RADIOLOGICAL EMERGENCY RESPONSE IN A MEDICAL WASTE TREATMENT UNIT

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ABSTRACT

Radioactive materials are largely used in medicine, research and industry. The amount of radioactive material employed in each application varies from negligible to large and it can be in sealed or non-sealed form. A medical waste treatment unit that deals only with A-type medical waste (ABNT-NBR 12808), which does not include radioactive waste, detected abnormal radiation levels in a collecting truck and the IPEN-CNEN/SP Nuclear and Radiological Emergency Response Team was called. The presence of radioactive material inside the truck was confirmed; however, its origin and nature were not possible to be determined because the truck had collected medical waste in several facilities. So, an operation in order to segregate and identify that material was carried out. During the operation, a second collecting truck presenting abnormal radiation levels arrived to the unit and the same procedure was carried out on that truck. In both situations, the contaminated objects found were infantile diapers. The radioactive waste was transported to IPEN-CNEN/SP to be managed. Samples of the radioactive materials were submitted to gamma spectrometry and the radionuclide was identified as Iodine-131. Since that attendance, similar occurrences have been frequent. These events suggest that it is necessary a better control of the radioactive waste at the generating facilities and there should be basic radioprotection orientations to the discharging patients that were submitted to nuclear medicine procedures.

I. INTRODUCTION

Medical wastes include all types of wastes generated by health care organizations such veterinary facilities, hospitals, clinics, dental offices, research facilities and other medical laboratories. These wastes are very heterogeneous in nature and often contain some infectious elements, thus it is essential that the handling and disposal of the waste be safely conducted [1]. The medical wastes can be classified in three different categories A, B and C [2] that are handled separately. The A-type medical waste typically includes human blood and blood products, cultures and stocks of infectious agents, laboratory animal carcasses and bedding material, needles, sharps and pathological wastes. The wastes of this category must be segregated at the point of origin in white-colored polyethylene bags, labeled and marked with the universal biological hazard symbol [3]. The C-type medical waste is the common trash from the offices and kitchens of those organizations, including paper, dust and anything else not contaminated by infectious, hazardous, or radioactive waste. The B-type medical waste includes pharmaceutical products, dangerous chemical substances and the radioactive waste generated in health care organizations. The amount of radioactive material employed in each application varies from negligible to large, for example, radioisotopes are used in radioimmunology (kBq), diagnostic techniques (MBq), or in chemotherapy (GBq) and it can be in sealed or non-sealed form. Polymorphism and low activity levels in a great volume characterize medical radioactive wastes and these wastes should be treated apart from the A-type medical waste. In order to avoid the mix of A and B-type wastes, many landfills, transfer stations and treatment units have surveyed the waste with NaI scintillation detectors and reject radioactive contaminated wastes [4]. This practice also prevents that lost radioactive sources from radiotherapy departments get into the medical waste treatment process. The brachytherapy sources are easily lost owning to unexpected behavior of the patient or inattention of the persons in charge of the sources [5], so it is possible that some of those lost sources leave the installation inside medical waste bags.

A Medical Waste Treatment Unit, located in São Paulo, Brazil, which deals only with A-type medical waste, detected abnormal radiation levels in a collecting truck and the IPEN-CNEN/SP Nuclear and Radiological Emergency Response Team (NRERT) was called.

II. THE OCCURRENCE

A new Medical Waste Treatment Unit was inaugurated to handle only A-type medical waste generated in São Paulo. The waste treatment process in that unit follows the procedure below:

1) Trucks with closed metal dump body of 1/8" thickness wall and 4-ton waste capacity, collect medical waste at the health care organizations, Fig. 1.

2) Along the itinerary, the drivers fill out a collecting control sheet, where information about schedules is logged.

3) When the truck is full, it is driven to the medical waste treatment unit. In the entrance, it is weighted and surveyed with a portable ratemeter, model FH 40G-L, ESM, equipped with a NaI scintillation probe, model FH Z 502 P, Eberline.

4) If no radioactive material is detected during the radiological survey, the truck is liberated to proceed for one of the access ramps of the section of wells of the installation. Those wells are 6 m depth and they are in negative pressure. The removed air of the section of wells is filtered in absolute filters and washed before being liberated to the atmosphere.

5) When the truck gets to the access ramp the gate of the section of wells is opened and the waste is discharged into the well without any contact with the operators, Fig. 2. The gate and the dump body are shut and the truck is liberated for new weighting before leaving of the unit.

6) The residues are hoisted from the well by a mechanical claw and placed in a shut line of crushers and homogenizers. The air of that line is also filtered and washed before liberation to the atmosphere.

7) At the end of the homogenizer line, to eliminate the pathological organisms, the residues are heated, by a Radio Frequency system, to 97 Celsius degrees, before being transported to landfill. About 2 tons of medical waste is processed per hour in that unit.

Figure 1. Collecting Truck of Medical Waste.

After about one week of operation, the Unit received a collecting truck presenting a count rate of 1400 cps in some parts of the dump body and 200 cps at one meter from those points. The local background was 60 cps. The truck was isolated inside the area of the Unit and the NRERT was called.

Figure 2. Collecting Truck Being Unloaded.

III. THE RESPONSE

The NRERT confirmed the presence of radioactive material inside the truck by a radiological survey, although the origin and nature of the radionuclide were not possible to be determined, as well as the activity present. According to the collecting control sheet, the truck had collected medical waste in five different facilities. Each one of these five facilities was contacted, and just one of them was licensed to work with radioisotopes. The person responsible for that installation sustained that the facility correctly manages the radioactive waste and its A-type medical waste could not contain radioactive material.

Due to the impossibility to determine the radioactive material characteristics through the available data, it was proposed an operation in order to segregate and identify that material. As the operation involved biological, environmental and radioactive risks, other institutions, as Municipal Environmental Secretary (SVMA) and Urban Cleaning Department (LIMPURB) were consulted to get permission to execute the operation.

The operation took place in an access ramp of the section of wells. The ramp was covered with polyethylene plastic sheeting to avoid any kind of contamination. Nine persons participated directly in the operation. There were two persons to move the waste bags and two persons to survey the waste with radiation detectors. These persons were dressed with impermeable coveralls, two pairs of gloves, rubber boots, plastic shoe covers and facial air mask. One person was at checkpoint and he was dressing cloth apron, one pair of gloves and semi-facial air mask. Four persons were present to provide the necessary infrastructure and they did not need to use any protective dressing.

Four different radiation detectors were used during the response:

A) Portable ratemeter with NaI scintillation detector, model SPP 2NF, Saphymo-SRAT.

B) Portable ratemeter with Pancake GM detector, model MIP-10, Eurysis.

C) Portable ratemeter with Pancake GM detector, model MIP-10, Eurysis.

D) Portable ratemeter with GM detector, model MC1K, SE Intenational.

Inside the truck were found four waste bags containing radioactive material. The count rates found in each bag are shown in Table 1.

During the operation, a second collecting truck presenting abnormal radiation levels (8000 cps, Monitor A) arrived to the unit and the same procedure was carried out on that truck. In this second truck was found only one bag containing radioactive material, It was identified as Bag 5 and its count rate is shown in Table 1.

In both trucks, the radioactive contaminated objects found were infantile diapers. The radioactive waste was segregated, put in a metallic drum and transported to IPEN-CNEN/SP to be managed. Two samples of bags 2 and 5 were collected and submitted to gamma spectrometry and the radionuclide was identified as Iodine-131.

TABLE 1. Count Rates Found in Each Bag.

Bag	Count Rate (cps)	Monitor Used
1	200	B
2	2000	B
3	200	C
4	3000	B
5	700	C

IV. DISCUSSION AND CONCLUSION

Patients receiving iodine-131 therapy constitute a potential hazard both as a gamma-emitting source of radiation and a radioactive contamination root. All patients submitted to iodine-131 treatment of more than 1100 MBq should be treated on an inpatient basis [6]. With less than this activity, it is unlikely that normal contact will produce exposures exceeding the maximum permissible limits to members of the public. However, when patients are discharged they should be instructed not to allow themselves close contact (closer than 1 meter) with others persons for extended periods. The patient may be discharged when the radioactivity falls below 1100 MBq, which will usually be when the dose rate at 1 m falls below 50 μGy/h [7]. Otherwise, analyzing the radioactive contamination risk, most of the radioactive iodine is excreted in the urine and it also appears in saliva, perspiration, vomits and feces, so, there should be basic radioprotection orientations to the discharging patients to control these kinds of excreta, not expecting that they will always be carried off in sewers or drains.

The radiological survey results and the identified radionuclide characteristics (Iodine-131, half-life of 8.0 days), as well as the activity levels used in the practices and the potential doses from these procedures [8] show that the biological and environmental risks involved in the segregating operation are greater than the radiological risk in treating the contaminated waste. Considering these facts, the NRERT proposed that those kinds of load should be incorporated to the normal treatment process of the medical waste treatment unit when the count rate outside the dump body is similar to that observed during the attendance.

On the other hand, since that attendance, similar occurrences have been frequent. These events suggest that it is necessary a better control and inspection of the radioactive waste at the generating facilities.

REFFERENCES

[1] Orofino, F. V. G., **Aplicação de um sistema de suporte multicritério – SAATY for Windows – na gestão dos resíduos sólidos de serviços de saúde – caso do Hospital Celso Ramos**, Florianópolis, UFSC, 1996. Dissertation (Master of Science in Engineering) - UFSC, 1996.

[2] Associação Brasileira de Normas Técnicas, **NBR 12808: Resíduos de serviços de saúde: classificação**, Rio de Janeiro, 1993.

[3] Associação Brasileira de Normas Técnicas, **NBR 9190: Sacos plásticos para acondicionamento de lixo: classificação**, Rio de Janeiro, 1993, 2p.

[4] Evdokimoff, V., Cash, C., Buckley, K., **Potential for radioactive patient excreta in hospital trash and medical waste**, Health Physics, vol. 66(2), p. 209-211, February 1994.

[5] De Almeida, A., **Protocolo para fontes de braquiterapia extraviadas no ambiente hospitalar**, Conferência Internacional Goiânia Dez Anos Depois, CD-ROM, Goiânia, Brazil, 1997.

[6] Comissão Nacional de Energia Nuclear, **CNEN-NN 3.05: Requisitos de radioproteção e segurança para serviços de medicina nuclear**, Rio de Janeiro, 1996, 12p.

[7] International Commission on Radiological Protection, **ICRP Publication 25: The handling, storage, use and disposal of unsealed radionuclides in hospitals and medical research facilities**, ICRP, 1977.

[8] De Lima, F., Khoury, H. J., Hazin, C. A., **Avaliação da dose recebida pelos familiares de pacientes com hipertireoidismo tratados com Iodo-131**, IV Encontro Nacional de Aplicações Nucleares, CD-ROM, Poços de Caldas, Brazil, 1997.