

REVIEW ARTICLE

Guidance on infection control and plume management with Laser and Energy-Based Devices taking into consideration COVID-19

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ABSTRACT

Background: The COVID-19 pandemic has disrupted the practice of medicine. Dermatologic laser and energy-based device (EBD) treatments carry a potential risk for the transmission of SARS-CoV-2 both for the patient and the practitioner. These risks include close practitioner to patient proximity, the treatment of higher viral load areas such as the face, the potential for infective bioparticles being carried by generated plumes and aerosols, and the direct contact between device, practitioner and patient.

Objectives: SARS-CoV-2 is a highly infective respiratory pathogen transmitted by respiratory droplets, respiratory/mucosal secretions, medically generated aerosols and via its transfer from contaminated fomites. This requires a review of the appropriateness of infection control protocols in regard to dermatologic laser and energy-based device treatments.

Methods: A critical evaluation of patient skin preparation including skin asepsis, device disinfection, laser and electro-surgical plume management and PPE in regard to SARS-CoV-2 was performed.

Results: The adherence to a high standard of skin preparation and asepsis, device disinfection, laser

and electro-surgical plume and aerosol management and appropriate PPE should help mitigate or reduce some of the inherent treatment risks. Head and neck treatments along with aerosol and laser plume generating treatments likely carry greater risk.

Conclusions: COVID-19 needs to be considered in the clinic set-up along with the planning, treatment and post-treatment care of patients utilising EBD procedures. Some of these treatment precautions are COVID-19 specific; however, most represent adherence to good infectious disease and established laser and EBD safety precautions.

Key words: aerosols, COVID-19, lasers, particulate matter, safety, SARS-CoV-2.

INTRODUCTION

The COVID-19 pandemic has made it necessary to revisit and update public health and infectious disease protocols when using energy-based devices (EBD) in dermatology. This includes measures pertaining to patient, medical staff and device(s) used. Skin preparation prior to treatment, disinfection of the EBD used, plume and aerosol management, as well as personal protective equipment (PPE) by staff form the main pillars.

This review is aimed to set guidance for risk reduction to patients and staff when EBD (including lasers and cautery) are utilised to treat dermatologic and/or aesthetic conditions. The chosen treatment modality by the health-care professional depends on multiple factors with patient safety lying at its core component. These factors include the presenting problem or treatment desire, its' severity and impact on the patient, along with the patient's risk of

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contracting COVID-19 disease. Other important factors are the specific clinic circumstances, including levels and type of PPE available, the vulnerability of any staff members to severe COVID-19 infection, the level of community transmission of the virus, and any current government or regulatory restrictions/requirements.

With advances in COVID-19 testing, in particular should serological tests to determine acquired immunity become available, patient workup, measures and services are likely to evolve with time. At present, all patients and staff should be considered potentially infective and/or susceptible to infection and as such measures should be based on this assumption. Screening of patients and general clinic considerations have been well covered.^{1,2}

SARS-COV-2 AND VIRAL INFECTIVITY

COVID-19 is caused by SARS-CoV-2, an enveloped single-stranded RNA virus.^{3,4} Its potential in humans to cause a severe and potentially fatal inflammatory respiratory and systemic disease necessitates extra precautions in the absence of an effective treatment and vaccine availability.⁴ Nosocomial COVID-19 infections have occurred worldwide irrespective of geographical and racial differences, highlighting the risks to both patient and health-care worker.⁵

Viral shedding is greatest during the early phase of the disease and may include a pre-symptomatic infectious period of several days.^{6,7} Whilst the role of asymptomatic carriers in disease transmission remains uncertain, given a potentially high rate of silent asymptomatic infection, COVID-19 precautions are required while community transmission is established or evolving.

Human-to-human spread of SARS-CoV-2 appears to be via droplets and aerosols, where the virus can survive for several hours;⁸ these may be inhaled or deposited on mucosal surfaces. In addition, self-inoculation through the mucous membranes of the nose, eyes or mouth may contribute to the hand-to-face spread of virus that has persisted and survived on surfaces.^{8,9} The stability of SARS-CoV-2 varies from few hours on porous fomites (e.g. paper, wood and cloth) to 4 or more days on smooth surfaces (e.g. plastic, glass and metal).^{8,9,10}

INFECTION CONTROL PROCEDURES

The basic principles of cleaning and disinfecting are valid for SARS-CoV-2, and the level of PPE precautions, needs to take into account staff, the patient, the procedure and device risks involved.^{10,11}

Cosmetic treatments may pose a particular risk given the high number of treatments involving the face. The mouth, nose and mucosal surfaces represent a particular infectious risk given the higher levels of SARS-CoV-2 exposure. Treatment to the neck and chest may also involve prolonged periods of close proximity (15 min or longer) to the face. This, associated with the known risks of aerosol-generating procedures in other medical areas,^{8,11,12} and their potential for transmission, need to be considered and

appropriate precautions taken with aerosol or plume generating treatments.

CORE PERSONAL PROTECTION PRECAUTIONS

Regular hand washing for at least 20 s including interdigital spaces, wrists and nail folds with soap and water remains the key method to reduce virus transmission.¹⁵ A reasonable alternative includes 70% alcohol-based hand rubs. This needs to be done before and after patient contact, including postremoval of PPE (gloves included). Touching of the face, in particular areas around the eyes, nose and mouth is strongly discouraged.¹⁵

EQUIPMENT CARE AND HANDLING

Ideally, surfaces and EBD equipment should be cleaned initially with a detergent and then disinfected (e.g. 70–80% alcohol or sodium hypochlorite 0.05–0.1%).^{9,10} Alternative biocidal products are available (many combine both detergent action plus disinfection): <https://echa.europa.eu/covid-19>.¹⁴ Surfaces must stay wet for the entire labelled contact or dwell time of the product for disinfection.¹⁴ For low touch, minimal organic matter contamination, surfaces, such as laser touch screens, their cleaning between each patients with a disinfectant such as minimum 70% alcohol may be sufficient, whilst for a handpiece contaminated by gel/ organic matter, cleaning then disinfecting between patients remains necessary. To minimise any potential damage to EBD, it is important to check the compatibility of the cleaning or disinfecting product used. Whilst alcohol is appropriate for most laser and EBD surfaces, sodium hypochlorite or bleach in particular may damage some medical equipment.

PATIENT PRETREATMENT AND ATTENDANCE COVID-19 SCREENING

Patients should be screened based on current public health guidance including making telephone or telehealth contact prior to patient attendance with repeat screening on arrival to the clinic.¹ This includes but is not limited to asking patients if they have been diagnosed with COVID-19 infection, along with COVID-19 symptom screening including acute respiratory symptoms, fever, headache and recent loss of smell. Enquiry should also encompass recent (last 14 days) international or cruise ship travel along with any close contact with a suspected or confirmed cases of COVID-19, or an individual required to isolate. On arrival to the clinic, these screening questions are repeated, alcohol hand rub utilised, social distancing followed where possible and practical and non-contact infrared patient temperature measured.¹

PATIENT PREPARATION

Skin preparation is important for addressing potential contamination particularly before any potential plume or

aerosol-generating treatments. First, remove all creams, make up, etc., from the skin to be treated; have the patient wash these areas with soap and water, or cleanser, for more than 20 s. This should be followed by the application of an appropriate biocidal agent, particularly when treating the hands (forearms) or head and neck. Alcohol (isopropyl- or ethyl- 70%) +/- chlorhexidine 0.05–0.1% or povidone-iodine (7.5–10%) have proven SARS-CoV-2 anti-sepsis activity with standard dwell times.^{9,10} All act relatively rapid (alcohol less than 30 s). Unlike alcohol and povidone-iodine, chlorhexidine has the added advantage of binding to the stratum corneum providing sustained or residual activity. Alternative agents for skin anti-sepsis include benzylkonium chloride 0.05–0.2% and hydrogen peroxide (less than 1%).^{9,10}

Awareness and enquiries on previous allergic reactions to any anti-microbials are recommended. Viral RNA has been found in aerosols (plus sink and toilet basins) of COVID-19 patient bathrooms, making it prudent to disinfect wash basins after use.¹⁵ Povidone-iodine is a chromophore and needs to be thoroughly removed after adequate dwell time with sterile water when using a 532–1064nm laser device.

AEROSOL-GENERATING PROCEDURES

Potential aerosol-generating dermatology procedures include

- All laser plumes and electro-surgical treatments (cautery).
- Air/Cryo & humidified cooling systems including dynamic in-built or free-standing systems are in many devices such as hair removal, pulse dye, Nd:YAG, Non-Ablative Fractionated (erbium glass & thulium), Ablative Fractionated (CO₂, Er:YAG & Er:YSGG), lasers and LED lights.
- Medical gases such as nitrous oxide delivered using a mask system also poses greater aerosol risks than, for example single use mouthpiece demand systems.
- Cryotherapy (unknown risk).

Plumes produced by vaporising tissue, in particular ablative lasers (CO₂, Er:YAG & Er:YSGG) and electro-surgery, need special consideration including the risks of bio-microparticles and their potential to transmit viable virus.^{16,17,18,19} The importance of reducing risks of inhalation of particulate matter (PM_{2.5}) in medicine is highlighted by its proven respiratory and cardiovascular risks. A postulated increase in infection and severe COVID-19 infection risk has been linked to higher PM_{2.5} air pollution levels.²⁰ Use of a laser-rated or N95/P2 mask should be considered in these circumstances. In addition, the use of a plume scavenging system (suction nozzle within 5cm from treatment site with high-efficiency particulate air filters (HEPA) or ultra-low penetration air filters (ULPA)) is required.^{14,15,16} Ideally, consider having a HEPA filter included in your AC system or your laser laboratory air purifier and/or combined with a carbon filter for volatile toxic organic chemicals.^{16,18,19} Plume scavenging systems

may not be as effective for picosecond and Q-switched lasers due to the speed of particle ejection, making room air HEPA filtering systems relatively more important when using these devices.¹⁶ Ensure you follow good infection control precautions when handling and changing these filters.

In cases of non-aerosol and laser plume generating treatments, normal surgical masks appear to provide some SARS-CoV-2 protection although these should not be relied on for higher risk laser and electro-surgery plume exposures or procedures as discussed above.¹¹

In addition to protective eyewear, consider a face shield particularly when using ablative, picosecond, and Q-switched lasers or devices requiring potential aerosol-generating air cooling systems. Consider wearing surgical caps, gloves and work scrubs (disposable gowns for significant aerosol-generating procedures). All staff should be trained and competent in using PPE correctly, including its safe removal and disposal. Significant facial hair reduces the seal efficacy of surgical masks; consider a facial hair-free COVID-19 period for added safety.

OTHER CONSIDERATIONS

Acetone is a defatting agent with some anti-microbial actions, though insufficient for adequate skin anti-sepsis. When used for skin preparation, this should be combined with a separate treatment, for example 70% isopropyl-alcohol.

Patients should be encouraged to wash the skin areas to be treated with soap/cleanser and water for at least 20 s prior to attending for their treatments (including their hair if adjacent to the prospective treated area) and refrain from touching their face or treatment area from then until their therapy.

Ensure all eye protection used is either disposable or disinfected between patients, but avoid shared elastic straps. Avoid chlorhexidine and sodium hypochlorite when disinfecting metal eye shields due to potential ocular toxicity.

POST-TREATMENT CARE

It is currently unknown whether postablative fractionated laser resurfaced or photodynamic therapy-treated skin or mucosa is at increased risk of SARS-CoV-2 infection. There is a theoretical risk that respiratory droplets or aerosols and fomite transfer containing SARS-CoV-2 landing on, or being transferred to inflamed and broken skin and/or mucous membrane barrier, could increase infection transmission risk. Post-EBD treatments, patients are often encouraged to regularly cleanse and apply topical agents. As a result, the risk of frequent touching of their face with their hands needs to be considered.

Counselling patients regarding the potential safety benefits of cleaning/ disinfecting and controlling their environment during the initial healing period. Patients should be instructed to wash their hands prior to application of any skincare products; these products should not be shared

with anyone else. Hypochlorous and acetic acid wound solutions have been shown to have anti-microbial benefits and are often recommended postablative treatments to control skin microbes; there are, however, no scientific studies into their SARS-CoV-2 activity.

CONCLUSION

COVID-19 currently needs to be considered in the clinic set-up along with the planning, treatment and post-treatment care of patients utilising EBD procedures. This involves extra precautions to keep both the patient and staff safe. Thorough explanation and counselling of patients undertaking procedures carrying significant COVID-19 transmission risk should be undertaken. Lack of access to appropriate PPE may result in reputational damage, and medicolegal risks should a staff member or patient contract COVID-19. There remains no specific proven anti-viral therapy for COVID-19, making containment and prevention of spread crucial. The high number of nosocomial COVID-19 disease cases in health-care workers around the world highlights the transmission risks of SARS-CoV-2 in medical settings.⁴ Most of these measures to mitigate risk represent adherence to good clinical practice with regard to infectious disease, laser and laser plus electro-surgical plume safety precautions and practices.

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