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Predictors of an increased length of stay following Total Knee Arthroplasty — Survey Report

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Abstract

Objective: To find various preoperative, intraoperative and postoperative factors that predict an increased length of stay in patients following total knee arthroplasty.

Methods: The retrospective cohort study was conducted at the Aga Khan University Hospital, Karachi, and comprised record of patients regardless of gender, co-morbids and age who had undergone a unilateral or bilateral total knee arthroplasty between January 2007 and December 2015. An increased length of stay was defined as ≥75th centile (≥11 days).

Results: Of the 577 patients, 448(77.6%) were women. Overall, 311(53.9%) patients were aged 56-70 years. Of the total, 100(17.3%) patients stayed for at least 11 days. There was a weak but positive correlation between increasing body mass index and increased length of stay (p=0.017). Following adjusted-multivariate logistic regression analysis, the most significant predictors contributing to an increased length of stay were bilateral knee surgery, postoperative transfusion and postoperative special care unit stay (p<0.05 each).

Conclusion: Bilateral total knee arthroplasty, postoperative transfusion and postoperative special care unit stay were found to be associated with an increased length of stay.

Keywords: Length of stay, Total knee arthroplasty, Predictors, LOS, TKA. (JPMA 69: 1159; 2019)

Introduction

Total Knee Arthroplasty (TKA) is currently regarded as the most effective treatment for osteoarthritis. There is an increasing number of knees being replaced every year not only in the United States but also worldwide.[1] Because of the economic burden of TKAs, there has been a push towards finding cost-effective strategies to reduce the financial burden on both hospitals and patients alike.[2] In the US alone, total knee replacements (TKR) cost insurance providers several billion dollars per year. In developing and developed countries alike, there has also been an inclination towards the implementation of fast track surgical procedures which intend to bring about cost effectiveness. Previous studies have shown that length of stay (LOS) is an important factor contributing to the increasing cost. Various patient and surgeon-based predictors have been identified that contribute significantly to an increased LOS such as age,[3-5] body mass index (BMI)(5), co-morbids,[4,6] gender,[6] preoperative haemoglobin (Hb) level and the need for postoperative transfusion.[3,5] Although this has been the subject of several studies, the results have been contradictory.

The current study was planned to look at various preoperative, intraoperative and postoperative factors that significantly contribute to increased LOS in patients undergoing TKA.

Materials and Methods

The retrospective cohort study was conducted at the Aga Khan University Hospital (AKUH), Karachi, and comprised record of patients regardless of gender, co-morbids and age who had undergone a unilateral or bilateral TKA between January 2007 and December 2015. After approval from the institutional ethics review committee, records for all TKAs done within the time period were accessed. Patients who had undergone a revision TKA were excluded and so were those with missing data.

Medical records were reviewed and a proforma was used to note down demographic data, including age, gender, co-morbids, American Society of Anesthesiologists (ASA) grade, and clinical data, including type of surgery, total operative time from incision to skin closure, total tourniquet time, the need for postoperative transfusion, LOS from admission to discharge, postoperative special care unit (SCU) stay, preoperative/postoperative Hb and haematocrit and postoperative complications. Nadler's formula was used to calculate the estimated blood volume of a person.[7] Intraoperative blood loss was calculated using the Gross formula, which has been previously used for calculating blood loss in total hip

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arthroplasties.[8] SCUs are in-patient nurse-led units for the management of the chronically and critically ill. These are distinct from intensive care units (ICUs) and are usually managed by a team of nurses and a pulmonologist.

The LOS data was skewed when tested with both Kolmogrov-Smirnov and Shapiro-Wilk tests. As such, non-parametric tests were used accordingly for data analysis. Dichotomous categorised data was analysed using Mann-Whitney U test. Data that was categorised into 3 or more groups, such as age, ASA grade, total operative time, total tourniquet time, and estimated blood loss, was analysed using Kruskal Wallis Test. Spearman's correlation coefficient was also done to assess correlations between significant variables in univariate analysis.

LOS was dichotomised into two categories based on the skewed data. A high LOS was defined as greater than or equal to 11 days (75th centile). Further comparison was carried out between categoriszed variables and dichotomised LOS and significant predictors contributing to an LOS of more than 11 days were identified using Pearson chi-square test. Multivariate logistic regression analysis was carried out between significant predictors to identify the most important predictors that contributed to increased LOS while adjusting for confounders.

Results

Of the 577 patients, 448(77.6%) were women. Overall, 311(53.9%) patients were aged 56-70 years. There was a weak but positive correlation between BMI and LOS (p=0.017). Both preoperative and postoperative Hb levels were found to have a significant negative correlation with LOS (p=0.003 each). A weak but significant correlation was also found between increasing ASA grades and LOS (p=0.03) (Table-1). Simultaneous bilateral TKA was associated with a significantly higher median LOS (and it was also a significant predictor of LOS >11 days (p<0.05). There was a positive significant correlation between operative time and LOS (p<0.001) and increased total operative time was significant independent predictor for LOS >11 days (p<0.05). Other significant independent predictors included postoperative SCU stay, postoperative transfusion need, complications during stay and urinary tract infection (UTI) (Table-2).

Multivariate logistic regression done on all the significant independent predictors suggested only the type of surgery, postoperative SCU stay and the need for postoperative transfusion as being significant (Table-3).

Table-1: Comparison of Variables using Mann-Whitney[1] and Kruskal Wallis[2] test.

Variables	Number (n=577)	Median LOS (days) with IQR	(P - Value)
Age			
0-55	154(26.7%)	8.0 (7-10)	0.846[2]
56-70	311(53.9%)	8.0 (7-10)	
71+	112(19.4%)	8.0 (7-10)	
Gender			
Male	129(22.4)	8.0 (7-10)	0.396[1]
Female	448 (77.6%)	8.0 (7-10)	
Co-morbid			
Diabetes Mellitus	165(28.6%)	9.0 (7-10)	0.037
Hypertension	337(58.4%)	8.0 (7-10)	0.915
COPD/Asthma	32(5.5%)	9.0 (7.25-10)	0.237
Hyperthyroidism	5(0.9%)	8.0 (7-12)	0.977
Hypothyroidism	53(5.5%)	9.0 (7-11)	0.158
Dyslipidaemia	21(3.6%)	9.0	0.558
CKD	16(2.8%)	9.0 (8-12)	0.035
BMI			
<24.9	76 (13.1%)	8.0 (7-9)	0.021[2]
25-29.9	179 (31.0%)	8.0 (7-9)	
30-34.9	199 (34.5%)	8.0 (7-10)	
>35	123 (21.3%)	9.0 (8-10)	
Type of Surgery			
Unilateral	255(44.2%)	7.0 (6-9)	<0.001[1]
Bilateral	321(55.6%)	9.0 (8-10)	
ASA			
I	30(5.2%)	8.0 (6.75-9)	0.072[2]
II	416(72.1%)	8.0 (7-10)	
III	130(22.5%)	9.0 (7-11)	
IV	1(0.17%)	8.0	
Operative Time (min)			
0-160	217(37.6%)	8.0 (7-9)	<0.001[2]
160-260	223(38.6%)	9.0 (7-10)	
>260	137(23.7%)	9.0 (8-10)	
Estimated Blood Loss (ml)			
0-500	192(33.3%)	8.0 (7-10)	0.212[2]
500-800	176(30.5%)	8.0 (7-9)	
>800	209(36.2%)	9.0 (7-10)	
Pre-Operative Hb (gm/dl)			
<12	230(39.9%)	9.0 (7-10)	0.009[1]
>12	347(60.1%)	8.0 (7-10)	
Post-Operative Hb(gm/dl)			
<12	509(88.2%)	8.0 (7-10)	0.013[1]
>12	68(11.8%)	8.0 (7-10)	
Post-Operative SCU (days)			
Yes	25(4.3%)	9.0 (8-13)	0.006[1]
No	552(95.7%)	8.0 (7-10)	
Post-Operative Transfusion Need			
Yes	105(18.2%)	10.0 (8-12)	<0.001[1]
No	472(81.8%)	8.0 (7-9)	
Complications During Stay (UTI, SSI, DVT and Cardiac)			
Yes	89 (15.4%)	9.0 (8-12)	0.001[1]
No	488 (84.6%)	8.0 (7-9)	

LOS: Length of stay; UTI: Urinary tract infection; SSI: Surgical site infection; DVT: Deep venous thrombosis; SCU: Special care unit; Hb: Haemoglobin; BMI: Body mass index; COPD: Chronic Obstructive Pulmonary Disease; CKD: Chronic kidney disease; ASA: American Society of Anaesthesiologists.

Table-2: Univariate Comparison using Chi-Square between variables in those staying at least 11 days.

Variables	Number of with LOS >=11 days (n=100)	(P-Value)
Age (years)		
0-55	27(17.5%)	0.992
56-70	54(17.4%)	
71+	19(17.0%)	
Gender		
Male	75 (16.7%)	0.485
Female	25 (19.4%)	
Co-morbid		
Diabetes Mellitus	28(17.0%)	0.885
Hypertension	57(16.9%)	0.754
COPD/Asthma	7(21.9%)	0.485
Hyperthyroidism	1(20%)	0.874
Hypothyroidism	9(28.1%)	0.097
Dyslipidaemia	3 (14.3%)	0.707
CKD	5 (31.2%)	0.136
BMI		
<24.9	12(15.8%)	0.570
25-29.9	27(15.1%)	
30-34.9	35(17.6%)	
>35	26 (21.1%)	
Type of Surgery		
Unilateral	23(9.0%)	0.000*
Bilateral	77(24.0%)	
ASA		
I	2(6.7%)	0.013*
II	64(15.4%)	
III	34(26.2%)	
IV	0	
Operative Time (min)		
0-160	24(11.1%)	0.007*
160-260	45(20.2%)	
>260	31(22.6%)	
Estimated Blood Loss		
0-500	32(16.7%)	0.520
500-800	27(15.3%)	
>800	41(19.6%)	
Pre-Operative Hb		
<12	49(21.3%)	0.04*
>12	51(14.7%)	
Post-Operative Hb		
<12	94 (18.5%)	0.048*
>12	6(8.8%)	
Post-Operative SCU		
Yes	11(44.0%)	0.000*
No	89(16.1%)	
Post-Operative Transfusion Need		
Yes	44(41.9%)	<0.001*
No	56(11.9%)	
Complications During Stay		
Yes	28(31.5%)	<0.001*
No	72(14.8%)	
UTI		
Yes	6(46.2%)	0.005*
No	94(16.7%)	

LOS: Length of stay; UTI: Urinary tract infection; SSI: Surgical site infection; DVT: Deep venous thrombosis; SCU: Special care unit; Hb: Haemoglobin; BMI: Body mass index; COPD: Chronic Obstructive Pulmonary Disease; CKD: Chronic kidney disease; ASA: American Society of Anaesthesiologists.

Table-3: Multivariate Logistic Regression Analysis carried out among significant predictor variables.

Variables	Adjusted Odds Ratio [CI - 95%]	P-value
Type of Surgery	2.425 [1.39, 4.20]	0.002
Post-Operative Special Care Unit(SCU) stay	2.789 [1.10, 7.05]	0.030
Post-Operative Transfusion	3.492 [2.04, 5.99]	<0.001

CI: Confidence interval.

Discussion

In our study, the only significant variables contributing to an increased LOS after multivariate analysis were the type of surgery, postoperative SCU stay and the need for postoperative transfusion. Though increasing BMI, higher ASA grades, preoprative Hb<12, postoperative Hb<12, complications during stay and UTI were found to be significantly associated with a higher LOS, the significance was lost after multivariate analysis.

Our findings were similar to previous studies showing that bilateral TKA is associated with a longer LOS compared to those who underwent a unilateral TKA.[9-12] Bilateral TKA is associated with bilateral soft tissue trauma at the knee and results in more pain and therefore a longer time to ambulation. However, conflicting evidence still remains with multiple studies showing that there is no significant difference in LOS between the two groups.[13-15] It is possible that there is a marked difference present between clinical care pathways in various countries, which could account for the difference in postoperative care and findings. Studies done evaluating LOS worldwide have shown that there is marked discrepancy between the average LOS worldwide due to a difference in clinical care and rehabilitation protocol.[16-18] Moreover, in our part of the world with a predominant pay for service and low health insurance rates, there are no rehabilitation facilities for these patients. Therefore these patients are discharged once they become functional and can independently take care of themselves with respect to mobility and activities of daily living.

Previous studies have shown that postoperative blood transfusion is associated with increased LOS.[5,19,20] It has been suggested that identifications of risk factors of allogenic transfusion and minimising the use of allogenic transfusion will significantly alter LOS. Monsef et al. showed that allogenic blood transfusion and the number of units transfused had a significant impact on increasing LOS. Similar to our findings, the study also showed that preoperative Hb levels had a negative correlation with LOS.[21] Autologous blood transfusion has been suggested as an alternative to allogenic blood transfusion in anaemic patients.[22]

We found postoperative SCU stay to be associated with greater LOS. A previous study done in Canada showed that a significant percentage of patients who spent at least some time in the SCU had LOS more than twice as long as those who did not stay in the SCU.[23] Minimising the SCU time by identifying risk factors responsible for an increased stay would be beneficial in reducing the total LOS overall. Our study did not assess any major intraoperative risks and postoperative risk factors that contributed to an overall increased SCU stay.

Total operative time was significant univariate predictor of increased LOS but after multivariate analysis it did not remain significant. The most likely reason would be that in both cases, type of surgery played an important confounding role. Similarly, even though past researches have indicated an increased ASA grade associated with higher LOS,[24] we found no association between higher ASA grades (3/4) with longer LOS. A very recent study comparing increasing BMI levels and LOS showed that higher BMI had a dose response effect on LOS.[25] Similarly, Jonas et al. showed that ASA grade, BMI and age were significant factors contributing to an increased LOS.[5] Our study, however, did not show any significant association between these factors and increased LOS.

This was a retrospective cohort study, and, as is the case with all such studies, there is a possibility of uncontrolled confounding factors playing a role. There was no detailed patient data on monthly financial income, marital status etc. that could have been included in the analysis. In addition, no data was gathered on the number of days spent in post-anaesthesia care unit (PACU) or SCU in order to further determine whether a specific number of days contributed to increased LOS. Also, no data was gathered with respect to how much blood was transfused and on which postoperative day. Previous researches have shown that both of these have a significant contribution to increased LOS. Our research is based on findings from a single tertiary care hospital in Pakistan. Though the hospital is one of the major referral centres of the country, the results cannot be generalised due to differences in preoperative and postoperative care in various regions and health facilities. As such, there is a need for a prospective study to identify further factors contributing to LOS.

Conclusion

Bilateral TKA, postoperative transfusion and postoperative SCU stay were found to be associated with

increased LOS. Identification of risk factors of postoperative allogenic transfusion and SCU stay will be useful in identifying patients who will stay longer.

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Conflict of Interest: None.

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