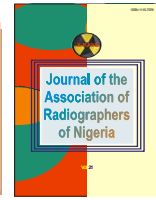




Contents lists available at

Journal of Association of Radiographers of Nigeria

Journal homepage: www.jarn-xray.org



An Analysis of repeated examinations in conventional film–screen radiography (FSR).

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ARTICLE INFO

Article history

Received 16th August, 2010

Received in revised form 22nd January, 2011

Accepted 6th February, 2011

Available online October 2011.

Keywords:

Analysis, conventional film-screen radiography, Repeat images.

Abstract

Background: X-ray is an ionising form of radiation used in conventional radiography and this can result in deleterious biological changes in the body if not regulated. Radiation safety is an important practice in a medical facility that utilizes radiation in any form for diagnosis, intervention or treatment. Repeat of non-diagnostic radiographs add to the radiation received by the patient and the personnel. The committee on quality assurance in diagnostic X-ray recommended a repeat rate of 5 – 7% or less.

Purpose: The purpose of this study was to determine image repeat rate and the causes of repeat in a University Teaching Hospital.

Materials and Methods: It was a prospective study involving all routine radiographic cases in department over a two month period during which 1251 examinations were carried out. Radiographs were assessed for diagnostic quality by Radiologists following the usual clinical protocols in radiology film review. The number of radiographs in each examination type which did not meet diagnostic criteria and therefore required repeat, were isolated and counted. Results are presented in simple percentages.

Results: The overall repeat rate was 8.6%. The highest repeat rate was observed in radiographs of the lumbosacral region (53.06%) and the lowest rate in the leg (2%). Under-exposure was the leading cause of repeat (41.67%), while film fog was the least cause (0.93%). Inappropriate selection of exposure factors and poor patient positioning by radiographers who are mainly interns (n=8) and junior radiographers (n=4) contributed most to the repeats. Patient faults or poor darkroom practice were the other reasons for repeats.

Conclusion: The rate of repeat is above the accepted limits recommended by the committee on quality assurance in diagnostic X-ray (5 – 7% or less). It has increased above the 4% previously obtained (1992 assessment). The rate can be reduced if the junior cadre radiographers are better supervised and a quality assurance program instituted.

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Introduction

Conventional radiographic examination represents the bulk of radiological requests sent to most radio-diagnostic units due to its diverse applications and been more readily available and cheap. However, it utilizes X-rays, an ionising radiation which can result in short or long term deleterious effects in patients and staffs of the department if used above the recommended dose. To prevent these harmful effects of X-rays, the three principles of radiation protection are observed: justification, optimization through the ALARA (As Low As Reasonably Achievable) concept and dose limit. To reduce or totally eliminate unnecessary exposures through repeat examinations, clinical governance through regular evaluation of the function of the different components of the X-ray system and appraisal of the performance of personnel involved in generating these radiographic images must be undertaken.

Repeat rate is the percentage of images that have been repeated due to errors or a poor image quality. An assessment of the rate of repeated images is a component of reject analysis which is an accepted standard of practice for quality assurance in conventional radiology ¹. The monitoring of repeats allow for the assessment of diagnostic image quality, modification of examination protocols, the need for in-service education and tracking of patient radiation exposures. For a diagnostic X-ray facility to produce consistently high quality images

with minimum exposure to the patients and personnel, a quality assurance program must be designed and implemented. Studies have shown a reduction in the rate of rejects following the introduction of a quality assurance program ².

The success of the program is dependent on the quality control of the different components of the X-ray system, which involve direct monitoring or testing and maintenance of the equipments and improving the skills of the personnel. The analysis of film reject should be carried out quarterly while the tracking the films should be ongoing ³. This can be done by the radiologist, the radiographer or the medical physicist with each involved at different levels.

The committee on quality assurance in the diagnostic X-ray recommend that facilities should strive for a repeat rate of no greater than 5 to 7% ³. There is no proper quality assurance program in our unit and the only analysis done in the past was of wasted X-ray films carried in 1992 ⁴. Presently the unit operates only a mobile X-ray machine and a manual processor. The hospital has just installed fixed conventional X-ray, fluoroscopy, mammography and computed tomography machines with automatic film processor. This study was carried out to serve as a baseline and to facilitate the establishment of a quality assurance program which will be modified and extended to the recently acquired machines. It is also expected that radiation exposure to patients and

personnel of the department will be reduced by reduction in the rate of repeats. Expenditure and work load will also be equally affected.

Materials and Methods

A prospective study over a two month period was carried out. All routine conventional radiographic examinations done in the department with the mobile X-ray machine were included in the study.

The wet radiographs were first assessed by the radiographer who conducted the radiographic examination. Later the coordinating radiographer (quality assurance officer) went through all the radiographs produced for the day to determine those that needed to be repeated and those adequate for being passed to the radiologist for interpretation.

Two radiologists working independently assessed the radiographs to confirm which was diagnostically inadequate and therefore required a repeat. Such confirmed radiographs were included in this study.

Rejected radiographs from this process, over the study period, were sorted into the different examinations, film faults and personnel responsible for the error leading to the reject. The results were expressed in percentages.

Results

Result data for all the routine examinations, the number of repeated images and the percentage of repeats during the study period are given in Table 1. A total of 1251 examinations were carried out, with chest X-rays being the highest (n=805) and mastoid the lowest (n=1). The highest rate of repeat was in lumbosacral examinations (53%) in which 26 out of the 49 examinations were repeated. The second and third high rates were in the skull (50%) and abdominal (25%) radiographs. The lowest rate of repeat was in radiographs of the leg (2.00%) with only 1 repeat out of 50 examinations. No repeat was observed in radiographs of the elbow, femur, hand, mastoid, post nasal space and radioulnar.

Table 1: Distribution of the rate of repeated examinations

| | Number of examinations | Number of repeated examinations | Percentage (%) of repeated examinations |
|---------------------|-------------------------------|--|--|
| Chest | 805 | 47 | 5.8 |
| Leg | 50 | 1 | 2.0 |
| Lumbosacral | 49 | 26 | 53.1 |
| Knee joint | 47 | 2 | 4.3 |
| Cervical spine | 45 | 1 | 2.2 |
| Post nasal space | 35 | 0 | 0.0 |
| Pelvic | 31 | 4 | 12.9 |
| Thoracolumbar spine | 22 | 5 | 22.7 |
| Femur | 21 | 3 | 14.3 |
| Elbow joint | 18 | 0 | 0.0 |
| Humerus | 17 | 1 | 5.9 |
| Hip joint | 16 | 1 | 16.7 |
| Abdominal | 16 | 4 | 25.0 |
| Skull | 12 | 6 | 50.0 |
| Shoulder joint | 11 | 2 | 18.2 |
| Hand | 11 | 0 | 0.0 |
| Paranasal sinuses | 10 | 2 | 20.0 |
| Foot | 10 | 1 | 10.0 |
| Mandible | 9 | 0 | 0.0 |
| Wrist joint | 7 | 1 | 14.3 |
| Ankle joint | 6 | 1 | 16.7 |
| Radioulnar | 2 | 0 | 0.0 |
| Mastoid | 1 | 0 | 0.0 |
| Total | 1251 | 108 | 8.6% |

The overall repeat rate for all the examination is 8.6%. The data of the different causes of repeat is given in Table 2. A total of 108 images were repeated and 45 of these were due to underexposure (41.7%). 27 were retaken

due to poor positioning (25%) and 9 due to overexposure (8.3%). Only 1 examination was repeated due to film fog (0.93%).

Table 2: Reasons for repeated radiography examinations

| Reasons for image repeats | Number of repeats | Percentage of repeat |
|------------------------------|-------------------|----------------------|
| Under exposure | 45 | 41.6% |
| Poor positioning | 27 | 25% |
| Over exposure | 9 | 8.33% |
| Artefacts | 8 | 7.41% |
| Motional blur | 8 | 7.41% |
| Wrong patient identification | 4 | 3.70% |
| Processing error | 2 | 1.85% |
| Poor centring | 2 | 1.85% |
| Uncooperative patient | 2 | 1.85% |
| Film fog | 1 | 0.93% |

The radiographers were responsible for most of the repeats; 87 out of 108 (80.6%). The dark room technicians and

patients were the cause of repeat in 11 and 10 of the examinations, respectively (Table 3).

Table 3: Causes of repeats in radiographic examination

| Cause of Repeat | Frequency | Percentage |
|----------------------|-----------|------------|
| Radiographers | 87 | 80.6 |
| Darkroom Technicians | 11 | 10.2 |
| Patients | 10 | 9.3 |

Discussion

Our repeat rate was 8.63%. This was lower than that observed by majority of other studies. Peer et al got a rate as high as 27.6%⁵. Values of 17.6% before a quality assurance program was instituted and 11.4% after² have equally been reported. Several workers have differently reported repeat rates of 9.6 - 13.2%⁶, 8.86%⁷, and 10 – 15%⁸. Lower rates of 7.93%, 5.5%, 4% and 3.7%, have equally been observed by other studies^{9, 10, 4 11}.

The major reason for repeat of conventional radiographic examination in our study included selection of wrong exposure factors (50%), a finding observed in three other studies but with

different rates^{2,9,10}. There was also positioning error, which accounted for 25% (second highest) of our repeats. This has been confirmed in at least one other study as the highest cause of repeat⁶.

Among all the errors detected in the current study, underexposure was the highest (41.7%). This was also the highest cause of error in the study by Al-malki et al (38%)⁹. Naturally being responsible for positioning and exposure factor selection, the radiographers were responsible for most of the repeats (80.6%). A study in Irua, also in the south-south zone of Nigeria made a similar observation (40.9%) with highest

rates being observed in the spine (13.8%) and skull (9.9%)⁷ radiographs.

The highest repeat rate in our study was observed in the examination of the lumbosacral region (53%) followed by the skull (50%) and abdomen (25%) and the lowest rate was in the leg (2.00%). The pelvis had the highest rate (13.6%), followed by the skull (11.6%) and abdomen (10.4%) in the study by Al-malki et al⁹. Some radiographs were rejected because of the presence of artefacts (7.4%). Cases of errors in patient identification (3.7%), an obvious darkroom error were also observed.

Our overall repeat rate is above recommended limits and the junior cadre radiographers are largely responsible for the repeats, which is highest in the lumbosacral region. The rate can be reduced with introduction of a quality assurance program, better supervision by the senior radiographers, creation of an objective assessment of image quality and regular refresher courses for all staffs involved in generating the images. Finally, conversion to digital radiography is advocated because it eliminates exposure errors which are the leading causes of repeat.

Conclusion

Conventional radiography film repeat rate in this study was found to be above recommended limits, suggesting the need for the introduction of a quality assurance programme. The study has outlined some measures to reduce the rate of repeats for improved radiology service delivery.

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