

Radiation Safety Evaluation of Surgical Staff in Hybrid Operating Room during Cardiovascular Procedures

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Introduction. Radiation safety and protection is a common practice in every hospital and diagnostic clinic. Still, every year the number of cases with number of occupational diseases of doctors and surgical staff that is under the risk of scattered radiation defects increase. In this study several interventional cardiovascular procedures were analyzed by using real time dosimeters to evaluate the risk of the staff in the hybrid operating room.

Aim, Materials and Methods. The aim is to determine the amount of scattered radiation and the risk of surgical staff, for example, surgeon, anesthesiologist and circulating nurse in various interventional cardiovascular procedures in the hybrid operating room.

The real time radiation safety badges used for this study were RaySafe i2 (Unfors RaySafe AB, Sweden). The medical imaging C-arm system used in the hybrid operating room was Artis zeego multi-axis system (Siemens AG, Germany). The acquired data was collected with RaySafe i2 dose viewer software (Unfors RaySafe AB, Sweden).

During each cardiovascular procedure the surgical staff was given a personal real time dosimeter at heart and/or thyroid level. The radiation safety specialist followed the procedure, collecting data of the total absorbed dose of the scattered radiation, evaluating the location of the person in the room, after the procedure the dosimeters were collected and the data was read by using special USB-cradle with NFC reader.

Results. As the European Union Directive about basic safety standards for protection against the dangers arising from exposure to ionizing radiation states that the dose limits for occupational exposure shall be a limit of 20 mSv in any single year, or in special circumstances not more than 50 mSv.

Depending on the duration and complication of the cardiovascular procedure where the C-arm system is used for imaging, the scattered radiation amount is different at various locations of the operating room. During > 10 cardiovascular procedures performed in operating room at Houston Methodist Hospital the data was collected from the surgical staff: surgeon, anesthesiologist and circulating nurse, because the location where each of the staff members is standing regarding the X-ray source is different. Also, the shielding plays a critical part, as well as the right choice of angulation, filter and windowing settings of the C-arm that can significantly reduce the amount of scattered radiation.

The collected results show a pattern of accumulated scattered radiation dose for procedures like the average cumulative dose for the anesthesiologist is 1.79 mSv ± 20% at the accuracy and linearity range of 150–300 mSv/h. This dose is absorbed in a typical 2 h procedure, for instance, carotid artery stenting or other cardiovascular procedure.

In a typical hospital a vascular surgeon does 2–3 procedures per day, as well as an anesthesiologist is exposed to a great amount of scattered radiation, mainly because of the location in the operating room: behind the patient's head and in a very close vicinity of the X-ray source.

Conclusions. The real time scattered radiation measurements should become a standard in every operating room where the surgical staff is being exposed to radiation during various interventions. It can be as a cross reference with widely used Thermoluminescent Dosimeter Badges combining with other shielding aids and X-ray device manufacturer's guidelines for using functions and modalities to achieve less exposure for the staff and the patient in compliance with ALARA principle. Still, the surgical staff is under a high risk, especially vascular surgeons and anaesthesiologists, while performing numerous procedures per year.