CASE REPORT

DETRIMENTAL EFFECTS OF THE COVID-19 PANDEMIC ON ELECTIVE ORTHOPEDIC SURGERY AND INSTITUTIONAL BONE BANK ACTIVITY

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ABSTRACT

The novel coronavirus SARS-CoV-2 (COVID-19) generated a 2020 global pandemic that has provoked drastic effects across world economies and healthcare systems. This article aimed to describe the impact of the COVID-19 pandemic on elective arthroplasty procedures and bone bank activity in the university hospital. We have performed a retrospective cohort study involving 600 adult orthopedic inpatients from March 15th to December 31st, 2019 and 2020, respectively. The number of primary total hip and knee arthroplasty procedures showed a highly significant decrease from 315 and 165 in the same period of 2019 to 106 and 14 in 2020 ($p < 0.001$). There was a highly significant decrease in the overall number of procurement procedures during the pandemic compared to the same period in 2019 ($p < 0.001$). The overall discard rate of bone allografts during the COVID-19 pandemic significantly increased from 31.57%. to 80.76% ($p < 0.03$). The leading cause of allograft rejection during 2019 and 2020 was the inability to perform serological tests due to lack of institutional support or the refusal of donors to perform a six-month retest. The COVID-19 pandemic had an extremely detrimental effect on elective orthopedic surgery and the normal functioning of the institutional bone bank.

Keywords: *COVID-19 pandemic, bone bank, total hip arthroplasty, total knee arthroplasty, bone procurement, femoral head allograft.*

INTRODUCTION

The novel coronavirus SARS-CoV-2 (COVID-19) generated a 2020 global pandemic that has provoked drastic effects across world economies and healthcare systems (1-3). With the rapid spread across the globe, many regions were overwhelmed with patients requiring respiratory support (4-6). After the first identified infection in late February 2020 and subsequent evidence of community spread, the state Government began drastically limiting businesses and issuing stay-at-home orders. On March 15th, 2020 Government declared a state of emergency, which lasted until May 6th, 2020. The Ministry of Health recommended that all elective surgeries in the public health sector should be suspended. Our university hospital began limiting elective surgical procedures following national health guidelines to slow the spread of the disease (7-9). Throughout this period we decreased our surgical activities and were allowed to treat only orthopedic trauma patients, so elective total hip arthroplasty (THA) and total knee arthroplasty (TKA) patients were forced to postpone their scheduled surgeries.

This article aims to describe the impact of the COVID-19 pandemic on elective arthroplasty procedures and the bone bank activity in the university hospital with the highest volume of trauma surgeries and total hip and knee replacements.

METHODS

We performed a retrospective observational cohort study involving 600 adult orthopedic inpatients at the university hospital, from March 15th, 2019 to December 31st, 2019 and March 15th, 2020 to December 31st, 2020, respectively. We compared the bone bank activities in the same period throughout the COVID-19 pandemic. Since March 15th, 2020, we have performed elective surgeries only in 9 weeks of 42. Femoral heads were taken from those patients with acute femoral neck fracture or after primary THA. Bone allografts are utilized to meet our demands in orthopedic and trauma procedures. The bone donation, as well as participation in institutional studies, was voluntary and no financial or other benefits were granted. Ethical approval from the institutional board was not required. This article represents the part of an ordinary quality control audit approved by the board in 2006. Informed consent was acquired according to the bone bank protocol, and a detailed history was taken to exclude malignancy, systemic and infectious diseases. All asymptomatic donors without fever, dyspnoea, and low oxygenation underwent PCR screening one day before orthopedic surgery. They were COVID-19-negative on preoperative screening. Donors were tested for hepatitis B and C, HIV (AIDS), and syphilis at donation and six months after surgery, according to the bone bank protocol. Femoral head allografts were retrieved in the conventional orthopedic theatre under aseptic conditions by sixteen orthopedic surgeons. A prophylactic antibiotic (Cefuroxime, 1.5 g, or Cefazoline 1.0 g) was administered 30 minutes before surgery. The femoral head was liberated from soft tissues and two swab samples were taken by the main surgeon: one from the joint site and the other one from the femoral head itself. Following size determination, the bone allograft was placed into a sterile plastic container by the surgeon. The container was sealed tightly, immediately isolated with two sterile separate bags, labeled, and stored in a freezer at -70°C within 30 minutes after procurement. Swab samples were sent to the hospital laboratory for microbiological evaluation. Two cultures of aerobic and anaerobic microorganisms in blood agar, MacConkey agar, and chocolate blood agar were evaluated. Histopathological evaluation of femoral heads retrieved from living donors was not performed. The allografts with unsuccessful selection criteria or those contaminated during harvesting have been rejected. Acceptable bone allografts were ready for use six months after admission and were stored for a maximum of five years.

Statistical analysis

We utilized SPSS 21.0 (IBM, Armonk, NY, USA) in the statistical evaluation of our data. The Chi-square test was used to compare the distribution of categorical variables that were expressed with the number and percentage. A two-sample *t*-test is used to test the means of two populations of donors. For the comparison of small samples, Z score, and Fisher's exact test were used. Differences were considered to be significant at $P<0.05$.

RESULTS

A total of 600 adult orthopedic inpatients at the university hospital were included. Two same periods from March 15th to December 31st, 2019 and 2020, respectively were compared, with a total of 434 living donors and 8 recipients included in this study. There were 135 male and 299 female donors with a mean age of 63 (39-86) and 66 (40-86), respectively. Patient demographics are presented in Table I. The number of primary total hip and knee arthroplasties showed a highly significant decrease from 223 and 165 in 2019 to 106 (52.47 % less) and 14 (91.52 % less) in the same period of 2020 ($p<0.00001$).

Table 1. The ratio between 2019 and 2020 concerning the patient demographics, the overall number, and type of donor procedures, the number of procured bone allografts, and the overall number of discarded allografts.

Characteristics	Mar 2019-Dec 2019	Mar 2020-Dec 2020	p-value
Donors (male/female)	92/223	43/76	**0.165**
Mean age	66.52 ±1.135	61.87 ±2.173	**0.00001**
No of THA/TKA	315/165	106/14	**0.00001**
No of THA/HA	223/92	61/58	**0.0002**
No of allografts/surgery	38/315	26/119	**0.038**
No of THA/TKA/per week	22±5/16±4	6±3/2±1	**0.529**
Inability to perform serology tests*	9 (23.68%)	14 (53.84%)	**0.142**
No of discarded allografts	12 (31.57%)	21 (80.76%)	**0.035**

P < 0.05 indicates a significant difference
*refusal/under budgeting

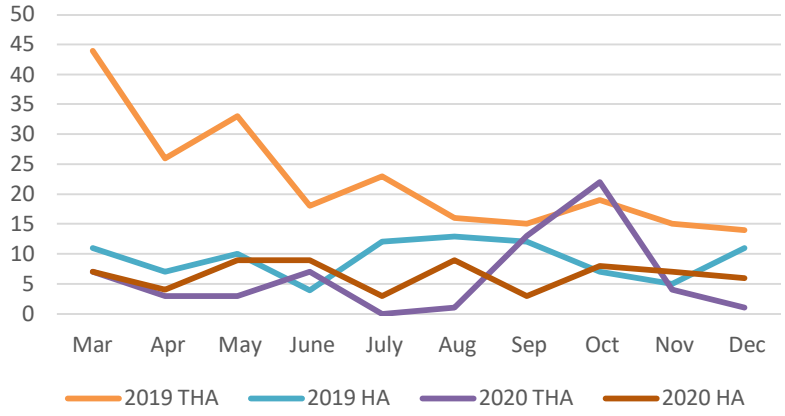
The mean number of THA and TKA per week did not differ substantially between the two periods (Table 1). The difference in ratios between the overall number of procurement procedures and the origin of femoral head allografts in 2019 was highly significant when compared to 2020 (p=0.0002). The overall number of THA`s, and hemiarthroplasties (HA`s) showed a significant decrease from 315 in the same period of 2019 to 119 in the year 2020 (p=0.013; Figure 1).

Since the declaration of the state of emergency, we have performed 61 primary THA and 58 HA. Of those 119 patients, 86 were trauma patients with femoral neck fracture and only 33 elective THA`s (p= 0.012). The number of procured femoral heads in 2020 significantly decreased when compared with those procured in 2019 (Table I). We have managed to harvest only 26 fresh femoral heads, whereas 12 (46.15%) were discarded immediately after procurement due to a lack of containers (2) or serology tests (10).

Of those 14 fresh femoral head allografts left, three (11.53%) were discarded due to the donor's refusal to perform serology retests after six months. Six (23.07%) were discarded due to a lack of serological tests. The inability to perform six-month serology retests (23.07%) in 2020 did not differ from 2019 (13.15%; Table I). The ratio between procured and discarded bone allografts in 2019 differed significantly from the ratio in 2020 (Table I).

Nowadays, only seven cryopreserved femoral head allografts are left in the bone bank. Over the past two periods, one femoral head allograft was utilized in the treatment of proximal humeral fracture, two in the treatment of tibial plateau fractures, and five allografts were used in primary and revision hip surgeries. During the postoperative follow-up of a mean 8.4 months (4-17), no complications were recorded in eight recipients.

Figure 1. The distribution of THA`s, and HA`s from March 15th, 2019 to December 31st, 2019 and March 15th, 2020 to December 31st, 2020.



DISCUSSION

In the present study, we have assessed the impact of the COVID-19 pandemic on elective orthopedic procedures and institutional bone bank activity. We postponed our elective arthroplasty procedures due to the recommendation of our Government as well as in many other countries (10-12). The decrease in the number of hip and knee arthroplasties between 2019 and 2020 correlates with the recent report from D'Apolito (13). Our results show that the hospital bone bank system operated with various difficulties during the COVID-19 pandemic such as a lack of institutional support as well as disinterest of donors to participate in the bone donation process. The overall discarding rate was from 17% to 33% in earlier reports (14-16). Most of the allograft rejections were reported as a result of incidents at the time of graft procurement or the inability to perform the six-month serology retests of donors (14,17). The leading cause of allograft rejection during the COVID-19 pandemic was the inability to perform serology retests due to underbudgeting, or donor refusal to perform serology retests, respectively. Our recent study showed that the overall discard rate of bone allografts following the past thirteen years was 26.86% (18). During the COVID-19 pandemic in 2020, the overall discard rate significantly increased to 80.76%. Proper donor selection and their resolute motivation to participate in bone banking are extremely important for its efficient functioning. On the other hand, the bone bank is dependable on institutional support and must be recognized as a valuable part of the existing healthcare system, when a lack of serology tests for donors was considered. The unsatisfactory discard rate due to institutional negligence and underbudgeting, as well as donor refusal to perform six-month serology retests suggests that the impact of the COVID-19 pandemic was extremely detrimental and critical in reducing surgical and bone banking activities.

This study has its limitations. It is retrospective and observational, but in such circumstances, it would not have been possible otherwise.

CONCLUSION

The COVID-19 pandemic has provoked dramatic changes in everyday life in Serbia and the rest of the world and has affected the routine activities of numerous hospitals, and most importantly affected the routine health care of our patients. Unfortunately, we have met problems such as a lack of donors and their motivation to participate in the bone banking process as well as a lack of institutional support necessary to ensure the adequate functioning of the bone bank. From the present study, we conclude that the COVID-19 pandemic had devastating effects on elective orthopedic procedures as the main source of tissue donors, as well as on the normal functioning of the institutional bone bank, and still has.

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