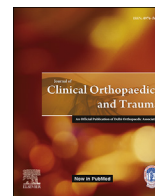




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Outcome of trauma and orthopaedic surgery at a UK District General Hospital during the Covid-19 pandemic

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ABSTRACT

Introduction: There are suggestions that elective surgery performed during the incubation period of COVID-19 infection may cause an immediate impairment of cell-mediated immunity, leading to high morbidity and mortality. However is contrasting data about the associated mortality. Since the outbreak, our unit has maintained a prospective database recording Trauma and Orthopaedic surgical activity. Our aim was to share our experience of the first 3 months with prospective data on outcome of essential surgery during the covid-19 peak. Our focus in this report was on the mortality rate as services begin to open. **Methods:** We prospectively collected data during the peak of the pandemic in the UK, for fracture neck of femur patients (NOF) the most commonly performed surgical procedure and the most vulnerable during this period. We compared this Covid-19 cohort of NOFs against a cohort of NOFs during the same time in 2019 and another cohort of NOFs in 2020 outside the lockdown period to compare mortality rates and give a broader perspective.

Results: During the period March 1, 2020 to May 31, 2020, total of 206 patients were operated. Ninety-four fracture NOF and another one hundred twelve essential surgical procedures were performed. In the NOF cohort, there were nine patients that died. Three of them were covid-19 positive, one was not tested and the rest five were covid-19 negative. There was no mortality reported in the non NOF group. **Conclusion:** In our unit, during the lock down period, mortality rate in patients undergoing fracture NOF was not significantly different from a similar cohort earlier in the year and similar period last year. We have not observed any mortality, to date in the Non NOF procedures carried out.

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1. Introduction

Novel Coronavirus disease 2019 (COVID-19), caused by the SARS corona virus 2 (SARS-CoV-2) broke out in Wuhan, Hubei Province, the People's Republic of China in December 2019. Over the next few months it spread and lead to a worldwide pandemic,¹ the largest health care crisis of this century.² The course of the COVID-19 is long, and is highly contagious even during the incubation period.^{3,4}

Furthermore, asymptomatic carriers may potentially transmit the virus during incubation time, making the identification and prevention of infection highly challenging.³ There are reports of

hospital-associated transmission affecting health care workers patients and carers; the real risk is currently unknown.⁵ The likelihood of health-care workers getting infected is three times more than the general population.⁶

Upon the announcement of lockdown in the UK, the practice of Trauma and Orthopaedic surgery in the UK was transformed along Royal College of Surgeons (RCS)⁷; British Orthopaedic Association (BOA)⁸ and Public Health England (PHE)⁹ guidelines. There was noticeable reduction in Accident and Emergency presentation and Trauma admissions.¹⁰ The British Orthopaedic Association (BOA) had recommended that during the corona virus pandemic, there should be an increased emphasis on managing patients with non-operative strategies.¹¹ Although, most non-essential surgeries have been cancelled during the pandemic, patients with life and limb-threatening conditions still underwent surgery.¹¹

There are suggestions that elective surgery performed during

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the incubation period of COVID-19 infection may cause an immediate impairment of cell-mediated immunity, leading to high morbidity and mortality.^{3,12} Lei et al. in a retrospective cohort of elective surgeries undertaken in asymptomatic patients during the outbreak reported 44.1% patients needed ICU care and mortality was 20.5%.³ Another multicenter study conducted over 24 countries reported clinical outcomes of patients who had surgery with perioperative SARS-CoV-2 infection. In that cohort, postoperative pulmonary complications occurred in half of the patients with perioperative SARS-CoV-2 infection and were associated with high mortality.¹³

Since the outbreak, our unit has maintained a current database recording Trauma and Orthopaedic surgical activity. As such, we aim to share our experience of essential surgeries performed during the peak of the pandemic, with a focus on the mortality rate as services begin to open.

2. Materials and method

This study was carried out at a District General Hospital, Surrey, United Kingdom. Data was collected from March 1, 2020 to May 31, 2020. Patients operated during this time period were discussed in a daily trauma multi-disciplinary team meeting, as per the usual practise protocol of the department. All the patients operated were included in this study. Their data was recorded on a bespoke Excel (™ Microsoft Office) database. Patient characteristics recorded included demographic data, details of procedure performed, timing to surgery and outcome of surgical intervention. The Covid-19 test status of the patients was recorded when available either prior to surgery, during their hospital stay or in the community. This was either test *not performed* (as patient had no symptoms), *negative* or *positive*. The testing practice continued to evolve during the pandemic. All members of the surgical team were permanent staff and we used regular surgical equipment. All procedures were carried out with full personal protection equipment (PPE) cover and as per guidelines of PHE.^{3,14} Our normally 400-bedded District General Hospital had Covid-19 positive ward, mixed ward where suspected patients were kept and Covid-19 free ward. Theatres were similarly demarcated and segregated between positive/suspected and Covid-19 free theatres. Theatres were cleaned after each case along PHE guidelines.

All patients who had surgery were divided into two groups, Group A: patients that underwent surgery for fracture neck of femur (NOF) and Group B: patients that had essential surgery for any other cause. The commonest procedures performed during the peak of the pandemic were surgeries for fracture NOF, they being the most vulnerable risk group. We compared Group A (NOF) patients operated during the covid-19 crisis to two other separate periods, an earlier period in 2020 and the same time period in 2019, mainly comparing their mortality rates to provide a broader perspective. We also analyzed the outcome of Group B patients which include procedures classified as manipulation under anaesthesia (MUA), soft tissue procedures, bony procedure, arthroscopy and spinal procedures. Statistical analysis was done using Microsoft Excel using 2 tailed, paired T test; Fishers Exact T test was used to determine test for significance.

3. Results

During the peak of the pandemic, Covid-19 period (March 01, 2020 – May 31, 2020) the total number of trauma and orthopaedics surgical procedures performed were 206. The mean age, total number, Covid-19 test¹⁵ status and mortality this period was as in Table 1.

3.1. Group A (NOF patients)

During this period nine patients died following surgery for NOF (8.46%). On further analysis, it was noted that three patients were Covid-19 positive, post operatively. One patient did not have any symptoms and hence was not tested; five patients who died were Covid-19 negative on testing.

3.1.1. Comparative analysis of NOF

We compared the prospectively collected data during the peak of the pandemic in the UK, for Group A, fracture NOF, with historical data from our trauma database: a cohort of NOF's in 2020 outside the lockdown period and another cohort during the same time period in 2019. The results which include total numbers of patients, mean age, number of patients with American Society of Anesthesiologists (ASA)¹⁶ 3 and 4, procedures performed within 24 h, mortality and the list of complications have been summarised in Table 2.

1) 2020 cohort of NOF's (January 01, 2020–February 29, 2020)

During this period a total of 82 fracture NOFs had surgery. The mean age of this group was 82.71 years. Out of the eighty-two patients, sixty-seven were ASA grade 3/4. Forty-seven patients had hemi-arthroplasty and the remaining thirty-five had fixation (Intra-medullary nail, Dynamic hip screw fixation). There was no statistical significant difference in age of patients treated in this 2020 cohort period and during the covid-19 period ($p = 0.61$). Similarly, no significance was found in terms of ASA grade 3/4 distributions of patients in both the groups, ($p = 1$). There were total of 10 deaths in this cohort of 2020 pre Covid-19 period. This was not statistically significant when compared to the Covid-19 period mortality ($p = 0.64$).

2) 2019 cohort of NOF's (March 01, 2019–May 30, 2019)

During this period a total of 106 NOFs had surgery. The mean age of this group was 82.42 years. Eighty patients were ASA grade 3/4. Fifty-two patients had hemi-arthroplasty and the remaining had fixation (Intra-medullary nail, Dynamic hip screw fixation). There was no statistical significance difference in the age of patients with fracture NOF treated in 2019 cohort and the Covid-19 period ($p = 0.44$). Similarly, no significance was found in terms of ASA grade 3/4 distributions of patients in both the groups, ($p = 0.83$). There were four deaths recorded in the 2019 cohort. This was not statistically significant when compared to the Covid-19 mortality, ($p = 0.15$).

3.2. Group B (Non NOF patients)

Patients who had surgery for causes other than fracture NOF were also recorded and reviewed. Such patients were either directly referred for surgery; had planned admissions or were tertiary referrals for specialist Ilizarov fine wire fixation of complex fractures.

The Group B (Non-NOF) included surgical procedures that were classified as manipulation under anaesthesia (MUA), soft tissue procedures, bony procedures, arthroscopy and spinal procedures. Sixty-seven of the 112 patients were not tested to date. Forty-five patients tested negative and none tested positive. Of note, there was no mortality in the Group B patients that underwent surgery during the peak of pandemic. Distribution of cases operated in the Group B and their characteristics are as in Table 3; Table 4 shows their mean waiting time to surgery. The main reason for delay in tertiary transfers from the local hospitals was pending covid-19 test results. Complications of Group B are listed in Table 5.

Table 1
Characteristic of patients operated during the peak of the pandemic, from March 01, 2020–May 31, 2020 (Covid-19 period).

	Total (Group A + B)	NOF patients (Group A)	Non-NOF patients (Group B)
Total number of patients	206	94	112
Mean Age in years		83.5	47.3
Covid-19 not tested	108	41	67
Covid-19 positive	6	6	0
Covid-19 negative	92	47	45
Total number of deaths	9/206 (4.37%)	9 (8.46%)	0

Table 2
Summary of the results of Group A: NOF during covid-19 and comparing them with other NOF cohorts.

	Covid-19 NOF's	2020 NOF's	2019 NOF's	Covid-19 V. 2020 data p value	Covid-19 V. 2019 data p value
Total number	94	82	106		
Mean Age	83.52	82.71	82.42	0.61	0.44
ASA grade 3 and 4	75	67	80	1	0.83
Mortality	9 (8.46%)	10 (8.2%)	4 (4.24%)	0.64	0.15
No. Of procedure performed in <24 h	52 (55.3%)	52 (63.4%)	74 (69.8%)	0.62	0.36
List of complications, (n = number of patients)	<ul style="list-style-type: none"> • Hemiarthroplasty dislocation (1) • Wound ooze (1) • Heel ulcers (2) • Wound infection (1) 	<ul style="list-style-type: none"> • Wound ooze (3) • Wound infection (2) • Fall (1) 	<ul style="list-style-type: none"> • Wound infection (3) • Postoperative bleeding (1) • Hematoma (2) • Falls (2) 		

Table 3
Distribution of cases operated in Group B: Non-NOF and their characteristics.

	MUA	Bony procedures	Soft tissue procedures	Arthroscopic procedures	Spinal procedures
Total number	6	64	19	12	11
Mean Age in years	56.5	51	36.1	44.3	43.6
Covid-19 positive	0	0	0	0	0
Deaths	0	0	0	0	0

Table 4
Describes the mean time to surgery for patients in Group B.

	Average waiting time to surgery
Group B	<ul style="list-style-type: none"> • Surgical admission 27.10 hours • Planned admission 8 days • Tertiary referral 13 days

Table 5
Complications observed in Group B: Non-NOF patients operated during Covid-19 pandemic.

Complication	Number of cases
Deep Wound infection	4
Haematoma	1
Postoperative Blood Transfusion	1
Pin site infection	1
Osteomyelitis	1
Readjustment of frame	2
Re-dislocation of joint	1
Spiral blade cut out	1

4. Discussion

This study was designed to share our data of outcomes of surgical procedures in Trauma and Orthopaedics during the peak of the pandemic in the UK, March 1, 2020 to May 31, 2020; all mortality figures have been reconfirmed as of May 31, 2020. There was a significant change in the presentation of patients during the lock down. However, essential surgery though reduced, carried on. The guidance for testing and use of PPE for Covid-19 in continued to

evolve during the entire period. We have included the timing of tests and results, when performed in hospital and community.

Our focus in this review is on the mortality of patients who have had to undergo essential extremity surgery during this period. The retrospective results from China with significant post-operative mortality in patients undergoing general surgical and obstetric procedures was concerning.^{3,14} Lei et al. in their retrospective cohort study of 34 operative patients with confirmed COVID-19, had 44.1% patients needing ICU care, and the mortality rate was 20.5% however this data does not purely represent orthopaedic surgical cohort. The Lancet recently published on 1128 patients who had surgery in 24 countries in 235 different hospitals between 1st January and March 31, 2020, of whom 835 (74.0%) had emergency surgery and 280 (24.8%) had elective surgery. SARS-CoV-2 infection was confirmed preoperatively in 294 (26.1%) patients. Their overall mortality was 23.8% (268 of 1128). This study has many limitations due its heterogeneity in terms of standardizing testing and operating protocols in the 24 different countries.³ Shakiba et al. have pointed out an overestimation of the mortality rate as well.¹⁷ Muñoz Vives et al.¹⁸ in May 2020 published a multicenter study of proximal femoral fracture surgery. Of the 136 patients included 124 had surgery. Only 62 of the 136 were tested for covid-19, of these 23 were positive and 39 were negative. Seven of the positive patients died and four of the negative. The figures and percentages appear to be higher however the difference does not achieve statistical significance ($p = 0.18$). In this multicenter study, the preexisting mortality figures of each unit are unknown.

There is diagnostic uncertainty regarding false negative reverse transcription polymerase chain reaction in detection of SARS-CoV-2 from nasopharyngeal specimens.^{19,20} Additionally there is an

concern of COVID-19 being transmitted by asymptomatic carriers during the incubation period.^{21,22} Hence comparing mortality of patients that tested positive or negative may not be entirely accurate. Our data demonstrates a mortality of 4.37% (9 out of 206) in the patients that were operated during the peak of the covid-19 pandemic in our hospital. In our series 98 of 206 patients were tested. Of the 98 patients only 6 tested positive; all in the NOF group. Of the 6 that tested positive 3 died; this would suggest an apparently high mortality rate in this sub-group. We have compared our Group A NOF patient operated during the peak of the pandemic against two similar cohorts in 2019 and 2020. We did not find any significant difference in mortality rates. We suggest it is more useful to compare and evaluate a single centers practice, where the pre covid-19 mortality rate is known. We have also analyzed outcomes of patients who had Non NOF surgery during the pandemic (Group B), of 112 only 45 were tested for covid-19 and all found negative. We have had no mortality in this group of 112 patients.

When hospitals resume routine surgery, it is likely to be in environments that remain exposed to SARS-CoV-2.³ In the future, moving ahead hospital-acquired infection will remain a challenge.^{3,5} Strategies are urgently required to minimize pulmonary complications in SARS-CoV-2-infected patients whose surgery cannot be delayed.^{3,4,6,23} As we begin to normalise services and practice, we thought it might be helpful to share our outcome of extremity surgery especially mortality data, for a DGH based practice in the UK. As a reference we have included our data from pre covid-19 period in 2020 and 2019 for the fracture NOF group for a broader perspective and comparison. We found no statistical significance in the mortality figures of these period compared to the Covid-19 period.

This study has limitations. Protocols for laboratory testing and radiological interpretation were not standardized across the period and were constantly evolving. We have not excluded any patient that was operated on in our Unit during this period however we acknowledge there was significant alteration to practice of trauma surgery.

Testing: Unfortunately not all patients undergoing surgery were tested. This was due to protocols for laboratory testing and radiological interpretation was not standardized across the period and was constantly evolving; criteria for testing of patients were also evolving. It is possible we had asymptomatic patients, as well as patients with illness who were not tested. Covid-19 testing has an error rate.

Practice: The practice of trauma surgery had changed with emphasis on non-operative management wherever possible. Whilst this did not affect the NOF (group A) patients; it did have an effect on the number of Group B patients – hence it was not meaningful to compare this cohort with other times in our unit.

5. Conclusion

We have presented our first three months of operating outcomes during the peak of the pandemic. In our Unit, during the lock down period, mortality rate in patients undergoing neck of femur fracture surgery (NOF) was not significantly different from a similar

cohort earlier in the year and similar period last year. We have not observed any mortality in the other essential procedures performed during the same time.

Declaration of competing interest

None.

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