CHOOSING OF SOME BLOOD PARAMETERS AND HEPATIC ENZYMES AS INDICATORS FOR RADIATION EXPOSURE IN EXPERIMENTAL RABBITS

Hanaa Salman Kadhim

Department of Biology, College of Science, Basrah University,Basrah, Iraq

ABSTRACT

Injection of 1 mg / kg of uranyle acetate caused an obvious changes in the numbers of white blood cells with progressing time of experiment, specially in the numbers of neutrophiles and monocytes which decreased significantly, while the numbers of eosinophiles has increased significantly after the first week of injection and then decreased significantly in the 2nd and 3rd week of exposure as compared with control group. Also, the injection caused significant decreasing in Hb and PCV values, while the activities of hepatic enzymes GPT, and GOT were not affected in comparison with control group.

So, it may be useful to use this variation of WBC percentage as a primary indication to persons who exposed to different doses of radioactive compound.

INTRODUCTION

Uranium is a heavy metal that contains radioactive isotopes (1). Researches conducted since 1991 Gulf war indicated that exposure to uranium may be mutagenic, cytotoxic, tumergenic, teratogenic, and neurotoxic (2).

Study in human and animal have shown that uranium can accumulate in the skeleton, liver, kidney, testes, and brain (3). In addition, animal experiment showed that uranium compounds cause leukemia, osteosarcoma, and carcinoma of lung, kidney, and reticulosarcoma of lung (4).

Studies over several decades have found that population with well above average occupational exposure to inhaled or ingested uranium suffer from increase rates of the cancer including leukemia which due to radiation (5, 6).

The blood changes in exposure have been well demonstrated , these changes include :- increased nitrogen retention ,decreased of serum albumin , largely unchanged serum protein ,and increased serum ammonia creatinine .Blood urea ,uric acid ,concentration of sodium and chloride were lowered ,and elevation in total lipid, cholesterol and blood glucose (7).

Uranyl acetate is one of the uranium compounds that use in biological researches. This compound use with lead citrate as a counter stains for staining techniques for electron microscopical examinations (8, 9).

As a result of exposure of many people in Iraq after Gulf war to different doses of radiation because of using of depleted uranium and which revealed as a different types of cancers including blood cancer, this study was aimed to determine changes in different blood parameters including white blood cells to be as an indicators for uranium exposure .Also, since the important application of uranyl acetate in most important biological researches ,this study also aimed to investigate the hematological effect of uranium acetate on rabbits.

MATERIALS AND METHODS

Sixth male and female rabbits were injected with 0.5 ml containing 1mg /kg of uranyl acetate intravenously .Tow rabbits left with out injection as a control group . Blood smear were made weekly from both control and injected animals for differential count of white blood cells. Each smear was stained with Gimsa's stain for stain for counting of the 5 types of white blob cells. Animals were dissected after three weeks of experiment after anesthetizing with chloroform, blood collected directly from heart in tubes with or with out (E.D.T.A.) anticoagulant according to (10) and (11).

Hemoglobin concentration, total count of white blood cells (W.B.C.), differential count of (W.B.C.), and packed cell volume (PCV) were done in the same day of collection.

Both Glutamate oxaloacetate transaminases (GOT) and Glutamate pyruvate transaminase (GPT) activities were measured according to (12).

RESULTS

Results of the present study showed that there are differences in each type of white blood cells numbers as comparing with control group after 1, 2, and 3 weeks of injection with uranyl acetate as ANOVA test analysis revealed.Numbers of neutrophiles were significantly decreased in comparison with control (P<0.01).Also, results showed that these cells were decreased in numbers between the first and third week of injection, but there was no differences between the second and third week of injection.

The numbers of lymphocyte were differed comparing with control group with progressing time. Also, there were significant changes among the treatment periods that concern the lymphocyte numbers.
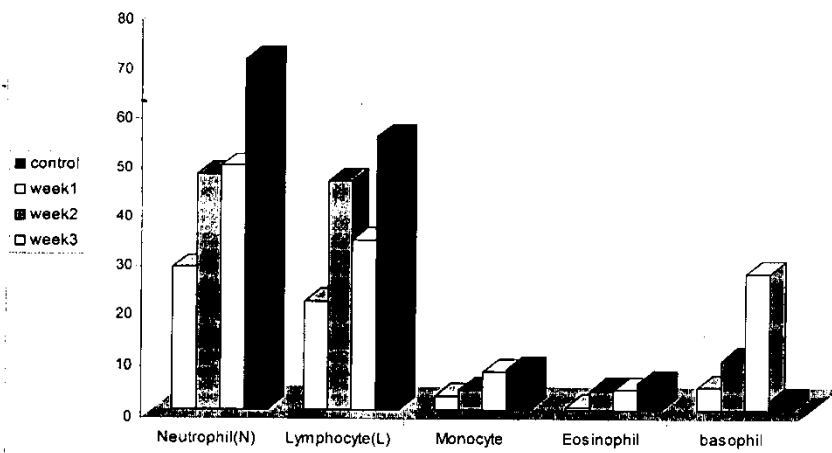
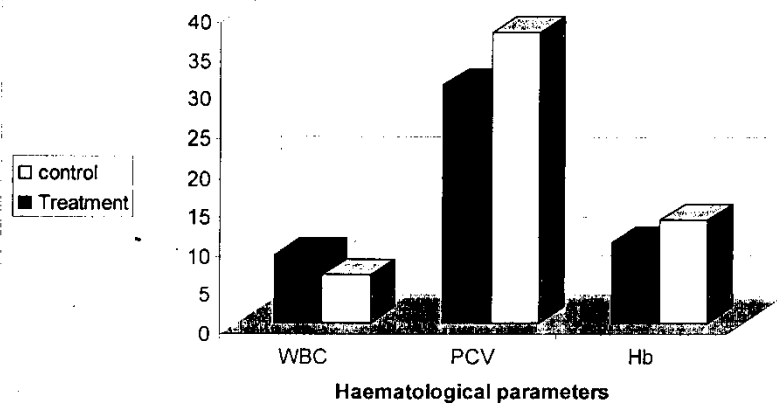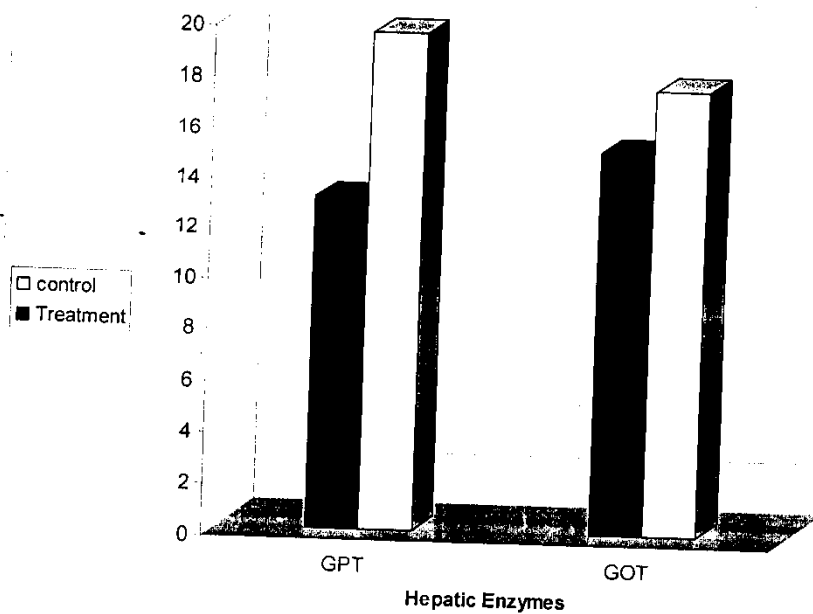.Fig. (1): Effect of uranyl acetate on types of white
blood cells with time.

Fig. (2): Effect of uranyl acetate on
haematological parameters

Fig. (3): Effect of uranyl acetate on
hepatic enzymes

Injection of uranyl acetate significantly decreased the number of monocyte among the treated groups compared with control group except the first week which was not differed from control, and there were no differences between the second and third week of treatment.

The treated animals showed no significant differences in eosinophil numbers as comparing with control group at both first and second weeks, the difference occur in the third week of exposury which differed significantly in comparison with the first and second weeks. The basophiles were increased significantly in treated animals (P. <0.01) in the first and second week of exposury but there was no significant differences in the third week as comparing with control, also numbers of the same cells was significantly differed in the second week compared with other period of exposuring fig.(1).

T- Test was done to the other blood parameters and to hepatic enzymes (GPT and GOT) and the following results were appeared:-

There were significant differences in Hb values (P<0.01) and PCV value (P<0.05) as comparing with control .But there were no differences in GPT and GOT in comparison with control group fig. (2)&(3).

DISCUSSION

Uranium compound such as uranium oxide, uranium hexafluoride, uranium chloride, uranium nitrate, uranium acetate and others .are produced when uranium burns, these compounds have different biological effect depending on their solubility in body fluids and their biological half life (13).

Results of the present study showed that all types of white blood cells affected specially after the third week of exposure to uranyl acetate ,this may due to increasing of uranium effect with time because uranium consider as

Mutagenic compound and give many effects on genes, this effect may need a period to appear obviously. Also this effect may due to the action of uranium on the division of haematopoetic cells leading to variation in W.B.C. types production .This effect also, related to the ability of uranium compounds to accumulate in different part of animal body leading to increase it's cytotoxicity   A study found out that uranium has cytotoxic effect against many type of tissues including blood (3).

Filippova (1978) found out that increasing in exposure time of animals to uranium soluble compounds lead to different types of leukemia (4).

The chemical toxicity of uranium varies according to administration dose, chemical form of uranium, route of administration, and type of experimental animal (14). Study found out that increasing in exposure dose resulting in increasing of toxic and carcinogenic effect of uranium (2) .Oral administration and inhalation of uranium compounds has less effect than subcutaneous and intravenous administration (15).

Gilman found no effect of uranium on hematological and histopathological parameters in rats orally administered with uranium (15).

Also, experiment with inhalation of uranium have show no effect on blood cells (14), on the other hand study on the Veterans in 1999 who exposed to uranium in Gulf war indicated that those veterans who reported as injuries had high concentration of uranium in their body and revealed lower mean lymphocyte counts and lowers mean monocyte percentage (16) .

Animal experimental study showed that rabbits are more sensitive than rat and mice to uranium according to the other parameters such as Hb which reduce significantly in treated animals, this may due to that uranim compounds concentrated and bind with red blood cells (17, 18) resulting in reduction in hemoglobin concentration, also study found out that many soluble uranium salts including uranyl acetate

bind with different type of blood proteins (19). Studies found that soluble uranium compound are more toxic and are easily to enter blood stream (14, 19).

Also uranium compounds are radioactive and may affect on DNA replication and then blocking cell division resulting in reduction in red blood cells by turn reduction in Hb concentration.

Results showed that each of GPT and GOT enzymes were less affected with uranium than other parameters, this slight effect of uranium may due to the toxic effect of uranium in causing a leakage in enzymes biosynthesis (20). These enzymes are responsible for the Hb synthesis in hepatic cells and are increase when there are lyses in these cells and uranium acetate may not effect on hepatic cell on this time of exposure.

اختيار بعض مقاييس الدموية والأنزيمات الكبدية كمؤشر للتعرض للإشعاع في الأرانب المختبرية.

هناء سلمان كاظم

قسم علوم الحياة, كلية العلوم, جامعة البصرة,البصرة,العراق.

الخلاصة

سبب حقن (1 mg / kg) من مادة Uranyl acetate تغيرات ملحوظة في نسب أعداد خلايا الدم البيضاء بتقدم فترة التجربة حيث سببت المادة انخفاض معنوي في نسب أعداد الخلايا العدلة، و الخلايا الوحيدة في حين أحدثت زيادة ملحوظة في أعداد الخلايا القاعدية بشكل كبير في الأسبوع الأول بعد الحقن ثم انخفضت و لكن بأعداد اكبر من إعدادها في مجاميع السيطرة، كذلك سبب الحقن انخفاضا ملحوظا في قيم خضاب الدم Hb و الحجم المضغوط لخلايا الدم PCV. في حين لم يسبب الحقن أي تغير ملحوظ في أنزيمات الكبد GPT، GOT بالمقارنة مع مجاميع السيطرة.

وبذلك يمكن اعتماد التغاير في نسب خلايا الدم البيض كمؤشر أولي لتعرض الأشخاص لجرع من المواد المشعة و بالتالي يمكن تفادي المصدر المؤثر.

REFERENCES

1- IPPNW, IEER. Plutonium: Deadly gold of the nuclear age .Cambridge, MA: International physician's press.1992.

2- Bordujenko, Alex. (Military medical aspects of depleted uranium munitions .ADF HealthVol.3 (2002)

3- Darryl, P.A, Kenneth, R.S., and Glenn, D.R. A review of the effects of uranium and depleted uranium exposure on reproductive and fetal development. Toxico .and industrial health (2001) (17) 5:150-191.

4. Filippova, L.G; nifatrov, A.P.; liubchanskii, E.R. Some of the long term sequelae of giving rats enriched uranium. Radiobiologia (1978) 18 (3):400-405.

5- Harley, N.H, Pasternack, B.S. A model for predicting lung cancer risks induced by environmental level of radon daughters. Health phys. (1981), 40: 307-316.

6- Harley, N.H. Radon and lung cancer in mines and homes. N. Engl. med. (1984) 310: 1525 -1527.

7-Durakoviae, A .Medical effects of internal contamination with uranium. Croatian medical journal (1999) .Vol 40(1).

8- Silva, M.T, Guerra, F.C., Magahaes, M.M. The fixative action of uranyl acetate in electron microscopy. Experientia (1968) 15; 24 (10): 1074.

9-Tezakis, J.A. Uranyl acetate, a stain and a fixative. J. Ultra structures.

(1968):22(1)168 -184.

10- Schalm ,O.W ; Jain , N.C; and Carroll , E .G .(eds) (1975) Veterinary hematology .3rd ed ., Lee and Febiger , Philadelphia , 807 pp.

11- Coles, E.H. (Ed) (1986). Veterinary clinical pathology. 4th ed.; W.B. Saunders Company Philadelphia, London, 457pp.

12- Varely, H. (Ed) (1980). Practical biochemistry 4th Ed, William Heinman medical book, London.

13- Fulco, C. E.; Liver man, C.T.; Sox H.C. (2000). Gulf war and Health Vol 1 Depleted uranium, pyridostigmine bomide, sarin, vaccines, during the Gulf wor .Division of Health promotion and disease prevention. Institute of medicine. National academy press. Washington.

14-Agency for toxic subtacnes and disease Registry (ATSDR) Toxicological profile for uranium. Prebared by RTI under contract no 205-93 – 0606 for USDHHS, Sept. 1999. 15- Gilman, A.P. , Moss, M.A.; Villeneuve ,D.C. , Secours ,V.E.; Yagminas , A.P;Tracy ,B.L.; Quinn ,J.M.; LONG ,G.J., and VALL, V.E. Uranyle nitrat :91-day exposure and recovery studies in the New Zealand white rabbits . Toxicol (1998, b) 41(1): 138-151

16- McDiarmid ,M.A; Squibb , K., Engel hardt , S. Oliver , M., Gucer , P.,Wilson,I ., P.D. ;kane ,R., kaba ,M. , kaup ,B., Anderson, L., Hoover, D-, Brow, L., and Jacobson,- Krom, D. Surveillance of delepted Uranium exposed Gulf – War veterans: health effects observed in an enlarged((friendly fire)) cohort. (2001). J. Occup. Environ, Med. 43,991-1000.

17- World Health Organization. Department of protection of the human environment. Depleted uranium: Sources, exposure. And health effects. WHO/SDE/PHE/10.1: Geneva: WHO April 2001.

18- Svensson, K., Darnerud, P.O., and Skerfring, S. Arisk assessment of Uranium in drinking water (2005) Livsmedelverkest rapport nr 10/2005.

19- Fisenne I.M, Perry, P.M. Isotopic U. concentration in human blood from New York City dones. Health physics (1985) 49:1272-1275.

20- Anthony M.L, Gartland K.P.R, Bedell, R.B., Lindon, J.C, and   Nicholson, J.K. Studies of the biochemical toxicology of uranyle nitrate in the rat. Toxicology (1994) 68:43-53