Minireview Article

Microscopy and the COVID-19 Pandemic, what we need to know? – The Hygiene protocols and Digitalization

Running title- Microscopy and the COVID-19

Abstract

The COVID-19 pandemic has reemphasized the significance of personal protection at all the levels, from public places to hospitals, to working spaces to residence and at individual levels. It is inevitable for personnel in a common working space to share items multiple times one after the other frequently. Laboratory is one such arena and is also of great concern as it is associated with handling pathogenic specimens, investigating and diagnosing pathologies. By nature, it can be of great concern due to the possibility of higher chances of cross contamination. This fact is made even more precarious by the current COVID 19 pandemic. Hence there is a great need for a set of guidelines, appropriate protocols, best hygiene practices and digitalization in reporting and teaching learning, to be followed in the laboratory to prevent cross contamination. Microscopy work area is part of laboratory where microscopes are placed and used by the professionals for pathological diagnosis or research. Though there are set guidelines to be followed for most aspects of the laboratory, the cleanliness and personal protective guidelines for microscopes are sparse. Use of a disposable or reusable plastic film for covering microscopes, selection of suitable disinfectant, use of proper cleaning and protective tools and safeguarding the sensitive parts of microscope are highly recommended.

Key Words

Microscope, Laboratory, Covid 19, Hygiene protocols, Digitalization, Disinfection

Introduction

The type of laboratories, facilities available, services rendered, and the human resource may vary from a small sized, medium sized, institutional to corporate laboratories. Irrespective of the kind of laboratories, the basic rules remains the same. The basic guidelines and protocols to be followed in the laboratories can majorly be grouped as routine laboratory precautions and biosafety guidance, disinfection of offices and work surface, cleaning of toilets and washrooms, laboratory waste management, care of staff and laboratory personnel, handling and performing hematology, biochemistry, microbiology investigations, sample processing, reporting and teaching learning.[1,2]

Microscopes are used virtually in each and every biological and medical laboratory.[3] The arena where microscopes are kept and used for microscopic examination of the samples is the microscopic working area or the station. The Kind of microscopic working arena and the persons accessing it varies. While microscopic working area may be a separate unit at some settings, it will be a part of laboratories in others. Whether combined or separate, the basic guidelines remain the same and should be adhered to. However, in case both the units are in the same section, special attention is required as there may be multiple associations and interactions between the laboratory and microscopic areas.[1]

Regular usage of microscope by multiple users in the laboratories causes contamination of its components. There is also the possibility of microscope contamination from the specimen itself.[4,5] Research studies have suggested that direct contact with microscope eyepieces while visualising slides can increase the risk of eye infections. It is shown that the oculars are

significantly contaminated with skin and environmental bacteria, including potential pathogens.[3] Hence regular cleaning of all its components is highly essential.[3,4,5]

COVID-19 virus has been found in eye secretions. Therefore, it is imperative for all the microscope users to take appropriate measures to maintain microscope hygiene.[6,7] Thus, frequent sanitization of the microscope is highly recommended to keep the lab technicians and research staff safe and healthy.[5,8] The hygienic protocols for microscope working area can broadly be categorized into the work area, microscope per se, personnel protection and protocols to be followed during reporting and teaching.

Protocols suggested before entering the workplace

- Performing screening or health check before entering the hospital/ institution/ laboratory should be the first and foremost step in preventing the spread of the infection.
- Self screening like temperature, cough, cold, throat irritation etc by individuals before coming to the workplace should be encouraged.[9]
- Thermal check should be compulsory. During thermal check, social distancing should be maintained, person performing the check should wear the gloves and stand behind a physical barrier. If non disposable thermal checkers are used, adequate guidelines should be followed in sanitizing it after each use.[9]
- A travel history and history of contact with Covid positive patient should be noted.
- Individuals with high temperature or under evaluation for COVID-19 or diagnosed with COVID-19 or not yet cleared to discontinue isolation should be discouraged to enter the workplace.[9]
- In case of practice of biometrics, sanitizing or washing the hands with soap water should be practiced before and after the biometrics.

- If possible, a sanitizing machine can be kept at the entrance, that sanitizes the person as a whole and their belongings before entering the workplace.

Hygiene protocols for Work Area

- Detailed planning and reorganisation of the lab space, staffing and the general physical environment of lab work station and microscopic area is necessary. It should be in accordance with the institutional facilities, guidance of infection control committee's or health and safety departments.[10]
- Use of personal protective equipment (PPE), physical distancing, appropriate materials for decontamination and sanitization, following standard laboratory procedures and maintaining optimal environment in the laboratory and microscopic working area such as temperature, humidity, gas or water delivery and air flow/Ventilation.[1,10]
- Entire laboratory and the designated work area should be regularly disinfected using proper disinfectants.[1]
- The working area, stationeries, equipment and the whole facility should be cleaned with 1% Sodium hypochlorite or Alcohol based solutions. All metallic surfaces in the area should be decontaminated using 70% alcohol.[11,12]
- Eating, drinking, smoking, applying cosmetics and handling of contact lenses should be prohibited while working in the laboratory.[1] Door handles, microscope parts, and computers including other peripheral devices should not be touched with bare hands.[13]
- Prevent spread of contaminants from workstation to the microscope area by regularly cleaning the workstation with appropriate techniques and chemicals.[4]

- Hand sanitizing stations should be installed in the office or laboratory premises, especially at the entry and exit point of microscope work area.[1]
- Access to the laboratory should be strictly limited. Persons can work in teams.[14]
- Detailed standard operating procedures (SOPs) for disinfecting equipment and work areas, should be noted in appropriate areas and should be followed before and after the work.[10]

Hygiene protocols for Microscopes

- Use a disposable or reusable plastic film to protect the microscope especially in areas that are frequently touched and are prone to high contamination such as eyepieces, focus knob, stage handle, binocular and body. Similarly, when computers are used in association with the microscopes, the computer parts which are prone to contamination such as keyboard, mouse and other touchable surfaces can be covered with protective plastic film or wrap. These films can be frequently disposed or disinfected and reused based on the degree of contamination the area is exposed to.[4,5,8,13,15] When usage of plastic wrap is not possible, disinfect the eyepieces and the binocular body before and after use. Eyepiece cups may be removed during disinfection.[13]
- Selection of suitable kind of disinfectant is highly recommended. Chemicals used for lab station are different from the ones used for microscope.[4]
- Not all components of the microscope can resist chemical disinfectants. Softer constituents such as rubber, plastic components, surface coatings of optical components like glues or adhesives can easily be damaged by the use of incorrect chemicals.[4,5]

- As lens coatings can be damaged, care needs to be taken in choosing the correct sterilization method. Spray lens paper with isopropanol or ethanol is to be used to clean and disinfectant eye pieces, including the glass lenses, rubber gaskets and other common touch points. Rubber gaskets around the eye pieces can be removed temporarily.[6]
- Use of proper cleaning and protective tools such as cotton swabs, optical cloths, lens cleaning paper and latex gloves is recommended.[4]
- As microscopes are extremely sensitive to extreme temperatures, they should never be disinfected with heat.[4] Abrasive cleaners should never be used as they cause scratching of the surfaces and thus, have a negative effect on the protective coatings of the microscope parts.[5]
- It is always advisable to follow optimal guidelines in the microscope's manual for proper cleaning techniques or contact microscope technician when essential.[4]

Personnel protection guidelines

- Only one user per microscope per session should be allowed. Number of persons occupying work station to be reduced to maintain social distancing.[13,15]
- Wear appropriate Personal Protective Equipment (PPE) based on the result of infectious risk assessment in your facilities.[2,16]
- Use of disposable gloves for microscope operation, cleaning, and decontamination is recommended. Disposable gloves can be decontaminated with 70% ethanol or isopropanol or should be disposed to minimize the risk of contamination.[5,13] Upon removal of gloves, wash hands with soap and water for 20 seconds or use an alcohol-based hand sanitizer that contains at least 60% alcohol.[6]

- Wear safety glasses for protection from virus transmission through the eyes.[6,13,15] This safety googles should be disinfected before and after each use. Safety glasses offer the advantages of being easily disinfected and are more sustainable. However, sometimes it may be hard to use it with the rubber eyecups.[12]
- Avoid touching of eyes, mouth, and nose or face until the hands are washed.[1]
- Users who have been in risk areas, had contact with confirmed SARS-CoV-2 patients, are SARS-Cov-2 positive or have health conditions with risk to develop severe symptoms are advised to avoid the use of microscopes and not access the facility for 14 days.[13,15]
- The laboratory personnel should be continuously trained and educated regarding the precautions to be taken while processing the samples to prevent cross contamination between the laboratory area and the microscope area.[14]

Pathology reporting guidelines

- Slides reporting can be done either individually or as a team composed of very few pathologists at a multi header station keeping at least 1 meter distance and after following appropriate microscope hygiene protocols.[1,14]
- It is preferable to use camera attached to microscope for all visualization instead of using the eye pieces.[6,12]
- Use of decahead/multi headed microscopes should be limited to two or three people to maintain adequate social distance.[1]
- The risk of contracting infection can be minimized using digital pathology or remote reporting.[1] If the facility is available, digital reporting should be encouraged.[14]

Guidelines for Educational institutions

- Teaching institutions can adopt online teaching for teaching of normal anatomy, histology, osteology, embryology and pathology slides.
- If offline teaching is unavoidable, social distancing should be encouraged and adopted.[14] Use of decahead/multihead microscopes and camera projections should be encouraged.[1]
- Scanning of slides can be done using digital slide scanners and utilized for online teaching.[14]

Disinfection protocols

Ability of disinfectants to kill different microorganisms varies due to the diverse tolerances of these microorganisms to specific disinfectants.[2,5] The disinfection efficiency of a single component depends on the type of disinfectant, its concentration in the liquid, contact time with the material, technique, shelf-life and the expiry date of the chemical.[1,2,5] Disinfectants with proved efficiency against the enveloped viruses' especially the respiratory types should be preferred.[1]

These recommended disinfectants for lab instruments and surfaces include liquids containing alcohols, aldehydes, chlorine compounds, phenols, and peroxides. They can be sodium hypochlorite, ethanol, isopropyl alcohol, hydrogen peroxide, quaternary ammonium compounds, and phenolic compounds.[2,5,17] For small surfaces 62–71% Ethanol, while for bigger areas 0.5% Hydrogen peroxide or 0.1-1% Sodium hypochlorite can be used. Only freshly prepared Sodium hypochlorite should be used. The disinfectant solution should be applied for at least 30 minutes. 0.05-0.2% Benzalkonium chloride or 0.02% Chlorhexidine digluconate are the other preferable disinfectants but are less effective. Bleach solution should be used for cleaning floors. SARS-CoV-2 is suspected of being inactivated by heat (70°C for 5 min or 60°C for 30 min) and UV radiation (30 min).[1,2,17-19]

For disinfection of microscope and the plastic wraps used on the microscope, 70% ethanol is most recommended since it effectively disinfects the microscope without damaging the frame or the plastic parts.[10,12] However it should not be sprayed directly onto screens/microscope.[15] The SARS-CoV-2 virus is also effectively neutralized by diluting its lipid layer and 70% ethanol is recommended for the same.[12] Possibly the eyepiece-less microscopes can be a solution for the cross contamination associated with the use of shared eyepiece microscopes.[7]

Digitalization, the current mandate

Current pandemic has pushed the world into digital era. Patient management softwares are part of the health care system since long, where all the patient details, diagnostic parameters and findings are digitalized. Digitalization and automation are the current mandate in all the sections and, laboratories and microscopes are no exception to it. Various aspects such as data management, reporting, quality control and analytics can be efficiently managed through this. This paper less system benefits by significantly organizing information and communication through the technology. It enhances productivity, increases work efficiency and transparency.[20-26]

Practice of telepathology and remote reporting is the need of the hour. Still images or live / recorded video, preparation of the virtual slide which contains the digital scans of a whole slide at a range of magnifications, can be used for remote viewing. As all the pathologists may not be available for slide viewing due to the current pandemic, telepathology and telemicroscopy can be used for expert opinion, case conferences, multidisciplinary meetings, education, training and assessments for undergraduate / postgraduate students/ research

scholars, for continuing professional development programmes, image analysis and quantification.[21,22]

Digital reports are always a boon over the printed. It prevents in person visit of the patient or their attendees to the laboratories, avoids hard copies which may be the source of infection too. Covid has pushed the pathologists to adopt the practice of remote reporting of digital slides. Such practice requires the pathologist to follow a validation procedure before practicing the same. This helps in better risk assessment and risk reduction.[22]

The use of digital microscope is advantageous over the conventional microscope especially during these pandemics, as it avoids the use of eyepiece and aids in telepathology too. It provides good images with high-resolution, high magnification, 2D and 3D images and can store huge amounts of data. They allow imaging and recording of movable and unmovable specimens and working with web based applications for better communication.[23,24] Automated tracking of laboratory materials, samples, reporting and the respective digital contents can done through the use of QR codes or RFID.[20]

Conclusion

It is suggested to take into account the recommendations before access to the workplace, practice a good hygiene all time, and enhance the precautions measures in microscopes. More important is keeping abreast with the latest guidelines issued by the concerned authorities regarding the standard control measures and preventive protocols for laboratories and meticulously following them. Digitalization is the need of the hour and has become mandate. Adoption of digital pathology and telepathology in the routine practice is highly recommended. Digitalization and artificial intelligence will be the future revolutionaries in the laboratory diagnosis.

References

1. Misra V, Agrawal R, Kumar H, Kar A, Kini U, Poojary A, et al. Guidelines for various laboratory sections in view of COVID-19: Recommendations from the Indian Association of Pathologists and Microbiologists. Indian J Pathol Microbiol 2020;63:350-7. doi: 10.4103/IJPM.IJPM_857_20.
2. Disinfection & Sterilization Guidelines | Guidelines Library | Infection Control | CDC. Available from https://www.cdc.gov/infectioncontrol/guidelines/disinfection/index.html [last accessed on 20 May 2021]
3. Fritz B, Schäfer K, März M, Wahl S, Ziemssen F, Egert M. Eye-Catching Microbes—Polyphasic Analysis of the Microbiota on Microscope Oculars Verifies Their Role as Fomites . J Clin Med. 2020, 9, 1572; doi:10.3390/jcm9051572.
4. 9 Tips to Keep Your Microscope Clean During COVID-19. Available from https://nuhsbaum.com/9-tips-to-keep-your-microscope-clean-during-covid-19/ [last accessed on 5 June 2021]
5. How to sanitize a microscope. Christoph Greb , Dr. • Leica Microsystems. April 03, 2020. Available from file:///D:/pub/microscp/yes-microscop%20c19/covid-sanittz%20microsc.pdf [last accessed on 5 June 2021]
6. General Microscope Hygiene Procedures. Clemson division of research. Available from http://media.clemson.edu/research/EMF/Microscope%20Hygiene.pdf [last accessed on 5 June 2021]
7. Walp N. Looking to the Future: How to Keep Microscope Users Safe from Cross-Contamination. September 1, 2020. Available from https://www.qualitymag.com/articles/96198-looking-to-the-future-how-to-keep-microscope-users-safe-from-cross-contamination [last accessed on 5 Jun 2021]

8. Lab Health and Safety How to Clean and Sterilize a Lab Microscope. September 22nd 2020, olympus corporation. Available from https://www.labmanager.com/lab-health-and-safety/how-to-clean-and-sterilize-a-lab-microscope-23899 [last accessed on 5 June 2021]
9. Reducing-the-Spread-of-COVID-19-in-Workplaces. Centers for disease control and prevention. Available from https://www.cdc.gov/coronavirus/2019-ncov/community/general-business-faq.html# [Last accessed on 07/07/2021]
10. Association of Biomolecular Resource Facilities (ABRF) Core Facility Ramp-Up Information. Version 4.1. May 1, 2020. Available from https://www.abrf.org/assets/ABRF%20Core%20Facility%20Ramp-Up%20Information%20V4.1.pdf [last accessed on 5 June 2021]
11. Van Doremalen N, Bushmaker T, Morris DH, Holbrook MG, Gamble A, Williamson BA, et al. Aerosol and surface stability of SARS- CoV-2 as compared with SARS-CoV-1. N Engl J Med 2020;382:1564-7. doi: 10.1056/NEJMc2004973.
12. Microscopy facilities: resuming operations after COVID-19. 1 June 2020. Available from file:///D:/pub/microscp/yes-microscop%20c19/Microscopy%20facilities_%20resuming%20operations%20after%20Covid-19%20-%20Argolight.html [last accessed on 5 June 2021]
13. Dietzel S, Ferrando-May E, Fried H, Kukat C, Naumann A, Nitschke R, Pasierbek P, Peychl J, Rasse TM, Schroth-Diez B, et al. A joint action in times of pandemic: The German BioImaging recommendations for operating imaging core facilities during the SARS-Cov-2 emergency. *Cytometry Part A* 2020;97A:882–886.
14. Srinivasan R, Gupta P, Rekhi B, Deb P, Nijhawan VS, Prasoon D, et al. Indian academy of cytologists national guidelines for cytopathology laboratories for handling

suspected and positive COVID-19 (SARS-CoV-2) patient samples. J Cytol 2020;37:67-71.

15. COVID-19 Shared Microscope Operating Rules. Available from https://www.gla.ac.uk/media/Media_723419_smxx.pdf [last accessed on 5 June 2021]
16. Recommended Handling and Disinfecting Procedures for Nikon Microscope products to reduce spread of infectious agents including SARS-CoV-2 (Coronavirus). Nikon Instruments Inc. Apr 16, 2020. Available from https://www.microscope.healthcare.nikon.com/about/news/recommended-handling-and-disinfecting-procedures-for-nikon-microscope-products-to-reduce-spread-of-infectious-agents-including-sars-cov-2-coronavirus [last accessed 5 June 2021]
17. Biosafety Guidance: Covid-19 Research at University Of South Carolina. Available from https://sc.edu/about/offices_and_divisions/ehs/documents/biosafety-guidance-for-covid-19-research-final.pdf [last accessed on 5 June 2021]
18. Duan SM, Zhao XS, Wen RF, Huang JJ, Pi GH, Zhang SX, et al. Stability of SARS coronavirus in human specimens and environment and its sensitivity to heating and UV irradiation. Biomed Environ Sci 2003;16:246–55.
19. Kampf G, Todt D, Pfaender S, Steinmann E. Persistence of coronaviruses on inanimate surfaces and its inactivation with biocidal agents. J Hosp Infect 2020;104:246-51. doi: 10.1016/j.jhin.2020.01.022.
20. Spencer M. The Importance of Digital Transformation in Laboratory Informatics | Technology Networks. Available from https://www.technologynetworks.com/informatics/blog/the-importance-of-digital-transformation-in-laboratory-informatics-341179 [Last accessed on 07/07/2021]

21. Telepathology: Guidance from The Royal College of Pathologists October 2013 Author Professor James Lowe, Chair of the Specialty Advisory Committee on Cellular Pathology. PUB 281013:1-11.
22. Williams BJ, Brettle D, Aslam M, Barrett P, Bryson G, Cross S, et al. Guidance for remote reporting of digital pathology slides during periods of exceptional service pressure: An emergency response from the UK royal college of pathologists. J Pathol Inform 2020;11:12
23. Digital Microscope | Microscopy | Microbe Notes. Available from file:///F:/aabc-sorted/pub/to%20be/microscope%20c19/digtlzn/dm-good.html. [Last accessed on 07/07/2021]
24. Elen A, Turan MK. Web based remote control of a digital microscope system. International Scientific and Vocational Studies Congress - Engineering, 2019, Ürgüp, Nevşehir/TURKEY:27-30.
25. Budd J, Miller BS, Manning EM, Lampos V,Zhuang M, Edelstein M et al,. Digital technologies in the public-health response to COVID-19. Nat Med 2020;26:1183–1192. https://doi.org/10.1038/s41591-020-1011-4
26. Horgan D, Hackett J, Westphalen CB, Kalra D, Richer E, Romao M et al,. Digitalisation and COVID-19: The Perfect Storm. Biomedicine hub 2020;5(3):1341–1363. https://doi.org/10.1159/000511232