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A questionnaire study of radiography educator opinions about patient lead shielding during digital projection radiography

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ABSTRACT

Background: In projection radiography, lead rubber shielding has long been used to protect the gonads both within and outside the collimated field. However, the relative radio-sensitivity of the gonads is considered lower than previously, and doses from digital projection radiography are reported as being lower than in previous eras. These factors, along with technical difficulties encountered in placing lead shielding effectively, lead to varied opinions on the efficacy of such shielding in peer reviewed literature. This current study has investigated what is currently being taught as good practice concerning the use of lead shielding during projection radiography.

Method: An online questionnaire was distributed to a purposive sample of 44 radiography educators across 15 countries, with the aim of establishing radiography educators' opinions about patient lead shielding and its teaching.

Results: From the 27 responding educators, 57% (n = 15) teach students to apply gonadal shielding across a range of radiographic examinations; only 22% (n = 6) do the same for the breast, despite respondents being aware that the breast has higher relative radio-sensitivity than the gonads. Radiation protection was the primary reason given for using shielding. Students are generally expected to apply patient lead shielding during assessments, although a small number of respondents report that students must justify whether or not to apply lead shielding. Educators generally held the opinion that no matter what they are taught, students are influenced by what they see radiographers do in clinical practice.

Conclusions: The current study has not found consensus in literature or in radiography educators' opinions concerning the use of patient lead shielding. Findings suggest that a large scale empirical study to establish a specific evidence base for the appropriate use of lead shielding across a range of projection radiography examinations would be useful.

Introduction

In projection radiography, lead rubber aprons and shielding (all termed lead shielding in this paper) may be used both within and outside the collimated field for the purpose of patient radiation protection, and traditionally have most commonly been applied to protect the gonads.[1] However, peer reviewed, English language literature published between 1998 and 2017 reveals mixed opinions on the use of such lead shielding.

During pelvic radiography, lead shielding of the female[2] and male[3] gonads has been reported to both reduce radiation exposure of the gonads when used within the primary beam[2–4] and to provide patient reassurance.[2] However, several authors advise against shielding the ovaries during pelvis radiography because of the risk of retake due to inaccurate positioning, anatomical variance and the potential negative impact on AEC function.[1,3,5–7]

Shielding of both male and female gonads outside of the collimated beam is reported by several authors to convey dose savings during spine and chest radiography.[8–12] Dose reductions to the breast and ovaries are reported, particularly in scoliosis imaging of the spine in female patients, with dose reductions of 80% to breast tissue reported in some cases.[8,11,12] However, an empirical study suggests that the gonadal dose levels are so low anyway that lead shielding is not warranted.[13]

Several papers have a paediatric focus.[1,3,4,6,14] For example, neonatal gonadal shielding is advocated during portable abdomen examinations because these may be serial examinations.[4] In direct

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response to this paper, other author's question whether the very low doses justify using such lead shielding.[14,15] Similarly in pelvis radiography, shielding is not advocated to be used due to risk of retake of projections.[1,6]

An Australian paper[3] combines the findings of a literature review with empirical consideration of dose levels, and proposes that for a range of single examinations, gonad shielding both within and outside collimation is ineffective at reducing the risk of genetic effects because the doses in question are so small anyway.

This low consensus on the efficacy of gonad shielding exists in an era when the relative radio-sensitivity of the gonads is considered lower than previously. Relative radio-sensitivity is a concept implicit in tissue weighting factor (Wt): any factor greater than 0 indicates higher than average radio-sensitivity, and the weighting factors of all the body tissues add up to 1.[16] In 2007, the International Commission on Radiological Protection (ICRP) reduced the gonadal Wt from 0.2 to 0.08,[17] implying that the relative radio-sensitivity of the gonads is considered less than it was previously. The main reason for decrease in gonadal Wt is the "reduced significance" attached to genetic effects.[17] In the same guidelines, the ICRP state that the radio-sensitivity of the breast is higher than previously specified, with a Wt increasing from 0.05 to 0.12. The main reason for the increase in Wt for the breast is the "focus on cancer incidence in detriment calculations".[17]

The Wt of different tissues permits consideration of their contribution to effective dose, which is a single value figure determined by the risks of cancer, hereditary diseases or genetic mutations due to ionising radiation.[17] It is relevant to these changed ICRP weighting factors that two recent papers advocate application of lead shielding over the female breast during lumbar spine examination[11] and during spine imaging for scoliosis.[12]

This context of mixed opinion and changed advice on tissue radio-sensitivity engendered consideration of what actually is good practice in the application of lead shielding during projection radiography. Consideration of the ALARA principle may persuade some radiographers that lead shielding should be applied no matter how small the dose saving, because any dose reduction enhances optimisation. Conversely, other radiographers may have the opinion that the various reported risks of misplacement along with the low doses in projection radiography are sufficiently compelling to dispense with gonad shielding. Also, current tissue weighting factors may be a stimulus for radiographers to reconsider which organs should be shielded. The initial basis for good practice and application of the ALARA principle has to be what radiographers learn in their pre-registration education.[18] The current research therefore set out to establish what is being taught as good practice in the placement of patient lead shielding.

Methods

The proposed research was approved by the institutional Ethics Committee. This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

Questionnaire design

The authors conducted a literature review to establish published evidence concerning the use of lead shielding. This evidence, along with knowledge of local clinical practice, was considered in developing an online questionnaire using commercial software (Survey Monkey ®) to investigate opinions about lead shielding, what is taught about lead shielding, and what influences curriculum content. The questions required either categorical or Likert type responses, with open text options to permit further explanation or additional opinions to be given. The questionnaire was reviewed by an academic radiography colleague before being tested in a small pilot study.

A pilot study was conducted to gather feedback on any ambiguity or lack of clarity which could be addressed before the main study.[19] The pilot study also established how long the questionnaire took to complete, the potential response rate, and approximately how long it took for the questionnaire to be returned. The questionnaire was sent to two academic teaching centres with one academic and one clinical lecturer invited to participate from each: this constituted approximately 10% of the proposed sample.[20] Pilot study participants were requested to complete the questionnaire within two weeks. A response rate of 25% (one participant) was received. Reasons for the remaining three participants who did not respond were not given. The same approach for selection of participants for the pilot study questionnaire was adopted for the main study. Minor grammatical amendments were made, and a decision was taken to follow up with reminders in the main study to enhance the response rate.

Survey sample

The research was directed at establishing opinions from radiography educators in centres with a reasonably comparable standard of radiography education. An overall population was not established. Purposive sampling was followed to draw a sample of educators from third level institutions that have at least a three year programme encompassing some clinical placement, and where the educators speak sufficient English to be able to complete the questionnaire: these were the inclusion criteria. The indicative sample was found through a combination of internet browsing and institutional associations, and the research supervisor reviewed that the level of practice of radiography was similar though not identical across all. Arising from the search and supervisor guidance, 23 third level institutions in 11 different countries were identified: nine in the United Kingdom and Ireland; seven in other European countries; three in Australia/New Zealand and four in the United States/Canada. A lecturer in each institution with an accessible e-mail address was contacted and asked to forward the participant invitation to one academic lecturer and one lecturer teaching in clinical practice. The potential sample of 44 educators is presented as indicative only, and power sampling was not applied. Clearly there are limitations to the sampling process, however the findings represent an initial attempt to establish opinions on this topic across an international cohort of educators.

Survey distribution

For the main study an active link to the online questionnaire was e-mailed to participants in early December 2016. In order to promote response rate, a polite reminder was e-mailed two weeks later. The questionnaire did not deactivate for a further two weeks after this to allow for as many respondents to respond as possible.

Analysis

Descriptive statistics were applied to establish the frequency of specific opinions about the use of lead shielding. Likert scale responses were evaluated by establishing median Likert scores. Open text responses were subject to simple thematic analysis to establish more common opinions or practices, although these must be appreciated in the context of the relatively small number of responses.

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