The risk of conventional X-RAY for abdominal examination at different Erbil hospitals

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الخلاصة

تم قياس جرع الاشعاعية باستخدام أقراص الوميض الحرارى والناتجة عن التصوير الشعاعى التقليدى للفحوصات المعروفة فى منطقة (البطن) للمرضى فى اربيل.
radiography Conventional(X-ray)
وقد اخذت بمجموع286 مرضى فى ثلاث مستشفيات التى يحتوى على هذا الفحص ,الاعمار التى اخذت للمرضى ما بين (40-85) سنة , أما الاحجام ما بين (64كغم-71كغم)وأخذت المعدل لجرع الدخول السطحية.
النتائج التى أضهرت فى معضم العينات (المرضى) لكل فحص أن القيم لجرع دخول السطحية السطحية قد بينت تقاربها وزيادتها مقارنة مع غانا , (وأيضا يشير الى الزيادة فى الجرعة , أى نحتاج الى الاهتمام والعناية من خلال التصوير الشعاعى فى هذه المستشفيات وهذا يعنى أن قسم الاشعاع لابد أن ياخذ اقتراع لمراجعة الاجهزة لكى يقوم بتقليل الجرعة ,وذالك باخذ معدل الجرع الاشعاعية للسطح.
أى الاجزاء المطلوبة التى أخذت من الجهاز اثناء Radiographic الفحص وهوParameters kVp,mAs وتم مقارنتها مع European , وأضهرت أن احدى المستشفيات يحتاج الى زيادة Tube filtration الجزء الاساسى فى هذا البحث هو أن الناتج قريبة من مستويات المرشدالدولى National Guidance Levels ألتى أخذت من مستويات الصحة العالمية Healthcare Level Countries.

Abstract

Thermo luminescent dosimeters (TLDs) have been used to measure the entrance surface doses (ESDs) of patients undergoing abdomen diagnostic X-ray examinations in Erbil. A total of three public hospitals and 286 patients were included in this investigation. The ages of the patients involved were from 40 years to 85 years, while their weights ranged from 64 kg to 71 kg. Mean, of ESDs are reported. The results showed that in most cases of the examinations, the individual ESD values are found to be comparable with, and higher than, those from Ghana and Tanzania, respectively.

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The ranges found in this work are high and this indicates more attention needs to be given to X-ray facilities in the country.

This also suggests that radiographic departments need to review their radiographic practices in order to bring their doses to optimum levels. Effective doses were also calculated from the ESD values. The radiographic parameters used for all the patients were also compared with the European criteria. It is recommended that the tube filtration at one hospital be increased. The importance of good regulatory activities and trained personnel is stressed in this work. Apart from the fact that the data provided in this work will be useful for the formulation of national guidance levels, they also provide patient dosimeter information on healthcare level countries.

Introduction

In applications of ionizing radiation to problems related to medicine, it is important to measure the amount of radiation delivered. In diagnostic procedures such as x-ray examinations, the number and range of X-ray facilities and X-ray equipment is increasing rapidly [1]. Although alternative modalities for diagnosis of diseases and injury, such as ultrasound and MRI are becoming increasingly available, steady improvement in the quality of X-ray images and patient protection have ensured that diagnostic X-rays remain the most used tool in diagnosis [2] and hence make a major contribution to man's exposure to ionizing radiation from artificial sources. In recent years, health physicists have devoted much effort to the minimization of patients' doses in diagnostic radiology. Through these efforts, substantial reductions in radiation doses to patients resulting from radiographic procedures have been achieved in many countries [3]. A useful background for such efforts is the knowledge of radiation doses to patients. This has led to surveys of patients' doses in diagnostic radiology in many countries [1–7].

In Nigeria, to the best of our knowledge, there are two published works on the survey of patients' doses in diagnostic radiology, one by Ajayi and Akinwumiju [4] and the other by Ogunseyinde et al

[5], financed by the International Atomic Energy Agency (IAEA). In their work, patients' doses in the X-ray examinations of chest poster anterior (PA), skull PA, skull AP and skull lateral (LAT) were reported. However, some examinations such as pelvis, abdomen and lumbar spine that were not considered in these two past studies are also known to contribute to the population collective dose [6]. During pelvis and abdomen examinations, critical organs that contribute to effective dose are exposed to radiation, while lumbar spine examinations are known to be associated with higher entrance surface dose (ESD) values compared with all other X-ray examinations [6]. Though Ajayi and Akinwumiju [4].According to the classification by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) [1], Nigeria is in the healthcare level IV category.

Radiographic techniques and dose for each radiograph were assessed during the study and have been compared with other published works from Africa [2, 4, 7], the quality criteria for diagnostic radiographic images proposed by the European Commission [8, 9] and the recently published UK reference doses [10].

The aim of the study

- Measure patients' doses arising from X-ray examinations of the abdomen in some selected hospitals in ERBIL.
- Data from these measurements will serve as a useful baseline against which measurements at individual X-ray departments may be compared and also as an investigation of the possibility of further reduction in patients' doses.
- The review according to this document will involve systematic compilation of new national survey data.
- Hence the patients' doses reported in this work will also be useful for this kind of review by both local and international organizations.
- Radiographic techniques and dose for each radiograph were assessed during the study and have been compared with other published works.

Materials and methods

This survey was carried out on 286 patients in three hospitals in the Erbil, Teaching hospital al-jemhori , Rezgare hospital, and the emergency hospital.

Teaching hospital Al jemhori is included in this study because it has many and more qualified radiologists and radiographers also because regulatory activities had been fairly prominent there. As a result, their operations are expected to be better optimized. For each X-ray room, available machine specific data such as type, model and year of manufacture were recorded. Information on film–screen speed was not available. These data are presented in Table 1. The only information that is available on the films used in these hospitals is the manufacturer's name and this has been included in the table.

Table 1: X-ray personnel and specific data of the X-ray machines used in each of the hospital:

Hospital name	Model/type	Manufacturer	Year of manufacturer	Year of installation	Filtration (mmAL)	Number of radiologists (radiographers)	Film type
Al- Jemhori	Semins AG	GERMAN	1998	2002	1.0	12	Agfa
Rezgari	Semins AG	GERMAN	1996	2001	1.5	8	Agfa
Emergency	Sedecal	SPAN	2000	2003	1.5	4	Agfa

Acceptability of diagnostic images is purely subjective and is assessed by the radiographers. For each patient and X-ray unit the following parameters were recorded: sex, weight, tube potential (kVp), mAs and focus–film distance (FFD). The ESD of each of the patients was also measured. For patient dosimeter in diagnostic radiology, guidelines established by the NRPB [11] advocate the estimation of ESD using TLD measurement techniques. In this work, the use of TLD was therefore adopted for the measurement of ESD.

Measurements of ESD were made with TLD attached to the patient's body at the centre of the X-ray field. The TLD- LiF (lithium fluoride) chips used were annealed by heating them at 400°C for 1 h and then at 80°C for 18 h. The chips were calibrated at Radiation Protection center of Ministry of science and

Technology in Bagdad. using the facilities of the Secondary Standard Dosimetry Laboratory (SSDL). For each of the filtrations (1.5 mmAl, 2.5 mmAl and 2.7 mmAl), calibration factors were first obtained for exposures at five different values of tube potential (45, 60, 75, 85 and 95 kVp). These five calibration factors from each hospital were interpolated in order to obtain the calibration factor to be used for a patient given the tube voltage used to produce the film.

Effective dose was estimated by using the dose conversion Coefficient in the NRPB document [12] for the radiographic procedures and projections studied. The effective doses in Rezgare hospital where the total filtration is 1.5 mmAl could not be calculated because there were no conversion factors listed in the document for X-ray machines with total filtration less than 2 mmAl.

Results and discussion

A total of 286 patients, from three different hospitals, Were included in this survey. Patient age, weight and their sex distribution by hospital and examination are shown in Table 2 the ratio of male to female can be seen to vary with the type of examination. The mean ages of the study sample are within the ages of patients (47–66 years) used in the UK survey [13].

Table 2: Sex distribution, mean of age and weight by examination of the patient for entrance surface dose measurements:

Hospital	Abdomen AP
Al-Jemhori	
• No. of male patients	80
• No, of female patients	32
• Age(year)	52.5(45-64)
• Weight (Kg)	66(65-71)
Rezgari	
• No. of male patients	72
• No, of female patients	70
• Age(year)	56.4(40-83)
• Weight (Kg)	65(64-68)
Emergency	
• No. of male patients	22
• No, of female patients	10
• Age(year)	54.1(40-85)
• Weight (Kg)	68(66-70)
All	
• No. of male patients	174
• No, of female patients	112
• Age(year)	54.6(40-85)
• Weight (Kg)	67(64-71)

The summary of the technical data (tube potential, exposure time) in each of the hospitals included in this survey is given in Table 3. Also included in the table are these parameters calculated using the patients in all the three hospitals .Ant scatter grids were employed only for some of the patients that underwent lumbar LAT examinations in Al- Jemhori hospital. In Rezgari hospital the total filtration used was below the range of values specified for total filtration recommended as good practice in the UK survey [8, 9]. It is surprising that this low filtration is used in a facility that was just installed in 2002.

Table 3: Mean (Range) of radiological data used in the hospitals:

Examination	Hospital	Tube voltage(kVp)	Exposure time (ms)
Abdomen AP	• ALjemhori	66.5(54-86)	152.4(60-400)
	• Rrzgari	82(76-85)	376.5(300-400)
	• Emergency	84.8(80-90)	500(500-500)
	• All	78(54-90)	351.8(60-500)

The values of tube potential and mAs used are also within the ranges of values of these parameters reported by NRPB [10]. The variations in these parameters, as reflected in the range values, are partially due to variations in patient size and technique. Most of the low tube potentials reported are used in Al- Jemhori hospital and the radiographers could not give any reason for this, other than the fact that it gives acceptable images. It therefore shows that in the hospital less attention is paid to patient dose, as the lower the tube potential the higher will be the dose to the patient.

Figure (1) table (4) gives a summary of ESD measurements (mean) for each hospital and examination surveyed. Also included in the figure are these parameters calculated using the patients in the entire three hospitals .The range factor (RF) is defined as the ratio of maximum individual ESD to minimum individual ESD for the same type of examination. The individual ESD values are within the range of individual ESD values that have been reported in the literature for each examination.

The mean ESD from the present work are found to be comparable with those from a measurement carried out in Ghana&Tanzania, the closeness in the values of radiological parameters used in this work and those used in the Ghana&Tanzania measurements, especially the tube potential, may explain the similar mean ESD values obtained from these two measurements. Comparison of the mean ESD values in this work with those from Ghana&Tanzania [2-7], showed that the present values are higher. A possible explanation for this may be the fact that in most of the Ghana&Tanzanian measurements, higher filtrations were employed. (Table 5). Therefore with the tube potential values similar to the ones used in the present work, lower ESD values are expected with the higher filtrations used in Tanzania. The mean ESD values are also found to be within the range of their corresponding values that have been reported from countries outside Africa [1, 6, 14, 15] and the radiological parameters (that influence ESD) in the present work are also within those reported from these other countries.

When compared with the UK (ESD) reference values [10], the mean ESD values in Al–Jemhori hospital and Emergency hospital are generally below their corresponding ESD reference values for abdominal examinations. Anti scatter grids were not used for most of the examinations and this may be responsible for the low doses reported in this work when compared with the UK reference where the use of grids is a standard. It is however expected that the lack of anti scatter grids (or any other alternative method) would have resulted in a lower quality image.

In Rezgari hospital the mean ESD values are above the Corresponding UK reference value for the examinations. Though the filtration values in this work were not measured, but given by the radiographers, a possible explanation for this may be because in Rezgari hospital very low filtration (1.5 mmAl) was employed when compared with UK standard that states that filtration should be greater than 2.5 mmAl.The observed interhospital and intrahospital dose variations, as revealed by the range factors, for the same type of X-ray examination, are an indication that operational conditions were not fully optimized. These variations are partly due to the differences in patient sizes (Table 3). Other sources of variations include possible differences in radiographic technique used by different radiographers, radiographic equipment, film type, processing chemicals and processing conditions. For example, if the filtration in Rezgari is increased the intrahospital variations will be reduced. Comparison of the range factors obtained in this work in ALL with those found in the literature [13] showed that the range factors we obtained are generally higher. This shows that operational conditions are less optimized in the hospitals used in this work and there is therefore much room for dose reduction.

Table 4: Entrance surface dose (mGy) obtained in this work with UK

Hospitals	(ESD)Abdomen
Aljemhori	2.3
Rezgari	14.6
Emergrncy	4.2
All	6.8
UK	5.6

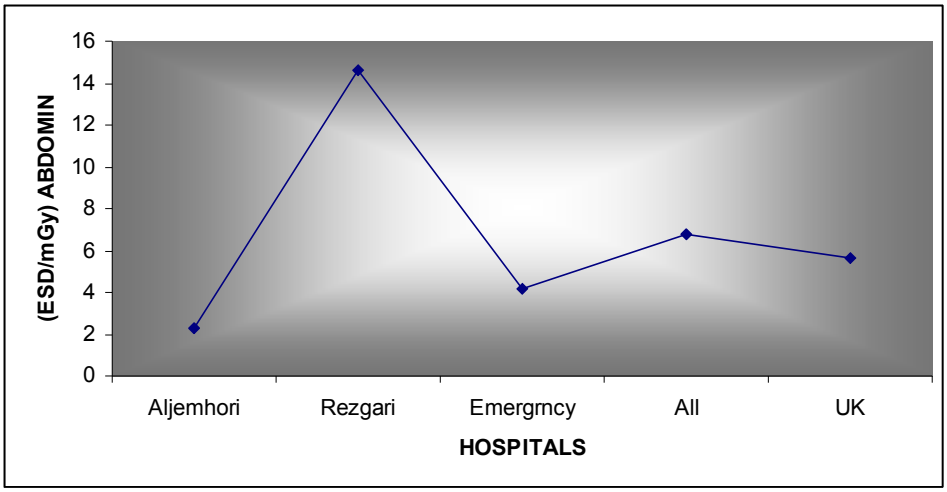

Figure 1: Mean entrance surface dose (mGy) for Abdomen anteroposteror (AP) in (Al jemhori hospital, Rezgari hospital, Emergency hospital , All & UK) .

Table 5: The ratio of maximum to minimum effective dose for abdominal X-ray examination at three hospitals in (Tanzania &Ghana)

Hospitals	x-ray examination	Mean effective dose (mSv)	Max. / min. ratio
KCMC	• Abdomen	10.3	4.6
BMC	Abdomen	12.7	3.3
RMC	Abdomen	13.2	2.0

Conclusion

1: Radiological parameters of patients undergoing abdomen examinations in three Erbil hospitals together with their radiation doses have been monitored. The individual ESD values were observed to be within the range of values that have been reported in other studies.

2: Comparison between the present measurements and those from Ghana and Tanzania, revealed that mean ESD values in the present work are mostly comparable with and higher than, those from Ghana and Tanzania, respectively.

3: From the present work, it is clear that if the filtration in Rezgari hospital is increased and if higher tube voltage settings were used in Aljemhori hospital the range factors will be reduced and may become comparable with those in the literature.

4: These findings point to the fact that there is a serious need to institute programs and monitoring aimed towards reducing patient dose in Erbil.
5: Provided data obtained with very low filtration are excluded, the mean effective doses from this work are generally below those reported from other countries.
6: Consequently, the radiation risk to an average patient in the hospitals included in this work is less than that of an average patient in the hospitals surveyed in these other studies.

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