



Evaluation of the frequency and accuracy of gonad shield placement in patients undergoing pelvic radiography

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ABSTRACT

Gonad shielding has been advocated to reduce radiation exposure in patients undergoing pelvic radiography. The aim of this study is to evaluate the frequency and accuracy of gonad shield placement in patients undergoing pelvic radiography. A retrospective study was performed on 1230 anteroposterior (AP) pelvic radiographs of 939 children under 16 years old. All the radiographs were reviewed to determine the frequency of gonad shielding and to evaluate whether gonad shields were correctly positioned when they are used. The gonad shield was present in 82 radiographs (30 girls and 52 boys) and was completely disregarded in 1148 radiographs. Of 82 images which shield was present, the gonad shields adequately positioned in 28 radiographs (3 girls and 25 boys) and in the remaining 54 radiographs, the shield did not adequately protected the gonads due to incorrect placement of the shield. The inaccuracy placement and absence of gonad shields were more common in girls than boys (P-value < 0.05). More care should be taken to correctly positioning of the gonad shields in boys and its usage should be encouraged. However, the practice of ovarian shielding is not an effective way to reduce radiation exposure in girls undergoing pelvis radiography.

Keywords: Gonad shielding, pelvic radiography, Radiation exposure.

1. INTRODUCTION

The international commission of radiological protection (ICRP) recommended that the gonads are highly sensitive to radiation due to the potential hereditary damage and malignant changes associated with ionizing radiation ⁽¹⁾. Evidences suggested that x-rays have direct effects on the gonads in both somatic and genetic forms ^(2, 3). As known there is no minimum threshold of radiation dose below which is safe ⁽⁴⁾, therefore it is essential that the dose is kept as low as reasonably achievable (ALARA).

Gonad shielding has been advocated for patients undergoing pelvic radiography especially in children due to gonad cells sensitivity to ionizing radiation ^(3, 5-7). Accordingly the effectiveness of gonad shielding has been well established ^(5, 6, 8). Gonad shielding decrease the radiation dose to the testis and ovaries about 14 and 7 folds, respectively ⁽⁹⁾. Absence or inadequate gonad shielding, increases the exposure of these organs followed by an incensement of malignancy and genetic effects risk in future generations ^(6, 10). The gonad shield would be perfect only when completely covered the gonads without interfering diagnostically information ⁽¹¹⁾. Previous international studies indicated that the practice of gonad shielding is poor or completely ignored during pelvic radiography. Even when it was used, frequently was positioned incorrectly and non-optimally, so that provides little or no protection to the gonads ^(5, 12).

The aim of this study is to determine the frequency and accuracy of gonad shield placement in children undergoing pelvic radiography in six different hospitals at Khuzestan-Iran province.

2. MATERIAL AND METHODS

After preliminary coordination, we searched the archived images from the digital radiography systems in six general hospitals of Khuzestan-Iran province to identify patients under 16 years old who underwent pelvic radiography during past two month (from 1 March 2015 to 1 June 2015). All radiographs were reviewed to determine the accuracy of gonad shield placement as

well as the number of radiographs was shielded. The presence or absence of gonad shields in all pelvic radiographs was recorded. If the shields were present, accuracy of gonad shields placement also was investigated. To decrease bias, all radiographs were evaluated by a single assistant radiologist. The criteria for adequately shielding were based on available standard protocols^(2, 6, 13). According to the protocols, the shields should be placed above the pubic symphysis as completely covered true pelvic in females and below the pubic arch, directly over the testicles, in males⁽²⁾.

2.1. Statistics:

T- test was used to assess significant difference between the groups of subjects in term of employing and accuracy positioning of the gonad shields. SPSS version 15 was used as statistical tools (IBM Corporation, New York, United States of America). P-value less than 0.05 were considered statistically significant.

3. RESULTS

In general 1230 anteroposterior (AP) pelvic radiographs of 939 patients (411 boys and 528 girls) were identified. The gonad shield was present in only 82 radiographs (30 girls and 52 boys) and was completely ignored in 1148 radiographs (Table 1). From 82 images which gonad shields were present, the gonad shields were adequately positioned in 28 radiographs (3 girls and 25 boys) and in the remaining 54 radiographs, the shield did not adequately protected the gonads due to incorrect positioning of the shield. There was significant statistically differences in both the frequency and accuracy of gonad shield placement between boys and girls (P-value < 0.05). Presence of gonad shields was more commonly in boys than girls (52 vs. 30; P-value = 0; Z = 4). Accuracy of gonad shield placement was also more commonly in boys than girls (25 vs. 3; P-value = 0; Z = 4.9).

Table 1: The frequency and accuracy of gonad shield placement in six hospitals evaluated

Gonad shields	Boys	Girls	Total
No of patients	411	528	939
No of pelvic radiographs	505	725	1230
No of radiographs with shield	52*	30*	82
No of radiographs with adequately shielding	28**	3**	31
* P-value < 0.05		** P-value < 0.05	

4. DISCUSSION

This study evaluated the frequency and adequacy of gonad shielding in 1230 AP pelvis radiographs. Comparing the results of this study with other study showed that the findings of this study are resemble to the findings of Doolan et al (2004) ⁽⁵⁾ who conducted a retrospective study on 198 pelvic radiographs and revealed that only 2 % (n = 4) of images had evidence of gonad shielding. Liakos et al (2001) ⁽¹²⁾ reported that only 1.6 % of pelvic radiographs had correctly placement of the gonad shields.

According to the results of this study, gonad shields were rarely used in clinical practice, especially in girls. Also inadequately gonad shield placement was more commonly in girls than boys (25 vs. 3). Although the radiation dose associated with a single pelvic examination is relatively low ^(5, 10), but radiation induce malignancy should not be ignore due to its wide frequency ⁽⁷⁾. Our results confirm the data from the previous studies ^(5, 12), but are in contrast with others ⁽¹¹⁾. It seems that during pelvic radiography, it is difficult task to optimally positioning of the gonad shields without concealing of diagnostically information ⁽⁸⁾. However, the design of gonadal shields has also been challenged by some researchers ⁽¹⁴⁾.

The current practice of gonad shielding is placement of a lead shield in the midline of the pelvis, lower than pubic symphysis to the testis and on the true pelvis to the ovaries ^(15, 16). The exteriorize location of the testis makes it possible to correctly positioning of the shield. In contrast, the ovaries due to locating in the abdominal cavity are not easily located using external landmarks

and can also obscure diagnostically information on the radiograph ⁽¹²⁾. Also it has been identified that the ovaries have a misleading anatomy with large spread positions in the pelvic ^(9, 15, 17). A study by Bardo et al (2009) ⁽¹⁷⁾ revealed that the ovaries are located far from the midline and almost always positioned laterally in the pelvis; hence to complete ovarian protection, the entire pelvis must be shielded and it is an impractical because nearly all relevant pelvic anatomy will be obscured. Our result showed that the boys' radiographs had a correctly positioning of the shield in 48 % (n=25), when shield was present. This result is in contrast with Gursu et al (2012) ⁽¹⁴⁾ which male radiographs had inaccuracy shield placement in 93.5 % of cases. Our study also showed that 90 % (n=27) of the girls' radiographs had an incorrectly placement when shield were employed. This result is in good agreement with ones reported by Frantzen et al (2012) ⁽⁸⁾, Liakos et al (2001) ⁽¹²⁾ and Doolan et al (2004) ⁽⁵⁾ in which the girl's radiographs had incorrectly positioning of the shield in 91 %, 98.4 % and 100 %, respectively.

According to results of this study, gonad shields were frequently incorrectly placed in girls with little or no protection to the ovaries. Inadequate positioning of the shield may obscure anatomy of interest and result increase radiation exposure to the patients followed by repeat of the examination. The practice of the gonad shielding during pelvis radiography in boy subjects depends on the skill of radiographers in adequacy gonad shield placement that could be potentially improved by the practical training. These results are commensurate with previous literatures ^(3, 8, 12, 18).

5. CONCLUSIONS

The inaccuracy placement and absence of gonad shields are frequently occurred in pelvis radiography and are more common in girls than boys. More care should be taken to correctly placement of the gonad shields in boys and its usage should be improved by practical training. However, the practice of ovarian shielding is not an effective way to reduce radiation exposure in girls undergoing pelvis radiography.

REFERENCES

1. Recommendations of the International Commission on Radiological Protection. ICRP publication 103. Ann ICRP 2007;37(2-4.)
2. Sikand M, Stinchcombe S, Livesley P. Study on the use of gonadal protection shields during paediatric pelvic X-rays. Annals of the Royal College of Surgeons of England. 2003;85(6):422–5.
3. Warlow T, Walker-Birch P, Cosson P. Gonad shielding in paediatric pelvic radiography: Effectiveness and practice. Radiography. 2014;20(3):178-82.
4. Dowd SB, Tilson ER. Practical radiation protection and applied radiobiology. 2nd ed. Philadelphia, PA: Saunders: WB Saunders; 1999.
5. Doolan A, Brennan PC, Rainford LA, Healy J. Gonad protection for the antero-posterior projection of the pelvis in diagnostic radiography in Dublin hospitals. Radiography. 2004;10(1):15-21.
6. Gul A, Zafar M, Maffulli N. Gonadal shields in pelvic radiographs in pediatric patients. Bulletin-hospital for joint diseases New York. 2005;63(1/2):13-4.
7. MacKay M, Hancy C, Crowe A, D'Rozario R, Ng C. Attitudes of medical imaging technologists on use of gonad shielding in general radiography. The Radiographer. 2012;59(2):35-9.
8. Frantzen MJ, Robben S, Postma AA, Zoetelief J, Wildberger JE, Kemerink GJ. Gonad shielding in paediatric pelvic radiography: disadvantages prevail over benefit. Insights into imaging. 2012;3(1):23-32.

9. Goodman TR, Amurao M. Medical imaging radiation safety for the female patient: rationale and implementation. *Radiographics*. 2012;32(6):1829-37.
10. Kenny N, Hill J. Gonad protection in young orthopaedic patients. *BMJ*. 1992;304(6839):1411-3.
11. Silva C, Silva P, Ventura SMR. The use and relevance of gonad protection shields in children during hips radiography. 2010:1-8.
12. Liakos P, Schoenecker PL, Lyons D, Gordon JE. Evaluation of the efficacy of pelvic shielding in preadolescent girls. *Journal of Pediatric Orthopaedics*. 2001;21(4):433-5.
13. Wainwright A. Shielding reproductive organs of orthopaedic patients during pelvic radiography. *Annals of the Royal College of Surgeons of England*. 2000;82(5):318-21.
14. Gürsu S, Gürsu T, Camurcu Y, Yıldırım T, Gürsu A, Şahin V. [Efficacy of gonadal shielding in pediatric pelvis X-rays]. *Eklem hastalıkları ve cerrahisi= Joint diseases & related surgery*. 2012;24(2):87-90.
15. Fawcett S, Gomez A, Barter S, Ditchfield M, Set P. More harm than good? The anatomy of misguided shielding of the ovaries. *The British Journal of Radiology*. 2014;85(2012):442-7.
16. Fawcett SL, Barter SJ. The use of gonad shielding in paediatric hip and pelvis radiographs. *The British Journal of Radiology*. 2009;82(977):363-70.
17. Bardo DM, Black M, Schenk K, Zaritzky MF. Location of the ovaries in girls from newborn to 18 years of age: reconsidering ovarian shielding. *Pediatric radiology*. 2009;39(3):253-9.

18. McCarty M, Waugh R, McCallum H, Montgomery RJ, Aszkenasy OM. Paediatric pelvic imaging: improvement in gonad shield placement by multidisciplinary audit. *Pediatric radiology*. 2001;31(9):646-9.