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Reduced Radiation Dose in Diagnostic Radiology

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Within the past 20 years, the radiographic examination in the medical field has increased by a factor of about 3 to 5 times, while the total radiation dose has increased by a factor of about 200-400. This has ascribed to the rapid increase in CT usage (1). The increased demand for CT scans has drawn the public's attention about radiological hazards and paved the way for the effort to reduce radiation exposure in every medical imaging field. There are some evidences why the radiation exposure management has become the most important issue nowadays. One study by Berrington et al. (2) estimated 29,000 cancer patients due to 70 million scans in the USA. The other study by Brenner and Hall (3) reported that 600,000 CTs performed on children under age 15 could lead to 500 deaths. CT scans for the pediatric imaging played a significant role in the raised incident rate of leukemia or brain tumors (4).

Two things should be considered to reduce radiation exposure dose (5-7). The first one is justification. The justification is based by the fact that radiographic examinations are essential for the diagnosis, which needs to be recognized first and then the examination is carried out subsequently. Justification includes a legitimate explanation to patients, and this ought to be always considered with the ethical issues. The medical ethics and the healthcare environment ethics have to hold a dominant position. Physician autonomy over the prescription along with obligation has to be ensured for this process.

If the qualification for justification is sufficed, the second conception, optimization, should be reckoned to reduce radiation exposure dose. In other words, provided the radiographic examination has been prescribed for the diagnosis, now think of how to minimize the detrimental effect from radiation. In spite of the minimum amount of radiation, it may produce delayed radiation damage such as cancer statistically 10-20 years later (8). That's why the dose of radiation has to be reduced to prevent radiation hazard. It is recommended to comply with a standard guide for radiographic examination to have the optimal imaging condition for a variety of situations and to wear proper radiation protection devices. If feasible, radiographic examinations have to be taken based on the principle of As Low As Reasonably Achievable (ALARA), which means that making every reasonable effort to maintain exposures to ionizing radiation as far below the dose limits as practical.

In addition to justification and optimization, another one which should be kept in mind is that the amount of radiation is not everything to be concerned in the medical radiological examination. The inappropriate treatment by neglected or omitted procedures owing to the expected radiation exposure damage may give rise to disastrous consequences.

Nowadays, CT screening is new topic issue in the point of radiation safety. CT is a very useful examination in the early detection of cancer because of its diagnostic accuracy. However, in the periodic CT screening, radiation hazards may be greater than the diagnostic benefit. So, if necessary, screening CT may be carried out with strict indications.

It is crucial for the medical institutions to monitor the amount of radiation exposure dose from CT scans or radiological procedures in optimization. Currently, the international organizations and each country are running or preparing various programs for the reduction of radiation exposure dose such as Smart card project in IAEA, My Child's Medical Imaging Record in American College of Radiology, Wallet card in Beaumount Hospital in Pennsylvania, California Senate Bill 1237 (Regulating CT Radiation Dose Practices in California into Law), Radiation Passport Project in Canada, Patient Exposure Registry (PER) in European Union (Dose DataMed (DDM) ProjectPACS), and Radiation Exposure Monitoring (REM) Integration Profile in Japan. Rehani et al. (9) has investigated with the help of the IAEA about the implementation of radiation exposure monitoring program. In a total survey of 76 countries, 11% are running a research on this program and 4% are drawing a blueprint only for the medical tests performed. Of them, 89% responded that these kinds of programs were assumed effective on reduction of radiation exposure dose, and 99% of the participating countries in this survey displayed an interest in such programs. By 2015, patient dose management systems which are developed in each country will be embodied.

The government of Korea recognized the importance of the management of the radiation dose tracking in patients. Since 2012, they have been developing a method for measuring the radiation dose. In 2012, that system for CT scan had built up frames already, and the thing for the plain radiography will be

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created in 2013.

It is very important to acknowledge the correct information about the radiology in the reduction of radiation exposure dose. In other countries, websites such as Image Gently (the society for pediatric radiology) and Image Wisely (radiation safety in adult medical imaging) provide the radiology-related information, education, and campaign. Also radiology-related organizations work together through these websites where tasks are publicized to accomplish justification and optimization for patients, physicians, radiological technologists, medical physicists and radiologists. In recent years, Choosing Wisely contributes to decrease unnecessary examinations in each medical field. In Korea, the Korean Alliance for Radiation Safety and Culture in Medicine (KARSM) was founded by the medical radiation related society, which aims promotion, education, and campaign of radiology-related affairs.

Endeavor to reduce radiation exposure dose can be done by national systematization. The government recommends Diagnostic Reference Level (DRL), which suggests medical institutions to limit the radiation exposure levels in each examination. DRL in CT scans and the plain radiograph has been established and recommended in Korea. When taking a closer look at the recommendation, CT scans set the bounds CTDIvol for skull 60 mGy, and for abdomen 20 mGy, and dose length product (DLP) for skull 1,000 mGy*cm, and for abdomen 700 mGy*cm. The radiation exposure dose for plain radiograph is delimitated skull AP 2.23 mGy, skull lateral 1.87 mGy, Chest PA 0.34 mGy, Chest lateral 2.80 mGy, Abdomen AP 2.77 mGy, Pelvis AP 3.42 mGy, C-spine AP 1.86 mGy, C-spine lateral 1.03 mGy, T-spine AP 3.79 mGy, T-spine lateral 8.15 mGy, L-spine AP 4.08 mGy, L-spine lateral 10.53 mGy, and L-spine oblique 6.35 mGy (10, 11). Nevertheless, the research and the recommendation of the safe radiation exposure levels in radionuclide imaging, cardiac CT, or cardiac catheterization and other imaging procedures have not done yet. Therefore, it is absolutely imperative that a strenuous study for the safety level should be completed for each medical radiation field and needs to be presented soon.

In conclusion, those who concern about reduced radiation exposure dose insist a greater effort to achieve their goal. Doctors are demanded to prescribe a radiographic imaging under the medically justified ethics in the optimal condition so that the maximal benefit from the examinations and the minimal unforeseen injuries are guaranteed. Not only radiologists or related specialists but also patients and the government should cooperate fully to resolve this issue, thereby excluding pruning away gratuitous examinations and fostering better environment for radiographic examinations.

Fear of the unknown accidents with a probability of 1 of 100,000 can be vanquished by collaboration firmly by justification and optimization with a wide variety of means. This collaboration connects every single nation into one to attain the true healthy medical environment.

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