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Brief Communication

Radiation exposure from diagnostic radiography: an assessment of X-ray beam collimation practice in some Nigerian Hospitals

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ABSTRACT: This study was carried out to evaluate the X-ray beam collimation practice, among radiographers, as a measure of radiation protection for patients undergoing radiodiagnostic investigations. Inadequate X-ray beam collimation practice was observed in all the hospitals studied. Light beam misalignment/malfunction, pressure of work and years of experience were identified as major contributory factors. There is therefore need for proper equipment maintenance, employment of adequate number of radiographers and periodic audit of work pattern and output to minimize radiation exposure to the population.

KEY WORDS: Radiation exposure; Diagnostic radiography; Nigeria

INTRODUCTION

Radiation hazards were reported few months after the discovery of x-rays in 1895 by Wilhelm Conrad Roentgen. Ever since then efforts have been geared towards the reduction of patients and personnel radiation exposure. While the amount of radiation exposure to the personnel has decreased drastically in the last two decades[1] the amount of radiation exposure to the patient in a given procedure has potentially increased[2]. With the introduction of ALARA principle (As low as reasonably achievable) each examination is expected to be optimized to obtain a quality diagnostic image while keeping the patient dose as low as possible[3]. The exposure of the human body to ionizing radiation (x-rays) results in local concentration of energy which may kill a cell directly or through the formation of free radicals. These free radicals are formed from the radiolysis of water which constitutes about 80% of human body. Somatic and genetic effects are the result of these processes of interaction of radiation with human body. Radiation protection is described as the activities directed towards minimizing radiation exposure of both patient and personnel during x-rays exposure[4]. Excessive beam size has been identified as the principal cause of unnecessary patient exposure in diagnostic radiology[5].

The introduction of computed radiography (CR) which is becoming widely available has grossly decreased repeat rates through post processing manipulation of either over exposed or under exposed images. The dark room processing faults are also completely eliminated, thus leaving out beam collimation and good technique as the major potential sources of patient's over exposure[6]. The aim of this study was to assess the level of radiation protection practices among radiographers using x-ray beam collimation as an assessment criterion.

METHODOLOGY

A total of 500 radiographs from five hospitals in South east Nigeria (3 Teaching and 2 specialist Hospitals) were evaluated. The evaluation was based on x-ray beam collimation observed on radiographs stored in the film library of the

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hospitals, questionnaires administered to radiographers and light beam misalignment test conducted on the x-ray machines. 100 radiographs selected by stratified random sampling were studied in each of the hospitals for presence of clear edges (silver lines) as evidence of collimation. Chest radiographs, abdominal and lumbo- sacral spines radiographs were chosen because of the proximity of these body parts to radio- sensitive organs in the body. Collimation was considered adequate if 3 or 4 side clear edges (silver lines) were noted on an appropriate film size. For cases done with large film sizes, the measurement included the appropriate film size area with 20% allowance.

Light beam misalignment test was conducted in the x-ray machines using 18x24cm cassette loaded with film. The cassette is placed on the x-ray couch and a narrow beam of light from the light beam diaphragm was centered on the middle of the cassette. A focus to film distance of 90cm was used for the entire study. Angle pins were placed on the four edges of the beam margin and a coin placed at the middle of the cassette. X-ray exposure was taken and the film processed manually, dried and necessary measurements taken. This procedure was carried out in all the centers studied.

Questionnaires were administered to all the radiographers working in the hospitals. The number of radiographers working in each hospital, years of experience and possible causes of inadequate beam collimation were derived from the questionnaires.

RESULTS

Assessment of collimation

Table 1 shows the number of radiographs evaluated from the two categories of hospitals. 52% of the radiographs evaluated in the teaching Hospitals showed inadequate beam collimation while 59% of the radiographs evaluated in the specialist Hospitals showed inadequate collimation. **Table 2** shows the x-ray beam collimation for different parts of the body. Lumbosacral x-rays showed the highest percentage of poor beam collimation (55.6%).

X-ray beam misalignment test

This was carried out on the functional x-ray machines at the time of the study. A total of six x-ray machines (5 static and 1 mobile units) were evaluated for x-ray beam alignment with the light beam diaphragm. Four static x-ray machines showed positive misalignment, which ranged from mild to marked while one static and mobile unit showed normal beam alignment with the light beam diaphragm.

Table 1: X-ray beam collimation practice

Hospital Category	No. of films examined	No. of cases done with correct film size	No. of films showing evidence of 3 or 4 sided coll.	No. of films with inadequate collimation
Teaching hospitals	300	182 (60.7%)	144 (48%)	156 (52%)
Specialist Hospital	200	109 (54.5%)	82 (41%)	118 (59%)

Table 2: X-ray beam collimation for different body regions

	Total	Adequate	Poor	% poor
Chest	213	97	116	54.5
Abdomen	143	65	78	54.6
Lumbosacral	144	64	80	55.6

DISCUSSION

This study revealed poor x-ray beam collimation practice among radiographers in the hospitals studied with 52% inadequate collimation in Teaching Hospitals and 59% in specialist Hospitals. The study also revealed lumbosacral x-ray as the greatest contributor to patient over exposure in diagnostic radiography. This is similar to the findings by Agwu[8] in which thoracolumbar spine showed highest number of inadequately collimated films. The study showed that an average of four registered radiographers was working in each of the hospitals with years of experience ranging between seven and thirty. This number of radiographers is inadequate when radiation protection concern and excessive workload are considered. Intern radiographers were allowed to work unsupervised and quality assurance tests had

not been carried out in any of the hospitals in the past five years.

CONCLUSION

Newer x-ray units have inbuilt mechanisms to automatically adjust the field size to the cassette size but they do not necessarily produce the optimum field size for the anatomy being radiographed[9]. It is our opinion that radiographers should be strict in the application of collimation to reduce population exposure to x-rays to minimum. Intern radiographers should not be left to conduct all categories of investigations alone. Every hospital administrator should ensure optimal functioning of radiographic equipment and adequate manpower for the overall benefit of the patient.

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