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Association between disease-specific anxiety at discharge and functional outcome in patients after total knee arthroplasty

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ABSTRACT

Background: Patients who undergo total knee arthroplasty (TKA) may experience disease-specific problems, including decline in motor function and intense pain, which may result in disease-specific anxiety. This study aimed to investigate disease-specific anxiety at discharge, and any association between anxiety and functional outcomes following TKA.
Methods: The study prospectively included 129 patients who had undergone TKA. Each patient's disease-specific anxiety about wounds, pain, gait, and falling was assessed at discharge using a numerical rating scale, in which 0 represented no anxiety and 10 represented the highest level of anxiety. In addition, patient-reported outcomes (PROs) were evaluated using the Knee Society Score (KSS) at six-months postoperatively. The effects of disease-specific anxiety at discharge were evaluated with the KSS at six-months postoperatively and analyzed separately using multiple regression analysis.
Results: The median score for anxiety about wounds, pain, and gait was 4.0 (IQR 2.0–5.0) at discharge five days after surgery. The median score for anxiety about falling was also 4.0 (IQR 2.0–6.0). The level of anxiety regarding wounds, pain, gait, and falling was negatively associated with the KSS six-months postoperatively after adjusting for all confounding factors (wounds: $\beta = -2.8$, 95% CI -4.3 to -1.3; pain: $\beta = -3.4$, 95% CI -4.9 to -1.9; gait: $\beta = -4.3$, 95% CI -5.8 to -2.9; falling: $\beta = -2.5$, 95% CI -3.9 to -1.1).
Conclusion: Patients reported similar levels of anxiety regarding wounds, pain, gait, and falling at discharge after TKA. The severity of anxiety symptoms at discharge was negatively associated with PROs six-months postoperatively.

1. Introduction

Total knee arthroplasty (TKA) is the most common surgical intervention for knee osteoarthritis (OA). It effectively alleviates pain and improves motor function and functional ability [1,2]. Although the length of hospital stay following TKA has considerably decreased in the past decade, from around 10–12 days to about three to six days currently [3–5], there are some problems regarding decreasing hospital stays. Several previous studies have demonstrated some disease-specific problems regarding decreasing hospital stays after TKA surgery: more than half of patients after discharge six days after surgery reported that the worst pain pe-

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riod occurred during the first two weeks at home [5]; patients demonstrated a decline in functional ability at discharge five days after surgery [6]; and patients after TKA showed a risk of falling at discharge three days after surgery [7].

Several studies have reported presence of pre-operative anxiety symptoms before TKA, and investigated the association between pre-operative anxiety symptoms and patient-reported outcomes (PROs) after TKA surgery [8–12]. These studies found that the degree of pre-operative anxiety symptoms is associated with worse PROs after TKA, and pre-operative anxiety symptoms are widely acknowledged as an important factor of PROs after TKA. Some patients after TKA may have some disease-specific anxiety symptoms resulting from disease-specific problems at discharge, as previously noted. However, there are very few studies investigating anxiety symptoms at discharge after TKA.

A prospective cohort study examined anxiety symptoms at discharge after TKA surgery in patients who received routine care and support from a psychologist [13]. The study concluded that there was a lower incidence of anxiety and depression in the groups of patients who received psychological support and underlined the importance of psychological support for patients after TKA. However, the study examined anxiety symptoms using the Hospital Anxiety and Depression (HAD) Scale questionnaire [14]. Although this questionnaire is useful for assessing generalized anxiety problems in hospitalized patients, data are lacking on disease-specific anxiety symptoms at discharge after TKA. In addition, although they assessed anxiety symptoms at discharge, the association between anxiety symptoms at discharge and postoperative PROs is unclear; thus, they failed to highlight the importance of assessing anxiety symptoms at discharge after TKA. To determine postoperative care after TKA surgery it is crucial to understand the association between disease-specific anxiety symptoms at discharge and PROs after TKA.

The present study aimed to investigate disease-specific anxiety symptoms at discharge after TKA. It also aimed to examine the association between disease-specific anxiety symptoms at discharge and PROs after TKA.

2. Methods

2.1. Participants

This study was a prospective cohort study of patients undergoing TKA, evaluated at discharge five days after surgery and at six months postoperatively. In this study, 162 patients were considered for inclusion, and 129 were enrolled (after applying the exclusion criteria) at a local orthopedic hospital between March and August 2015. Inclusion criteria were: (1) patient aged 50–79 years, and (2) completion of primary unilateral TKA for knee OA staged as Grade 3 or 4 based on the Kellgren and Lawrence radiographic grading system. Exclusion criteria were: (1) presence of uncontrolled hypertension or diabetes; (2) neurologic impairments; and (3) coexisting OA or other orthopedic conditions in the contralateral hip or knee requiring surgery within six months. After application of the exclusion criteria, 129 patients were selected. The study protocol was approved by the Institutional Review Board (2014-25), and written informed consent was obtained from all participants.

2.2. Procedures

Pre-operatively, data were collected on age, gender, body mass index (BMI), number of comorbidities, depressive symptoms, and Knee Society Score (KSS) as PROs [15]. All patients underwent primary TKA by using posterior-stabilized knee arthroplasty with a medial parapatellar surgical approach, and data on the duration of surgery were collected. After surgery, all patients participated in a rehabilitation program consisting of standard five-day inpatient and 12-week outpatient rehabilitation programs. Inpatient rehabilitation at the hospital was conducted twice daily for five days and the primary mobility-related goal at discharge was independent walking using a cane. After discharge five days after surgery, patients continued outpatient rehabilitation for 12 weeks (once per week; mean of 12 visits). The rehabilitation programs were aimed at controlling pain and swelling, and improving knee range of motion (ROM), muscle strength, and functional ability.

At discharge, nurses explained about wound healing process and self-care for wounds at home. Physical therapists gave an explanation regarding self-care for pain and recovery process of knee ROM, muscle strength, and functional ability. In addition, all patients were given a standard home exercise program. Physical therapists also assessed disease-specific anxiety symptoms at discharge.

The follow-up assessment was completed six months after TKA surgery. Physical therapists evaluated the KSS as a primary outcome. Previous studies have reported that patients recovering after TKA surgery typically plateau in functional gains by six months following surgery [2,16,17]; therefore, the current study chose to assess patients six months postoperatively.

2.3. Assessment of anxiety

The current study assessed disease-specific anxiety symptoms about wounds, pain, gait, and falling at discharge after TKA surgery using a numerical rating scale (NRS). The reasons why it focused on disease-specific anxiety symptoms about wounds, pain, gait, and falling at discharge were as follows: patients had to care for their wounds by themselves at home because the sutures were not removed in the hospital; more than half of patients experienced the worst pain at home after discharge [5]; patients demonstrated a decline in functional ability at discharge [6]; and patients showed a risk of falling at discharge [7]. Patients were asked: “how would you rate your anxiety about wounds (pain, gait, or falling), with 0 representing no anxiety and 10 representing the highest level of anxiety?” The NRS has been widely used to assess anxiety symptoms [18–20], and the scale for anxiety symptoms has been validated and proven to be reliable [21].

2.4. Assessment of functional outcome

This study also evaluated PROs using the KSS at six months postoperatively as a primary outcome [15]. The KSS consists of four categories: symptoms, patient satisfaction, patient expectations, and functional activities. The total score of these four categories was calculated and the score ranged from 0 to 180. Higher scores represented less pain and better level of patient satisfaction, expectations, and physical functioning. The KSS is a valid and reliable instrument to capture subjective aspects of the functional symptoms and abilities of patients who undergo TKA [15].

2.5. Confounding factor

Data were collected on age [22], gender, BMI [23], surgical time, and pre-operative KSS as confounding factors. Additionally, the following were evaluated: number of pre-operative comorbidities included in the Charlson Comorbidity Index [24], and pre-operative depressive symptoms using a short 10-item version of the Center for Epidemiologic Studies Depression Scale (CES-D) [25]. The short 10-item CES-D consists of 10 questionnaires and scores range from 0 to 30, with higher scores reflecting serious depressive symptoms. Previous studies have demonstrated reliability and validity of the short 10-item CES-D as a measure of depression [25,26].

2.6. Statistical analysis

An exploratory design was used to examine the association between disease-specific anxiety symptoms at discharge and PROs after TKA. An estimation of sample size was performed according to Harris' formula; an absolute minimum of 10 participants per predictor variable is appropriate [27]; therefore, it was determined that the required sample size should be at least 100 in consideration of 10 independent variables. To allow for undetermined problems (i.e., loss to follow-up or missing data), it was planned to recruit 120 patients for this study.

First, the study described the characteristics of patients and KSS before surgery and at six months postoperatively, with continuous variables as mean (standard deviation (SD)) and categorical variables as number of individuals and proportions. Second, it described the anxiety symptoms about wounds, pain, gait, and falling at discharge five days after surgery as medians (Interquartile range (IQR)). Third, it used multiple regression analysis to investigate the association between anxiety symptoms at discharge and functional outcome after TKA, with adjustment for potential confounding factors. The dependent variables included KSS at six months postoperatively. The scores of anxiety symptoms about wounds, pain, gait, and falling at discharge were separately included as independent variables. The potential confounding factors as age, gender, BMI, duration of surgery, pre-operative KSS, number of comorbidities and short 10-item CES-D score were also included as independent variables across all four regression models. If patients dropped out from the clinical pathway or missed the six-month postoperative assessment, they were excluded from statistical analysis. The software was Statistical Package for the Social Sciences (SPSS, Windows version 21.0; SPSS, Inc., Chicago, IL), and level of significance was set at five percent.

3. Results

Among the 129 individuals included, all patients were discharged at five days after TKA surgery. Of them, 13 patients missed the six-month postoperative assessment due to conflicting schedules. Therefore, 116 individuals were included in final analyses. Table 1 shows the study characteristics.

At discharge five days after surgery, the median scores for anxiety about wounds, pain, and gait were all 4.0 (2.0–5.0) (Figure 1). Additionally, the median of anxiety score about falling was 4.0 (2.0–6.0) (Figure 1). The KSS was 81.5 (SD 23.3) before surgery and 116.4 (SD 23.2) at six months postoperatively.

The level of anxiety symptoms for wounds, pain, gait, and falling, and the KSS at six months postoperatively exhibited negative relationships, after adjusting for all confounding factors (wounds $\beta = -2.8$, 95% CI -4.3 to -1.3, $P < 0.001$; pain $\beta = -3.4$, 95% CI -4.9 to -1.9, $P < 0.001$; gait $\beta = -4.3$, 95% CI -5.8 to -2.9, $P < 0.001$; and falling $\beta = -2.5$, 95% CI -3.9 to -1.1, $P < 0.001$) (Table 2). A negative association was also observed between the short 10-item CES-D and postoperative KSS for all four models (wounds: $\beta = -1.1$, 95% CI -1.9 to -0.3, $P = 0.007$; pain: $\beta = -0.83$, 95% CI -1.6 to -0.04, $P = 0.04$; gait: $\beta =$

Table 1
Pre-operative characteristics of patients and surgical time.

	N = 116
Age, mean years, (SD)	70.6 (6.1)
Women, n (%)	92 (79.3)
Body mass index, mean kg/m^2, (SD)	26.7 (4.4)
Number of comorbidities, mean (SD)	1.4 (1.0)
CES-D score, mean (SD, range)	9.1 (5.2, 0–33)
Surgical time, mean minutes, (SD)	92.3 (19.7)
Pre-operative Knee Society Score, mean (SD, range)	81.5 (23.3, 27–135)

CES-D, the Center for Epidemiologic Studies Depression Scale; SD, standard deviation.

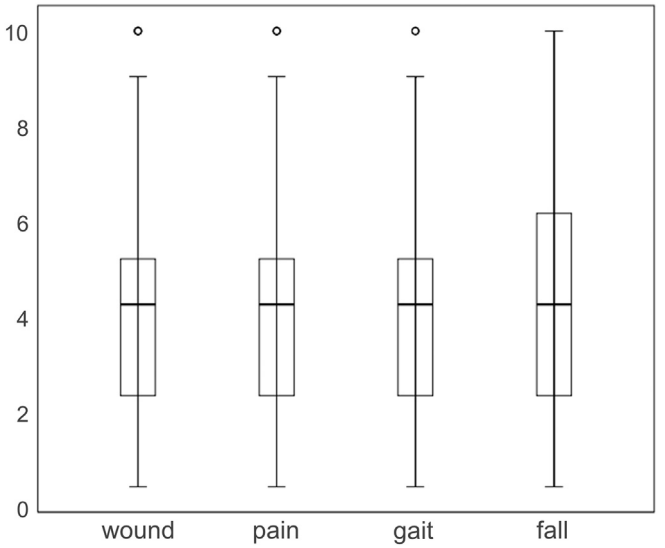

Figure 1. Anxiety about wounds, pain, gait, and falling at discharge five days after surgery.

Table 2
Impact of anxiety about wounds, pain, gait, and falling at discharge on the postoperative Knee Society Score.

	Unstandardized coefficient	95% CI	*P*
Model of anxiety about wounds (adjusted R^2 values; 0.23)			
Anxiety	−2.8	−4.3 to −1.3	<0.001
Age	−0.44	−1.1 to 0.22	0.19
Gender	4.7	−4.8 to 14.3	0.33
BMI	0.23	−0.67 to 1.1	0.62
Surgical time	0.08	−0.12 to 0.29	0.43
Pre-operative KSS	0.23	0.06 to 0.41	0.009
Number of comorbidities	−0.65	−1.5 to 3.2	0.74
CES-D	−1.1	−1.9 to −0.30	0.007
Model of anxiety about pain (adjusted R^2 values; 0.28)			
Anxiety	−3.4	−4.9 to −1.9	<0.001
Age	−0.53	−1.2 to 0.10	0.10
Gender	6.0	−3.3 to 15.3	0.20
BMI	0.17	−0.70 to 1.05	0.70
Surgical time	0.05	−0.15 to 0.25	0.64
Pre-operative KSS	0.24	0.07 to 0.40	0.007
Number of comorbidities	−0.70	−4.5 to 3.1	0.71
CES-D	−0.83	−1.6 to −0.04	0.04
Model of anxiety about gait (adjusted R^2 values; 0.36)			
Anxiety	−4.3	−5.8 to −2.9	<0.001
Age	−0.71	−1.3 to 0.11	0.21
Gender	6.2	−2.6 to 15.0	0.16
BMI	0.34	−0.48 to 1.2	0.41
Surgical time	0.04	−0.15 to 0.23	0.69
Pre-operative KSS	0.26	0.10 to 0.42	0.001
Number of comorbidities	−0.67	−4.2 to 2.9	0.71
CES-D	−0.78	−1.5 to −0.04	0.04
Model of anxiety about falling (adjusted R^2 values; 0.23)			
Anxiety	−2.5	−3.9 to −1.1	<0.001
Age	−0.62	−1.3 to 0.03	0.06
Gender	9.6	−0.25 to 19.4	0.06
BMI	0.24	−0.66 to 1.14	0.60
Surgical time	0.06	−0.14 to 0.27	0.55
Pre-operative KSS	0.24	0.07 to 0.42	0.006
Number of comorbidities	−1.2	−5.1 to 2.7	0.54
CES-D	−0.91	−1.72 to −0.10	0.03

CI, confidence interval; BMI, body mass index; KSS, Knee Society Score; CES-D, the Center for Epidemiologic Studies Depression Scale.
In multiple regression analyses, dependent variables included the KSS at six months postoperatively.

−0.78, 95% CI −1.5 to −0.04, $P = 0.04$; and falling: $\beta = -0.91$, 95% CI −1.7 to −0.1, $P = 0.03$) (Table 2). Likewise, the pre-operative KSS was positively associated with postoperative KSS in all four regression models (wounds: $\beta = 0.23$, 95% CI 0.06–0.41, $P = 0.009$; pain: $\beta = 0.24$, 95% CI 0.07–0.40, $P = 0.007$; gait: $\beta = 0.26$, 95% CI 0.10–0.42, $P = 0.001$; and falling: $\beta = 0.24$, 95% CI 0.07–0.42, $P = 0.006$) (Table 2).

4. Discussion

It is believed that this is the first study to investigate disease-specific anxiety symptoms at discharge after TKA, and examine the association between disease-specific anxiety symptoms and postoperative PROs. Patients reported a similar level of anxiety symptoms with respect to wounds, pain, gait, and falling at discharge after TKA. In addition, the severity of anxiety symptoms at discharge was negatively associated with PROs at six months postoperatively. The PROs at six months postoperatively were also negatively related to pre-operative depressive symptoms and positively related to pre-operative PROs, and these results were consistent with those of previous studies [28–30]. Even after adjusting for these pre-operative factors, the current study was able to demonstrate a negative association between the severity of anxiety symptoms at discharge and postoperative PROs. These results underline the importance of assessing anxiety symptoms at discharge to improve postoperative PROs.

A systematic review identified that a higher pre-operative anxiety level predicted a poorer outcome after TKA [31]. Findings from the present study exhibited similarities with those of this systematic review. However, in the systematic review, most studies showed a relationship between pre-operative anxiety and poorer outcome using the HAD scale [8–11]. By contrast, the present study demonstrated a relationship between disease-specific anxiety at discharge and poorer outcome, and showed that the impact of anxiety at discharge on outcome varied according to the kind of anxiety. The results implied that clinicians should more carefully assess what kind of anxiety patients who have undergone TKA experience at discharge, and the magnitude of their anxiety. Attempts to reduce anxiety symptoms could be effective for better functional improvement after discharge. Therefore, a more valid measurement of anxiety symptoms and cut-off points to identify anxious patients who are more likely to obtain worse functional improvement after discharge should be established. Previous studies that assessed anxiety symptoms using NRS reported different cut-off points: one study reported that NRS 1–3 = mild anxiety, NRS 4–7 = moderate anxiety, and NRS >7 = severe anxiety [18]; another study reported that NRS 1–3 = mild anxiety, NRS 4–5 = moderate anxiety, and NRS >6 = severe anxiety [32]. These cut-off points could not be applied in the current study as the disease-specific questionnaires were different from those previously used. Developing cut-off points by disease-specific questions for TKA would be helpful for clinicians to easily interpret results from assessments of anxiety symptoms using the NRS.

A previous study identified that adding pre-operative and postoperative psychological support to routine treatment had a beneficial effect on the reduction in general anxiety symptoms at discharge in patients who had undergone TKA [13]. In addition, a systematic review demonstrated that neuroscience education, which differs from traditional education and focuses not on anatomical or biomechanical models, but rather on neurophysiology, neurobiology, and the processing and representation of pain, was effective for improving anxiety symptoms in musculoskeletal disorders [33]. Therefore, postoperative psychological support and neuroscience education in addition to the usual perioperative care may be effective for reducing anxiety symptoms of TKA patients at discharge.

The current study found that the most negative impact on postoperative PROs was the severity of anxiety symptoms about gait. The second most important negative impact was about pain. Compared with anxiety symptoms about gait and pain, the severity of anxiety symptoms about wounds and falling had a relatively smaller impact on the postoperative PROs regardless of the same levels of severity of anxiety symptoms. Most of PROs after TKA, including the KSS used in this study, involve more elements of gait and pain than wounds and falling, and gait and pain are important factors for patients after TKA [15,34,35]. Consequently, the PROs at six months after TKA more strongly reflected anxiety symptoms about gait and pain than were seen for wounds and falling at discharge. Therefore, it is predicted that it will be effective for reducing anxiety symptoms about gait and pain at discharge in order to improve PROs after TKA.

A previous cohort study reported that patients who had undergone TKA demonstrated a decline in self-efficacy for gait with the decline in functional ability [36]. Patients demonstrated a significant decline in functional ability at discharge after TKA, and this decline may have resulted in anxiety symptoms about gait in the present study [6]. In addition, patients experienced severe pain in the acute phase after TKA [37]. A prospective cohort study showed that joint pain resulted in anxiety and that severe pain in the acute phase may have contributed to symptoms of anxiety about pain [38]. Thus, the improvement of the decline in functional ability and acute pain management may contribute to reducing anxiety symptoms about gait and pain at discharge. The decline in functional ability and acute pain are significant issues and a lot of studies have addressed these challenges (e.g., early initiation of postoperative rehabilitation provided safer gait at an earlier stage of recovery) [39,40]; transcutaneous electrical nerve stimulation significantly reduced the patients' subjective rating of pain at discharge [41]; and neuromuscular electrical stimulation improved the torque of quadriceps and decreased fatigue [42]. Therefore, clinicians should also attempt to prevent decline in functional ability and severe acute pain after TKA through these approaches to reduce symptoms of anxiety about gait and pain at discharge, and improve functional recovery after discharge.

Several limitations of this study should be acknowledged. First, it assessed disease-specific anxiety symptoms using NRS. Although the NRS has been a validated and reliable instrument for assessing anxiety symptoms, it could not investigate the validity and reliability of the NRS for disease-specific questions. Further studies should be performed to establish validity and reliability of this method. Second, although it adjusted the measured confounding factors in the analysis, unmeasured confounding factors such as pre-operative other psychological factors, including pain catastrophizing, could still be present. Finally, it investigated patients' anxiety symptoms at discharge five days postoperatively. Although the average length of hospital stay following TKA is currently about four to six days [3–5], there is the trend towards early hospital discharge and many previous studies have reported a few

days of length of hospital stay after TKA [27,28]; thus, the results of this study may not be applicable for early hospital discharge and future study should examine disease-specific anxiety at early hospital discharge.

In summary, the current study investigated disease-specific anxiety symptoms at discharge after TKA and examined the association between disease-specific anxiety symptoms at discharge and PROs at six months after TKA. A similar severity of anxiety symptoms with respect to wounds, pain, gait, and falling was reported by the patients at discharge after TKA. Additionally, the severity of anxiety symptoms at discharge showed a negative association with PROs at six months postoperatively. Future studies should assess the impact of psychological interventions on disease-specific anxiety at discharge and postoperative PROs after TKA.

Declarations of interest

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