

Effects of acute UWB pulse exposure on KM mice

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Abstract—KM mice were exposed to the ultra wide-band electromagnetic pulse (UWB-EMP) (2 ns pulse width, 500 ps rising front edge and 100 Hz repetition rate) of different field intensity for 10-60 min. The acute exposure resulted in the increase of ALT and AST in blood, liver and kidney, as well as the histological alternation of hepatic and renal tissue. At the meantime, the levels of malondialdehyde, superoxide dismutase, catalase and glutathione peroxidase were also increased, which indicated the enhanced oxidative response induced by UWB-EMP. Moreover, the UWB-EMP exposure resulted in the decrease of locomotor activity. Most of the observed alternation could be restored 72h after exposure.

Keywords: UWB-EMP exposure, locomotor activity, oxidative stress, hepatic injury, renal injury.

I. Introduction

UWB-EMP combines the high power characteristics of electromagnetic pulse and the high bandwidth ratio of UWB signal, which can be widely used in varieties of civil and military fields. With the rapid development of electromagnetic technology, the potential health risk of UWB-EMP radiation has been paid more and more attention [1-2]. It is of great significance to carry out the study of the biological effects and the exposure safety of UWB-EMP radiation.

In this study, we analyzed the effects of acute UWB-EMP exposure on KM mice. The UWB radiation system was used to generated the EMP (2 ns pulse duration, 500 ps rising time and 100 Hz repetition rate). The general physiological parameters, histological analysis and locomotor activity test were used to evaluated the effects of field intensity and irradiation time on the physiological state of KM mice.

II. Materials and methods

KM mice were randomly divided into five treating groups and one control group. The five treating groups were exposed to the UWB-EMP of 344 kv/m for 10 min, 168 kv/m for 10 min, 168 kv/m for 30 min, 98 kv/m for 30 min and 98 kv/m for 60 min, respectively. The control group was place in the same environment but without UWB-EMP radiation. Mice were sacrificed at 3h, 24h and 72h after exposure, respectively. The blood samples and tissue samples were prepared and analyzed according to the corresponding standard protocols. Locomotor activity was studied by open field test.

III. Results

UWB-EMP exposure decreased the locomotor activity

Mice were irradiated with different field intensity for different time. The locomotor activity was decreased after exposure to UWB-EMP and the results were shown in figure 1. Decrease of total moving distance, central area retention duration and times of enter into the center area suggested the

UWB-EMP exposure impaired the exploration intention of KM mice.

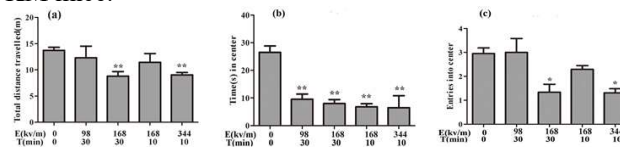


Figure 1. UWB-EMP exposure decreased the locomotor activity (a) Moving distance (b) Centre area retention duration (c) Times of enter into the centre area (* $p < 0.05$ Vs Control, ** $p < 0.01$ Vs Control)

UWB-EMP exposure enhanced the oxidative stress in hepatic and renal tissue of KM mice.

Significant increase of the malondialdehyde (MDA), superoxide dismutase (SOD), catalase (CAT) and glutathione peroxidase (GSH-PX) were observed both in hepatic and renal tissue 24h after UWB-EMP exposure especially in the group that treated under 98 kv/m for 60 min, suggesting the UWB-EMP radiation could induce oxidative stress. While the level of MDA, SOD, CAT and GSH-PX were decrease 72h after radiation, which indicated the acute oxidative response could be restored. while the accumulation of the number of pulses made a greater damage on the mouse than the field intensity.

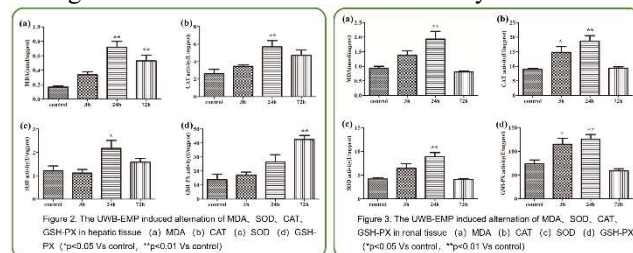
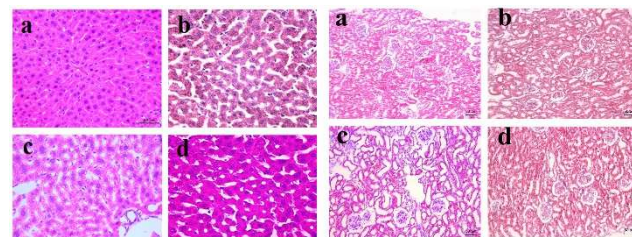


Figure 2. The UWB-EMP induced alternation of MDA, SOD, CAT, GSH-PX in hepatic tissue. (a) MDA (b) CAT (c) SOD (d) GSH-PX (* $p < 0.05$ Vs control, ** $p < 0.01$ Vs control)

Figure 3. The UWB-EMP induced alternation of MDA, SOD, CAT, GSH-PX in renal tissue. (a) MDA (b) CAT (c) SOD (d) GSH-PX (* $p < 0.05$ Vs control, ** $p < 0.01$ Vs control)

Histological characteristic of hepatic and kidney tissue

The hepatic and renal tissue damage were also revealed by the histological HE staining. 98 kv/m UWB-EMP exposure for 60min resulted in lipid drops accumulating inside the hepatic cells and hepatocyte edema around the central vein at 24h after exposure. It also induced the renal glomerulus enlargement and the renal capsules expansion. These histological alternations could be reversed after 72h. No obvious alternation could be observed under other exposure conditions.



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