MIRD형 표준한국인 팬텀 제작을 위한 한국인 남성 Voxel팬텀과 MIRD팬텀 비교
A Comparison between Korean Voxel Phantom and MIRD phantom

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요 약

표준한국인 MIRD형 팬텀 제작을 위한 기초연구로 한국인 남성 Voxel팬텀, HYMAN과 서구의 MIRD팬텀의 표준방사선장 내 장기선량을 비교 분석하였다. 표준 방사선장 내에서 팬텀간의 장기선량 차이는 첫째로 팬텀 표면에서부터 장기까지의 깊이 차이에 의존하며 둘째로 장기들 간의 구조에 의한 차폐효과 차이에 의존한다. 표준한국인 MIRD팬텀은 기존의 서구 MIRD팬텀의 변형을 통해 제작하는 것으로 방향을 정하였고 이를 위해 한국인 남성 전신 MR이미지를 이용하여 제작된 voxel팬텀, HYMAN과 변형 대상이 되는 MIRD팬텀을 이용하여 AP, PA, LLAT, RLAT방향에서 입사하는 0.4MeV, 0.8MeV 넓고 평행한 방사선장에서의 장기선량을 계산하여 비교하였다. 조직가중치가 큰 장기들 중 생식선, 위, 결장에 대한 선량 차이가 30% 이상의 차이를 보였고 조직가중치가 낮은 장기들 중에서는 갑상선, 부신, 상부대장, 소장의 선량 차이가 30% 이상을 보였다. HYMAN을 기준으로 MIRD5의 장기위치를 변형시키기 위해 4개 방향에 대한 선량차이를 상대비로 나타냈다. 본 연구를 통해 표준한국인 MIRD형 팬텀 제작을 위한 방법론과 장기위치 변경에 대한 기초자료를 얻게 되었다.

Induced Radioadaptive response by Doses and Dose Rate Radiation in Human B-Lymphocytes as Measured by Acridine Orange-Stained Micronuclei Technique

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Introduction

Micronuclei formed due to nondisjunction and chromosome breakage have been employed as a common cytogenic marker to elucidate the phenomenon of adaptive response in human lymphocytes [1] . Several authors have reported simple staining procedures which facilitate rapid manual scoring of events of DNA damage in lymphocytes, such as Giemsa-stained micronucleus assay. The Giemsa test, however, has disadvantages because not only micronuclei, but also some cell inclusions containing RNA and other acidic materials are stained by Giemsa [2,3] . Previous reports have suggested that the specificity of the Acridine Orange for micronuclei greatly increases

the probability of true micronuclei being easily distinguished from misscored artifacts [4] . In this study, the Acridine Orange stain technique was used to quantify the degree of micronuclei in B-lymphocytes as a methodology

It is well known that ionizing irradiation is able to cause cell death and radiation-generated DNA damage. There has been evidence that exposure to low doses of radiation and/or chemicals can prime an organism to withstand the stress from subsequent exposure to higher doses of the same or other agents, namely radioadaptive response in the case of radiation [5] . The first report of adaptive responses showed that exposure of human lymphocytes to low levels of radioactive material reduced chromosomal aberrations induced by a subsequent high dose of X-rays [6] . Recent evidence also suggests that biological effects of low dose exposure may be quantitatively at variance with those at higher doses. However, there have been other reports that note the lack of such effects, even though adaptive response to ionizing radiation has been described in human lymphocytes [7] and mammalian cell types [8] . In fact, multiple blood subpopulations may account for some of the variation in reported radiation-induced chromosome aberration and micronuclei frequencies [9-11] . Lymphocyte subpopulations have different susceptibilities to cell damage by ionizing radiation and earlier investigations provide evidence of the radiosensitivity of B-lymphocytes by demonstrating apoptosis proceeding [12] . These data indicate that a prevalence of adaptive response within lymphocytes correlated with adaptive dose [13] . These reports also suggest that frequencies of micronuclei in B-lymphocytes are highly relevant to DNA repair mechanisms during treatment with low dose and low dose rate radiation, because radioadaptive response induced by a low dose of radiation can be attributed to the induction of a DNA repair mechanism [14-16] . Contrary to this, other investigators have reported a lack of induction of proteins by γ-radiation in human lymphocytes [17] . To our knowledge, there has been no comprehensive study in literature to address in issues in B-lymphocytes of blood populations, and the role of various factors contributing to the variability of adaptive response reported by different investigators remains to be elucidated. For this reason, attempts have been made to discern the role of various variables pertaining to low dose and dose rate on the induction of adaptive response in B-lymphocytes under an experimental protocol of micronucleus assay. The present paper describes the effect of the pretreatment with low dose and low dose rate on the frequency of micronuclei induced by subsequent exposure to high doses of irradiation in B-lymphocytes allowed to recover.