What is medical diagnostic imaging and radiology?

Religion

Radiologydiagnosticimaging is an important tool for appropriate therapy planning and for clinical diagnosis of diseases. However, in recent years, there has been an increase of requests require diagnosis by radiation (Siciliano, 2017). So, as the use of radiation increase and become very important in evaluate and diagnose pathology, it become essentially importance to focus on its risks, especially in pediatric.

In young person's, exposure to ionizing radiation must kept low as can as possible, because their tissues are highly radiosensitive. In this age radiation induce risks is relatively high as tissues mitosis rates are high. As a result, it is fundamentally more vulnerable to damage than inactive tissues, it cause DNA metabolism damaged by radiation.

The radiation risk is therefore highest in infancy and earlychildhood. Children, who have many years left to live (life expectancy), are more likely than adults to develop radiation-induced cancer; also, as future parents, they are at risk for passing on radiation-induced genetic defects to the next generation. (AlzenandBenz-Bohm, 2011).

For these reasons, whenever possible, radiological studies on children should replace by other imaging modality that does not involve radiation such as, magnetic resonance or ultrasound imaging. Pediatric conventional X-rays and computerized tomography (CT) require special examining protocols and techniques sets by the radiology department that are suitable to the patient's age and to the indication for the study in order to prevent the patient from unnecessary dose (Siciliano, 2017).

This article is to discuss the principles of radiation protection for pediatric in general radiography, components of equipment using in the plain radiograph and it's function in lowering radiation dose in pediatric patient, the role of radiographer, technical and radiation exposure consideration in this issue with clinical example to evaluate the radiation dose for some common pediatric x-ray examination performed by digital radiography system.

Body

The attention of the medical communities and scientific has greatly focused on the biological effects of ionizing radiations and, in general, on the radiation protection. The purpose of these studies is to provide protection andhealthfor persons who are subjected to radiation exposure especially for pediatric patient (Siciliano, 2017. " searches estimated that exposure to radiation in the first ten years of life induces a risk two to three times higher than exposures incurred between thirty and forty years of age"(Siciliano, 2017 pp. 134) .

In particular, the pediatric patient in this age they are still growing so , they are more radiosensitive than an adult (and having a longer life expectancy), therefore, " the probability of health effects by IR in a child is three times greater than that of an adult"(Siciliano, 2017) . A child's body differ in some respects from adult's body. Actually, pediatric body is short and wide in contrary, to the adult body which is long and less broad.

If the trunk of small child's body is X-rayed, the shape of the body make it difficult to avoid non-require part from irradiate that's because the larger areas of the body lie within the radiation field and are consequently, more

affected by scattered radiation. (Alzen and Benz-Bohm , 2011) . That is mean for example if trunk is x-rayed, other parts like extremities will be affected by scatter radiation. Tissue, which is at high risk of damage by radiation such as hematopoietic bone marrow, differ in location between adults and infants.

" In adults, 74% (spine, ribs, and pelvis) is located in the trunk, and only 9% in the extremities. In infants, 29% is located in the trunk and 35% in the extremities"(Alzen and Benz-Bohm , 2011. pp. 408). This indicates that child hematopoietic bone marrow distributes widely in all parts of the body. That is why we must to reduce the dose to the pediatric patient.

The use of radiation in pediatric radiology must be minimize as can as possible in order to protect child patient form radiation induce risk or try to lower the radiation dose by following certain criteria in pediatric imaging particularly in examinations that require more radiation and more than one projection such as skeletal survey.

Equipment use in general radiography: Equipment that carry general examinations have an essential role in reducing the dose to the young patients. Most digital radiography (DR) now are sufficient in lowering patient radiation dose compared to screen-film radiography and previous used equipment but reverse is also possible (uffmann, 2009).

Because the modern DR system have detectors with higher detective quantum efficiency (CsI: TI/a-Si DR detectors)it become able to improve image quality with less radiation dose(Knight, 2014). This system use technique of raising the KVP and lowering the mAs which responsible to the radiation dose (Knight, 2014) .

This fact make it perfect to use in pediatric radiography. However, in digital system blackening of film at higher dose not exist in the radiograph as this will lead to unnoticed increase in dose over time when using digital system with manual tube sitting(uffmann, 2009). To overcome this problem, the radiographer can manipulate exposure factor and select it carefully without affecting the image quality (Knight, 2014).

The radiographer have an important role in lowering radiation dose and provide radiation safety to the pediatric patients using several methods and techniques for maximum protection while obtaining optimum diagnostic image.

1. Wearing colorful uniforms to gain child trust and make them cooperative (Sulieman, 2015) .
2. Obtain good position by positioning the patient correctly in close contact with the cassata to prevent scatter radiation and repetition (AlzenandBenz-Bohm, 2011).
3. Use the infant holder rather than let someone to hold and give unnecessary radiation to that person (AlzenandBenz-Bohm, 2011).
4. Adjust optimum exposure factor.
5. Using of immobilization device will avoid movement and repetition of image.
6. Apply gonad protection will lead to reduce the dose absorbed by testicular by up to 95%. Protecting ovaries will lower the dose up to 50% (Sulieman, 2015)

7. Preparing the patient perfectly to avoid any appearance of artifact in the image which will cause to repeat the image and consequently increasing the dose.

There is a lot of consideration and techniques must be follow to lower the radiation dose to young patient. ALARA principle (as low as reasonably achievable) is an important techniques to achieve the optimum dose for an X-ray examination in pediatric radiography while obtaining good image quality. Firstly, should to consider in tube voltage use for each examination.

As the result of smaller and thinner body of children than adult then the dose deliver to the child must be lower (Alzen and Benz-Bohm, 2011). The American Society of Radiologic Technologists(ASRT)white paper says " using the highest kVp with the lowest amount of mAs is needed to provide an adequate exposure to the image receptor and therefore decrease amount of attenuation and dose to the patient is the best technique for pediatric in digital imaging" (Stephen, 2014) .

In addition, the authors' research has shown that using an additional tube filter of 1mm aluminum (Al) and 0. 1 to 0. 2 mm copper (Cu) for pediatric radiography will result in decreasing the surface dose by half. Also using proper collimation help to minimize primary and scatter radiation. Karami. et. al,(2016) focused on the essential role of increasing the X-ray focus to film distance (FFD) in lowering the radiation dose to the chest in general pediatric radiography.

Study shown that is increasing FFD from 100 cm to 130 cm its effective to reduce patient radiation dose. Specifically, following special technique when

imaging chest x-ray in pediatric is very important. The breast tissue in this age is very sensitive to the ionizing radiation. Therefore, a PA chest technique is favorable if the patient is cooperate and can perform it (Sulieman, 2015).

This to prevent this sensitive tissue from primary beam. . Table 1. Briefly, demonstrate the techniques of pediatric patient protection in plain film radiography. Thiscase studywas done in SQU Hospital for 7 months old male patient come to the department for skeletal survey. He has skeletal abnormality from birth. Doctorrequested to do AP and lateral skull, AP chest, AP spine, AP pelvic, AP full lower limb, AP feet, AP both upper extremities, PA both hands.

There was absence of right hand and forearm and meromelia " which is a partial absence of part of the limbs"(Nayak S et al. 2016, pp pp106-108) of right upper limb with normal appearance of right humerus, right humerus is slightly smaller compared to left humerus. As many projection was done I compared the radiation dose (DAP) given for some part with the standard dose should give to the pediatric patient in plain radiograph a according to diagram below. In AP skull the patient get 1. 41 dGy

- cm2 (14. 1µGy. m2) and for lateral skull 0. 400 dGy
- cm2 (4 µGy. m2).

Dose considered high in AP skull compared to the standard, this due improper selection of exposure factor. In contrary, lateral skull dose its optimum. Also an image for humerus was repeated and expose patient again

due to poor immobilization and movement of the patient that cause increased dose to the patient.

In conclusion, protecting child from radiation is necessary for many reasons; the most important one is because of their tissue sensitivity as they still in growth stage and does not mature yet. As result they will be more vulnerable to radiation induce risk and the radiation effect noticeble more in them.

Pediatric group are more likely than other age group of society to be irradiated for several reasons, one of them is that, child in this age become sick or get disease easily therefore, they need sometimes for x-ray for accurate diagnosis. Researchers and those who are interested in radiology done many studies in this topic and they found that, there is many methods and ways to reduce dose to the pediatric patient some of this ways come with the machine and some based on radiographers.

For example reducing exposure factors, use gonad protection, immobilization device in addition to perform spatial techniques in imaging pediatric patient.