review every step in the RT process. They check whether the used protocol is applicable, if the choices made in the RT process are logical and whether the workflow was correct. Afterwards, the reviews are discussed plenarily by the four physicist-RTT couples and a radiation oncologist (RTO) specialized in the tumor site. In this meeting, actions to optimize the RT process are defined. For the retrospective analysis, the items on the action lists are categorized either as: protocol checks (incomplete/incorrect protocol), procedure checks (difference in interpretation of protocols) and abnormalities in human actions (misunderstanding/human error) or techniques (technical shortcoming).

Results: In three years the APQ resulted in a total of 76 actions. The results are displayed in Table 1. Examples of some typical actions include: adjusting the dose volume histogram reports in showing more relevant information, unifying the workflow around peer review of delineations, securing consistency of patient setup information.

Table 1. Percentage categories per process step

<table>
<thead>
<tr>
<th>Category</th>
<th>Imaging preparation</th>
<th>Treatment planning</th>
<th>Radiation treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol</td>
<td>7%</td>
<td>14%</td>
<td>5%</td>
</tr>
<tr>
<td>Procedure</td>
<td>8%</td>
<td>13%</td>
<td>7%</td>
</tr>
<tr>
<td>Abnormality (human)</td>
<td>5%</td>
<td>8%</td>
<td>3%</td>
</tr>
<tr>
<td>Abnormality (technique)</td>
<td>5%</td>
<td>7%</td>
<td>18%</td>
</tr>
</tbody>
</table>

Only small abnormalities were found, which didn’t influence the radiation treatment or caused any injury. In addition, the APQ turns out to be a good tool to enhance collaboration between multidisciplinary professionals like physics, RTT’s and physicians.

Conclusion: From our results, it follows that the APQ detects several types of (small) abnormalities in the total RT process. It is known that large errors typically result from a combination of small abnormalities through the process chain. Therefore we believe that by finding and correcting these small abnormalities, the APQ inherently improves the quality and safety of our treatment. In discussing the quality of our treatment in this multidisciplinary setting, we increase commitment and mutual understanding. In short, the APQ is a unique and effective process audit to enhance the quality and safety of the entire RT process.

PV-0223

Accuracy of 2D angiogram to 3D MRI registration for frameless stereotactic targeting of brain AVM

I.T. Kuijper1, O. Hertgers1, J.P. Cuijpers1, F.J. Lagerwaard1

VU University Medical Center, Radiation Oncology, Amsterdam, The Netherlands

Purpose or Objective: Stereotactic Radiosurgery (SRS) is an established treatment option for arteriovenous malformations in the brain (bAVM). Two dimensional (2D) digital subtraction angiography (DSA) is used for accurate delineation of the AVM because of its high temporal resolution. In current practice, an invasive head frame and localizer box are used to indirectly register 2D DSA with 3D magnetic resonance angiography (MRA) datasets. The new registration method, which is commercially available, segments a vessel tree from the 3D MRA, and matches this unique vessel projection with the vessel projection in the 2D DSA images. This study aimed to measure the accuracy and feasibility of this new registration method and compare it to the traditional image localization technique.

Material and Methods: 69 image-registrations from 52 bAVM patients were analyzed. Patients with more than one AVM feeder artery had two registrations. In the traditional technique the 3D CT and 2D DSA datasets were indirectly registered using the localizer box. The CT was fused to the 3D MRA establishing a registration between DSA- and MRA-datasets. In the new technique the vessel tree segmentation from the 3D MRA was directly fused to the vessel tree from the frontal and lateral 2D DSA images of each patient (figure 1). Two observers independently performed registrations and the accuracy was compared to the traditional one. The mean rotational and translational differences and outliers were calculated for the frontal and lateral DSA images. In addition, feasibility was analyzed for different factors e.g. vertebral or carotid artery registrations, prior embolization/hemorrhage and MRA/DSA image quality.

Results: The mean difference of the new compared to the traditional registration technique was 1.1 mm and 1.3 ° for translations and rotations, and 2/69 (3%) exceeded 3 mm. The 3D vector had a mean (SD) of 1.5 ± 0.71 mm (range 0.1-4.7 mm). The mean (± 1 SD) results for 69 registrations of each DSA image are shown in figure 1. No difference >0.5 mm was seen between registrations with the DSA of either the carotid- or vertebral artery. Furthermore, no significant differences were found in patients with prior hemorrhage and/or embolization (p>0.05). The mean inter-observer disagreement between the two observers was 0.3 mm with maximum differences of 2.6 mm. Good image quality, the correct orientation of the DSA image sets together with whole brain MRA scans for optimal vessel segmentation are important criteria for accurate registration using the new method.

Conclusion: The new software based DSA-MRA registration using vessel tree segmentation is a feasible and accurate approach and agrees to within a mean of 1.1 mm and 1.3 ° with the traditional method using a frame and localization box. The new registration method allows the application of frameless (fractionated) radio surgery and could facilitate the import of external diagnostic DSA images for treatment planning.

PV-0224

To be greeted as a human being - A meta-synthesis of cancer patients’ experiences of radiotherapy

S. Petri1

1Copenhagen University Hospital - Rigshospitalet, Department of Oncology- Section for Radiotherapy, Copenhagen, Denmark

Purpose or Objective: Around 35,000 Danish people are diagnosed with cancer each year, and approximately 16,000 people receive one or several radiotherapy fractions. In Denmark radiotherapy is delivered by special educated oncology nurses and radiographers, in the following referred to as radiation therapists (RTTs). Results from existing research suggest that the RTTs play an important role in relation to how the radiotherapy treatment is experienced by the patients. In addition, patients feel tied down and as slaves of the time due to the daily treatments. Furthermore the high-tech context in a radiotherapy department may seem intimidating to the patients and consequently create insecurity and uncertainty in an already vulnerable situation. However, in order to establish a culture of patient-centered care and communication in clinical practice more knowledge on how patients experience radiotherapy treatment is warranted. The purpose of the study was therefore to explore how adult cancer patients experience radiotherapy based on existing qualitative research.
Material and Methods: Based on qualitative meta-synthesis as described by Sandelowski and Barroso four research articles were systemically identified and included in the study. Only studies conducted in the Scandinavian countries were included to ensure a similar cultural context and organization of the health care system. The meta-synthesis was conducted in a hermeneutic perspective, and consisted of five phases; search phase, appraisal phase, classification phase, analysis phase and synthesis phase. The synthesis phase was complemented by the approach imported concepts to expand comprehension and integrate the findings.

Results: The results suggest that the experience of radiotherapy is described by the main theme: The importance of being greeted as a human being and six sub-themes; The role and competence of the RTT; Continuity and relationships; Isolation; High-tech environment; Active participation and Knowledge and guidance. The main theme and sub-themes are illustrated in Figure 1.

![Figure 1](image)

The results are integrated with notions on care by Kari Martinsen with reference to the Danish philosopher Loegstrup, suggesting that the RTTs must be very aware of their role in the encounter with the individual; including being responsible for building trust and protecting the continuity in the relationship. The results suggest that structural issues in the health care system, such as efficacy and task prioritization, can jeopardize the relationship and communication between the RTT and the patient.

Conclusion: The results of the study provide evidence to work more actively with ensuring continuity during the radiotherapy trajectory to provide a higher level of care and communication with the individual patient. In addition, the study introduces an increased awareness amongst RTTs regarding their specific role in the patients’ experiences of a radiotherapy trajectory.

PV-0225 Investigating optimal modality for boost treatment of left breast with deep inspiration breath hold

A. Sen1, A. Michalski1, B. Done1, A. Windsor2
1Central Coast Cancer Centre, Radiation Oncology, Gosford, Australia
2University of New South Wales, Faculty of Medicine, Randwick, Australia

Purpose or Objective: Deep inspiration breath hold (DIBH) for breast boost requires photons due to the limitations of the Varian RPM DIBH monitoring equipment, precluding the use of electrons. Traditionally, an electron boost was felt to be superior compared to photons due to their rapid dose fall off and resultant low dose to the heart and short treatment time. If an electron boost was deemed superior, this would need to be delivered with the patient free breathing (FB) due to aforementioned limitations. The primary aim of this study is to compare photons at DIBH to electron boost at FB with regards to plan quality and organ at risk (OAR) constraints to the heart and lungs in left sided breast patients. The secondary aim was to assess if the dosimetric detriment of the inferior modality would detract from the benefits gained in Phase 1, whole breast DIBH treatment.

Material and Methods: Twenty consecutive patients undergoing radiotherapy to the left breast with DIBH were identified. All patients underwent dual CT scans at DIBH and FB as per the standard departmental protocol. A boost treatment was retrospectively planned with electrons on the FB scan and photons on a DIBH scan to a prescription on 10Gy in 5 fractions. PTV coverage, mean and maximum, doses to the heart and left anterior descending artery (LAD) and mean doses to the lungs were compared. The results were further analysed by the location of the boost volume as defined by breast quadrants.

Results: Doses to the planning target volume (PTV) and mean heart doses were comparable between photons and electrons. Maximum heart doses reduced by 60% while maximum and mean LAD doses reduced by 54% and 51.2% respectively using photons, while mean left lung dose reduced by 43%. These reductions were seen across all four breast quadrants.

Conclusion: Dosimetrically photons was a superior modality when compared to electrons in phase 2. Left breast treatment maintaining benefits to the heart and lung gained through DIBH without compromising PTV coverage. The results were applicable regardless of the location of the boost volume. The increase in mean lung, maximum heart and maximum and mean LAD doses would negatively impact on the dosimetric benefit seen during DIBH for Phase 1 of left breast treatment.

PV-0226 Pattern of relapse of glioblastoma treated with Stupp protocol: could a margin reduction be proposed?

S. Pedretti1, M. Buglione2, P. Borghetti1, L. Costa1, L. Triggiani1, L. Pegurri2, P. Ghirardelli2, F. Foscarini2, S. Pandini1, L. Spiazzi3, G. Tesini1, C. Uccelli2, F. Salani1, S. Magrini1
1Spedali Civili di Brescia, Radiation Oncology, Brescia, Italy
2Brescia University, Radiation Oncology, Brescia, Italy
3Spedali Civili di Brescia, Medical Physics, Brescia, Italy

Purpose or Objective: To analyse the pattern of recurrence and acute and late toxicity of 105 patients treated with Stupp protocol in relation to both radiotherapy technique (3D, IMRT and helical IMRT) and treatment volumes; to compare in silico plans with reduced GTV-CTV margin (1 cm) with the original ones (2 cm). The CTV-PTV margin (5 mm) was maintained.

Material and Methods: Relapse was considered as in field, marginal and distant if more than 80%, 20-80% or <20% of the relapse volume was included respectively in the 95% isodose. In silico plans with reduced margin were retrospectively re-calculated using exactly the same technique, the same field angles and, if possible, the same TPS of the original plans. Statistical analysis was performed with SPSS® software.

Results: Eighty-five patients had local recurrence: 3 were excluded because underwent follow-up MRI at FB with hospitals; 14 because the original treatment plans were not recoverable. The analysis was therefore executed on 68 patients. They were in field, marginal and distant respectively in 88%, 10% and 2% of the cases. This pattern of