Evaluation of image guided radiotherapy (IGRT) in lung cancer. Is weekly cone beam CT (CBCT) enough?

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Purpose/Objective: To determine if a weekly cone-beam CT (CBCT) is enough to evaluate the entire tumor inclusion and the reproducibility throughout the radiation course treatment in lung cancer.

Materials and Methods: Thirty-six lung cancer patients were treated with image-guided radiotherapy (IGRT) on an Elekta Synergy Beam Modulator linear accelerator. The GTV included the tumor and the positive nodes in PET-CT and pathologic analysis. The PTV was configured with the GTV and a margin of 0.7 cm - 1 cm in all directions. Our preliminary results showed that in most lung cancer patients treated with IGRT, once an average is calculated after the first five days of treatment, a weekly cone-beam CT is enough to evaluate the entire tumor inclusion and the reproducibility throughout the radiation treatment.

Results
The graphics summarize the result of our analysis.

In 29 patients (80.6%) the mean value of the difference between the positional errors compared to the average was: x = (0.19 ± 0.14) cm, y = (0.21 ± 0.14) cm, z = (0.27 ± 0.16) cm. All these values were less than 0.5 cm and were considered correct for the suitable treatment of the patients. The shifts in the z axis showed more variability compared to the other axes mainly related to breathing movements. Nevertheless this z axis variability did not influence on the entire tumor inclusion and the set up reproducibility.

Conclusions: Our preliminary results showed that in most lung cancer patients treated with IGRT, once an average is calculated after the first five days of treatment, a weekly cone-beam CT is enough to evaluate the entire tumor inclusion and the reproducibility throughout the radiation treatment.

Training for RTTs in image verification in breast cancer: from portal imaging to IGRT.

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Purpose/objective: Recent innovations in Radiation Oncology demand a higher implication of radiation technologists (RTTs) in imaging verification. Certain complex breast cancer treatments, and partial breast irradiation, may require image-guided radiotherapy (IGRT) with daily imaging. This creates a need to train RTTs to perform reliable online imaging evaluations, which would equally recognize their expertise and optimize human resources. The aim of this study is to evaluate the effectiveness of a training program in electronic portal imaging (EPI) for RTTs.

Materials/methods: This training project had a theoretical component, a single day lecture program; and a practical one to one session between the radiation oncologist and the RTT. The impact of the theoretical module was assessed by an evaluation before and after the lessons, via an online survey service. For the practical module, an RTT specific file in the online survey service allowed access from every treatment unit, data input of the difference between the radiation oncologist and the RTT EPI verification and the radiation oncologist evaluation and auto-evaluation of the RTT skills in EPI guided patient positioning.

Results: An initial analysis has been performed in September 2014 with twenty RTTs on 39 breast cancer cases, 129 images, evaluated by one radiation oncologist. A significant (p < 0.05) improvement was shown between the pre and the post-theoretical module evaluation by the ANOVA test (Fig 1). When assessed by the radiation oncologist, 87.2% of RTTs had acquired expert skills in EPI evaluation, and 12.8% had assimilated how to evaluate EPIs. This percentage lowered when autoassessed by the RTT to 66.7% for expert and grew to 33.3% for assimilated skills. As for the margin of error, a deviation of > 3 mm or 5 mm of the RTT verification with respect to the radiation oncologist verification was found in 1 image in the X axis (3% of the total images) and for 9 images in the Y axis (7%). There were no deviations of > 5 mm with respect to the radiation oncologist EPI validation. The post-training satisfaction questionnaire showed an overall average satisfaction of 3.35/4 (Table 1).

Conclusion: This training methodology seems feasible and shows excellent results both in terms of theoretical and practical skills in EPI evaluation. This allows RTTs to develop their skills in EPI evaluation and be autonomous. An online evaluation questionnaire is an effective tool to assess the immediate educational impact. This model is promising for training for IGRT imaging evaluation.

The course that you have attended: Average score

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Fig. 1. In red pre-theoretical module evaluation answers to 31 multiple-choice questions. In blue the post-theoretical module answers to the same evaluation. Results expressed in the average percentage of correct answers per question.
Table 1. Average results of the satisfaction questionnaire, with answers scored from 0-4, being 0: no satisfaction; and 4: extreme satisfaction.

### Stereotactic body radiation therapy for localized prostate cancer: institutional experience

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**Introduction:** Stereotactic body radiotherapy (SBRT) is a radiation technique designed to administer precisely directed high-dose irradiation that tightly conforms the target, in order to create a desired radiobiologic response with tumoral ablative intent, while minimizing radiation dose to surrounding normal tissue, within an image-guided course of treatment that does not exceed 5 fractions. SBRT in the treatment of localized prostate cancer is widely accepted, being the second extracranial malignancy treated with this technique, with excellent biochemical control rates and low and acceptable toxicity outcomes.

**Purpose:** To report preliminary clinical and dosimetric analysis of stereotactic body radiotherapy treatment for organ-confined prostate cancer in a period of 3 years.

**Material/methods:** From May 2011 through May 2014 a total of 13 patients with clinically localized prostate cancer were treated using a CyberKnife. Four intraprostatic fiducial marks were placed via transrectal ultrasound, two at the prostate apex and two at the base separated at least by 2 cm, and controlled with orthogonal radiography. After five days allowing time for possible seed migration, treatment planning was performed using a CT scan (1.25 mm). The course of radiotherapy consisted of 5 daily fractions of 7.25 Gy for a total dose of 36.25 Gy to the prostate PTV; considered an $\alpha/\beta$ of 1.5 the DEQ2Gy results 90.6 Gy. The PTV was defined extending the margin of prostate CTV 5 mm on all sides except for posteriorly (by the rectum) where a 3 mm margin was used.

**Results:** Ten patients were low-risk (77%), intermediate-risk (23%). The median prescription isodose was 83% [80-87%], the prescribed dose reached a median GTV coverage of 99.95% [99.84-100%] and PTV coverage of 96.1% [95.1-97.1%]. With a median follow-up of 18 months there was no patient with PSA failure, showing a progressive reduction in all of them.

Acute Grade I and II urinary toxicities occurred in 32% and 18% of patients respectively, only 7% of Grade I late urinary toxicities were observed with no higher Grade. Rectal acute Grade I and II complications were observed in 23% and 7% of patients, and no late toxicity. No patients experienced Radiation Therapy Oncology Group Grade III or IV complications, both late and acute.

**Conclusions:** The current evidence supports consideration of stereotactic body radiotherapy among the therapeutic options for localized prostate cancer. In well selected patients SBRT’s advantages of noninvasiveness, delivery without anesthesia or hospitalization and its outcomes, compares favorably this technique with other definitive treatments. The low toxicity and maintained reduction in PSA values seen in this serie are highly encouraging, and additional follow-up is needed to determine long-term biochemical control and maintenance of low toxicity.