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Many of the dangers to healthcare workers from coronavirus disease 2019 (COVID-19) have been highlighted,¹ but to reduce hazards further, as COVID-19 and other viral diseases can be spread by aerosol transmission, there is a need to minimize aerosol formation during surgical procedures. A six-fold increased risk of transmission of viral diseases, such as severe acute respiratory syndrome (SARS) has been reported during anaesthetic procedures such as endotracheal intubation.² No definite transmission has been reported due to surgical procedures, however unlike other viral diseases such as SARS and Middle East respiratory syndrome (MERS), COVID-19 appears to be both severe and highly transmissible and therefore could pose a far higher risk to surgeons and operating room staff.³ Transmissibility is measured using R_0 , the basic reproduction number, which is defined as the number of additional persons one case infects over the course of their illness. If R_0 is > 1 , there is the potential for sustained transmission. For both SARS and MERS, R_0 is < 1 ,^{4,5} whereas for COVID-19 the current estimate is much higher between 2.2 and 3.4.⁶ Therefore, it is possible that there is a greater risk from perioperative aerosols than with other diseases.

A number of surgical procedures generate aerosols; power tools such as bone saws, drills, and burrs are well known to do this as well as pulse lavage irrigation systems.⁷ A less reported but potentially larger source of aerosols are cutting diathermies.⁸ Recent reports from China suggest that up to 30% to 40% of COVID-19 patients have virus detectable in the blood.^{9,10} Viral load was found to be higher and longer-persisting in saliva, stool, and blood of severe COVID-19 cases.^{9,11} In comparison to SARS, in which only very low plasma levels of virus have been reported,¹² the blood of COVID-19 patients is likely to have a higher potential for aerosols produced during surgical procedures to carry the virus. Best practice should thus be to minimize

the amount of aerosol production wherever possible. As those closest to aerosol generation procedures are most at risk, when generation of aerosols is unavoidable, the sucker should be kept near to the interface of the tool and tissue to remove as much of the aerosol as possible to minimize this risk.

Although most non-essential surgery has been cancelled during the pandemic, there are still patients with life- and limb-threatening conditions or in severe pain who need to undergo emergency and urgent procedures. There is increasing evidence that a significant number of potentially up to 50% or more of individuals infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV2) are asymptomatic.¹³ Moreover, a recent report suggested that a considerable number of patients highly likely to have COVID-19 are not diagnosed with the currently available molecular polymerase chain reaction (PCR) tests in respiratory samples.¹⁴ Thus, although current guidelines recommend that patients are tested prior to having surgery, it would seem prudent to minimize aerosol production wherever possible - certainly in all patients who have respiratory symptoms, but potentially in all surgical cases during the current crisis.

The British Orthopaedic Association (BOA) has recommended that during the coronavirus pandemic, there should be an increased emphasis on managing patients with nonoperative strategies.¹⁵ In addition, in conjunction with Public Health England, they have recommended that ventilation in both laminar flow and conventionally ventilated theatres should remain fully on during surgical procedures where patients may have COVID-19 infection, as the rapid dilution of these aerosols by operating theatre ventilation will help to protect operating room staff. Air passing from operating theatres to adjacent areas will be highly diluted and is not considered to be a risk. An alternative approach has been reported from

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Singapore, which describes the reversal of the air flow to create a negative pressure within the operating room.¹⁶ However, it is not known if this is accompanied by an increase in the rate of implant infection, which is known to pose major diagnostic^{17–20} and treatment^{21–24} challenges. Wong et al²⁵ concur with the view that a high frequency (> 25 per hour) of air changes will rapidly reduce the viral load in the operating theatre, suggesting that in terms of minimizing risk to the patient of implant infection and to the staff of COVID-19 infection, this is a pragmatic way to reduce the risk of aerosol transmission.

Finally, it should also be taken into account that SARS-CoV2 can potentially be transmitted via blood transfusions and blood products. Although there is some evidence that the viral load is higher in severe COVID-19 cases, SARS-CoV2 has also been detected in the blood of mild cases.^{9,11} There are currently no reports about positive COVID-19 PCR results in asymptomatic cases, but given the huge and increasing number of COVID-19 cases worldwide, such cases are likely to exist, and blood products from such donors will be able to transmit the disease.

In summary the following general advice should be followed:

Avoid using diathermy especially cutting diathermy

Avoid pulse lavage

Avoid ultrasonic tools

Place sucker near to power tool/tissue interface

Use a tourniquet when possible

Consider using a powered air-purifying respirator (PAPR) or a surgical body suit/space suit

During bone and joint procedures:

Limit use of power tools when possible

Avoid use of ultradrive and high speed burr if revising hips

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