

Radiation protection and quality assurance

P-155 Exclusion of the lens of the eye in CT head examinations - closing the audit loop

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Introduction: The current standard set by the Royal College of Radiologists states that 100% of CT head scans should be performed with the baseline set so as to exclude the lens of the eye, thereby reducing the radiation dose to the eyes and the likelihood of cataracts formation.

Aims: To re-audit the practice of CT head scans performed at our institution against the RCR standard. Scans were reviewed to assess whether the lens of one or both eyes were included in the field of examination.

Materials and Methods: We performed a retrospective audit of 50 CT head scans performed in February 2012. Data obtained were compared to results from the 2011 audit cycle.

Results: In 2012, 19 scans (38%) included one or both lenses on CT compared with 24 scans (48%) in 2011. 31 scans (62%) excluded the lenses of both eyes in 2012 compared to 26 scans (52%) in 2011. The improvement in practice between 2011 and 2012 did not reach statistical significance ($p=0.14$, chi square test).

Discussion: Recommendations from the 2011 audit cycle included: (i) updating the local protocol for CT head scans, (ii) emphasizing to radiographers the importance of excluding the lens and (iii) implementing specific training sessions for radiographers. These recommendations led to an overall improvement in performance in 2012.

Conclusion: The re-audit shows that although there has been an improvement, we are still below the standard set by the RCR. On-going training and education for radiographers aims to address this issue.

P-156 IQ works analysis tree for measurement of square wave contrast transfer factor in mammography

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Aims/Objectives: Square Wave Contrast Transfer Factor (SWCTF) is a parameter used to assess detector resolution in full field digital mammography systems. IQWorks is a software package that allows analysis of test images through the construction of an automated analysis tree. The aim of this study is to construct an IQWorks analysis tree that can automatically calculate the SWCTF from a test image of the resolution grating test object.

Content: The analysis tree consists of an edge detection algorithm that can detect the edge of the TOR Max phantom and also the edge of the resolution bar grating. Then Regions of Interests (ROI's) are automatically placed in accordance with the test protocol described in NHSBSP Report 0604 and a series of simple math modules calculates the SWCTF at multiple different spatial frequencies. A PDF report is then produced displaying the results of the test. The analysis tree will be then tested by applying the tree to test images acquired under the conditions described in the test protocol and results will be compared between those measured manually.

Relevance/Impact: Automated analysis reduces the time required to analyse images and automatic ROI placement removes potential error in ROI placement.

Discussion: The biggest challenge in creating an analysis tree is finding an edge detection algorithm that can successfully detect the edge of the object of all images.

P-157 Mammography AEC checks: correcting CNR measurements made with different sets of PMMA blocks

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Differences between sets of test equipment can be problematic to medical physicists when they want to compare measurements with baselines from previous routine QA surveys. In mammography, small differences in the quality of PMMA blocks and aluminium sheet can produce differences in measurements of contrast to noise ratio (CNR) which are sufficiently large to cause systems to fail tests of AEC performance which compare CNR measurements to baselines set on commissioning surveys. The aim of this investigation was to determine a correction factor that can

be applied to measurements made using a set of PMMA/Al in order to mitigate the differences in quality between it and a second set of PMMA/Al. Both sets of kit were used to perform AEC checks on several different digital mammography systems and the data was used to perform a regression analysis to determine a function which can accurately convert CNR measurements made using one set of kit to their equivalent values from a second set. The resulting regression model was highly accurate ($R^2 > 0.95$) and was consistent across a range of different digital mammography system manufacturers and models. As workloads increase, the problem of making comparisons between different sets of test equipment is likely to become more commonplace; the methods used to calculate a correction factor in this study may provide a template for dealing with this issue and allow medical physicists to track changes in system performance over time with different sets of equipment.

P-158 The increased SID technique: what is preventing implementation in clinical practice?

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Purpose: Evidence in literature demonstrates that increasing the source to image-receptor distance (SID) can optimise specific radiographic projections yet despite this evidence-base the technique is not commonly practiced within all radiology departments. The present work aims to bridge the gap between evidence and practice by interviewing allied health professionals to investigate the feasibility of implementing the technique in clinical practice.

Methods: Opinions were sought from multiple sources and professionals including radiographers, medical physicists, professional body council members and university lecturers to triangulate the data. Data were collected via telephone and departmental surveys, self-administered questionnaires, focus groups and individual interviews. Analysis via key words and themes was undertaken.

Results: Results demonstrate that despite increased SID being beneficial for dose reduction, perceived limitations were identified which contribute to the poor uptake of the technique in practice. Tradition, the capacity to change practice and radiographic equipment were perceived as the main obstacles against clinical implementation. 75% of radiographers working with modern equipment did not perceive any disadvantage to the radiographer in extending the SID by 30-50cm compared to 59% of radiographers working with older equipment. When radiographer perceptions of implementing the technique were analysed however, 100% of radiographers responded positively to increased SID implementation especially 'if given more information'.

Conclusions: The research concludes that there are no insurmountable issues preventing the implementation of the increased SID technique in clinical practice. The key to effective implementation is to adopt a multi-disciplinary approach and actively disseminate information amongst hospital management and radiographers.

P-159 Increasing the source to image receptor distance: a simple optimisation strategy

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Purpose: Previous work has established that for film screen and computed radiography sizable reductions in effective dose are achievable using the increased source to image-receptor distance (SID) technique although some contention exists among authors as to the magnitude and mechanism of these reductions. The hypothesis stating that reduction in radiation dose due to increased SID is linked directly to the inverse square law and is independent of the image receptor therefore still requires demonstration. The purpose of this work was to comprehensively investigate all aspects of increased SID in optimisation to conclude on the extent of possible dose reductions for direct digital radiography (dDR).

Methods: The dose-reduction potential and image quality at various SIDs was investigated using dDR for lateral cervical spine, antero-posterior abdomen, occipital-frontal and lateral skull projections. Entrance surface dose was measured using thermoluminescent dosimeters and effective dose (ED) calculated using PCMCv2.0. Image quality was assessed using visual grading analysis.

Results: Increased SID resulted in significant decreases ($p \leq 0.05$) in ED ranging from 8.7% for the abdomen (130cm SID) to 39.4% for the lateral cervical spine (210cm SID). Image quality was maintained or improved for all projections tested with increased SID. The results found that increasing the SID above 100cm was consistently the optimum choice.

Conclusion: Increasing SID reduces radiation dose while maintaining clinically acceptable image quality. It is recommended that current imaging guidelines are updated to reflect these findings. Diagnostic Imaging professionals should adopt this simple optimisation strategy in clinical practice to reduce the radiation dose to the patient.

P-160 Emergency doctors knowledge of radiation dose and risk

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Aims/ Objectives: To assess Emergency doctors' knowledge of radiation doses and risk regarding commonly requested imaging investigations, pre- and post- education on this topic.

- Use a questionnaire to assess existing knowledge.
- Education session covering relevance to practice, radiation doses and potential harms.
- 6 weeks later, reassess knowledge with the same questionnaire.

Content: We created a questionnaire requesting the "equivalent Chest X-ray dose" of 11 investigations, and the cancer-related risk of 2 investigations. Surveys were completed by doctors in an inner city Emergency department. An oral presentation, or written information for those unable to attend the presentation, discussed the questionnaire and clinical importance of the topic.

Results of our first questionnaire showed a average score of 47.3%, with an improvement to 71% average score on the second questionnaire after education. The results of our statistical analysis will be available soon.

Relevance/Impact : With the escalating use of imaging in the Emergency department, together with the legal responsibilities of doctors when referring patients for investigations involving ionising radiation, an adequate understanding of the potential risks involved is paramount to choosing the most appropriate imaging modality and allowing patients to make fully informed decisions. There is an ongoing need for continuing education of doctors working in Emergency Departments.

Outcomes : We have displayed a poster in our Emergency Department reminding our doctors to continue using the ALARA (as low as reasonably achievable) principle, by balancing the risks and benefits of investigations and considering radiation-free alternatives where possible.

P-161 Establishing a MRI quality assurance toolkit

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Aim: to support the company's overall quality objectives by providing a standardised approach to performing quality assurance checks on our MRI systems, both static and mobile. It was hoped a unified approach would help raise and maintain standards whilst also providing a means of evidencing system performance for external assessment such as BUPA.

Methods: following review of literature, published guidelines and discussion with the Group MRI Safety Advisor, a selection of visual checks and generic technical tests were put together. It was important the process wasn't time consuming or complicated, provided results that were meaningful and of use, and could be applied across different makes of scanner with minimal financial outlay.

The toolkit included monthly equipment checks, weekly setup tests, and a rotating assessment of selected coils looking at signal, ghosting and uniformity.

It also outlined the importance of departments including some form of breast coil QA within the programme as screening is carried out on a lot of sites.

Results: once confident with the procedures involved, tests and their interpretation take around 15 minutes. Results obtained are easily calculated within a spreadsheet and can be quickly checked for deviation against baselines.

Outcomes: early results from publication of the toolkit have already detected faulty coils that were in clinical use and provided early detection of system faults, helping to minimise downtime and maintain image quality.

P-162 Regadenoson (Rapiscan): Tips and tricks

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Aims: Our institution like many was struggling to cope with demand for myocardial perfusion scintigraphy. Given claims about the product, it could simplify and shorten the stressing technique so allowing increase patient thru'put in the same time frame. We share our experiences of learning on the go.

Content: Bullet points with illustrations on simple and not so obvious aspects to MPS stressing with Rapiscan to further optimise the techniques for patients and staff.

Impact/Outcomes: Increased thru'put with atleast comparable patient comfort and safety and with increased staff convenience is possible with this product, off-setting possible increased costs.

Discussion: Cost effective solution showing that spending a little more initially can bring benefits down stream.

P-163 Electronic delivery of annual IRMER update and radiation safety awareness

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Providing annual IRMER updates to radiology department staff through presentations to groups of staff was shown to be problematic due to staff availability, time constraints and multiple departmental locations.

The development of format which could be delivered via the existing on-line training software would enable improved access to material for staff involved with ionising radiation at a time of their convenience and provide documented evidence to comply with mandatory training requirements.

The content, developed with input from the RPS and RPA covers relevant IRMER legislation and information with regards to increased awareness of radiation safety. Ten multiple choice questions at the end of the core material assess knowledge and a certificate of completion issued for CPD records.

The core material can be amended as required with annual reviews of content scheduled.

Quarterly reports indicate individuals who have completed the module, the time spent on it and the pass result obtained. The data can be cross referenced by line managers against relevant staff highlighting individuals who have not completed the module.

Initial results in the first year of using this delivery format has shown a significant improvement of access to information by staff when compared to attendance at organised presentations in time which could be utilised clinically.

P-164 A preliminary description of a new best practice approach for assurance of regulatory compliance in radiation protection

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Aims: In 2011 we altered the management of radiation protection compliance, implementing a comprehensive programme providing statutory assurance, identifying areas of weakness and placing responsibility for demonstrating compliance with Clinical Directorates.

Method: We developed an audit cycle covering requirements under IRR, IR(ME)R and EPR. A 3 year cycle was proposed, with critical requirements audited annually. All requirements were cross-referenced to CQC regulations and NHSLA requirements with a single set of indicators used. A support structure for directorates was established

through “user groups”, supported by a senior Clinical Scientist to troubleshoot, aid the process and share best practice. Reports were submitted quarterly to the Trust Radiation Protection Committee and Safe Care Group.

Results: Previously, compliance against statutory regulations was not clear. The RPC received reports containing subjective evidence reliant on the Radiation Protection Service, little contribution from clinical directorates, providing inadequate assurance to the Trust Board. The changed arrangements provided robust, good quality evidence. Quarterly audits suggested overall compliance to be well-monitored and improving. At the end of Quarter 3 the RPC received a summary of the previous year’s compliance, and recommendations were made to Clinical Directors. The changed arrangements will allow future comparative audits of compliance to be undertaken.

Relevance: Due to legislation, trusts require robust assurance of safety and quality, especially under CQC regulations and foundation requirements. Trusts should ensure that they can demonstrate compliance and assure regulators of continually improving care. This process allows assessment of compliance and will monitor improvement.

General

P-165 Establishing an MR lymphography service for patients with chronic lymphoedema

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Purpose: Chronic Lymphoedema (CL) of the lower extremities is a debilitating condition, and conventional imaging is often inadequate for diagnosis and clinical management. Magnetic Resonance Lymphography (MRL) is a useful non-invasive technique for evaluating CL. The purpose of this work is to provide a pictorial review of our initial experience in performing MRL within the context of establishing a clinical MRL service.

Methods: Twelve patients with known CL were referred for MRL. Imaging was performed on Siemens scanners (1.5T Avanto, 3.0T Trio) using body, spine and peripheral angio coils. Pre-contrast Fast Low Angle Shot (FLASH) coronal images were acquired at three stations - abdomen, upper legs and lower legs. Subsequently a gadolinium contrast agent with Lignocaine was injected between the toes, and post-contrast data were acquired at each station at 0, 10, 20, 30, 40 and 50 minutes. Pre- and post-contrast images were subtracted and maximum intensity projection (MIP) images derived.

Results: In all cases the main lymphatic vessels in the leg and thigh were clearly demonstrated. Two were radiologically normal (no pathology detected), but the other ten contained some degree of pathology at one or more station. Deep vessel obstruction, dilated vessels and collateral lymphatic vessels were all well visualised.

Conclusions: MRL can provide detailed anatomical information of the lymphatic system and soft tissues in patients with CL of the lower extremities. This enables a more accurate diagnosis and is now the modality of choice for the investigation of CL at our centre.

P-167 Role of nanotechnology in medical imaging

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Like many other applications of nanotechnology in the field of science and technology this technology is also attracting researchers in diagnosis and treatment of diseases. Man-made nanoparticles, of the order of 100 nm, can be used for imaging and diagnosis of diseases at initial stages. A number of nanomaterials are under development for their applications in diagnosis and treatment of diseases. This technology is not only proving to be capable to enhance diagnosis capability of the traditional imaging modalities like MRI but also introducing other methods of detecting abnormalities in patients. This review indicating that in future it may one of the most promising techniques for imaging abnormalities.

P-168 ‘The waves of sound’ - A short history of evolution of ultrasonography for medical imaging

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