

Short Review

Estimation of Radiation Dose to Blood Vessels and Components from Medical Imaging Procedures: Current Status

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Abstract

Aim: This study aims to determine the current status for estimation of radiation dose to blood vessels and components from medical imaging procedures.

Methodology: A database search on internet via PubMed and Google Scholar was performed to find published papers in estimation of radiation dose to blood vessels and components from medical imaging procedures.

Results: Few published papers were found; namely two published papers. Radiation dose to blood vessels and components were assumed to be included in total radiation dose estimation for organ or tissue, without considering different in radiosensitivity.

Conclusion: It seems that effect of radiation on blood vessels and components is underestimated, in ICRP 60 and 103 recommendations reports.

Recommendation: It is recommended to conduct more studies to estimate radiation dose for blood vessels and components from medical imaging procedures and revise the value of tissue weighting factor for bone marrow.

More Information

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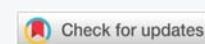
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Keywords: Radiation dose; Blood vessels and components; Medical imaging



Introduction and importance

Radiation causing depression in blood components and vascular damages is excluded for low radiation dose from medical imaging procedures [1]. In addition, electromagnetic radiation (i.e., X and gamma rays) was considered to have the lowest biological effectiveness [2]. However, random or stochastic effects could occur with any radiation dose values. The stochastic effect is a mutation of cell from its original function and cancer could occur. The intensity of radiation induced cancer increases as the radiation dose increases. The main concern of low radiation dose is radiation induced late cancers [3]. This study aims to determine the current status for estimation of radiation dose to blood vessels and components from medical imaging procedures.

Methodology

Database search on the internet was performed to find published papers in estimation of radiation dose to blood vessels and components from medical imaging procedures.

Search on the internet was conducted via PubMed and Google Scholar. The keywords used in this database search were "Radiation dose, Blood vessels and components, Medical imaging". Published paper methodologies of real measurement or simulation to estimate radiation dose to blood vessels and components from medical imaging procedures were selected to be included.

Ethics statement

This study was based on website searching, thus ethical approval was waived.

Results and discussions

It is remarkable that papers published in estimation of radiation dose to blood vessels and components from medical imaging procedures were few; namely two published papers [4,5], The two published papers were conducted using simulation method. The first study reported that the radiation dose from x-ray guided endovascular aneurysm repair reached the dose threshold for depression in blood components [4].

The second study estimate blood dose and related cancer risk for paediatric CT examinations [5]. Nevertheless, maybe few published papers in this topic were not appeared in the internet search.

Blood vessels and components radiosensitivity is different from those organs that blood is calculating through, thus it is important to differentiate between the effect of radiation on organ tissue types and blood vessels or components. It could be useful to estimate the amount of blood vessels and circulation in each organ and then the dose to organ and blood vessels and components can be weighted and then estimated.

Definition of tissue weighting factor is the contribution of radiation dose of organ or tissue to the total body radiation dose (i.e. effective radiation dose), from uniform radiation beam. In ICRP publications 60 (1991) and publication 103 (2007), blood vessels and components were not given certain tissue weighting factor value. However, if it assumed that blood components radiosensitivity is the same as that for bone marrow radiosensitivity, the radiosensitivity of bone marrow is evaluated, in in ICRP publications 60 and 103, to be 0.12. The factor was the same as that given to colon, lung, stomach, and breast [6,7].

Thus, radiation dose to blood vessels and components were assumed to be included in the total radiation dose estimation for organ or tissue, without considering different in radiosensitivity. In addition, this could be reason for the deficiency in published papers regarding this topic. However, it seems that effect of radiation on blood vessels and components is underestimated. This is because the results from therapeutic procedures, simulations, experiments and radiation accidents showed that the first response to acute radiation exposure was depression in blood components [8-12]. Consequently, low radiation dose for blood vessels and components could receive the highest effect from radiation among different organs or tissue types.

Conclusions and Recommendations

It seems that effect of radiation on blood vessels and components is underestimated, in ICRP 60 and 103 recommendations reports. It is recommended to conduct more studies to estimate radiation dose to blood vessels and components from medical imaging procedures, especially for

innervational and x-ray guided procedures. Revision of tissue weighting factor value for bone marrow could be required.

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