Gonadal Shields in Pelvic Radiographs in Pediatric Patients

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Abstract

We performed a retrospective study of pelvic radiographs of children between August 2003 and January 2004 to determine whether gonadal shields effectively protected the gonads during pelvic radiographs in pediatric patients. We considered 1,047 radiographs of 111 children under the age of 16 years who were examined by the orthopaedic department at the University Hospital of North Staffordshire. The presence and absence of gonadal shields in all the pelvic radiographs was recorded. If the shields were present, then whether the gonads were effectively protected was recorded. An average of 9.4 radiographs were taken per patient. The gonadal shields effectively protected the gonads in 466 (49.2%) radiographs and were completely omitted in 270 (28.5%) radiographs. In the remaining 212 (22.3%) radiographs, the shields did not adequately protect the gonads, which were therefore exposed to radiation in 482 (50.8%) of all the eligible pelvic radiographs. Children receive many radiographs with avoidable excess radiation from inadequate positioning or complete omission of gonadal shields. This may increase the potential for disease in the future offspring of these patients. Strict adherence to guidelines is required to decrease radiation exposure.

Radiography of the pelvis is commonly performed in children. The gonads are particularly sensitive to the effects of radiation, especially at or below reproductive age. Absence or incorrect placement of gonadal shields may cause direct gonadal damage and mutation. The guidelines in our hospital regarding pediatric pelvic radiography exclude the first pelvic radiograph of a trauma patient. Patients coming to the orthopaedic outpatient department for the first time have protection on the pelvic anteroposterior view only. The frog lateral view should be taken without gonadal protection. Full protection should be provided on all subsequent examinations. This study evaluated whether these guidelines were followed in our setting.

Patients and Methods

This study included complete sets of pelvic radiographs of children aged less than 16 years who had received at least one radiograph in the period from August 2003 to January 2004 at the University Hospital of North Staffordshire. The presence or absence of gonadal shields in all the pelvic radiographs was recorded. If the shields were present, whether the gonads were effectively protected was recorded.

The position of the gonads was considered to be within the scrotal sac below the pubic arch which is readily visible on a plain pelvic radiograph. The female gonads were considered to rest adjacent to ischial spines above the pubic arch, which is also readily visible on plain pelvic radiographs. The gonadal shield was considered to be inadequately positioned when these areas were not shielded.

Results

The 111 children (44 males and 67 females; average age: 8.8 years; range: 1 to 16 years) in the study had 1,047 radiographs taken. After excluding the first pelvic radiograph in trauma patients and the first frog lateral view of other patients (since guidelines allow these radiographs to be...
taken unshielded) 948 radiographs qualified for inclusion in the study. On average, 9.4 radiographs were taken per patient. Sixty-seven (60.36%) patients had more than five pelvic radiographs.

The gonadal shields effectively protected the gonads in 466 (49.2%) radiographs and were completely omitted in 270 (28.5%) radiographs. The gonadal shields in the remaining 212 (22.3%) did not adequately protect the gonads, which were therefore exposed to radiation in 482 (50.8%) of all the eligible pelvic radiographs.

**Discussion**

Children may receive many radiographs with avoidable excess radiation to the gonads resulting from the inadequate positioning or complete omission of gonadal shields. Our results are similar to the studies by Hill and colleagues and Sikand and associates. In both these studies, the gonadal shields were absent or inadequate in 70% of the pelvic radiographs. In the present investigation, the gonads were exposed to radiation in 50.8% of the eligible radiographs. We made no attempt to ascertain the actual radiation dose to the gonads; nor did we study whether these patients had additional radiological investigations such as computed tomography or fluoroscopy, as in the study by Sikand and associates. It is therefore possible that these children received even higher exposure to ionizing radiation.

Radiation is cumulative and the risks of radiation exposure are greatest in young patients. The main late effects of exposure to low levels of radiation are an increased incidence of cancer in the exposed individual and hereditary disease in exposed individual’s offspring. The probability of either of these effects occurring, and not their severity, depends on the radiation dose. The probability of fatal cancer being introduced to an individual from a series of radiographic examinations is very small. The lifetime risk of developing a fatal cancer from a single pelvic radiograph is estimated at 15 per million and at 55 per million in all age groups combined. The risk increases in children and with the number of radiographs performed over the lifetime of the individual. The National Radiological Protection Board (NRPB) guidance notes state that gonad protection should be implemented whenever possible, and ideally in all radiological procedures. This is most important in those patients directly exposed to radiation, such as during the course of pelvic radiography.

Our study shows that strict adherence to guidelines needs to be monitored to achieve the required level of protection from unnecessary radiation. Orthopaedic surgeons rely heavily on ionizing radiation for imaging purposes. They share a responsibility to reduce the radiation exposure to their patients by avoiding unnecessary radiographs and limiting the number of views requested. They should be aware of the need to keep the radiation exposure to their patients to a minimum and to utilize other methods of investigation where possible. Radiologists and radiographers should all take responsibility for protecting patients. Proper and regular instructions should be issued to radiographers to ensure correct positioning of gonadal shields and their use should be more rigidly enforced. Future studies should focus on the reasons for the non-compliance of the use of gonadal shields.

**References**