Blood and Radioactive Contamination in Commercial Dose Containers

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Abstract

As lead unit dose containers (pigs) are reused by the radiopharmaceutical companies, there may be a hazard from bloodborne pathogens and radioactive contamination to nuclear medicine technologists and to radiopharmaceutical staff. The purpose of this study was to determine the current level of risk from these potential hazards.

Methods: Using a phenolphthalein presumptive blood test kit, 75 container samples were tested for blood contamination. The outside of the pigs were wiped two times, while the inside of the pig was wiped one time. Using a well counter, 25 samples were wiped from the outside of the lead pigs after dose administration, to test for radioactive contamination.

Results: None of the 75 samples tested for blood contamination exhibited a positive outcome for blood. One of the 25 samples tested for radioactive contamination was found contaminated (4%).

Conclusion: The risk of blood or radioactive contamination from reuse of lead unit dose containers is low.

Introduction

In 1998, there was research done on residual blood contamination in commercially used radiopharmaceutical unit dose containers from radiopharmacies throughout the United States. The research tested two different lead unit dose containers (pigs). One container used plastic, disposable inserts and the other container did not. About 39% of the containers without the plastic inserts were contaminated with blood when they arrived in the department with doses (*1).*

Blood contamination in or on pigs exposes healthcare workers, patients, and radiopharmacy workers to bloodborne pathogens. Such pathogens spread through contact with dirty needles and other avenues especially involving great volumes of blood (*2).* Nuclear medicine technologists and other healthcare personnel have numerous opportunities to be exposed to bloodborne pathogens.

Hepatitis B virus (HBV) is a pathogen which could be transmitted in nuclear medicine departments, since technologists have a large degree of contact with blood. Although needle stick injuries are the most proficient means to transfer HBV, it can also be transmitted through environmental surfaces or blood contaminated objects (*3*). The HBV vaccination can decrease the risk of infection of Hepatitis B, however, it cannot reduce the threat of the Hepatitis C virus or the human immunodeficiency virus (HIV) infection (*4*).

HIV was first acknowledged in the United States in 1981. HIV attacks the body's immune system with several symptoms that can lead to serious infections and other problems. The most common mode of transmission to healthcare

workers from 1995 to 1999 was needlestick injuries with an 89% occurrence. In 2006, an estimated 18.5 per 100,000 people in the general population were reported with HIV or AIDS (*4,5).*

Occupational Safety and Health Administration (OSHA) has a current standard, since 1992, that pertains to exposure to blood or other contagious material (*2).* This standard describes occupational practices to minimize exposure, such as personal protective equipment and cleaning procedures (*4).* Laboratory equipment in contact with blood should be cleaned the same as environmental surfaces contaminated with HIV (*1).*

According to the Nuclear Regulatory Commission (NRC), there is a procedure to wear gloves while radioactive packages are being opened (*6).* The NRC, however, does not address the use of gloves when returning the dose container back to the package. It has been observed that numerous technologists do not wear gloves upon returning the pigs to the packages. This study investigated radiation and blood contamination within pigs, without plastic inserts, distributed from a commercial radiopharmacy.

Methods

Over two months, 25 unit dose containers without plastic inserts were tested for blood contamination. Each pig was wiped three times to test for the presence of blood, resulting in 75 samples. Before the dose syringe was removed from the container, the exterior was wiped around the pig in a circular motion from top to bottom with a cotton swab (sample 1). Then, while the dose was being given to the patient or being assayed in the calibrator, the inside of the

container was wiped (sample 2). The cotton swab was started at the bottom of the inside of the pig and worked upwards in a circular motion.

After the dose had been given and the syringe was replaced back in the pig, the exterior was wiped again (sample 3). This sample was wiped in a circular motion from top to bottom. The 25 samples that were tested for radioactivity were wiped after the dose had been given (sample 4).

The same protocol used for blood contamination was followed. These 25 samples were placed into a single well wipe test counter that measured radioactive contamination. The wipe test counter was calibrated every morning with a test source. Each sample was placed into the holder and counted until a pass/fail response. The green "pass" light indicated the wipe was less than 2000 disintegrations per minute (dpm). The red "fail" light indicated the wipe exceeded the 2000 dpm.

A phenolphthalein presumptive blood test kit was used to detect the presence of blood and was purchased from a commercial manufacturer (Crime Scene, Phoenix, AZ) (*7)*. The kit contained cotton swabs, ethanol, phenolphthalein, and hydrogen peroxide. Six steps for testing blood contamination as listed in the package insert were followed (*8)*.

Step 1: a known bloodstain control was used to test the solutions prior to testing evidence stains to demonstrate a positive result. Step 2: Use a cotton swab to sample the suspected blood stain. Step 3: Add one drop of alcohol to the sample area of the cotton swab. Step 4: Place one drop of the Phenolphthalein reagent on the cotton swab. Step 5: Apply one drop of hydrogen peroxide to the

swab. Step 6: Blood was indicated if a bright pink color was observed within several seconds. If a pink color developed after the addition of the phenolphthalein reagent, but before the addition of the hydrogen peroxide, this indicated that non-blood contamination was present, known as a false positive.

Results

Of the 25 pigs sampled for blood contamination, none of the 75 swab samples (3 tests for each pig) exhibited a positive response for the presence of blood. However, one of the 25 wipes tested for radioactive contamination failed the wipe counter (4%).

Discussion

Although the previous research exhibited blood contamination in several lead pigs without the removable, plastic inserts, this study showed that none of the tested pigs had detectable residual blood contamination *(1)*. Even though the prior investigation was done throughout the US and sampled containers from numerous radiopharmaceutical companies, the cleaning procedures may have improved in the past 12 years.

Since technologists handle doses in an array of containers, personal protective equipment should always be worn. With only one sample contaminated with radiation, this still shows that precautions are still of utmost importance.

Sampling was only performed on Mondays, Wednesdays, and Fridays. This might have skewed the sampling results by not having random sampling throughout the entire week.

Conclusion

The level of risk was low for reusable unit dose containers contaminated with radioactivity, and nonexistent for blood contamination.

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