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The Incidence and Outcomes of Post-Operative SARS-CoV-2 Infection in Unscreened Orthopedic Patients Treated Surgically at UK Major Trauma Centre - Implications for Resumption of Elective Orthopedic Surgery

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Abstract

Background: The objectives of this study were to establish the incidence of contracting perioperative SARS-CoV-2 infection in a cohort of unscreened asymptomatic patients undergoing orthopedic trauma surgery, better understand the implications of contracting the virus in the post-operative period and risk stratify for future surgery.

Methods: Data on 301 consecutive adult patients undergoing orthopedic trauma surgery in a UK major trauma centre was collected prospectively over a 13-week lockdown period at the height of the first wave of the pandemic.

Results: A total of 134 patients were treated for a fractured neck of femur, 17 were treated for poly trauma and 151 were treated for isolated trauma or infection. 217 (72.1%) were unscreened pre-operatively and 84 (27.9%) had a SARS-CoV-2 test. 34 patients (11.3%) showed evidence of contracting SARS-CoV-2 in the post-operative period. There were 27 mortalities (9%) in the post-operative period. This was significantly higher than for the same time period in 2019 (p<0.0001). Mortality was attributable to COVID-19 in 13 patients (4.3%). The mortality rate in ASA1 or 2 patients aged <70 yrs (n=125) was 0% and the overall incidence of SARS-CoV-2 infection was 5.6%. In comparison, the mortality rate of ASA3 or 4 patients aged >70 years (n=112) was significantly higher (20.5%, 23 patients p<0.0001). In 10 patients (8.9%) this was attributable to SARS-CoV-2. The overall incidence of SARS-CoV-2 infection in this group was 13.4% - also significantly higher (p=0.039). Similarly, Patients admitted for ≤ 1 night (n=55) had a 0% mortality and incidence of SARS-CoV-2 infection of 7.2%. Comparatively, patients admitted for >1 night (n=246) had a mortality rate of 11% (5.3% attributed to COVID) and incidence of SARS-CoV-2 infection of 12.6%. Mortality was significantly higher in this group (p=0.01), but infection risk was higher without reaching statistical significance (p=0.265). The study showed no significant difference based on anesthesia type.

Conclusion: The risk of post-operative COVID-19 in an unscreened asymptomatic population following orthopedic trauma surgery was negligible in ASA1 and 2 patients <70 years old. There was a positive correlation with low mortality and COVID diagnosis in day-case or single night admissions.

Keywords: SARS-CoV-2; COVID-19; Coronavirus; Orthopedics; Trauma; Elective surgery

Introduction

Since the World Health Organization (WHO) declared Coronavirus Disease 2019 (COVID-19) a pandemic in March 2020, the disease has continued to rapidly spread across the world. By October 2020, the disease had infected over 37 million people and led to over 1 million deaths in 236 countries, with an estimate case fatality ratio of 2.9% [1]. This global pandemic due to Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) has severely affected healthcare provision in the United Kingdom (UK). Early redeployment of surgical personnel and theatre staff to critical care as well as shielding of vulnerable healthcare professionals has affected the workforce significantly. Guidance from the Royal College of Surgeons (RCS) [2] and British Orthopedic Association (BOA) [3] has led to widespread cessation of elective orthopedic operations. However, orthopedic surgery

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for traumatic and infectious pathologies has continued throughout the COVID-19 pandemic, often in unscreened patients. Studying this patient group can provide insights that can aid risk stratification in the recovery plan for elective surgery.

Several recent studies have found that patients with SARS-CoV-2 undergoing surgical procedures have increased risk of postoperative pulmonary complications and mortality as high as 20% [4-7]. The mortality of hip fracture patients with postoperative SARS-CoV-2 is even higher at 30% [6,7]. Until vaccination is widespread and successful, the risks of SARS-CoV-2 during surgical treatment will need to be taken account of for some time to come.

Although, the literature has shown the increased risks of surgery with perioperative SARS-CoV-2 infection [4-7], the risk of asymptomatic unscreened patients developing SARS-CoV-2 post-operatively is unclear. Similarly, the consequence to these patients of contracting the virus in the perioperative period is also unknown. We investigated a cohort of patients who underwent emergency trauma surgery without preoperative self isolation or testing. These were patients treated in a Major Trauma Centre (MTC) during lockdown from 23rd March 2020 to 11th May 2020. The patients treated during this period represent a cohort of patients without any framework to reduce their risk of infection. The emergency nature of their conditions means that they may require surgery regardless of their SARS-CoV-2 test result. They present at all ages, often after injuries when away from home, not self-isolating. They may be at particular risk from COVID-19 due to the pro-inflammatory and immunosuppressive effects of both trauma and surgery [4].

The primary objectives of this study were to:

- Establish the incidence of perioperative SARS-CoV-2 in a cohort of unscreened asymptomatic patients undergoing orthopedic trauma surgery
- Determine the sequelae of contracting SARS-CoV-2 in the post-operative period
- Stratify the risk to patients undergoing future surgery.

Methods

Study design

This prospective cohort study included all adult patients undergoing surgical treatment by the Trauma & Orthopedic team at a UK major trauma centre between 1st March 2020 and 30th May 2020.

Inclusion criteria: All adult patients with acute trauma or infection requiring emergency or urgent orthopedic surgical intervention.

Exclusion criteria: Patients aged under 16 at the time of injury, patients still a current inpatient at time of data analysis, patients already inpatients when referred to the orthopedic team and patients with a diagnosis of COVID-19 on admission.

Data collection

Data collection was performed by 2 orthopedic registrars (AS/MD) using a standardized data collection proforma. Data was collected from electronic patient records, radiology systems and pathology systems. All patients were then contacted *via* telephone at least 21 days after their discharge and at least 30 days after their surgery, in order to complete the dataset.

The following dataset was collected:

- Patient demographics and baseline characteristics (age, gender, ASA grade, comorbidities)
- Pre-operative COVID Screening (pre-operative COVID symptoms, pre-operative COVID test results, pre-operative chest imaging results, pre-operative isolation at home)
- Inpatient factors (diagnosis/diagnoses, duration of inpatient stay, anesthetic type)
- Post-operative outcomes (surgical complications, post-operative COVID test results, post-operative COVID symptoms and mortality)

Definitions

The 'COVID test' is defined as the Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) SARS-CoV-2 assay using combined nose and throat swabs performed at the trust.

Potential COVID symptoms were defined as shortness of breath, cough, fever, loss of smell, loss of taste as per the UK Government official list of COVID-19 symptoms updated on 18th May 2020 [8].

Either a positive test or presence of symptoms were used to avoid underestimation of risk given the issues with test sensitivity (70% sensitivity) [9] and to consider a worst-case scenario.

The 30 days mortality of trauma patients in the same time period in 2019 was also examined in order to better understand the effect of the pandemic on perioperative mortality.

Statistics and ethics

Chi squared test was used for statistical analysis between groups. No ethical approval was required as this is a service improvement project studying a patient group who are still in active follow up.

Results

Emergency or urgent procedures were performed for 316 patients: After exclusions 301 were included for analysis. We excluded 9 patients (5 current inpatients, 1 aged under 16, 2 inpatients under another medical team when referred, 1 with positive diagnosis of COVID-19 on admission) and 6 patients were uncontactable and lost to follow up.

Demographics and baseline characteristics

Age: The age range was 16 to 94 years, with a median age of 73 and an Interquartile Range (IQR) of 50 to 84.

Gender: A total of 166 women (55.1%) and 135 men (44.9%) were included.

ASA grade: 85 patients were ASA1 (28.2%), 89 ASA2 (29.6%), 99 ASA3 (32.9%) and 28 ASA4 (9.3%).

Preoperative COVID screening

Preoperative COVID symptoms: 6 patients had pre-operative symptoms potentially indicating SARS-CoV-2 infection (1 fever, 4 cough, 1 fever & cough). Of these 5 had negative findings on both RT-PCR and chest imaging so remained in the study with 1 having a positive RT-PCR test and was excluded from analysis.

Preoperative COVID tests results: 84 patients (28%) underwent RT-PCR screening tests on admission, testing negative. The remaining 217 (72%) were unscreened on admission.

Preoperative chest imaging results: 57 Patients (18.9%) had

Table 1: Overall mortality.

Died (+ve test)	Died (Symptoms but -ve test)	Died without COVID-19
5/10 Female	3/3 Female	9/14 Female
6/10 #NOF	2/3 #NOF	10/14 #NOF
9/10>70	3/3>70 yrs	14/14>70 yrs
2/10 ASA2, 3/10 ASA3, 5/10 ASA4	2/3 ASA3, 1/3 ASA4	1/14 ASA2, 9/14 ASA3, 4/14 ASA4

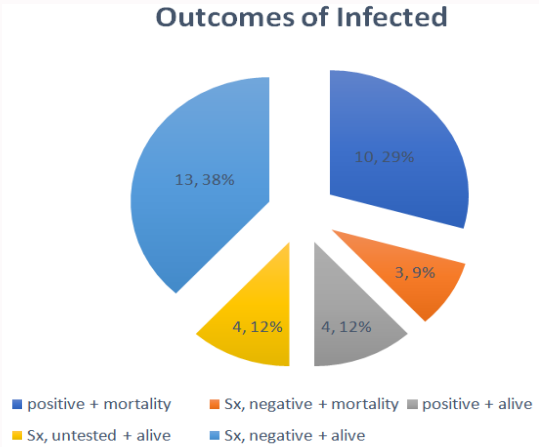

Figure 1: Outcomes following SARS-CoV-2 infection.

chest imaging on admission; all negative for signs of SARS-CoV-2 infection. 244 (81.1%) had no screening chest imaging.

Pre-operative isolation at home: Only 73 (24.2%) were isolating at home prior to admission, either shielding as per government advice, or following advice from the orthopedic team to isolate whilst awaiting a planned admission for their trauma surgery.

Inpatient factors

Diagnosis: A total of 133 patients (44.2%) presented with low energy fractured neck of femur, 17 patients (5.6%) presented with poly trauma and 151 patients (49.8%) had isolated trauma or infection.

Duration of inpatient stay: The duration of inpatient stay range was 0 to 47 nights, with a median stay of 7 nights and an IQR of 2 to 15 nights.

Anesthetic type: A total of 139 patients had a General Anesthetic (GA) only, with a further 32 having a combination of general and regional anesthetic. Therefore, a total of 171 (56.8%) underwent a general anesthetic. The remaining 130 (43.1%) had only regional or local anesthesia.

Postoperative outcomes

Postoperative COVID tests results: A total of 14 patients (4.7%) tested positive for SARS-CoV-2 postoperatively. As routine testing was done prior to discharge to nursing or residential homes, 56 patients (18.6%) underwent routine postoperative tests for the virus without showing any symptoms, all testing negative.

Postoperative COVID symptoms: In addition to the 14 patients testing positive, a further 16 patients (5.3%) had symptoms but tested negative for the virus and further 4 patients (1.3%) had symptoms typical for infection but were not tested. If all the symptomatic patients were positive, the overall infection rate was 11.3% (n=34) (Figure 1).

Table 2: Patients who had SARS-CoV-2 infection and survived.

Surviving (+ve test)	Surviving (Symptoms but -ve test)	Surviving (Symptoms but not tested)
2/4 Female	7/13 Female	2/4 Female
3/4 #NOF	9/13 #NOF	0/4 #NOF
4/4>70 yrs	10/13>70 yrs	0/4>70 yrs
4/4 ASA2	2/13 ASA1, 6/13 ASA2, 5/13 ASA3	4/4 ASA2

Table 3: Impact of length of stay.

In hospital stay 0-1 night	In hospital stay >1 night
n=55	n=246
0 Mortalities (0%)	27 Mortalities (11%) (p=0.01) (10 +ve, 3 Symptomatic & –ve test)
4 COVID-19 (7.3%)	31 COVID-19 (12.6%) (p=0.265)
0 Symptomatic with +ve test	14 Symptomatic with +ve test
3 Symptomatic not tested	2 Symptomatic not tested
1 Symptomatic and -ve test	15 Symptomatic and -ve test

Mortality and morbidity: A total of 10 patients (3.3%) died following positive SARS-CoV-2 RT-PCR tests, representing 71% of the positive test results. 3 symptomatic patients (1%) died following a postoperative negative test result for SARS-CoV-2. This results in an overall COVID-19 related mortality of 4.3%. 14 patients (4.7%) died without a post-operative test for or symptoms attributable to the virus. Therefore, 27 patients died in total with an overall all-cause mortality rate of 9%. 19 (70.4%) of these were fractured neck of femur patients (Table 1). Excluding these mortalities, the surviving 4 patients with positive test results and 17 with symptoms with or without negative test results all suffered only mild symptoms with full recovery to date (Figure 1 & Table 2). During the same time period in 2019 12 out of 475 patients died within 30 days of their surgery, giving a 30 days mortality of 2.5%, significantly lower than our study period (p<0.0001) (Figure 2).

Complications: There were 6 superficial wound infections, 3 neuropraxias, 1 failure of fixation, 1 skin tip necrosis and 1 tight scar tissue requiring surgical release.

Subgroup analysis and risk stratification

Impact of length of stay: As shown in Table 3, there was a statistically higher mortality rate in those patients staying in hospital for more than 1 night. There was also a trend towards higher infection rate in this group, but it did not reach statistical significance.

Impact of age and ASA: As shown in Table 4, there was a statistically significant higher rate of both mortality and infection rate in patients aged over 70 and ASA3 or 4 in comparison to those aged under 70 and ASA1 or 2.

Impact of anesthetic type: Patients undergoing GA (n=171) had a mortality rate of 7.6%, whereas those undergoing regional anesthesia only (n=130), had a mortality rate of 10.8% (p=0.45). COVID incidence in the GA group was 9.9% compared to 3.1% in the regional anesthesia group (p=0.50). Neither mortality nor rate of infection showed any significant difference by anesthetic type (Table 5).

Discussion

The UK response to COVID-19 pandemic has included redeployment of surgical personnel and theatre staff to critical care

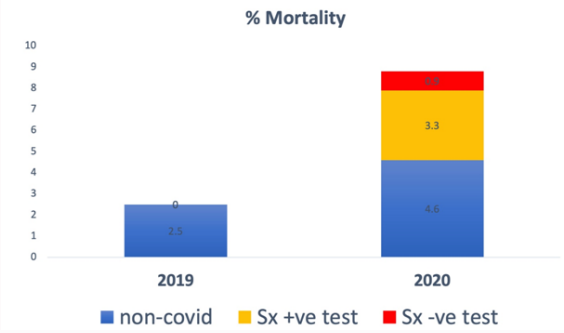

Figure 2: Mortality in 2020 compared to the same period in 2019.

Table 4: Impact of age and ASA.

<70 Y, ASA1 OR 2	>70 Y, ASA3 OR 4
n=125	n=112
0 Mortalities (0%)	23 Mortalities (20.5%) (p<0.0001) 10 COVID related (8.9%) (7 +ve, 3 Symptomatic & –ve test)
7 COVID-19 (5.6%)	15 COVID-19 (13.4%) (p=0.039)
0 Symptomatic with +ve test	7 Symptomatic with +ve test
4 Symptomatic not tested	0 Symptomatic not tested
3 Symptomatic and -ve test	8 Symptomatic and -ve test

Table 5: Impact of anaesthetic type.

General Anaesthetic	Regional Anaesthetic only
n=171	n=130
13 mortalities (0%)	14 mortalities (10.8%) (p=0.45)
17 COVID (9.9%)	4 COVID (3.1%) (p=0.050)

units, shielding of vulnerable healthcare professionals and cessation of elective orthopedic operations [2,3]. Consequently, the waiting list for elective orthopedic surgical procedures has been considerably prolonged. Dealing with this backlog will involve balancing the increased risk of surgical procedures against the benefit to patients [4,10]. In contrast, trauma and emergency care has continued throughout the pandemic and analyzing the effect of COVID-19 on this group may provide some useful information when planning resumption of elective surgery. The aims of this study were to

1. Establish the incidence of perioperative SARS-CoV-2 in a cohort of unscreened asymptomatic patients undergoing orthopedic trauma surgery.

2. Determine the sequelae of contracting SARS-CoV-2 in the post-operative period and

3. Stratify the risk to patients undergoing future elective surgery. To date, available outcome data of patients undergoing surgery during the pandemic remains limited, making it difficult for physicians and institutions to determine how to stratify patient risk factors when providing surgical services. Our cohort represents a varied patient demographic undergoing surgery during the first wave of the pandemic despite the risks involved. The results of this study can therefore be used to both understand and stratify risk to patients undergoing future elective surgery.

Incidence of perioperative SARS-CoV-2

Given the poor sensitivity of SARS-CoV-2 RT-PCR test [9], we chose to rely on clinical screening using WHO and UK government guidelines [8], examining a worst-case scenario, where anyone with the classical symptoms considered having the virus. We acknowledge the limitation that despite a strong likelihood of patients being infected with SARS-CoV-2, the lack of formal viral testing in all cases makes it impossible for us to verify this claim. There were also likely asymptomatic SARS-CoV-2 positive patients in the cohort, but the number of these is difficult to quantify without universal screening and a 100% accurate test. The overall incidence of SARS-CoV-2 infection identified in our cohort was 11.3%. The RT-PCR confirmed incidence was 4.7%.

The sequelae of contracting SARS-CoV-2 in the post-operative period

The COVID related mortality was 4.3% in our study. The overall mortality in this period was 9% which was significantly higher than the same period in 2019. This increase in mortality is supported by several recent studies [4-7]. 10 out of 14 patients died following positive SARS-CoV-2 RT-PCR tests, representing 71% of the positive test results. Aside from this high mortality rate, the remaining symptomatic patients, whether tested positive or not, all had only mild symptoms that fully resolved by 30-day follow-up.

Stratifying the risk to patients undergoing future elective surgery

We found statistically significant differences in both COVID-19 infection rate and mortality based on patient age/ASA, highlighting the known risk association of age as well as comorbidity profile with serious illness secondary to viral infection [11,12]. We also found a statistically significant difference in mortality in patients admitted for 1 night or less. The SARS-CoV-2 infection risk was also higher in patients admitted more than 1 night (12.6%) without reaching statistical significance.

Our findings support the safety of resuming elective day-case procedures, especially in a younger, fitter cohort. Although not statistically significant, longer admissions should be avoided, either by selecting appropriate cases, or by expediting discharge. Given the winter bed pressures in the NHS even before COVID-19, the relative safety of day-case procedures shown by our study gives some hope to performing some elective surgery for patients.

There have been concerns regarding the safety of general anesthetics during the pandemic, leading to joint American and European recommendations that regional anesthesia should be preferred over general anesthesia where possible [13]. This is in part due to the risk of transmission to nearby staff during intubation, an Aerosol Generating Procedure (AGP) [13,14], but there is also some evidence that general anesthesia may contribute to decreased perioperative immunity and may influence the high mortality seen in patients having surgery with undiagnosed perioperative COVID-19 [4,15]. Although our study showed no significant difference between regional or general anesthesia, the reduced risk to staff as well as the previously known benefits in orthopedic surgery make regional anesthesia still often the best option, although the optimum anesthetic must be considered on an individual case by case basis.

Conclusion

In conclusion, to the best of our knowledge, this is the first study examining the incidence and implications of COVID-19 in patients treated surgically for all types of orthopedic trauma or infections during the peak of first wave of the pandemic in a major trauma setting. The risk of post-operative SARS-CoV-2 in an unscreened

asymptomatic population in a non-green zone following orthopedic trauma surgery was negligible in ASA1 and 2 patients <70 years old. There was a positive correlation with low mortality and COVID-19 diagnosis in day-case or single night admissions. The results represent a worst-case scenario and are useful in risk stratification for elective fully screened patients due to undergo surgery in green zones during the pandemic.

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