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A Study on Blood Transfusion, Postoperative Pain and Length of Hospital Stay in Staggered Total Knee Replacement: A Retrospective Analysis on 120 Patients.

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Abstract

BACKGROUND: Total Knee Arthroplasty (TKA) is one of the most successful orthopaedic surgical procedures which improves the quality of life of patients who experiences knee joint dysfunction (due to degenerative and other joint disorders) ,by alleviating pain and restoring knee joint function .Since degenerative disease (osteoarthritis) tops the list there is an affection of both the knees, and thereby requires bilateral TKA. In this context staggered total knee replacement is getting popularized, wherein both knees are replaced in a few days' interval under two anaesthesia, in a single hospital admission. Normal TKA is associated with blood loss and high transfusion rates as per literature, but very few studies on staggered knee replacement regarding same .This study aims to estimate blood transfusion rate in staggered TKA (between first knee and second knee) and if found significantly higher ,we can derive a selective criteria on patients to undergo staggered knee replacement, which reduces the blood transfusion rate and hence the complications associated with blood transfusion can be minimized. Moreover, postoperative pain, immediate postoperative rehabilitation time and length of hospital stay is another major concern in staggered knee arthroplasty. In this study we also address the same, wherein if there is significant increase in postoperative pain, rehabilitation time or length of hospital stay between two surgeries, a patient selection protocol can be derived, so as to have a better functional outcome and reduced economic burden on patient. **Materials and methods:** The approval was obtained from the hospital's ethics committee and a **Retrospective** analysis was conducted on data gathered from the medical files ,EMR (Electronic medical registry and database),and operation theatre records of all patients who underwent Staggered TKA, performed from January 2015 to January 2017 in **Dept. of Orthopedics, Azeezia Medical College and Hospital, Meeyannoor, Kollam. 120 consecutive patients (240 knees)** fulfilled the inclusion criteria of bilateral osteoarthritis and rheumatoid arthritis, while patients requiring revisions and complex procedures such as stem extensions, augments and semi or fully constrained systems were excluded from this study. The patient's data was categorized based on gender, age diagnosis, preoperative and postoperative hemoglobin levels of first and second knee, hemoglobin drop, number of blood

transfusion required after each knee surgery. Also, the post-operative pain difference between the first and second knee on DAY 1 and DAY 3 was assessed using VAS (visual analogue scale) score, along with total length of hospital stay and immediate postoperative rehabilitation time. The data obtained was entered into a study Performa and then entered into Microsoft Excel sheet for statistical analysis. Mean and Standard Deviation (SD) were calculated for continuous variables and percentages were calculated for categorical variables. Correlation coefficient (r) was used to find the correlation between two continuous variables. The chi square test was used to find the association between two categorical variables. t-test was used to compare the mean values of two continuous variables. **Results** Out of 120 patients 92 (77%) were female and 28 (23%) were male, and the mean age was 65.5years (range: 41–83). Diagnosis wise 8% were rheumatoid knees and 92% cases of osteoarthritis. The mean preoperative hemoglobin level of first knee is 11.57g/dl (range :8.4- 14.3 g/dl). The mean postoperative hemoglobin level of first knee is 10.48 g/dl (range: 7.3 - 13.7 g/dl) .The mean preoperative hemoglobin level of second knee is 10.11g/dl (range :7.9 - 12.9 g/dl). The mean postoperative hemoglobin level of second knee is 9.11 g/dl (range : 6.9 -12 g/dl). The average hemoglobin drop in the first knee was 1.09 g/dl, with a reduction of 9.4% of the preoperative hemoglobin, and that of the second knee was 1.00 g/dl, with a reduction of 9.9% of the preoperative hemoglobin, and was found to be statistically significant.

Conclusion To conclude in staggered total knee arthroplasty, the blood transfusion rate and postoperative pain is more after the second knee surgery compared to the first knee with an increase in immediate postoperative rehabilitation time and length of hospital stay. Also preoperative hemoglobin concentration is an important predictor of blood transfusion rate in our study. Hence appropriate patient selection should be implemented in staggered TKA to reduce the postoperative blood transfusion rate and to shorten the length of hospital stay and immediate postoperative rehabilitation time.

Keywords Staggered knees - blood transfusion - postoperative pain -knee.

Introduction

Total knee arthroplasty is one of the most commonly performed successful orthopaedic surgical procedures which will improve the quality of life of patients, especially of the ageing population who experiences knee joint dysfunction due to degenerative and other joint disorders. The number of TKAs being performed each year is increasing and is expected to reach 3.48 million by the year 2030.***[1]*** Degenerative disorders especially osteoarthritis tops the list with predilection of affection of both the knees, requiring bilateral total knee replacements. Investigators have reported that approximately 18.6% of the patients treated with TKA need a bilateral knee replacement. There is still a controversy regarding surgical strategy for dealing with patients who have severe bilateral knee arthritis. Bilateral total knee arthroplasty can be performed either –

- Simultaneously under the same anaesthesia (SINGLE STAGE BILATERAL).
- Staged under two anesthetics during one admission (STAGGERED) **[2]**
- Staged separately during two admissions (STAGGERED).

Even though TKA effectively improve joint function and quality of life, it is often associated with substantial blood loss and a high transfusion rate. National transfusion rates over the last 30 years have varied throughout the United

States increasing from 42 units per 1,000 patients in 1979 to 50 units per 1,000 patients in 2001 **[3-6]**.

Blood transfusion effectively corrects anemia, but increases the economic burden placed on patients. Also the risks associated with blood transfusion include infection viral [**7]** and bacterial [**8]**, immunologic responses**[8,9],** intravascular hemolysis[**8-11**], acute lung injury**[9,12**], transfusion-induced coagulopathy, and mis-transfusion[**13]** . Staggered total knee arthroplasty has been considered as an alternative choice to single stage bilateral total knee arthroplasty under the assumption that two episodes of surgical stress are tolerated better, when they are separated by several days compared to a few hours.

In Single stage BTKA, temporal summation of the 2 TKA associated responses may exceed the limited compensation capability, especially in elderly patients with chronic systemic diseases **[14]. One** of the causes of systemic compromise is coagulation dysfunction.

Bold et al observed that, in sequential BTKA, the second knee bled more than the first one. Hemodynamically unstable patients who do not timely receive blood transfusion are at risk for myocardial infarction and cerebrovascular accidents.

Another advantage of staggered TKA is that since most of the patients undergoing TKA are of the elderly age group, it also gives us an opportunity to stage the procedure after first knee surgery, if any systemic decompensation occurs in immediate postoperative period as compared to single stage BTKA. Blood management is also an important factor in terms of cost, which has increased between 1991 and 2008 and it accounts for approximately 2.5% of the overall allocation of hospital cost for primary Total knee arthroplasty **[30].** TKA patients receiving blood transfusions increase the total hospital admission cost by 10% to 20% and also 20-25% increase in length of stay at hospital**. [16,17,18]**. Minimizing blood loss and blood transfusions associated with TKA is critical to avoid unnecessary expense and complications. These will facilitate better outcomes during the early postoperative period, thus improving postoperative patient satisfaction. Postoperative pain is another important issue which all arthroplasty surgeons' encounters, and it hampers patient's postoperative knee function. Not only does it lead to patient's dissatisfaction with the treatment results, but also hinders their postoperative walking ability knee exercises, and increases their hospital stay and rehabilitation time.

There are benefits for the patient as well as the hospital and the society, with a decrease in the transfusion rate in arthroplasty surgery. With fewer transfusions, there will be a lower incidence of complications as infections and systemic complications and will also cause in shorter hospitalization as mentioned in the literature. A decrease in complications for the patient will further lead to more satisfied patients. Another forgotten aspect is the economic burden on blood transfusion. To order, store and transport blood is, an unnecessary economic burden for the hospital. So reduced transfusion rates will result in less expenses for the hospital too.

Aims and Objectives

1. To analyze the postoperative blood transfusion rate between the first and second knee surgery in staggered total knee replacement.

2. To assess the severity of postoperative pain in staggered total knee arthroplasty and its relation to immediate postoperative rehabilitation protocol and length of hospital stay.

Material and Methods

The approval was obtained from the hospital's ethics committee and a **Retrospective analysis** was conducted on data gathered from the medical files, EMR (Electronic medical registry and database), and operation theatre records of all patients who underwent Staggered

TKA, performed from January 2015 to January 2017 in **Dept. of Orthopedics, Azeezia Medical College and Hospital, Meeyannor, Kollam**

Inclusion Criteria

All patients of bilateral osteoarthritis and rheumatoid arthritis who underwent total knee arthroplasty.

Exclusion Criteria

Patient requiring complex procedures such as stem extensions, augments and semi or fully constrained systems and revision procedures.

120 consecutive patients (240 knees) who underwent staggered total knee replacement fulfilled the above criteria and were studied. All the patients were operated by the same surgeon, after identical preoperative preparation and preanesthetic evaluation. Spinal or epidural anaesthesia was used for most patients except for those who had contraindication for regional anaesthesia techniques or refused them. Antibiotic prophylaxis was given for all patients before skin incision.

Under tourniquet control, the conventional technique for total knee arthroplasty was followed, by means of a midline incision and medial parapatellar arthrotomy with eversion of patella. Cemented prosthesis was used for all patients.

After the pneumatic tourniquet had been released, hemostasis was performed and extraarticular drain was placed. Suturing was performed in layers, with full free knee movements made after closing each layer, and compressive dressings were given. Physiotherapy was started in a uniform fashion for all patients including continuous passive motion (CPM) instituted on the next day after surgery. Active knee bending and quadriceps exercises were also performed on the first postoperative day and continuing till discharge from hospital.

The aim is to achieve active flexion of at least 90°, complete extension and walking with full weight-bearing, with the help of a walking frame. Same analgesic protocol and thromboembolic prophylaxis was followed for all patients.

The patient's data was categorized based on gender, age. diagnosis, preoperative and postoperative DAY1 hemoglobin levels of first and second knee, number of blood transfusion required after each knee surgery. The post-operative pain difference between the first and second knee on DAY 1 and DAY 3 was assessed along with total length of hospital stay and immediate postoperative rehabilitation time. The data obtained was entered into a study Performa and then entered into Microsoft Excel sheet for further analysis.

Method of Scoring

Visual Analog Scale Scoring system was used

Statistical Analysis

Mean and Standard Deviation (SD) were calculated for continuous variables and percentages were calculated for categorical variables. Correlation coefficient (r) was used to find the correlation between two continuous variables. The chi square test was used to find the association between two categorical variables. t-test was used to compare the mean values of two continuous variables. Comparison between groups was made by the Nonparametric Mann - Whitney test. Early postoperative pain scores (VAS) between the both operations were compared using paired t-test, and difference in pain severity (ΔVAS) between the second and first knee in

different time intervals was compared using one-way analysis of variance (ANOVA) and followed post hoc test (LSD-t test) .A p value of <0.05 using a two-tailed test was taken as being of significance for all statistical tests. All data were analysed with a statistical software package (SPSS, version 16.0 for windows).

Results

Demographic Data

120 consecutive Staggered Total Knee Arthroplasty patients **(240 knees), satisfied** the inclusion and exclusion criteria and were included in this **retrospective study**, out of which **92 (77%) were females and 28 (23%) were males.**

Table.1 : Age Distribution

AGE	MALE	(%)	FEMALE	(%)
41 – 50	1	1%	5	6%
51 – 60	4	3%	17	21%
61 – 70	15	13%	50	63%
71 – 80	7	6%	18	23%
>80	1	1%	2	3%
Total	28		92	

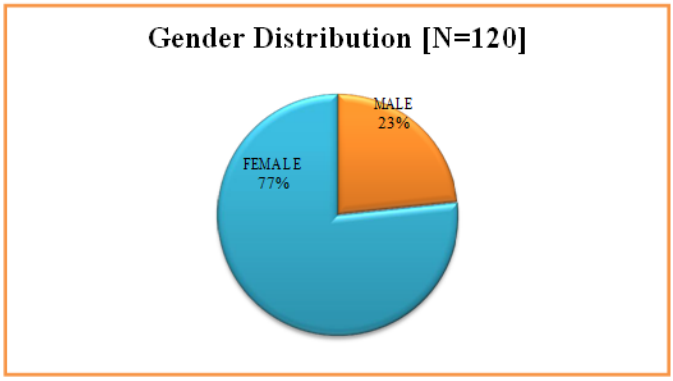

Fig 1: The mean age for males in study was 67.04 yrs (range 41-82 yrs) and that of females was 65.04yrs (range 42-83 yrs).

TABLE 2 Mean Age with Gender

AGE	Mean	SD	Std. Error	95% CI for Mean		Minimum	Maximum	Sig
				Lower	Upper			
MALE	67.04	8.54	1.614	63.72	70.35	41	82	
FEMALE	65.04	7.854	0.819	63.42	66.67	42	83	>0.05

Out of these there were 10 cases of rheumatoid arthritis knee, and 110 cases of osteoarthritis, which constitute 8% and 92% respectively of the patients who underwent staggered TKA**.**

Table.3: Diagnosis

	N	(%)
RHEUMATOID	10	8%
OSTEOARTHRITIS	110	92%

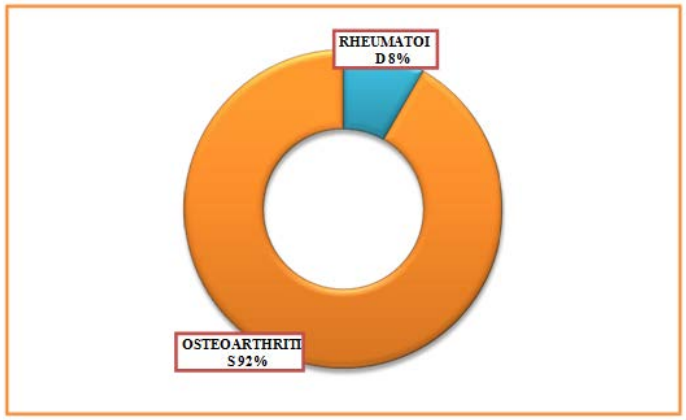

Fig 2: The preoperative hemoglobin levels and first postoperative day hemoglobin levels of first and second knee was analysed and compared, and the hemoglobin drop was estimated.

Table 4: Mean Hemoglobin Level Compared Pre & Post Surgery – 1 St Knee & 2 Nd Knee

		Mean	SD	SD	95% CI for Mean		Minimum	Maximum	p value
					Lower	Upper			
I ST KNEE	PRE	11.5758	1.29141	0.11789	11.3424	11.8093	8.4	14.3	<0.001
	POST	10.4825	1.30395	0.11903	10.2468	10.7182	7.3	13.7	
II ND KNEE	PRE	10.1075	1.05593	0.09639	9.9166	10.2984	7.9	12.9	<0.001
	POST	9.1075	1.06457	0.09718	8.9151	9.2999	6.9	12	

The mean preoperative hemoglobin level of first knee is 11.57g/dl (range: 8.4 -14.3 g/dl)

The mean postoperative hemoglobin level of first knee is 10.48 g/dl (range: 7.3 - 13.7 g/dl)

The mean preoperative hemoglobin level of second knee is10.11g/dl (range: 7.9 -12.9 g/dl) The mean postoperative hemoglobin level of second knee is 9.11 g/dl (range: 6.9 - 12 g/dl).

The average hemoglobin drop in the first knee was 1.09 g/dl, with a reduction of 9.4% of the preoperative hemoglobin, while that of the second knee was 1.00 g/dl, with a reduction of 9.9% of the preoperative hemoglobin, and was found to be statistically significant (p value<0.001) (Tab.5).

Table 5: Mean Pre Op Hb Compared With Transusfusion of 1st Knee & 2nd Knee

PRE OP HB	Transfusion	Mean	SD	SE	95% CI for Mean Lower	Upper	Minimum	Maximum	p value
I ST KNEE	YES	10.02	1.09	0.28	9.42	10.62	8.4	12	
	NO	11.80	1.16	0.11	11.57	12.02	8.8	14.3	<0.001
II ND KNEE	YES	9.43	0.74	0.11	9.22	9.65	7.9	11.7	
	NO	10.56	0.99	0.12	10.32	10.79	8.5	12.9	<0.001

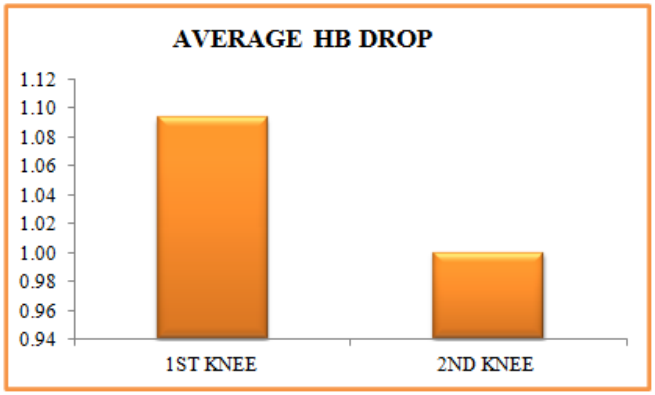

Fig 3: Average Hb Drop.

Blood transfusion was initiated in those patients who had post-operative hemoglobin levels below 8 g/dl or with symptoms of tissue hypoperfusion or hypotension. Based on that transfusion rates were analysed and compared between first and second knees and with the preoperative hemoglobin levels. Regarding the **first knee,** those patients who had a preoperative hemoglobin of **11.80 g/dl** and above did not require blood transfusion, while those with preoperative hemoglobin of **10.02 g/dl** or below required a blood transfusion, and the association between preoperative hemoglobin levels and blood transfusion rates was found to be statistically significant (p value<0.001).

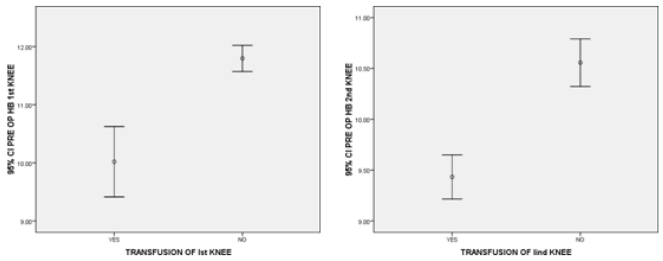

Fig 4: Prevalence of Blood Transfusion

Out of the 120 patients who underwent staggered TKA, 15 patients required blood transfusion after the **first knee** surgery, with a blood transfusion rate of **12.5%** and a total of 20 blood units were consumed, with a mean of 1.3 blood units per person. Whereas after the **second knee** surgery, 48 out of 120 patients required a blood transfusion, causing a steep rise in the blood transfusion rate to **40 %** and a total of 62 units of blood was consumed. (Fig.7), with a mean of 1.3 blood unit per person. Whereas the overall transfusion rate in staggered TKR was **26.25%.**

Table 6: Prevalence Of Blood Transfusion

	N(out of 120)	%	Blood units transfused
1ST KNEE	15	12.5%	20 Units
2ND KNEE	48	40.0%	62 Units

An analysis was also made between Gender and Age distribution with blood transfusion, 100% of the blood transfusion occurred in the females after the first knee surgery, and 85% of blood transfusion occurred in females after second knee surgery, but it was not statistically significant.

Table 7: Association of Gender With Blood Transfusion

Gender	Ist KNEE	EE (%)	IInd KNEE	E (%)
Male	0	0%	7	15%
Female	15	100%	41	85%
Total	15		48	

Similarly, there was no statistically significant correlation between age and blood transfusion rates, although most of

the blood transfusion for the first knee occurred in the age group of

(61.93 +/-9.6 SD) yrs, and for the second knee is(66.02+/-8.4 SD) yrs.

Pain Assessment: Post-operative pain on DAY1 and DAY3 was assessed for first and second knee, by using Visual Analogue Score. The patient was asked to mark a point on the Visual analogue scale corresponding to degree of pain in range of knee movement possible and the results were analysed. The VAS scoring of the first knee on Postoperative DAY1 was 4.41+/-1.18 and that of DAY 3 was 2.55 +/-0.95 while the VAS scoring of second knee was 5.95 +/-1.15 on DAY1 and 3.12+/-0.9 on DAY 3 respectively. The pain difference was estimated between first and second knee and was found that postoperative pain in the second knee was more compared to first knee even on postoperative DAY 1 and DAY3 and was found to be statistically significant with p value<0.001.

Length of the Hospital Stay: The average length of hospital stays in patients who underwent staggered total knee replacement was **15.07 days.** The mean time gap between the first and second knee surgery was **6.46 days**, which can be considered as immediate postoperative rehabilitation time of first knee, while the second knee rehabilitation time was calculated from second knee surgery to discharge (Rehab time) and was **8.55 days.**

A comparative analysis was done between the immediate postoperative rehabilitation time between first and second knee, and there was an increase in immediate postoperative rehabilitation time by 2.09 days after the second knee surgery, and it was found to be statistically significant (p value <0.001).

Results Summary

Statistically significant parameters.	P-value
Blood transfusion rate. Knee 1< Knee 2	<0.001
Blood transfusion and preoperative hemoglobin	<0.001
Post-operative pain Knee1< Knee2 VAS SCORE	<0.001
Immediate post op rehabilitation time Knee1 < Knee 2	<0.001
Length of hospital stay vs Blood transfusion	<0.05

Conclusion

To conclude in staggered total knee arthroplasty, the blood transfusion rate and postoperative pain is more after the second knee surgery compared to the first knee with an increase in immediate postoperative rehabilitation time and length of hospital stay. Also, preoperative hemoglobin concentration is an important predictor of blood transfusion rate in our study. Hence appropriate patient selection should be implemented in staggered TKA to reduce the postoperative blood transfusion rate and to shorten the length of hospital stay and immediate postoperative rehabilitation time.

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