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Delay in Geriatric Hip Fracture Surgery: Retrospective Analysis of Factors Associated with Perioperative Anesthesiologic Management and Their Impact on 30-Day Mortality and Morbidity

Geriatrik Kalça Kırığı Cerrahisinde Gecikme: Perioperatif Anesteziyolojik Yönetimle İlişkili Faktörlerin ve Bunların 30 Günlük Mortalite ve Morbidite Üzerindeki Etkisinin Retrospektif Analizi

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ABSTRACT

Objective: Although surgical treatment of hip fracture provides favourable outcomes, comorbidities and preoperative optimization determine the recovery and rehabilitation period in elderly population. This study evaluated the role of anesthesiologic management for appropriate timing of surgery, and other patient-specific factors for surgical intervention.

Methods: The study group comprised of 240 geriatric patients with acute hip fractures, who underwent surgery at an academic tertiary care unit. Preoperative, intraoperative and postoperative variables associated with anesthesiologic management were retrospectively evaluated. A 30-day mortality and morbidity were the primary and secondary outcomes.

Results: The median time between the patient's admission to the hospital and the time of surgery was 1 day. Approximately 29% patients stayed in intensive care unit postoperatively. The median length of hospitalization was 5 days, while the 30-day mortality rate was 1.3%. The American Society of Anesthesiologists (ASA) physical status was identified as the most common factor that significantly affected the 30-day mortality.

Conclusion: To date, no consensus has been reached on the appropriate delay period for surgery of acute hip fractures. Our study demonstrates that the main factors determining the patient prognosis are ASA physical status score, and the functional status of the patients. Therefore, perioperative anesthesiologic management should be prioritized to provide optimization of these patients.

Keywords: Anesthesiology, hip fractures, geriatrics, time-to-treatment, morbidity, mortality

ÖZ

Amaç: Kalça kırıklarında cerrahi tedavi olumlu sonuçlar ile birliktelik göstermesine rağmen özellikle yaşlı olgularda iyileşme ve rehabilitasyon sürecini eşlik eden hastalıklar ile ameliyat öncesi optimizasyon belirlemektedir. Bu çalışma, söz konusu hasta grubunda, cerrahi girişimin zamanlamasında anesteziyolojik yönetimin rolünü ve hasta ile ilişkili faktörleri değerlendirmektedir.

Yöntem: Üçüncü basamak akademik bir sağlık kuruluşunda akut kalça kırığı nedeniyle ameliyat edilen 240 geriatrik olgu çalışma grubunu oluşturdu. Perioperatif anestezi yönetimi ile ilişkili ameliyat öncesi, sırası ve sonrasındaki değişkenler retrospektif olarak değerlendirildi. Otuz günlük mortalite ve morbidite birincil ve ikincil sonuçlar olarak tanımlandı.

Bulgular: Olguların hastaneye kabulü ile cerrahi tedavi zamanı arasında geçen ortanca süre 1 gündü. Ameliyat sonrasında hastaların yaklaşık %29'u yoğun bakıma transfer edildi. Hastanede kalış süresi 5 gün (ortanca) iken, 30 günlük mortalite oranı %1,3 olarak hesaplandı. Amerikan Anesteziyoloji Derneği (ASA) fiziksel durum sınıfı 30 günlük mortaliteyi etkileyen en yaygın belirleyici olarak bulundu.

Sonuç: Geriatrik yaş grubunda akut kalça kırıklarının cerrahi tedavisinin zamanlamasında en uygun süre konusunda henüz fikir birliğine varılamamıştır. Bu çalışmanın bulguları, söz konusu hastalarda hastalık ve tedavi seyrini belirleyen temel etmenlerin ASA fiziksel durum sınıfı ve fonksiyonel durum olduğunu göstermiştir. Dolayısı ile bu hastaların optimizasyonunun sağlanması için perioperatif anestezi yönetimine öncelik verilmesi tavsiye edilmektedir.

Anahtar sözcükler: Anesteziyoloji, kalça kırıkları, geriatri, tedavi zamanlaması, morbidite, mortalite

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INTRODUCTION

Hip fractures are common injuries with an incidence rate of 1.3 million/year worldwide (1). Numerous publications have reported that surgical treatment is associated with better anatomical result, shorter hospital stay, and rehabilitation period (2,3). However, high postoperative complication and mortality rates in these patients are still bothersome. In addition, comorbidities, age, and male gender have been described as other causes of poor prognosis (4).

In particular, preoperative risk stratification and patient optimization must be particularly considered in geriatric population. Both the increased incidence and high cost even though poor clinical outcomes are challenges for anesthesiologists and orthopedic surgeons (5). Anesthesiologists play a major role in this aspect and the most important component of perioperative patient management is rapid and appropriate preoperative evaluation. However, no consensus exists on the optimal surgery time for this fragile, geriatric patients. Current studies recommend surgery within the first 24-36 hours, or 48 hours after hospital admission (5,6). An unforeseen delay in surgery has been reported to increase the number and severity of complications, as well as the cost and length of the hospital stay (7). Therefore, the anesthesiologists must accelerate the preoperative optimal and safe evaluation of the patient.

Generally, changes in optimal surgery times may be due to avoidable reasons like scheduling errors, shortage of materials, and inadequate preoperative evaluation, or unavoidable reasons like emergency cases intervening in the daily schedule, unexpected changes in the patients' medical status (8). Nowadays, the increased number of preanesthesia assessment clinics support these problems (9). This is very important for secure and on-time anesthetic practice since by this way, anesthesia-related risk factors and high-risk patients are detected early and patients are prepared physically and psychologically for anesthesia without any delay (10). Except those, there is controversy about the effect of type of anesthesia for the prognosis of these patients. Mayordomo-Cava et al. operated nonagenarians with hip fracture under spinal anesthesia (SA) and showed a decreased rate for the 30-day mortality (11). However, different guidelines recommend either the use of both anesthesia techiques or only local anesthesia (12-16). In order to reduce postoperative delirium, and to facilitate early mobilization, some authors prefer the use of SA (11). In a recently published Cochrane review, no statistically significant differences was found in 30-day mortality as well as the rates of serious respiratory, cardiovascular, cerebral, or renal complications or for the length of hospital stay in patients who had either regional (R) or general anesthesia (GA) for hip fracture surgery (17). Of note, the level of evidence was low, and the studies were underpowered (17).

In this study, we aimed to determine the factors leading to delay of hip fracture surgery in the elderly at our institution. Herein, we specifically investigated issues related to rapid preoperative optimization of this patient group for improved postoperative outcomes and quality of treatment. This investigation may increase the sensitivity of the problem to both anesthesiologists and orthopedic surgeons as well as other clinicians consulting them and health professionals in hospital management for better outcomes.

MATERIAL and METHODS

Institutional Clinical Research and Ethics Committee approval (KA 19/420) was obtained for the current study.

We retrospectively evaluated a total of 240 geriatric patients, who underwent hip fracture surgery in an academic tertiary care unit, between January 2017 and December 2019. Using the patients' medical records, we analysed the demographic data (age, gender, body mass index (BMI)), comorbidities, American Society of Anesthesiologists physical status classification (ASA), preoperative ejection fraction (EF), the time between hospital admission and surgery, surgical method (prosthesis or osteosynthesis), duration of surgery and anesthesia, type of anesthesia, need for blood transfusion, duration of intensive care unit (ICU) stay-if transferred to ICU, duration of hospital stay after surgery, complications during and after surgery, and the 30-day mortality and morbidity. Patients under the age of 60 years, and those with a history of polytrauma were excluded from the study.

We determined the 30-day morbidity and mortality rates in association with time-to-surgery as the primary outcome. The factors leading to delay for surgery, and the incidence ofpostoperative survival (survivor: alive at the end of the study period) and death (non-survivor: noted as deceased at the end of the study period) were also analysed.

A study flow diagram is shown in Figure 1.

Anesthesiological Management

The preference for either RA or GA techniques depended on the responsible anesthesiologists' decisions. Patients who were not appropriate for RA, or if the anesthesiologists did not feel themselves safe enough to perform a RA technique, those patients were treated under GA. Spinal anesthesia was performed by central neuraxial block at mainly L_3-L_4 levels with heavy marcaine. On the other hand, GA was done through a smooth induction with a titrated hypnotic agent, an opioid, and a short-lasting neuromuscular agent for endotracheal intubation.

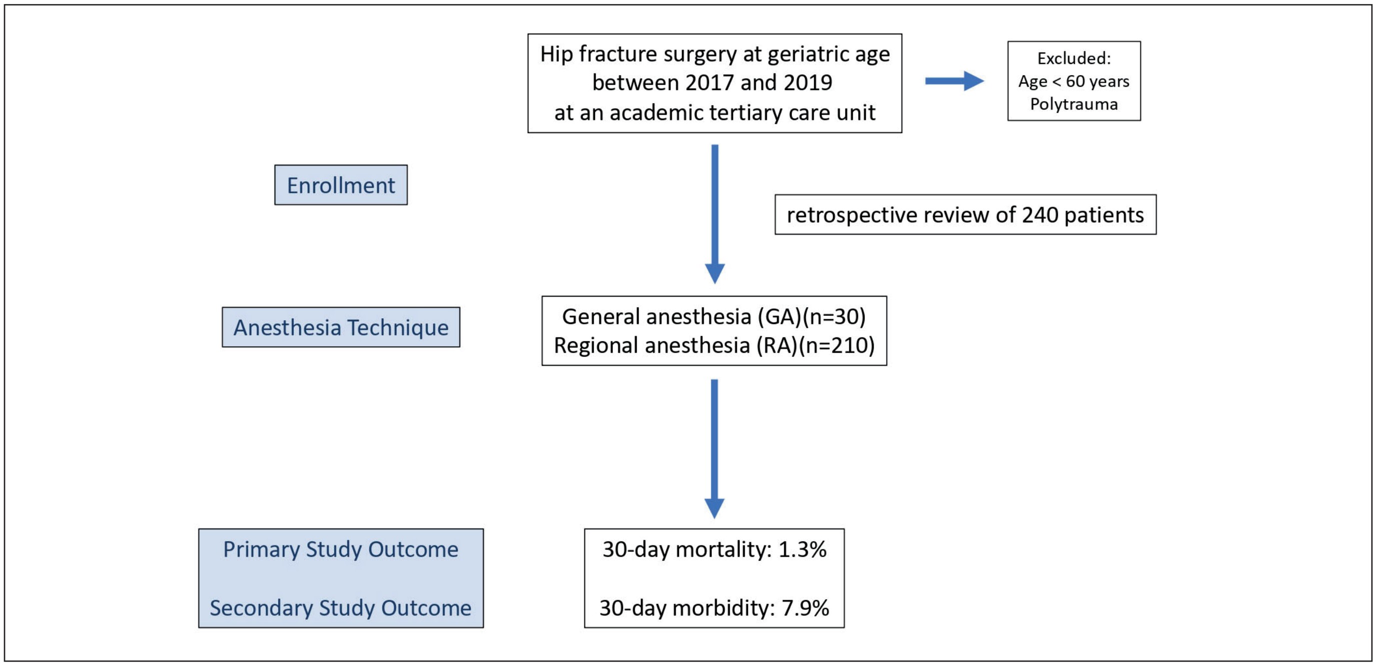

Figure 1: Study flowchart.

Statistical Analysis

Statistical analysis was performed by using IBM®Statistical Package for the Social Sciences (SPSS®) version 25.0 software (IBM Corporation, Armonk, NY, US). Kolmogorov–Smirnov test was used to investigate the normal distribution. Categorical data were expressed as numbers (n) and percentages (%), while quantitative data were expressed as mean ± SD and median (min-max). The mean differences between groups were compared mainly by Student's t test, while the Mann–Whitney U test was applied for the comparisons of continuous variables that were not normally distributed. Pearson's χ^2 test was used in the analysis of categorical data unless otherwise stated. The Continuity corrected χ^2 test was used in all 2 × 2 contingency tables to compare the categorical variables, when one or more of the cells had an expected frequency of 5-25. Fisher's exact test was used when one or more of the cells had an expected frequency of five or less. Fisher–Freeman–Halton test was used in all R × C contingency tables to compare categorical variables when one-fourth or more of the cells had an expected frequency of five or less. Multiple logistic regression analyses (LR) via Forward LR procedure were applied to determine the best predictor(s) of morbidity and mortality. Any variable with p value <0.10 in a univariable test was accepted as a candidate for the multivariable modelling along with all known variables of clinical importance. Odds ratios, 95% confidence intervals and Wald statistics for each independent variable were also calculated. A p value less than 0.05 was considered statistically significant.

RESULTS

In this study, 240 patients with hip fracture between January 2017 to December 2019 were analysed retrospectively through their medical records. The mean age of the patients was recorded at 71.8 ± 16.6 years, with females comprising of 73.3% of the patients. 87.5% of our patients had spinal anesthesia, while the rest (12.5%) of them had general anesthesia (Table I). The median time between the patient's admission to hospital and the time of operation was identified to be 24 hours. The surgery of 6.3% of patients was delayed beyond 24 hours due to patients' pre-existing medical condition. The hospital stay was recorded at a range of 2-23 days, with a median duration of 5 days (Table I).

Among the survivors (225 patients), at the end of 30 days, 26 had GA, while only 4 patients had GA in the non-survivors group (15 patients). This ratio didn't make any difference at 30-day mortality (Table II, p=0.025).

Intraoperative adverse events (hypo/hypertension, bradycardia and hypoxia) requiring medical intervention were similarly present between the patients with or without 30-day mortality. At least one complication developed in the first postoperative 48 hours in 92.5% of the patients. Approximately 29.6% of the patients were transferred to ICU for postoperative care. The 30-day mortality and morbidity rates of 240 patients involved in the study were 1.3%, and 7.9%, respectively. The factors that significantly increased the 30-day mortality and morbidity were higher ASA scores, pre-ex-

Table I: Demographic and Clinical Characteristics of the Study Patients

Characteristics	Value
Age; (mean ± std. dev) (years)	71.8 ± 16.6
Gender	
Female; n (%)	176 (73.3)
Male; n (%)	64 (26.7)
ASA	
1; n (%)	15 (6.3)
2; n (%)	151 (62.9)
3; n (%)	70 (29.1)
4; n (%)	4 (1.7)
Number of delayed surgeries; n (%)	15 (6.3)
Time to operation; (median) (range) (days)	1 (0-7)
Type of anesthesia	
General; n (%)	30 (12.5)
Regional; n (%)	210 (87.5)
Duration of anesthesia; (median) (minutes) (range)	150 (45-420)
Duration of surgery; (median) (minutes) (range)	120 (30-400)
Admission to ICU; n (%)	71 (29.6)
Length of stay in ICU; (median) (days) (range)	0 (0-16)
Length of stay in hospital; (median) (days) (range)	5 (2-23)

ASA: American Society of Anesthesiologists physical status classification, **ICU:** Intensive Care Unit.

isting heart valve diseases, congestive heart failure, chronic kidney disease, and longer ICU and hospital stay. Although there was no significant difference in postoperative complications among the patients, the incidence of urinary tract infections was significantly higher in survivor group of patients (p=0.003) (Table II, Table III).

DISCUSSION

Our findings from this retrospective study demonstrated that ASA scores and functional status play significant roles in determining the time of surgery of elderly hip fracture patients and thereby their prognosis. In this study, the time of surgery within 48 hours was found to be independently associated with 30-day mortality and morbidity.

Earlier studies have claimed that surgical delay beyond two calendar days doubles the risk of death rate in the first postoperative year (18). McGuire et al. and Gdalevich et al. reported that a delay of two or more days between admission and surgery time was associated with significantly increased mortality (18,19). In contrast, surgery performed in less than 24 hours was associated with shorter hospital stays (20). In another study, patients of similar age and comorbidities had a mortality of 10.1% to 21.8% with respect to surgery within or beyond 6 hours, respectively (21). On the other hand, in a retrospective study of 8383 patients, Grimes et al. reported that the timing was not associated with short or long-term mortality when acute medical status was controlled and surgery was performed within 24 hours (22). Moran et al. could not

Table II: Demographic and Clinical Data of Survivors* and Non-Survivors*

Patient Characteristics	Survivor* (n=225)	Non-Survivor* (n=15)	p-value
Age; (mean ± std. dev.) (years)	71.1 ± 16.6	81.7 ± 13.4	**0.016†**
Gender			0.553‡
Female; n (%)	166 (73.8)	10 (66.7)	
Male; n (%)	59 (26.2)	5 (33.3)	
ASA			**<0.001¶**
1; n (%)	15 (6.7)	0 (0)	
2; n (%)	148 (65.8)	3 (20)	
3; n (%)	60 (26.7)	10 (66.7)	
4; n (%)	2 (0.9)	2 (13.3)	
Number of delayed surgeries; n (%)	12 (5.3)	3 (20)	0.057‡
Median Time to operation; (days)	1 (0-7)	1 (0-3)	0.186¥
Type of anesthesia General and Regional	G: 26 R: 199	G: 4 R: 11	**0.025¶**
Admission to ICU; n (%)	60 (26.7)	11 (73.3)	**<0.001‡**
Median length of stay in ICU; (days)	0 (0-5)	1 (0-16)	**<0.001¥**
Median length of stay in hospital; (days)	5 (2-17)	7 (3-23)	**0.003¥**

†: Student's t test, **‡:** Fisher's exact probability test, **¶:** Fisher Freeman Halton test, **¥:** Mann Whitney U test.***:** For the definitions of "Survivor" and "Non-survivor" please refer to main text, **ASA:** American Society of Anesthesiologists physical status classification, **ICU:** Intensive Care Unit.

Table III: Postoperative Complications[a] and 30-Day Morbidity Rates Between Survivors* and Non-Survivors*

Complications	Survivor* (n=225)	Non-Survivor* (n=15)	p-value
Post-operative complications[b]; n (%), (total)	208 (92.4)	14 (93.3)	>0.999†
Respiratory system[a]; n (%)	9 (4.0)	1 (6.7)	0.482†
Cardiovascular system[a]; n (%)	99 (44.0)	8 (53.3)	0.663‡
Neurological system[a]; n (%)	26 (11.6)	2 (13.3)	0.689†
Urinary tract[a]; n (%)	30 (13.3)	7 (46.7)	**0.003**†
Endocrine system[a]; n (%)	9 (4.0)	1 (6.7)	0.482†
Gastrointestinal system[a]; n (%)	3 (1.3)	0 (0.0)	>0.999†
Others[a, **]; n (%)	164 (72.9)	8 (53.3)	0.137†
Need for ICU admission; n (%)	5 (2.2)	2 (13.3)	0.064†
30-day morbidity	14 (6.2)	5 (33.3)	**0.003**†

†: Fisher's exact probability test, **‡:** $\chi 2$ test with continuity correction, p<0.05: significant, **ICU:** Intensive Care Unit, **a:** Patients may have developed more than one complications, **b:** The total number of patients who were suffering from post-operative complications, *****: For the definitions of "Survivor" and "Non-survivor" please refer to main text, ******: Others; post-operative bleeding, infection, electrolyte imbalance, and pain requiring treatment other than the standard regimen.

conclude the contribution of delay in surgery to an increased mortality rate. In his study, no significant difference could be demonstrated between patients planned for surgery on time or planned for surgery with a delay. Even a delay up to 4 days in patients without acute comorbidities was shown to have no effect on their results (23). Another study highlighted stability in patients receiving early surgery, where "stability" was defined according to individual treating physician (25). Nevertheless, the authors showed that a delay longer than 4 days significantly increased the mortality rate (18). These conflicting results may result from other factors beyond the timing of the surgery.

In the current study, we demonstrated that a waiting time of 24 hours was not associated with the mortality rate in patients with acute hip fractures. As patients were retrospectively collected, those who died after 1 year had a maximum 3 days' delay in the surgery, while patients who survived after 1 year had 7 days of delay in surgery. This compromises that, more than timing of surgery, other factors should be have playing roles in these ratios. So we should ask the question of the necessity for delays in surgery. In a meta-analysis by Shiga et al., no benefit of early surgery was demonstrated in older patients with high baseline risk, which might be because of the association between underlying risk of age and 1-year mortality in most of the retrospective studies that were included (7).

In our department, a delay in surgery of less than 48 hours is usually implemented unless the patient needs detailed preoperative examination to stabilize any pre-existing medical condition. This protocol is similar to studies that consider medical status, sex, and age of patients as the main predictors of mortality (18,21,25). A multidisciplinary team in our hospital evaluates the patients preoperatively for risk stratification. Although surgical interventions improve the quality and duration of life, the adverse effects of surgery such as cardiac complications, infection and cognitive disorders must be evaluated. Urinary tract infection has been the main cause of mortality in our patient group. Although the mortality rates within 30 days and at 1 year in our study were lower than similar studies in the literature, the influencing factors were the same (18,24,25). Similarly, in another study, 1-year mortality was reported at 18.4%, which was mainly influenced by higher ASA score and age (25). A meticulous and immediate surgical care provided during early postoperative care also improved the quality and outcomes of the surgical care. Therefore, we probably induced the beneficial effect by eliminating high ASA scores and poor medical status.

In fact, we do not claim the necessity of a preoperative medical condition stabilization time that was highlighted by Kenzora et al. (26). However, higher rate of ICU admission and a longer stay in the ICU suggests the existence of comparatively serious co-morbidities and higher ASA status in these patients. Higher ASA scores may cause longer ICU stays, and may affect the overall mortality rate.

Generally, the surgery is performed as soon as the patient's preoperative status is optimal, but this involves the anaesthesiologist's opinion, the orthopedic surgeon's preference, and availability of the operating room. Nevertheless, undue delay, especially in young and comparably healthier patients, is prevented in our hospital.

In a few studies, association between anesthesia type and mortality after hospital discharge were evaluated. In one of them, Neuman et al. reported that RA patients had a lower odds for mortality when compared with patients treated under GA (27). In contrast, Patorno et al found no difference between RA, GA, and combined groups when investigating in-hospital mortality. However, the included patients were 18 years of age and older, and this study enrolled only patients who had hip fracture repair after a 2-day hospital stay (28). In another retrospective cohort study, in-hospital mortality and morbidity varied among 3 different anesthesia types as GA, RA, or when RA was converted to GA labeled as the conversion group (Cv). Both GA and Cv was found to be associated with higher in-hospital mortality and a shorter time to expiring. Moreover, the GA group experienced more discharges to a health care facility and had a longer time to discharge compared with the RA group (5). Interestingly, in the setting of slightly different inclusion and exclusion criteria, Brox and colleagues found no statistically significant differences in mortality risk at 30-day, 3-month, and 1-year between RA and GA (29). On the other hand, the effect of anesthesia type might play a greater role in the immediate postoperative period, short-term outcomes might be more closely related to anesthesia type when compared to long-term outcomes, as was shown by Qui et al. (5). The decision for the type of anesthesia should be selected carefully after individual risk and benefit assessment. In patients who underwent SA had improved pain scores and pain satisfaction, as well as less opiate requirement when compared to those who underwent GA in such a group of hip arthroplasty population (30). Furthermore, the rate of complications and postoperative cognitive dysfunction were also less in patients after SA than those after GA (31,32). However, SA is associated with relative hypotension, which might place additional strain on the heart; as a result, SA may not be recommended for patients who have significant aortic stenosis or coronary artery disease (33). For hip fracture surgery, no particular anesthesia management has been suggested to yet, SA and GA methods are represented to be the most often used techniques (32-36).

However, we didn't aim to investigate the effect of anesthesia types for mortality and morbidity in this study. The effect of time passing until the date of surgery on patients' mortality and morbidity was more interesting for us, to investigate.

Nevertheless, we had GA in very limited number of patients. As our patients admitting to our hospital are more well-cared and with middle-high socio-cultural levels, RA was commonly appropriate to perform. However, the choice of anesthesia technique didn't change the mortality and morbidity rates of our study group.

As for the complications following surgery, we found that 92.5% of patients had at least one postoperative complication. Due to the retrospective collection of the data, we can't interpret the timing and superemposing of the complications.

This study had a few limitations. A selection bias might be introduced on the basis of the patients that were presented and admitted to our hospital that is not designated primarily as a trauma center. In addition, the study consisted of a small sample size. Further, the preoperative medical statuses of the patients were frequently in an optimal state. As we did not have a written consensus about the timing of surgery for these patients, we planned the surgery as soon as the patient was ready, which resulted in a wide range of surgery times.

CONCLUSION

In conclusion, our findings do not encourage a mandatory, rapid surgery in the first 24-48 hours for hip fracture patients. Nevertheless, we cannot exclude the effect of timing on the prognosis. However, other factors, especially ASA score, should not be underestimated. Thus, anesthesiologists play a crucial role in planning and scheduling of these surgeries.

AUTHOR CONTRIBUTIONS

Conception or design of the work: EK
Data collection: AA, CY, NA
Data analysis and interpretation: AA, EK
Drafting the article: AA, CY, NA
Critical revision of the article: EK
Other (study supervision, fundings, materials, etc): EK
The author (AA, EK, CY, NA) reviewed the results and approved the final version of the manuscript.

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