Debate: There are many existing IGRT options for highly accurate dose delivery. Is there a need for large-scale in-room MR-guidance?

SP-0113
For the motion
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The statements that will be made highlighting the strong position we are already in when using all currently available advanced image-guidance strategies are used are the following:
- If there is a necessity for on line MR-guidance, there is a general necessity for broad use of advanced imaging strategies, particularly as successful screening programs such as those for lung cancer and potentially even pancreatic cancer are established, as this potentially leads to more localized disease being treated.
- Several such strategies are now available but are underutilized, typically for lack of funding or perceived complexity. Recent developments such as FFF-delivery and fast collimators have, however, shortened a lot of treatments and thus rendered advanced imaging strategies more feasible. Considerable expertise is needed, as it is mandatory also for MR-guidance.
- MR-guidance can be and has already been more easily applied to brachytherapy, a highly effective form of local therapy where technically applicable.
- Continuous 2D-tracking based on fiducials placed in minimally invasive procedures has entered the clinical routine for the ablation of small lesions without complex interference of OARs.
- 3D-imaging with CBCT, particularly in conjunction with breathhold strategies, still has considerable potential. Accuracies in the range of 3mm can be consistently achieved across treatment targets, and in deep inspiration breathhold typically with very favorable dose distributions and straightforward dose accumulation. 4D-approaches are available, ultrafast ‘snapshot’ volume imaging is ready to be deployed clinically.
- Ultrasound, where applicable, allows not only for positioning but for tracking in 2D and 3D.
- Surface scanning may simultaneously provide patient surveillance and gating signals during a therapy session.
- Noncoplanar treatment strategies and high-LET radiation may have further potential to improve clinical results independent of imaging strategy and are currently not possible in conjunction with in-room MR-guidance.

The statements suggesting that in-room MRI guidance will add significantly to the current armamentarium comprise the following:
- Cancer is primarily a soft tissue disease. MRI offers unparalleled soft tissue contrast imaging across a wide range of cancer types and locations. In-room MRI guidance for cancer radiotherapy combines exquisite soft tissue imaging of the cancer and surrounding healthy structures with precision radiotherapy to optimally target the cancer and spare healthy tissues, affecting quality of life, cancer outcomes and reducing the health and economic burden of managing treatment-related side effects.
- This ability to simultaneously image and target the cancer with radiotherapy is intuitive to patients and the treatment team alike. Indeed, the image quality of MRI-guidance is so high that a commercial online adaptive radiotherapy system is only available with the system that combines it all.
- Cancer physiology is heterogeneous and changes with time.
- MRI is the only in-room physiological targeting system for cancer radiotherapy. An example, tumor hypoxia, is a strong negative prognostic indicator of survival across a wide range of cancer sites, and the tumor hypoxic status changes over the time period of a single treatment. The ability to selectively image and target the most aggressive and resistant parts of the cancer opens up a new window to dramatically change cancer outcomes.
- In addition to in-room MRI-guidance offering an improved treatment across a range of cancer sites, this new device also opens up the opportunity to explore the treatment of non-oncologic diseases. An example is atrial fibrillation, a disease suffered by 6 million Europeans, with many of these patients treated in an invasive, long, expensive procedure. MRI-guided radiotherapy offers an non-invasive, short and cost-effective treatment of atrial fibrillation. This treatment is enabled by using MRI to solve the challenging problem of imaging and target imaging small volumes affected by both respiratory and cardiac motion, a problem too difficult for other in-room imaging systems.
- The improved outcomes and applications observed from in-room MRI-guided radiotherapy will affect patient referral patterns and policy guidelines to increase the global radiotherapy need, benefiting the radiation oncology and global communities.

SP-0114
Clinical evidence for in-room MRI guidance
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Join abstract submitted

Symposium: Additional tools for contouring

SP-0115
Functional and molecular imaging techniques and personalized radiotherapy
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Advances in radiotherapy delivery have been due to improved technique and image guidance. In contrary to the “one size fits it all” paradigm, personalized medicine tries to incorporate all available imaging information in order to optimally delineate the target volume. It will be highlighted, in how far molecular imaging such as PET has become a cornerstone for certain types of cancer and how PET information may be integrated into target delineation. Furthermore, it will be discussed in how far there is a role for a biological target volume (BTV) and how appropriate margins can be chosen; new tracers beyond FDG are discussed. The meaning of MRI and its applications as well as available pitfalls will be presented employing an example of a brain tumor treatment.

SP-0116
General recontouring with deformal registration
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Significant patient anatomy changes may occur during the course of radiotherapy, more particularly for head and neck, pelvic and lung tumours. These modifications may degrade the plan quality over time, and hence require treatment adaptation based on the anatomy depicted from images of the treatment day.
Any comprehensive adaptive solution will necessarily require automatic tools that, first, depict patients who actually need adaptation (dose recomputation on daily image and clinical indicators of plan quality), and then assist the radiation oncologist/therapist in the labour-intensive task of target volumes and organs at risk recontouring. Ultimately, this approach should allow treatment plan re-optimization if required, without unmanageable additional workload in real-life clinical routine.
In this framework, deformable image registration allows the alignment of datasets in a non-linear way, providing a voxel-
to-voxel mapping between the initial planning scan and the treatment scan. Therefore, deformation maps can be applied to propagate contours from planning CT to daily images, but also to compute dose distribution from the deformed images for dose accumulation purpose.

In this presentation, we will describe the general framework of deformable image registration, and will cover the main class-solutions for registration-based recountouring according to the tumor location and the available imaging modality, i.e. kV- or MV/CB-CT. Typical adaptive workflows based on deformable registration will be presented, as well as their advantages and potential limitations. Last, we will emphasize the essential role of the operator for accuracy and consistency check of the deformed contours, any inaccuracy in this step necessarily introducing systematic errors in the planning process.

**Poster Viewing: 3: Clinical: Gastrointestinal and gynaecology**

**PV-0118**

Prognostic impact of presurgical CA 19-9 level in pancreatic adenocarcinoma: a pooled analysis.


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**Purpose or Objective:** Preoperative level of CA 19-9 (prCA19.9) predicts survival of patients (pts) undergoing surgery for pancreatic adenocarcinoma (PAC). Actually, there is no evidence of using prCA19.9 as a marker customizing and modulating effectivenss of adjuvant treatment or predicting pattern of failure. Therefore, the purpose of this pooled analysis was to determine whether prCA19.9 could predict overall survival (OS), local control (LC), disease metastasis free survival (DMFS) and evaluate effectiveness of adjuvant therapies in a broad population.

**Material and Methods:** We performed a multicenter retrospective analysis of 1122 patients (pts) who underwent surgical resection +/- adjuvant treatment [chemotherapy (aCT), radiotherapy +/- concommitant CT (RCT)] for PAC between 2000 and 2014 from 8 different institutions. Among 700 pts with prCA19.9 value we applied the Kaplan-Meier method and the log-rank test to investigate differences in OS, LC, DMFS between defined groups based on: clinical and pathological factors, 4 prCA19.9 cutoff (5, 37, 100, 353) and 5 relative prCA19.9 classes (0.0-5.0, 5.1-37.0, 37.1-100, 100.1-353.0, >353.1). We fitted Weibull regression model with shared frailty on institution to identify independent predictors of OS using data from 404 pts with complete information. We applied a backward stepwise strategy to select the covariates, forcing CRT and RT in the final model.

**Results:** Median follow-up (FU) was 27 months (2-225). At univariate analysis there was a strong impact of prCA19.9 classes (0.0-5.0, 5.1-37.0, 37.1-100, 100.1-353.0, >353.1) on 5-years OS (5.7% vs 37.9 vs 27.1 vs 17.4 vs 10.9, p<0.001, Figure 1), 5-years LC (47.2% vs 63.3% vs 59.4% vs 43.4% vs 50.2%, p=0.008), 5-years DMFS (17.0% vs 46.0% vs 39.0% vs 26.7 vs 23.4, p=0.001), respectively. Only in pts with prCA 19.9 > 353.1 U/ml aCT had positive impact on 5-year OS (47.4% in pts treated with aCT vs 30.2% in pts not treated with aCT, p=0.006). At multivariable model, sub-analysis of 404 pts showed (Table 1): worse OS for grading 3 tumor (HR: 1.85 95%CI 1.26-2.70, p=0.002) tumor diameter > 30 mm (HR: 1.85, 95%CI: 1.35-2.53, p<0.001), and better OS for pts treated with CRT doses > 50 Gy (HR: 0.38, 95%CI: 0.23-0.63, p=0.001), Median OS was 'prolonged in pts with prCA19.9 >100 and <353 (HR: 1.77, 95%CI: 1.23-2.56, p=0.002) and in pts with prCA19.9 ≥353.1 (HR: 1.92, 95%CI: 1.34-2.76, p<0.001).

*Figure 1 in Impact of prCA19.9 on OS*