Estimation of Patients Effective dose while they are Exposed for Long Time Fluoroscopic Examination in Extra Corporal Shockwave Lithotripsy(ESWL).

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Abstract

The fluoroscopic examination in extra corporal shockwave lithotripsy unit in order to localizing the position of renal stones in a given patients before the destruction of renal stone, offering long time exposure to the X-ray, resulting in high patients dose .Rad Pro software has been used to evaluate the patient effective dose. Thirty three cases were enrolled in this project(19 male,14 female) .Different radiographic techniques (X-ray tube current and potential difference) are used representing different size of body patient, which were introduced to the software to calculate the effective doses for patient .The results obtained are significantly high relative to the international diagnostic reference level, these results present large variations between each case that reflect the disparity of radiographic techniques(X-ray tube current and potential difference) in the examination.

الخلاصة

الفحص الفلوروسكوبي في وحدة تفتيت الحصى من أجل تحديد موقع الحصى الكلوي في المرضى المعنيين قبل عملية التفتيت للحصى الكلوي يؤدي إلى عملية تعرض عالية للأشعة السينية و لفترة طويلة مؤدية إلى جرعة عالية للمرضى.برنامج (الراد برو) تم استخدامه لتخمين الجرعة المؤثرة .ثلاث وثلاثون حالة تم تسجيلها في هذا البحث(19 ذكر،14 أنثى) .مختلف التقنيات الإشعاعية (فولتية وتيار أنبوبة الأشعة)ممثلة اختلاف الظروف الخاصة بكل مريض (حجم المريض) التي يتم إدخالها للبرنامج المستخدم لحساب الجرعة المؤثرة للمرضى. النتائج المستحصلة كانت وبشكل واضح كبيرة نسبةً إلى المستوى العالمي القياسي . هذه النتائج أوجدت اختلافات كبيرة فيما بين كل حالة مما يعكس التفاوت في التقنيات الإشعاعية (فولتية وتيار أنبوبة الأشعة) للفحوصات.

Introduction

The effective dose, is a dosimetery parameter which take into accounts the dose received by all irradiated radiosensitive organs and may be taken to be measure of stochastic risk. Although the effective dose is an occupational dose quantity based on age profile for radiation workers ,this dose descriptor is being increasingly used to quantify the amount of radiation received by patients under diagnostic examinations[Walter,*et al*1997].

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[Koenig ,*et al* 2001]

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. [Mahadevappa,2001]

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[Robert, *et al* 1999]

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 [Wagner, *et al* 1998].

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. Dermal atrophy may develop after several months and become more severe after a year. At doses in excess of about 1,800 rad (18 Gy), more severe skin burns involving dermal necrosis may slowly evolve over many months. 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)[Bushberg, *et a*l1994].

Aim of project

The aim of this study is to determine the radiation doses to patients during extracorporeal shock wave lithotripsy (ESWL) and compare them with the available bibliographical data. In this method localization of the renal stones is attained by the use of fluoroscopy, and thus ESWL is included among those medical practices associated with patient radiation exposure.

Material and method

***** 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 2.5mm 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.

Results

Table(1):
Show the effective dose of the patients(mSv) relative to the different radiographic techniques that which are applied during the examinations.

No.	Tube voltage (KV)	Tube current (mA)	Time of exposure (Sec.)	Effective dose rate(mSv/hr.)
1	65	3.9	45	4584.261
2	65	4.2	35	4936.896
3	68	6.4	45	541.2824
4	69	7	35	789.3864
5	69	7.1	50	800.6633
6	69	7.3	60	823.2172
7	70	8	80	10532.29
8	71	7.9	45	297.1671
9	75	7.3	60	10984.80
10	76	7.1	90	300.2917
11	78	7.1	45	900.9120
12	79	6.8	70	1150.484
13	79	6.9	80	1167.403
14	80	6.7	70	11499.95
15	81	6.7	80	220.7520
16	82	6.7	40	441.5051
17	83	6.6	40	652.3749
18	85	6.3	70	11851.41
19	86	6.3	85	237.0288
20	87	6.2	60	466.5341
21	88	6.1	90	688.5158
22	90	6	70	12415.92
23	91	6	70	225.7447
24	93	5.8	85	654.6630
25	95	5.6	90	12641.84
26	98	5.6	90	710.6413
27	99	5.5	70	930.6042
28	100	5.4	90	13332.61
29	102	5.3	90	374.4377
30	103	5.3	60	561.6553
31	104	5.3	80	748.872
32	105	5.2	85	13757.09
33	110	5	65	14109.07

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. Effective dose rate are calculated in unit of mSv per hour ,but , the actual time that patient subjected to was below one hour as mentioned above in table (1) ,also the time of exposure was significantly very as what recommended by ICRP for radiation protection.

Our observations come in high agreement with[Perisinakis,*et al* 2002] 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) .

[Osibote, *et al* 2008] 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 [Sandilos, *et al* 2006] ,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).

[Koler, *et al* 2001] were calculate the effective dose and dose equivalent for the patient in many category of examination to provide data base about the radiation dose received by patient under examination by X-ray.

Conclusion

Presented data may be used to determine patient effective dose 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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