

The quality control of diagnostic radiology devices in hospitals of Sistan and Baluchestan, Iran

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Abstract

One of the most significant factors in decreasing the radiation exposure dose is quality control and making sure of the quality of radiological devices. The aim of this study is to consider the quality control of nine radiological device in nine hospitals in Sistan and Baluchestan, Iran, so that the question can be answered whether radiological devices are in the best efficiency conditions or not and to assure about their appropriate function. This study was performed cross-sectional in the year 2009, and the DIAVOLT and the dosimeter device named DIADOSE made by PTW's company were used for conduction quality control experiment. For making this experiment practical, various parameters of quality control programs as output repeatability of X-ray tube, time accuracy, time repeatability, output linearity with mA, voltage accuracy, adapting the optical field with radiation field, being vertical of radiation field on the film and the filtration of the concerned devices based on the analyzable standards are implemented. Our finding reveals that six out of the nine devices have not the required standards for voltage accuracy and need mending. In addition, all the nine devices have defects concerning adaptation with optical field and radiation field and one of the devices has not also sufficient filtration. The quality control of the utilized radiological devices should be performed periodically and regularly and the defects of the devices should be removed in order to be assured of the appropriate function of the devices. Unfortunately, all the devices need mending because of lack of implementing the quality control program regularly, which indicates that the quality control programs should be extended regularly.

Keywords: X-ray, Radiology, quality control, patient dose, radiation protection, Sistan and Baluchestan.

Introduction

One of the beneficial applications of ionizing radiation is in medicine, but considering the protection principles is unavoidable which must be paid attention to the health physics managers and radiation workers in order the dose of the persons working with radiation and patient's dose to be decreased. One of the helpful factors to this issue is the quality control of the radiological devices regularly in order to the appropriate function of all the devices be assured. Performing the quality control programs regularly and removing the radiological devices defects lead to increasing the devices efficiency, increasing the devices longevity, enhancing the radiological image quality and decreasing the patient's dose (Mohammad Javad Keikhai *et al.*, 2011). Besides saving the costs it can provide the society's psychological security through enhancing the radiation hygiene. Not only must this quality control program hold the patient's dose down, but guarantee the suitable image quality. For this reason, the radiation security and the suitable image quality should be assured through quality control experiments while establishing the device and also regular supervision in throughput ongoing works (Darby, 1997). The quality assurance in diagnostic radiology means equipment function, including device characteristics and optimizing the parameters and protecting them (recommendations of the international commission on radiological protection, 1990).

Concerning the quality control of the diagnostic radiology, extensive studies have been implemented (Sohrabi, 1990; Stewart, 1992; Gari *et al.*, 1995). The analysis of the parameters related to quality control and making decision on these parameters cause the patient's doses decreased, which is one of the best ways for

decreasing exposure for being simple and economical (Ortiz *et al.*, 1995). (Godechal *et al.* (1995) performed quality assurance study for X-rays devices, a systematic measurement were implemented for considering the performance of the X-rays devices characteristics, in which the main weak points was related to insufficient filtration of the devices. Therefore, the quality control of the radiology devices have many significances because of more visitors to diagnostic radiology parts and using ionizing radiation in these parts, and the necessity for applying this quality control is significant in terms of decreasing the accumulate dose, decreasing economical costs and also decreasing the exposure of those who deal permanently with radiation and increasing the devices longevity.

Materials and methods

The protocol of "Navy Environmental Health Center Technical Manual NEHTM 6470/03" (Aug 2003) was used in this study for applying the quality control tests. In addition, the devices as DIAVOLT Universal and DIADOSE made in PTW company was used for applying the quality assurance program. DIAVOLT device is used for measuring the output voltage and radiation time, and the DIADOSE device is designed for measuring the outputs of the X-ray equipment in dentistry, mammography, fluoroscopy, radiography and CT. The device characteristics in each hospital are shown in Table 1. The performed quality control tests in this study and the objectives related to each tests are as follows:

Output repeatability test: This test is to make sure that the patient's exposure for a similar Kvp and mAs adjustment is the same as other exposure.

Time accuracy test: To make sure that X-ray generator provides the time at what has been set in control console.

Time repeatability test: To make sure that the X-ray generator provides the same exposure time output as other exposure in a similar time set.

Output linearity test with mA: To make sure that patient's exposure is identical in a similar Kvp and mAs time set regardless mA and the time used.

Voltage accuracy test: To make sure that X-ray generator provides that voltage which is regulated in control consol.

Voltage Repeatability Test: To make sure that X-ray generator provides an identical voltage in output from one exposure to another for a similar regulatory voltage.

Tube and collimator leakage test: To make sure that the radiation is has not been leaked.

Optical field and radiation field adaptation test: To make sure about X-rays field adaptation with optical field.

The test of radiation filed verticality on film: To make sure about the similarity of radiation intensity on the film.

Radiation quality measurement test: To make sure about inherent and additional filtration sufficiency for decreasing the patient's dose and increasing the image quality.

The experiments were performed for all the devices under consideration and the results were compared with the standard related to the NEHTM 6470/03 protocol.

Findings

The results of quality control show that the function of the X-ray equipment differed considerably among hospitals studied. Concerning the tests of output repeatability, time accuracy, time repeatability, output linearity with mA, voltage repeatability, tube and collimator leakage of all these devices under consideration have appropriate function, and this functions is in a standard range.

Concerning the adaptation of optical field with radiation field, all the devices were in unauthorized range and should be mended. Regarding the test of radiation field verticality on the film, all the devices were in standard range except Imam Khomeini hospital in Zabol. Concerning the test of radiation quality measurement, all the devices had sufficient filtration in standard range, except the Toshiba X-ray device of the Tamin Ejtemaie hospital in Zahedan which did not have enough filtration causing increased patient's dose.

Results and conclusion

The radiation of diagnostic radiology devices can have deleterious effects on the patients and the staff dealing with radiation, and if the protective principles and the issues related to quality control of the devices in these parts is not considered. On the other hand, if the quality control program was performed appropriately, valuable results would be achieved as decreasing the patient's exposure, preventing wasting the economic resources and increasing the devices longitude, as the reports indicate, in some studies performed, by applying the quality control program and doing necessary corrections, the patient's dose has significantly been decreased (30-40 %) (Gustafsson, 1983; Mustafa, 1985). In addition, a previous study (Sohrabi, 1990) in Iranian context indicates the significance of applying the quality control program in decreasing the society's exposure,

Table 1. X-ray device characteristics in each hospital under consideration

Hospital name	Make	maximum of Kvp	maximum of mA	Total filtration (mmAl)
Aliebhabitaleb of zahedan	varian	125	800	0.7
Boali of zahedan	shimadzu	150	1000	1
Nabiakram of zahedan	shimadzu	150	500	1.5
Taminejtemai of zahedan	toshiba	150	640	0.7
Amiralmomenin of zabol	varian	150	600	0.7
Imamkhomeyni of zabol	shimadzu	150	1000	1
Khatam of iranshahr	Shimadzu	150	500	1.5
Iran of iranshahr	varian	150	600	0.7
Imamali of chabahar	varian	150	600	0.7

and quality control is considered as one of the best ways in decreasing the patient's exposure and staff of radiology.

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