Innovations in Ophthalmology

Semiautomated disinfection of ophthalmic contact lenses

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The ophthalmic lenses that come in contact with the eyes pose a high risk for the transmission of bacterial and viral infections in eye clinics. Disinfecting these lenses does not happen stringently in a busy practice. We describe a novel method of disinfecting ophthalmic contact lenses using a semiautomated lens disinfector equipment, semiautomated lens disinfector. The equipment has motors to pump in and pump out water and disinfecting solution into a reservoir bath. The used ophthalmic lenses will be placed in a tray that partially dips into the bath for disinfection. Microbiology tests that were done to check the quality of the disinfection cycle showed good outcomes. Disinfection of ophthalmic contact lenses with the new equipment appeared to effectively eliminate contaminant microorganisms. This equipment can be used in busy ophthalmic clinics to alleviate the chances of cross-infection.

Key words: Applanation, cross-infection, disinfection, gonioscopy, ophthalmic lenses, sanitizer

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The ophthalmologist's clinic is a potential place for the transmission of infections. The cross-infection can happen between patients and also from patients to staff. Instruments that are commonly reported in this transmission are gonioscopy lenses and applanation tonometer prisms. The eye is susceptible to infections with gram-negative bacilli, adenoviruses, herpes simplex, and fungi that may be transferred by ophthalmic contact instruments.[1] Isolation of human immunodeficiency virus (HIV) from human tears,[2] corneas, and contact lenses have focussed attention on the infected patient as the source of transmission of disease. The possible risk of horizontal transmission of Creutzfeldt–Jakob disease (CJD) via contact tonometry has given further cause for concern.[3] Failure to efficiently disinfect applanation tonometer tips could represent a possible mode of infection transmission.[4]

A review of the literature reveals that many disinfection methods like 5-min soak in 3% hydrogen peroxide (or 70% isopropyl alcohol or a 1:10 dilution of sodium hypochlorite) are suggested for tonometric prisms, even if it is not always clear which organisms are eliminated and which may be left behind with every single regimen.[5]

In a busy outpatient clinic, it is practically difficult to implement the above disinfection methods and some of the seemingly easy techniques may cause damage to the lenses itself. The equipment we devised in collaboration with the regional science center requires less human effort and has been found to be reliable.

Innovation

Semiautomated lens disinfection unit

This unit consists of an electronic panel that is used to preset and customize the duration of the disinfection cycle. Instruments include a controller unit that gives commands to a relay switching unit that acts as an electronic switch and a float switch that identifies filling levels of the tank.

The disinfecting unit consists of a lens holding tray placed over a tank tray (used for keeping ophthalmic Contact lenses [Fig. 1c and d]), an inlet unit with two motors for pumping liquids into the tank, and one vibrator, which vibrates the liquid filled in the tank for augmenting the cleaning process and one outlet motor to eject the liquid from the tank [Fig. 1a and b]. Other parts of the tank are made with silicon and acrylic to avoid rusting and prevent leakage, ensuring the long life of the equipment. Disinfectant solutions enter the tank under the lens holding tray through the inlet unit and leave the tank through the outlet unit. Disinfecting unit is designed in such a way that disinfectant solutions touch only the tips of the ophthalmic lenses placed in the tray. This tray was three-dimensionally (3-D) printed and the perforations in the tray were customized to accommodate the tips of the ophthalmic lenses. The lens holding tray can be custom-made according to the lenses we use. We use reverse osmosis (RO) purified water and sodium hypochlorite solutions for this procedure.

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Figure 1: (a) Semiautomated lens disinfection unit, (b) Main unit with display, (c and d) Instrument tray for contact lenses

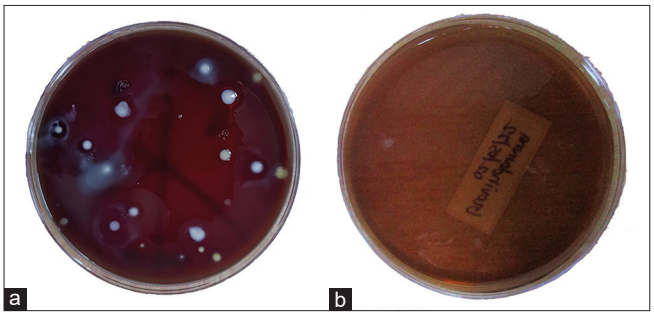

Figure 2: (a) Positive growth for coagulase-negative Staphylococci before disinfection, (b) No growth after disinfection

There are three steps in the disinfection process: 1. Cleaning with RO water (2 min), 2. NaOCl disinfection (5 min), and 3. Final cleaning with RO water (2 min).

We used gonioscopy lenses and tonometer prisms to evaluate the efficiency of our equipment. Five swabs are taken for culture (2 from tonometer prisms and 3 from gonioscopy lenses) each before and after the disinfection process. They were inoculated into blood agar plates and observed for growth after 48 hours.

Swabs taken from all contact lenses showed positive growth [Fig. 2] for coagulase-negative Staphylococci before disinfection, which are completely eliminated after disinfection with our equipment.

Discussion

In our hospital, we have been using this newly innovated semiautomated disinfecting equipment in our glaucoma clinic past 6 months. Our ophthalmic assistants operate this equipment twice daily and disinfect the applanation prisms and gonioscope lenses. The staff is finding it very easy to use and the feedback has been positive.

In a review, tonometer prisms disinfected with 5-min soak in different disinfectant solutions adequately eliminated most ocular pathogens, with the exception of *Acanthamoeba*.[5]

A study to evaluate the adequacy of different disinfection regimens based on exposure time, demonstrated a relative disinfection efficacy for different regimens, provided that correct exposure times are adopted for the chosen disinfectants, a condition difficult to ensure in a busy clinic setting.[6]

The centers for disease control and prevention (CDC's) recommendations suggest wiping the tonometer tip and then disinfecting it with 5 min soak in disinfectant solutions. The American academy of ophthalmology (AAO) has adopted these recommendations and added the option of simply wiping the tip with a 70% isopropyl alcohol swab.[7]

Of potential concern is the finding that the very common method of using a 70% isopropyl alcohol wipe for disinfection decontaminated only half of the tonometer tips tested.[5] So just wiping, which is commonly practiced in clinics may not be a safe way to do in the clinics.

The wipe disinfection methods are more convenient than the soaking methods, both in terms of disinfection time and reduced risks of damaging the instrument. Treating only the tip of the tonometer instead of the entire prism, the damages to the prism that have been observed in extended soaking regimens[8-10] could be prevented, but the reduced contact time may not be adequate for complete disinfection.

Our instrument semiautomated lens sanitizer unit reduces manual handling of instruments, thereby reducing the chances of finger burns that can occur with the above disinfectant solutions. Calibration marks over the sides of tonometers will get damaged with time on contact with the above disinfectant solutions. This is prevented by our equipment because the instrument placing tray was designed in such a way that disinfectant solutions will touch only the tips of the instruments. It also allows efficient cleaning of instruments by rotating them during the disinfection process with the help of a vibrator. The efficiency of the instrument looks promising as it eliminated contaminant microorganisms in our microbiology testing. Also, as the disinfectant exposure step is followed by the final step of cleaning with RO water with vibration the residues in the lens tips are very minimal.

This equipment is innovatively designed in a way to take care of the shortfalls associated with the routine disinfection process. The merits are as follows: 1. The staff need not touch the patient's contact area of the lens while doing this disinfection thereby reducing their risk, 2. The calibration marks are not damaged in this process as only the tip of the lens is soaked in the solution, 3. Reliable disinfection process as it is programmed as per the standard recommendations, 4. The tips of the lenses are less likely to be damaged as there is no need to wipe with swabs, which can induce microscratches leading to errors in measurement, and 5. Since it is automated, the clinic personnel needs to just place the lenses in the tray and take back the lenses after the cleaning process.

The area in which we are still working on this equipment is reducing the tank size so that the utilization of water and disinfecting solutions consumed for each cycle can be reduced. Also, the equipment had once a circuit failure, which was rectified by the engineering team.

In developed nations, disposable tips are used in practice and are quite safe. Nevertheless, the clinics in developing nations cannot afford to use it on a regular basis. Further refinement and upgrading of this semiautomated disinfecting equipment will be of great use in all the Ophthalmology clinics in reducing hospital-acquired infections.

Conclusion

This newly innovated equipment is easy to use and also effective in disinfection of diagnostic contact lenses. We recommend eye clinics to utilize this newly designed equipment for the safety of the patients and staff.

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Conflicts of interest

There are no conflicts of interest.

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