A Novel method of Radioprotection for the Gastrointestinal System: Efficacy of the Reduced form of Coenzyme Q10

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Purpose:
Small intestine is known as a highly radiosensitive organ, however, effective method to avoid radiation damage has not been proposed. Here, we introduce our findings that Reduced form of Coenzyme Q10 could be a novel and potent radioprotective effects of the small intestine in vivo.

Materials and methods:
To detect reactive oxygen species (ROS) production, a 30 mg/kg of the dihydroethidium was intraperitoneally injected 24 hr before the irradiation and mice were sacrificed at 4 hr after IR (13 Gy) with or without oxidized (ubiquinone) or reduced (ubiquinol) forms of Coenzyme Q10 administration. Apoptotic cells in the crypt and villi were counted by a TUNEL assay at 8h after IR using a fluorescence or and H-E staining (7 days) by normal microscope.

Results:
1. ROS was observed in vivo in the crypts near the epithelium after 4 hr of the irradiation, and administration of Reduced form of Coenzyme Q10 showed the sharp and significant (P < 0.05) effect to decrease numbers of the ROS producing cells.
2. Reduced form of Coenzyme Q10 reduced significantly radiation-induced apoptosis (P < 0.05).
3. Reduced form of Coenzyme Q10 rescued significantly from radiation-induced damage including weight loss and survival (P < 0.05).

Conclusions:
These results together indicate that the Reduced form of Coenzyme Q10 had a sharp radioprotective effects in vivo leading to the survival of intestinal crypt cells and villi after the abdominal irradiation.

ROS mediate Apoptosis after IR

Body weight loss, Survival, and Mortality

All mice lost their weight or died within 8 days after the 13 Gy of irradiation, then recovered their appetite and regain their weight.

All mice died within 8 days after the 13 Gy of irradiation, while mice in which the Reduced form of Coenzyme Q10 were administered before the radiation survived instead of same dose of IR. (Oxidized form of Coenzyme Q10 had weaker effects)

ROS production, apoptosis in the crypt and villi, structures change of the small intestine were observed after the 13 Gy of the irradiation. Administration of Reduced form of Coenzyme Q10 diminished ROS, apoptosis, and structure change. (Oxidized form of Coenzyme Q10 had weaker effects)

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