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A Proposal for the Development of Boron Neutron Capture Therapy Agents based on Simulation Studies using PHITS Microdosimetry/PHITS を用いたシミュレーション解析に基づくホウ素中性子捕捉療法用ホウ素剤の開発指針

BNCT is a radiation methodology utilizing the BNCR mechanism, depicted by $^{10}B(n.\alpha)^{7}Li$, to accurately target and eradicate tumor cells. The required ^{10}B level for its therapeutic effect in BPA-BNCT is usually between 15-40 ppm. While this concentration serves as a standard for several boron derivatives, the precise ^{10}B demand for alternative boron compounds, with their distinct accumulation patterns, remains unclear. To examine this, we crafted a virtual cell model with organelles. Using the particle and heavy ion transport system, we calculated the BPA equivalent dose concentration for the cell nucleus. Additionally, we presented the idea of the intranuclear minimal region (IMR), referring to the domain in the microdosimetric kinetic mode, and projected the BPA's equivalence dose concentration to the IMR. The findings suggest that the required boron dosage can change markedly based on how boron molecules settle within cell components. It appears important to consider the BNCR's impact, emphasizing the individual accumulation profiles, rather than strictly using the 15-40 ppm as a reference.

References

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