5 - 57 Radio-sensitivity of Proliferating and Quiescent HeLa Cells to Carbon Ion Irradiation*

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Radioresistance serves as the main contributor to treatment failure, bringing about tumour relapse and metastasis. Quiescent cancer cells are therapeutically challenging owing to their resistance to most conventional photon treatments that selectively act on proliferating cells[1,2]. Heavy-ion radiotherapy (RT) has become an increasingly valid treatment option owing to its advantageous dose profile and radio-biological effects compared to conventional RT[3]. Unlike low-linear energy transfer (LET) ionizing radiation (IR), which induces less complex DNA damage, high-LET IR causes extensive damage and often has fatal biological consequences[4,5]. However, the functional role to overcome the radioresistance of quiescent tumor cells using carbon-ion beams are not fully understood.

Cell proliferation was evaluated using the CCK-8 and colony formation assays. The viability of proliferating cells was only slightly decreased at 72 and 96 h post-irradiation (Fig. 1(a)). X-rays did not exhibit a cytotoxic effect in quiescent cells at 24∼96 h post-radiation (Fig. 1b). Notably, carbon ion irradiation more potently inhibited the viability of proliferating and quiescent cells than X-ray irradiation (Fig. 1(c) and 1(d)).

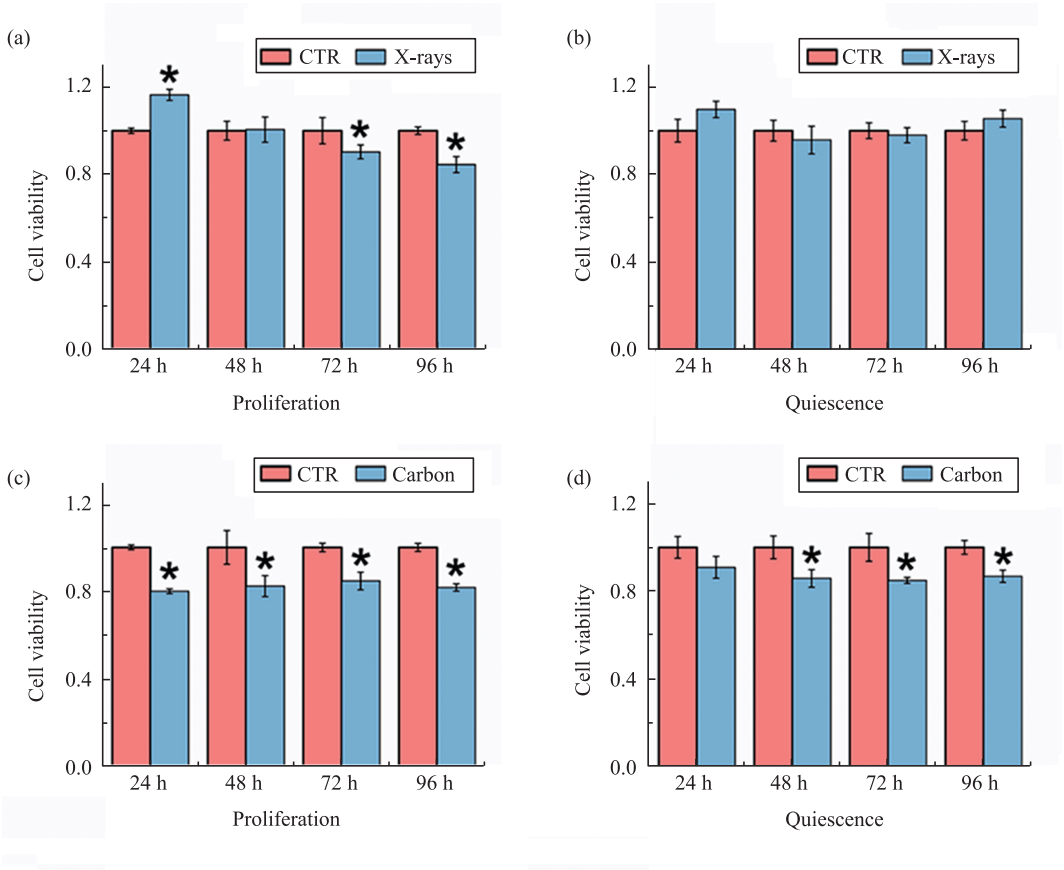

Fig. 1 (color online) Carbon-ion radiation inhibited cell viability in proliferating and quiescent HeLa cells. (a) Cell viability of prolifearting HeLa cells exposed to X-rays was analysed by CCK8 assay, (b) Cell viability of quiescent HeLa cells exposed to X-rays was analysed by CCK8 assay, (c) Cell viability of prolifearting HeLa cells exposed to carbon ions was analysed by CCK8 assay, (d) Cell viability of quiescent HeLa cells exposed to carbon ions was analysed by CCK8 assay. The data represent the mean ± SD of triplicate experiments. $^*P<0.05$ (vs. control group).

Based on the colony formation assay, quiescent HeLa cells formed more colonies after irradiation than proliferating cells. In addition, quiescent HeLa cells were markedly more sensitive to irradiation with carbon ions than with X-rays (2 Gy: (21.67 ± 4.54)% vs. (62.16 ± 4.50)%; 4 Gy: (2.10 ± 0.58)% vs. (36.42 ± 3.24)%; Fig. 2(a) and 2(b)). Overall, quiescent HeLa cells exhibited a poorer response to IR than proliferating cells. Strikingly, carbon ion treatment effectively overcame the radioresistance of quiescent HeLa cells.

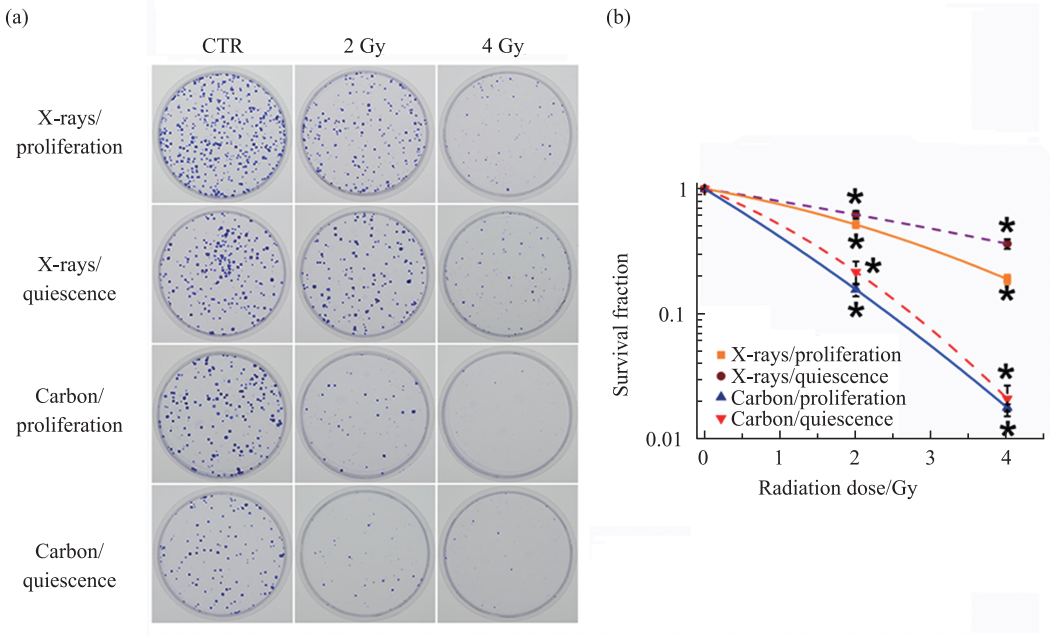

Fig. 2 (color online) (a) Representative images of colony forming potential of proliferating and quiescent HeLa cells in different treatment groups, (b) Cell surviving fraction curve was performed with cell clonogenic survival assay. Colonies consisting of more than 50 cells were scored. The data represent the mean ± SD of triplicate measurements. All experiments were performed in three independent experiments. $^*P<0.05$ (vs. control group).

References

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