

Preliminary study on the practice of gonad shielding during pelvic radiography

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Abstract

Objective: To investigate the practice and attitudes of Medical radiologic technologists (MRTs)/radiographers on the use of Gonad shielding (GS) in pediatric radiological imaging.

Methods: A questionnaire regarding MRTs' attitudes and on the use of Gonad shielding was developed based on relevant literatures and distributed to MRTs/radiographers working in general radiography at Black Lion and St. Paul hospitals in a study period from June to August 2014. Descriptive (percentage of frequency) study was used to analyze the responses of the multiple choices. A separate questionnaire was prepared to evaluate the practice of GS in these two hospitals.

Results: The radiographers had shown a positive attitude towards using GS, however none of them used it in daily practice for a various reason such as (GS may obscure region of interest 11.1%, uncooperative patient 16.7%, too busy 13.9%, GS not available 27.8% and no appropriate size GS 27.8%). The investigators had also reviewed 94 abdominal-pelvic radiographs and none was taken with application of GS.

Conclusion: Although the radiographers had a positive attitude, none of them had applied GS while taking plain radiographs and/or CT scan in and around the gonads. Updates on their knowledge on gonadal shielding and enforcing every medical imaging technologist to comply with hospital protocols are recommended.

Introduction

In medical practice, radiation is used extensively for purpose of diagnosis and treatment. Most of the ionizing radiation from medical procedures originates either from x-rays (including computed tomography (CT) and fluoroscopy) or radioactive tracers.

Protective safeguarding of radiosensitive organs like gonads, thyroid during medical imaging has gained ground mainly based on extrapolation of existing data from Japanese survivors of atomic bombings that took place in 1945 [1,2]. The analysis showed direct relationship between the dose and risk of developing any solid cancer. Patient radio sensitivity was heavily dependent on age at the time of exposure, with children at greater risk of developing future radiation-induced cancer than adults [3].

In order to ensure that the patient receives the lowest possible radiation dose during the diagnostic imaging; adjusting the parameters like; the use of correct collimation of the primary beam, selection of appropriate exposure factors and correct radiographic positioning are essential [4]. In addition, protecting the gonads of children is of particular importance during diagnostic imaging of the pelvis lower abdomen or proximal femur, since evidence suggests that X-rays could cause direct damage to the gonad which could result in mutation [5]. Using gonad shielding during diagnostic X-ray procedures is: an effective way of reducing the risk of genetic effects in future generations [6], may be quite effective to lower the dose to the tests (95%) than females (50%) ovaries [7,8]. In clinical practice, omission of gonadal shielding is not rare [9-12]. Inadequate shielding and or omission of gonad shielding may increase the radiation dose of the

gonads which leads to harmful effects..Omission and/ or inadequate shielding can be caused by lack of skill and the attitudes of medical radiologic technologist/radiographers towards gonad shielding. The use of gonad shielding relies on the attitudes of medical imaging technologists (MRTs)/radiographers to steadily follow to professional conduct requirements [13-16]. In a retrospective study done on pelvic radiographs it was found that only 23 % of radiographs (out of 355 radiographs) had been performed correct gonad shielding. In the other 67% of radiographs gonad shielding were not used at all. In the remaining 10% gonad shielding, the shield was applied incorrectly [17]. In the same research from all patients having x-ray examination 45% of them were exposed twice, to unnecessary radiation [17]. In another retrospective study which considers 1,047 radiographs of 111 children under the age of 16 years, the gonadal shields successfully protected the gonads in 466 (49.2 %) radiographs, while 270 (28.5%) of radiographers were completely omitted. The remaining 212(22.3%) of radiographs the gonad shielding did not protect the gonads exposing them to unnecessary radiation [18]. In a similar study done by Kenny N, Hill J [19] shows Gonad shields had been completely omitted in 137 (40%) antero-posterior pelvic radiographs performed on the 32 patients at the time of completion of the study. In 100 radiographs

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(29%) the gonad shields were adequately protecting the gonads, but in 109 radiographs (31%) the gonad shields were not protecting the gonads due to incorrect positioning of the shield [19]. The incorrect positioning of the gonad shields was more commonly found in girls than boys (64 vs 45; p less than 0.012), presumably because of the difficulty in determining gonadal position in relation to surface landmarks [19].

Different studies confirm that pelvic radiography of children was commonly performed during x-ray examination. Below the reproductive ages, the gonads were highly sensitive to the effects of radiation. Incorrect or absence of gonad shielding may lead to mutation or direct gonadal damage [16]. Gonad shielding in radiology has become common practice and is recommended by national and international bodies during plain film radiography and/or CT of the abdomen, pelvis, lower spine or proximal femora, from the primary radiation beam when it does not interfere with obtaining the required diagnostic information. In Ethiopia, gonad shielding may not be applied in diagnostic radiology department, for the following reason: the nature of the examination, the awareness of patients about the advantages of gonad shielding; the devotion of radiographer to apply the gonad shielding to a patient who will be examined and the absence of gonad shielding material. Even if applied the positioning of gonad shields in children's pelvic X-rays may be less than inadequate, allowing for increased gonad exposure to radiation, covering areas of interest [20]. So, this study is intended to assess the practice of gonad shielding during pelvic radiography in two large public general hospitals in the capital city of Ethiopia, Addis Ababa. The study also tried to investigate the attitude of medical radiologic technologists/radiographers towards application of gonad shielding of pediatric patients during radiographic examination

Materials and methods

The aim of this work is to investigate the application of gonadal shielding of pediatric patients under 15 years of age undergoing diagnostic X-ray examinations and to evaluate knowledge and practice of gonad shielding of technologists/Radiographers towards gonad shielding. The study utilized a cross-sectional study design. The study was done in two large public general hospitals located in Addis Ababa. These two hospitals were chosen because in addition to well experienced staffs and well-established x-ray departments most pediatric patients are served here as compared to other public hospitals in the city. All 94 pediatric patients radiograph who visited both hospitals' x-ray departments to seek pelvic x-ray and/or abdomen-pelvic CT during the study period of three month (from June 1 to August 30, 2014) were included in the research by convenience. 55 (58.5%) radiographs were from Black Lion and the rest 39(41.5%) were from Saint Paulo's Hospitals. All X-rays were reviewed by a single person for consistency. All 36 medical imaging technologists/Radiographer's working in these two hospitals were the study population

Data collection was done with the cooperation of departmental staff, which included radiographers, medical radiologic technologists and darkroom technicians. Data collection was accomplished using self-administered questionnaires designed to obtain relevant socio demographic characteristics such as age, level of education, work experience. Daily recordings were compiled by frontline senior radiologists and or residents in the reporting room to assess the application of gonadal shielding in all pediatric X-ray examinations. Information sheets explaining about the objectives of the study and the benefits of the research findings to patients undergoing radiologic

investigation in particular was provided to each study subject before submitting the questionnaire. A brief consent form was also submitted to the study participants and those who consented were provided the self-administered questionnaires.

The collected data was anonymous and the investigators did not provide information to the third parties. The collected data cleaned, coded and entered using SPSS version 20 statistical software package and analyzed.

Result

A total of 36 medical radiologic technologists (MRT)/radiographers were involved in this study. The demographic characteristics of respondents who completed questionnaires are given in Table 1.

The mean age of the respondents was 32 +/- 10.4 years (range 20 to 60 years) where 25 of them were female and 11 males. About 80.6% (29 of 36) of them are MRT (4years education) while 19.4% (7 of 36) were radiographer (2year education). The mean years of professional experience was 9.4 years with maximum years of above 20 and minimum years of 1 year (Table 1).

As shown in Table 2, out of 36 employees; 25 were working at plain radiograph, 7 at procedure unit and 4 at CT scan unit. 72.2% (26 of 36) of them responded Gonadal shield was available in their unit (16 plain radiographs, 7 at procedure and 3 at CT unit) while the remaining 27.8% (10 of 36) of respondent were not aware of the existence of GS at their unit. As shown in Table 3, although 100% (36 of 36) of MRTs/radiographers agreed on the protective value of GS, none of them were used it for different reason (Table 4). The investigators had reviewed observations on total of 94 pelvic, lower abdomen and lumbosacral radiographs (55 at Saint Paul and 39 at BLH) and found out none of the image were taken with application of GS.

Discussion

For about five decades, medical radiologic technologists/radiographers worldwide have been taking in the radiography of the pelvis and abdomen. As a result, children may receive several radiographic examinations with unavoidable extra radiation to their gonads from poor positioning and/or complete omission of GS.

Table 1. Demographic characteristics of the respondents

Characteristic	Total population (n=36)		
		Range (20-60yr)	%
Age			
Sex	Male	25	69.4
	Female	11	30.6
Level of education	Diploma	7	19.5
	Degree	29	80.5
Professional year of experience	1-4	17	47.2
	5-9	7	19.4
	10-14	3	8.3
	15-19	6	16.7
	>20	3	8.3

Table 2. Availability of gonad shielding at the working unit

Working unit	Total	Availability of gonad shielding			
		Yes	%	No	%
Plain radiograph	25	16	64%	9	36%
Procedure	7	7	100%	0	
CT unit	4	3	75%	1	25%
Total	36	26		10	

Table 3. Attitudes on the use of gonad shielding in general radiography

Question		Frequency
1. Likelihood of gonad shielding application for examination	A. Lower abdomen & pelvic	29 (80.5%)
	B. Chest radiograph	6 (16.6)
	C. Lower spine	21(58.3)
2. Self-perception	Importance of gonad shielding	36/36 (100%)
3. Gonad shielding protocol available in workplace	A. Yes	29 (80.6%)
	B. No	4 (11.1%)
	C. Unaware	3 (8.3)
4. Likelihood of not using gonad shielding when encountering:	A. May obscure region of interest	4 (11.1)
	B. Uncooperative patient	6 (16.7%)
	C. Too busy	5 (13.9%)
	D. Not available	10(27.8%)
	E. No appropriate size	11(30.6%)
5. Likelihood of shield availability affecting usage.	A. has protective value but not often apply it	26 (72.2%)
	B. not available	10 (27.8%)

Table 4. Review of radiographs at two hospitals

Hospital	Male	Female	No. of image taken	GS applied
BLH	21	34	55	0
St. Paul	18	21	39	0
Total	39	55	94	None

It appears that like some other researches [21-23] the effective use of shielding during examinations of the hip and pelvis in these two hospitals is inadequate. Our result indicated that 100% of children in two hospitals (Table 4) had radiographs taken with no application of protective GS.

The findings presented in Table 3 demonstrate that MRTs/radiographers possess appropriate knowledge towards the use of gonad shielding in general radiography. Nearly all MRTs/radiographers (80.6%, 29/36) were aware of the issue of gonad shielding protocol existence. They all perceived gonad shielding as an important issue overall. Nonetheless, the reasons suggested by the respondents for not using the shielding was not in accordance with the guidelines of ICRP publication 34 [6]. The availability of gonad shielding (Table 2) in their respective departments rarely affects the radiographer's intentions to use it (with 72.2% thought GS had protective value but did not apply it) (Table 3). Only 11.1% (10/36) of the radiographers/ medical radiologic technologists were not aware of the availability of gonad shielding in their respective exposure room.

Although the attitude and knowledge of radiographer were good, none of them had applied GS during their practice (Table 4). It was found that level of education and years of professional experience had no significant impact on the application of GS in their day to day practice. (Table 1).

It was well known that the risks of exposure of radiation are greatest with young patients. The highest late effects of exposure to low level of radiation are an increased incidence of cancer in exposed individual. The risk increases in children with number of radiographers performed over life time of individual. NRPB guidance [24] about gonad protection should be implemented in all radiological procedures. This is important in pediatric patients in which they are directly exposed to radiation during the course of pelvic examination.

MRTs/radiographers should all take responsibility for protecting pediatric patients. Proper and regular instructions should be issued to

them, to ensure correct use of gonadal shielding. Because of resource limitation the current research focuses only in two Hospitals. Further studies should focus on the reason for the non-compliance of the use of gonadal shields. A truly national audit would be needed to confirm our suspicion that this is indeed a problem across in Ethiopia.

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