TEACHING LECTURE:

SP-0192
Biomarkers and the prediction of outcome in breast conserving therapy
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Risk factors for local recurrence in breast cancer after breast conserving therapy (BCT) differ from those for local recurrence after mastectomy. To better guide optimal treatment of individual patients, it is desirable to identify patients at high risk for local recurrence. Several clinical and histopathological factors, such as young age and presence of ductal carcinoma in situ, are known to be predictors for local recurrence after BCT. After mastectomy lymph node status and tumor size are dominant risk factors for local recurrence. Extensive research was therefore aimed at developing and validating biomarkers to predict a local recurrence after BCT. Recent gene expression profiling studies are already in clinical use for predicting prognosis and guiding the indication for adjuvant systemic therapy and in some cases also the type of chemotherapy. New published and unpublished data reveal that these and other gene expression profiles may be used to predict local recurrence after BCT or RM. Although the variation in different subtypes in breast cancer and the difference in amount of tumor burden remaining after surgery, makes that finding robust predictive profiles is still complex. During this teaching lecture biomarkers will be presented for predicting local recurrence after mastectomy and BCT, and they also will be related to the outcome of some recent clinical trials.

SP-0193
MRI for radiotherapy planning
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High dose radiation therapy requires accurate localization of the tumor volume and its relationship to surrounding normal tissue. Further parameters that influence the results of radiation therapy are mainly related to tumor characteristics and the radiation technique used.

As compared to CT, radiotherapy planning with MRI has major advantages. Tumor delineation is improved due to its superior soft tissue contrast. Furthermore, functional data such as the oxygenisation status, pH, and the tissue temperature of the tumor can be obtained. In addition MRI does not use ionizing radiation. Therefore, MRI maybe optimal for radiotherapy planning.

However, because of difficulties in image interpretation and image distortion as well as missing radiation absorption information it is currently not used routinely. Therefore CT is still used more frequently. Thus methods are being developed to convert MRI tissue intensities into HU data surrogates for radiation planning. Using new fast pulse sequences and standard plastic radiation therapy immobilization casts with MR positive surface markers, MRI may be employed more frequently. Areas in which MRI is already used are those areas of the body with low or almost no movement such as the brain, head and neck region, and pelvic organs, such as the uterus and prostate.

During the last years positron emission tomography (PET) is of growing importance for radiotherapy planning. Since first combined PET-MR systems are available MR imaging may play a major role in the future of radiotherapy planning.

SP-0194
Functional MRI: how can it assist IMRT
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Intensity-modulated radiotherapy (IMRT) has provided a means for shaping the dose distribution not only to the geometry but also to the differences in radiobiology across tumors. This information on tumor biology and heterogeneity can be derived from functional images. The spectrum of imaging biomarkers consists of imaging of tumor metabolism (PET with new tracers), angiogenesis (perfusion MRI), cellularity (diffusion MRI) and hypoxia (FMISO PET and BOLD MRI). Apart from that, automated segmentation of imaging data, provides per pixel measurement of the heterogenous characteristic of the tumor in a objective way and improves the assessment of response to radiation oncology by imaging. This lecture is to learn about the range of MR imaging biomarkers that can be used for markers of tumor microenvironment and heterogeneity and to understand how these biomarkers can assist IMRT in radiotherapy.

SP-0195
PRV margins and other measures to handle geometrical uncertainties of normal tissue
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An important goal in radiotherapy is to minimize the risk of adverse side effects following treatment. Geometrical uncertainties make this a challenging task because they cause variation in the delivered normal tissue dose. A method/concept for handling geometrical uncertainties of normal tissue should ideally be able to 1) predict the delivered dose to the organ at risk (OAR) in optimization - within a certain probability, 2) allow for correction of predicted dose-volume parameters with adverse effects to develop reliable complication-/organ-specific constraints, and 3) communicate these constraints to the optimization algorithm.

The ICRU report no.62 introduced the concept of a planning organ at risk volume (PRV) to address this problem - in analogy to the planning target volume (PTV) [1]. While the PTV should secure the described dose to be delivered to the critical target volume (CTV) with a certain probability, the PRV should help controlling normal tissue complications. The latter is more challenging both because the shape of the dose distribution around OARs is case dependent and will vary much more from organ to organ than the CTV and because the dose-volume response varies from organ to organ [2-4]. Consequently, no universal PRV recipe - in analogy to the van Herk [5] or Stroom [6] recipes for PTVs exists, and the concept of PRV is somewhat confusing. Inconsistency in the ICRU report no. 62 and 83 about for which organ and when to use PRVs further contributes to the uncertainty of the concept [1,7].

Despite no general PRV recipe - the concept is well established and plays an important role in clinical cases where a serial OAR is close to a critical dose level (e.g. around the spinal cord in head and neck IMRT) [2,3,8,9]. The usefulness of the PRV concept for other treatment situations and OARs with a less serial dose-volume response is debated [3,10]. Patient-specific alternatives to PRVs have been suggested and are promising [11-16]. Some of these concepts completely abandon the use of hard margins - both PRVs and PTVs and replace them by directly incorporating geometrical uncertainties of the CTVs and OARs in so-called robust optimization. Implementing these concepts clinically would thus require us to reframe our thinking into a more abstract way of evaluating dose distributions. Nevertheless, these alternatives could help us to better exploit the potentials of advanced radiotherapy delivery techniques, including intensity-modulated photon and hadron therapy.

5) Van Herk M. SeminRadiatOncol2004;14:52-64.
7) ICRU Report 83. Bethesda, MD: ICRU; 2010

SP-0196
A practical guide to radiochromic film dosimetry
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Historically the standard tool for quality assurance of IMRT has been radiographic film, which has had a long history of use in radiotherapy QA programs. The trend towards filmless radiology and radiotherapy...