Valuation of Radiation Dose in Lumbosacral Examination

Yousif Mohamed Y. Abdallah¹, ², Maryem Milad Hemair³, Amel S. Algaddal⁴

¹College of Medical Radiological Science, Sudan University of Science and Technology, Khartoum, Sudan
²College of Applied Medical Science, Almajmah University, Riyadh, KSA
³Faculty of Medical Technology, Alzawya University, Alzawya, Libya
⁴Sebha Infertility Center, Sebha, Libya

Abstract: The biological damage produce by radiation is closely related to the amount of energy absorbed in the case of x-rays. Measurement of produced ionizing is provided a useful assessment of the total energy absorbed. This study was performed in Khartoum teaching hospital in period of January to June 2014. This study performed to assess the effective dose (ED) received in lumbosacral radiographic examination and to analyze effective dose distributions among radiological departments under study. The study was performed in Khartoum teaching hospital, covering two x-ray units and a sample of 50 patients. The following parameters were recorded age, weight, height, body mass index (BMI) derived from weight (kg) and (height (m)) and exposure factors. The dose was measured for lumbosacral x-rays examination. For effective dose calculation, the entrance surface dose (ESD) values were estimated from the x-ray tube output parameters for Lumbosacral Spine AP and lateral examinations. The ED values were then calculated from the obtained ESD values using IAEA calculation methods. Effective doses were then calculated from energy imparted using ED conversion factors proposed by IAEA. The results of ED values showed that patient exposure were within the normal range of exposure. The mean ED values calculated were 2.49 + 0.03 and 5.60 ± 0.22 for Lumbosacral Spine AP and lateral examinations, respectively. Further studies are recommended with more number of patients and using more two modalities for comparison.

Keywords: radiation dose, radiation protection, lumbosacral imaging

1. Introduction

Worldwide the number and range of x-ray facilities and x-ray equipment are almost in variably under taken under some degree of automated control of technique factors. As a result, the technique factor stand to change continually during the examination. In addition the area irradiated by the primary beam also changes during the examination. In this dose area product or air kerma area product correlate reasonably well with radiation risk, as the number of interactions with in the patient is proportional to both dose or air kerma and field size [11-14].

2. Methods and Materials

This study involved 50 patients undergoing lumbar spine radiographic examinations in different radiology departments at Khartoum teaching Hospital in period of June to December 2014. The radiographic equipment used was Toshiba and shimadzu imaging system. The target angle for the X-ray tube was 12°, and the measured ripple for tube potential was in the region of 1%. Total filtration for the X-ray system measured as 2.7 mm of aluminum equivalent. ESDs in this study were calculated using the following equation:

\[ ESD = OP(\frac{kV}{80})^2 \times mA \times (\frac{100}{FSD})^2 \times BSF \]

Where:
- (OP) is the output in mGy/ (mA) of the X-ray tube at 80 kV at a focus distance of 1 m normalized to 10 mA s, (kV) the tube potential, (mA) the product of the tube current (mA) and the exposure time(s), (FSD) the focus-to-skin distance (in cm), (BSF) the backscatter factor, the normalization at 80 kV and 10 mAs was used as the potentials across the X-ray tube.

Volume 4 Issue 2, February 2015

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and the tube current are highly stabilized at this point. The results were tabulated in the Tables (Mean ± Standard Deviation (SD)).

3. The Results

For the group of patients where age distribution was measured, 24% of patients were within the 15-25 years age range, 12% of patients were within the 26-35 years age range, 16% of patients were within the 36-45 years age range, 28% of patients were within the 46-55 years age range, 20% of patients were within the 56-65 years age range. The key parameters for this group are shown in Fig. 1.

For the group of patients where Body Mass Index (BMI) was measured, 24% of patients were within the 1.9 + 0.44 (male), 2.07 + 0.78 (female) BMI ratio range, 12% of patients were within the 2.08 + 0.50 (male) BMI ratio range, 16% of patients were within the 2.6 + 0.28 (male) BMI ratio range, 28% of patients were within the 2.6 + 0.28 (male) and 2.8 ± 0.59 (female) BMI ratio range, 20% of patients were within the 3.2 + 0.21 (male) and 3.14 ± 1.44 (female) BMI ratio range. The key parameters for this group are shown in Fig. 2.

For the group of patients where x-rays exposure factors (kVp and mAs) was measured, 24% of patients were within the 82.0 ± 5.9 (kVp), 52.6 ± 17.3 (mAs) exposure factors ratio range, 12% of patients were within the 82.1 ± 34.6 (kVp) and 59.6 ± 16.2 (mAs) exposure factors ratio range, 16% of patients were within the 85.6 ± 8.8 (kVp) and 58.7 ± 21.8 (mAs) exposure factors ratio range, 28% of patients were within the 85.4 ± 8.07 (kVp) and 79.8 ± 23.8 (mAs) exposure factors ratio range. The correlation between the entrance skin dose ESD (mGy) and tube potential kVp in (kVp) to patients undergoing LS X-ray this group were shown in fig. 3.

![Figure 1: Age Distribution in Sample](image)

![Figure 2: Relationship between entrance skin dose ESD (mGy) and body mass index BMI (Kg/m2) of patients undergoing LS X-ray](image)

![Figure 3: Relationship between entrance skin dose ESD (mGy) and tube potential (kVp).](image)

![Figure 4: Relationship between entrance skin dose ESD (mGy) and tube current (mAs).](image)

The measured dose was 2.49 ±0.03 mGy and 5.60 ± 0.22 for anteroposterior and lateral projection respectively.

4. Conclusion

In this study it was found that doses for L/S for the entire examination were higher AP/LS and LA/LS respectively. Unlike other trails, the dose in L/S radiography was higher in conventional radiography compared to other techniques. Recently digital and computed radiography are becoming more popular due to the important advantage of digital imaging is cost and access. The image quality met the criteria of the departments for all investigation. Further studies are recommended with more number of patients and using more two modalities for comparison and dose optimization during CR imaging must be considered.

References


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Yousif Mohamed Yousif Abdallah received the B.S., M.Sc. and PhD degrees and M.Sc. in nuclear medicine and Radiotherapy Technology from College of Medical radiological Science, Sudan University of Science and Technology in 2005, 2009 and 2013, respectively. During 2006 up to date, he is staying in College of Medical radiological Science, Sudan University of Science and Technology. He is now assistant professor and Consultant Radiation Therapist.

Maryem Milad Hemair is working in Faculty of Medical Technology, Alzawya University, Alzawya, Libya

Amel S. Algaddal is working in Sebha Infertility Center, Sebha, Libya