumatic tears are often associated with other degenerative changes in cartilage and bone tissue in the knee (3,4). Severe pain is experienced in newly formed meniscal tears, and sensitivity is experienced at the medial and lateral joint line. Because there are no nerves innervating the menisci, sensitivity and pain are associated with synovitis adjacent to the capsular and synovial structures. Swelling in meniscal lesions usually occurs within a few days; however, these lesions are not a result of meniscal tears but occur because of the rupture of synovial and ligamentous adhesion sites. The effusion that occurs within a short period after injury is usually a symptom of haemarthrosis and may occur in conditions that disrupt the continuity of the capsular and ligament structure. Haemarthrosis may be caused by injury to vascular structures in the periphery of the menisci, but lack of effusion does not indicate the absence of meniscal tears (5,6). Any loss or damage to the menisci increases contact stress on the cartilage and leads to osteoarthritis. Degenerative meniscal tears are commonly observed with knee osteoarthritis. The cause of pain in osteoarthritis has

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not been completely elucidated, but it is thought that both nociceptive and neuropathic components play a role in the development of pain. The stimuli caused by cartilage destruction, bone damage and inflammation stimulate nociceptive receptors. The resulting continuous and intense sensitivity can lead to central sensitization. This may subsequently lead to neuropathic pain. Neuropathic pain in osteoarthritis occurs because of mechanical irritation or affected nerve roots that are inflamed by secreted cytokines (7-9). Although there are few studies in the literature suggesting that meniscal tears indirectly cause neuropathic pain after osteoarthritis, there are no studies investigating neuropathic pain development after isolated meniscal tears and subsequent injury.

The aim of our study was to determine whether the presence of meniscal tears, bone edema, synovitis and effusion in the knee joint present a risk factor for neuropathic pain.

MATERIAL and METHODS

A total of 103 patients with knee pain were included in this cross-sectional, single-blind, observational study. Meniscal tears and bone marrow lesions, effusion and synovitis in the knee joint were determined using magnetic resonance imaging (MRI). We investigated whether these lesions were a risk factor for the development of neuropathic pain.

Measurement Tools

The visual analogue scale (VAS) used for the evaluation of pain consists of a 10-cm line with 'no pain' written on one end and 'maximum conceivable pain' written on the other end. According to instructions, patients were asked to mark their pain at rest and function on a 10-cm line (0: no pain, 10: very severe pain) (10). The neuropathic pain level of the patients was evaluated using the Leeds Assessment of Neuropathic Symptoms & Signs (LANSS) scale. The LANSS scale comprises seven items that are objective questions requiring a 'yes' or 'no' answer. Five are items that question the pain symptoms and two are sensory examination questions, including allodynia and needle sensation test. The scale is scored between 0 and 24, with a score of 12 or more indicating neuropathic pain. Yucel et al. performed the Turkish validity and reliability study of the LANSS pain scale in 2004 (11).

Inclusion Criteria

1. Pain for at least 3 months
2. Aged 30–70 years
3. Literate
4. Patients with grade 2 and 3 meniscal tear in the internal or external meniscus

Exclusion Criteria

1. Previous knee surgery or hyaluronic acid, platelet rich plasma or cortisone injection in the last 6 months
2. No history of neuropathic pain treatment
3. Having an infectious or inflammatory disease
4. Cancer or metabolic diseases
5. Diabetes or peripheral-central nervous neuropathy
6. Other causes of neuropathy (alcoholism, heavy metal toxicity, vitamin B12 deficiency, etc.)

The present study protocol was reviewed and approved by the local ethic committee. Written informed consents were obtained from each patient. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Statistical Analysis

For data with normal distribution, the Shapiro–Wilk test was performed for cases with neuropathy, whereas the Lilliefors-corrected Kolmogorov–Smirnov test was performed for cases without neuropathy. Data with normal distribution (age, weight, body mass index) were expressed as mean ± standard deviation, whereas data without normal distribution were expressed as median and interquartile range (IQR). Categorical data were expressed as numbers and frequencies. The unpaired t test and Mann–Whitney U test were used to compare means between groups. The effects of meniscal tear, synovitis, bone marrow edemas and effusion as risk factors of neuropathic pain were determined using the relative risk ratio. The distribution of cases with and without neuropathic pain in terms of meniscal tears, synovitis, bone marrow edemas and effusion was analyzed using the continuity correction chi-square test and Fisher's exact test. $P<0.05$ was considered statistically significant. Statistical analyses were performed using Predictive Analytics SoftWare (PASW) for windows (ver. 18.0).

RESULTS

A total of 66 female and 37 male patients with a mean age of 51.1 years were included in the study. The average BMI of the patients was 30.8±5.1 kg/m^2. Neuropathic pain was found in 14.6% of patients according to the LANSS scale. No statistically significant difference was found between the patients with and without neuropathic pain in terms of age, BMI and gender distribution. Demographic characteristics of patients with and without neuropathic pain are shown in Table 1.

Night pain was higher in patients with neuropathic pain compared with those without neuropathic pain [median (IQR) 7 (1–9) and 3 (0–5), respectively, P=0.014]. Rest pain was higher in patients with neuropathic pain compared with those without neuropathic pain [5 (1–8) and 2 (0–4), respectively, P=0.026]. Movement pain was higher in patients with neuropathic pain compared to those without neuropathic pain [8 (6-9) and 5 (4–8), respectively, P=0.004] (Table 2).

Meniscal tears was present in 76.7% of the patients. Neuropathic pain was identified in 16.45% of patients, and the ratios of bone marrow lesions, synovitis and effusion were 22.3%, 43.7% and 64.1%, respectively. Neuropathic pain ratios of bone marrow lesions, synovitis and effusion were 13.04%, 8.88% and 13.63%, respectively. (Table 3)

The relative risk ratios of meniscal tears, bone edema, effusion in the knee and synovitis in the development of

neuropathic pain (with 95% confidence interval) were 1.9 (0.4–8.1), 0.9 (0.3–2.8), 0.8 (0.3–2.2) and 0.5 (0.2–1.4), respectively (Table 4).

Table 1. Demographic characteristics

	Neuropathic Pain (+)	Neuropathic Pain (-)	P value
Age (yrs)	53.0±9.5	50.7±11.7	0.918
BMI (kg/m^2)	30.0±4.7	29.1±4.9	0.831
Gender			
Female	12 (80%)	54 (61.4%)	0.272
Male	3 (20%)	34 (38.6%)	
Education			
Illiterate	2 (2.3%)	0 (0%)	
Literate	14 (15.9%)	7 (46.7%)	
Primary-Secondary	45 (51.1%)	4 (26.7%)	0.076
High School	15 (17.0%)	3 (20.0%)	
University	12 (13.6%)	1 (6.7%)	

Continuous data were given as mean±SD, categorical data were given as frequency (percent)

Table 2. Pain assessment results of the patients with knee pain

	Neuropathic Pain (+)	Neuropathic Pain (-)	P value
Pain duration	21 (42)	16 (18)	0.346
VAS night	7 (8)	3 (5)	0.014
VAS (rest)	5 (7)	2 (4)	0.026
VAS (active)	8 (3)	5 (4)	0.004

VAS: Visual analog scale
Data were given as median (interquartile range)

Table 3. Pathological findings of the patients with knee pain

		Neuropathic Pain (+)	Neuropathic Pain (-)	P value
Meniscal tears	(+)	13 (86.7%)	66 (75.0%)	0.510
	(-)	2 (13.3%)	22 (25.0%)	
Bone marrow lesions	(+)	3 (20.0%)	20 (22.7%)	1.000
	(-)	12 (80.0%)	68 (77.3%)	
Synovitis	(+)	4 (26.7%)	41 (46.6%)	0.171
	(-)	11 (73.3%)	47 (53.4%)	
Effusion	(+)	9 (60.0%)	57 (64.8%)	0.774
	(-)	6 (40.0%)	31 (35.2%)	

Continuity Correction chi-square test and Fisher's exact test was used

Table 4. Risk estimate for neuropathic pain

	RR Ratio	95% CI	
		Lower	Upper
Meniscal tears with neuropathic pain	1.975	0.479	8.144
Bone marrow edema with neuropathic pain	0.87	0.268	2.822
Synovitis with neuropathic pain	0.469	0.16	1.375

Relative Risk (RR) Ratios were given with 95% confidence interval (CI)

DISCUSSION

We found that meniscal tears, bone edema, knee effusion and synovitis identified on knee MRI were not risk factors for neuropathic pain. Previous studies investigating the innervation characteristics of menisci reported the presence of proprioceptive receptors. Menisci exhibit proprioceptive characteristics, such as type I and II nerve endings in the anterior and posterior horns. Following meniscal rupture, uncontrolled damage develops in some mechanoreceptors and irregular afferent stimuli are generated by the remaining healthy mechanoreceptors. This results in a general decrease in proprioceptive sensitivity in the knee (12,13).

For instance, peripheral nociceptors may become sensitized because of inflamed synovium and damaged subchondral bone. Continuous and intensive nociceptive sensitivity may cause central sensitization and is clinically associated with neuropathic pain (14,15). Degenerative meniscal tears are commonly observed with knee osteoarthritis. In a study of 174 patients with osteoarthritis aged >45 years who presented with unilateral knee pain, symptomatic meniscal tears were found in 24% of the cases based on MRI findings (16). However, symptomatic meniscal tears may also occur in patients without radiological osteoarthritis findings (17). The cause of pain in osteoarthritis is not fully known, but it is believed that both nociceptive and neuropathic components play a role in the development of pain. In studies investigating the neuropathic pain component in knee osteoarthritis, a significant correlation was found between neuropathic pain and VAS and functional status scores (WOMAC) (18,19).

In our study, VAS night pain, rest pain and movement pain scores were higher in patients with neuropathic pain compared with those without neuropathic pain. Chondral lesions in the compartment often accompany Meniscal tears on the same side, and limb axis disorders may occur. In patients with axis disorders, the femoral condyle on the side with the deformity is usually painful. Effusion and synovial hypertrophy can also be detected, and arthritis may accompany the incident (20). Although we did not specifically examine the presence and degree of osteoarthritis, we assessed whether meniscal tears and/or synovitis, effusion and bone marrow edema lesions in the knee caused neuropathic pain in patients with knee pain. We identified neuropathic pain in 16.45% and 8.33% of patients with and without meniscal tears, respectively. Furthermore, we found that the presence of synovitis, effusion and bone marrow edema lesions had a low risk rate for neuropathic pain development. In a study investigating whether meniscal tears are a risk factor for neuropathic pain in patients with osteoarthritis, Roubille et al. examined knee MRIs of 50 patients (21). In addition to meniscal tears, they examined bone marrow edema, synovial effusion and cartilage volume and reported a significant relationship between neuropathic pain scores obtained using the pain DETECT questionnaire and

meniscal tears and bone marrow edema in the lateral compartment. Moreover, bone marrow edema in the medial compartment, synovial effusion and cartilage volume were found to have no effect on the neuropathic pain scores.

The relationship between meniscal tears and neuropathic pain in the knee remains unclear. Possible causes include the loss of mechanical protection provided by the meniscus following rupture and bone marrow edema. Additionally, increased vascular penetration and sensory nerve densities in the medial meniscus of patients with osteoarthritis are thought to represent the potential role of meniscal sensory nerve growth during osteoarthritis knee pain and may contribute to the neuropathic component of pain. Other studies suggested that mechanical stress of the joint capsule with impaired tissue following meniscal injury may be a possible cause (22,23).

This study has some limitations. Patients with knee pain were evaluated as a single group without categorizing the patients into any specific disease group. There was no control group in this study, and the LANSS scale used in this study is not the gold-standard assessment tool for evaluating neuropathic pain. On the other hand, the scarcity of studies in the literature investigating this topic and the fact that the number of patients assessed was higher in this study compared with that in other studies investigating causes of neuropathic knee pain are strengths of the present study. We believe that our study will help guide future studies aiming to elucidate the cause of neuropathic pain.

CONCLUSION

Based on our study findings, it can be concluded that night pain, rest pain and movement pain were more common in patients with neuropathic pain, and meniscal tears, bone oedema, knee effusion and synovitis lesions did not have an effect on neuropathic pain development. Randomized controlled trials evaluating a larger number of patients are necessary to clarify whether meniscal tears cause neuropathic pain.

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