

Experimental Study of the Effect of GdYVO₄:Eu₃ Nanoparticles on the Metabolic and Histologic Features of Liver

ISSN: 2637-7632



***Corresponding author:** Gubina-Vakulik GI, Department of Pathological Anatomy, Kharkiv National Medical University, 4 Nauky ave, 61022 Kharkiv, Ukraine

Submission:  October 25, 2023

Published:  November 07, 2023

Volume 7 - Issue 5

How to cite this article: Gubina-Vakulik GI*, Nakonechna OA, Gorbach TV, Denisenko SA, Balak AK, Klochkov VA and Yefimova SL. Experimental Study of the Effect of GdYVO₄:Eu₃ Nanoparticles on the Metabolic and Histologic Features of Liver. *Gastro Med Res.* 7(5). GMR. 000672. 2023. DOI: [10.31031/GMR.2023.07.000672](https://doi.org/10.31031/GMR.2023.07.000672)

Copyright@ Gubina-Vakulik GI, This article is distributed under the terms of the Creative Commons Attribution 4.0 International License, which permits unrestricted use and redistribution provided that the original author and source are credited.

Gubina-Vakulik GI*, Nakonechna OA, Gorbach TV, Denisenko SA, Balak AK, Klochkov VA and Yefimova SL

Department of Pathological Anatomy, Kharkiv National Medical University, 4 Nauky ave, 61022 Kharkiv, Ukraine

Introduction

Nowadays nanoparticles are used in medicine for diagnostic purposes, for drug delivery to the target organ, the possibility of using nanoparticles for the treatment of oncologic diseases is being considered. Use for the treatment of oncologic diseases [1,2]. The point of view about their low toxicity is widespread of their low toxicity. However, there are articles that report observed side effects, including anaphylaxis, anaphylactic shock, and renal fibrosis [3,4]. We have no information about possible liver damage. The aim of the study was to investigate the metabolic and histologic features of liver tissue during peroral administration peculiarities of liver tissue at oral prolonged administration of nanoparticles of gadolinium GdYVO₄:Eu₃.

Materials and Methods

A colloidal solution of GdYVO₄:Eu₃ nanoparticles was used, possessing unique red-ox properties, obtained according to the method of Klochkov VA [5,6]. Male rats of the WAG population with bodyweight 200-220g were daily for 14 days were injected using an automatic pipette of 0.18-0.20ml of gadolinium solution with different doses: 50mg/kg body weight, 100mg/kg, 200mg/kg, i.e. 3 main groups were formed: gr. G: gr. G-50, gr. G-100, gr. G-200, 6 animals in each group. Animals of the control group (gr. C - 6 animals) received a similar volume of physiological solution. At slaughter using a guillotine, cubital blood, and liver tissue were taken for biochemical and morphological examination. To determine the degree of possible damage of hepatocytes in the blood, the activity of alanine aminotransferase (ALT), and the content of direct and indirect bilirubin spectrophotometrically, using reagent kits (comp, Cormey). In hepatic tissue - superoxide dismutase activity (spectrophotometric method, quercetin oxidation). For the morphologic study liver pieces were fixed in 10% neutral formalin. Animals were fixed in 10% neutral formalin, embedded in paraffin and slices were stained with hematoxylin-eosin and gallocyanin according to Einarson (for nucleic acids). Statistical processing was performed by the Mann-Whitney test.

Results

The median ALT activity in the blood serum of group C animals was 0.135μmol/hour/ml. In group G-50 - significantly less, and in groups G-100 and G-200 - significantly less, respectively, 1.6 and 2.3 times. Median SOD activity in liver homogenate tissue group C was 2.11cu/g protein, in group G-50 the value of the indicator was significantly increased, and in group G-100 and group G-200 - significantly reduced, and, respectively, by 1.1 times and 2.3 times, which indicates activation of the antioxidant system when a small dose is administered drug and insufficiency of antioxidant activity when administered at high

doses, which leads to an increase in the processes of peroxidation of lipids and membrane proteins. Increased ALT activity in the blood and decreased SOD levels in liver tissue indicate damage and destruction of hepatocytes in rats of two main groups - G-100 and G-200. Based on the level of indirect and direct bilirubin in the blood serum, one can judge detoxification functions of the liver: the level of indirect bilirubin consistently increases in group G-100 and in group G-200, and the level of direct bilirubin decreases in all main groups, least of all in group G-50 and most of all in group G-200. The median ratio of indirect and direct bilirubin is gr. C -3.5, gr. G-50 - 4.9, gr. G-100 - 6.9, gr. G-200 - 10.5, i.e. in all main groups there is increasing dysfunction liver.

Histological examination of the liver allowed us to visualize the biochemically detected signs of liver damage. Due to the oral administration of gadolinium into the body, signs of dystrophy and destruction of hepatitis developed precisely in the 2nd zone of the hepatic acinuses, where the branches of the v. porte run into the sinusoids. The size of the foci with dying parenchyma increases in area as the dose of the nano preparation received by the animals increases of the nano preparation to the animals. Regenerative processes are also activated, the most pronounced in gr. G-50. Obviously, therefore, the biochemical indices given in this report characterizing destructive processes in hepatocytes and disturbance of function of bilirubin synthesis in gr. G-50 are close to the control. In the group with the highest used dose (gr. G-200) destruction of hepatic parenchyma is so pronounced, and regenerative possibilities are so exhausted that in the 2nd zone of acinuses small pseudocysts are formed small pseudocysts (obviously, after utilization of a group of dead hepatocytes).

Conclusion

It is necessary to expand and deepen the study of the influence of different doses of nanoparticles, including gadolinium GdYVO₄:Eu³⁺ on the organism in order to reduce the probability of iatrogenic pathology, due to the following reasons iatrogenic pathology due to gadolinium toxicity, which, according to the results of the presented study occurs in the liver and is all the more dangerous in the presence of a patient with a compromised liver.

References

1. Yetisgin AA, Cetinel S, Zuvin M, Kosar A, Kutlu O (2020) Therapeutic nanoparticles and their targeted delivery applications. *Molecules* 25(9): 2193.
2. Martinelly C, Pucci C, Ciofani G (2019) Nanostructured carriers as innovative tools for cancer diagnosis and therapy. *APL Bioeng* 3(1): 011502.
3. Davies J, Siebenhandl-Wolff P, Tranquart F, Jones P, Evans P (2022) Gadolinium: Pharmacokinetics and toxicity in humans and laboratory animals following contrast agent administration. *Arch Toxicol* 96(2): 403–429.
4. Sun H, Jiang C, Wu L, Bai X, Zhai S (2019) Cytotoxicity-related bioeffects induced by nanoparticles: The role of surface chemistry. *Front Bioeng Biotechnol* 7: 414.
5. Klochkov VK, Malysenko AL, Sedyh OO, Malyukin YV (2011) Wet-chemical synthesis and characterization of luminescent colloidal nanoparticles ReVO₄: Eu³⁺ (Re=La, Gd, Y) with rod-like and spindle-like shape. *Functional materials* 18(1): 111-115.
6. Yefimova SL, Maksimchuk PO, Hubenko KO, Omielaieva VV, Kavok NS, et al. (2020) Light-triggered redox activity of GdYVO₄: Eu³⁺ nanoparticles. *Spectrochim Acta A Mol Biomol Spectrosc* 242: 118741.