Original Article

A sleep disturbance after total knee arthroplasty

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Abstract

Background: Knee osteoarthritis (OA) is common arthritis in elderly. Total knee arthroplasty; (TKA) is effective to restore mobility and improve quality of life in patients with OA. One of TKA complications is sleep disturbance. **Objective:** Aim was to evaluate sleep disturbance after TKA despite differences in postoperative pain managements. **Methods:** Prospective cohort study was performed on 67 patients who underwent primary TKA by different surgeons during May to March 2019. Samples were collected randomly from different hospitals in Sulaimani, Kurdistan, Iraq. Sleep pattern was assessed by Pittsburgh Sleep Quality Index (PSQI) and pain was assessed by visual analogue scale (VAS) for three months postoperatively. **Results:** Mean ± standard deviation (SD) age (year) and body mass index (BMI; kg/m^2) of participants were 64.2 ± 7.5 (range: 40–82) and 27.3 ± 3.7 (range: 21.3–41.6), respectively. About 83.6% were females with male to female ratio of (0.2:1). There were statistically insignificant associations of age, gender, BMI, and history of diabetes mellitus with PSQI. Degree of pain was gradually decreasing during follow-up, but sleep was better at beginning followed by peaked disturbance after one month, then it started to improve gradually at end of follow-up. **Conclusions:** Sleep disturbance assessment needs multimodal approaches in order to improve it and satisfy patients.

Keywords: Osteoarthritis, primary, total knee arthroplasty, sleep disturbance

Introduction

Knee osteoarthritis (OA) is the most common arthritis in elderly patients—especially more than 65 years old,[1-3] which is a painful condition may disrupt quality of life and leads to depression and anxiety.[3,4]

The most common complaint of knee OA is pain that make the patient to seek medical care.[2] At the end stage of this disease, the patient needs surgery to replace the joint. Total knee arthroplasty (TKA) is well-accepted worldwide as an effective treatment to restore the mobility and improve the quality of life in patients with OA.[3,5-8] Moreover, TKA is a procedure that is increasing day by day; it is expected to increase more than 650% between 2005 and 2030, i.e., more than sixfolds.[2,7,9] Although TKA gives the patients nearly about the same physiological trauma, the speed of recovery between patients is different.[10] Furthermore, one of the main symptoms of advanced OA is continuous nocturnal knee pain that necessitates replacement.[1]

One of the complications that is annoying to the patients and not clearly understood is sleep disturbance after TKA; it happens in about 50% of patients.[3,9] Few studies are available on how TKA affect sleep quality.[3] Normal sleep cycle is important for the patients, both physiologically and mentally, because it helps the patients' rehabilitation process.[11]

Sleep disturbance is multifactorial and poorly understand complication after surgery. According to previous studies, we classify its factors into patient's factors, surgical factor, and postoperative factors.[1] Disturbance of sleep may be present before replacement surgery due to severity of OA.[1]

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Preoperative central sensitization is a factor to cause postoperative pain.[12] Diabetes mellitus (DM) leads to slower resolution from pain and rehabilitation and preoperative psychological distress leads to poor outcome.[13,14] Moreover, this major surgical procedure by itself is trauma to the patients and there is evidence that severity of surgical trauma may disrupt sleep quality.[11,15,16] Postoperative pain after TKA is that factor which is still poorly managed and poorly understood; about one-third of patients have disturbing pain after TKA specifically in the first three months, which in turn make the patients unable to sleep.[2,17] Furthermore, chronic neuropathic pain is a difficult situation, which may develop postoperatively and may disturb sleep.[18,19] Another postoperative disturbing condition is persistence anterior knee pain, which previously had been studied by Lee *et al*.[20] It is a common condition, about 50%, after TKA due to patellar hypertension syndrome which can be successfully treated by patellar decompression during surgery.[21,22]

Pain perception is increased by poor sleep quality.[10] Many centers assumed that strong pain control medication is enough to restore sleep, but actually those medications by themselves may disturb the sleep.[10,16]

Opioids are group of medications which are used to control severe pain and they can cause sleep deprivations.[11] Therefore, Krenk *et al*.[11] was using opioid-free modalities to control pain after hip and knee arthroplasties, which in turn showed dramatic response in improving sleep quality. In addition, opioid-free anesthesia has beneficial effect on sleep quality.[16]

Improving sleep quality has been studied to improve outcome and hasten recovery after TKA.[9] There are multimodal pathways to decrease postoperative pain; the ideal pathway should control pain, promote rehabilitation, and not affect sleep.[11,17] Periarticular injections are safe method to control postoperative pain[5] as well as local infiltration of analgesia.[17,23]

We intended to evaluate the sleep disturbance after TKA which had been performed by different surgeons and they had used different modalities to control postoperative pain. Ethics committee of Kurdistan board for medical speciality (KBMS), reference no. 21 on 10/1/2018.

Materials and Methods

A prospective cohort study was performed among patients who underwent primary TKA by different surgeons during May to March 2019. The samples were collected randomly from different private and governmental hospitals in Sulaymaniyah Governorate, Kurdistan Region, Iraq.

Research Ethical Committee of Kurdistan Board of Medical Specialties (KBMS) approved the study proposal and informed consent has also been taken from the patients for their inclusion in this study.

The inclusion criteria were patients who underwent primary TKA. The exclusion criteria were patients with history of previous sleep disorder, history of psychological problem, revision of TKA, and refusal to participate in the study.

Sixty seven patients who were included in the study were filled questionnaire preoperatively, immediately postoperative, one-month postoperatively, and three-month postoperatively.

Almost all the operations (97%) performed under spinal anesthesia (SA), no one received preincisional analgesia, and all the participants were received postoperative analgesia (opioids and acetaminophen or nonsteroidal anti-inflammatory drugs "NSAIDs") for 3–10 days, broadspectrum antibiotics for an average of 2–14 days, and 51 (76.1%) of the patients had epidural catheter for epidural analgesia. Patients discharged hospital on an average of three (2–4) days.

Sleep pattern assessed by Pittsburgh Sleep Quality Index (PSQI) from preoperative to three months postoperatively.[24] The scale consists of seven main components: sleep quality, sleep efficiency, sleep latency, sleep duration, sleep disturbance, using sleep medication, and daytime dysfunction. Each component scored from 0 (no difficulty) to 3 (severe difficulty) and the component scores were then summed up to produce a global score (range 0 to 21); higher score was indicating worse sleep quality.

Pain was assessed by visual analogue scale (VAS).[20] It scored from 0 to 10 with higher score being more severe. The VAS scores were taken preoperatively, immediately postoperative, and one-month and three-month postoperatively.

The "IBM SPSS Statistics version 25" was used for the analysis of the data and both descriptive and inferential statistics were used. Furthermore, P value of ($\leq$0.05) was considered as statistically significant. In addition, Pearson Chi-square test was used to find out the significance of association between independent and dependent variable pairs, and Pearson's R correlation was used to calculate the direction of the correlation between the two variables.

Results

The demographic features of the participants are shown in [Table 1].

There were statistically insignificant association of participants' age, gender, BMI, and history of diabetes mellitus with PSQI during preoperative and three months of follow-up [Table 2].

The duration of postoperative analgesic treatment and intraoperative tourniquet duration as well as the assessment of pain and sleep of the patients by using VAS and PSQI scales, respectively, were shown in [Table 3].

The degree of pain was more severe at the beginning followed by gradual decrease in its intensity during the follow-up period,

while the sleep of the participants was better preoperatively and immediately postoperatively followed peaked disturbance after one-month postoperatively, then it started to improve gradually at the end of follow-up period [Table 4].

There was statistically significant association of epidural catheter usage for delivering analgesic agents with sleep of the participants at the end of the follow-up period [Table 5].

Discussion

The TKA is well-accepted worldwide as an effective treatment to restore the mobility and improve the quality of life.[3,5,7,8,18] One of the complications that are annoying to the patients and not clearly understood is sleep disturbance after TKA—it happens in about 50% of patients.[3,7]

Sleep disturbance is a neglected problem. Still there are few studies on this subject; therefore, the purpose of our study was to assess patients' sleep prospectively for the duration of three consecutive months after primary TKA to find out the association of gender, BMI, diabetes on the patients' recoveries postoperatively. In addition, to know the effect of postoperative pain control modalities, periarticular injection, epidural catheter for analgesia, and medications on sleep quality.

Most of our patients had moderate to severe pain and end-stage OA and then they decided to replace the knee; this was consistent with other studies in which night pain was common in their patients.[1,3,4,9] Initially, sleep disturbance increased among our patients especially until the first postoperative month, then slowly it declined to base line and improvement was continued in 43% of patients until our last follow-up at the end of three postoperative months. These findings were inconsistent with the study of Sasaki *et al*.[1]; in their study they followed their patients for up to six months and they found an initial increase in sleep disturbance until six weeks postoperatively followed by a decline and improvement in their sleep quality during the remaining follow-up period.[5] The study of Mulier *et al*.[9] concluded that improvement of sleep disturbance after TKA needs longer period—may be until 10 months postoperatively—, whereas the study of Krenk *et al*.[11] in which they used fast track modality among patients of TKA and total hip arthroplasty (THA) showed quite early returning into normal sleep pattern within 4–9 days. We think these variations are due to the variations in psychological and genetic factors among different populations in different geographical areas.

Sleep disturbance had a higher percentage of the variation in functional limitations than self-reported pain did in our study and this was similar to the study performed by Chen *et al*.[5] Moreover, the studies of Rissanen *et al*.[3] clearly mentioned that patient with greater pain and sleep disturbance at one month following surgery demonstrate greater functional limitation than after three months postoperatively.

Table 1: Demographic features of the participants

Demographic features		Mean±SD	Range
Age (year)		64.2±7.5	40 to 82
BMI (kg/m²)		27.3±3.7	21.3 to 41.6
Body weight (kg)		76.6±10	58 to 110
Body height (cm)		168±6.2	155 to 186
Occupation (%)	Employee	10 (14.9)	
	Housewife	34 (50.7)	
	Lawyer	1 (1.5)	
	Retired	16 (23.9)	
	Teacher	3 (4.5)	
	Worker	3 (4.5)	
Residency (%)	Inside city	42 (62.7)	
	Outside city	25 (37.3)	

BMI=body mass index; cm=centimeter; kg=kilogram; m=meter; SD=Standard Deviation

Table 2: Associations of demographic features with sleep disturbances assessed by PSQI

Demographic features		Preoperative PSQI (%)		Immediately postoperative PSQI (%)		One-month postoperatively PSQI (%)		Three-month postoperative PSQI (%)	
		Good (0-4)	Bad (≥5)	Good (0-4)	Bad (≥5)	Good (0-4)	Bad (≥5)	Good (0-4)	Bad (≥5)
Age (year)	40-49	1 (1.5)	0 (0)	1 (1.5)	0 (0)	0 (0)	1 (1.5)	0 (0)	1 (1.5)
	50-59	14 (20.9)	0 (0)	14 (20.9)	0 (0)	0 (0)	14 (20.9)	5 (7.5)	9 (13.4)
	60-69	33 (42.3)	0 (0)	33 (42.3)	0 (0)	4 (6)	29 (43.3)	14 (20.9)	19 (28.4)
	70-82	18 (26.9)	0 (0)	18 (26.9)	0 (0)	0 (0)	18 (26.9)	10 (14.9)	8 (11.9)
	P (Pearson's R correlation)	0.9 (-0.01)		0.9 (-0.01)		0.36 (0.02)		0.56 (-0.13)	
Gender (M:F ratio=0.2:1)	Female	56 (83.6)	0 (0)	56 (83.6)	0 (0)	3 (4.5)	53 (79.1)	26 (38.8)	30 (44.8)
	Male	11 (16.4)	0 (0)	11 (16.4)	0 (0)	1 (1.5)	10 (14.9)	3 (4.5)	8 (11.9)
	P (Pearson's R Correlation)	0.7 (-0.06)		0.7 (-0.06)		0.6 (-0.06)		0.24 (0.14)	
DM	Yes	21 (31.3)	1 (1.5)	21 (31.3)	1 (1.5)	2 (3)	20 (29.9)	9 (13.4)	13 (32.8)
	P (Pearson's R Correlation)	0.4 (0.17)		0.4 (0.17)		0.7 (-0.1)		0.6 (0.005)	
BMI	Normal (18.5-24.9)	22 (32.9)	0 (0)	22 (32.9)	0 (0)	3 (4.5)	19 (28.4)	12 (17.9)	10 (14.9)
	Over weight (25-29.9)	31 (46.3)	1 (1.5)	32 (47.7)	0 (0)	1 (1.5)	31 (46.3)	14 (20.9)	18 (26.9)
	Obese (30-40)	12 (17.9)	0 (0)	12 (17.9)	0 (0)	1 (1.5)	11 (16.4)	2 (3)	10 (14.9)
	Morbid obesity (>40)	1 (1.5)	0 (0)	1 (1.5)	0 (0)	0 (0)	1 (1.5)	1 (1.5)	0 (0)
	P (Pearson's R Correlation)	0.9 (-0.008)		0.9 (-0.008)		0.8 (0.08)		0.19 (0.05)	

BMI=body mass index; DM=diabetes mellitus; M: F=male to female

The PSQI in our study improved in less than half of the patients at three months postoperatively, in comparison to other studies,[5] our patients were revealing lower improvement of their sleep. Thus, we worked to find out the causes of sleep disturbance and we found that patients with high BMI showed long recovery from pain and poor sleep pattern after TKA, which is not described in other studies. In addition, diabetes was another risk factor for poor recovery but this has been described by other studies such as the study performed by Amusat *et al*.[13]

Table 3: Results of both VAS and PSQI scales during preoperatively as well as during postoperative follow-up period

Variables	Mean±SD	Range
Preoperative pain (VAS score)	6.5±0.8	5-8
Preoperative sleep disturbance (PSQI)	7.6±1.6	5-13
Duration of postoperative analgesic agent(s) usage (day)	6.1±2	2-10
Tourniquet period (minute)	59.6±10.5	40-120
Immediately postoperative pain (VAS score)	5.3±2.3	1-9
Immediately postoperative sleep disturbance (PSQI)	7.5±1.7	5-13
One-month postoperative pain (VAS score)	4.8±1.3	2-7
One-month postoperative sleep disturbance (PSQI)	6.1±1.2	4-11
Three-month postoperative pain (VAS score)	3.9±1.3	2-7
Three-month postoperative sleep disturbance (PSQI)	4.8±1.2	2-9

PSQI=Pittsburgh Sleep Quality Index; SD=Standard Deviation; TKA=total knee arthroplasty; VAS=Visual Analogue Scale

The VAS scores for assessment of pain in our study showed continuous improvement till the end of the three months period of follow-up—63% of the patients showed great improvement—; therefore, we expect that there is a relation between pain and sleep disturbance although the study done by Chen *et al*.[5] showed no correlation between the two. Moreover, periarticular injection is another method to decrease postoperative pain and better functional recovery; therefore, the less need for opioid. Furthermore, periarticular injection was used for 94% of our patients with better outcome as compared to the other 6% of patients in whom we did not use periarticular injections. Our results were consistent with the study of Guild 3rd *et al*.[17] Furthermore, epidural catheter to deliver pain control medication was another modality that we used in 76.1% of the patients, which showed better early pain score than other groups.

Irrigation with cold 0.5% epinephrine solution was a beneficial and cost-effective treatment that decreased acute postoperative VAS score immediately and one day after the surgery in other studies.[25] These modalities were not used in our practice. But, as it was shown by the study done by Krenk *et al*.,[11] postoperative analgesic regime can have impacts on sleep. Krenk *et al*.[11] hypothesized that the reduced impact of surgery in fast track setup, i.e. short length of stay and opioid sparing analgesia, would reduce postoperative sleep disturbances.[11,26] The fast track setup was in contrast to our modality in which we mostly depended on opioid to control pain.

Opioid is known to affect sleep pattern; in addition, it increases the risk of central apnea during sleep which potentially in turn

Table 4: Patients' outcomes assessed by VAS and PSQI scales

Outcomes		Preoperative (%)	Immediately postoperative (%)	One-month postoperatively (%)	Three-month postoperative (%)
PSQI	Good (0-4)	67 (100)	67 (100)	4 (6)	29 (43.3)
	Bad (≥5)	0 (0)	0 (0)	63 (94)	38 (56.7)
	Total	67 (100)	67 (100)	67 (100)	67 (100)
VAS	Mild pain (1-4)	0 (0)	22 (32.8)	27 (40.3)	50 (74.6)
	Moderate pain (5-7)	63 (94)	29 (43.3)	40 (59.7)	17 (25.4)
	Severe pain (8-10)	4 (6)	16 (23.9)	0 (0)	0 (0)
	Total	67 (100)	67 (100)	67 (100)	67 (100)

PSQI=Pittsburgh Sleep Quality Index; VAS=Visual Analogue Scale

Table 5: Association of pain management modalities with sleep of the participants

Variables		Preoperative PSQI (%)		Immediately postoperative PSQI (%)		One-month postoperatively PSQI (%)		Three-month postoperative PSQI (%)	
		Good (0-4)	Bad (≥5)	Good (0-4)	Bad (≥5)	Good (0-4)	Bad (≥5)	Good (0-4)	Bad (≥5)
Periarticular injection	Yes	-	-	63 (94)	0 (0)	4 (6)	59 (88.1)	29 (43.3)	34 (50.7)
	P (Pearson's R Correlation)	-		-		0.6 (-0.06)		0.07 (-0.22)	
Type of postoperative analgesic agent(s)	Opioid	-	-	12 (17.9)	0 (0)	0 (0)	12 (17.9)	2 (3)	10 (14.9)
	Opioid and Acetaminophen	-	-	49 (73.1)	0 (0)	4 (6)	45 (67.2)	25 (37.3)	24 (35.8)
	Opioid and NSAID	-	-	6 (9)	(0)	0 (0)	6 (9)	2 (3)	4 (6)
	P (Pearson's R Correlation)	-		-		0.67 (-0.05)		0.17 (-0.17)	
Epidural catheter for analgesia	Yes	-	-	51 (76.1)	0 (0)	4 (6)	47 (70.1)	26 (38.8)	25 (37.3)
	P (Pearson's R Correlation)	-		-		0.25 (-0.14)		0.02 (-0.3)	

PSQI=Pittsburgh Sleep Quality Index

worsens the postoperative sleep disturbance.[11] Furthermore, opioids have the ability to inhibit the release of acetylcholine and this pathway accounts for an indirect negative effect on rapid eye movements (REM) sleep.[16] Moreover, another plausible explanation for the reduction in REM sleep and short wave sleep after opioids could be that they derange the circadian pacemaker; therefore, opioid-free anesthesia will be beneficial for the patients.[16]

We also found that unilateral TKA was worsening the knee pain on the contralateral side, which may have a role disturbing sleep. This was supported by the study of Smith *et al*.[27] and they also stated that women had higher rate of developing contralateral knee pain.

Conclusions

Sleep disturbance assessment needs multimodal approaches in order to improve it and satisfy the patients. We think that the duration of follow-up in the current study was short; therefore, we recommend a longer duration of follow-up in the subsequent research studies.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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