COMPLICATIONS IN SIMULTANEOUS BILATERAL TOTAL KNEE ARTHROPLASTY, IS IT A SAFE PROCEDURE?

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ABSTRACT

Background

There is controversy regarding various aspects of simultaneous bilateral total knee replacement (SBTKR). We found disparity in the postoperative outcomes and complications associated with the procedure in the literature linked with the topic.

Objective

To retrospectively analyze the need for blood transfusion after surgery and complications associated with total knee replacement according to the type of procedure (SBTKR or unilateral).

Methods

Retrospective cohort analytical study. We included 251 patients with severe knee osteoarthritis that were divided into two groups. 124 (49%) who underwent SBTKR and 127 upon whom unilateral total knee replacement (UTKR) was performed. Demographic data, days of hospitalization, complications within the first 90 days after surgery (thromboembolic events, superficial and deep infection, stiffness, death); and percentages of patients transfused with blood products during hospitalization were evaluated.

Results

There were no statistical differences in the analysis of postoperative complications in the first 90 days after surgery. In the SBTKR group, 8 patients (6.5%) presented some thromboembolic complication during the postoperative period, while this event was observed in only 2 patients (1.5%) from the other group. The analysis showed a statistically significant drop in postoperative hemoglobin, on average that of 0.8 g/dl, in the SBTKR patient group compared to the UTKR group (95% CI 0.44-1.13; p<0.001). A higher proportion of patients who required transfusion were observed in the SBTKR group (40%) (OR=7.12; 95% CI 3.3 - 16; p<0.001).
We analyzed the cause of postoperative transfusion in the patients who required transfusion taking into account two parameters: hemoglobin less than 8 g/dl and the clinical needs of the patients (symptoms of hypotension, decay, difficulty to rehabilitate without pain, dyspnea). 59 patients received transfusion (50 in the SBTKR group and 9 in the other group). Of these, 19 patients (32.2%) did not meet any transfusion criteria.

Conclusion

We consider SBTKR a safe procedure, which does not increase postoperative complications compared to UTKR. Although there is an increase in blood loss in SBTKR, it does not generate clinical symptoms of relevance.

Level of evidence: Level III

Keywords: Simultaneous bilateral total knee replacement, complications, blood loss, blood transfusion.

Abbreviations: TKR: Total Knee Replacement; SBTKR: Simultaneous Bilateral Total Knee Replacement; UTKR: Unilateral Total Knee Replacement; BMI: Body Mass Index; DM: Diabetes Mellitus; RA: Rheumatoid Arthritis; DVT/PTE: Deep Venous Thrombosis / Pulmonary ThromboEmbolism.

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“What are the new findings”

We consider simultaneous bilateral total knee replacement a safe procedure, which does not increase postoperative complications compared to unilateral total knee replacement.
1. INTRODUCTION

Total knee replacement (TKR) continues to be the most effective treatment in the final stage of knee osteoarthritis. At present, simultaneous bilateral total knee replacement (SBTKR) is gaining a place as another treatment option in bilateral knee osteoarthritis.

From the beginning, this practice has been questioned for presenting worse postoperative pain management, greater exposure of the organs to perioperative injury, and greater blood loss.[1–3] In any case, in the last decade there has been an increase in the percentage of SBTKR as a consequence of better management of postoperative pain with the use of peripheral blocks and intra-articular anesthetic cocktail during surgery [4,5]; and, at the same time, the occurrence of intraoperative and postoperative bleeding has decreased with the use of tranexamic acid in perioperative prophylaxis.[6,7]

There is current literature that supports the performing of SBTKR, highlighting that there are no significant differences in the results and postoperative complications when compared with unilateral total knee replacement (UTKR) or bilateral total knee replacement in two surgical stages.[8] In 2013, Memtsoudis et al. published a consensus regarding the perioperative management of patients and the ideal candidates upon which to perform the SBTKR.[9] In addition to the presence of symptomatic osteoarthritis in both knees as an essential factor for performing the procedure, they present recommended exclusion criteria detailed in Figure N°1.

The objective of this work is to retrospectively analyze and compare complications in the first 90 postoperative days associated with total knee replacement, either simultaneous bilateral or unilateral; and also, analyze blood loss and the need for blood transfusion after surgery.

2. METHODS

Retrospective cohort analytical study. All patients operated on with SBTKR in the study period were included and compared with a random sample of patients who had undergone UTKR in the same study period to obtain a ratio between patients with SBTKR and patients with UTKR of 1. We select the patients for SBTKR following the recommendations in figure
N°1, except for a portion of ASA 3 patients (28 patients) and one ASA 4 patient who were very symptomatic in both knees.

2.1. Surgical Technique and Perioperative Care

All patients had a diagnosis of severe knee osteoarthritis. Patients who underwent a procedure associated with TKR (osteotomy, extensor mechanism reconstruction, osteosynthesis), partial knee replacement with unicompartmental prostheses or revision surgery were excluded. The patient flow chart is presented in Figure N° 2. All patients underwent a preoperative cardiac and anesthetic evaluation and were operated on by the same surgical team in the period from July 2014 to December 2018. An anterior approach to the knee was performed with a medial arthrotomy. Surgical cement was used for prosthetic fixation. A hemostatic cuff was not used in surgery except for 5 cases. All patients, without specific contraindication, received tranexamic acid as prophylaxis to control bleeding, using 1gr diluted in 100ml of physiological solution, administered in 10 minutes intravenously, thirty minutes prior to the incision and, after cementation of the final components, the second dose of 1gr diluted in 100ml of physiological solution was administered. Same dose of tranexamic acid in both groups.

The patients who underwent SBTKR had both knees included in the surgical field, starting with the second knee after closing the first. For postoperative pain management, combination treatment was performed between peripheral saphenous nerve block and an anesthetic cocktail of morphine diluted in 10cm$^3$ of physiological solution (only 8cm$^3$ was used), one ampoule of ropivacaine, epinephrine diluted in 10cm$^3$ of physiological solution (only 2cm$^3$ was used) and methylprednisolone also diluted in 10cm$^3$ of physiological solution (only 3cm$^3$ was used). 60 cm$^3$ are completed with physiological solution. The posterior capsule and both epicondyles are infiltrated. In patients undergoing SBTKR, a double cocktail is used but the dose of morphine and epinephrine is divided into the infiltrations for each knee. Until 2016, deep drains were used postoperatively.
All patients received a daily dose of low-molecular-weight heparin as antithrombotic prophylaxis beginning the day after surgery and for up to two weeks after surgery. In addition, the rehabilitation program started the day after surgery in all patients. A retrospective analysis of the patients was performed using the electronic medical records of our Institution. Demographic data, including age, sex, and body mass index (BMI), was evaluated. In addition, the date of surgery, surgical time, postoperative days of hospitalization, the American Society of Anesthesiologists (ASA) scale and the use or not of drainage in the operated knees were obtained. Comorbidities of each patient were evaluated, taking into account history of diabetes mellitus (DM), rheumatoid arthritis (RA), coronary heart disease, neurological disease, previous thromboembolic disease and use of oral anticoagulants. In both groups, postoperative complications presented within 90 days of surgery are described.

The complications evaluated are thromboembolic disease (deep venous thrombosis/pulmonary thromboembolism), superficial infection (need for surgical debridement but without removal of implants), deep infection (need for surgical debridement with removal of implants and placement of a cement spacer with antibiotics), postoperative stiffness (defined as the need for intervention for mobilization under anesthesia or open arthrolysis), acute heart attack and death due to causes related or not to surgery. In addition, an analysis of preoperative hemoglobin values was performed on the first and second days after surgery, along with the percentage of patients transfused with blood products during hospitalization and the number of units they received. Furthermore, the causes of transfusion in these patients were evaluated either due to a hemoglobin value less than 8 g/dl or due to clinical necessity (hypotension, dyspnea, decay), both defined in the hospital's clinical practice and transfusion medicine guidelines.

2.2. Statistical Analysis

The quantitative variables were reported as mean and standard deviation or median and interquartile range 25-75% according to the observed distribution, while the categorical
variables were done so as proportions, with the respective 95% confidence intervals for each of the estimators.

Comparisons between categorical variables were made using the chi-square test or the Fischer test where necessary. For comparisons between groups of continuous variables, the T-test or the Wilcoxon test were used according to distribution.

For the analysis of possible confounders, multivariate logistic regression was carried out, considering the percentage of transfused patients, the postoperative hemoglobin value and thromboembolic complications as result variables. A value of p <0.05 will be considered. The analysis was carried out with the statistical package Stata 13.0.

2.3. Ethical Considerations

This work was approved by the Ethics Committee for Research Protocols of the Hospital (CEPI). The study was carried out in full accordance with current national and international regulations: Declaration of Helsinki of the World Medical Association and the Standards of Good Clinical Practice ICH E6. Approved according to I.C.H regulations: IRB00010193.

All study data was treated with the utmost confidentiality, anonymously, with restricted access only for personnel authorized for the purposes of the study in accordance with current legal regulations (National Personal Data Protection Law 25,326 Habeas Data Law). The authors declare that they have no conflict of interest.

3. RESULTS

A total of 251 patients were included, of which 124 (49%) correspond to the SBTKR group. The distribution by sex in both groups was similar and the patients belonging to the SBTKR group were, on average, younger than those in the UTKR group. The rest of the demographic data is shown in Table N°1. The comorbidities found in patients are detailed in Table N°2.

Regarding complications, we registered only one patient in the SBTKR group (0.8%) and two in the UTKR group (1.5%) who presented superficial infections, while only one patient in the UTKR group had a deep infection (0.8%). Stiffness occurred in 3 patients (2.5%) in the
SBTKR group and only one patient (0.8%) in the UTKR group presented instability. There were no deaths at the 90-day follow-up in either group.

In the SBTKR group, 8 patients (6.5%) presented some thromboembolic complication during the postoperative period, while this event was observed in only 2 patients (1.5%) from the other group, regardless of age, BMI, or ASA of the patient (OR 4.5; 95% CI 0.91-22.5; p = 0.06).

In the analysis of hemoglobin values and pre and postoperative transfusion requirements, a drop in postoperative hemoglobin on the first day was observed of 0.8 g/dl, on average, in the SBTKR group compared to the other group (95% CI 0.44-1.13; p <0.001); and 1.03 g/dl on the second postoperative day (95% CI 0.69-1.37; p <0.001). Regarding postoperative transfusions, patients in the SBTKR group required transfusion in a higher proportion (40%) than those in the other group (9%), (OR = 7.12; 95% CI 3.3-16; p <0.001). (Table N°3)

A multivariate analysis was carried out using logistic regression considering age, BMI, ASA, and the use of drainage as possible confounders. We did not find an increase in the percentage of transfusion associated with age, BMI, and ASA scale but when adjusting the OR with the use of drainage, an increase in value was recorded (OR = 8.55; 95% CI 3.4-14.7; p<0.0001) (Table N°4). Table N°5 shows the analysis of the number of units of blood products used in patients who received transfusion, with a statistically significant difference in the SBTKR group.

Finally, the cause of postoperative transfusion of the patients who received transfusion was analyzed taking into account two parameters: hemoglobin less than 8 g/dl and the clinical needs of the patients (symptoms of hypotension, decay, difficulty to rehabilitate without pain, dyspnea). 59 patients received transfusion (50 in the SBTKR group and 9 in the other group). Of these, 19 patients (32.2%) did not meet any transfusion criteria; 13 from the SBTKR group and 6 from the UTKR group. Although there are higher cases in the SBTKR group, this difference was not significant (p = 0.22).
4. DISCUSSION

Analyzing both groups, we can say that they are comparable populations with no significant differences in age, sex, BMI, ASA scale and comorbidities prior to surgery. In addition, they have the same preoperative hemoglobin value. Only a significant difference in favor of the UTKR group is observed in patients who use oral anticoagulants, which speaks to adequate preoperative assessment, associated with the recommended exclusion criteria previously detailed.[5] A longitudinal cohort study describes a significant decrease in major complications from 6.2% to 2.4% (p <0.001) and minor complications from 28.9% to 21.5% (p <0.001) when performing a preoperative optimal assessment.[10] The ASA scale is a useful indicator to demonstrate the preoperative health status of patients and the potential risks of morbidity and mortality after surgery.[11] In 2018, Cao reported that patients with an ASA scale greater than or equal to 3 have a higher risk of postoperative transfusion and described the importance of an adequate preoperative assessment with high Hb prior to surgery and the use of tranexamic acid as perioperative prophylaxis.[12] In our work, we highlight the percentage of patients operated on for SBTKR with an ASA greater than or equal to 3 (around 23%), with no increase in the complication rate or percentage of patients who required transfusion when used as a parameter in logistic regression and multivariate analysis.

Regarding complications at 90 days postoperatively, more thromboembolic events were found in the SBTKR group than in the UTKR group, a difference that is not statistically significant. No deaths were recorded in either group. These findings are compatible with different studies where we found no increase in morbidity and mortality associated with surgery.[8,13,14] On the contrary, in a retrospective cohort, 150,581 UTKR and 4,441 SBTKR were analyzed with a follow-up in the first 30 postoperative days. They observed a higher risk of developing DVT in the SBTKR group (OR 138 1.97, 95% CI: 1.64-2.37).[15] In the literature we can find works that compared groups of patients with SBTKR with groups that underwent stepped bilateral total knee replacement. Tsay et al. describe a statistically significant increase in terms of complications when compared with UTKR, but when
measuring the absolute risk, that is, compared with stepped bilateral TKR, the differences are minimal.[16] We did not find an increase in complications associated with age and the ASA scale value, which is also described by Vaishya et al. where they evaluate complications in patients older than 70 years and consider SBTKR viable and efficient.[14]

Regarding infections, our results showed one patient in the SBTKR group (0.8%) and two in the UTKR group (1.5%) who presented superficial infections, while only one patient in the UTKR group had a deep infection (0.8%). In a series of 11,445 SBTKR's and 23,715 UTKR's with a minimum year of follow-up, Meehan JP et al. obtained a clinically important reduction in the incidence of periprosthetic joint infection in the first group.[17] 3 episodes of stiffness were found in the SBTKR group but the patients were unable to complete the corresponding rehabilitation for different personal reasons.

In this study, we noted a statistically significant drop in postoperative hemoglobin in the SBTKR group of patients compared to the UTKR group, both on the first postoperative day 9.8g/dl (±1.5) and 10.6 (±1.2) respectively, as well as on the second day after surgery 9.33g/dl (±1.3) and 10.3 (±1). From a clinical point of view, this variation does not demonstrate differences in the patients. Regarding the percentage of patients who required postoperative transfusion, an increase was observed in patients who underwent SBTKR (OR = 7.1; 95% CI 3.5-14.5; p<0.000). When adjusting the OR value using logistic regression with the use of drainage, an increase in value was evidenced (OR = 8.55; 95% CI 3.4-14.7; p<0.0001). The latter translates into an increase in the percentage of transfusions associated with the use of drainage. The bibliography reports an increase in the percentage of blood transfusions in bilateral knee replacement.[12,13,18] A retrospective, multicenter study in Canada demonstrated similar values to our work. In a population of 238,373 patients a percentage of transfusions in the SBTKR group of 41% was found, versus 19% in that of the UTKR.[18] There is controversy about the risk factors for the patient that could be associated with a higher percentage of transfusion after surgery. Deep drainage is widely used in orthopedic surgery and helps prevent bruising, favoring early rehabilitation and better management of postoperative pain,[19] however, other authors describe it as
unnecessary. [20] There are studies that highlight a relationship between the use of deep drainage in the knee, a higher ASA scale, and the use of a hemostatic cuff as risk factors for a higher percentage of blood transfusion. [12] In our work we only found the use of drainage as a factor that could increase the percentage of patients who required transfusion. There are other ways of controlling blood loss in the postoperative period of TKR. [21] The use of tranexamic acid in the perioperative period has shown benefits in the control of postoperative bleeding. [22,23]

Evaluating the number of units of blood products used, a significant difference is observed in favor of the SBTKR group (p=0.005). In the analysis conducted, one of the patients with a complication as a result of thromboembolic disease had a prolonged hospitalization and received 10 units, which could suggest unreliable results. Yongjian et al, analyzed the number of milliliters transfused and also observed a significant difference in the SBTKR group (UTKR: 410.00 (±275.61) vs SBTKR: 815.63 (±447.85); p=<0.001)) [8]. When analyzing the cause of transfusion, we found a percentage of patients (32.2%) who did not present the criteria for transfusion, with more cases in the SBTKR group (13 vs 6). This difference is not statistically significant (p=0.22), so we can say that there was no preventive or biased indication as a result of SBTKR having been performed. This led us to search clinical records of patients to assess the indication in greater detail, without finding relevant data. This aforementioned analysis is used for daily practice in our hospital, thus reducing the number of transfusions without indication in order to avoid complications associated with the transfusion of blood products.

We are aware that our work has limitations. In the first place, as it is a retrospective cohort, the data obtained from the medical history is out of date and there may be confounding factors that have not been evaluated. On the other hand, blood loss was calculated with the fall in hemoglobin alone. Although analyzed on two different days, no other laboratory values were taken, such as the hematocrit value. In addition, a series treated in a single health center was analyzed, which may not apply to all institutions.
Based on the findings of this work, the authors consider SBTKR to be a safe procedure, which does not increase postoperative complications compared to UTKR and that the increase in blood loss after surgery, although greater, does not generate clinical symptoms of relevance.

5. TABLES AND FIGURES

Table N°1. Demographic data

<table>
<thead>
<tr>
<th></th>
<th>SBTKR (n=124)</th>
<th>UTKR (n=127)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female sex, n (%)</td>
<td>88 (71)</td>
<td>92 (72)</td>
<td>0,79</td>
</tr>
<tr>
<td>Age (years), mean (+ SD)</td>
<td>67,7 (8,2)</td>
<td>70,3 (9,5)</td>
<td>0,01</td>
</tr>
<tr>
<td>BMI, mean (+ SD)</td>
<td>31 (6)</td>
<td>31 (5)</td>
<td>0,38</td>
</tr>
<tr>
<td>Days of hospitalization, median (IR 25-75)</td>
<td>5 (4-6)</td>
<td>3 (3-5)</td>
<td>&lt;0,001</td>
</tr>
<tr>
<td>ASA scale, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1 (0,8)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>94 (76)</td>
<td>87 (69)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>28 (22)</td>
<td>40 (31)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1 (0,8)</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

SBTKR= Simultaneous Bilateral Total Knee Replacement; UTKR= Unilateral Total Knee Replacement; SD= Standard Deviation; BMI= Body Mass Index; IR= Interquartile Range.

Table N°2. Comorbidities analysis
### Table N°3. Pre and Postoperative Hemoglobin and Requirement for blood products according to type of surgery. Univariate Analysis.

<table>
<thead>
<tr>
<th>Comorbidities</th>
<th>SBTKR (n=124)</th>
<th>UTKR (n=127)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td>10 (8,06%)</td>
<td>14 (11,02)</td>
<td>0,42</td>
</tr>
<tr>
<td>RA</td>
<td>4 (3,23%)</td>
<td>4 (3,15%)</td>
<td>0,97</td>
</tr>
<tr>
<td>Previous DVT/PTE</td>
<td>2 (1,61%)</td>
<td>5 (3,94%)</td>
<td>0,26</td>
</tr>
<tr>
<td>Use of OAC</td>
<td>2 (1,61%)</td>
<td>9 (7,09%)</td>
<td>0,03</td>
</tr>
<tr>
<td>Coronary Heart Disease</td>
<td>7 (5,65%)</td>
<td>6 (4,72%)</td>
<td>0,74</td>
</tr>
<tr>
<td>Neurologic disease</td>
<td>3 (2,42)</td>
<td>3 (2,36)</td>
<td>0,97</td>
</tr>
</tbody>
</table>

DM= Diabetes Mellitus; RA=Rheumatoid Arthritis; DVT/PTE= Deep Venous Thrombosis / Pulmonary Thromboembolism; OAC= Oral Anticoagulants.

### Table N°4. Multivariate analysis of blood transfusion and presence of DVT/PTE

<table>
<thead>
<tr>
<th></th>
<th>OR (CI 95%)</th>
<th>p</th>
<th>Adjusted OR (CI 95%)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postoperative transfusion</td>
<td>7.1 (3.5-14.5)</td>
<td>&lt;0.000</td>
<td>8.55 (3.4-14.7)</td>
<td>&lt;0.000</td>
</tr>
<tr>
<td>DVT/PTE</td>
<td>4.3 (.9-20.9)</td>
<td>0.06</td>
<td>4.5 (0.91-22.5)</td>
<td>0.06</td>
</tr>
</tbody>
</table>

DVT/PTE=Deep Venous Thrombosis/ Pulmonary Thromboembolism; OR=Odds Ratio; CI= Confidence Interval. Adjusted OR: using logistic regression by age, BMI, use of drainage, and ASA>3.

### Table N°5. Number of units of blood products transfused

<table>
<thead>
<tr>
<th></th>
<th>SBTKR</th>
<th>UTKR</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units of blood products transfused, mean (+SD)</td>
<td>1.9 (+1.4)</td>
<td>0.9 (+0.8)</td>
<td>0.005</td>
</tr>
</tbody>
</table>

SD= Standard Deviation
Figure N°1. Recommended exclusion criteria for SBTKR

EXCLUSION CRITERIA FOR SBTKR

- Patients over 75 years old.
- ASA scale ≥ 3
- Active ischemic heart disease
- Decreased ventricular function (LVEF <50%)
- Moderate to severe lung disease
- Morbid Obesity (BMI >40 kg/m²)
- Renal failure (Creatinine >1.6 mg/dl)
- Chronic liver disease
- Poorly controlled Diabetes Mellitus
- Cerebrovascular disease (History of stroke)
- Vascular bypass or stent in lower limbs

Figure N°2. Flowchart of patients who underwent SBTKR.
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6. BIBLIOGRAPHY


Declaration of interests

☑ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐ The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: