Forensic Luminol Blood Test for Preventing Cross-contamination in Dentistry: An Evaluation of a Dental School Clinic

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Date of Submission: Feb 24, 2014

Date of Acceptance: Aug 22, 2014

How to cite this article: Bortoluzzi MC, Cadore P, Gallon A, Imanishi SWA. Forensic Luminol Blood Test for Preventing Cross-contamination in Dentistry: An Evaluation of a Dental School Clinic. Int J Prev Med 2014;5:1342-45.

ABSTRACT

Background: More than 200 different diseases may be transmitted from exposure to blood in the dental setting.

The aim of this study is to identify possible faults in the cross-contamination chain control in a dental school clinic searching for traces of blood in the clinical contact surfaces (CCS) through forensic luminol blood test.

Methods: Traces of invisible blood where randomly searched in CCS of one dental school clinic.

Results: Forty eight surfaces areas in the CCS were tested and the presence of invisible and remnant blood was identified in 28 (58.3%) items.

Conclusions: We suggest that the luminol method is suitable for identifying contamination with invisible blood traces and this method may be a useful tool to prevent cross-contamination in the dental care setting.

Keywords: Blood, bloodborne pathogens, cross-contamination, dental setting, dentistry

Brief Communication

INTRODUCTION

More than 200 different diseases may be transmitted from exposure to blood and theoretically, almost any infectious disease could be transmitted in the dental setting.[1-5] Three of the most serious in terms of long-term health risks are hepatitis B virus (HBV), hepatitis C virus (HCV), and HIV.[1-3] HBV, HCV and HIV can all survive outside the human body for several weeks in the presence of blood[4] and besides all, the likelihood of cross-infections in dentistry to be detected, reported, documented and published may be considered as under-reported.[1-5]

In dental clinics and in all places where dentists practice, protections are especially important to provide safeguards against biologic pathogen transmission, since dentists are frequently working in close contact to patient blood and saliva (which is usually contaminated with blood) and, there is the possibility of exposure to pathogens with each patient contact. Therefore, environmental surfaces in the dental treatment area are assumed to be contaminated due to the

aerosols and handling surfaces during dental procedures. Aerosolized material may also include viruses, blood, and supra- and subgingival plaque organisms. Those areas are also described as clinical contact surfaces (CCSs) which are often contaminated during treatment, allowing organisms to be transferred from the surface to the patient. Transmission of bloodborne pathogens can normally be prevented through the use of standard precautions and for all equipment and environmental workplace, the surfaces must be cleaned and decontaminated after contact with blood or any other bodily fluid, excretion, or secretion before and after concluding patient visits, and barriers should be used to protect clinical surfaces that cannot be easily cleaned.[1-5]

The forensic luminol (5-amino-2,3-dihydro-1, 4-phthalazinedione) has been described as a method for the detection of traces of blood in the environment and, for this reason, can also be used to monitor cleaning and disinfection procedures in units at risk for contamination with blood.[6] The aim of this study is to identify possible faults in the cross-contamination chain control in a dental school clinic by searching for traces of blood in the CCS through forensic luminol blood test.

METHODS

Dental school clinic

The search for blood traces was performed in one of the four dental clinic of the School of Dentistry of the West of Santa Catarina University. This clinic is composed by 21 dental chairs fully equipped and it is used by 3-5 years/class dental students. This clinic may receive around 200 patients in a week.

The search for blood traces were randomly conducted in the CCSs as dental seating lever, seat holder for dental handpieces and three-way syringe, seat holder for aspirators, reflectors and reflectors handlers, dental spittoon, accessory wood table and student's dental apron uniforms, or parts of dental equipment usually touched by students and which is shared in the clinic like as amalgamator, curing light, ultrasonic scaling, dental X-ray head and shutter button, dark box for dental X-ray film and dental ultrasonic washing machine.

Forensic luminol blood test

The chemiluminescent property of luminol has been employed in forensic science for over 40 years as a presumptive test reagent to detect or enhance small, diluted latent bloodstains which are often invisible to the naked eye. Luminol (5-amino-2, 3-dihydro-1,4-phthalazinedione) exhibits chemiluminescene in the presence of blood, when mixed with an appropriate oxidizing agent (H_2O_2 and NaOH). The iron found in hemoglobin catalyzes the chemical reaction, leaving a striking blue glow, which lasts for about 30 s. The luminol test does not give a positive reaction to other body fluids such as saliva. This test has been described as nontoxic and easy to use, however, side-effects has been described such as mucocutaneous irritations of the eye, skin and gastrointestinal tract with diarrhea and vomiting and, for this reason is advisable to ensure fresh air circulation during the procedure.[6,7]

This study used a commercially available forensic luminol test (Alfa-Luminox®, Alfa Rio Química Ltda, Rio de Janeiro, Brazil), and followed the recommendations of the producer. The solution was sprayed over the selected surface and, in darkness, the reagents produce a blue chemiluminescent signal. The specificity of luminol, has been described as to react with bleach in a positive manner,[7] however, bleach products are usually not recommended for the dental CCSs due to it highly corrosivity. Digital photographs were taken in the presence of the blue chemiluminescent signal.

RESULTS

Forty eight surfaces areas in the CCS were tested and the presence of invisible and remnant blood was identified in 28 (58.3%) items [Table 1]. Strong presence of the blue chemiluminescent signal can be viewed in Figure 1.

DISCUSSION

Dental schools are alert about the infection and cross-contamination control and these issues has become an essential part of their curricula and certainly cannot be underestimated. While there is evidence to suggest that the risk of acquiring an infection is quite small, dental students may be a

Table 1: Blood contamination evidenced through Alfa-Luminox® in areas and items of clinical contact surfaces evaluated in one teaching dental clinic

Clinical contact surfaces	Number of tested items/area	Number of items tested positive (%)
Amalgamator	1	1 (100)
Accessory wood table	5	4 (80)
Seat holder for dental handpieces and three-way syringe	6	3 (50)
Dental spittoon area	6	6 (100)
Curing light	3	0 (0)
Apron uniforms	3	2 (66.6)
Ultrasonic washing machine	1	1 (100)
Dental seating lever	5	1 (20)
Reflectors and reflectors handlers	5	1 (20)
Dark box for dental X-ray film	3	1 (33.3)
X-ray head	1	0 (0)
X-ray shutter button	1	0 (0)
Seat holder for aspirators	6	6 (100)
Ultrasonic scaling	2	2 (100)

Figure 1: Seat holder for aspirators and the presence of the luminol blue chemiluminescent signal

particularly vulnerable group for many reasons, including their lack of experience and skill.[8,9] For these reasons a constant search for possible transmissible focuses in dental setting must be implemented in order to establish a safe practice for both dentists and patients. Our results show that the area becoming contaminated with invisible blood during dental procedures may be dangerous in large dental school clinics paving the way for cross-contamination with bloodborne pathogens, nevertheless, the pathogens viability in those areas still remains to be investigated. Besides the identification of blood traces in the dental CCS, none case of cross-contamination was identified in the dental school.

The transmission of bloodborne pathogens (i.e., HBV, HCV, and rarely, HIV) are often related to common source of exposure and those sources are usually contaminated medical device.[10] According to the 2007 guideline for preventing transmission of infectious agents in health care settings,[10] the indirect contact transmission involves the transfer of an infectious agent through a contaminated intermediate object or person and the remaining blood detected in this study in many dental devices, clothing and furniture are clear cross-contamination risk examples. Very recently, Radcliffe *et al.*[11] confirmed an epidemiologic outbreak of HBV infection where the transmission occurred in three patients and two volunteers and which it likely have occurred at a portable dental clinic. From those infected three case patients underwent extractions; one received restorations and one a dental prophylaxis and interestingly, one case volunteer worked in maintenance of clean and dirty dental equipment and the other directed patients from triage to the treatment waiting area. Redd *et al.*[12] reported patient-to-patient transmission of HBV between two oral surgery patients operated on 161 min apart.

Our observations indicate that in highly active or larger dental clinics such as dental schools settings, disinfection between patients should be made as rigorous as possible and should be extend to the detail, since remaining blood was detected besides all efforts made by dental school staff members and students who cleaned the area according to strict infection-control protocols. The possible infected area suggest that when performing periodontal and oral surgeries or in any situation with open wounds, the dental clinic should be seen more as operating theatres than a regular office in order to minimize the risks of cross-infection, and that means the use of sterilized aprons and sheets to cover all CCS, avoiding touch any unprotected area, however, costs and the possible implications of changes in the way of work for dentists are still to be evaluated. Nevertheless, according to Laheij *et al.*[1] the cross-infection control regulations should undergo regular monitoring and need to be subjected to revision whenever necessary.

Besides forensic luminol blood test has been used since 1930 as an additional searching technique to detect hidden blood stains for criminalistics purposes, only in 2008 it was suggested that the luminol method may be suitable for identifying contamination of the

hospital environment in infection control audits.[6] This method proved to be reliable and cheap enough for the same purposes in dentistry and moreover, it may indicate places which are not usually cleaned by personal staff and dentists due to anatomically and functionally complex structures of difficult access and visualization, and which may be rich in blood and potentially pathogenic microorganisms like as seat holder for dental handpieces, three-way syringe and for aspirators. To our knowledge this is the first manuscript that use forensic luminol test in dentistry and to indicate its value to prevent cross-contamination for dental settings.

On the basis of our study findings, we encourage dental professionals to continue to be vigilant and to maintain the highest standards of infection control procedures in order to minimize the possible spread of bloodborne pathogens during dental treatment and disinfect periodically nonpatient care surfaces and items touched by many hands. We also suggest that the luminol method is suitable for identifying contamination with invisible blood traces and this method may be a useful tool to prevent cross-contamination in the dental care setting.

CONCLUSIONS

The results of this study suggest that the luminol method is suitable for identifying contamination with invisible blood traces and this method may be a useful tool to prevent cross-contamination in the dental care setting.

ACKNOWLEDGMENTS

The authors would like to thanks the School of Dentistry of Oeste de Santa Catarina University for their support for this research.

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Source of Support: School of Dentistry of Oeste de Santa Catarina University, **Conflict of Interest:** None declared.