Did we do the right thing? The appropriateness of orthopedic operative interventions during the height of the coronavirus disease 2019 pandemic

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Abstract

Purpose: During the coronavirus disease (COVID) pandemic elective surgeries were cancelled and operative indications curtailed to counteract shortages in resources. We aimed to review each orthopedic operative indication at an urban Level 1 Trauma Center inundated with COVID. We aimed to classify the appropriateness of each operative intervention and determine if exposure to COVID impacted morbidity or mortality.

Methods: All orthopedic procedures between March 16, 2020 and May 16, 2020 were reviewed. The most urgent surgical indication for each procedure was classified by 2 fellowship trained orthopedic trauma surgeons and 2 senior residents. The appropriateness of the operative intervention was determined. The American Academy of Orthopedic Surgery (AAOS) and American College of Surgeons (ACS) guidelines for surgery during the pandemic were considered.

Results: Seventy-six surgical encounters were performed on 71 inpatients including 99 total procedures. No outpatient procedures were performed. Fifty-four of 71 patients were male. There was a mean age of 51.6 years. Of 71 patients, 41 presented to the emergency department without trauma activation with a mean time to presentation of 2.7 days post injury. The most urgent surgical indications included 18 hip fractures, 18 periarticular fractures, 17 open fractures, 7 severe infections, 5 pelvic fractures, 5 femoral shaft fractures, 3 spinal injuries, 1 tibial fracture, 1 tendon injury, and 1 clavicle fracture. Four procedures could have been delayed for conservative management without causing significant harm. Upon discharge 13/71 patients had tested positive for COVID, 41/71 had remained negative throughout their hospital stay, and 17/71 patients never were tested. Four patients contracted COVID in the hospital. There were 4 in hospital deaths, 2 attributed to hypoxic respiratory failure secondary to COVID pneumonia.

Conclusion: It was determined that 72/76 cases were considered appropriate in following guidelines of the AAOS and ACS. This highlights the value of halting outpatient procedures and limiting patient exposure to COVID. Comprehensive patient/provider discussions addressing the risks, benefits, alternatives to surgery, and the risk of exposure to respiratory illness are vital. It behooves the surgical team to follow established guidelines such as those of the AAOS and ACS when triaging orthopedic patients for a surgical admission.

Keywords: COVID, operative indications, urgent surgery

1. Introduction

In March of 2020 the coronavirus disease 2019 (COVID-19) pandemic struck New York City swiftly. Nearly 1/3rd of the first 150,000 COVID tests performed in the area were confirmed positive. The incidence of new cases steadily increased from 2128 new cases on March 16 to 6378 new cases on April 6. In order to address the vast influx of critically ill patients New York Hospitals scrambled to prepare new protocols and alter existing practice paradigms. The expected shortages of personal protective equipment, hospital beds, ventilators, and human resources specifically impacted the practice management of orthopedic surgeons as well as operative indications. In an attempt to conserve resources at our Level 1 Trauma Center the orthopedic surgery department curtailed operative indications during the pandemic’s peak and scrupulously considered what qualified as urgent and emergent procedures. All other orthopedic surgeries were cancelled to conserve resources and our providers drew on the long history of nonoperative orthopedic management and temporizing treatments to provide care for our patients.

While our department was indicating surgical procedures on a case-by-case basis, operative guidelines were released from both the American Academy of Orthopedic Surgeons (AAOS) and the American College of Surgeons (ACS). Although useful, these guidelines served as a broad outline for the management of orthopedic conditions and did not apply to all cases. This study aimed to assess the appropriateness of the operative indications at our New York City Level 1 Trauma Center during the early days of the COVID-19 pandemic. Specifically, the study sought to
classify each operative intervention during the pandemic’s peak as appropriate or inappropriate, and determine the morbidity or mortality associated with COVID-19 exposure on this cohort of patients. Finally, we aimed to examine how successful we were in allocating hospital resources and judge the efficacy of the guidelines issued by the AAOS and the ACS.

2. Methods

This study represents a retrospective review including all patients who underwent an orthopedic procedure in the operating room setting at an academic Level 1 Trauma Center in the Bronx, NY during the peak of the COVID-19 pandemic in New York City. The peak months of COVID at our hospital were based on institutional data. Additionally, this time frame was chosen because there were no elective procedures being performed in the Department of Orthopedic Surgery, as mandated by both hospital policy and government regulation. Based on this data all patients who underwent procedures between the dates of March 16, 2020 and May 16, 2020 were included. All use of patient data was approved by local Institutional Review Board.

Data collection encompassed multiple facets of both the patient and hospital profile. Demographic data including gender, age, height, weight, and body mass index (BMI) were collected. Further data relevant to each patient’s presentation was collected including date of injury/onset of symptoms, date of hospital presentation and mechanism of injury/disease pathology. Information pertinent to the surgery was then collected, including date of surgery, time from hospital admission to surgery, date of discharge, length of stay, trauma activation level (if applicable), surgical indication, surgical procedure performed, estimated blood loss, and operative time. Relevant patient medical information was gathered, including COVID-19 test results, COVID-19 status at discharge, and number of COVID-19 tests. Hospital course was recorded including intubation status, need for supplemental oxygen, and transfusion requirement. Finally, information related to complications was recorded. This included symptomatic deep vein thrombosis, pulmonary embolism, pneumonia, urinary tract infection, mortality in the hospital, mortality after discharge, discharge disposition, and hospital readmission.

Surgical indications, procedures performed and other surgical data was gathered from operative reports. In cases where multiple operations were performed, the most urgent operative indication was established by a panel of 2 fellowship trained orthopedic trauma surgeons and 1 post graduate year 5 (PGY-5) and 1 PGY-4 orthopedic resident. Unanimous agreement was required to determine the “most urgent operative indication” and in the case of disagreement a vote was used to determine the indication. The most urgent surgical indications were categorized, and included: severe infection, traumatic spinal cord compression, open fracture, hip fracture, pelvic fracture, femoral shaft fracture, tibial shaft fracture, periarticular fracture, tendon injury, and clavicle fracture. While normally a clavicular fracture would not be considered an urgent procedure, this clavicle fracture was categorized as an urgent case due to the presence of skin tenting. It was felt that urgent surgery was required to prevent an open fracture. Every surgical procedure was assessed for appropriateness retrospectively by the panel using guidelines set forth by AAOS and ACS during the COVID-19 pandemic.[4,5] As these guidelines were released after the study period our aim was to compare if our institutional practices during the early days of the pandemic were in line with the guidelines put forth later on by the AAOS and ACS.

All statistical analysis was performed using STATA 13.0 (Stata Corp LLC, College Station, Texas). Descriptive statistics were used to describe the study population. Data is presented as mean ± standard deviations. Comparisons were made via chi-squared tests, Fisher exact test, or student t-tests as appropriate. Any factor with a P value less than .05 was considered statistically significant.

3. Results

In this retrospective review of all orthopedic patients treated at our institution during the pandemic, there were a total of 76 surgical encounters. Of the 76 encounters, there were 99 total intraoperative procedures that were completed on 71 patients. This included 54 male and 17 female patients. The mean age of the patients was 51.6 years, with an age range of 13 to 97 years. The mean BMI of all patients was 27.2. All surgical procedures were performed on inpatients admitted for orthopedic or non-orthopedic medical conditions as our department had halted all outpatient procedures to conserve resources.

Forty-one of the 71 patients presented to the emergency department without a trauma activation. Five patients presented as level 3 trauma activations, 19 patients presented as level 2 activations, and 6 patients presented as level 1 activations. Time from injury to hospital presentation was analyzed for patients who presented with trauma activation and for those without trauma activations. The mean time to presentation was 2.7 days post injury for patients who did not have trauma activation and 0.03 days post injury for those who did have trauma activations.

The cases were then categorized by the panel of 2 fellowship trained orthopedic trauma surgeons and a PGY-5 and PGY-4 orthopedic resident according to the most urgent surgical indication. Of the 76 surgical encounters, the most urgent operative indications were as follows: 18 hip fractures, 17 periarticular fractures, 17 open fractures, 7 severe infections, 5 pelvic fractures, 5 femoral shaft fractures, 3 spinal injuries, 1 tibial fracture, 1 tendon injury, and 1 clavicle fracture (Fig. 1). There were no disagreements in determining the most urgent operative indications among the panel (Fig. 1).

The panel determined that 4 of the 76 surgical encounters could have been avoided or delayed for nonoperative management without causing significant long term or irreversible harm to the patient. These 4 procedures were deemed inappropriate. However, the panel noted that these 4 procedures were completed on inpatients that were admitted for non-orthopedic medical reasons. Therefore, it was determined that there was no unnecessary or avoidable exposure to COVID-19 in these 4 cases. These procedures consisted of removal of hardware, open reduction internal fixation for 2 proximal humerus fractures, and open reduction internal fixation of a midshaft clavicle fracture.

Of the 71 total patients, 13 tested positive for COVID-19 at some point during their hospital stay. Forty-one patients remained COVID-19 negative during the entirety of their hospital stay. Seventeen of the 71 patients did not receive any COVID-19 testing.(Fig. 2) During the study period COVID tests were extremely scarce. Testing was prioritized for patients who exhibited obvious signs and symptoms of COVID-19. Not all trauma patients were routinely tested preoperatively. However, when patients became symptomatic postoperative testing was triggered. All patients who were taken to the operating room were presumed COVID positive for intubation and cleaning protocols. Four patients had tested negative at the beginning of
their hospital stay, became symptomatic and subsequently tested positive for COVID-19 during their admissions.

For the COVID positive cohort, the average BMI was 27.1 with a mean age of 38 years. Eleven of the COVID positive patients were male, and 2 of the patients were female. Two COVID positive patients died while admitted due to complications associated with COVID-19. Another patient who had contracted COVID-19 during their hospital stay was ultimately transferred to another hospital system closer to their home after their initial injuries were temporized and was subsequently lost to follow up. The other 10 patients did not experience early COVID related morbidities or mortality in the time the study took place. Patients were followed until August of 2020.

In total, there were 4 in hospital deaths. One death was attributed to trauma in a patient with a pelvic fracture. Two deaths were attributed to hypoxemic respiratory failure secondary to COVID pneumonia. One of these 2 patients had a bimalleolar ankle fracture and the other had an open tibia fracture. The final patient sustained a hip fracture and succumbed postoperatively to a massive pulmonary embolism. This patient tested negative for COVID during his stay at the hospital. Despite the negative test it is possible that this PE and mortality was related to COVID-19 infection, given associations between the virus and deep vein thromboses and pulmonary emboli.[6]

Of the 4 patients that contracted symptomatic COVID-19 during their stay, the mean age was 48.5 years. All 4 of the patients were male. There were no mortalities recorded in this group.

4. Discussion

In this study, we analyzed all orthopedic surgery cases at a single level 1 trauma center during the COVID-19 pandemic in New York City. Using established guidelines from the AAOS and ACS, we determined the “appropriateness” of each operative indication based on the nature of the injury and/or the urgent or emergent status of the surgical intervention. This study reports a high level of appropriate operative indications with minimal unnecessary exposure to COVID-19 in the early months of the pandemic in New York City.

During the initial months of the COVID-19 pandemic little was known about the virus and the potential risk associated with unnecessary in-hospital exposure to the virus. As such, hospital systems placed judicious protocols to avoid unnecessary exposures. During this uncertain time, informed consent conversations with families and patients drastically changed. For example, although the merits of early operative intervention for geriatric hip fractures are clearly defined in the literature, the real risk of unnecessary exposure to COVID-19 during the pandemic may change a patient with limited ambulatory requirements desire for early operative intervention.[5] This cohort clearly demonstrates the real risk associated with contracting COVID-19 as 2 patients in this cohort died secondary to COVID-19 hypoxemic respiratory failure. Furthermore, 4 patients who were COVID negative on arrival either contracted the illness during their stay or seroconverted during their stay.

Anecdotally, less people presented to the emergency department with acute traumatic injuries during the pandemic and there were longer delays between the time of injury and time of presentation. This concept is supported by the 2.7 days mean time to presentation reported in patients who presented to the emergency department on their own accord. The patients who did have trauma activation had a mean time to presentation of
0.03 days post injury. This phenomenon was likely due to fear of contracting COVID-19 upon presentation to the hospital.

As our understanding and medical management of COVID-19 improves, further discussion between patients and providers should outline the risks and benefits of elective surgical interventions in areas with high exposure risk to COVID-19. Future guidelines should be streamlined to quantify risk factors, comorbidities, and operative complexity in order to help healthcare providers weigh the risks of delaying surgery in light of respiratory viral illnesses. While guidelines exist to describe the operative urgency of various pathologies there is little data elucidating the consequences of postponing outpatient operations on outcomes.\[3,7\] It would behoove institutions to prepare for the possibility of future pandemic level respiratory illnesses by creating general orthopedic recommendations regarding the time sensitive nature of procedures typically performed on an outpatient basis. In this unprecedented time a systematic and equitable system for defining which hospitals are able to perform outpatient procedures and which procedures require urgent or emergent operative intervention would provide more equitable care to patients, especially in urban and underserved areas. It was our experience that many institutions continued to perform nonurgent outpatient procedures through the entirety of the pandemic and were largely shielded from caring for the high case load of COVID patients in lower socio-economic areas. Standardized guidelines, and improved communication between hospitals, local government and federal government could optimize access to care for all patients. In a health care environment where the immediate dangers of COVID-19 exposure must be weighed against long term sequelae of delayed operative or nonoperative management, ensuring equal access to care is vital for underserved communities.

Obesity has been linked to greater COVID related morbidity and mortality, but not necessarily greater risk of contracting the virus.\[8\] In our limited number of COVID positive patients, there were 2 COVID related mortalities. These patients had increased BMI's categorized as “obese” by the Centers for Disease Control and Prevention (CDC).\[9\] Of the other eleven COVID positive patients, 2 required supplemental oxygen and intubation. These 2 patients both were in the “normal” BMI category.\[9\]

Parvizi et al demonstrated that despite the pandemic there is still significant demand for elective orthopedic procedures. Furthermore, many of the patients who desire these procedures are at higher risk of COVID associated complications as they are of an older demographic, such as patients who desire total joint arthroplasty.\[10\] Despite continued patient demand for elective orthopedic procedures, avoiding unnecessary exposure to COVID-19 will continue to be vital. Furthermore, protocols that help us plan and prepare for the possibility of future respiratory illnesses are paramount.

5. Limitations

The sample size is a limiting factor with regards to drawing conclusions with respect to COVID-19. With 13 patients, it is difficult to make substantive claims that discount the risk of random error. However, this study aimed to specifically evaluate the appropriateness of orthopedic indications at a level 1 trauma center during the peak of the pandemic. As the panel which determined the appropriateness of each operative indication were from the institution where these procedures were performed, inherent bias is introduced. Nonetheless, not all procedures were found to be considered appropriate and only through honest introspection can we prepare for future events and limit risk to our patients.

6. Conclusion

This study chronicles each surgical case taken to the operating room during the height of the COVID-19 pandemic in New York City. The study assessed the appropriateness of each indication retrospectively and determined that the vast majority of cases were considered appropriate. This highlights the value of stopping outpatient procedures and limiting patient exposure to COVID-19. As new light is shed on the medical implications of COVID-19, joint decision making is paramount in the management of urgent and emergent orthopedic injuries. Comprehensive patient/provider discussions addressing the risks, benefits, and alternatives to surgery, and the risk of exposure to viral respiratory illness are vital. It also behooves the surgical team to follow established guidelines such as those of the AAOS and ACS, when triaging orthopedic patients for a surgical admission (Appendix, http://links.lww.com/OTA/A37).

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