3 - 56 Curcumin Ameliorates Heavy Ion Irradiation-induced Learning and Memory Deficits Through Enhancing Nrf2 Antioxidant Signaling Pathways*

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Oxidative stress is one of the major mechanisms implicated in carbon ion irradiation[1,2]. Curcumin is a natural phenolic compound with impressive antioxidant properties[3]. What's more, curcumin is recently proved to exert radioprotective effect. In vivo, we investigated the protective effects of curcumin against $^{12}C^{6+}$radiation-induced cerebral injury.

Our results showed that 4 Gy heavy ion radiation-induced spatial strategy and memory decline (Fig. 1), reduction of brain Superoxide Dismutase (SOD) activity levels, were all consistently improved by curcumin, as well as the augmentation of cerebral malonaldehyde (MDA), was lowered by curcumin (Fig. 2). Furthermore, both the cerebral cells Nuclear erythroid 2-related factor 2 (Nrf2) protein and three typically recognized Nrf2 downstream genes, NADP(H) quinine oxidoreductase 1 (NQO1), heme oxygenase-1 (HO-1), and γ-glutamyl cysteine synthetase (γ-GCS) were consistently up-regulated in curcumin-pretreated mice (Fig. 3).

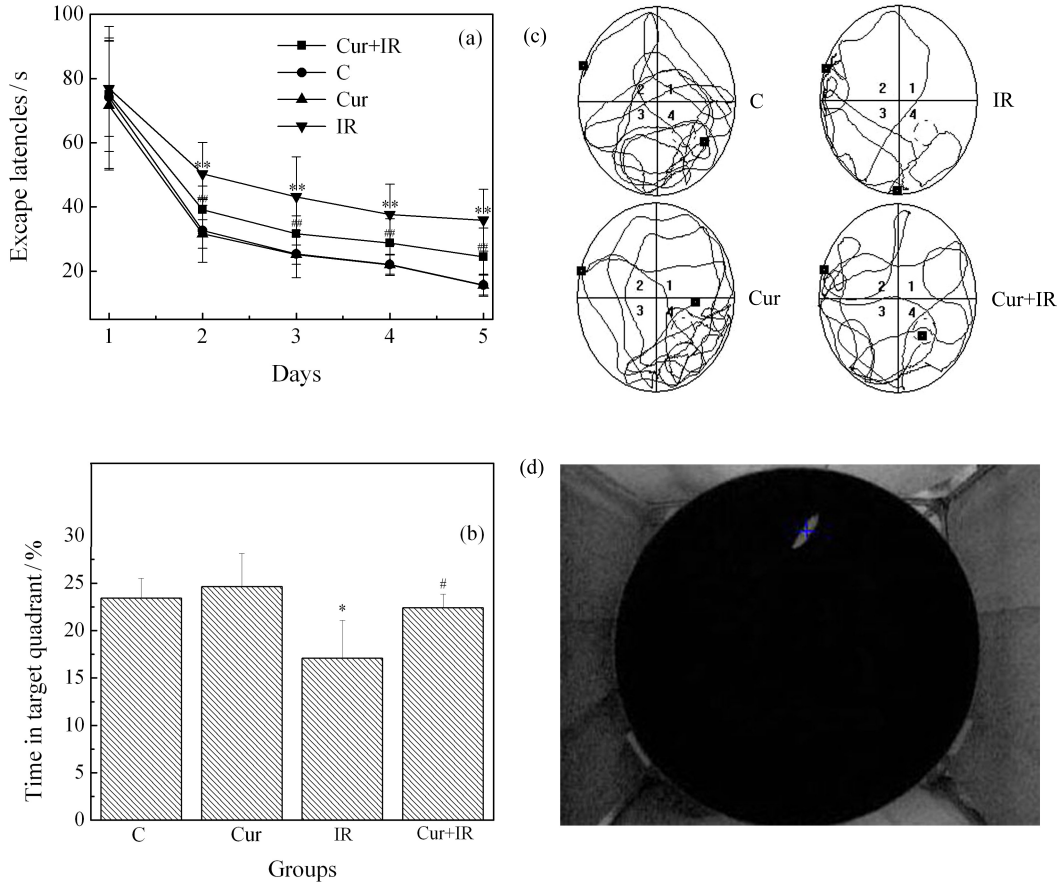

Fig. 1 (color online) Effects of curcumin on carbon ion irradiation-induced cognitive dysfunction. (a) Cur+IR group mice exhibited significantly lower escape latency on Days 2∼5 during training trials compared to IR group mice ($^{\#\#}P$ <0.01 vs IR group). Irradiation treatment significantly increased escape latency compared to C group mice on day 2∼5 ($**P$ <0.01 vs Control). (b) Swimming time spent in each quadrant in the probe trial on day 6. Curcumin treatment significantly prevented the memory impairment, as indicated by the increase in the time spent in target quadrant ($*P$ <0.5 vs Control,$^{\#}P$ <0.05 vs IR group). (c) Representative path tracings of the single probe test. (d) A photograph of experimental Morris water maze pool with a mouse.

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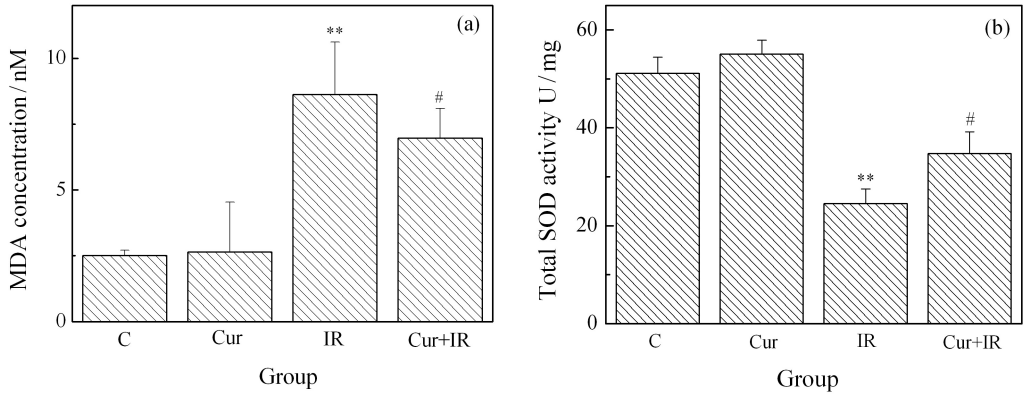

Fig. 2 (color online) Showing cerebral malondialdehyde (a) and superoxide dismutase (b) activity levels in group-C, group-Cur, group-IR and group-Cur+IR ($**P<0.01$ vs Control,$^{\#}P<0.05$ vs. IR group).

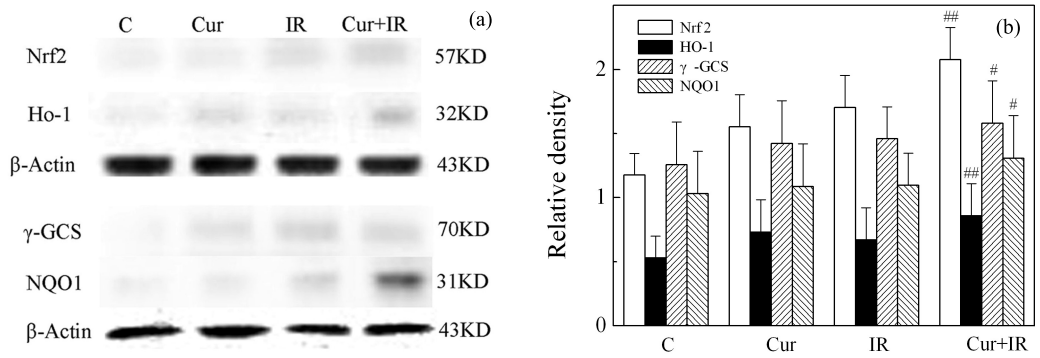

Fig. 3 (color online) Effects of carbon ion irradiation on the protein level of Nrf2, HO-1, γ-GCS and HQO1 in the brain. β-action was blotted as the loading control. (a) Representative photographs of western blot of Nrf2, HO-1, γ-GCS and HQO1 protein and actin control in the brain. (b) Bar graph of western blot illustrated the heavy ion irradiation inducing proteins of Nrf2, HO-1 , γ-GCS and HQO1 ($^{\#\#}P<0.01$ and $^{\#}P<0.05$ vs IR group).

Our study confirmed the antagonistic roles of curcumin to counteract radiation-induced cerebral injury in vivo, and suggested that the potent Nrf2 activation capability might be valuable for the protective effects of curcumin against radiation.

In view of the exposure to irradiation and associated human health risk, we are trying to provide the experimental evidences to counteract and relieve the chronic cerebral injuries of irradiation by means of dietary components.

References

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