BULLET SCINTIGRAPHY: CAN GAMMA CAMERA BE USED FOR DEPLETED URANIUM ACCIDENT MEASUREMENTS?[1]

Rajko Spaić, Stevan Marković, Snežana Pavlović, Živojin Radić**, Radojko Pavlović*, Boris Ajdinović, Branislav Baškot, Branka Djurović****
Institute of Nuclear Medicine, Medical Military Academy, Belgrade, Yugoslavia
**VINČA Institute of Nuclear Sciences, Belgrade, Yugoslavia*
***Clinic of Nuclear Medicine, KBC, Banja Luka, Republic of Srpska*
****Institute of Health Medicine, Medical Military Academy, Belgrade, Yugoslavia*

ABSTRACT

The aim of this study was to see could gamma cameras be used for measurement of internal contamination with depleted uranium. Radioactive waste depleted uranium, which is by-product from the production of enriched fuel for nuclear rectors and weapons now, is used for manufacture bullets, which are used in Iraq, Republic of Srpska and Yugoslavia. In this paper is measured minimum detectable activity (MDA) of gamma cameras for depleted uranium, iodine and technetium. For detection of the depleted uranium are used low energy X-rays, energy of 100 keV with 20% windows width. About 40% of gamma emissions of the depleted uranium are in these limits. Measured MDA activities 50-100 Bq for depleted uranium, iodine and techentium are about then times more then same for WBC (5 Bq). Gamma cameras can be used for relatively measurement of depleted uranium activity, what can be used for absorbed dose estimation. Detection of low level internal contamination with depleted uranium can be done with gamma cameras.

Key words: depleted uranium, bullets, gamma camera, measurements, internal contamination, minimum detectable activity

INTRODUCTION

The aim of this study was to prepare gamma cameras to be used for measurement of the internal contamination with depleted uranium. Radioactive waste depleted uranium, which is by-product from the production of enriched fuel for nuclear rectors and weapons now, is used for manufacture bullets, which were used in Iraq, Republic Srpska and Yugoslavia.

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This bullets are extremely dense and capable of penetrating heavily armored vehicles, but it have another undesirable physical property, is that seventy percent of the uranium in this weapons spontaneously burns in impact, creating tiny aerosolized particles less than five microns in diameter, small enough to be inhaled, and which travel long distances when airborne.
It seems that is not only use of depleted uranium. Last year was happened some aircraft in some quantity (hundreds kilograms) of depleted uranium burned. Also, some quantity burned in fire of the depot where depleted uranium was stocked. All of that point to depleted uranium is more and more used in wars but and during the peace. What means that depleted uranium became global problem and that radiation accidents with depleted uranium became frequently and more possible.
Because of that nuclear medicine's scientists must be ready to measure internal contaminated people with this radioactive material. Whole body counter (WBC) is equipment for these situations, but there are no so much them in countries, specially in our country, because gamma cameras will be alternatives (1-3).

METHODS

In May of last year, we got first bullet used in territory of Yugoslavia. It was 292 gr. heavy bullet. With HPGe gammaspectroscopy it's measured that bullet have 12,4 kgBq/gr of the U-238, and 2,3 kgBq/gr of the U-234 and about 0,16 kgBq/gr of the U-235. Radioactive material with this ratio of activities and concentrations: 99,8% of the U-238 and 0,2% of the U-235, is known as depleted uranium
Minimum detectable activity (MDA) of gamma cameras for depleted uranium, iodine and technetium was measured in air and in tissue equivalent material (TEM). MDA was calculated by method described in references (4,5). For detection of the depleted uranium are used low energy X-rays, energy of 100 keV with 20% windows width. About 40% of gamma emissions of the depleted uranium are in these limits (Fig. 1).

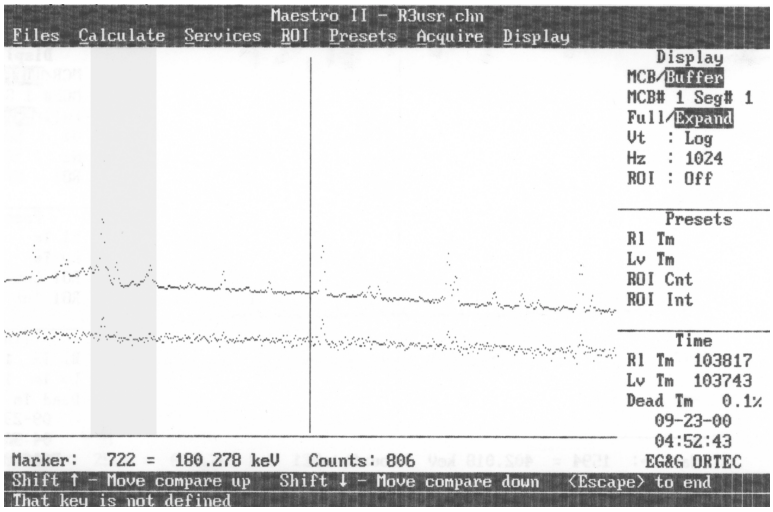

Fig. 1 Gammaspectroscopy of depleted uranium from 50 to 310 keV and background in same range.

Under gamma camera with ¼" crystal and with parallel holes low energy collimator, and with energy of 100 keV and windows width of 20%, for 30 minutes is collected 189.965 counts, and got this bullet scintigraphy (Fig. 2).

Fig. 2 Bullet scintigraphy

RESULTS

In Tab. 1 are given all measured MDA value calculated with method, which is reported before (4,5).

Tab. 1 Measured MDA values for Gamma Camera

Radioisotope	*Gamma Camera MDA (Bq)		**WBC MDA (Bq)
	in air	in tissue eq. material (TEM)	in air
Tc-99m	38	66	4
I-131	42	85	4
Depleted Uranium	51	90	-

*Data for Gamma Camera MDA are medium value for three cameras.
**Data for WBC MDA are from literature (4).

Measured MDA activities 50-100 Bq for depleted uranium, iodine and technetium are about then times more then same for WBC (about 5 Bq). But, this is not limitation that gamma camera can be used for lung or whole body internal contamination with depleted uranium (6).

CONCLUSION

Gamma cameras can be used for relatively measurements of depleted uranium activity, what can be used for absorbed dose estimation.
Detection of low level internal contamination with depleted uranium can be done with gamma cameras.

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