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Quality Control in Sonography: Possibility of Defining Acceptability Criteria

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Abstract

Recently, several authors and institutions proposed quality control procedures for 2-D B-mode sonographic image analysis. The aim of this study was to assess if it is possible to define a range of acceptability of the different parameters measured.

Phantoms for 2-D B-mode acquisitions were employed with 11 of the same model high-level ultrasound scanners. Uniformity, axial and lateral resolution, axial distance accuracy, geometric distortion, image contrast, dead zone and penetration depth were measured. All images were acquired by experienced operators and saved by frame grabbing the analog video output signal. A small subset of images was also saved directly in DICOM 3.0 format on a magneto optical disk. Images were analysed with in-house developed software.

Quality control test results for 2-D B-mode images were demonstrated to be related to the probe employed. We also found that the results were not dependant on the operator and type of imaging capture method used. By selecting data from the same type of scanner and dividing probes into two groups (convex medium-low frequency and linear medium-high frequency) it is possible to find a reasonably narrow range of variability for almost all of the parameters studied. Mean values of the different parameters measured, 95% confidence limits and proposed intervals of acceptability are presented.

Therefore, it is possible to establish range of acceptability for the results of a quality control test of an ultrasound scanner operated in 2-D B-mode given the type of scanner and the type of probe. This is particularly useful both for quality assurance and maintenance programmes.

KEYWORDS: Ultrasound, B-mode, Quality control.

Current methods for absorbed dose planning for radioiodine treatment of hyperthyroidism in Sweden

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Abstract

Radioiodine therapy is a common form for treatment of hyperthyroidism. This treatment has been performed for half a century, with the annual number of ¹³¹I-iodide therapies for hyperthyroidism in Sweden being around 3000 since the 1970s. Methods used to calculate the administered activity to the individual patient differ widely, and a survey was made to get information about the different protocols currently used in 23 hospitals in Sweden, which administer radioiodide for therapy of hyperthyroidism.

Eighteen hospitals calculate the activity to be administered for a prescribed absorbed dose to the thyroid. The calculations of the activity to administer consider individual parameters such as the active volume of the thyroid and its uptake of ¹³¹I-iodide, but only 9 of the 18 hospitals consider the individual biological half-time of ¹³¹I in the thyroid. Five hospitals do not consider any individual biokinetic parameter or volume and prescribe just the activity to be administered. In total, 17 different protocols are used, and the investigation clearly illustrates the need to converge and optimize the radioiodine therapy in Sweden.

KEYWORDS: Radioiodine, Therapy, Hyperthyroidism, Absorbed dose.

Inter-observer variability in post-plan seed localization after permanent prostate brachytherapy: a multicentric study

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Abstract

A multicentric study involving eight Italian brachytherapy centers was performed to analyse to what extent the variations in the reconstructed seed distribution can affect the dosimetric parameters commonly used in post plan evaluations of permanent prostate brachytherapy. The geometrical seeds distributions were reconstructed by eight reviewers on CT and MR images of six implanted patients. Independently on the imaging modality, the geometric reconstruction of the seeds distribution showed little effect on quality dosimetric parameters D_{90} and V_{100} of the prostate implant. On the contrary a strong effect upon organs at risk (OARs) related parameters was found. The spread of the D_1 and V_{150} values for the urethra calls into question the significance and the specificity of these parameters. Our preliminary results show the difficulty of collecting dosimetric data that could be correlated with biochemical relapse-free survival (RFS) or prostate specific antigen (PSA) and, particularly, with side effects. Nevertheless, in our opinion, prostate and OAR contouring remains the largest source of uncertainty in post plan evaluation.

KEYWORDS: Permanent prostate brachytherapy, Post-plan dosimetry, I-125, Dosimetric parameters.

Verification of computed portal doses by a linear array of liquid ion-chambers

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Abstract

In this work a linear array of liquid ion-chambers has been used as a detector for the transmission dose below a Rando phantom. The good dosimetric characteristics of the LA48 linear array, that uses 47 liquid ionization chambers, have suggested its use as a detector to verify computed portal dose, obtained by a treatment planning system (TPS) first for conventional irradiation beams (open beams) and later for step and shoot intensity modulated radiotherapy (IMRT) beams. For this last technique, that often uses many sub beam sequences with a small number of monitor units (MU), the early and recent electronic portal imaging devices (EPID) present deviations at beam start-up that affect the transmitted dose accuracy.

Absolute transmitted dose profiles with a spatial resolution of 1 mm have been determined along a direction orthogonal to the beam central axis below an anthropomorphic phantom by the LA48, calibrated in terms of dose to water. Computed portal dose profiles have been obtained by a commercial TPS. For open beams of different sizes, the computed portal dose profiles of 20 anthropomorphic phantom sections have been compared with the experimental dose profiles. The percentage of the γ index values < 1 , $P_{\gamma < 1}$, is greater than 90%, when $\Delta D_{\max} = 3\%$ and $\Delta d_{\max} = 3$ mm acceptance criteria were selected. Using the step and shoot IMRT beams, which give sequences with small numbers of MU, the acceptance criteria for the dose computation, $\Delta D_{\max} = 5\%$ and $\Delta d_{\max} = 4$ mm were selected to obtain a percentage $P_{\gamma < 1} > 90\%$. These acceptance criteria were obtained by a simulation of step and shoot IMRT for head tumors in anthropomorphic phantom.

The simulation procedure was a useful training for physicists and oncologists involved in the step and shoot IMRT process, to obtain a greater comfort with this technique. Indeed the simulation on an initial clinical site supplied useful information about: (i) the correct execution of the beam sequences, (ii) the correct delivery of the doses due to small number of MUs, (iii) the accuracy needed to the beam centering, observing the agreement between computed and measured portal dose profiles also near the inhomogeneities.

The results reported here could encourage plans to make 2-D detectors that better simulate a simple phantom for the transmitted dose measurements.

KEYWORDS: Portal-dose, IMRT, Radiotherapy

Investigation of *Caenorhabditis elegans* using Soft X-ray Contact Microscopy

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Abstract

Soft X-ray Contact Microscopy (sXCM) experiments have been performed on the nematode *Caenorhabditis elegans* using the Prague Asterix Iodine Laser System (PALS). Pulsed X-rays were generated using gold and molybdenum targets with laser intensities $I \geq 10^{14}$ W/cm² to record the contact images of *C. elegans* on PMMA photoresists. Results were analyzed using an atomic force microscope operating in constant force mode. Our results show some characteristic features of the *C. elegans* and the suitability of the sXCM technique for the study of multi-cellular specimens.

KEYWORDS: *C. elegans*, Soft X-ray contact microscopy, Intense laser plasma, Gold target.