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Radiation Exposure in Endourology: Balancing Exposure and Imaging Quality

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Editorial

Endourology is nowadays a well-established practice for the minimally-invasive treatment of upper urinary tract affections, including stones, tumors and strictures. Fluoroscopic guidance is routinely used to guide endourology procedures. Although medical ionizing radiation is a concern both among patients and endourology medical teams, there is still a consistent lack of knowledge about the how fluoroscopy works and the actual risks related to radiation exposure. Moreover, the absence of widely accepted guidelines affects consistent heterogeneity in the everyday practice, medical devices and patients' management. The damage of ionizing radiation has been divided into two categories: Deterministic and stochastic. Deterministic effects take place when a certain threshold of radiation exposure is exceeded; hair loss, cataract and skin injury are some examples [1]. Stochastic effects occur by chance, without a threshold dose; although their probability is proportional to the level of exposure, the severity of the injury does not; radiation-induced neoplasms are the main expression of stochastic damage [2]. Radiation exposure differ between patients and medical teams: Patients are exposed to direct radiation (primary exposure), whilst secondary exposure (due to scatter radiation) is much more common for the medical personnel. Although no study has assessed the risk of radiation exposure between endourologists, several papers found a consistent association between higher risk of radiation-induced injuries and malignancies between other medical specialties, such as interventional radiology and interventional cardiology [3-5]. Endourologists usually have a lower effective radiation exposure than interventional radiologists and cardiologists, and it rarely happens to exceed the annual dose of occupational exposure of 50 mSv as stated by the International Commission on Radiological Protection; however, there is no evidence about which should be an "acceptable" lifelong exposure [6]. In spite of the well-known risks of radiation exposure, endourologists show little awareness and concern for the problem in the everyday practice. For example, a recent publication by the International Atomic Energy Agency-South-Eastern European Group for Urolithiasis Research Study found appropriate measures for body protection, but not eye protection, in 6 large European Endourology Centers [7]. Is this a matter of lack of theoretical knowledge or negligence in the operative room? The outcomes of an ESUT/EULIS survey by Tzelves suggest that endourologists have a good knowledge of radiation physics, risks of damage and protective measures to be taken, but in the operative room bad habits and convenience count. For example, lead aprons were used by just around 90% of responders, thyroid shields by just around 85%, while the use of glasses (14.7%) and gloves (8.1%) was a rarity. Endourology patients are associated with a higher radiation exposure than medical personnel. Radiation exposure took place both in the operative room, through direct exposure, and in the diagnostic and follow-up pathway, through chest and abdomen radiography, urography images and CT scans. Repeated imaging, repeated procedures, type of procedures (i.e. PCNL), patient habitus (i.e. obesity) and a greater burden of disease have been associated with higher radiation exposure and a estimated increased risk of lifetime malignancy of about 0.15% [6,8-12]. Several interventions have been suggested to reduce radiation exposure both for patients and the medical personnel, accordingly to the ALARA (As Low as Reasonably Achievable) principle. Patient's reduction of the radiation risk involved both the diagnostic and the intraoperative phase. As for the diagnostic step, attention to and revision of the appropriateness of the exam, both on the part of the radiologist and the urologist, may reduce useless studies by one quarter [13]. CT scan is extremely more sensitive (95%) and specific (98%) than US (45% and 88% respectively) in the diagnosis of kidney stones, but up to 60% of patients may not require a subsequent CT following upfront US. Low dose CT has been associated with similar sensitivity and specificity for clinically significant stones (i.e. equal or greater than 4 mm) to standard CT, but patient exposure is reduced to one fifth [14,15]. Within the operative theatre, several interventions have been associated with reduction in patient' radiation exposure. First of all, awareness of the risk of radiation exposure and formal training in

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radiation safety may reduce the fluoroscopy usage between 24% and 56% [16,17]. C-arm is associated with a significantly lower estimated organ doses and effective dose rate than fixed table fluoroscopy [18]. Moreover, proper set of c-arm according to the ALARA principle and a dedicated fluoroscopy technician may lower radiation delivery to patient in range of 60% to 80%, without loss in safety and accuracy [19,20]. The endourology team benefits both of the aforementioned interventions to reduce the radiation dose delivered intraoperatively (in the range of 60%) and of proper body protections and surgical room setup (in the range of 40% of the total dose delivered) [21,22].

In conclusion, patient and medical personnel safety during endourology procedures is the result of a number of interventions, such as proper diagnostic imaging, proper choice of the procedure, proper team training, and proper medical equipment. However, there is a lack for comprehensive guidelines setting the baseline requirements for each endourology surgery; it is up to each endourologist to tailor the operative setting from time to time, in compliance with the national and center rules.

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