

Orthopaedic Perspective regarding Operating on COVID-19 Positive Trauma Patients

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ABSTRACT

As most of the orthopaedic procedures are Aerosol Generating Procedures (AGPs), the health care workers are potentially at an increased risk of exposure to COVID-19 during surgical procedures. We have presented the protocol that was followed during this lengthy essential trauma procedure. By meticulous pre-planning and following a comprehensive, robust and protocol-driven infection control workflow, the risk of exposure to the healthcare workers can be kept to a minimum.

KEY WORDS: Orthopaedic procedures, COVID-19 exposure, exposure risk

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Introduction:

The Coronavirus (COVID-19) outbreak was first reported in late December 2019 as many patients in the Wuhan province in China were being diagnosed with pneumonia due to an unknown cause. Later, it was linked to a seafood and wholesale wet market in Wuhan, Hubei Province, China [1]. On 30th January 2020, the World Health Organization (WHO) declared this emerging infectious disease, now known as Coronavirus disease 2019 (COVID-19) as a public health emergency of international concern and on 11th March 2020, declared it a global pandemic [2].

As of 28th May 2020, the coronavirus has infected 5,864,341 patients and claimed 360,319 lives throughout the world [3]. The American continent and Europe have now become the epicentre of this pandemic. In the UK, to date, 269,127 patients have been infected with 37,837 deaths [3]. With daily exponential increase in numbers across the globe, screening and diagnostic tests are being stepped up to contain this pandemic.

Emergency, respiratory, infectious diseases and intensive care physicians are the front-line staff taking a central role in the fight against this pandemic. Although the role of orthopaedic surgeons in controlling this outbreak may appear limited, they also have a crucial role to play, especially while managing suspected or confirmed COVID-19 trauma and orthopaedic patients [4].

Due to the frequent use of high-speed drills, most trauma and orthopaedic procedures are Aerosol Generating Procedures (AGPs); they are therefore classed as high-risk Level 3 interventions (**Table 1**) [7,8]. Public Health England guidelines for the use of full Personal Protective Equipment (PPE) while undertaking Aerosol Generating Procedures (AGPs) have evolved over time and the current guidelines are to use full PPE while undertaking these procedures [5]. Currently, this includes an appropriate Filtering Face Piece Class 3 (FFP3) Respirator mask following a computer-based fit test, a long sleeve fluid repellent disposable gown, a full-face shield or a visor for eye protection, and gloves (**Table 2**).

The aim of this paper is to share our experience and lessons learnt from a major trauma operative

procedure. Our main goal is to divide the whole exercise into Pre-operative (including WHO check list), Intra-operative and Post-operative phases, so that the steps are reproducible and easy to follow during the course of the procedure (**Table 3 & Figure 1**).

PRE-OPERATIVE:

The patient was reviewed by the anaesthetic team for anaesthetic fitness. Informed consent was taken and the operative site was marked by the surgical team.

Meticulous pre-operative surgical planning was done to ensure that all the necessary instrumentation and implants/prosthesis were available and checked. Digital templating for prosthesis size was carried out and a printed copy of the images was made available to avoid the need for PACS images in theatre. An appropriate ward pre-operative checklist was completed by the nursing staff. The transfer of the patient between the ward and the theatre complex was meticulously planned and timed in such a way to avoid any unnecessary exposure to others en-route. In our case, due to the proximity of the ward to the theatre complex, a pre-decided path was used.

Theatre Teams:

The theatre team comprised of anaesthetic, scrub and surgical teams with designated specific and shared responsibilities within theatre [7]. Staff with appropriate skill mix and experience was selected to work effectively and efficiently in their respective roles. There was regular communication amongst the teams confirming the agreed protocols and standard operating procedures. All staff members of the theatre team were previously fit tested for fluid repellent surgical respirator face mask (FFP3).

Anaesthetic team included lead Consultant Anaesthetist, Trainee Anaesthetist and Anaesthetic Nurse Practitioner. Another anaesthetic team was on standby in case of an overrun. Scrub team included a lead nurse and two operating room runners in the main theatre. Another staff in the anaesthetic room acted as a communicator between operating room

TABLE 1
Potentially infectious AGPs [5]:
Intubation, extubation and related procedures, for example, manual ventilation and open suctioning of the respiratory tract (including the upper respiratory tract)
Tracheotomy or tracheostomy procedures (insertion or open suctioning or removal)
Bronchoscopy and upper ENT airway procedures that involve suctioning
Upper gastro-intestinal endoscopy where there is open suctioning of the upper respiratory tract
Surgery and post-mortem procedures involving high-speed devices
Some dental procedures (for example, high-speed drilling)
Non-invasive ventilation (NIV); Bi-level Positive Airway Pressure Ventilation (BiPAP) and Continuous Positive Airway Pressure Ventilation (CPAP)
High Frequency Oscillatory Ventilation (HFOV)
Induction of sputum
High flow nasal oxygen (HFNO)

TABLE 2
Personal protective equipment (PPE)
Plastic apron
FFP3 Respirator mask
Surgical hood that covers the head and neck area
Full Face Shield
Water-resistant Fabric-Reinforced gown
Surgical gloves
Kevlar reinforced gloves
Impervious shoe cover

staff and an experienced runner in the corridor outside the theatre providing any drugs/equipment/instruments/prosthesis needed for the procedure. Surgical team included a lead surgeon and two surgical assistants.

WHO Check listing:

A detailed WHO checklist was performed outside

of designated COVID-19 theatre in the corridor and the same documentation was transferred to the white board in theatre. Specific and shared responsibilities of each member of the team was discussed, agreed, and documented. The PPE requirement of each member of the team was confirmed and at this stage, availability of each piece of PPE for the whole team was confirmed (Table 2). The donning and doffing sequence for each member of all the teams was reconfirmed (Table 4 & 5). The specific anaesthetic and surgical steps were discussed and documented. The availability of previously discussed instruments, prostheses, and additional materials like sutures and drains required for the surgical procedure were reconfirmed so that they could be brought into theatre without any delay. Personal belongings of each member of the team were transferred to individual pouches and securely stored. Duplicate copy of the clearly legible consent form was made available in the operative theatre and rest of the patient's notes were left in the buffer zone 1. Scrub and surgical staff were instructed to carry the required impervious gown and gloves with them so that they were available in the scrub area. The post-operative protocol to be followed by each member of the team

TABLE 3

Sequence of Pre, Intra and Postoperative Events:

Theatre team fit tested for Fluid resistant face mask (FFP3)
Preoperative planning and check availability of instruments and implants
Anaesthetic review for fitness, preoperative checklist
Patient ready for transfer by porter by a pre-agreed controlled path from ward to theatre
WHO checklist in corridor outside theatre
Personal belongings of staff transferred to a pouch and securely stored
Every team member to enter through the anaesthetic room (Buffer Zone 1) to the Theatre
Agreed PPE Donning and Doffing sequence for each member of staff
Lead nurse scrubbed and sterility of instruments checked
Patient transferred to Theatre through a designated route
Anaesthetic procedure
20-minute break
Patient catheterised and positioned on table
20- minute break: Orthopaedic team to scrub and don sterile impervious gown and gloves
Timeout according to WHO protocol
Surgical procedure according to plan
Sign off and Patient Transfer to bed/ trolley
Surgical team Doff off
Extubation
20-minute break
Patient recovery in theatre
Patient transferred back through designated route to pre-agreed destination

was discussed and reconfirmed.

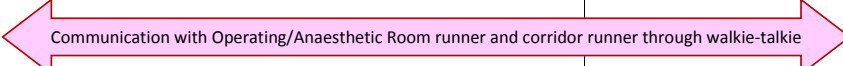
Theatre Setting:

An operating theatre pre-designated exclusively for all confirmed and suspected COVID-19 cases was used. Entry of every staff member into theatre was through the anaesthetic room which acted as a buffer zone 1 for donning the Personal Protective Equipment (PPE). Patient was brought into theatre through the pre-agreed route. Following the completion of the procedure, all members of the team exited through the sluice room which acted as buffer zone 2 that was used for doffing the PPE. All other entrances were blocked with "No Entrance - COVID 19 Theatre" notification. All the staffs using the the-

atre complex was made aware of the operating procedure protocols for COVID-19 theatre. Only necessary equipment required for surgical procedure were kept in theatre and all the computer monitors and other equipment were covered with disposable covers to prevent any aerosol contamination.

The surgery was undertaken in a laminar flow theatre with ventilation remaining fully on throughout the procedure. It is important for the team to be aware of the number of air changes per hour (ACH) of each theatre to determine the safe period to enter an aerosol generating zone. In general, in theatres that are fitted with standard HEPA filters, 5 air changes reduce the amount of airborne contamination to less than 1% [6]. With the estates department

Figure 1

Management of COVID-19 Positive Patient in Operating Theatre				
	OR Charge Nurse & Scrub Staff Team	Anaesthetic Room Runner (Buffer Zone)	Consultant & Trainee Anaesthetist and Anaesthesia Nurse	Orthopaedic Team (Lead surgeon & 2 assistant surgeons)
Pre-operative planning	Activate theatre team ↓ Delegate OR staff ↓ Check availability of: • PPE • Instrumentation • Implants	Check availability of: • PPE • Donning & Doffing Protocol	Pre-operative review of patient ↓ Check anaesthetic equipment & drugs	Pre-operative review of patient ↓ Check consent & site marketing ↓ Check availability of instruments & implants
WHO check list	Staff introduction ↓ Patient briefing ↓ Steps of PPE donning & doffing	Discuss anaesthetic plan		Discuss planned procedure & positioning of patient ↓ Reconfirm availability of PPE, instruments & implants
Intra-operative phase	Helping operating team in surgical procedure and communication with OR runner	Continue with anaesthesia, all unused drugs & consumable discarded 		Carry out proposed operative procedure Request orthopaedic implants
Post-operative phase	Signing out of procedure Swabs & instruments check	Extubation and recovery of patient in theatre Twenty minutes delay to settle down aerosols Transfer to ward		Doffing as per established protocol

advice that the theatre had 35 ACH, a waiting period of 10 air changes (20 mins) after each aerosol generating intervention was deemed to be safe.

INTRA-OPERATIVE:

Sterility of the instruments was checked by the lead scrub nurse before the patient was transferred to the theatre to reduce the time of exposure. Access to the operating theatre was allowed only through designated entrance and exit doors.

The patient was anaesthetised (Spinal and GA in this case) in the operating room, followed by a break of 20 minutes for the aerosols to settle down.

Any additional procedures and positioning with appropriate supports were undertaken by a PPE donned member of the surgical team with the help of the anaesthetic team (Catheterisation and lateral decubitus in this case). This surgical team member then doffed the surgical gown and gloves. This was followed by a 20-minute break during which the surgical team scrubbed and donned reinforced im-

pervious gowns and triple gloves with Kevlar glove as the inner most layer. Timeout was done according to WHO protocol and consent/site mark form checked for the procedure and confirmed with the staff in buffer zone 1.

Following principles were adhered to during the entire procedure [7,8]:

- Minimum required number of staff in theatre
- Appropriate PPE for all staff in theatre depending on role and risk
- Minimum number of staff during high AGPs like Intubation and Extubation
- Use Smoke Extraction/Capture system for diathermy / other energy sources
- Avoid the use of devices that produce splash/spray secretions, e.g. Pulse Lavage
- Every care was taken to minimise fluid spillage from the operative area
- Consider stand by teams for prolonged procedures in full PPE

Surgical procedure was performed as planned.

TABLE 4

Donning sequence for PPE (for a sterile procedure)**STEP 1:** Plastic apron**STEP 2:** Protective shoe cover**STEP 3:**

- FFP3 respirator mask
- Start by placing respirator on your chin first and then over the nose
- Secure the elastic bands at the middle of the head and neck
- Fit flexible band to nose bridge
- Fit snug to face and below chin
- Fit check respirator for any air leakage with finger at lower and upper edges

**STEP 4:**

- Hood covering head and neck

**STEP 5:**

- Full Face Eye shield; adjust to fit

**STEP 6:**

- Impervious Gown fully covering torso from neck to knees, arms to end of wrist and wrapped around the back
- Tie gown behind the neck and waist

STEP 7:

- 3 pairs of gloves
- 1 Kevlar reinforced gloves and 2 sterile surgical gloves

During surgery there was regular communication between the theatre team with staff in the buffer zone and the runner in the corridor for any consumables, drugs, instruments, and prosthesis needed which were handed to the theatre staff as and when required.

In this case, after 2 hours of patient intubation, a member each from the anaesthetic and surgical teams was relieved by the standby team. Total surgical time was approximately three hours. Lead surgeon and the lead scrub nurse remained scrubbed throughout the procedure.

POST-OPERATIVE

At the conclusion of the procedure, a standard sign out was done including confirmation of the swab count and instruments checklist. Patient was transferred to a trolley after positioning back to supine position. All items of contaminated linen were removed. Surgical team performed doffing with the help of a buddy as per established protocol. Exit out of the theatre was into the sluice room (buffer zone 2).

Patient was extubated and recovered in the operating room. A break of 20 minutes was then taken

TABLE 5

Doffing sequence for PPE (following a sterile procedure)

It is important to safely remove PPEs without contaminating your clothes, skin, or mucous membrane with potentially infectious material. All PPEs except respirator mask are doffed in the sluice room (buffer zone2). All doffed contaminated PPEs should be discarded in the orange lined bins for safe disposal. Remove respirator after leaving the sluice room and closing the door.

Following sequence is recommended for doffing the PPE

STEP 1: Gloves

- Outside of gloves are contaminated
- Using a gloved hand, grasp the palm area of the other gloved hand and peel off first glove.
- Hold removed glove in gloved hand
- Slide fingers of removed gloved hand under remaining glove at wrist and peel off second glove over first glove
- Discard gloves
- Repeat same for 2nd pair of gloves. Leave Kevlar reinforced gloves.



STEP 2: Remove shoe covers and discard

STEP 3: Gown

- Gown front and sleeves and the outside of gloves are contaminated!
- Grasp the gown from the front and pull away from your body so that the ties break, touching outside of gown only with gloved hands.
- While removing the gown, fold or roll the gown inside out into a bundle
- As you are removing the gown, peel off your gloves at the same time, only touching inside of gloves and gown with your hands.
- Place gown and gloves into a waste container
- Sanitise hands with alcohol gel



STEP 4: Face and eye shield

- Outside of face shield are contaminated!
- Remove face shield from back by lifting head band and without touching the front of face shield
- If item is reusable, place in designated receptacle for reprocessing otherwise discard in waste container
- Use alcohol gel to clean hands

STEP 5: Surgical hood

- Grab hood at the back and remove the hood and place in the waste container
- Clean hands with alcohol gel

STEP 6: Respirator mask

- Come out of sluice room
- Front of respirator is contaminated!
- Grasp bottom elastic of the respirator and then the ones at the top and remove away from face without touching the front.
- Discard in waste bin
- Wash hands with alcohol gel



STEP 7: Remove theatre shoes and send for wash

STEP 8: Shower and change to a new theatre dress

AT ANY STEP OF REMOVAL OF PPEs IF HANDS ARE CONTAMINATED, CLEAN WITH ALCOHOL BASED HAND SANITIZER

to allow the aerosols to settle before transferring patient to a pre-agreed destination through a designated route.

All members of the team followed a pre-agreed

path to the shower room. ^A

Conflict of interest

The authors declare no conflicts of interest.

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