Using starch powder for the decontamination of I-131 in isolation rooms

Original Article

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ABSTRACT

Introduction: Various iodine isotopes are undergoing radioactive decay except Iodine-127 (I-127. Iodine I-131 is unsealed radioactive material used in nuclear medicine for both diagnostic and therapeutic procedures in Royal Hospital since 2006. In radiotoxic classification, I-131 is in group 2 element. I-131 is highly reactive element due to its volatilization nature. Currently, commercial Radio-active wash spray method used for I-131 decontamination in nuclear medicine.

Methods: Violated fumes from stable Iodine I-127 after heating in fume hood were exposed to starch powder and sugar to verify the starch affinity in trapping iodine reaction and compare with sugar. Then, decontaminate two areas, one by applying starch powder with alkaline and the other area was decontaminated using commercial Radio-active wash spray. Wipes were taken from both areas after each decontamination attempts and measured using well counter (Capintec, CRC-55-tW, and USA).The I-131 decontamination attempts measurements were plotted for both starch powder and Radio-active wash.

Results: The starch has affinity of trapping Iodine permanently, while the sugar did not have this property. The effectiveness of starch in case of Iodine-131 contamination was assessed practically. The reduction in contamination by cleaning up using starch powder was more effective compared to the commercial Radio-active wash.

Conclusion: This technical note explains the starch effect on I-131 decontamination compare to usual method which is commercial Radio-active wash. Using starch powder for trapping is an efficient and cost effective technique for decontamination of I-131.

Key words: Starch; Decontamination; Iodate; Iodide

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INTRODUCTION

Iodine is a halogen inorganic reactive chemical [1]. Various iodine isotopes undergo radioactive decay except Iodine-127 (I-127), the stable one. It has two common forms which are Iodate and Iodide. Iodate is a strong oxidizing agent, while Iodide is a strong reducing agent. Iodate to Iodide conversion process occurs as the Iodine does not exist in nature [2].

Elemental Iodine is rapidly lost at air through evaporation and diffusion and it is readily sublimes. Iodide is oxidized to volatile Iodine with availability of those factors: humid environment, acid media and in oxidizing agent presence [3]. Tri-iodide is formed from Iodine with Iodide chemical reaction. A deep blue color with starch developed as a reaction of Tri-iodide with amylase content of starch specifically [2].

Iodine-131 is of high Radiotoxicity (Group 2) which widely used in Nuclear Medicine Department. About 40 GBq of I-131 are used monthly for both diagnostic and therapeutic procedures. Most of these quantities were given for thyroid cancer patients and majority of them need patient hospitalization. The thyroid cancer patients in average excrete about 90% of the administered dose in different pathways [4]. Floor and surface contamination is a daily problem in patient isolation rooms. Thus, cleaning up these rooms involves considerable risk of cross contamination and inhalation of Iodine vapors. As the starch has the affinity to trap the iodine [5], an efficient, easy and cheap method required to recover this problem. Starch provides evidence to be alternative practical solution for I-131 contamination.

In this study, the starch affinity of iodine reaction was investigated and compared with sugar. Due to this affinity, the effectiveness of starch in case of Iodine-131 contamination was assessed practically.

METHODS

Study approval

The Medical Ethics and Scientific Research Committee (SRC) of the Royal Hospital, Ministry of Health, Oman, has approved the research study to be conducted in Nuclear Medicine Department and Molecular Imaging Center in its documents with the code SRC No. 90/2017 dated on 7th November 2017.

Iodine trapping in starch

A fume hood (Supreme Air LV, Kewaunee Scientific Corporation, USA) was used as shown in Figure 1. The stable Iodine was heated by hot air gun. The violate Iodine fumes came out by heating. These fumes were exposed to two dishes of sugar and starch, 100 gram of each.

Then, both dishes were colored by Iodine fumes. The dishes were followed for a three months to track changes. Figure 2 shows the stable Iodine I-127 and the violate Iodine fumes after heating.

Fig 1. The experimental setup inside fume hood.

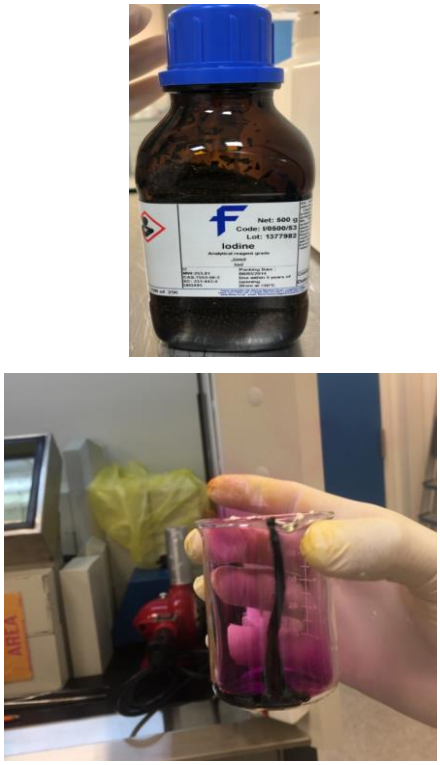

Fig 2. The stable Iodine (above) and the violate Iodine fumes after heating (below).

Iodine I-131 decontamination with starch powder

Decontamination was initiated with all proper Personal Protective Equipment (PPE) and by following local controlled document in Royal Hospital "Wipe Test for surface Contamination in Nuclear Medicine." .The contaminated areas were monitored by the Survey meter Co-Mo170 (NUVIATECH instruments, International Group of 13 countries) and it was labeled by a marker. Wipes were taken before decontamination process of the areas. One area was decontaminated using starch powder (1000 grams) with alkaline NaOH spray and another area was

decontaminated using commercial Radio-active wash spray (Biodex, USA). Wipes were taken from both areas after each decontamination attempts. The process was repeated three times. All wipes were measured using well counter (Capintec, CRC-55-tW, USA).The I-131 decontamination attempts measurements were plotted for both starch and Radio-active wash.

RESULTS AND DISCUSSION

Iodine trapping in starch

Fume hood was used for this study because Iodine has a volatilization nature. The first part demonstrates that the elemental Iodine trapped permanently by starch powder as showed by the deep blue color in Figure 3. This process will guarantee that the evaporated Iodine will not escape from the collected starch matrix. The starch has affinity of trapping Iodine permanently, while the sugar as an example do not have this property. The sugar was selected for comparison as it was available option and easy to show.

Fig 3. The starch powder before and after the stable iodine (I-127) trapping.

Iodine I-131 decontamination with starch powder

The Iodine compound was stabilized by using alkaline solution like NaOH to slow down the volatile process. Acidic solutions enhance the oxidation of Iodide compounds to elemental Iodine; by this means, increasing volatility. Subsequently, the clean-up was performed on contaminated wet surfaces by NaOH spray using starch powder.

The iodine I-131 decontamination was compared between two different methods Starch and Radio-active wash. Radio-active wash is a synergic liquid compound and has a pH of 3.5. It is optimally combines of chemical and physical properties in order to act as a surface-wetting sequestering agent and chelator [6]. Wipe test was performed post each decontamination attempt, in order to check the I-131 radioactivity contamination by well counter (Capintec, CRC-55-tW,USA).The reduction in contamination by cleaning up using starch powder was more effective compare to the commercial Radio-active wash as shown in the Figure 4.

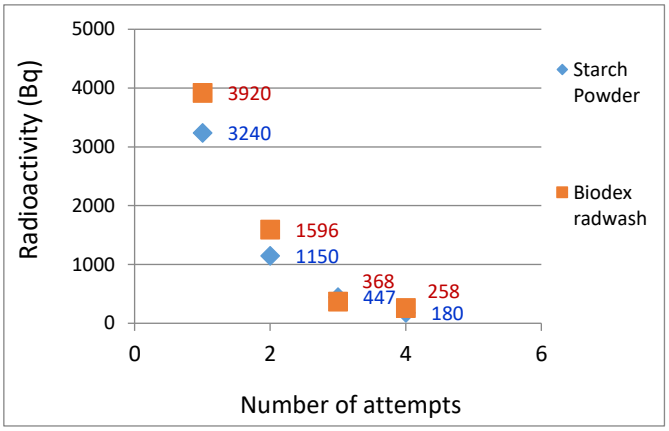

Fig 4. Comparison of starch powder and Radio-active wash effects on I-131 decontamination.

Study limitation

The study is limited to the time period in which the study was conducted. Moreover, the starch decontamination consumes time, effort and large quantity of waste disposal. In addition, there were no similar studies found to make comparisons.

CONCLUSION

Commercial Starch is a low-cost natural product available in the local market compare to the commercial Radio-active wash imported from USA. I-131 decontamination by starch powder is proved to be a successful practical solution for cleaning up the I-131 isolation rooms which involves considerable risk of cross contamination and inhalation of volatile Iodine radioisotope. In addition, using starch powder for trapping is a cost effective technique for decontamination compared to Radio-active wash.

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