Decontamination of an HIV-Contaminated CPR Manikin

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ABSTRACT

There has been a concern that the number of persons engaging in cardiopulmonary resuscitation (CPR) training could decline because of questions about human immunodeficiency virus (HIV-1) transmission. We investigated the theoretical possibility that a CPR manikin might serve as a fomite for HIV-1 transmission. Decontamination protocols were tested by using elevated levels of virus and decreasing decontamination times. Even under these compromising conditions, however, decontamination was effective. (*Am J Public Health.* 1992;82:1542–1543)

Introduction

Cardiopulmonary resuscitation (CPR) training is mandatory for many health care workers and First Response personnel. It is estimated that 40 million people in the United States and 150 million people worldwide were taught CPR procedures from 1961 to 1986.[1] Given the estimated 1 to 1.5 million people infected with human immunodeficiency virus (HIV-1) in the United States alone, it is possible that a person who is unaware of his or her seropositivity will receive CPR training. Although it is not common for CPR training to be associated with the transmission of infectious diseases,[2] a few cases have been documented in the literature.[3] Thus, laymen and professionals alike may be concerned about engaging in CPR training with manikins immediately after an HIV-infected individual has done so.[4]

While there is no evidence that HIV-1 can be casually transmitted through shared household effects,[5,6] several reports exist concerning the consequences of direct oral contact.[7–10] Findings on the prevalence of HIV-1 in saliva[11,12] conflict with reports both of greater frequency in the asymptomatic period and of no differences at different disease stages.[13–15] Given these ambiguities and the serious consequences of HIV-1 infection, we must be concerned about the adequacy of current decontamination procedures for CPR manikins.

Intermittent manikin decontamination is recommended together with daily decontamination to prevent transmission of organisms between CPR trainees. Intermittent decontamination, consisting of a chemical application for 30 seconds and a wipe-down with a dry sponge, is recommended to cleanse the manikin's external buccal area after contact with each CPR trainee when individual face shields are not used. Although sodium hypochlorite solution is the preferred decontamination vehicle, the standards recognize that hypochlorite odor may be "objectionable"; thus, 70% alcohol (isopropanol or ethanol) is recommended "reluctantly" as an alternative.[16] We considered it important to test the adequacy of this less desirable but commonly used decontaminant. Positing a worst-case scenario, we performed experiments using higher titers of HIV-1 than those found in patients, in combination with less-than-recommended disinfection times.[4,17]

Methods

Uninfected and chronically infected CEM cells were used in all the studies. (CEM is a CD4+ human T-lymphoblastoid cell line.) Infectious pools of HIV-1, acute infection, and quantitation of virus by reverse transcriptase activity assay, p24 enzyme-linked immunosorbent assay (ELISA), and endpoint titration have been described previously.[18]

Contamination was achieved by immersing a cotton-tipped swab in a solution of virus containing medium and applying the swab to the external buccal area of a Resusci Anne manikin (Laerdal) composed of head and neck without a rebreathing device. Following a viral application at 10^7 infectious units per milliliter, sampling detected the virus at 10^5 infectious units.

Decontamination was achieved by disinfecting the contaminated surface with 70% isopropyl alcohol, varying both the time (10 seconds and 5 seconds) and the mode of application (alcohol sponge or spray). Following disinfection, a drying time of 30 seconds was allowed. A second sampling was taken from a spot that was different from the spot previously sampled and that incorporated a larger surface (three quarters of the lips vs one quarter). Mechanical disinfection was achieved by wiping the circumoral area with a dry sponge for 5 seconds and repeating the sampling.

To recover the virus, swabs used for sampling were placed in 5-mL centrifuge tubes containing 1 mL of RPMI tissue culture medium. For cell-associated virus ex-

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periments, the virus was pipeted onto the manikin surface at a concentration of 5×10^6 cells per milliliter. The procedure was otherwise the same as that just described. Experiments also were performed in which the virus was mixed with saliva prior to application to test manikin decontamination in the presence of large amounts of cellular and proteinaceous material.

Results and Discussion

The initial experiments addressed the capability of the assay system to detect the virus. Results indicated that, although the detection system resulted in a ten- to one hundredfold loss in titer, infection was repeatedly detected at a 10^5 sample dilution, a level higher than would be expected in saliva.

The virus was detected following manikin contamination with high levels of supernatant reverse transcriptase and p24 antigen at 1 and 2 weeks postinfection. Virus-producing cultures were detected at a five-log dilution of samples removed from the manikin. Cultures were identified as positive by microscopic observation of syncytium formation. Reverse transcriptase activity assay and p24 ELISA were performed at 1 and 2 weeks. The results were similar at both points in time. At week 2, virus production was significant at a dilution of 1:10,240. Following disinfection by alcohol sponge or spray, no infectious virus was detected at a 1:10 dilution. A culture of an undiluted sample for up to 6 weeks detected no evidence of virus.

These results concur with Resnick et al., who report inactivation with 70% alcohol in less than 1 minute.[19] Experiments using cell-associated HIV produced similar results. Given the emphasis on wiping in manikin decontamination, another experiment explored the effect of wiping the buccal area with a dry 4 × 4 sponge without chemical disinfection. Although it was reduced by two logs, the virus was not eliminated from the manikin. This result confirms the importance of chemical disinfection for manikin decontamination. Additional experiments determined that saliva did not interfere with the action of alcohol on the virus.

Our data suggest that one should not refrain from CPR training out of fear of contracting HIV infection. However, these findings should not be interpreted as suggesting that recommendations for intermittent decontamination be changed. Safe conditions are best maintained by chemically disinfecting the manikin's circumoral surface for 30 seconds. □

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