**EP-1930**

**Cancer patient experience of slow, single arc rotation to simplify radiation therapy delivery**

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**Purpose or Objective:** Conventionally in radiotherapy, a large beam forming apparatus is rotated around a stationary patient in order to achieve multiple beam angles. However, for a number of emerging and existing treatment modalities such as proton therapy, heavy ion therapy, MRI guided therapy, and synchrotron based therapies, such an approach results in prohibitively expensive and complex treatment systems. At the same time, much of the world has no access whatsoever to even conventional radiation therapy treatments. Replacing the gantry rotation with patient rotation could lead to much simpler and more cost effective treatment units. However, it is often assumed that patient acceptance would be a major barrier to widespread use of such a system. The purpose of this work was to test this assumption by investigating patient tolerance to slow single arc rotation.

**Material and Methods:** The Epley Omniax (Figure 1) is a clinically approved medical device conventionally used in balance disorder therapy, and can rotate 360 degrees around each axis. We used this device to test patient tolerance to slow, single arc rotation. Each patient underwent slow, single arc rotation in two orientations; sitting and lying. Patients were rotated a full 360 degrees in increments of 45 degrees. The rotation was paused for 30 seconds at each 45 degree increment to simulate beam delivery; in total this simulates the delivery of 8 beams. Patients were rotated in both an upright (sitting) and lying position in the same session. Response was monitored via validated psychometric questionnaires for claustrophobia, anxiety, and motion sickness. Thus far, 10 of a planned 15 current or former cancer patients have been recruited.


Figure 1: The Epley Omniax was used to test patient response to both upright and lying rotation to enable simplified and cost effective treatment machines

**Results:** Patient tolerance has been high – 9 out of 10 have completed the study without incident, and in general patient feedback has been positive. One patient was unable to complete the lying rotation, but was still able to complete the sitting rotation without issue. No detectible differences in anxiety or motion sickness have been observed from either sitting or lying rotation. A summary of the patient cohort and results thus far is outlined in table 1. Accrual for this study is ongoing.

Table 1: Outline of patient cohort and key results. Where 'percent' is used, 100 is the maximum possible score and 0 the minimum. The last two entries show the difference in patient's anxiety and motion sickness scores before and after the study.

| | Mean | Std. Dev. | Range |
|---|---|---|---|
| Age (years) | 62 | 13 | 39-78 |
| Weight (kgs) | 77 | 12 | 65-100 |
| Time since last RT treatment (months) | 34 | 60 | 0-168 |
| Claustrophobia Score (percent) | 24 | 18 | 1-50 |
| Difference in Anxiety Score (Before/after - percent) | 2.2 | 32 | 0-78 |
| Difference in motion sickness score (Before/after - percent) | -6 | 10 | -25-0 |

**Conclusion:** Patient rotation could enable much simpler treatment for both conventional and advanced treatments – however, it is often assumed that patient tolerance to rotation would be very low. The results generated thus far show that there is at least a cohort of patients who would find slow rotation an acceptable therapeutic intervention.

**EP-1931**

Abstract withdrawn

**EP-1932**

**Quality assurance in implementing a national dose escalation trial in NSCLC – report from NARLAL2**

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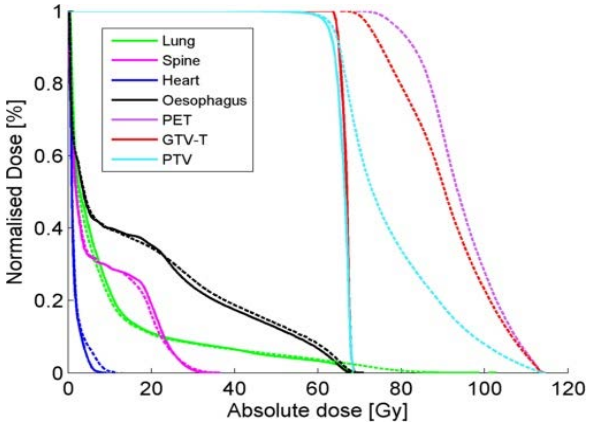
**Purpose or Objective:** Potential severe or lethal toxicity in regards to dose escalation of locally-advanced NSCLC patients calls for caution. A national quality assurance program was conducted over a period of three years in Denmark in order to prepare for the heterogeneous FDG-guided dose escalation phase 3 trial: NARLAL2.

**Material and Methods:** A national work group consisting of clinical oncologists and medical physicists was established. Different workshops were conducted in order to standardise 1) delineation of organs at risk (OAR) and target, 2) PET determination, 3) treatment planning, and 4) IGRT and adaptive strategy. In the standard arm, the planning target volume (PTV) is prescribed a homogeneous mean dose of 66 Gy / 33 fractions (fr). For the experimental arm, the mean dose is heterogeneously escalated up to 95 Gy / 33 fr for the most FDG-PET active part of the primary tumour and 74 Gy / 33fr for malignant lymph nodes ≥ 4 cc. The escalation is always limited in favour of OAR constraints. Dose constraints were added to reduce the risk of severe complications. Besides the traditional spinal cord, heart and oesophagus delineations, thorax wall, aorta, bronchi, trachea, and connective tissue (here defined as any remaining voxels in mediastinum not included in other OARs or GTV) were delineated. A maximum dose of D1cc < 74 Gy for these OARs was chosen as safe dose constraints (D1cc < 70 Gy for oesophagus). An online catalogue with examples of such delineations was created for oncologists. The randomisation is performed when both the standard and escalated plans are clinically accepted. The two treatment plans, delineations and images are prospectively exported to a national database, which requires a consistent naming convention for delineations within each centre. Endpoint of trial is local control and the standard procedure for suspicion of tumour recurrence is biopsy. For cases where biopsy is not applicable, a central committee has been established to evaluate each case. Blood samples are obtained during the treatment course for future examination.

**Results:** Dose-volume-histogram data for the standard (solid) and escalated (dashed) arms for one patient is presented (Figure 1). Centres entering the NARLAL2 trial must successfully pass a workshop evaluation on delineation, PET determination, treatment planning, and IGRT strategy. Additionally, all participating centres should expect to enrol ≥5 patients/year, use 4D-CT and PET, inverse treatment planning, daily online match on soft tissue, and have an adaptive treatment strategy. Planning and treatment of the initial two patients within each centre are thoroughly investigated by a small QA work group consisting of 2 clinical oncologists and 4 physicists. Furthermore, every six month each centre will be visited by an external oncologist in order to ensure that guidelines are still followed throughout the duration of the trial.




**Conclusion:** The NARLAL2 trial started patient accrual in January 2015 based on this extensive QA work.

**EP-1933**

**End-to-end dosimetric audit – comparison of TLD and lithium formate EPR dosimetry**

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**Purpose or Objective:** The purpose of the study was to compare a lithium formate dosimetry system with a lithium fluoride TL dosimetry system as used in a solid phantom developed for remote end-to-end audits of advanced radiotherapy treatments, such as IMRT and VMAT. This type of inter-dosimeter comparison is of benefit for better understanding of advantages and limitations in the use of these dosimeters in remote audit programs for radiotherapy.

**Material and Methods:** A phantom was designed by a multinational coordinated research group (Coordinated Research Project E24018) with the intention to be used for remote end-to-end audits of advanced radiotherapy treatment (IMRT and VMAT). The phantom is made of polystyrene and includes solid water volumes representing a target region (PTV) and an organ at risk (OAR) with two measurement points in each. For an audit, the phantom is to be loaded with either TLD or EPR dosimeters and sent to external clinics to be treated using their local procedure for IMRT or VMAT. Dimensions of the active volume of the dosimeters used were: 20 mm length and 3 mm diameter for TLD, 5 mm height and 4.5 mm diameter for the EPR dosimeter. In addition, gafchromic film is used in the audit but this is not a subject of the current study. Irradiations were performed using VMAT technique and the doses determined by the TLDs and EPR dosimeters were compared with the TPS calculated doses.

**Results:** The absorbed dose determined by the EPR and TL dosimeters agreed within 2% with the TPS calculated doses in the PTV. In the OAR the discrepancy was larger; the dose determined by the EPR system was 3% lower compared to the TPS dose while the dose determined by the TLD was 5% higher than the TPS dose. The dose difference in the OAR was expected to be larger due to the steep dose gradients in this region over the dosimeter volume and the phantom positioning uncertainties involved.

**Conclusion:** Both dosimetry systems agree with the TPS calculated doses within 2% in the PTV and 5% in the OAR. This study shows that both dosimetry systems give results acceptable for this application and can be used for remote dosimetry audits of IMRT or VMAT. The EPR dosimeters have higher resolution due to their smaller size. This is an advantage of the EPRs over the TLDs since it is possible to resolve dose gradients to a higher extent.

**EP-1934**

**Event reporting and learning in radiotherapy: evaluation over 4 years**

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**Purpose or Objective:** Radiotherapy is one of the primary treatment options in cancer management. Radiotherapy is recognised as one of the safest areas of modern medicine; however, when errors occur, the consequences for the patient can be significant.

The rapid development of new technology has significantly changed the way in which radiotherapy is planned and delivered. Quality and safety programs in radiotherapy have been recommended by international bodies, such ESTRO and AAPM.

The purpose of this work is twofold: to report on the long-term use of an event reporting and learning system in an RT department to record and classify events, and to compare a restricted access system to an open-access system

**Material and Methods:** A voluntary web-based safety information database for RT was designed for reporting individual events in RT and was clinically implemented in 2011. An event was defined as any occurrence that could have, or had, resulted in a deviation in the intended delivery of cancer care. The aim of the reporting systemm was to encourage process improvement in patient care and safety.

During the RT process, when something goes wrong and results in event, it is initially recorded and reported within the RT Department. Initially only the management group registered events. From June 2012 all team at RT Department (radiation oncologist, radiation therapists, medical physicists, nurses, technicians, dosimetrists, medical secretary) can directly register events. All events were analyzed inside a management group who selected and proposed actions to be taken.

**Results:** We analyzed events from 2011 to 2014 for 6108 patients who have undergone radiation treatment at our hospital. Over this period of time 298 events were reported. After the event reporting system became open access (June 2012), the registered number of events increased significally: from 22 in 2011 to 44 in 2012, 120 in 2013 and 112 in 2014. The spectrum of reported deviations extendent from minor workflow issues to errors in treatment delivery.

The distribution of the professional who registered the event was: