Clinical and Experimental Health Sciences

Predictors of 30-Day Re-hospitalization After Total Hip and Total Knee Arthroplasty: A Orthopedic Ward Perspective

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ABSTRACT

Objective: The study was aimed to elucidate risk factors identifiable from ward-derived data of thirty-day re-hospitalization among patients undergoing total hip and total knee arthroplasty.

Methods: The study was designed as a cross-sectional and prospective study. The data of the study were collected through the Patient Sociodemographic Form, the Nurse Physical Assessment and Observation Form, the Charlson Comorbidity Index (CCI), and the Katz Activities of Daily Living (ADL) Scale.

Results: Patients were scored using this CCI system and grouped as high (high CCI group >2, n = 49) and low CCI (low CCI group ≤2, n = 78) with a cut-off score of 2. The 30-day re-hospitalization rate was 14.2%, and the most common reason for re-hospitalization was a surgical infection. Surgical risk, Activities of daily living dependency, and comorbidities index scores of the patients were not significantly additive effects on re-hospitalization (p> 0.05). The results indicate that surgical infection was often the cause of higher rates of re-hospitalization among patients with total knee and total hip arthroplasty.

Conclusions: Orthopedic nurses should close observation of surgical site infection and design an effective discharge following-up order to the prevention of re-hospitalization in patients with"high risk".

Keywords: Re-hospitalization, rates, causes, knee, hip, arthroplasty.

1. INTRODUCTION

Hip and knee arthroplasty surgery has been one of the most frequently required orthopedic surgery procedures in recent years. Epidemiologic analyses indicate that total hip arthroplasty rates increased by 30% between 2000 and 2015, while knee arthroplasty almost doubled (1). Total hip and total knee arthroplasty are most often implemented in patients in old age; patients with cardiovascular diseases and chronic liver diseases have a higher incidence of post-surgical complications (2). Comorbidities are defined as diseases or medical conditions which do not relate causally to the primary diagnosis but coexist with it. Elderly patients generally have more comorbidities but the effects of comorbidities on the results of arthroplasty need to be further studied (3). In a medical environment, classifying comorbidities using value-based metrics can help improve pre-surgical counseling, decrease potential complications and allow for perioperative resources to be properly assigned. Orthopedists commonly use the American Society of Anesthesiologists' physical status classification (ASA-PSC) or the Charlson Comorbidity Index (CCI) (4). The CCI is also utilized as a predictor for postoperative adverse cases, revision surgery, and re-hospitalization in post-operative arthroplasty (5).

Re-hospitalization rates increase in the first 30 days after surgery, indicating that the risk of re-hospitalization in the early postoperative stage is highest (6). Re-hospitalization forms a great part of health costs. The re-hospitalization of a patient within a month of discharge is a serious problem for the healthcare system (7). The 30-day re-hospitalization rate reported in orthopedic surgery alone is around 2-14% (8), and it has been predicted that 12% will be re-hospitalized for potentially preventable causes (7). According to a systematic review and meta-analysis study, the reasons for the 30-day rehospitalization of orthopedic patients include three categories: In the Wound related category; surgical site infection (32.2%), non-infected wound (14%), cellulitis (9%), seroma (6.5%), and hematoma (4.2%), in the Surgical category; fixation failure (9.4%), pain (7.7%) and dural tear (4.1%), and in the Medical category; medical complication

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(26.4%), deep vein thrombosis (DVT) (3.5%) (8). Reducing unscheduled re-hospitalizations significantly improves the quality of health care and lowers costs. Some healthcare systems thus use re-hospitalization rates as a quality criterion to calculate health service payments (8).

Also, osteoarthritis or hip fracture severely restrain an individual's ability to perform daily life activities, so patients with joint disorders are the most likely to need help from unofficial caregivers while waiting for surgery or after surgery (9). In the period following arthroplasty, it should not be forgotten that the "inability to cope" in the home environment can be an important factor leading to re-hospitalization and that the patient is physically restricted and at risk of comorbidity after an early discharge (10).

In clinical practice, nurse assessment tools can consistently produce data about a person's potential health status. Value-based nurse assessment tools translate organic misery and signs of risk into an understandable language (11). Such tools are one of the chief ways of understanding patients to better provide high-quality patient care. Family members may not always be present at a patient's bedside to offer help. However, nurses continuously evaluate their patients and they endeavor to understand and interpret their needs from different perspectives. The nurses who work at a hospital and the assessment tools they routinely use are the best sources of information about a patient. Those nurses who know the patient best, and who have all the available data from patient follow-ups, play a vital role when it comes to detecting the factors affecting 30-day unscheduled re-hospitalization (12). In re-hospitalization, various social and medical factors, such as the patient's age, the severity of the disease, functionality, and comorbidities, are critical (3). However, there are too few studies specifying the variables that may affect re-hospitalization rates among patients who have had arthroplasty. These studies mainly focus on the effects of the patients' demographic and clinical characteristics, the surgical procedure, and the comorbidity index score on re-hospitalization (7,13). There is too little information about the relationship of nurses' follow-up data or daily life activity to re-hospitalization (14). Consequently, the current study included as variables the nurse assessment tools (pain, pressure sore, risk of fall, system examination criterion), comorbidity risk index (ASA, CCI), and the patients' daily activity levels, in addition to predictive variables like age, surgical procedure, lengthy hospitalization. It sought to provide a broader perspective concerning the 30-day re-hospitalization of the patients who had total hip arthroplasty and total knee arthroplasty. The aim was to analyze the effects of the clinical condition and comorbidity risk levels of patients who had had hip and knee arthroplasty on ADL 30-day unscheduled re-hospitalization.

2. METHODS

2.1. Participants

The study was conducted in a 500-bed urban hospital with a 20-bed orthopedics and traumatology clinic, whose staff consisted of 12 nurses, seven orthopedics and traumatology specialists, and ten junior doctors. A descriptive prospective design was used to analyze the patient-related factors affecting the 30-day unscheduled re-hospitalization of patients who had had total hip arthroplasty and total knee arthroplasty. Inclusion criteria: (a) patients aged 20 and above; (b) indication of elective primary total knee and hip arthroplasty; (c) patients who did not have a communication problem (speech, hearing, foreign language); (d) volunteering for the research. Exclusion criteria: (a) patients aged under 20; (b) who had not had total hip and knee arthroplasty; (c) patients who did not volunteer to participate; (d) patients with who it was not possible to communicate. The universe of this study consisted of 307 patients aged 18 years and over and who underwent total hip or knee replacement surgery in the orthopedics and traumatology clinic between June 2019 and January 2020. The cluster sampling method was used in this study. The sample size was determined using the simple sampling method (15). To determine the sample size of the research, the suggested formula for quantitative research (n=N.s2.Zα2 /[(N-1). d2+s2. Zα2) was used (16). Accordingly, the standard deviation was taken to be s=1, and the significance level as 0.05 (95% confidence level), the corresponding theoretical value Z0.05=1.96, and influence quantity giving a sampling error of d=0.15. According to the formula, the sample size was calculated as 113. During the study, a total of 180 patients who did not suitable for the criteria of the study, were excluded from the study. Considering that the number of questionnaires returned may be low due to incomplete, inaccurate, or low-suitability questionnaires, a total of 127 patients were included. There was no data loss because all of 127 patients voluntarily in the research.

2.2. Data Collection Tools

The data of the patients were obtained through the Patient Introduction Form, the Nurse Physical Assessment and Observation Form, the Charlson Comorbidity Index (CCI), and the Katz Activities of Daily Living Scale.

Patient Introduction Form: This form includes 10 questions about patients' data (5) and their hospitalization-related data in the orthopedic ward where they were the length of stay (5). 30-day re-hospitalization data were obtained through the hospital information system and by telephone by the orthopedic nurse researchers.

Nurse Physical Assessment and Observation Form: This is a form routinely used by the nurses to monitor the inpatients' medical records and follow-ups. It includes a history of the patient, a nurse physical examination form, vital signs, Visual Analog Scale (VAS), Braden Risk Assessment Scale, and ITAKI

fall risk scores, as well as observation notes. We collected patient's clinical data from these forms. In this study, the Numeric Rating Scale of VAS was used as a measurement method for the intensity of pain. The patients were asked to mark their pain levels on a horizontal line with a 0-10 scale (0= "no pain" and 10= "worst possible pain") (17). The Braden Risk Assessment Scale is composed of six dimensions that reflect sensory perception, skin moisture, activity, mobility, friction and shear, and nutritional status. Braden risk scores of 12 or less are defined to be at high risk of pressure ulcers development, those with a score between 13-14 are defined to be at moderate risk and those with a score between 15-16 are defined to be at low risk. The validity and safety study for this scale was made by Oguz in Turkey and the reliability and the validity of the scales were found to be quite high (18). The ITAKI Fall Risk Scale consists of a total of 19 risk factors that may cause patient falls. Two risk levels, low and high, were determined over the total score obtained as a result of the evaluation of risk factors. If the total score is below five, the risk of falling is considered low, and if it is five or more, the risk of falling is considered high (19).

Charlson Comorbidities Index: The CCI was developed in a New York hospital in 1987 as a measurement of one-year mortality risk and a load of disease. It involves 19 medical diagnoses and the index is scored from 1 to 6 points. In clinical practice, a single numerical score is given to the medical diagnoses included in the CCI. Comorbidities are given points from 1 to 6 for the mortality risk and severity of the disease. These scores are added up to obtain the total index score. One point is added for the age of 40 and every ten years above 40. The lowest score obtainable is "0" and the highest is "37". As the score increases, so does the predicted mortality rate increases (20).

ASA Physical Condition Classification System: This is an assessment system in which the patient is preoperatively classified and the medical comorbidities of a patient before anesthesia are evaluated. The classification system alone does not predict perioperative risks. Determining the ASA level is a clinical decision based on multiple factors. The physical condition can be classified at various times during the patient's pre-surgical evaluation, but the final evaluation is done by an anesthetist on the day of anesthesia (21).

Katz ADL: The Katz ADL Scale scores six activities (bathing, dressing, toilet, movement, excretion, nutrition). The validity and reliability studies of the Turkish version of the scale were conducted by Pehlivanoğlu et al. in 2018. Every activity on the Katz ADL Scale includes three options: dependent (1 point), semi-dependent (2 points), and independent (3 points). In the Katz ADL index, scores of 0-6 are evaluated as the patient being dependent, 7-12 as the patient being semi-dependent, and scores of 13-18 as the patient being independent (22). The Cronbach's alpha for the Turkish version of the KATZ ADL scale was found to be 0.83 (22). In the present study, Cronbach's alpha for the Turkish version of KATZ was found to be 0.87.

2.3. Procedure

The data was obtained by the researcher through face-to-face meetings with the patients. The researcher met each patient on the day of hospitalization and the day of discharge. On the first day of hospitalization, the patient's vital signs, Braden Pressure Ulcer Risk Tool, ITAKI Fall Risk Tool, VAS, CCI, ASA, and Katz ADL evaluations were conducted by the researcher. Finally, the researcher met the patients on the day of discharge and recorded again the patient's vital signs, Braden Pressure Ulcer Risk Tool, ITAKI Fall Risk Tool, VAS and ASA follow-ups.

2.4. Data Analysis

The data were analyzed using the Statistical Package for Social Sciences program (SPSS-22). Numbers, percentages, arithmetic means, and standard deviation was used for the analysis. To compare the variables, non-parametric Chi-square tests, and Univariate Logistic Regression, and Pearson Correlation and Multicollinearity Regression Analysis were applied. The statistical significance of the alpha level was accepted as $p < 0.05$.

2.5. Ethical Considerations

After approval had been obtained from the Clinical Trials Ethics Committee (date: 05.07.2019 and no: 2019/245), the descriptive and prospective data of patients who had had elective total hip or knee arthroplasty were collected between June 2019 and January 2020. The institutions to which each writer belonged approved the human protocol for this research and all the research was conducted according to ethical principles. The patients were informed about the study and were obtained written and verbal consent.

3. RESULTS

The mean age of the patients was 63.35 (SD=9.67). Most of the total hip and knee arthroplasty patients were women. 14.2% of the patients were re-hospitalized within 30 days. The most frequent reason for unscheduled re-hospitalization was surgical infection (Table 1).

3.1. Patients' CCI, ASA, Katz ADL, and Nurse Follow-up Assessments

Almost all of the patients (91.6%) had medium systemic disorders according to the ASA classification. The ADL levels of 58.3% of the patients were "semi-dependent". According to the patients' CCI scores, 61.4% had a one-year mortality risk score of ≤2; 38.6% had a score of>2, and the mean CKI score was 2.59±2.411 (Table 1).

The vital signs and risk scores (including the nurse follow-ups) for the patients' hospitalization and discharge days are given in Table 2. The VAS mean scores of the patients were 1.09±1.211 during hospitalization and 1.06±1.194 during discharge. The

ASA mean scores were 1.06±1.194 during hospitalization and discharge. According to the Braden Risk Assessment Scale, risk mean scores were respectively 21.023±1.887during hospitalization and 21±1.881 during discharge. The ITAKI fall risk mean scores were 8.692±2.961duringhospitalization and 9.189±2.402 during discharge.

3.2. Predictors Affecting Re-hospitalization

According to the sociodemographic characteristics of the patients, there was no significant difference at the p<0.001 significance level (Table 3). In Table 4, the Exp (β) values show ODDS rates. The ODDS rates show how many times more or how many times less the probability arises of observing two events studied alongside one another. When the β coefficients for the independent variables are negative, the ODDS rate as Exp (β) is interpreted as decreasing by considering the negative relationship. According to this, 16.2% were women and the Total Knee Arthroplasty (TKA) was 38.4%. As the Braden risk and ASA scores decrease, this also contributed to re-hospitalization but this was not statistically significant (p>0.05).

Table 1. *Patients' sociodemographic and clinical characteristics (n=127)*

Variables		Number (n)	Percent (%)
Gender	Female	101	79.5
	Male	26	20.5
Length of stay (day) (Mean±SD)	9.34±7.92	Min:3 Max: 65	
Age (years) (Mean±SD)	65.35±9.679	Min:24 Max: 82	
Age group (years)	≤50	11	8.7
	51-60	22	17.3
	61-70	51	40.2
	≥71	43	33.8
Level of education	Illiterate	34	26.8
	Primary	79	62.2
	Secondary	6	4.7
	Higher Education	8	6.3
Caregiver	Partner	23	18.1
	Daughter	51	40.2
	Son	16	12.6
	Relative	37	29.1
Prosthesis type	Total Hip Arthroplasty	26	20.5
	Total Knee Arthroplasty	101	79.5
30-day rehospitalization	Yes	18	14.2
	No	109	85.8
Rehospitalization clinic	Orthopedic and traumatology	11	61.1
	Physical therapy and rehabilitation	6	33.3
	Neurology	1	5.6
Causes of rehospitalization	Surgical infection	9	50.0
	Physiotheraphy	6	33.3
	Change in consciousness	1	5.5
	Dislocation	2	11.1
ASA classification	ASA 1	12	9.4
	ASA 2	77	60.2
	ASA 3	38	30.4
Katz ADL	Dependent	2	1.5
	Partially dependent	74	58.3
	Independent	51	40.2
Katz ADL (Mean±SD)	12.606±3.21	Min:3	Max:18
CCI	≤2 (equal to the one-year relative risk)	78	61.4
	>2 (higher to Relative risk 2 times)	49	38.6
CCI (Mean±SD) 2.59±2.411		Min:0	Max:19

ASA: American Society of Anesthesiologists; Katz ADL: Activities of Daily Living; CCI: The Charlson comorbidity index; SD: Standart Deviation

Table 2. *Clinical data of patients*

Variables	Hospitalization day		Day of discharge	
Vital signs	Mean±SD	Min – Max	Mean±SD	Min – Max
Pulse	83.78 ± 12.453	56 – 130	83.464±7.985	62-102
Body temperature (°C)	36.349 ± 0.247	36 – 37	36.440±0.240	36-36.9
Systolic blood pressure (mmHg)	119.763±11.715	100 – 160	119.527±7.648	100-140
Diastolic blood pressure (mmHg)	72.440±9.147	60 – 90	73.464±8.579	60-90
SPO_2	92.866±2.917	89 – 98	93.362±1.858	90-98
VAS	1.09±1.211	0-6	1.060±1.194	0-6
ASA classifications	2.20±0.618	0-3	2.200±0.618	0-3
Braden Pressure Ulcer Risk Tool	21.023±1.887	16-23	21.000±1.881	16-23
Itaki Fall Risk Tool	8.692±2.961	1-15	9.189±2.402	6-15

SPO2: Oxygen saturation; VAS: Visual Analogue Scale; ASA: American Society of Anesthesiologists; SD: Standart Deviation

Table 3. *Individual data of the patients with bivariate relationships to 30-day rehospitalization (yes/no)*

		30-day re-hospitalization			
		Yes n(%)	No n(%)	X^2;	p
Gender	Female	14 (11.0)	87 (68.5)	0.843;	0.528
	Male	4 (3.1)	22 (17.4)		
Age (year)	≤60	3 (2.4)	30 (23.6)	0.947;	0.331
	≥61	15 (11.8)	79 (62.2)		
BMI (kg/m^2)	≤24,9	1(0.8)	8(6.2)	0.075;	0.626
	≥25	17(13.4)	101(79.6)		
Prosthesis type	Total Hip Arthroplasty	16 (12.6)	85 (66.9)	1.129;	0.235
	Total Knee Arthroplasty	2 (1.6)	24 (18.9)		

BMI: Body Mass Index; CCI: The Charlson comorbidity index X2: Chi-Square test; p<0.001

Table 4. *Logistic regression analysis of some clinical data about patient-related conditions and 30-day rehospitalization*

							95% C.I. EXP (βp)	
	β	Standard error	Wald	df	p	Exp(β)	Alt	Üst
Constant	5.95	6.68	0.781	1	0.377	366.870		
Age group	-0.048	0.044	1.218	1	0.270	1.04	0.874	1.038
Female	0.162	0.702	0.053	1	0.818	1.175	0.297	4.648
TKA	0.384	0.264	2.123	1	0.145	1.468	0.876	2.462
Katz ADL	-0.057	0.107	0.289	1	0.591	1.051	0.766	1.164
CCI	0.055	0.162	0.116	1	0.734	1.057	0.770	1.450
Braden risk score	-0.127	0.182	0.487	1	0.485	1.135	0.617	1.258
ITAKI Fall risk score	0.076	0.105	0.522	1	0.470	1.079	0.878	1.327
ASA mean score	-0.591	0.589	1.009	1	0.315	1.805	0.175	1.755

TKA: Total Knee Arthroplasty; Katz ADL: Activities of Daily Living; CCI: Charloson Comorbid Indeks; ASA: American Society of Anesthesiologists

4. DISCUSSION

This study aimed to analyze the effects of the social and medical conditions of patients who had had total knee and hip arthroplasty on re-hospitalization; the results of the study are here discussed in the light of the relevant literature.

4.1. Sociodemographic Characteristics of the Patients

In a meta-analysis, it was emphasized that osteoarthritis generally affects the knees and that it shows an increasing incidence with age, especially in women (3). In the literature, the variable mean age for arthroplasty was found to be 66.5 ± 6.2 (3). The mean ages of the patients who had had surgery and who were observed in this study were similar to those in other studies, including international populations.

4.2. Re-hospitalization of Patients and Potential Predictors

In the literature, it is observed that the re-hospitalization rates of the patients vary depending on the patient profile and the specialty of the service provided. 30-day re-hospitalization rates in orthopedics alone are around 2-14% and the most common reason is surgical site infection (8,23-26). In a meta-analysis conducted by Kurtz et al. (2016) it was found that the 30-day re-hospitalization rate in the patients who had had total hip arthroplasty varied between 0% and 22% (median: 4.9%). In the current study, the 30-day re-hospitalization rates of the patients who had had arthroplasty were found to be close to the highest level. The reason for the high rate of re-hospitalization in the first 30 days after the surgical procedure: it may be an indication that patients are not ready for discharge, do not fully understand the instructions and directions for discharge or receive inadequate post-operative discharge training (6). The most common reason for re-hospitalization was surgical site infection, in line with the literature (7,8,13), which shows that focus should be placed on the training and follow-up of this patient group. To determine the increasing cost of the hospitalization of patients who have had total hip and knee arthroplasty, it is important to evaluate the rates of re-hospitalization, when that occurs, and the reasons for it. Taking measures against the most common reasons for re-hospitalization can be effective in reducing the cost (26). Hospital nurses should develop new strategies for educating patients who have had arthroplasty.

The ASA classification is commonly used in orthopedics studies. This classification divides patients into subgroups according to the severity of the associated diseases (21). In this study, most of the patients had systemic diseases according to these classifications. It was thought that knowing the ASA score would be beneficial in determining the connection between re-hospitalization. Patients with high ASA scores were expected to have serious comorbidities and high needs in the postoperative period. However, the ASA classification was not found to be related to re-hospitalization. In analyzing the ODDS rates, it was found that women who had poor scores in the ASA classification and for Braden risk were more likely to be re-hospitalized.

The study evaluated the comorbidity index scores of the patients who had had hip and joint arthroplasty. The patients were graded with the CCI system and were divided into groups: high CCI group > 2, n = 49; low CCI group ≤2, n = 78. The CCI mean score was 2.59±2.411. The findings of the study are compatible with the findings of previous studies (4,27). The findings also showed that there was no correlation between the age and gender of the patient, prosthesis site, comorbidity index, Katz ADL, Braden risk score, and fall risk score and re-hospitalization. Nevertheless, in the analysis of the ODDS rates, it was found that the women patients with pressure ulcers risk according to the Braden score had a high risk of re-hospitalization. Although this information has minimal value prospectively in managing re-hospitalization, we can prospectively conclude that a patient with pressure ulcers risk according to the Braden score will likely be more intensive re-hospitalization either from high infection risk or a long stay. This is particularly significant for re-hospitalization in patients of total hip and knee arthroplasty are age, gender, hypertension, obesity, and the characteristics of the hospital. As Braden Score includes an assessment of chronic comorbidities, and poor baseline in the patients with pressure ulcers risk according to the Braden score could account for all of these associations. According to the nurse follow-ups during the hospitalization and discharge of the patients, there was no significant change in the medical characteristics of patients and this was not correlated with re-hospitalization. In similar studies, it was observed that the age and gender of patients who had arthroplasty were not related to re-hospitalization (28). In contrast, in some studies, the age of the patient, the preoperative body mass index, the ASA 3 classification, the number of comorbidities, and the duration of hospitalization were defined as predictors of re-hospitalization in the patients who had had total knee arthroplasty (29,30). The evidence for risk factors for 30-day re-hospitalization in total hip and knee arthroplasty patients shows inconsistencies for some sociodemographic factors such as age, gender, and ASA classification, which includes the comorbidity burden.

Strengths and Limitations

Some limitations should be taken into consideration when discussing the effect of the independent variables on re-hospitalization. The reliability of the results is limited to the answers of the patients. The other limitation is the prospective collection of data during a short period of research in one university hospital in one region. The results cannot, therefore, be generalized, although they can provide an idea of how similar patient groups might function. The error rate of the data based on criteria within independent variables seems to be acceptably low. More than one criterion was used, so it can be thought that almost all the aspects of each patient were reached.

5. CONCLUSION

The 30-day re-hospitalization rate was high after hip and knee arthroplasty. Re-hospitalization often occurred due to surgical site infections. Surgeons and nurses should thus focus on educating and following up with this patient group. The assessment tools used in this study, including the CCI, the ASA, and the ADL, were found not beneficial as predictors of adverse cases related to re-hospitalization or surgical site infection.

We also suggest that the CCI, ASA, ADL be used to identify "high-risk" patients because each of these tools relates to a specific aspect of a patient's health condition. While the ASA and CCI provide a limited picture of each patient's risk (4), the goal of this study was to form a complete image by using additional risk assessment tools. It was found that surgical site infection was the main cause of the 30-day re-hospitalization of patients who had arthroplasty. Close observation of surgical site infection is thus of vital importance to prevent re-hospitalization. Identifying "high-risk" patients using value-based metrics can help to decrease the incidence of re-hospitalization. Patients and family caregivers should be seen as part of the rehabilitation process and they should be given training on infections, dislocation, mobilization, exercise.

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Conflict of Interest

The authors declare no potential conflict of interest.

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