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A Review on Diagnostic and Interventional Radiology that Optimizes Radiation Doses

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Abstract

The exponential rise in utilization is due to the widespread availability of medical radiological imaging technology. There is still a lack of evidence that radiation doses below 100mSv pose a cancer risk. Dosage adjustment for patients is required. In digital radiology, interventional radiology, and mammography, a literature review was carried out to ascertain the factors that contribute to the significance of optimization as well as the procedures that must be followed to ensure a successful optimization process.

Keywords: Interventional radiology; Radiation; Diagnostic radiology

Introduction

Five steps for a dose optimization process are suggested based on recent research. These are the steps: 1) establishing a program for quality assurance; 2) the formation of a dose optimization team comprised of a radiologist, a medical physicist, and a radiation technologist; 3) the determination of baseline dose levels and image quality as well as comparisons with benchmarks in order to determine which exam protocols should be optimized; 4) the modification of protocols by the medical physicist; and 5) the evaluation of the optimization process and its effect on patient dose and image quality [1].

The performance of the equipment the customization of the exam protocol, and the behavior of the staff should all be the focus of joint efforts during the optimization process. Exam protocol details and instruction on how to use dose reduction features should be provided by manufacturers. In order to promote the value of the optimization process, the diagnostic radiology medical physicist ought to emerge and take a proactive lead in the daily clinical routine.

Medical imaging has proven to be crucial to the entire process and plays a crucial role in accurate disease diagnosis and improved patient treatment. In both curative and palliative medicine, as well as at all levels of health care, its application is essential. The medical field has seen a steady shift in technology over the past 50 years that has increased the use of ionizing radiation from X-ray equipment, moving from analogue to digital detectors and platforms, single slice to multidetector-row computed tomography (CT), fluoroscopy to sophisticated angiography systems, simple intraoral dental machines to panoramic and cone beam CT technologies, and so on. Numerous other clinical specialists, including interventional cardiologists, orthopaedic surgeons, gastroenterologists, dentists, anaesthesiologists, urologists, and others, use modern X-ray medical imaging outside of the traditional radiology department due to its widespread accessibility and increased patient demand [2,3].

Literature review

For radiation doses less than 100 mSv, there is little evidence that radiation causes cancer. Even for CT, which is considered one of the high dose diagnostic procedures, there is still no firm consensus among the scientific community regarding the level of cancer risk from diagnostic radiology. About 30,000 A-bomb survivors who lived on the outskirts of Hiroshima and Nagasaki and were exposed to a similar low dose range provide the only direct epidemiological data. Over the course of more than 70 years, this low-dose subpopulation has been observed to have a modest but statistically significant increased cancer risk [4].

The level of radiation dose associated with X-ray procedures becomes the inevitable next question as their use, variety, and complexity grow. This is crucial for the optimization process's strategic planning. The majority of radiological examinations fall within the sub mSv (chest X-ray) to 10–15 mSv (CT or interventional procedures) range [5]. Medical imaging radiation doses can now be reduced thanks to technological advancements. Due to the recent reports of injuries and the higher doses compared to other X-ray techniques, the international literature has primarily focused on CT. The issue of CT radiation dose is also being discussed by patients and the media, resulting in exaggerated articles, excessive patient stress, or even persuading patients to decline a CT scan that could benefit their health. As a response, the CT industry and the scientific community expanded and focused their research on optimizing tools and more accurately estimating radiation doses. A number of steps to reduce the effective dose from a typical single phase abdominal and pelvis CT from 10 mSv to less than 1 mSv (or) one-third of the average annual dose from background radiation [6]. This is also evident in fluoroscopy and interventional procedures, where new, advanced machines offer a variety of examination protocols that are pre-set by the manufacturer for ease of use but cannot be guaranteed to be used correctly. Even if one believes that the settings in the protocol are ideal for the clinical task, it is still necessary to have knowledge of how those settings actually work in practice in order to use the manufacturer's tools effectively and successfully optimize. Unfortunately, no single implementation exists.

Discussion

After steps 1 through 3 have been completed, the medical physicist needs to collaborate with the other team members to modify exam protocols in order to optimize radiation dose [7]. Today's medical

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technology offers a variety of tools to accomplish this, but they should only be used if a thorough understanding of machine performance and the ways in which each technical parameter, post-processing algorithm, or other feature can affect image quality and radiation dose are taken into account are gained. Therefore, in order for the medical physicist to comprehend the optimization tools and features of each machine, they will need to study all technical documentation. The application specialists at the manufacturer are able to provide in-depth knowledge, best practices, and helpful hints for the particular mode of operation at hand [8].

Conclusion

The approaches that doctors take to deal with a variety of clinical issues, patients, and diseases that pose a threat to their lives have been fundamentally altered by medical imaging. However, an X-ray machine's error, misuse, or malfunction can affect the health or life of thousands of people, not just one. Established quality assurance programs must be used to closely monitor X-ray systems, and each patient's needs should be met with the right quality and dose. Key professionals should collaborate on the optimization process, with activities centered on 1) equipment performance, 2) customizing exam protocols, and 3) staff behavior. The medical industry has a responsibility to provide training on the application of predetermined exam protocols as well as additional tools for optimizing radiation dose. Lastly, the hospital's clinically qualified diagnostic radiology medical physicist should lead the optimization process and fully participate in everyday medical imaging activities.

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Conflict of Interest

None

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