

Gonad Shielding for Patients Undergoing Conventional Radiological Examinations: Is There Cause for Concern?

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Abstract

Background: Gonad shielding is one of the fundamental methods by which to protect reproductive organs in patients undergoing conventional radiological examinations. A lack of or inadequate shielding of the gonads may increase the exposure of these organs and result in malignancies future generations.

Objectives: The aim of this study is to investigate the prevalence of gonad shielding in patients undergoing conventional radiological examinations and the availability of gonad shields and gonad shielding protocols in radiology departments.

Materials and Methods: A retrospective, observational cross-sectional study on the application of gonad shielding, the availability of gonad shields and the existence of gonad shielding protocols in radiology departments was performed in five different hospitals in Ahvaz, Iran.

Results: The highest application of gonad shielding was 6.6% for the pediatric hospital. The prevalence of gonad shielding was less than 0.2%. In 64.3% of the radiography rooms, at least one flat-contact gonad shield of a large size was available. Only large-sized gonad shields were available. Curved-contact and shadow gonad shields did not exist. Gonad shielding protocols were not existence in any of the fourteen radiography rooms investigated.

Conclusions: Comprehensive protection programs with on-the-job training courses for staff members are strongly recommended, as well as, the provision of radiological shields and gonad shielding protocols in radiology departments to reduce the patient's radiation dose during radiological examinations.

Keywords: Gonad Shielding, Radiation Risk, Radiation Protection, Radiology

1. Background

While more than 10 million diagnostic radiology procedures are being conducted every day around the world, the use of ionizing radiation for the imaging of patients is steadily increasing (1). The associated risks following the exposure of such a large population due to the stochastic and non-stochastic effects of ionization radiation created a global concern (2). According to ALARA (as low as reasonable achievable) recommendations, no dose of radiation is safe (3). The gonads in the pelvic region are highly sensitive to radiation (with a tissue weighting factor of 0.08), which indicates the high potential for hereditary and malignant damage resulting from radiation exposure (4). Furthermore, mutation as a direct effect of radiation could be induced in the gonad (3). Shielding is one of the fundamental methods by which to protect radiosensitive organs such as the gonads (5). Various studies have been carried out to evaluate gonad shielding during radiological examinations using pelvic radiographs (3, 4, 6), question-

naires (7) and direct observation (8). Gonadal shields are divided into contact and shadow shields. Contact shields (applied to the patient's gonads) are more interesting compared to shadow shields (which are adjusted on the tube) due to a greater reduction in the gonad dose (9-11). Various designs of gonad shields are available, depending on the patient's age and gender. Gonad shielding should always be performed if the gonads are within or near the primary beam (5 cm), unless the presence of the shield disturbs important anatomical data (6, 10, 11). Proper gonad shielding can reduce the dose to the testes and the ovaries by about 95% and 50%, respectively (6, 11). A lack of or inadequate shielding of the gonads may increase the exposure of these organs and result in both genetic and hereditary effects in future generations (12, 13).

2. Objectives

The aim of this study is to investigate the prevalence of gonad shielding in patients undergoing conventional radi-

ological examinations and the availability of gonad shields and departmental gonad shielding protocols, as recommended by the International Atomic Energy Agency (IAEA), in radiology department in Ahvaz, Iran.

3. Materials and Methods

A retrospective, observational cross-sectional study was performed on five different hospitals in Ahvaz city, which included fourteen radiography rooms, from April 2014 to August 2014. Ten radiologic technologist students (in their fourth year) were invited and agreed to participate in this audit. After training, the students were sent to radiology departments. The students were asked to attend as an observer in the control room and record gonad shielding in patients undergoing conventional radiological examinations in which gonads were directly or indirectly exposed during two work shifts (from 8 am to 20 pm). Privacy was respected in the study. The head of each department was interviewed to evaluate the existence and subsequent detail of written gonad shielding guidelines. Following this, all radiography rooms were investigated to determine the availability of various types and sizes of gonad shields. The number, age and gender of patients were recorded in [Table 1](#). The collected data were analyzed, using the SPSS software (Version 20), through descriptive statistics.

4. Results

According to the results of this study, there was no statistically significant difference regarding gonad shielding between hospitals. However, the highest application of gonad shielding was 6.6% for hospital "H5", which is a children's hospital and has the lowest number of patients. As can be seen in [Table 1](#), the prevalence of gonad shielding was less than 0.2%. The availability of gonad shields in radiographic rooms varied between hospitals ([Table 2](#)). In 64.3% of the radiographic rooms, at least one flat-contact gonad shield of a large size was available. Only large-sized gonad shields were available, which cannot be applied in procedures in which gonads are directly exposed. Furthermore, curved-contact and shadow gonad shields did not exist. In addition, we found that departmental gonad shielding protocols were not in existence in any of the fourteen radiographic rooms investigated.

5. Discussion

The results of this study confirm data from previous studies ([4, 14](#)). However, they are in contrast with others

([12, 15](#)). Doolan et al. (2004) conducted a retrospective study on 198 pelvic radiographs and revealed that only 2% ($n = 4$) of images had evidence of gonad shielding. However, these shields were placed incorrectly or gonads were not sufficiently protected ([4](#)). Liakos et al. (2001) reported that only 1.6% of pelvic radiographs had the correct placement of gonad shields ([14](#)). The results of this study are worrying as the importance of gonad shielding has been well established in the literature ([4, 6, 11](#)). It seems that, in procedures in which gonads are exposed in the primary beam, it is difficult to correctly position the gonad shields so that gonads are completely obscured whilst not concealing important anatomical data ([4, 6, 7, 11](#)). MacKay et al. (2012) believed that "one of the main reasons for omission of the gonad shield is a lack confidence or skill in the gonad shield placement of radiographers and the attitude that gonad shielding is not applied to patients whilst not compromising the diagnostic quality of the image" ([7](#)). However, some studies suggested that gonad shields can be omitted in the first pelvic radiographs to prevent covering important anatomical data ([13](#)). Other studies suggested that the provision of gonad shielding guidelines in radiology departments could improve its application ([4, 7, 16-18](#)). However our results were based on direct observation in which gonads were directly and indirectly exposed. It seems that most internal and external radiology departments have the same situation concerning gonad shielding ([4, 14](#)) and it may be a nationwide and even international cause for concern. A comprehensive protection program with on-the-job training courses for staff members to reduce the patient's radiation dose is strongly recommended. The implementation of radiation protection courses and a higher level of inspection and supervision by the health care authorities as well as the provision of radiological shields and gonad shielding protocols in radiology departments could be effective methods by which to reduce the patient's radiation dose during radiological examinations. To improve the use of gonad shields, radiation protection courses should further emphasize the importance of gonad shielding and departmental gonad shielding protocols in radiology departments and encourage radiographers to dedicate time to gonad shielding. Gonad shielding should be performed whenever possible, especially for children and women of reproductive age, as they are more sensitive to radiation.

It is noted that not only should both radiographers and physicians reduce the number of unnecessarily prescribed radiographs, but radiographers should also be encouraged to apply shielding on the request sheet. More investigation is needed to ascertain the prevalence of gonad shielding in patients undergoing radiological examinations in Iran. These data could help to narrow the gap be-

Table 1. The Number, Age and Gender of Patients Undergoing Conventional Radiological Examinations

X-Ray Room	No. of Patients	Gender ^a		Age, y ^a						
		Male	Female	< 1	1-5	5-15	15-25	25-40	40-60	> 60
Hospital 1										
1	43	21	22	0	2	5	13	19	4	0
2	22	10	12	0	1	3	6	7	3	2
3	35	27	8	0	3	7	9	8	5	3
4	27	16	11	1	0	4	3	6	9	4
5	5	4	1	0	0	0	1	1	1	2
Hospital 2										
1	30	22	8	0	1	0	6	9	13	5
2	25	18	7	0	1	4	2	6	7	5
3	13	5	8	1	1	4	1	4	2	0
4	10	4	6	1	0	1	1	2	2	3
Hospital 3										
1	25	16	9	1	1	3	5	4	5	6
2	31	23	8	0	2	4	5	5	8	7
Hospital 4										
1	22	17	5	1	2	4	3	4	6	2
Hospital 5										
1	15	9	6	5	7	2	0	1	0	0

^aValues are presented as No.**Table 2.** The Frequency of Gonad Shielding, Available Gonad Shields and Departmental Gonad Shielding Protocols in Radiology Departments

X-Ray Room	No. of Patients Undergoing Radiological Examinations	No. of Projections in Which Gonads Were Directly or Indirectly Exposed	No. of Patients Shielded	No. of Available Gonad Shields in Departments	No. of Available Written Protocols
Hospital 1					
1	43	32	0	1	0
2	22	14	0	0	0
3	35	21	0	0	0
4	27	20	1	1	0
5	5	4	0	0	0
Hospital 2					
1	30	28	0	2	0
2	25	14	1	1	0
3	13	9	0	1	0
4	10	6	0	2	0
Hospital 3					
1	25	18	0	2	0
2	31	12	0	0	0
Hospital 4					
1	22	18	1	2	0
Hospital 5					
1	15	17	1	2	0

tween the interest in gonad shielding and the implementation of effective gonad shielding programs.

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