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Estimation of entrance skin exposure for patients undergoing fluoroscopic examination in extracorporeal shockwave lithotripsy(ESWL)

تخمين تعرض الدخول لجلد المرضى المعرضين الى الفحص بجهاز الفلوروسكوبي في وحدة تفتيت الحصى(الازول).

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Abstract:

Localization of renal stone in extracorporeal shockwave lithotripsy (ESWL) involving the use of fluoroscopic examination before the destruction of renal stones ,that which offering high exposure to the X-ray which in return contribute to high patient dose. Rad Pro software had been used to calculate the patient entrance exposure(mR).33 casa were enrolled in this project (19 male and 14 female).Different radiographic techniques (X-ray tube voltage and current) were used representing different patients conditions (body weight and size) that which input to the software to calculate entrance skin exposure .The results obtained was significantly very high when compared with international diagnostic level.

الخلاصة :

تحديد موقع الحصوة الكلوية في جهاز تفتيت الحصى يتضمن استخدام الفحص بجهاز الفلوروسكوبي قبل عملية التفتيت للحصوة الكلوية ,الذي يؤدي إلى تعرض عالي إلى الأشعة السينية مما يؤدي بالمقابل الى المساهمة في زيادة جرعة المريض الممتصة .برنامج الراد برو تم استخدامه لحساب تعرض الدخول للجلد (ملرونتجن).ثلاث وثلاثون حالة تم تسجيلها في هذا البحث(19ذكر و14انثى) .مختلف التقنيات الإشعاعية(فولتية وتيار أنبوبة الأشعة) استخدمت ممثلة مختلف الظروف الجسمانية للمريض(وزن وحجم الجسم)التي تم ادخالها للبرنامج لحساب تعرض الدخول لجلد المرضى.النتائج المستحصلة كانت وبشكل واضح عالية مقارنة بالمستوى القياسي العالمي لعلم الشعة التشخيصية.

Introduction:

Since radiation measurement devices can't be put just under the skin of patients undergoing x-ray exams, we use a radiation instrument with a "phantom" (a plastic sphere or square to represent a body) in the beam to estimate entrance skin exposure dose for various exams. The radiation instrument is placed on the phantom to catch the x rays just as they enter the phantom. The instrument result is actually an exposure-in-air measurement and we use it to estimate skin dose and to calculate organ doses (for organs that lie in the x-ray path). The entrance skin exposure ESE) is measured in units of Roentgen (R) or milliRoentgen (mR)[1].**(**Exposure is defined strictly for air as the interacting medium. However, the term entrance skin exposure is frequently used in comparing techniques for various radiologic procedures, and it refers to the exposure at the location in space at which the central ray of the radiation beam enters the patient. Entrance skin exposure is not equivalent to entrance skin dose, because it does not include the contributions from radiation scattered within the patient. It is, however, a quantity that can be easily measured and compared among facilities.[2].

Diagnostic X-rays are used so extensively in medicine that they represent by far the largest man-made source of public exposure to ionizing radiation. Patient radiation dose from conventional radiographic procedures ranges from 0.1 mSv to 10 mSv, resulting in a collective dose to the population that can be significant[3].

Fluoroscopy guided medical procedures are an essential part of the contemporary practice of medicine. By and large, the risk of stochastic or deterministic injury as a result of radiation exposure during these procedures is low. Fluoroscopic procedures may involve high patient radiation doses. The radiation dose depends on the type of examination, the patient size, the equipment, the technique, and many other factors [4].

A typical fluoroscopic entrance exposure rate for a man of medium build is approximately 3 R/min (30 mGy/min) .Dose rates of up to 50 R/min (500 mGy/min) and higher may be encountered during recorded interventional and cardiac catheterization studies, such as those that involve a series of multiple, still-frame image acquisitions[5].

The dose rate to the patient is greatest at the skin where the x-ray beam first enters the patient. Although most literature has begun to report dose rate in milligray per minute, existing regulations still specify limits in terms of an exposure rate (roentgen per minute). The entrance exposure limit for standard operation of a fluoroscope is 10 R/min (100 mGy/min). Some fluoroscopes are equipped with a high-output or "boost" mode, and the limit for operation in this mode on state-of-the-art equipment is 20 R/min (200 mGy/min) .There is no limit on entrance exposure rate during any type of recorded fluoroscopy, such as cinefluorography or digital acquisitions[6].

A very long examination involving 30 minutes of fluoroscopy time could result in doses of <90–1,500 rad (900 mGy to 15 Gy). Although a dose of 90 rad (900 mGy) will most likely produce no apparent effects, 1,500 rad (15 Gy) can cause severe skin burns that develop slowly and may take months to heal. Physicians must know how to minimize radiation doses to patients to avoid short-term (<2 years) radiation-induced injuries (eg, burns) and long-term (>2 years) harm (e.g., cancer)[7].

Material and method of calculation.

***** Measurements were performed in extracorporeal shockwave lithotripsy unit in Al-Sadder teaching hospital.

* 33 case(patients) of different age ,size and weight were enrolled in this project(19 males and 14 females) ,where all of them had complain from having renal stones of different size.
* Different radiographic techniques were used (tube potential in kilovolt and tube current in milliampere) representing different patient' body size.
*Filter of the X-ray tube was made of Aluminum(Al) with 3mm thickness (used in software).
* The distance between the X-ray tube and patients are approximately 50cm (used in software).
* In order to increase the speed and efficiency of the patients dosimetery process , a windows based computer program ,called Pad Pro software was used in this study .This software has gained popularity with many other nuclear professionals in medical engineering, medical physics and other nuclear physics disciplines. The x-ray machine/device calculator allows the choice of empirical data or the use of known x-ray tube output. Software developed by Ray Mc Ginnis ,last update Augst,6,2007.[7].

Results:

Table(1):

Show the entrance skin exposure of the patients(mR) relative to the different radiographic techniques that which are applied during the examinations.

No.	Tube voltage (KV)	Tube current (mA)	Time of exposure (Sec.)	Entrance skin exposure(mR)
1	65	3.9	45	3315.0
2	65	4.2	35	2777.0
3	68	6.4	45	594.00
4	69	7	35	674.00
5	69	7.1	50	977.00
6	69	7.3	60	1206.0
7	70	8	80	14297
8	71	7.9	45	244.00
9	75	7.3	60	11.289
10	76	7.1	90	438.00
11	78	7.1	45	658.00
12	79	6.8	70	1307.0
13	79	6.9	80	1516.0
14	80	6.7	70	1370.0
15	81	6.7	80	430.00
16	82	6.7	40	430.00
17	83	6.6	40	635.00
18	85	6.3	70	1112.0
19	86	6.3	85	367.00
20	87	6.2	60	511.00
21	88	6.1	90	1131.0
22	90	6	70	15398
23	91	6	70	288.00
24	93	5.8	85	1016.0
25	95	5.6	90	20209
26	98	5.6	90	1038.0
27	99	5.5	70	1057.0
28	100	5.4	90	21157
29	102	5.3	90	765.00
30	103	5.3	60	765.00
31	104	5.3	80	1361.0
32	105	5.2	85	21015
33	110	5	65	13756

Discussion:

It is necessary to keep the exposure doses from fluoroscopy as low as is reasonably achievable to avoid radiation skin injuries in patients undergoing fluoroscopic examination.Entrance skin exposure was calculated in(mR) relative to the time of exposure that mentioned in table (1).

Our observations come in high agreement with[8] who are measured the effective dose for the patients treated extra corporal shockwave lithotripsy that calculate the effective dose using phantom and thermo luminescence dosimeters(practical work) .

[9]calculate the patient effective dose using DoseCal software in different hospitals in conventional radiography ,where the results were lower than our results as the time was significantly lower than the extra corporal shockwave lithotripsy.

Our result are in harmony with study [10] ,who are measured the effective dose for the patients who are treated by ESWL and also measure the entrance dose in unit of mGy using thermoluminesnce dosimeters(practical work).

[11] measuring the radiation exposure using different dosimetric method and instrument(dosimeters) for the patient undergoing standared radiographic procedures where the results were lower than our results due to short exposure times.
Enrance skin exposure recommended(upper limit) by [12] to various X-ray examination for patients ranged from (20 mR to 627 mR).
One of the that measure the radiation exposure from typical survey CT(computed tomography) scans, to compare their exposure to that of typical chest radiographs, and to explore methods for radiation exposure reduction, had entrance skin exposure values range from(3.2 mR to 74.7 mR)[13].

Conclusion:

Presented data may be used to determine patient exposure from extracorporeal shock-wave lithotripsy procedures performed in any laboratory
The results of this study showed high exposure levels relative to the time to which the patient are exposed to the X-ray .
It was observed that there was a wide variation in patient dose that reflect different radiographic techniques(tube voltage and tube currents).

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