Epidemiological and Clinical Profile of Patients Submitted to Total Knee Arthroplasty[*]

Perfil epidemiológico e clínico dos pacientes submetidos a artroplastia total do joelho

Fabrício Bolpato Loures[1,2]   Rogério Franco de Araújo Góes[1]   Caio Veloso Gusmão[1]

Rodrigo Sattamini Pires e Albuquerque[3]   Pedro José Labronici[3]

[1] Hospital Santa Teresa, Petrópolis, RJ, Brazil
[2] Universidade do Estado do Rio de Janeiro, Rio de Janeiro, RJ, Brazil
[3] Department of Orthopedics and Traumatology, Universidade Federal Fluminense, Niterói, RJ, Brazil

Address for correspondence Fabrício Bolpato Loures, PhD, Rua Dr. Nelson de Sá Earp, 111/901, Centro, Petrópolis, Rio de Janeiro, 25680-195, Brazil (e-mail: fbolpato@gmail.com).

Abstract

Objective To define the epidemiological profile and the associated comorbidities of patients submitted to total knee arthroplasty (TKA) in two reference hospitals.

Methods During the present cross-sectional observational study, 294 patients submitted to TKA were evaluated in 2 tertiary care hospitals. The diagnosis of self-reported comorbidities was collected by direct interview. The Functional Comorbidity Index (FCI) and the 5-Factor Modified Frailty Index (mFI-5) were calculated. The incidence of comorbidities and their relationship with the calculated indexes were evaluated.

Results Most of the patients in the sample were women ($p = 0.000$) between the seventh and eighth decades of life. Systemic arterial hypertension was the most common pathology, followed by obesity and diabetes mellitus. The FCI presented a direct relationship with females ($p = 0.038$) and obesity ($p < 0.001$). The mFI-5 was only associated to obesity ($p = 0.022$), demonstrating a higher chance of complications in this group.

Conclusion Patients undergoing TKA are essentially carriers of clinical comorbidities that can negatively influence functional results and compromise the safety of the procedure. The identification of risk factors can contribute to the safety and better selection of TKA candidates.

Keywords
► arthroplasty
► knee
► comorbidity
► epidemiology
► postoperative complications

[*] Study developed at the Knee Surgery Group, Hospital Santa Teresa, Petrópolis, RJ, Brazil.

Resumo

Objetivo   Definir o perfil epidemiológico e as comorbidades associadas dos pacientes submetidos a artroplastia total do joelho (ATJ) em dois hospitais de referência.

Materiais e Métodos   Durante o estudo observacional transversal, foram avaliados 294 pacientes submetidos a ATJ em 2 hospitais de atenção terciária. Coletou-se, por entrevista direta, o diagnóstico das comorbidades auto-relatadas. Foram calculados o índice de comorbidades funcionais (do inglês Functional Comorbidity Index, FCI) e o índice modificado de cinco fatores de fragilidade (do inglês 5-Factor Modified Frailty Index, mFI-5). Avaliaram-se a incidências das comorbidades e a relação destas com os índices calculados.

Resultados   A maioria dos pacientes da amostra eram mulheres ($p = 0,000$) entre a sétima e oitava décadas de vida. A hipertensão arterial sistêmica foi a patologia mais comum, seguida de obesidade e diabetes mellitus. O ICF apresentou uma relação direta com sexo feminino ($p = 0,038$) e a obesidade ($p < 0,001$). O IMFG-5 apresentou relação somente com a obesidade ($p = 0,022$), e demonstrou uma chance maior de complicações nesse grupo.

Conclusão   Os pacientes submetidos a ATJ são essencialmente portadores de comorbidades clínicas que podem influenciar negativamente os resultados funcionais e comprometer a segurança do procedimento. A identificação dos fatores de risco pode contribuir para a segurança e melhor seleção dos candidatos a ATJ.

Palavras-chave
► artroplastia
► joelho
► comorbidade
► epidemiologia
► complicações pós-operatórias

Introduction

Total knee arthroplasty (TKA) is the treatment option for patients with severe osteoarthritis (OA) refractory to conservative treatment. This surgery can improve pain by providing limb alignment and the return of mobility.[1] Most candidates for TKA are elderly patients with low physical demand and associated pathologies.[2]

Total knee arthroplasty is one of the most successful procedures of the last century.[3] More than 13 thousand procedures were performed in Brazil in 2019.[4,5] This number should grow exponentially, driven by the aging of the population, increased obesity,[6] and the greater demand of the elderly population for quality of life.[7] Although safe, this surgery is considered large, and it is susceptible to possible complications.[8] A significant portion of patients remain dissatisfied after surgery. For these reasons, an index that can predict the functional outcome and the possible candidates with the greatest chance of complications will be extremely useful.

Comorbidities are defined as diseases or medical conditions with no causal relationship with the main diagnosis, coexisting with the pathology of interest.[9] Complications are adverse events that occur during a disease, and are not part of this pathology, although they may result from it.[10] The vast majority of patients who are candidates for TKA have associated clinical diseases that can significantly contribute to a higher rate of peri- and postoperative complications.[11] In order to predict the functional result after TKA and the possible chance of complication, respectively, two practical and objective questionnaires can be used: the Functional Comorbidity Index (FCI)[10] and the 5-Factor Modified Frailty index (mFI-5).[11]

Brazil has a large deficit in the care for arthroplasty surgeries, which are complex and costly procedures.[7] Anticipating the possible factors that lead to complications and worse functional results can contribute to a greater control of expenses and better patient selection. To this end, it is essential to know the profile of the patients submitted to TKA and the incidences of associated pathologies, improving the quality of care and avoiding unfavorable results.

The aim of the present study is to define the epidemiological profile of patients submitted to TKA and their associated comorbidities in two reference hospitals for this procedure.

Materials and Methods

The present cross-sectional observational study was approved by the Ethics in Research Committees of the institutions involved. All procedures were performed in accordance with the ethical standards of the 1964 Declaration of Helsinki, with their subsequent changes or comparable ethical standards. Patients were recruited from two high-complexity hospitals (tertiary care) that references for the TKA procedure. The sample consisted of patients from several socioeconomic levels. The ethnicity was diverse, as is characteristic of the Brazilian population. Although the phenotypic manifestation of skin color has little relation to ancestry, this characteristic was documented by self-report.

The Informed Consent Form (ICF) was signed by all patients before their inclusion in the study. Data were collected between August 2012 and December 2016. A total of 294 patients were prospectively evaluated, 203 female and 91 male. Data on comorbidities were collected by direct interview, with self-reported diagnosis. After the documentation, the FCI[10] and the mFI-5 were calculated.[11] As defined in the preoperative

evaluation protocol, the patients were weighed and had their height measured wearing only underwear and an apron. After these measurements, body mass indexes were calculated, and a categorization was performed according to the parameters described by the World Health Organization (WHO). The radiographic OA degree was classified by the main author according to the criteria of the Ahlbäck classification modified by Keyes et al.[12]

The descriptive analysis of the data was based on graphs and on the calculation of descriptive statistics (proportions of interest, minimum, maximum, mean, median, and standard deviation). In the inferential analysis, statistical-significance tests were performed. Given the non-normality of the distributions of the variables FCI and mFI-5, a nonparametric approach was used. The Kruskall-Wallis nonparametric test was used to compare two independent groups, and the Mann-Whitney test was chosen for the comparison of more than two independent groups. The level of significance adopted was 5%. The association between two quantitative or ordinal variables was investigated by the Spearman order correlation coefficient. The significance of correlation coefficients was evaluated by the correlation coefficient test. The analyses were made using the Statistical Package for the Social Sciences (SPSS, IBM Corp., Armonk, NY, US) software, version 22.0, and the 2011 Microsoft Excel (Microsoft Corp., Redmond, WA, US) software.

Results

In total, 294 patients who met the inclusion criteria and agreed to participate in the study were submitted to TKA signing the ICF. The sample consisted of 203 (69%) female patients and 91 (31%) male patients, with a difference in the distribution in relation to gender ($p = 0.000$).

The age of the patients ranged from 40 to 86 years. The mean age was 69 years, 68.3 years for the male group and 69.4 years for the female group. There was no significant difference in the age group between the sexes ($p = 0.239$). Age statistics are shown in ►Table 1.

Most patients in the sample declared themselves white (72.7%), followed by brown (15.9%) and black (11.4%). The body mass index (BMI) of the patients ranged from 17.3 kg/m² to 44.1 kg/m², with an average of 30 kg/m², standard deviation of 4.9 kg/m², median of 29.7 kg/m², and normal distribution in both groups. Women were significantly heavier than men ($p = 0.017$), although there was no significant difference in the proportion of obese individuals ($p = 0.70$). Analyses of the BMI of the global sample and of the sample divided by groups are shown in ►Table 2.

Comorbidities were analyzed by gender and their distribution in the total sample. There was no difference between the genders in the distribution of pathologies, except for rheumatoid arthritis, which was more frequent in the female group ($p = 0.021$). The main statistics of the distribution of pathologies are shown in ►Table 3.

►Figure 1 illustrates the distribution of the most common pathologies in the total sample and their distribution by gender.

Table 1 Age statistics

Age (years)	Female	Male	Global
Average	69.4	68.3	69.0
Median	70.0	68.0	69.0
Standard deviation	7.5	7.9	7.6
Minimum	40.0	43.0	40.0
Maximum	86.0	82.0	86.0
Range	46.0	39.0	46.0
Coefficient of variation	0.11	0.12	0.11
Number of cases	203	91	294
p-value of the Kolmogorov-Smirnov test	0.053	0.044	0.002
p-value of the Shapiro-Wilk test	0.032	0.054	0.0011
p-value of the Mann-Whitney test	**0.293**		

Table 2 Distribution accordin g to body mass index

Weight Classification	Gender		
	Female	Male	Global
Low weight	1 (0.5%)	0	1 (0.3%)
Normal weight	30 (15%)	18 (20.2%)	48 (16.6%)
Overweight	65 (32.5%)	35 (39.3%)	100 (34.6%)
Obesity I	64 (32.0%)	29 (32.6%)	93 (32.2%)
Obesity II	32 (16%)	6 (6.7%)	38 (13.1%)
Obesity III	8 (4.0%)	1 (1.1%)	9 (3.1%)

Most of the sample was aged between 60 and 70 years, and the comorbidities were also more frequent among this age group, although there was no statistically significant difference regarding the FCI ($p = 0.221$) and mFI-5 ($p = 0.365$) among the age groups. The distribution of pathologies by age group is shown in ►Table 4.

The FCI presented a direct relationship with the female gender ($p = 0.038$) and with BMI ($p < 0.001$), but it was not related to age ($p = 0.221$), skin color ($p = 0.058$) or OA radiographic classification (Ahlbäck) ($p = 0.420$). The only variable that presented a significant correlation with the mFI-5 was BMI ($p = 0.022$), which was not related to gender ($p = 0.237$), age ($p = 0.365$), skin color ($p = 0.251$) or OA severity ($p = 0.874$).

Discussion

Total knee arthroplasty is one of the most performed surgeries in the world. In the United States, about 700 thousand TKAs are performed per year, reaching an average of 213.28 TKAs per 100 thousand inhabitants.[7] In Brazil, 13,210 TKAs were performed in 2019,[4,5] representing 6.29 TKAs/100 thousand inhabitants. In addition to the more restricted indications and the different population profile, the lack of

Table 3 Relative frequency of clinical comorbidities

Comorbidities	Incidence of comorbidity (%)			p-value of the test comparing the incidences in the female and male groups
	Female	Male	Global	
Systemic arterial hypertension	67.5	58.2	64.6	0.125*
Obesity	52.0	40.4	48.4	0.070*
Diabetes mellitus	14.8	14.3	14.6	0.912*
Rheumatoid arthritis	5.9	0.0	4.1	0.021**
Dyslipidemia	4.4	2.2	3.7	0.512**
Cardiopathy	3.0	3.3	3.1	1.000**
Hypothyroidism	3.9	0.0	2.7	0.062**
Asthma	2.0	0.0	1.4	0.315**
Chronic obstructive pulmonary disease	1.0	1.1	1.0	1.000**
Glaucoma	0.5	2.2	1.0	0.227**
Venous insufficiency	1.5	0.0	1.0	0.555**

Notes: *Chi-squared test; **Fisher exact test.
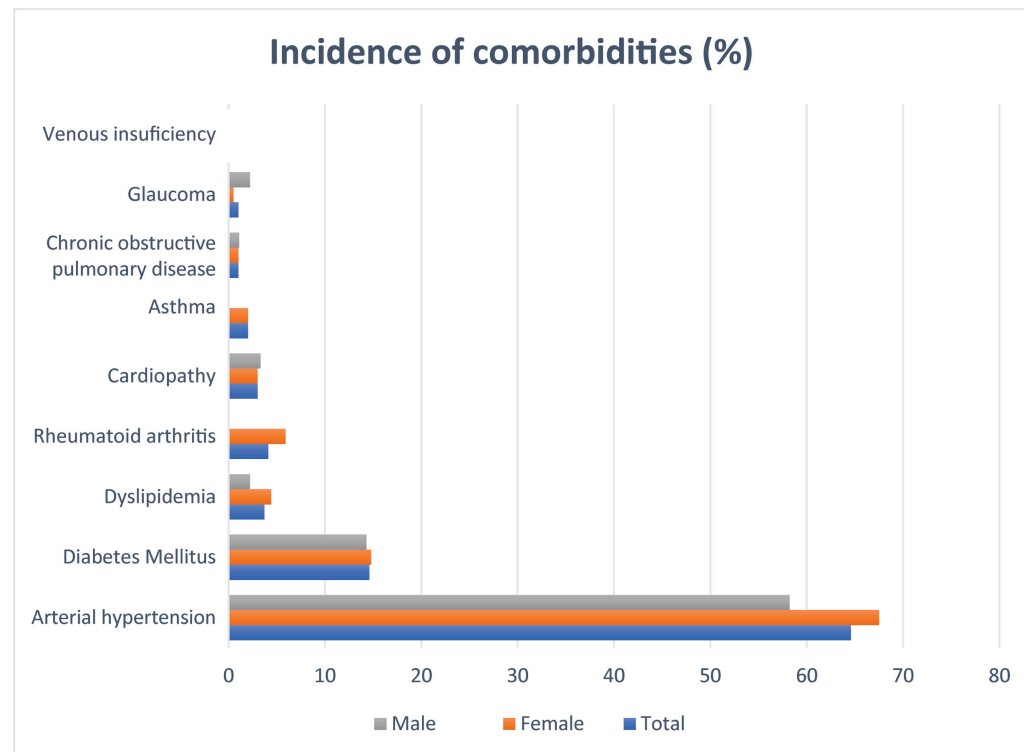
Fig. 1 Distribution of the most common pathologies in the total sample and their distribution by gender.

care and problems with the notification contribute to this large difference. There is an exponential increase, driven by population changes and greater access to health services, and it is important to direct resources to patients who will obtain greater benefits from the procedure.[13]

The sample consisted of a larger number of female patients, reflecting the incidence of OA, which affects two to three women for every man.[14] Although it is controversial in the literature, the satisfaction rate after TKA does not seem to diverge between men and women. Singh et al.,[15] after evaluating almost 18 thousand patients undergoing TA,

found in men the highest chance of infection (+31%), readmission in the first 30 days (+25%), revision in the first 5 years (+20%), and the highest mortality rate in the first year (+48%). Robinson et al.[16] studied 32,848 patients undergoing TKA, and concluded that female gender is a protective factor against sepsis and cardiovascular and oral complications, although it presents a higher risk of developing urinary infection, of needing blood transfusion, and of presenting difficulty supporting loads on the operated limb.

For the evaluation of the surgical results, it is important to know the epidemiological profile of the treated patients,

Table 4 Frequency of clinical comorbidities by age group

Age group/Comorbidities	41–50 years	51–60 years	61–70 years	71–80 years	> 80 years
Number	3	36	128	113	14
Systemic arterial hypertension	33.3%	56.6%	60.6%	69.9%	64.3%
Diabetes mellitus	–	16.7%	16.5%	20.4%	7.1%
Rheumatoid arthritis	33.3%	16.7%	0.8%	1.8%	7.1%
Dyslipidemia	–	2.8%	3.2%	4.4%	–
Cardiopathy	–	2.8%	3.1%	3.5%	–
Hypothyroidism	–	2.8%	3.1%	0.9%	7.1%
Asthma	–	0	0.8%	1.8%	–
Chronic obstructive pulmonary disease	–	2.8%	0.8%	0.9%	–
Glaucoma	–	–	–	2.7%	–
Venous insufficiency	–	–	0.8%	1.8%	–
Average Functional Comorbidity Index	1.7 ± 0.6	1.8 ± 0.6	1.8 ± 0.8	1.8 ± 0.8	1.6 ± 0.5
Median Functional Comorbidity Index	2.0	2.0	2.0	2.0	2.0
Average 5-Factor Modified Frailty Index	0.07 ± 0.12	0.16 ± 0.15	0.16 ± 0.14	0.19 ± 0.13	0.14 ± 0.12
Median 5-Factor Modified Frailty Index	0.00	0.20	0.20	0.20	0.20

because several clinical comorbidities can directly impact the outcome,[17] compromising metabolic demand, wound healing, and anesthesia administration.[18] Despite the benefits associated with TKA, up to 24% of the operated patients may face serious adverse events, and it is essential to consider who should undergo the procedure. The preoperative evaluation aims to clinically optimize the patients, minimizing their risks and facilitating their recovery.[19]

We used self-reported diagnoses as a tool to list comorbidities because they are an attractive method for chronic diseases. Najafi et al.[20] described this strategy as reliable and efficient, presenting some advantages over the analysis of the medical records, as it does not depend on the bias of the notifier. Furthermore, for administrative and contractual reasons, these pathologies may be omitted and underreported. All patients in our sample were treated by the Brazilian Unified Health System (Sistema Único de Saúde, SUS, in Portuguese), which is ideal for this type of study, because they did not suffer pressure from the insurer, and there was no influence regarding the omission of pathologies.

The most frequently found comorbidity was systemic arterial hypertension (SAH), which affected 64.9% of the sample. The highest incidence occurred in the eighth decade of life (69.9%). The prevalence of the disease was similar the in male and female groups ($p = 0.125$). This result is consistent with that described by Feng et al.,[21] who highlighted that SAH is the most common comorbidity in the orthopedic practice. The literature is scarce in studies on the possible influence of SAH on the outcome of patients undergoing TKA. Elmallah et al.[22] found worse functional results in hypertensive patients when compared to normotensive patients, although the improvement in pain was similar. Thus, SAH can negatively influence the functional outcome of surgery.

Dyslipidemia affected less than 5% of the patients, being also more frequent in the eighth decade of life. The use of statins should be continued, as there is evidence that this medication may cause a decrease both in the early mortality rate and in the chance of aseptic loosening of the prosthesis in the first ten years.[19]

Diabetes mellitus (DM) was present in 14.6% of the total sample, being higher in the eighth decade of life (20.4%). There was no difference between gender groups ($p = 0.912$). According to Flor and Campos,[23] the incidence in the Brazilian population older than 65 years of age is of 16.7%. The sample included patients below this age group, between 41 and 50 years old, who did not present DM and influenced the total mean. Diabetes mellitus is a pathology that interferes with wound healing, decreases osteoblastic activity, and impairs the immune system.[19] Diabetic patients have an increase in the rate of complications, such as periprosthetic infection (relative risk, RR: 1.6), deep venous thrombosis (RR: 2.57) and aseptic loosening (RR: 9.36).[24] Singh and Lewallen[25] evaluated 7,139 diabetic patients submitted to TKA, and concluded that DM is an independent risk factor for unfavorable results after surgery. Despite the higher number of complications and poorer functional outcomes, diabetic patients have a satisfaction rate similar to that of nondiabetic patients, and the procedure is able to generate other benefits, such as a reduction in BMI of 50% among those operated.[26] Attention should be given to preoperative glycemic levels, with the value of 200 mg/dL being the limit.[27]

The analysis of age revealed that 82% of the patients are between the seventh and eighth decades of life. These data reflect the stricter indications for this surgery in Latin patients. Although younger patients have a faster recovery and excellent functional results,[28] they have a lower satisfaction rate and a higher risk of revision. Life expectancy in

Brazil has increased exponentially, reaching 76.74 years for births in 2020. Projections indicate that by 2050 it will reach 81.29 years. Cher et al.[29] evaluated 209 octogenarians submitted to TKA and found excellent functional results, not differing from those of their younger peers. However, the authors point out that, alongside the improvement in quality of life, there is an increase in the cost to offer surgical treatment to increasingly elderly patients. Each year of age added increases the chance of rehospitalization and mortality.[30]

Obesity is a factor that is clearly involved in the genesis and progression of knee OA.[6] This fact was proven in our sample, in which only 16.9% of the patients were normotrophic, with the remainder being overweight or obese. Female patients were associated with higher BMIs ($p = 0.017$). Obesity is an independent risk factor for postoperative and perioperative complications, such as acute myocardial infarction, stroke, periprosthetic infection and need for revision,[19,21] in addition to the greater chance of rehospitalization and mortality.[30] Several institutions have restricted TKA in patients with BMI greater than $40 \, kg/m^2$ due to the higher cost and chance of unfavorable events.[21] Weight control should be encouraged for patients with BMI greater than $25 \, kg/m^2$, and bariatric surgery may be a pre-TKA resource for obese patients refractory to the conservative treatment. Traven et al.[11] created a protocol with five factors (mFI-5) capable of foreseeing the chance of complication after TKA. In the sample studied, obesity was the only factor directly related to mFI-5 ($p = 0.022$), proving the relationship of excess body weight and a worse prognosis.

Despite the success of TKA in restoring function and improving quality of life, up to 20% of patients may experience postoperative pain or dissatisfaction. Several authors have developed tools to predict the functional result. Groll et al.[10] developed the FCI. Unlike other indexes, which assess the time of hospitalization and the mortality rate, the FCI indicates the probable functional outcome of the patients, with 77% of efficacy. The authors included 18 pathologies in the questionnaire, which may be self-applicable. The questions include the evaluation of mental health and respiratory diseases, which are important factors related to the outcome of the TKA. The sample studied presented a worse functional prognosis for obese individuals ($p < 0.001$) and female patients ($p = 0.038$), which is consistent with the findings by Robinson et al.,[16] who described a greater difficulty of ambulation after surgery in female and obese patients.[16]

The present study has some limitations. Because it is a cross-sectional observational study, the patients did not have their outcome analyzed. However, we believe that the results meet the objective of defining the epidemiological profile of patients undergoing TKA. The instruments included, the FCI and the mFI-5, are interesting tools, but they are not able to establish a limit after which TKA should not be performed. Therefore, the participation of patients and family members in the decision-making process should be encouraged.

Conclusion

Patients undergoing TKA are essentially carriers of clinical comorbidities that can negatively influence the functional outcomes and increase the rate of surgery complications. The identification of risk factors contributes to the safety and better selection of candidates.

Conflict of Interests
The authors have no conflict of interests to declare.

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