MEASURMENT OF RADIATION LEVELS OUTSIDE X-RAY MAMMOGRAPHY ,FLUOROSCOPY AND CT SCAN ROOMS OF AL-HUSSAINI HOSPITEL,KARBALA,IRAQ.

قياس مستويات الاشعاع خارج غرف الاشعة السينية ، التصوير الشعاعي للثدي ، الكشف الفلوري والتصوير المقطعي في مستشفى الحسيني ، كربلاء ، العراق .

Mahdi J.saeed,Header S.jaafer
Kerbala university
College of medicine
Medical physics department

Abstract:

In this work the radiation levels out side x-ray, Mammography ,fluoroscopy and ct scan rooms of AL-Hussaini hospital at karbala city were measured. The measured doses were a random selection of 48 examinations for different cases. For each patient the age and sex were recorded, also the main technical parameters of tube voltage (kv),current (mA) and time (T) or current time product (mAs) were recorded during each radiographic exposure with an average of eight readings for each room. The radiation levels were measured in μsv/h and for an actual duty cycle in this hospital of 5 hours a day ,5 days a week ,50 weeks a year, all measured doses converted to msv/y and compared to the dose limits of ICRP .The results show that the radiation out side room 2 where about 1141 to 735 times greater than the general public limit of ICRP and about 57 to 36.75 times greater than the occupational limit of ICRP.The radiation levels outside room 3 where less than the occupational limit but were about 1.66 to 1.5 times greater than the general public limit, and for ct scan the levels of four readings were about 2.05 to 1.75 times greater than the occupational limit and all the ct scan readings greater than the public limit. For fluoroscopy and mammography rooms the limits were less than both the occupational and general public limits of ICRP

الخلاصة:

في هذا العمل تم قياس مستويات الاشعاع خارح غرف الاشعة السينية ،، التصوير الشعاعي للثدي ، الكشف الفلوري والتصوير المقطعي في مستشفى الحسيني في مدينة كربلاء.

الجرع المقاسة هي اختيار عشوائي لـ 48 تشخيص لحالات مختلفة. لكل مريض تم تسجيل العمر والجنس.كذلك سجلت البارامترات الفنية الرئيسة من فولتية الانبوب (kv) ، التيار (mA) والزمن (T) او حاصل ضرب (التيار زمن) (mAs) وبمعدل ثمان قراءات لكل غرفة.

تم قياس مستويات الاشعاع بوحدة μsv/h ولدورة عمل فعلي في هذه المستشفى بمقدار 5 ساعات في اليوم ، 5 ايام في الاسبوع ، 50 اسبوع في السنة فأن جميع الجرع المقاسة حولت الى msv/y وقورنت بحدود الجرع لـ ICRP بينت النتائج ان الاشعاع خارج غرفة 2 كانت بحدود **1141** الى **735** ضعف اكبر من حد عامة الجمهور لـ ICRP وبحدود **57** الى **36.75** ضعف اكبر من الحد المهني لـ ICRP

مستويات الاشعاع خارج غرفة 3 كانت اقل من الحد المهني ولكنها كانت بحدود **1.66** الى **1.5** ضعف اكبر من حد عامة الجمهور وللتصوير المقطعي كانت المستويات لاربع قراءات بحدود **2.05** الى **1.75** ضعف اكبر من الحد المهني وكل قراءات التصوير المقطعي كانت اكبر من حد الجمهور.

بالنسبة لغرف الكشف الفلوري والتصوير الشعاعي للثدي فأن الحدود كانت اقل من كلا الحدود المهنية وعامة الجمهور لـ ICRP

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Introduction:

An x-ray is an electromagnetic wave such as light ,but with a higher energy level, thus capable to some extent of traveling through matter[1] .They are classified as ionizing radiation and are extensively used for industrial ,medical diagnosis and therapeutic purposes. When ionizing radiation was discovered , its beneficial uses were discovered by the medical profession. Over the years new diagnostic and therapeutic techniques have been developed and the general level of health care1 has improved. This has resulted in medical radiation exposures becoming a significant component of the total radiation exposure of populations[2]. The largest single man-made source of x-ray exposure is the medical diagnostic radiography[3] Most people are aware of the use of X-rays in medical diagnostic work and may, indeed, have had practical experience of it. Whilst it provides benefits of a unique kind in this application, it has a nuisance value when produced in situations where it is not wanted, so it is essential that patients are not subject to unnecessary radiological examinations ,and are protected from excessive exposure when the radiological exposures are required[4,5] .

The key rule in the administration of radiation for diagnostic purposes is to obtain the information required with minimum risk of harm from exposure to the radiation[6] ,thus several major dose survey have been reported especially from advanced countries[7-14] , and since the 1990 publication of patient dose reduction in diagnostic radiology by the UK national radiological protection board (NRPB) [15] , the worldwide have been stimulated and interested in patient dose measurement .

Dose reference levels suggested by a national or international regulations are the main sources in improvement on the radiation protection of the patients. The guidance provided by international commission on radiological protection (ICRP) [16] become one of the most important reference in numerical dose limits.

Materials and method :

Radiation was measured outside 3 x-ray rooms, Mammography ,fluoroscopy and ct scan rooms of Al-Hussein hospital in karbala city ,Iraq.

Radiation measurements was carried out using a portable radiation detector type Genitron mini – tracey GmbH – Germany.

In the unit of (μsv/h) , the background radiation was measured out side the diagnostic rooms before and during the machines were switched on.

During exposure the radiation was measured in different points immediately behind the doors ,out side the diagnostic rooms.

Measurements were randomly selection of 48 samples of diagnostic examinations cases during two days, so there were 24 readings per a daytime between 9 Am to 2 Pm ,the type of examination,sex ,age of patients and the most important technical parameters kv and mAs were recorded. The three participant x-ray rooms were equipped with stationary x-ray units type shimadzu whereas fluoroscopy room equipped with machine type siemens.

The mammography machine type IMS-sitto while the ct scan room equipped with a spiral ct scan type siemens.

Results and discussion :

Table 1 shows the radiation dose levels measured immediately behind the doors of the three x-ray rooms together with the background radiation out side each room .The radiation was measured in (μsv/h) and then converted to (msv/y) for actual duty of 5 hours per a day ,5 days per a week ,50 weeks per a year .It is obvious from table 1 the huge variations in radiation levels before examination which is the background radiation and during each examination for room No. 2 whereas the levels of radiation for room 1 and 3 are equal to that of the background levels. Table 2 shows the radiation levels of random samples of radiation levels out side Mammography, fluoroscopy and CT scan rooms with background radiation before each examination. It is clear from table 2 the are no differences in radiation levels before and during examinations for Mammography and fluoroscopy while the differences .

The doses limits recommended by ICRP [15] states that the annual average dose over five years should not exceed 20msv for occupational exposure
,and the public should not exposed to more than an average of 1msv per year. For comparison, it is very clear that the radiation levels out side x-ray

Table 1:Radiation levels out side the three x-ray diagnostic rooms

Name of the room	*Examination*	*Age*	*Sex*	*Kvp*	*mA*	T(sec)	*mAs*	*Background radiation (Msv/y)*	*Radiation levels during examination (Msv/y)*
Room 1	*Elbow*	*19*	*f*	*57*	*…*	*…*	*23*	*0.16*	*0.16*
Room 1	*Hand*	*45*	*m*	*60*	*…*	*…*	*23*	*0.16*	*0.18*
Room 1	*Hand*	*36*	*m*	*55*	*…*	*…*	*23*	*0.16*	*0.18*
Room 1	*Knee joint*	*27*	*f*	*56*	*…*	*…*	*23*	*0.18*	*0.18*
Room 1	*Knee joint*	*51*	*m*	*56*	*…*	*…*	*23*	*0.18*	*0.16*
Room 1	*Leg*	*14*	*f*	*55*	*…*	*…*	*23*	*0.16*	*0.16*
Room 1	*Elbow*	*27*	*m*	*60*	*…*	*…*	*23*	*0.16*	*0.16*
Room 1	*Leg*	*33*	*m*	*60*	*…*	*…*	*23*	*0.16*	*0.16*
Room 2	*LUMBAR PA*	*42*	*m*	*102*	*400*	*0.22*	*…*	*0.18*	*1135*
Room 2	*femur*	*23*	*m*	*60*	*400*	*0.1*	*…*	*0.18*	*768.75*
Room 2	*pelvis*	*56*	*f*	*74*	*400*	*0.16*	*…*	*0.16*	*906.25*
Room 2	*LUMBAR AP*	*9*	*m*	*60*	*400*	*71*	*…*	*0.18*	*1041.25*
Room 2	*Cervical AP*	*34*	*m*	*60*	*400*	*0.1*	*…*	*0.18*	*1055*
Room 2	*femur*	*6*	*m*	*56*	*400*	*63*	*…*	*0.18*	*745*
Room 2	*shoulder*	*38*	*m*	*60*	*400*	*0.1*	*…*	*0.18*	*735*
Room 2	*LUMBAR AP*	*40*	*m*	*90*	*400*	*0.2*	*…*	*0.18*	*1141.35*
Room 3	*Chest AP*	*41*	*f*	*77*	*200*	*80*	*…*	*0.18*	*1.66*
Room 3	*Chest AP*	*25*	*m*	*67*	*200*	*80*	*…*	*0.18*	*1.62*
Room 3	*Chest PA*	*40*	*m*	*85*	*200*	*80*	*…*	*0.18*	*1.60*
Room 3	*abdomen*	*33*	*m*	*77*	*200*	*80*	*…*	*0.18*	*1.60*
Room									

3	*Chest Lat*	*47*	*m*	*87*	*200*	*80*	…	*0.18*	*1.60*
Room 3	*abdomen*	*51*	*f*	*78*	*200*	*80*	…	*0.18*	*1.50*
Room 3	*Chest AP*	*19*	*m*	*65*	*200*	*80*	…	*0.18*	*1.50*
Room 3	*abdomen*	*34*	*m*	*78*	*200*	*80*	…	*0.18*	*1.60*

Table 2: Radiation levels out side the Mammography, Fluoroscopy and CT scan rooms

Name of the room	*Examination*	Age	Sex	*Kvp*	*mAs*	*Total mAs*	*Background radiation (Msv/y)*	*Radiation levels during examination (Msv/y)*
Mammography room	…	*38*	*f*	*27.5*	*35*	…	*0.18*	*0.18*
Mammography room	…	*46*	*f*	*27.5*	*50*	…	*0.18*	*0.18*
Mammography room	…	*27*	*f*	*26*	*25*	…	*0.18*	*0.16*
Mammography room	…	*44*	*f*	*27*	*35*	…	*0.16*	*0.18*
Mammography room	…	*16*	*f*	*20*	*20*	…	*0.16*	*0.16*
Mammography room	…	*29*	*f*	*24*	*22*	…	*0.16*	*0.18*
Mammography room	…	*35*	*f*	*26.5*	*25*	…	*0.16*	*0.16*
Mammography room	…	*44*	*f*	*26*	*25*	…	*0.18*	*0.16*
Fluoroscopy room	*Knee joint*	*12*	*m*	*52*	*22*	…	*0.18*	*0.16*
Fluoroscopy room	*Hand*	*26*	*m*	*41*	*18*	…	*0.18*	*0.18*
Fluoroscopy room	*Foot*	*37*	*f*	*49*	*18*	…	*0.18*	*0.18*
Fluoroscopy room	*Hand*	*29*	*f*	*49*	*18*	…	*0.18*	*0.18*
Fluoroscopy room	*Chest*	*41*	*f*	*60*	*28*	…	*0.18*	*0.18*
Fluoroscopy room	*Lumbar*	*53*	*m*	*93*	*45*	…	*0.16*	*0.18*
Fluoroscopy room	*Kub*	*58*	*m*	*75*	*32*	…	*0.16*	*0.16*
Fluoroscopy room	*kub*	*41*	*m*	*75*	*45*	…	*0.16*	*0.16*
CT scan room	*Pelvis (hip joint)*	*50*	*f*	*130*	…	*6549*	*0.18*	*41.25*
CT scan room								

	Brain	***3***	***m***	***130***	***…***	***3332***	***0.18***	***35***
CT scan room	***Chest***	***33***	***m***	***130***	***…***	***984***	***0.18***	***20***
CT scan room	***Lumbar (Lambosacral)***	***45***	***m***	***130***	***…***	***6051***	***0.16***	***38.75***
CT scan room	***abdomen***	***52***	***m***	***130***	***…***	***4037***	***0.18***	***37***
CT scan room	***Brain (sinus)***	***14***	***f***	***130***	***…***	***996***	***0.18***	***11.06***
CT scan room	***Shoulder***	***10***	***f***	***130***	***…***	***1282***	***0.18***	***10.37***
CT scan room	***Brain***	***37***	***m***	***130***	***…***	***990***	***0.16***	***10.12***

room 2 where about 1141 to 735 times greater than the general public limit and about 57 to 36.75 times greater than the occupational limits of ICRP.

The radiation levels outside room 3 where less than the occupational limit but were about 1.66 to 1.5 times greater than the general public..

According to table 2 the radiation levels out side fluoroscopy and mammography rooms were less than both the occupational and general public limits of ICRP,whereas the levels of ct scan room were about 2.05 to 1.75 times greater than the occupational limits for four readings and all the ct scan readings were greater than the public limit. The actual exceed of all diagnostic rooms compared to the prescribed limits were about 1141 to 1.5 times.

Conclusion :

The radiation dose extent out side the three diagnostic rooms which are scattered from the patients and leakage from housing of the x-ray devices suggests very high exceed compared to prescribed limits of exposure which indicates that the operational conditions are not fully optimised which in turn predicts that there is a very high risk associated to public,patients, technicians and all the other employees staff in this section ,therefore results in general show that proper shielding of x-ray rooms is mandatory further more assessment of the level of shielding in the rooms 1,2 and 3 must be conducted seriously and with high accuracy also leakage radiation from housing of x-ray tubes should measure to ensure that the leakage radiation within the limits allowed or not to save the patients ,public operators and medical personnel.

References :

[1] Richard Zimmermann, Nuclear Medicine, Radioactivity for diagnosis and therapy, France EDP sciences 2007.
[2] UNITED NATIONS, Sources and Effects of Ionizing Radiation (Report to the General Assembly), Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), UN, New York (1993).
[3] Bouzarjomehri. F. : Reduction of unwarranted patients exposure in x-ray examinations ,Iran. J. Radiol. December 2003.
[4] Hart D. and Wall B.F. , Radiation exposure of the UK population from medical and dental x-ray examinations , NRPB-W4 March 2002.
[5] Shrimpton PC. and Wall B.F. , Doses to patients from medical radiological examinations in Great Britain. Radio Port Bull ;77 , 10-14, 1986.
[6] Shapire J. , Radiation protection : A guide for scientists ,regulators and physicians , fourth ed. President and fellows of Harvard college , 2002.
[7] National Radiological Protection Board /Royal college of Radiologists. Patient dose reduction in diagnostic radiology. In documents of the NRPB London :HMSO,1(3),1990.
[8] National Council on Radiation Protection and Measurements, Exposure of the US population from diagnostic medical radiation ,Bethesda ,Maryland ,USA ,NCRP,1989.
[9] Shrimpton P.C. , Wall BF Jones D.G. ,Fisher E.S. ,Hillier M.C. ,Kendall G.M. et al. ,Doses to patients from routine diagnostic x-ray examinations in England ,Br J Radiol 59:749-758,1986.
[10] Shrimpton P.C. , Wall B.F. Jones D.G. ,Fisher E.S. ,Hillier M.C. ,Kendall G.M. et al. A national Survey of doses to patients undergoing a selection of routine x-ray examinations in English hospitals NRPB –R200 , London :HMSO ,1986.
[11] Hart D. ,Hillier M.C. ,Wall B.F. ,Shrimpton P.C. and Bungay D. ,Doses to patients from medical x-ray examinations in the UK -1995 review ,NRPB-R289 ,London :HMSO,1996.
[12] Heggie J.cp. A survey of doses to patients in large public hospitals resulting from common plain film radiographic procedures. Austral Phys Eng Sci Med :13 ,71-80,1990.
[13] International Atomic Energy Agency /Commission of the Europe Communities ,Radiation doses in diagnostic radiology and methods for dose reduction ,IAEA-TECDOC-796,Brussles: CEC,1995.
[14] Drtiz P. ,Maccia C. ,Padovani R. ,Vano E. ,Carlsson G.A. and Schibilla H. ,Results oh the IAEA-CEC coordinated research program on radiation doses in diagnostic radiology and methods for reduction .Radiat prot Dosim ,57:95-109,1995.
[15] National Radiological Protection Board / Royal College of Radiologists, Patient dose reduction in diagnostic radiology :In Documents oh the NRPB.London:HSMO:1(3),1990.
[16] International Commission on Radiological Protection ,Radiological Protection and Safety in Medicine ,Pergamon Press ,Oxford ,UK :Annals of ICRP,v.26,n.2,ICRP publication 73 (1996).