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Iatrogenic Cancer Risks from Ionizing Radiation: Traumatic Patients', Cardiac and Spinal Physicians' Lessons

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We scrutinized the excellent study by Howard and colleagues (1) with great interest. They presented the first persuasive line of evidence revealing elevated estimated risk of fatal carcinogenesis of poly-traumatic patients from diagnostic ionizing radiation exposure. Analyzing 2,394 cases, they noted considerable cumulative radiation dose during the first year following injury, as high as 30.45mSv. In conclusions, Howard and colleagues pointed out that radiation exposure and fatal carcinogenesis correlate positively to the severity of injuries to the body. We have several comments.

First, a number of traumatic patients within the cohort experienced high-dose radiation exposure over 100mSv. Indeed, 4.8% patients amongst the cohort received over 100mSv radiation dose, exceeding the limit of low-dose radiation exposure. The radiation exposure of these 115 patients belongs to high-dose radiation according to the US Department of Energy (2). Consequently, the radiation will lead to deterministic effects, including cellular death/tissue dysfunction, cutaneous side effects (3), angiosarcoma (4), cataract anomaly, even death. Typical events include Fukushima nuclear crisis in 2011 and skin radiation injuries. It is well established that carcinogenic risks have linear correlation with effective radiation dose. Therefore, these 115 patients had high definite carcinogenic risks.

Second, the majority of radiation exposure from diagnostic imaging belongs to low and cumulative type leading to stochastic effects. In 2018, Cohen and colleagues (5) presented the first line of evidence indicating the linkage between ionizing radiation exposure and long-term carcinogenesis for adult patients with congenital heart disease. Analyzing 24,833 cases, Cohen and colleagues noted increased cancer risks in cardiac patients in comparison with matched controls, even if excluding the smoking factor.

Third, not only patients, but cardiac and Orthopaedic physicians are facing with health harms. Based on the US nationwide prospective cohort study of 90,957 radiologic technologists completing survey during 1994-2008, Rajaraman et al (6,7) reported increased incidence of stroke, elevated risks of brain cancer, breast cancer, and melanoma for technologists performing fluoroscopically guided interventional procedures. Gausden et al (8) studied cumulative radiation exposure in Orthopaedic surgeons and residents. They noted that higher doses of radiation were amongst residents and attending surgeons with trauma or deformity surgical procedures than other subspecialities.

Notwithstanding the harmful and even lethal impact, the awareness of cumulative radiation exposure is relatively low amongst medical professionals, patients and the public. Collectively, [awareness of] cancer and health harms from ionizing radiation should be spread, aiming for benefiting patients and health professionals.

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Article Author Response

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Article Author(s) to Letter Writer(s)

We read with interest the e letter Prof Hai-Qiang Wang and Dr Zhi-Heng Liu (Dated 23 August, 2019). We thank them for their comments for our manuscript, Howard et al. (1) and their interest in this important topic. In respect of their points raised, we would make the following remarks:

With regards to the first comment raise by the Authors, care needs to be taken to ensure that deterministic and stochastic effects of radiation are not confused. The radiation effects demonstrated in Sanchez-Perez et al. (2) and Plichta & Hughes (3) (as cited by the Authors) are deterministic skin effects caused (in the Sanchez-Perez case, by one acute high dose fluoroscopy procedure; and in the Plichta & Hughes case, by a course of breast radiotherapy). Such deterministic effects occur once a threshold of dose has been exceeded, such as 2Gy to the skin which is generally taken as the threshold for transient erythema. The risk of fatal cancer resulting from a radiation exposure is a stochastic effect and therefore does not have a threshold dose above which the effect will occur with near certainty. Currently used models indicate that the risk of fatal cancer increases linearly with dose and it is this model which we have used to calculate the risks presented in our publication. As such, we cannot say that any of the patients will exhibit deterministic effects such as cellular death/tissue dysfunction, cutaneous side effects, angiosarcoma, cataract anomaly or death. However, we can identify patients that have higher risk of developing fatal cancer in later life, knowing that any radiation induced solid tumours would occur with a latency period of decades post exposure, whilst the latency period for leukemia may be in the order of 5 – 10 years. Whilst it may be ideal to actively follow up the patients with the highest fatal cancer risk, this is beyond the scope of the current study.

The second comment confirms our findings that in a large proportion of patients, indeed the radiation dosage is below the harmful threshold but one should be aware of this inadvertent risk in patients being treated for polytrauma.

The third comment is a crucial one and we thank the authors for highlighting the risks that we clinicians (and our paramedical staff) are taking without really being aware of the harmful effects.

We agree entirely with the authors regarding their conclusion that the main aim of our paper is to increase the awareness of cumulative radiation exposure, which at present is relatively low amongst medical professionals, patients and the public.

Collectively, awareness of cancer and health harms from ionizing radiation should be spread, aiming for benefiting patients and health professionals.

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