



HIP and Knee Arthroplasty Deaths: Frequency and Causes

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Abstract

Introduction: Hip and knee arthroplasty are often accompanied by intraoperative and postoperative complications, and deaths after hip and knee arthroplasty are not uncommon.

Purpose. To analyze publications on the incidence and causes of death at different times after hip and knee replacement for osteoarthritis.

Materials and Methods: Literature data were searched in the PubMed and eLIBRARY open electronic scientific literature databases. The search was carried out by keywords and phrases: knee osteoarthritis; hip osteoarthritis; knee replacement, hip replacement, mortality. The search depth was 20 years.

Results: Most authors studying the incidence and causes of death after large joint arthroplasty use the following time-based periods: intraoperative mortality, death rates in the early postoperative period; 30 and 90 days after surgery, and 1, 5 and 10 years after joint replacement. Mortality rates, according to different researchers, range from 0.1-0.6% in the early postoperative period, reaching 25-26% 10 years after hip and knee arthroplasty.

Conclusion: Studying the frequency and structure of deaths at different times after hip and knee arthroplasty performed in connection with osteoarthritis will clarify the indications and contraindications for arthroplasty and develop a set of measures aimed at reducing mortality at different times after replacing large joints with implants.

Keywords: hip joint osteoarthritis; knee joint osteoarthritis; knee arthroplasty, hip arthroplasty, mortality

Introduction

To date, joint replacement is considered to be one of the most effective methods of treating the extreme stages of osteoarthritis of the hip and knee joints. Arthroplasty in these cases is the operation of choice [1]. At the same time, THR and TKR does not always lead to a positive outcome [2,3]. The development of complications in both early and long-term postoperative periods undoubtedly affects the quality of life of patients and the prognosis of disease outcomes [3,4]. Postoperative mortality is not uncommon [5,6].

The technique and technologies of implant osteointegration for endoprosthesis continue to be improved [7]. This leads to an annual increase in the number of such operations, making them the treatment of choice in most patients with hip and knee joint pathology [7]. At the same time, the frequency of deaths after arthroplasty of hip and knee does not have a steady downward trend, which attracts the attention of specialists from different countries to study the causes of deaths during arthroplasty of large joints [8].

Aim

Analyze publications on the incidence and causes of death at different times after hip and knee implant replacement for osteoarthritis.

Materials and Methods

Literature data were searched in the PubMed and eLIBRARY open electronic scientific literature databases. The search was carried out by keywords and phrases: knee osteoarthritis; hip osteoarthritis; knee replacement, hip replacement, mortality. The search depth was 20 years.

Results

The number of patients undergoing replacement of large joints of the lower extremities is growing annually [9]. For example, in Russia the numbers of such operations were 21.6% in 2009 and 14.3% in 2010 [7]. In 2016, about 100,000 hip or knee replacement operations were performed in the Russian Federation [10]. The report of the N.N. Priorov National Medical Research Center for Medical Research in 2018 provides data on 116,597 operations, of which 70,316 are hip arthroplasty and 42,904 are knee arthroplasty in a ratio of 1.6: 1.0.

Along with the increase in the number of arthroplasty, the number of revision arthroplasty is inevitably increasing, the frequency of which, according to some authors, will be 10% of the number of primary operations, or about 400,000 cases per year [11]. According to R.M. Tikhilov et al. (2008) the proportion of revision arthroplasty in large centers of the world is 4:1 and even 3:1 will be in the near future, for every two primary operations, there may be one revision arthroplasty or its component [7].

According to I.I. Shubnyakov et al. (2021) the ratio of men to women in primary joint replacement is 1.4: 1, however, it was variable for all years, both in primary and revision arthroplasty of hip joint, from 1:1 to 1.8: 1 [12].

According to the R.R. Vreden National Medical Research Center Register, the average age of patients in the register database was 57.8 years, this age is significantly less than data from national registers of European countries, in which the average age ranges from 68 to 70 years. Differences in age were also noted among men and women who underwent joint replacement surgery, amounting to 55.5 years in men and 58.8 years in women. According to the same register from 2007 to 2020 the main most frequent indications to operation were: primary coxarthrosis, displastic coxarthrosis, aseptic necrosis of a head of a femur, post-traumatic coxarthrosis [12].

According to M.Inacio et al. (2017), the incidence of death early after surgery, according to most authors, ranges from 0.6% in primary TKR to 1.8% in revision arthroplasty. Mortality after THR is 0.9% and does not change significantly regardless of the timing of the intervention [13]. Basic information on mortality at different times after arthroplasty of the knee and hip joints is given in Table 1.

Deaths in the early postoperative period (0-90 days post operation) were analyzed separately. In THR, A. Pedersen et al. (2011) showed that within a month of surgery, there was an increase in mortality among these patients, but overall early mortality (0 to 90 days) was significantly lower than in the general population

Authors	Mortality rates
Miller, K.A. <i>et al</i> , 2003 [14]	After THR: 90 days - 0,98%
Blom, A. <i>et al</i> , 2006 [15]	After THR: 90 days - 1% (90-day mortality - 0.2% in patients under 70, 1.3% in patients aged 70 to 80, and 2.5% in patients over 80.)
Kirksey, M. <i>et al</i> , 2008 [16]	In-hospital mortality after THR 0.19% after TKR - 0.09%
Parry, M. <i>et al</i> . 2008[17]	after THR for 30 and 90 days 0%
Aynardi M. <i>et al</i> , 2009[18]	after THR: 30 days - 0,24%
Lie, S. A. <i>et al</i> , 2010[19]	after THR and TKR: 30 days - 0,2%
Parry, M.C. <i>et al</i> , 2011[20]	after THR: 30 days - 0,4% 90 days - 0,8%
Singh, J. A <i>et al</i> , 2011[21]	90 days after THR - 0,7% 90 days after TKR - 0,4%
Jämsen, E. <i>et al</i> , 2012[22]	after THR and TKR 30 days - 0,15% 90 days - 0,35% 1 year - 1,60% 3 years - 7,6% 5 years -16%
Singh, J. A. <i>et al</i> , 2012[23]	Mortality after THR 7 days - 0.1%; 30 days - 0.2%; 90 days - 0.5%; Mortality after TKR 7 days - 0.1%; 30 days - 0.2%; 90 days - 0.4%
Hunt L.P. <i>et al</i> , 2013[24]	90 days after THR in 2003 - 0.56%; in 2011 - 0.29%
Berstock, J.R. <i>et al</i> , 2014 [8]	after THR: 30 days - 0,3% 90 days - 0,65%
Hunt, L.P. <i>et al</i> , 2017[5]	Mortality after THR < 90 days - 0.64%, < 1 year - 0.41% TKR < 90 days - 0.53%, < 1 year - 0.35%

Berstock, J.R. <i>et al</i> , 2018[25]	Mortality after TKR: 30 days - 0,20% 90 days - 0,39%
Choi H.J. <i>et al</i> , 2021[26]	The in-hospital mortality rate after THR from 2005 to 2018 remained unchanged at 0.04%, the 90-day level was from 0.17% to 0.15%, Annual mortality was from 0.78 to 0.54%
National Joint Registry for England, Wales and Northern Ireland. 19 th Annual Report 2022 [27]	Mortality after THR 30 days - 0.2%; 90 days - 0.5%; 1 year - 1.5%; 5 years - 9.6%; 10 years - 25.6% Mortality after TKR 30 days - 0.16%; 90 days - 0.3%; 1 year - 1%; 5 years - 8.7%; 10 years -26.1%
Ali, Z. <i>et al</i> , 2023 [28]	Postoperative mortality after TKR 0.9%

Table 1: Mortality rates after hip and knee replacement

(0.8; 95% (CI) 0.7-0.9) [29]. It should be noted, however, that a significant increase in early mortality was observed for patients younger than 60 years and among patients who underwent THR without comorbidity recorded before arthroplasty. J. Barrett *et al*, (2005) also showed that within 30 days after surgery, mortality among THR patients increased, followed by a decrease in relative mortality over time [30]. Li *et al*. (2010) compared the increased risk of death with that in the general population and found an excess mortality of 0.12%, within 26 days and 0.26% 30 days after hip replacement [31].

In their study, Aynardi M. *et al*., 2009, showed that cardiovascular disease was responsible for the majority of deaths following hip replacement. This group was represented by the following diagnoses: acute coronary syndrome, stroke, pulmonary embolism and cardiac arrhythmias. In addition, respiratory complications, malignant neoplasms and sepsis were recorded as well [18].

Similar results were obtained by A. Pedersen *et al*., 2011. Cardiovascular complications were the predominant cause of death at different time intervals [29].

J.R. Berstock *et al*. (2014) noted in their meta-analysis that 6 of 7 studies examining mortality after hip and knee arthroplasty reported higher mortality after hip replacement, but the difference was not significant (p = 0.3 for both 30-day and 90-day postoperative mortality) (5). The main cause of death was acute cardiovascular disorders (acute myocardial infarction and acute heart failure). At the same time, coronary artery disease accounts for 41.1%, acute cerebrovascular accidents 23.1%, pulmonary embolism 11.8% of deaths. [8]

In a study by Miller, K.A., *et al*. (2003) cause of death within 90 days of arthroplasty surgery included 12 cases of myocardial infarction (0.28%), 12 pulmonary embolism (0.28%), 5 pneumonia (0.12%), 4 cases of congestive heart failure (0.09%), 2 cases of sepsis, (0.05%), 1 respiratory arrest (0.02%), 1 cardiac arrhythmia (0.02%), 1 renal insufficiency (0.02%), 1 lung cancer (0.02%), 1 suicide (0.02%.) and 2 multifactorial (0.05%). The cause of death within 90 days after surgery in revision cases included 3 myocardial infarctions (0.37%), 1 pulmonary embolism (0.12%), 1 pneumonia (0.12%), 1 acute respiratory distress syndrome (0.12%) and 1 hemorrhage (0.12%) [14]

According to a study by L.P.Hunt et al. (2017), malignancies rank first among causes of death 33.8% [9037] of 26766 deaths in patients undergoing total hip replacement and 33.3% [9917] of 29802 in patients undergoing knee replacement. The second place was occupied by circulatory system disorders 32.8% [8784] of deaths in patients with total hip replacement and 33.3% [9,932] deaths in patients with total knee replacement). Respiratory system disorders (10.9% [2,928] deaths in total hip arthroplasty patients and 9.8% [2,932] deaths in total knee arthroplasty patients) and digestive system diseases (5.5% [1,465] deaths in total hip arthroplasty patients and 5.3% [1,572] deaths in patients who had total hip arthroplasty) [5]

Coronary artery disease was the most common cause of death within 90 days (29% [431] deaths in patients with primary hip replacement and 31% [436] deaths in patients with primary knee replacement). There was an increased risk of death from causes associated with pathology of the cardiovascular, respiratory and digestive systems within 90 days after surgery compared to a period of 91 days to 1 year after surgery [5].

In knee arthroplasty, early postoperative mortality is generally slightly lower at 1.08 (95% confidence interval (CI): 1.06 to 1.09), however, this is 8% higher compared to the general population.

In many studies on the causes of death in the long term after THR and TKR, it is diseases of the cardiovascular system that are the main, but not the only cause of death. During 5 years of follow-up, according to Y. Zhou et al. 2023, there is a decrease in mortality (0.59 95% CI: 0.57-0.60), but the situation changes dramatically in the long-term follow-up period. In patients who have undergone total knee replacement with a follow-up period of more than 11 years, especially in men over the age of 75, mortality increases significantly (3.13 [95% CI: 2.95-3.31] [32]. Of course, the increase in mortality cannot be associated only with arthroplasty, however, the data significantly exceed the risks in the general population. Ramiah, R. D. et al (2007) and Lie S.A. et al. (2000) reported an increase in late relative mortality after THR in patients younger than 60 years of age with osteoarthritis and in patients not previously hospitalized, indicating that THR poses a risk that becomes most apparent in patients with a initially low risk of death [33,34]. Considering the current increase in the number of THR and TKR performed in young healthy patients, as well as the constant expansion of indications for these interventions, due to the higher

expectations regarding the quality of life of patients, it is necessary to pay more attention to the criteria for selecting patients and the feasibility of performing operations taking into account risks both in the early and distant postoperative periods.

Hip and knee arthroplasty is carried out all over the world, but the results of the operations performed cannot be called unambiguously positive. A significant part of patients who underwent total hip replacement remains dissatisfied with the results of surgical treatment, especially the results of revision arthroplasty [35, 36].

Discussion

Despite the effectiveness of arthroplasty, a significant number of publications on postoperative complications appear. Their number does not tend to decrease and is growing simultaneously with an increase in the frequency of operations performed. Fatal outcomes after THR and TKR are not uncommon. Their frequency has also not declined in recent years. There are few studies on the frequency and causes of deaths after arthroplasty of hip and knee joint. As a rule, researchers in their publications mention intraoperative mortality or mortality in the early postoperative period.

In recent years, the term "endoprosthesis survival" has appeared. Many experts focus on this very concept. This term only reflects the condition of the implant and its relationship with the bone.

In a literature review, Mei X.Y et al., (2019) present the results of survival of prostheses over different periods of time [37]. The survival rate of endoprotheses in the sample over 12 years, calculated using the Kaplan-Meier method, was 89% (80-97%), taking into account the totality of all revisions. [38] The survival of the cemented acetabular component over a 15-year observation period is the most significant one, corresponding to 0.971 standard units. [42].

However, when assessing the survival of the endoprosthesis, the general condition of the patient is not taken into account, which subsequently leads to the "distorted" results of the operations performed and does not allow fully assess the effectiveness of the operation and the percentage of complications that lead to death [39,40]. Many researchers prefer to use the assessment of the functional results of THR and TKR and the assessment of the

quality of life of patients [41,42]. Data on functional outcomes and quality of life of patients are much worse. So, according to B.G. Aliev et al. (2022) only 86% of patients have an excellent and good quality of life 5 years after THR [43].

Thus, information about deaths is not taken into account by all specialists involved in hip and knee arthroplasty. And the works devoted to the analysis of the causes of death in different postoperative periods are isolated and contradictory.

Conclusions

In general, the following conclusions can be made:

1. The mortality rate after joint replacement with an implant in the early postoperative period averages 0.21% with hip replacement and 0.16% with knee replacement [27].
2. In the early, as well as in the long-term after THR and TKR, mortality exceeds that in the average population.
3. The main cause of death in the long term after arthroplasty according to most authors is the pathology of CCC; further in frequency are malignant tumors, diseases of the respiratory system and intoxication.

Conflict of interest

The authors declare that there is no conflict of interest.

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