Effects of 900MHz Microwave Radiation on $\gamma$-ray-Induced Damage to mouse Hematopoietic System

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INTRODUCTION
Combining ionizing radiation and non-ionizing radiation may be encountered in clinical practice for tumor therapy. Only limited experimental data are available regarding combined effects of ionizing and non-ionizing radiation on mammals. The aim of the present study was to examine the effects of microwave exposure on hematopoietic damage induced by ionizing radiation.

MATERIALS AND METHODS
Ninety-six male Kunming mice were randomly divided into 4 groups of control (C), microwave (M, 120μW/cm²), $\gamma$-ray (I, 5Gy $^{60}$Co $\gamma$-ray), and combined (M+I, microwave + $\gamma$-ray) group. Group M mice were exposed to 900MHz microwave radiation, 1hr/day for 14 days. Group I mice were exposed to 5 Gy $^{60}$Co $\gamma$-rays only on day 15. Group M + I was exposed initially to 900 MHz microwave radiation for 14 days and subsequently to 5Gy $^{60}$Co $\gamma$-ray irradiation on day 15.

Tissue slices of sternum and spleen were stained with hematoxylin and eosin (H&E) and observed under a microscope. Bone marrow nucleated cells (BMNC) were collected for the CFU-GM assay, and serum GM-CSF and IL-3 levels of mice were measured at different times after the treatment by using the ELISA kits.

RESULTS
The mouse bone marrow presented apparent hematopoietic damage by $\gamma$-ray irradiation as evidenced by pathological changes with a significant reduction in hematopoietic cell number accompanied by typical apoptotic changes such as karyopyknosis, formation of nuclear debris and apoptotic bodies. In comparison, in combined group, pathological alterations were less severe as evidenced by less hematopoietic cell reduction, higher hematopoietic tissue volume with less interstitial hemorrhage, and decreased edema.

The $\gamma$-ray irradiation also significantly reduced the area of white pulp in spleen, with a smaller body size, germinal centers shrunk, and expanded and congestive lymphatic sinus. In the combined group, lymphoid tissue was more compacted, apoptotic cells were relatively fewer, and proliferation of lymphocytes was observed in white pulp. The recovery of spleen injuries occurred sooner compared to $\gamma$-ray irradiation alone, as the spleen complex body (particular in germinal center) was almost restored to the control appearance.

Compared with control, numbers of CFU-GM in microwave group were significantly increased, and serum IL-3 levels were significantly higher than the control.
CONCLUSIONS

Our results showed that pre-exposure to low dose microwave exposure attenuated hematopoietic injuries produced by subsequent γ-ray irradiation. The protective effects of microwave irradiation appeared to be related to (1) up-expression of some hematopoietic growth factors, (2) stimulation of proliferation of the GM-CSF in bone marrow, and (3) antagonism of the γ-ray induced inhibition of HSC/HPC.

REFERENCES