patients are dual scanned i.e. IV contrast 3D scan followed by non contrast 4DCT.
Sixty five percent of centres agreed or strongly agreed updated guidelines would be useful.

Conclusion: The results suggest adherence to RCR guidelines is poor. Very little current evidence exists relating to optimal IV contrast protocols both in the UK and internationally. No standardised guidelines exist in relation to 4DCT IV contrast protocols and timings which in some centres is resulting in patients being dual scanned. There are many areas such as flow rates, timings and administration in conjunction with advanced techniques which require further research to enable updated standardised guidelines to be identified. The need for updated guidelines is supported by 65% of respondents of this study.

Poster Viewing: 8: Physics: Inter-fraction motion management II

PV-0375
Comparison of carina- versus bony anatomy-based registration for IGRT in esophageal cancer.
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Purpose or Objective: In image-guided radiotherapy (IGRT) for esophageal cancer, it is common to use bony anatomy-based registration (BR) for setup verification. A recent study, in which we investigated fiducial marker-based registration relative to BR, indicated marker-based registration to be infeasible due to tissue deformation. In the present study, we investigated the feasibility and geometric accuracy of carina-based registration (CR) for CBCT-guided setup verification in esophageal cancer IGRT.

Material and Methods: Retrospectively, 24 esophageal cancer patients with 65 implanted fiducial markers, visible on planning CTs and follow-up CBCTs, were included in this study. Fiducial markers were considered as standard for tumor position. All available CBCT scans (n=236) were independently rigidly registered to the reference CT with respect to either the bony anatomy or to the carina using XVI software (Elekta Ltd. Crawley) to determine the individual marker displacement relative to the bony anatomy and to the carina, respectively. Automatic registrations were visually checked and manually adjusted when necessary. Subsequently, we assessed and compared per individual marker the mean marker displacement over the treatment course (systematic position error, SE) associated with either BR or CR. Markers were classified into four subgroups based on their locations in the esophagus (proximal, mid-esophagus, distal, cardia) and analysis was similarly as mentioned above performed per subgroup. Comparison between both registration methods was done using a paired Wilcoxon signed-rank test.

Results: The distributions of the absolute mean systematic position error of the individual markers relative to the bony anatomy and carina, especially in the CC direction. Figure 1.B, illustrates the slightly favorable use of the BR for proximal located markers. Markers located in the mid-esophagus show a smaller SE in CC and AP direction when using the CR, however this difference was not significant. For markers located in the distal esophagus and cardia, the BR is favorable in AP direction (p<0.001). Furthermore, the majority of the CRs were more challenging given the low contrast resolution in comparison with the BRs.

Conclusion: The mean marker displacement (SE), residual tumor position error, over the treatment course remains large and is in most directions even slightly larger when using CR compared with BR. Only for tumors located in the mid-esophagus the CR can be slightly favorable. However, esophageal tumors typically extend across regions and the majority of tumors are located distally. Therefore, our data endorse the use of BR over CR for setup verification.

PV-0376
Contrast-enhanced respiration managed cone-beam CT for image-guided intrahepatic radiotherapy
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Purpose or Objective: Contrast enhancement and respiration management are widely used during image acquisition for radiotherapy treatment planning of liver tumors along with respiration management at the treatment unit. However, neither respiration management nor intravenous contrast is commonly used during cone-beam CT (CBCT) image acquisition for alignment prior to radiotherapy. In this study, the authors investigate the potential gains of injecting an iodinated contrast agent in combination with respiration management during CBCT acquisition for liver tumor radiotherapy.

Material and Methods: Five rabbits with implanted liver tumors were subjected to CBCT with and without motion management and contrast injection. The acquired CBCT images were registered to the planning CT to determine alignment accuracy and dosimetric impact. We developed a simulation tool for simulating contrast-enhanced CBCT images from dynamic contrast enhanced CT imaging (DCE-CT) to determine optimal contrast injection protocols. The tool was validated against contrast-enhanced CBCT of the rabbit subjects and was used for five human patients diagnosed with hepatocellular carcinoma.

Results: In the rabbit experiment, when neither motion management nor contrast was used, tumor centroid misalignment between planning image and CBCT was 9.2 mm. This was reduced to 2.8 mm when both techniques were employed. Tumors were not visualized in clinical CBCT images of human subjects. Simulated contrast-enhanced CBCT was found to improve tumor contrast in all subjects. Different patients were found to require different contrast injection protocols to maximize tumor contrast.

Conclusion: Localization of the tumor during treatment is the weak link in IGRT for liver. Respiration managed contrast-enhanced CBCT provides a possible solution. Simulation tools for optimal contrast injection, recommended margins for interfraction motion and additional benefits from patient specific tracer kinetics determined from DCE-CT are presented.

PV-0377 Inter-fraction bladder variations in RT of prostate cancer: impact on dose surface maps

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Purpose or Objective: Bladder is a hollow and flexible organ exposed to high doses in RT for prostate cancer. Its absorbed dose can be properly described by the dose surface maps (DSM) however, due to its flexible nature, the discrepancy between the planned dose and the dose absorbed during the treatment is a major issue. Present work aims at verifying the robustness of DSMs relative to the daily inter-fraction movement of bladder during RT of prostate cancer.

Material and Methods: 18 patients treated with moderately hypofractionated Tomotherapy were considered (prescription of 70 Gy at 2.5 Gy/fr in 28 fractions and full bladder). All patients underwent daily Image Guided Radiotherapy (through MVCT) with rigid registration on the prostate. After matching, bladder contours were delineated on each MVCT by a single observer and copied on the planning CT; the planned dose distribution was employed to generate DSMs. For each patient, the bladder DSMs from the planned treatment and from each fraction were then computed by unfolding the bladder contours on a 2D plane: they were anteriorly cut at the points intersecting the sagittal plane passing through the center of mass. The DSMs were then laterally normalized and aligned at the bladder base, while cranially they were cut at the minimal extension of the planned DSMs. Discrepancies between planned and treatment DSMs were analyzed through the average map of individual systematic errors, the map of population systematic errors (standard deviation of individual systematic errors) and that of population random errors (average of individual random errors) of dose.

Results: 472 normalized DSM were considered (cranial extension 34 mm); the mean number of available daily MVCTs was 25 (18-28) per patient. The Figure shows the average planned map (panel A), the average map of individual systematic errors (B), the map of population systematic errors (C) and that of population random errors (D). Two main regions can be recognized: 1) the central posterior bladder base (light/dark blue in D) and 2) the region that surrounds it, involving the lateral and the more cranial portion of bladder (orange/red in D). Region 1), which absorbs the highest doses (see A), appears to be the most stable one during the treatment: panel B shows mean values between -1 Gy and 1 Gy in region 1) and around 2-3 Gy in 2). Population systematic (C) and random errors (D) are below 4 and 3 Gy respectively in region 1), while they reach values between 6-11 Gy and 5-7 Gy, respectively, in 2).

Conclusion: The results show that DSMs are quite stable with respect to changes occurring during daily IGRT for prostate cancer in the high-dose region, in the first 1-2 cm from bladder base. Larger systematic variations occur in the anterior portion and cranially 2.5-3.5cm from the base: these effects may be due to systematic differences in bladder filling and to systematic shits of bladder base between planning and treatment.

PV-0378 CBCT derived CTV-PTV margins for elective pelvic node irradiation of prostate cancer patients

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Purpose or Objective: To derive suitable CTV-PTV margins, using only anatomical information contained within cone