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Medical Consequences of Depleted Uranium Use in Northern Kosovo

Dejan Gurešić[1*], N. Srbljak[2], Veljko Đukić[3]
[1] Faculty of Agriculture, Kopaonicka bb, 38219 Lesak, Kosovska Mitrovica, Serbia
[*]Corresponding author, e-mail: dejanguresic@yahoo.com
[2]Health Centre, Anri Dinan bb, 38220 Kosovska Mitrovica, Serbia
[3]Pan-European University APEIRON, Banja Luka, Bosnia and Herzegovina

Abstract: The very fact that during NATO bombardment of Kosovo and Metohija, ammunition with depleted uranium (DU) was used is of considerable importance in the case of an increased number of malignant diseases in the post-war period. This research refers to the period of time from 1997 to 2008. The pre-war period has been taken into consideration in order to compare numbers of the diseased in the period before the use of ammunition with DU and the period after its use. This research was carried out on 30.000 patients hospitalized, during the stated period, in seven wards of Health Centre in Kosovska Mitrovica.

Keywords: depleted uranium, radiation, malignant disease, consequences.

Introduction

The man is, practically from the beginning, exposed to different types of radiation, which essentially have no harmful effect on him. Earth's crust contains a great variety of radioactive rocks. The radiation comes to us from cosmos, the air contains small amounts of radioactive radon and human and animal bodies have a certain amount of radiation too. Radioactivity is a spontaneous process in which atomic nuclei emit one or more particles, or quanta of electromagnetic radiation and transform them into the other core. Initially, the nature of radiation was unknown but it was called radiation, and this phenomenon of the core "break up" was called radioactivity, and cores that emit particles or radiation are called radioactive isotopes or radioactive nuclei. Initial dissolution of the core - "the core of parents" created "a descendant of the core," which may have the reference number Z and / or mass number A, different from the "core of parents." Radioactive decay is characterized by the type and energy of the emitted radiation and the half-life. In nature, there are *alpha*, *beta* and *gamma* decay and spontaneous fission as well. In *alpha* decay, radioactive nuclei emit Helium nucleus $^{4}He^{2+}$. In *beta* decay, the nucleus emits an electron and the antineutrino, and in *gamma* decay, the core radiates electromagnetic waves (photons) of great power.

Half-life period is a characteristic of each chemical element, i.e. isotopes, and it represents the time needed to break down half of the initial number of atoms of certain isotopes [Draganic, 1995].

Radioactive elements (radio-nuclides) are elements which, through the *alpha*, *beta* or *gamma* decay, transform into new elements, in accordance with the law of conservation of mass and energy. These laws are determined by the so-called laws on moving which define the new elements resulted from the disintegration of the polar nuclei. *Gamma*-ray emission, which follows the transformation of certain elements, does not change either the atomic number or weight; however, only internal changes are made within the core. Radioactive elements with reference numbers from 81 to 92 are classified into three radioactive series: the uranium series (from $^{238}{}_{92}U$ to $^{206}{}_{82}Pb$), thorium (from $^{232}{}_{90}Th$ to $^{208}{}_{82}Pb$) and actinium (from $^{215}{}_{92}AcU$ to $^{207}{}_{82}Pb$). All members of a series are genetically related and are the result of the gradual decay of the first member of the series. The initial members of all three series have a long period of half-life. Members with the reference number 88 are in the gaseous state and are isotopes of radon; furthermore, those with serial number 83 are isotopes of bismuth. All three sets of stable isotopes end with the reference number 82, i.e. isotopes of lead [Lederer, 1978]. In addition to the elements belonging to these sequences, low radioactivity is also shown by potassium, rubidium, samarium, lutetium and rhenium.

Depleted uranium (DU) is a by-product of the uranium enrichment process and presents a very dangerous nuclear waste [Rajković, 2001]. About one hundred tons of this waste was kept in special storehouses until the beginning of the seventies in the last century, when it was used for ammunition, primarily aimed against armored vehicles.

The DU missiles were used during bombardment campaign in FRY in 1999. On such occasion, 112 locations (mainly on the territory of Kosovo) were hit with approximately 13 tons of DU. According to the reports of the NATO alliance leaders, the largest number of the missiles filled with DU was used on the territory west of Peć – Djakovica – Prizren road in the surroundings of Klina and on the territory of Prizren, Uroševac and Suva Reka municipalities (Fig. 1). Places in the vicinity of Kosovo (four locations in the municipalities of Bujanovac, Preševo, and Vranje) and one location in Montenegro were also bombarded.

Fig. 1. Locations identified as DU ammunition target

DU is inserted into the tops of the conventional, non-nuclear missiles. Being almost two times thicker than the lead (19, 06 g/cm^3, to 11, 3 g/cm^3) missiles filled with DU easily penetrate the domes of modern tanks and other armored vehicles. The missiles filled with DU break when hitting the target, start burning, thus causing its dissolution into a great number of tiny grains (fine dust - aerosol), which are dispersed into the atmosphere. These particles can have a form of air suspension, when inhaled or swallowed they enter an organism where they accumulate in the organs such as kidneys, liver or spleen. An individual contaminated in such a way, gains a continuous source of radiation in his organism, which as a rule has catastrophic consequences. Emission of DU creates ionic pairs which among other things destroy genetic material that is transferred onto descendents. DU and its products of dissolution emit both *alpha* and *beta*-radiation, and as cancer carriers they can damage lung, bone, kidney, prostate, intestines and brain cells causing cancer in these organs. After inhaling, DU is dissolved and transferred from the lungs into other organs including liver, fat and muscles. It is finally excreted via kidneys, where being a heavy metal it causes nephritis, a chronic kidney disease [Caldicott, 2009].

Chemical toxicity of DU

The chemical toxicity of depleted uranium is about a million times greater *in vitro* than its radiological hazard [Miler et al., 2002]. Health effects of DU are determined by factors such as the extent of exposure and whether it was internal or external. Three main pathways exist by which internalization of uranium may occur: inhalation, ingestion, and embedded fragments or shrapnel contamination. Properties such as phase (e.g. particulate or gaseous), oxidation state (e.g. metallic or ceramic), and the solubility of uranium and its compounds influence their absorption, distribution, translocation, elimination and the resulting toxicity. For example, metallic uranium is less toxic compared to hexavalent uranium (VI) uranyl compounds such as uranium trioxide [Gmelin Handbuch der anorganishen Chemie, 1982; Haley et al., 1999].

Uranium is pyrophoric when finely divided. It will corrode under the influence of air and water producing insoluble uranium (IV) and soluble uranium (VI) salts. Soluble uranium salts are toxic. Uranium slowly accumulates in several organs, such as the liver, spleen, and kidneys. The *World Health Organization* has established a daily "tolerated intake" of soluble uranium salts for the general public of 0.5 μg/kg body weight, or 35 μg for a 70 kg adult.

Epidemiological studies and toxicological tests on laboratory animals point to it as being immunotoxic [Wan et al., 2006], teratogenic [Arfsten et al., 2001], neurotoxic [Briner and Murray, 2005], with carcinogenic and leukemogenic potential [Miller et al., 2005]. A 2005 report by epidemiologists concluded: "the human epidemiological evidence is consistent with increased risk of birth defects in offspring of persons exposed to DU." Early studies of depleted uranium aerosol exposure assumed that uranium combustion product particles would quickly settle out of the air and thus could not be able to affect population more than a few kilometers from target areas, and that such particles, if inhaled, would remain undissolved in the lungs for a great length of time and thus could be detected in urine. Burning uranium droplets violently produces a gaseous vapor comprising about half of the uranium in their original mass. Uranyl ion contamination in uranium oxides has been detected in the residue of DU munitions fires.

Radiological hazards of DU

External exposure to radiation from pure depleted uranium is less of a concern, because the *alpha* particle emitted by its isotopes travels only a few centimeters in air or can be stopped by a sheet of paper. Also, the low concentration of uranium-235 that remains in depleted uranium emits only a small amount of low-energy *gamma* radiation. However, internal *alpha* radiation exposure from a particle lodged in tissues is a more serious matter, because adjacent tissues will be irradiated.

According to the *World Health Organization*, radiation dose from it would be about 60% of that from purified natural uranium with the same mass; the radiological dangers are lower due to its longer half-life and the removal of the more radioactive isotopes. However, in a matter of a month or so, depleted uranium generates amount of thorium-234 and protactinium-234 which emit *beta* particles at almost the same rate as that of the *alpha* particles from the uranium-238.

Approximately 90 micrograms of natural uranium, on average, exist in the human body as a result of normal intake of water, food and air. Most is in the skeleton. The biochemistry of depleted uranium is, for all practical purposes, the same as natural uranium.

Increase of malignant diseases in the northern Kosovo (1997 – 2008)

A research under the conduct of Medical section of SANU *(Serbian Academy of Sciences)*, was presented in 2005. It points to an alarming decrease in the number of births and simultaneously, a considerable number of abortions. Also, another conclusion of the same research points to a considerable increase in the number of malignant diseases such as tumors of both benign and malign nature. Thus, a number of tumors of uterus cervix and ovaries has increased from 26 to 496. A number of dead, premature born children has increased from 50 to 357, a number of children with malformations from 121 to 610 [Medicinska sekcija

SNU, 2005]. There is a similar situation with other kinds of malignant diseases.

Malignant diseases are diseases with a highest percentage of lethal outcome. History of malignant diseases is not well known, but risk factors which have effects on a higher incidence of malignant diseases (radiation, smoking) are known. During the NATO bombardment of Kosovo and Metohija ammunition with DU was used, which can be regarded as a considerable factor of the increased number of malignant diseases.

This research comprised population of Northern part of Kosovo and Metohija i.e. mainly Serbian population. War capable population from this region participated in the army formations in the district of Peć (a territory which suffered most severe attacks by ammunition filled with DU). An average age of this population group is between 30 and 40.

Material and methods

The aim of this research is a numerical data processing of malignant disease frequency in the observed population as well as the determination of basic epidemiological characteristics of malignant patients via diagnostic and therapeutic treatment.

A period of time between 1997 and 2008 was under our observation. The pre-war period was taken into consideration in order to compare a number of the diseased in the period before the use of DU ammunition and the period after its use. A clinical, prospective, retrospective and numerical research was undertaken. The diagnostic procedure is based on laboratory analyses, x-ray and ultra-sound findings.

Results and discussion

The research comprised 30.000 patients, hospitalized in some of the seven wards of the Health Centre in Kosovska Mitrovica. Table 1 shows years when the research was conducted and the percentage of the patients with malignant diseases.

Table 1. The percentage of the patients, suffering from malignant diseases, treated in Kosovska Mitrovica Hospital

WARD	1997	1998	1999	2000
ORTHOPEDICS	0.6	0.3	0.2	1.3
PEDIATRICS	0.4	0.3	0.3	0.5
GYNECOLOGY	2.6	1.6	1.0	3.6
SURGERY	1.3	2.6	3.8	3.4
PNEUMOPHTISIOL	2.6	1.7	4.0	22.0
UROLOGY	1.6	3.9	3.1	16.0
INTERNAL DISEASES	1.1	1.2	1.8	2.1

From the reasons stated above, one can conclude that the number of malignant diseases on the territory of Northern Kosovo has drastically increased after the NATO bombardment campaign.

An increase in the number of malignant diseases goes to the extent of 2 to 10 times.

Our epidemiological data points to the increase in the number of malignant diseases in patients from 30 to 45 years of age, while in the previous periods the most jeopardized age groups were in the range of 65 to 75 years (Fig. 2, 3 and 4). About 30% of the diseases end lethally (Fig. 5).

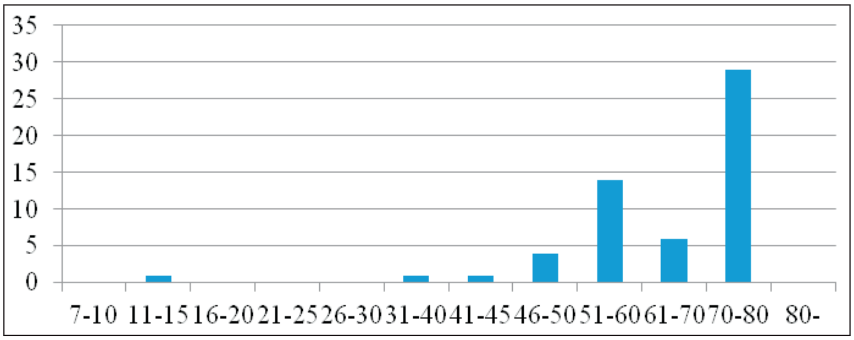

Fig. 2. The patients age breakdown – 2004

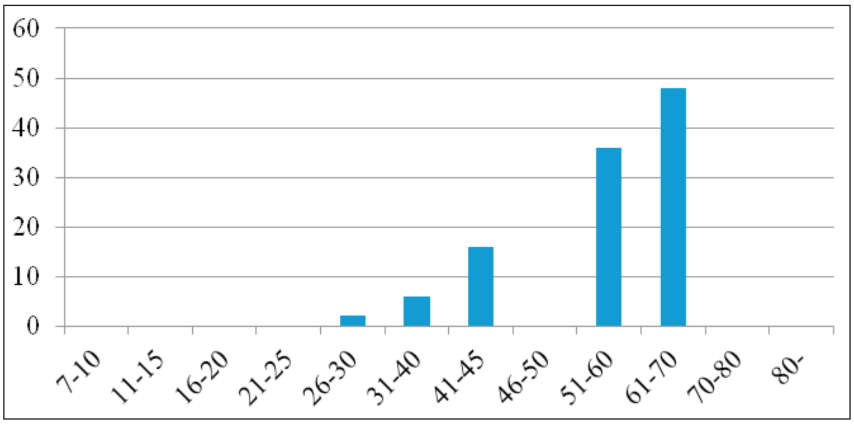

Fig. 3. The patients age breakdown – 2006

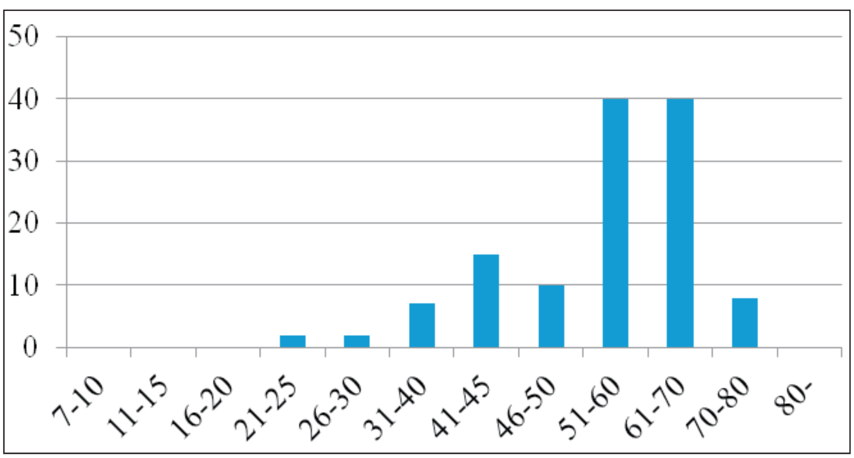

Fig. 4. The patients age breakdown – 2008

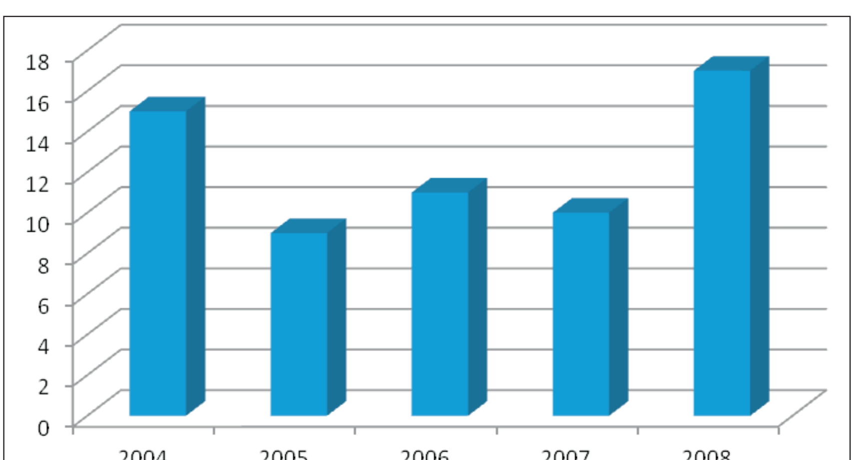

Fig. 5. The number of malignant diseases with deadly outcome in the period from 2004 – 2008

The basic reason for such increase in the number of malignant diseases can be found in the increase of radiation and the stress in the whole territory of Kosovo and Metohija. As a proof of this assertion, an occurrence of malignant diseases in children in 2002 can be used. A frequent occurence of malignant diseases of hematopoeses organs in children was observed, as well as abortion occurence due to the degenaration of the fetus. Among increasing malignant disesaes, cancer of lungs, cancer of colon, prostate in men and cancer of uterus cervix and cancer of breast in women are the most frequent ones.

Conclusions

On the basis of this research an evident increase of malignant diseases has been proved, with tendencies of increase in future years, due to the long lasting effects on the population which resides in the areas where the ammunition with DU filling was used. It has also proved that the group with the highest risk of getting those diseases is male population of the Northern Kosovo, which participated in army formations in the area of Peć district (a teritory which suffered the worst devastation by the ammunition filled with DU).

This population has been advised to undertake regular health checks, at least annualy, with special emphasis on the war participants.

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