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S 01 TOWARD MRI-ONLY ADAPTIVE PROTON THERAPY: EXPERIMENTAL VALIDATION OF DIRECT MRI-BASED DOSE CALCULATION AND PLAN RE-OPTIMIZATION IN EX VIVO BIOLOGICAL TISSUE

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Aims In adaptive proton therapy, repeated imaging is needed to capture anatomical changes and guide plan adaptation. Computed-tomography (CT) enables dose calculation but adds imaging dose, whereas magnetic-resonance-imaging (MRI) avoids this exposure and provides excellent soft-tissue contrast, but does not natively support proton dose calculation.

MRI-derived synthetic-CTs are increasingly investigated, but their use in proton therapy remains challenging because inaccuracies in stopping-power estimation can directly translate into proton range errors. We recently proposed a deep-learning framework for direct proton dose calculation on MRI, avoiding synthetic-CT generation and its associated uncertainties and processing time (Li et al. (2025): <https://doi.org/10.1016/j.phro.2025.100806>). Following retrospective simulations, we experimentally evaluated this approach in ex-vivo biological tissue against the clinical CT-based standard.

Methods The direct-to-MRI dose calculation algorithm uses deep-learning to map MRI-derived anatomical information and beam parameters directly to Monte-Carlo-simulated proton dose distributions. For experimental validation, MRI and CT scans of two ex-vivo pig heads were acquired for initial treatment planning and algorithm fine-tuning. A two-beam proton plan, using beam angles of 50° and 80°, was optimized to deliver 2 Gy to an L-shaped target.

Two days later, repeat MRI and CT scans were acquired. Treatment plans were re-optimized directly on MRI and, for comparison, on CT representing the clinical standard workflow. The re-optimized plans were delivered to sectioned pig heads equipped with Gafchromic films for relative dosimetric measurements. Planned and measured dose distributions were compared using 3%/3 mm global gamma analysis with a 20% dose threshold.

Results All gamma pass rates comparing calculated and measured dose were above 92.6%. For direct MRI-based re-optimization, gamma pass rates ranged from 92.6% to 95.2%. For the reference CT-based re-optimization workflow, gamma pass rates ranged from 94.9% to 97.8%.

Conclusions Direct MRI-based proton dose calculation and plan re-optimization achieved dosimetric agreement close to the conventional CT-based workflow in this first experimental validation in ex-vivo biological tissue. By

avoiding synthetic-CT generation, this approach may simplify and accelerate MRI-guided adaptive proton therapy while reducing additional imaging dose. Although further validation, quality assurance strategies and clinical workflow integration are required, these results support the feasibility of direct MRI-based adaptive proton therapy.

SHORT TALK

S 02 SAKK 16/18: QA AND DELIVERY OF NEOADJUVANT IMMUNE-MODULATORY RADIOTHERAPY IN RESECTABLE STAGE III(N2) NSCLC

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Purpose SAKK 16/18 is a prospective multicenter phase II trial exploring immune-modulatory RT to enhance neoadjuvant PD-L1 blockade after chemotherapy in resectable stage III(N2) NSCLC. We report on the QA and delivery of immune-modulatory RT.

Methods Patients with resectable stage IIIA-B(N2) NSCLC received three cycles of cisplatin/docetaxel followed by single-dose durvalumab and one of three

randomized RT regimens: 20 x 2 Gy (arm A), 5 x 5 Gy (B), or 3 x 8 Gy (C; prescribed to the 65-80% isodose line). Patients then underwent resection, followed by adjuvant durvalumab for one year. The primary endpoint was 12-month event-free survival, with exploratory analyses evaluating potential differences between RT regimens.

Immune-modulatory RT was delivered to the primary tumor only, with strict constraints for OARs and metastatic LN in the mediastinum. RTQA procedures included a pre-trial dummy run, and plan reviews of each center's first patient per arm.

Results Eighty-eight patients (median age 64 years) were enrolled at 14 sites between 07/2020 and 07/2025. Dummy runs were completed by all centers, with major deviations observed in 2 (5%) out of 39 test plans. Thirty-seven pre-treatment reviews were performed, revealing two major deviations (chest wall and in-PTV hot-spot).

Eighty-two patients (93%) underwent immune-modulatory RT, all completed as planned. Median GTV and PTV measured 13.0 cc (0.5-250.6) and 44.7 cc (5.1-402.5), respectively. PTV D95% was a median of 38.3 Gy (arm A), 24.0 Gy (B) and 22.9 Gy (C). D50% delivered to primary GTV/ITV equated to a median $BED_{\alpha/\beta=10Gy}$ of 48.4 Gy (arm A), 37.7 Gy (B) and 55.6 Gy (C). Dmean to mediastinal LN metastases was median 3.3 Gy, and median lung Dmean was 3.9 Gy and 2.1 Gy for ipsilateral and total lung, respectively. The contralateral lung was spared, with a median V5Gy of 0%.

Interim safety results were presented previously, with 30-day postoperative mortality of 0% in the first 25 patients, and RT accounting for 4% of all adverse events.

Conclusion SAKK 16/18 introduced and delivered neoadjuvant immune-modulatory RT in a multicenter trial for patients with resectable stage III(N2) NSCLC undergoing perioperative chemo-immunotherapy. The primary endpoint will be presented in 2027.

SHORT TALK

S 03* **D-GUIDE: DOSE-DRIVEN CONTOUR GUIDANCE FOR EFFICIENT REVIEW IN ONLINE ADAPTIVE RADIOTHERAPY**

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Aims: A major challenge in implementing online adaptive radiotherapy is the time-intensive process of reviewing daily contours. Significant time is often spent correcting contours with minimal dosimetric impact. To address this, we developed D-GUIDE (Dose-driven Guidance for Uncertainty-Informed Delineation Edits), a visual guidance map to streamline manual revision of automatically

generated contours. We hypothesized that such guidance could improve efficiency while maintaining dosimetric accuracy.

Method: D-GUIDE combines multiple independently generated auto-contours, obtained from deformable image registration-based propagation and AI-based segmentation, into voxel-wise contour uncertainty maps. For organs-at-risk (OARs), uncertainty maps were transformed into reduced and expanded contour representations and the difference in the relevant clinical endpoint between the two was used to filter what to inspect both at the structure and slice level. For targets, high dose-gradient regions are incorporated to prioritize uncertainty map regions with potential higher impact on target coverage. The framework was evaluated retrospectively in 10 head-and-neck proton therapy patients with a total of 44 repeat CTs and corresponding expert manual reference contours. D-GUIDE-guided correction was simulated by replacing highlighted contour regions with the corresponding manual contours. Plans optimized on D-GUIDE-corrected contours were compared with plans optimized on uncorrected auto-contours and with manual-contour reference plans.

Results: Fully automatic contour use resulted in 40/308 organ-at-risk endpoint failures, defined as deviations >5% of the prescribed dose relative to the manual-contour reference plan, with a maximum deviation of 21%. With D-GUIDE-guided correction, failures were reduced to 7/308 and the maximum deviation to 12%. No target D98% failure was observed after D-GUIDE-guided correction. Over all OARs, D-GUIDE highlighted only 5% of the boundary voxels (36% of OARs flagged, 36% of slices selected within flagged OARs and 42% of the in-slice boundary voxels highlighted). For targets, all structures were flagged, but review was spatially restricted to 51% of the target boundary voxels.

Conclusions: D-GUIDE provides binary, spatially resolved contour guidance that combines auto-contour uncertainty with dose relevance for both OARs and targets. Based on this proof-of-concept study, D-GUIDE may serve as a dose-informed quality assurance tool to support efficient verification and correction of auto-generated contours in time-constrained online adaptive workflows.

S 04* CUMULATIVE DOSE METRICS INCLUDING BIOLOGICAL EFFECTIVE DOSE FOR DAILY ONLINE ADAPTIVE RADIOTHERAPY IN ESOPHAGEAL CANCER

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Aims: Online-adaptive-radiotherapy (oART) addresses anatomical changes through daily plan reoptimization. Cumulative dose metrics (CDM) can estimate total treatment dose parameters by averaging dose parameters across fractions or accumulating daily doses on the planning image (pCT). We implemented biological effective dose (BED) accumulation to account for daily fraction-dose distribution variations and compared it to conventional physical-dose-based CDMs for esophageal cancer (EC) oART.

Methods: 26 patients with EC received CBCT-guided oART with 50.4 Gy in 28 fractions to median PTV. CDMs were computed for CTV/PTV target coverage (D95%, D99%), PTV/CTV D5%, lung and heart Dmean, Lung V20Gy and spinal-canal Dmax. DoseAcc used the physical dose, and BEDacc the BED ($\alpha/\beta = 10$ Gy for target and 3 Gy for organs-of-interest), accumulated on pCT. MeanOnFx averaged endpoints over all fraction doses. MeanOnpCT averaged fraction-endpoints after dose propagation to the pCT. Physical CDMs were converted to BED for comparison. For each endpoint, CDMs were compared using Friedman's test and posthoc pair-wise comparison (Wilcoxon test with Holm correction). Note that DoseAcc is always equal or lower than BEDacc (mathematically proven), so it was not included in the statistical comparison.

Results: CDMs for lung or heart endpoints were not significantly different. They were for PTV/CTV and spinal-canal with the following significant post-hoc pair-wise differences: MeanOnpCT for target coverage were 1.2-5.5 Gy lower than BEDacc while CTV/PTV D5% and spinal-canal Dmax were 0.8-3.8 Gy higher. MeanOnFx for target coverage were 2.3-19.9 Gy higher than MeanOnpCT while CTV/PTV D5% and spinal-canal Dmax were 0.5-1.1 Gy lower. BEDacc target coverage was 1.2-14.3 Gy lower and spinal-canal Dmax was 3.3 Gy lower than MeanOnFx. All BEDacc endpoints were at most 0.2 Gy higher than DoseAcc.

Conclusions: Averaging (MeanOnFx, MeanOnpCT) overestimates degradation in near-max and (near-)min doses by neglecting dose distribution effects. In particular,

it neglects that daily plan reoptimization distributes spinal-canal Dmax. Propagating dose distributions optimized on daily images and contours onto pCT (MeanOnpCT, accumulated dose and BED) is affected by contouring inconsistencies and propagation uncertainties. Accumulating physical dose or BED was equivalent in oART.

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SHORT TALK

S 05 UP-FRONT NECK TRIAL: DEFINITIVE (CHEMO)RADIOTHERAPY WITH OR WITHOUT UP-FRONT NECK DISSECTION FOR REGIONALLY ADVANCED HEAD AND NECK SQUAMOUS CELL CARCINOMA

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Aims: Up-front neck dissection (UFND) before definitive (chemo)radiotherapy ((C)RT) may reduce toxicity in node-positive head and neck squamous cell carcinoma

(HNSCC), but has not been tested against (C)RT alone in a randomised trial. We assessed whether UFND reduces toxicity without compromising oncological or quality-of-life (QoL) outcomes.

Methods: Multicentre, open-label superiority trial (NCT02918955) at two university hospitals, 2016–2023. Patients declining randomisation entered parallel observational cohorts (comprehensive cohort design). Adults with cT1–4 cN1–3 cM0 HNSCC of the oropharynx, hypopharynx or larynx received RT to 70 Gy with cisplatin as indicated, alone or after modified radical neck dissection. The primary endpoint was grade ≥ 3 toxicity within 90 days of RT. Risk ratios (RR) were estimated by modified Poisson regression, prespecified in the fully randomised set (FRAS) and additionally in the inverse-probability-weighted full analysis set (FAS).

Results: Of 221 assessed, 66 (30%) were enrolled and 65 analysed (26 randomised, 39 observational; 37 (C)RT, 28 UFND+(C)RT). Median follow-up was 55.6 months. Although grade ≥ 3 acute toxicity was non-significantly less frequent after UFND (FRAS 23% versus 31%, RR 0.75, $p=0.69$; FAS 29% versus 43%, RR 0.68, 95% CI 0.33–1.39, $p=0.29$), as were late grade ≥ 3 toxicity (24 months, FAS 5% versus 16%, RR 0.37, $p=0.37$) and cumulative grade ≥ 3 burden (mean difference -0.20 , $p=0.37$). No differences occurred in disease-specific ($p=0.58$) or overall survival ($p=0.91$), locoregional control ($p=0.47$) or progression-free survival ($p=0.14$, all FAS); no isolated nodal recurrence occurred. No Clavien–Dindo grade IV–V complications occurred. Tracheostomy in place after radiotherapy (4% versus 3%, $p=0.81$) and feeding-tube dependence (26% versus 35%, $p=0.51$) did not differ. Swallowing at 3 months (primary QoL endpoint) did not differ (-0.01 , 95% CI -0.12 to 0.10); shoulder problems were worse after UFND (-0.24 , 95% CI -0.39 to -0.09). The commonest reason for non-enrolment (53/155, 34%) was contraindication to UFND, mostly regarding accessory nerve.

Conclusions: UFND was safe and feasible, but superiority was not demonstrated and no clear oncological or QoL benefit was detected in this underpowered comparison; confidence intervals were wide and compatible with benefit and harm. Given added shoulder morbidity and no demonstrated benefit, routine UFND before definitive (C)RT cannot be recommended.

SHORT TALK

S 06 WEEKLY 6 X 6 GY BLADDER RADIOTHERAPY IN THE ELDERLY: A SINGLE-INSTITUTION DOSIMETRIC AND CLINICAL ANALYSIS

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Background: Elderly patients with bladder cancer may be unsuitable for standard multimodal treatment. We evaluated feasibility, dosimetry, disease control, toxicity, and survival after six-fraction ultra-hypofractionated radiotherapy (uhRT).

Methods: We retrospectively analyzed 24 patients treated between July 2021 and June 2026. Twenty elderly patients received homogeneous 6 x 6 Gy; four a 6 x 5 Gy with simultaneous 6 Gy boost. Treatment was applied once weekly in 23 patients. Dosimetry was benchmarked against HYBRID trial rectal and other-bowel constraints. Local failure was defined as definite tumor progression on clinical assessment, imaging, or histology, or the need for additional local tumor treatment. Positive bladder-wash cytology or equivocal cystoscopy alone was considered indeterminate; these cases were counted as failures only in the sensitivity analysis. Acute toxicity comprised on-treatment or ≤ 90 -day events; late toxicity was >90 days.

Results: Mean/median age was 86.8/87 years (range, 70–93); 21/24 presented with cT2–3 M0 disease. Prescribed treatment was completed in 23/24 (95.8%). Median rectum V28/V36 was 2.3%/0.0% (IQRs, 0–4.6 and 0–0.2), other-bowel V28/V36 was 16.0/1.1 cm³ (IQRs, 8.0–39.5 and 0–6.3), respectively. All plans met acceptable HYBRID limits; ideal V36 limits were met for rectum in 24/24 and other bowel in 22/24. Mean/median observed follow-up was 14.1/11.1 months. Among 17/24 (70.8%) classifiable patients, local control was 15/17 (88.2%). Cystoscopy showed definite local progression in two patients, neither of whom had histological confirmation. Two additional cases with positive wash cytology and/or equivocal cystoscopy alone were considered indeterminate; five remained unassessed. Counting indeterminate cases as failures, 15/19 yielded local control (78.9%). Regional and distant progression occurred in 1/13 and 3/12 assessable patients, respectively. Grade ≥ 3 GU/GI acute toxicity or symptoms occurred in 2/23 (8.7%), late toxicity in 3/15 (20.0%); one and two, respectively, were at least possibly uhRT-related. Twelve deaths occurred; the median overall survival was 25.0 months, 12-month survival was 65.2% (95% CI, 40.5–81.6).

Conclusion: Weekly six-fraction radiotherapy was feasible in this elderly patient cohort, local control was 88.2% after a mean/median follow-up of 14.1/11.1 months. Grade ≥ 3 late events were observed in 3/15 assessable patients (20.0%). Longer follow-up and larger cohorts are needed to define the true late-toxicity burden.

S 07 INSPECTION CAMPAIGN BY THE FEDERAL OFFICE OF PUBLIC HEALTH IN SWISS RADIOTHERAPY CENTRES WITH A FOCUS ON QUALITY MANAGEMENT, RISK MANAGEMENT AND ARTIFICIAL INTELLIGENCE – FIRST RESULTS

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1. Federal Office of Public Health, Radiation Protection Division

Aims

Assessment of patient and staff safety in radiotherapy is one of the main goal of the Federal Office of Public Health (FOPH) as the competent radiological protection authority for medical applications in Switzerland. With the aim of ensuring a safe operation and a high-quality care of patients in radiotherapy (RT), the FOPH launched a new inspection campaign in all Swiss RT centres, focusing on quality management systems (QMS), prospective risk management (RM) and the integration of artificial intelligence (AI).

Methods

Three months before the inspection, a structured questionnaire on QMS, RM and AI applications is sent to the radiotherapy centre for preparation. The inspections are conducted by FOPH inspectors. The centre presents its self-assessment, and a written report with major results and recommendations is issued by the FOPH within two weeks. The campaign runs from September 2025 to December 2027.

Results

So far, 12 out of 34 inspections are completed. All centres show high clinical and technical quality and meet legal radiation protection requirements, but marked heterogeneity is observed across the three focus areas. RT QMS ranges from ISO 9001:2015-aligned electronic systems and group-wide integrated frameworks (e.g. DKG-certified tumour centres) to discipline-specific systems only loosely connected to the hospital-wide QMS. Critical incident reporting systems (CIRS) are established in all centres, but a structured interface to the hospital-wide CIRS is frequently absent. RM is the most heterogeneous domain: some centres have implemented extensive prospective frameworks covering several hundred process steps with explicit risk-acceptance levels and established methods such as Failure Mode and Effects Analysis (FMEA), while others rely on pragmatic, experience-based and mainly retrospective approaches without a designated risk manager. AI is currently used almost exclusively for auto-contouring of organs at risk under human supervision; formal frameworks for introduction, validation, monitoring and integration into RM are only emerging.

Conclusions

The campaign reveals a wide spectrum of QMS, RM and AI maturity in Swiss RT centres. The FOPH will use the consolidated findings to disseminate best practices, support centres in formalising RM and AI governance, organise regional QMS/RM meetings and a national radiation safety culture day for RT.

SHORT TALK

S 08 40 YEARS OF RADIATION ONCOLOGY- A PERSONAL ACCOUNT

Dr. Markus Notter¹

1. Radio-Onkologie

Aim: To compare the standard of care in radiation therapy (RT) over the last 40 years, and present the advancements that took place over this time.

Method: The author was first introduced to radiation oncology in 1982, and has been actively treating patients since 1984. Personal anecdotes, notes, treatment documents and photos will be utilized to demonstrate the comparison of bygone techniques to the modern treatment approaches that are currently used today.

Results: In the year of 1982, there were a very limited number of CT scanners in all of Switzerland and at this moment in time, it was inconceivable that there may also be applications for treatment planning. The initial attempts to acquire a CT scanner at my first RT institution were refused, as planning and dose calculation had been traditionally performed by hand. The significant role of physicists was established once linear accelerators were introduced in the clinical setting. Treatments were achieved by mounting standardized blocks on the collimator of the machine to define the treatment field. These blocks were eventually individually cast for each patient, ensuring a more conformal and individualized treatment. The accepted dose for a single fraction of RT was 1.8-2.5Gray (Gy), with 2.5Gy being the maximum dose that one would prescribe. This approach to dose fractionation was later revised and patients can now be treated with a much higher dose per fraction when applicable. With all of the advancements made in radiation oncology, it has become an important partner in modern oncological treatments.

Conclusions: Tremendous improvements have been made in the field of radiation therapy including but not limited to adaptive radiotherapy, stereotactic radiotherapy and radiosurgery, lattice therapy and hyperthermia in conjunction with radiation. All of the aforementioned innovations are now a part of the standard practice in this ever evolving field.

S 09 PRE-CALCULATED BEAMLETS FOR ONLINE ADAPTIVE RADIOTHERAPY TREATMENT PLANNING

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Aims: Online adaptive radiotherapy (oART) requires new fraction plans to be adjusted to daily patient anatomy in minutes. One time-consuming step is beamlet calculation, which determines the dosimetric contribution of small, grid-arrayed sub-beams to patient anatomy. We investigate under which anatomical criteria beamlets from previous fractions can be reused for online plan optimization.

Methods: Beamlet reuse criteria were first characterized using emulated daily anatomical changes (PTV translation, shrinkage, elongation) in an academic phantom, followed by evaluation in clinically motivated cases (lung, esophagus, head-and-neck). Phantom, lung, esophageal, and head-and-neck plans had identical setups (2-arc VMAT, 6MV photons), with prescribed doses (D_p) of 60, 60, 50.4, 54Gy delivered in 30, 30, 28, 27 fractions, respectively. In phantom, an ellipsoidal PTV was sagittally translated by 2.5cm, isotropically shrunk from 619 to 208cm³, and elongated along the major axis from 619 to 742cm³. Beamlets from the first 20% of fractions were used for full plan optimization, final dose calculation and monitor unit weight re-optimization of remaining fractions. Subsequently, beamlet reuse appropriateness was characterized by relating dosimetric quality (dose-volume metrics) to volumetric and spatial similarity between fraction anatomies (PTV [cm³]; Dice similarity coefficient, DSC; mean surface distance, MSD; Hausdorff distance, HD95). Plan quality metrics and calculation times were compared against full online replanning with ground-truth recalculated beamlets in clinical cases and phantom as reference.

Results: In phantom, pre-calculated beamlets for elongation yielded near-identical dosimetry (Dmean averaged over 3 OARs: +0.16%, NormalTissue Dmean: -0.13%), whereas shrinkage degraded dosimetric quality (average OAR Dmean: +1.4%, NormalTissue Dmean: +0.32). For head-and-neck, pre-calculated beamlets with 20% PTV shrinkage degraded plans (D5%: +1.8%), but within acceptable limits. For esophagus, all pre-calculated beamlets yielded high-quality plans (D95% within $\pm 2.0\%$ of D_p). Overall, structural similarity criteria of MSD<2.5mm, HD95<2cm, and DSC>0.85 yielded adequate plan quality, while reducing average per-arc computation time from 34 to 13 minutes.

Discussion & Conclusions: Pre-calculated beamlets derived from early fractions yield clinically adequate plan quality in <40% of the time of online replanning for provided cases. Methods are proof-of-concept and not optimized for speed.

Supported by SNSF grant 10001696 and partly Siemens Healthineers through its business line Varian.

SHORT TALK

S 10 CLINICAL EDITING OF DEEP LEARNING-BASED ORGAN-AT-RISK AUTO-SEGMENTATIONS IN ROUTINE RADIOTHERAPY: A GEOMETRIC AND DOSIMETRIC ANALYSIS ACROSS THREE ANATOMICAL SITES

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Aims: Deep learning-based auto-segmentation (DLAS) of organs at risk (OARs) is increasingly used in radiotherapy, but safe implementation requires quality assurance (QA) incorporating both model performance and clinician review. While geometric accuracy, clinical acceptability, and dosimetric effects have been studied in controlled settings, evidence on real-world editing behaviour remains limited. We aimed to characterize contour adjustments across three anatomical cohorts and assess their dosimetric relevance to define QA strategies for clinical DLAS use.

Methods: This retrospective single-institution study compared auto-segmented (Theraplanacea ART-plan V2.3.3) and clinically approved OAR contours in 200 pelvic, 200 thoracic, and 199 head-and-neck/brain (HNB) cases treated between February and December 2025. Contours present in both auto-segmented and clinical structure sets were evaluated geometrically using relative surface Dice (rSD) with a 1-mm tolerance (rSD < 1 defines as adjusted contour) and dosimetrically using changes in mean and maximum dose from the clinical plan. For selected OARs, changes in structure-specific dose-constraint parameters were also assessed. Temporal trends were evaluated using logistic regression, and reviewer-related variability (total of 22 reviewers) within the dominant treatment subgroup of each cohort using Cramér's V.

Results: Adjustment ratios among paired contours were 20.8% (pelvic), 7.3% (thoracic), and 17.9% (HNB), ranging from 0.5% for femoral heads to 94.5% for the pharynx.

Predefined dose-change thresholds (>2 Gy mean or >3 Gy maximum dose) were exceeded in 40.2%, 14.4%, and 34.5% of adjustments, respectively. Structures near target volumes, including the bladder, penile bulb, pharynx, and parotids, showed the greatest dosimetric impact. Adjustment frequency showed modest temporal changes (odds ratios 0.90–0.98 per month), without a marked progressive shift over time. Reviewer identity showed weak associations with adjustment decisions (Cramér's V 0.07–0.21), strongest in thoracic and HNB cases.

Conclusions: Most DLAS-generated OAR contours were retained without adjustment in routine practice, but editing frequency varied substantially between structures, cohorts, and reviewers. A meaningful subset of adjustments produced notable changes in dose metrics. These findings support the consideration risk-stratified, dosimetrically informed QA approaches that prioritize structures most likely to require clinically consequential correction rather than uniform review intensity for all auto-segmented contours.

SHORT TALK

S 11* **MARGIN REDUCTION IN ONLINE ADAPTIVE RADIOTHERAPY USING “UP-TO-NOW” OPTIMIZATION**

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Aims: We propose up-to-now (UTN)-optimization: a novel online adaptive radiotherapy (ART) optimization strategy incorporating accumulated dose to compensate for inter-fraction over- or underdosage. This work investigates the potential for CTV-to-PTV margin reduction enabled by this UTN-strategy via an in silico case study.

Methods: One clinically motivated esophageal cancer case (50.4 Gy in 28 fractions) with daily synthetic CTs (sCTs) was used. Five CTV-to-PTV margins (0, 2, 5, 7, 10 mm) were explored. For each margin, three treatment strategies were compared: (1) conventional non-adaptive radiotherapy (cRT); (2) standard online ART (stdoART); (3) UTN-oART, where re-optimization accounts for the sum of the accumulated dose up-to-now and the currently optimized, yet-to-be-delivered dose. All plans utilized a three-arc VMAT beam setup and were generated using an in-house optimizer with the same objectives. For dosimetric comparison, all fraction doses were accumulated onto the sCT of the last fraction.

Results: Reducing the CTV-to-PTV margin compromised CTV coverage, while improving sparing of proximal organs at risk (OARs), (e.g. lungs and heart). Across the evaluated margins, the CTV D_{95%} ranged [35.2-47.2] Gy for cRT, [44.4-48.8] Gy for stdoART, and [48.8-49.8] Gy for UTN-

oART, while the reference plans (planned dose on planning CT) CTV D_{95%} ranged [48.4 – 49.6] Gy. For stdoART and UTN-oART, the largest margins yielded better CTV D_{95%}. Conversely, cRT achieved its best D_{95%} with a 5 mm margin, as OAR dose constraints degraded CTV D_{95%} with larger margins. Notably, UTN-oART maintained CTV D_{95%} even at margins <5 mm and increased CTV D_{95%} compared to the reference plans for 5, 7, and 10 mm margins. CTV D_{95%} was equivalent for cRT with a 5 mm margin, stdoART with 7 mm, and UTN-oART with 2 mm but UTN-oART reduced the mean heart dose by >2 Gy with similar doses to other OARs compared.

Conclusions: UTN-oART demonstrates the potential to maintain CTV D_{95%} at CTV-to-PTV margins smaller than 5 mm. This margin reduction improves proximal OAR sparing, as demonstrated by a mean heart dose reduction exceeding 2 Gy in the evaluated case.

Supported by SNSF grant 10001696 partly by Siemens Healthineers through its business line Varian.

SHORT TALK

S 12 **A NOVEL TREATMENT PLANING APPROACH FOR BREAST WITH LYMPH NODES INCLUDING MAMARIA INTERNA**

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1. Stadtsptal Zürich

Purpose: Volumetric Modulated Arc Therapy (VMAT) is the current standard technique for breast cancer radiotherapy including lymph node irradiation, but achieving adequate target coverage while sparing healthy tissue remains challenging, particularly for complex cases. RapidArc Dynamic (RAD), a novel technique integrating dynamic arcs with Static Angle Modulated Ports (STAMPs), has been proposed to improve dose distribution. This study comprehensively compared VMAT and RAD with respect to target coverage, organ-at-risk sparing and plan quality.

Methods: A paired-sample study was conducted using four breast cancer patient datasets (n=4; 2 left-sided and 2 right-sided), with each patient serving as their own control. A RAD treatment plan (2 arcs with 5 STAMPs) was compared with the corresponding clinical VMAT plan. Evaluated endpoints included clinical goals for the ipsilateral lung and heart, as well as target coverage of the primary breast PTV (PTVp), nodal PTV, and internal mammary node (IMN) PTV. Plan quality was evaluated using the Homogeneity Index (HI) and Conformity. Statistical significance was evaluated using a paired Student's t-test (p<0.05), and effect sizes were quantified using paired Cohen's d.

Results: RAD achieved significantly better primary target coverage (PTVp V95%), with 98.3±1.6% compared with 95.5±2.0% for VMAT (p=0.01, d=2.85). It also demonstrated a lower HI (0.13±0.03 vs. 0.16±0.02; p=0.09, d=1.24), indicating a more homogeneous dose distribution. RAD also achieved lower mean doses to the

heart ($2.28 \pm 0.16\text{Gy}$ vs. $2.44 \pm 0.25\text{Gy}$; $p=0.05$, $d=1.53$), while the reduction in ipsilateral lung dose ($12.44 \pm 0.43\text{Gy}$ vs. $12.80 \pm 0.65\text{Gy}$; $p=0.14$, $d=1.01$) showed a large effect size despite lacking statistical significance. Coverage of the nodal and IMN PTVs, conformity, and other organ-at-risk clinical goals showed no statistically significant differences between the techniques. In one challenging case, the IMN PTV could not be included in the clinical VMAT plan because organ-at-risk constraints were exceeded. RAD successfully achieved IMN coverage while maintaining comparable organ-at-risk doses.

Conclusion: Despite the limited sample size, RAD demonstrated dosimetric advantages over clinical VMAT, providing superior primary target coverage, more homogeneous dose distributions, and trends toward improved heart and lung sparing. In addition, RAD proved to be a promising planning tool for complex breast cancer cases.

SHORT TALK

S 13* **PREDICTING RADIOTHERAPY RESPONSE FROM DNA DAMAGE RESPONSE GENES USING BIOLOGY-INFORMED NEURAL NETWORKS**

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Radiation therapy dose prescription remains largely defined on population averages, lacking personalization for individual radiosensitivity. Although the genomic-adjusted radiation dose (GARD) was proposed to address this, it relies on a limited 10-gene transcriptomic signature. We present a comprehensive investigation of biology-informed (BI) deep learning models to predict radiosensitivity from transcriptomic profiles, aiming to improve current prediction methods.

We benchmarked a BI graph-neural-network (DRPreter), representing 94 DNA Damage Response (DDR) KEGG pathways (254 genes) as interconnected subgraphs using high-confidence STRING interactions, against GARD, BulkFormer (RNA-seq foundation model), TabPFN (tabular foundation model), Logistic regression and a multilayer perceptron.

Models were trained using either gene expression or pathway activity scores (GSVA), with feature selection applied to either the DDR genes or the full transcriptome (~19,000 genes), yielding a reduced set of the most informative features in both cases.

Feature selection and hyperparameter optimization were performed through nested cross-validation. All models were trained using a pan-cancer CCLE/DepMap transcriptomic data (1406 cell lines), using Survival Fraction at 2Gy (SF2) from the NCI-60 panel to define a balanced binary classification dataset of 344 radiosensitive/resistant cell lines. To reduce overfitting, strategies included contrastive pretraining (~1000

unlabeled cell lines), data augmentation, pathway graph pruning and transfer learning were applied. The top-performing approach was validated against GARD on radiotherapy-treated patient cohorts (TCGA-GBM, TCGA-LUSC, TCGA-HNSC, TCGA-BRCA, GSE190826) using log-rank p-value and cox-regression C-index as evaluation metrics.

Restricting inputs to DDR-related genes/pathways consistently improved prediction performance, with gains of up to 0.07 ROC-AUC over full-transcriptome inputs. TabPFN trained on DDR genes achieved the best performance (ROC-AUC 0.74 ± 0.02), outperforming GARD (ROC-AUC 0.58 ± 0.03) and our best performing BI-GNN (ROC-AUC 0.66 ± 0.02), emphasizing the advantage of pretrained foundation models in small-data settings. Survival analyses across chemoRT and RT-only cohorts showed improved patient stratification using MLP and TabPFN predictions compared with GARD. The strongest survival associations were obtained with MLP-KEGG in TCGA-GBM chemoRT ($p=0.0012$) and TCGA-LUSC RT-only ($p=0.0022$).

DDR-informed feature selection substantially improves radiosensitivity prediction, with even simple models outperforming existing approaches such as GARD. Graph-based DDR modeling remains constrained by limited labeled data, indicating the need for improved semi-supervised and transfer learning approaches.

SHORT TALK

S 14 **CONSTRAINED SPATIOTEMPORAL FRACTIONATION FOR BRAIN METASTASES**

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Aims Stereotactic radiotherapy (SRT) offers effective treatment of multiple brain metastases with improved healthy brain sparing relative to whole brain radiotherapy. Nevertheless, increasing metastasis count elevates the risk of treatment-related toxicities: higher mean doses to healthy brain tissue are associated with neurocognitive decline, while larger healthy brain volumes exposed to high doses increases the risk of radionecrosis. Constrained spatiotemporal fractionation (cSTF) is investigated as a novel concept to reduce healthy brain BED. By treating different metastases to different doses in distinct fractions, cSTF can achieve hypofractionation in the target with uniform fractionation in the healthy brain. In this study we further quantify the benefit of cSTF through

characterization of the trade-off between the dosimetric goals of minimizing the volume of healthy brain receiving a high dose and minimizing the mean healthy brain dose.

Methods

For 23 patients harboring 6-95 brain metastases, we generated 3-fraction UF and cSTF plans, each delivering a prescribed cumulative BED₁₀ of 43.2 Gy to all metastases with dose conformity. Optimization minimized the mean healthy brain BED₂ and volume receiving a BED₂ higher than 60 Gy (V60). Patients were stratified into two subgroups by metastasis count: 6-20 (median: 15, 13 patients) and ≥20 (median: 44, 10 patients).

Results Across all cases, cSTF yielded lower mean healthy brain BED₂ compared to UF, while maintaining comparable or superior V60 BED₂. In the cohort of 6-20 metastases, the median reduction in mean healthy brain BED₂ was -1% (Q1;Q3: -0.7;-2.5%), with a comparable or marginally increased V60 (median: 0.3%; Q1;Q3: 0.0;0.6%). In the cohort of ≥20 metastases, a more pronounced median reduction in mean healthy brain BED₂ of -11% was observed (Q1;Q3: -4;-13%), accompanied by a comparable or slightly decreased V60 (median: -0.6%; Q1;Q3: -1.7;0.4%). The biggest reductions were -18% (65 metastases) and -4.4% (95 metastases) for mean BED₂ and V60, respectively.

Conclusion

Compared to UF, cSTF yields reductions in mean healthy brain BED₂, with slight improvements in V60. Dosimetric benefit increases with the number of metastases, suggesting that cSTF is particularly advantageous for patients with a higher metastatic burden.

SHORT TALK

S 15 ASSESSING THE FEASIBILITY OF LONGITUDINAL INDIVIDUAL CANCER LESION TRACKING THROUGH IMAGE REGISTRATION

Mr. Maksym Fritsak¹, Dr. Hubert Gabrys¹, Dr. S. M. Christ¹, Dr. Jonas Willmann¹, Dr. Urs Mühlematter¹, Dr. Alexander Maurer¹, Prof. Martin Hüllner¹, Prof. M. Guckenberger¹, Prof. Stephanie Tanadini-Lang¹

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Introduction

The increasing availability of longitudinal cancer imaging data enables studies of the temporal behavior of individual cancer lesions. However, individual lesion tracking across serial imaging examinations remains a challenging and labor-intensive task. This study investigates the feasibility of using image registration to automatically track individual cancer lesions over time.

Materials and Methods

A longitudinal FDG-PET/CT metastatic melanoma dataset consisting of 115 patients with 975 unique manually tracked cancer lesions across three imaging time points

was analyzed. Two registration approaches were evaluated: (1) conventional, consisting of rigid and affine registration and (2) deep learning (DL), with the open-source uniGradICON model.

The follow-up CT scans were registered to baseline. Lesion tracking performance was assessed based on lesion overlap correspondence. A follow-up lesion was considered correctly matched if it superimposed only with itself at baseline. Lesions present exclusively at follow-up were considered correctly matched when no overlap with any baseline lesion was observed. Different uncertainty margins and matching strategies were investigated.

Results At 0 mm uncertainty margin, DL-based registration achieved a substantially higher cancer lesion matching rate than conventional registration (87.3% vs. 68.4%). The highest correct matching rates were observed at a 5 mm margin, reaching 89.5% for DL-based registration and 73.8% for conventional registration. Increasing margins beyond 5 mm resulted in a gradual decrease in correct matching due to an increasing number of multiple-lesion overlaps. When lesion correspondence was determined using the nearest-lesion criterion instead of uncertainty margin, DL-based registration again consistently outperformed conventional registration across all evaluated distance thresholds. At a 10 mm nearest-lesion threshold, DL-based registration achieved a highest correct matching rate of 92.8%, compared with 80.1% for conventional registration. Increasing the matching radius further reduced the rate of missed cancer lesions but increased the proportion of incorrect nearest-neighbor assignments.

Conclusions Deep learning-based image registration enabled accurate longitudinal cancer lesion tracking, achieving an 87.3% correct matching rate without any uncertainty margin, 89.5% with 5 mm margin, and 92.8% when lesions were matched to the nearest lesion within a 10 mm radius. It consistently outperformed conventional registration, demonstrating its potential for automated longitudinal cancer analyses at lesion level.

SHORT TALK

S 16 COMBINED FLASH AND CONVENTIONAL RADIOTHERAPY: PERSPECTIVE FOR DUAL IRRADIATION FRACTIONATION PROTOCOLS

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Purpose/objective:

Maintaining dose conformity while benefiting from the FLASH sparing effect in future clinical protocols may prove challenging. One solution could be to combine ultra-high dose rate radiotherapy (FLASH-RT) with conventional dose rate radiotherapy (CONV-RT) within a treatment. Our research aims to systematically characterize the FLASH

sparing effect within such combined radiation protocols and to identify dependence of this effect on the magnitude of the FLASH-RT dose.

Materials/methods:

The abdomen of C57BL/6 mice and the skin of BALB/c mice were irradiated using the IntraOp Mobetron and the Oriatron eRT6 irradiators. Single fraction hybrid irradiation involved a split dose configuration of a boost dose delivered by FLASH-RT or CONV-RT followed by increased doses of CONV-RT, 1 minute later. Fractionated hybrid regimen consisted of three fractions with one or two fractions delivered by FLASH-RT and the remaining fractions delivered by CONV-RT. Abdominal and skin toxicity were assessed for each experimental configuration.

Results:

In the gastrointestinal toxicity model, a single fraction hybrid irradiation demonstrated the preservation of the FLASH sparing effect for the boost dose of 14 Gy, whereas reducing the boost dose to 10 Gy resulted in the loss of this effect. Similarly, single fraction hybrid skin irradiation revealed a significant sparing FLASH sparing effect for a 20 Gy boost dose. Reducing the boost dose negatively impacted the sparing effect. Fractionated hybrid regimen (FLASH-FLASH-CONV/FLASH-CONV-CONV) resulted in significant lower toxicity compared to delivering all three fractions by CONV-RT.

Conclusion:

By changing the size of the boost in a single fraction hybrid protocol, we were able to detect the presence of tissue specific dose thresholds, below which the FLASH sparing effect is not observed. Characterization of these thresholds is crucial for implementation of FLASH-RT in the clinic. Fractionated hybrid regimens demonstrated that increase in the number of CONV-RT fractions diminished the magnitude of the FLASH sparing effect. However, a substantial quantity of the FLASH sparing effect maintained when 1 or 2 out of 3 fractions were delivered by CONV-RT. In addition, our findings support the feasibility of hybrid irradiation approaches as a pathway for translating FLASH-RT into future clinical applications.

SHORT TALK

S 17 IMPROVING COMMUNICATION IN RADIATION ONCOLOGY: IS NARRATIVE MEDICINE UNDERRATED?

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Introduction: Narrative medicine/fictitious story-telling/abstract re-telling can be used to transfer critical medical information from health care staff to patients and their families. It is also a teaching tool for healthcare staff to discuss and improve professional conversation skills.

Material and Methods: In this "perspective" abstract a series of 7 microstories will be presented for a fictitious radiation oncology patient going from cancer diagnosis to radiation therapy and subsequently to a complete remission. Then, after a metastatic cancer recurrence, palliative care and a pre-terminal phase of the patients life are described, all by fictitious story telling. Could AI support or even replace such medical staff generated, human story telling with better tailored, even more concise microstories of a patients situation? This will be discussed comparing a staff written microstory of a radiation oncology patient with a twice optimized AI generated patient story using the same keywords.

Results: 7 fictitious microstories of a radiation oncology patient (Health Problem, Cancer Diagnosis, Radiation Therapy, Survival with/without Cancer, Medical Emergency, Palliative Care, Death) will be presented and discussed. Also at least two paired microstories will be presented written by a radiation oncology staff person vs. an AI generated microstory based on a real patient situation but in an anonymous way.

The potential impact of story telling in patients discussions and staff teaching is not yet known. Before widespread use carefully designed cohort studies in a specific cultural background are needed to document the potential benefit for patients, their families and radiation oncology health care staff.

Discussion:

Story telling is used worldwide to bridge a communication block in a human crisis or in a human emergency situation. Most Radiation Oncology patients face a crisis and/or an emergency situation during their treatment course. Therefore the impact of introducing narrative radiation oncology should be discussed. After an institutional pilot phase likely subsequent cohort studies designed with care for patient data protection, respecting ethical principles, feasibility and methodology could then be conducted. The systematic introduction of fictitious patients stories could both improve communication quality and eventually even shorten conversation time between radiation oncology staff and the patient.

S 18 CONFIDENCE OF RADIATION THERAPISTS IN IMAGE MATCHING: THE INFLUENCE OF EXPERIENCE AND IMAGE QUALITY IN A MULTI-MODALITY WORKFLOW

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Aims Accurate image matching is essential in image-guided radiotherapy, directly affecting treatment precision and patient safety. With the increasing implementation of new imaging modalities, evaluating Radiation Therapists' confidence during image matching is important for quality assurance and training. This study assessed Radiation Therapists' self-perceived confidence and investigated the influence of professional experience and factors contributing to uncertainty.

Methods Data were collected over two weeks from 150 patients treated by 10 Radiation Therapists with 1 month to 11 years of experience. Image guidance was performed using Cone-Beam CT (CBCT) and kV/kV imaging, with CBCT as the predominant modality. Confidence was rated on a 5-point scale (1 = very unsure, 5 = very sure), and image-matching duration was recorded. Treatments included SBRT, VMAT, and IMRT across multiple anatomical regions, including brain, head and neck, thorax, abdomen, pelvis, breast, bone metastases, axilla, and extremities.

Results

Among 150 image matches, confidence levels were 0% very unsure, 2% unsure, 5% neutral, 33% sure, and 60% very sure. In cases with reduced confidence, 56% were attributed to anatomical changes between planning and treatment images, such as bladder or rectal filling variations, 22% to image artefacts caused by implants or tracheostomy tubes, and 22% to other factors. No correlation was found between professional experience and confidence levels.

The image matches rated as "unsure" were reviewed offline, and no plan modifications were required. In one case, retrospective offline review by the Radiation Oncologist disagreed with a match despite the Radiation Therapists reporting high confidence. In two further cases, the Radiation Oncologist agreed with the match but requested additional imaging because of considerable anatomical changes.

Conclusion Radiation Therapists demonstrated high confidence in image matching independent of clinical experience. Uncertainty was mainly related to patient-specific anatomical variations and image quality rather than operator expertise. These findings indicate that future

training should focus on managing anatomical changes and image artefacts to improve confidence and consistency in clinical image matching.

SHORT TALK

S 19 THE VIRTUAL HOSPITAL IN RADIOTHERAPY: AN INNOVATIVE EDUCATIONAL TOOL TO BRIDGE THE THEORY-PRACTICE GAP

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Introduction: The framework curriculum of the Radiographers (TRM) program (PEC 22) structures the training around core competencies, which are further delineated into learning objectives and didactic scenarios. Despite a blended learning approach comprising lectures, simulations, workshops, tutorials, and a requirement of 20% independent study, several issues have emerged. Students struggle with self-directed learning, despite the availability of digital tools (notably e-learning and AI) and the activities designed by the faculty. Furthermore, they lack the contextual framework necessary to connect theoretical knowledge with clinical practice. Confronted with increasing student cohorts, limited on-site teaching hours, and diverse student profiles with specific scheduling constraints (extracurricular activities, commuting), teaching resources are under severe strain.

Objectives: This project aims to develop a novel educational tool based on a virtual hospital environment for learning activities in both radiology and radiotherapy. The primary goal is to provide greater meaning to the curriculum, foster self-directed learning, and simulate clinical reality (patient-centered care) to compensate for the limited practical immersion.

Methods / Project Description: The virtual environment facilitates the integration of fundamental radiotherapy concepts and the active application of clinical terminology (e.g., TNM classification, target volumes, irradiation techniques, immobilization devices). Specifically in radiotherapy, the tool offers immersive activities modeled on the patient pathway and the role of the RTT:

- Interactive clinical cases utilizing both textual data and medical imaging;
- Simulation workshops on a dedicated CT scanner focusing on patient positioning and the selection of immobilization devices;
- Contouring exercises to reinforce anatomical knowledge;
- Image registration (matching) sessions introducing radiological anatomy and adaptive radiotherapy (ART);
- Treatment planning via a direct link to the Eclipse Treatment Planning System (TPS) hosted on a local server.

Perspectives / Conclusion: This virtual hospital provides a flexible and contextualized framework, essential for stimulating student engagement outside of standard contact hours. Scheduled for initial implementation in the second year of the radiographer's curriculum, this platform is intended to be progressively expanded to other cohorts and potentially to cross-disciplinary collaborations, ultimately establishing itself as a sustainable solution to the logistical and pedagogical challenges in healthcare education.

SHORT TALK

S 21 POSTOPERATIVE NON-STEREOTACTIC IMRT/VMAT VERSUS GAMMA KNIFE RADIOTHERAPY FOR RESECTED BRAIN METASTASES: A SINGLE-INSTITUTION COMPARATIVE ANALYSIS

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Aims Postoperative radiotherapy (RT) is the standard adjuvant treatment after resection of brain metastases, typically delivered as stereotactic radiosurgery or fractionated stereotactic RT (SRS/SRT) to the resection cavity. Pachymeningeal failure (PMF) is an increasingly recognised relapse pattern after SRS/SRT, possibly associated with narrow margins. In 2021 our institution transitioned from Gamma Knife SRS/SRT to non-stereotactic, margin-expanded intensity-modulated/volumetric-modulated arc RT (IMRT/VMAT). We compared outcomes between both techniques.

Methods We retrospectively analysed 235 consecutive patients treated with postoperative cavity RT: 119 with IMRT/VMAT (25–30 Gy, all in 5 fractions, homogeneous prescription; clinical target volume = cavity + 2 mm including surgical tract and affected dura, plus 3–5 mm planning margin) in 2021–2024, and 116 with Gamma Knife SRS/SRT (14–27 Gy, 1–3 fractions) in 2010–2019. The primary endpoint was PMF; secondary endpoints were local failure, distant brain failure, leptomeningeal disease, symptomatic radiation necrosis (CTCAE grade 2 or higher) and overall survival. Cumulative incidences (death as competing event) were compared using Gray's test/Fine-Gray models; Overall survival using Kaplan-Meier and Cox models.

Results Median age was 62 years, median follow-up 13.4 months. The IMRT/VMAT cohort had a less favourable baseline profile (Graded Prognostic Assessment score, median 2.0 vs 2.5; concurrent brain metastases, mean 1.64 vs 0.75; preoperative tumour diameter 3.78 vs 3.27 cm; extracranial disease 65% vs 36%; all $p \leq 0.002$), whereas preoperative dural contact was comparable (85% vs 79%; $p = 0.29$). Cumulative incidence of PMF was 6.8% at both 12 and 24 months after IMRT/VMAT (8 events) vs 15.6% and 17.7% after SRS/SRT (21 events; Gray $p = 0.010$); after adjustment, IMRT/VMAT remained associated with lower PMF risk (subdistribution hazard ratio 0.42, 95% confidence interval 0.18–0.97; $p = 0.042$). Local failure (12/24 months 12.8%/15.5% vs 7.8%/14.8%; $p = 0.90$), symptomatic radiation necrosis (5.2%/9.7% vs 7.0%/12.0%; $p = 0.55$), leptomeningeal disease (5.1%/6.9% vs 3.4%/6.5%; $p = 0.37$) and distant brain failure (40.9%/45.7% vs 33.0%/38.1%; $p = 0.15$) did not differ. Median overall survival was 17.0 vs 19.2 months ($p = 0.58$).

Conclusions Non-stereotactic IMRT/VMAT was associated with a significantly lower incidence of PMF than Gamma Knife SRS/SRT, with similar local control and radiation necrosis. These findings derive from two consecutive treatment eras and warrant prospective validation.

SHORT TALK

S 22* / P 03* A RETROSPECTIVE STUDY OF REIRRADIATION PATTERNS OVER THE YEARS - DATA FROM A SINGLE INSTITUTION

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Background

Reirradiation has become increasingly common due to improved patient survival, advances in radiotherapy technology, and growing evidence supporting its safety and efficacy. Modern treatment techniques and advances in image registration, particularly deformable image registration (DIR), have enabled more accurate cumulative dose assessment, facilitating more conformal retreatment approaches and reassessment of organ-of-interest (OOI) constraints. However, the impact of these developments on clinical practice remains poorly characterised. This study investigated temporal changes in reirradiation patterns at a single institution, focusing on treatment techniques, prescription doses, and cumulative dose exposure.

Methods

All composite radiotherapy plan sums created between January 2015 and December 2025 at the University Hospital of Zurich were retrospectively extracted. These plan sums were generated using an in-house dose accumulation script to calculate Equivalent Dose in 2 Gy fractions (EQD2). Following data curation, non-reirradiation

cases were excluded, structure names were harmonised, and plan- and structure-specific dosimetric parameters were analysed. Temporal trends in treatment characteristics, cumulative OOI doses, prescription doses, and treatment techniques were evaluated using the curated reirradiation dataset.

Results

Following manual validation and data curation, a total of 1,317 courses in 1,056 patients were confirmed as reirradiation treatments and included in the analysis.

Repeated reirradiation was common, with 180 patients undergoing two reirradiation courses, 47 patients undergoing three or more courses, and a maximum of eight reirradiation courses observed in a single patient.

Seventeen OOs were analysed using harmonised structure nomenclature and institution-specific dose constraints. Temporal analyses of treatment courses, cumulative dosimetric parameters, and OOI threshold exceedances demonstrated substantial variation in reirradiation practice over the study period, reflecting the increasing complexity and utilisation of reirradiation treatments.

Conclusion

The observed patterns over the past decade suggest a growing acceptance of reirradiation and increasing confidence in delivering cumulative doses that exceed conventional reirradiation constraints and potentially a shift towards more personalised and more aggressive reirradiation strategies. Comprehensive analysis of real-world reirradiation data may help refine dose constraints, improve treatment decision-making, and inform future evidence-based guidelines for reirradiation.

SHORT TALK

S 23 PLASMA PROTEOMIC PROFILING OF CANINE OSTEOSARCOMA PATIENTS TREATED WITH MICROBEAM RADIOTHERAPY SUPPORTS ACTIVATION OF BONE REMODELLING AND ADAPTIVE IMMUNE RESPONSE

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Background-Unlike conventional radiation therapy (RT), which is limited by healthy tissue toxicity, sub-millimetre spatially fractionated RT, including microbeam RT (MRT), improves normal tissue sparing while maintaining tumour control. This study assessed the feasibility, safety and biological effects of MRT followed by standard-of-care carboplatin in companion dogs with spontaneous osteosarcoma, a translational model of human disease, focusing on systemic proteomic changes.

Methods-Four dogs with distal limb osteosarcoma underwent partial tumor irradiation with MRT at the Australian Synchrotron, followed by carboplatin. Tumors received an average peak-dose of 130Gy and valley-dose of 4.1Gy across a 20x20 mm irradiation field (17–40% of the gross tumor volume). Tumor and bone responses were assessed using computed tomography (CT), dynamic contrast-enhanced magnetic resonance imaging and histopathology. Serial plasma samples collected before treatment (T0), 2 hours (T1) and 7–12 days (T2) post-MRT were analyzed using the SomaScan™ platform, quantifying 7,289 proteins. Differential protein expression, Gene Set Enrichment Analysis (GSEA), and protein–protein interaction network analyses were performed to identify treatment-induced biological pathways.

Results-MRT was excellently tolerated in all non-cancerous tissues. No skin toxicity or alopecia was observed for up to six months (entrance peak dose: 160-185Gy). Dogs resumed weight-bearing within two

days after treatment (in-field valley dose to the bones: 0.3-4.2Gy; and peak dose 0-130Gy). Despite partial irradiation, tumours regressed beyond the irradiated field, with the unexpected replacement of tumour tissue by new bone, confirmed by CT and histopathology. Plasma proteomic analysis identified the greatest number of differentially expressed proteins at both post-treatment time points compared with baseline, indicating a rapid and sustained systemic response to treatment. GSEA revealed significant enrichment of biological processes associated with bone remodelling and adaptive immune activation. Network analysis of bone remodelling proteins revealed coordinated modulation of osteoclast-associated proteins (cathepsin K, p60-Src and IL-7), consistent with the initiation of bone resorption. Concurrent activation of WNT16, TGF- β 1 and PTH1R suggests osteoclast-osteoblast coupling to promote bone formation, while reduced sRANKL together with increased WNT16 indicates regulation of osteoclast activity, supporting a controlled bone remodelling programme.

Conclusion-

These findings support the clinical translational potential of microbeam radiation therapy as a safe and effective treatment for spontaneous osteosarcoma.

SHORT TALK

S 24 LONG-TERM OUTCOMES OF NASOPHARYNGEAL CARCINOMA TREATED WITH PENCIL BEAM SCANNING PROTON THERAPY

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Aims

To assess long-term oncological outcomes of pencil beam scanning proton therapy (PBS-PT) for patients with nasopharyngeal carcinoma (NPC) and explore whether proton arc therapy could reduce organ-at-risk (OAR) doses without compromising target coverage.

Methods

We retrospectively analyzed 50 NPC patients treated with PBS-PT between 1999 and 2026, with the majority treated after 2019. Overall survival (OS), disease-free survival (DFS), locoregional control (LRC), and distant metastasis-free survival (DMFS) were measured from PBS-PT initiation. In an exploratory planning analysis, 24 adults receiving a simultaneous integrated boost were replanned with proton arc therapy to model contemporary treatment. Arc plans were generated to maintain equivalent or superior target coverage relative to clinical multifield optimization (MFO) plans; OAR doses were then compared using Wilcoxon signed-rank tests with Holm-Bonferroni adjustment.

Results

Median follow-up was 50.2 months (95% CI 35.6–73.1, range 3.0–164.9). The 2- and 5-year estimates were 90.6% and 78.0% for OS, 75.2% and 71.7% for DFS, 76.8% at both time points for LRC, and 86.7% and 77.7% for DMFS. Target coverage was equivalent or superior with proton arc therapy. Arc plans reduced mean doses to 9 of 10 OARs after multiplicity adjustment (all adjusted $p \leq 0.003$) with the largest reductions in the inferior and middle pharyngeal constrictors (–20.3 Gy(RBE) [–63%] and –18.3 Gy(RBE) [–37%]), bilateral parotid stem cell regions (–12.6 Gy(RBE) [–51%] and –11.0 Gy(RBE) [–58%]), the oral cavity (–11.0 Gy(RBE) [–34%]), and bilateral parotid glands (–10.5 Gy(RBE) [–40%] and –9.4 Gy(RBE) [–39%]). All 24 patients had lower doses to both parotid glands, both stem cell regions, and the oral cavity. The right submandibular gland showed no significant reduction (–1.4 Gy(RBE), adjusted $p = 0.084$), possibly reflecting proximity to the target volume in a subset of patients.

Conclusions

PBS-PT provided durable disease control in this NPC cohort. Proton arc plans reduced doses to salivary and swallowing-related OARs without compromising target coverage supporting proton arc therapy as a promising approach for further normal-tissue sparing in NPC and warranting prospective evaluation incorporating adverse events and patient-reported outcomes.

SHORT TALK

S 25* REDUCED IRON RELEASE AND LIPID PEROXIDATION UNDER UHDR RADIATION: A MECHANISTIC BASIS FOR THE FLASH SPARING EFFECT VIA FERROPTOSIS EVASION

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Aims FLASH radiotherapy, utilizing ultra-high dose rates (UHDR, > 100 Gy/s), protects healthy tissue while maintaining the anti-tumor efficacy of conventional dose rate (CDR) radiation. The mechanisms behind this "FLASH effect" remain under investigation, but results of recent studies point toward the involvement of ferroptosis, an iron-dependent form of cell death triggered by the accumulation of lipid peroxidation (LPO) in cell membranes. Radiation can promote ferroptosis by inducing LPO and by increasing the free iron pool. We investigated how these processes depend on the dose rate.

Methods Irradiations were performed using an Oriatron eRT6 electron beam under UHDR and CDR modalities. Membrane damage was assessed in synthetic phosphatidylcholine liposomes containing various levels of polyunsaturated fatty acids, cholesterol, and α -tocopherol. LPO yield was quantified by oxygen consumption, malondialdehyde and hydroperoxides

production. To study iron dynamics, we evaluated superoxide-mediated Fe (II) release from ferritin using UV-Vis spectrophotometry across varying pH levels and dose rates. Free radical and superoxide yields were quantified by electron-paramagnetic resonance (EPR) spectrometry using various spin traps and spin probes.

Results

CDR causes progressive oxidative damage that physically alters and destroys membranes. In contrast, UHDR fails to trigger pro-ferroptosis LPO, mimicking the protective effects provided by high concentrations of antioxidants like tocopherol. Moreover, radiation-induced Fe(II) release from ferritin shows a strong dose-rate dependency, with CDR yielding several-fold more Fe(II) than UHDR. Reducing the pH to levels characteristic of the acidic tumor microenvironment significantly increases Fe(II) release in both radiation modalities. The suppression of Fe(II) release by superoxide dismutase confirms that radiolytic superoxide is the primary reducing agent driving this process. EPR measurements indicated similar yields of primary and secondary free radicals produced by UHDR and CDR, confirming that the FLASH effect appears at the level of superoxide- timescale.

Conclusions This study demonstrates that LPO and Fe(II)-release are highly dependent on the average dose rate. UHDR suppresses the pro-ferroptosis action of radiation, providing a mechanistic explanation for normal tissue sparing.

SHORT TALK

S 26 TOWARD PERSONALIZED RADIOTHERAPY: ASSESSING GENOMIC RADIOSENSITIVITY METRICS IN CANINE SINONASAL TUMORS

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Aims: Canine sinonasal tumors exhibit heterogeneous outcomes after radiotherapy. Predicting tumor radiosensitivity could enable personalized dose adaptation and subsequently improve treatment outcomes. In human oncology, a gene expression-based Radiosensitivity Index (RSI) and its derivative genome adjusted radiation dose (GARD) have been correlated with radiotherapy response in various tumors and may support individualized radiotherapy protocols. Whether this concept can be applied to canine tumors remains unanswered. By using modern genomic data extraction methods

(RNAsequencing) we evaluated the association with the established 10-gene-based RSI/GARD. We also tested broader predefined transcriptional signatures related to radiation response. Our future aim is to establish a fraction-dynamic-genome-based-radiosensitivity signature in order to apply personalized genome-adjusted radiotherapy.

Methods: The retrospective cohort comprised 76 dogs. RNA sequencing was performed on tumor tissue isolated by laser-capture microdissection (LCM) and/or scrolls to determine RSI, GARD and gene expression programs. Cox models evaluated OS, DSS and TTP, with Weight and log (GTV/Nasal) adjustment in 72 complete cases.

Results: In total, 60 deaths were observed, of which 42 were disease-specific. Median OS, DSS and TTP were 500, 695 and 399 days. Canonical RSI and GARD were not associated with any endpoint. Four DNA repair and cell-cycle related transcriptomic programs were associated with shorter OS. Short survivors showed significantly increased proliferation- and cell cycle checkpoint transcriptional activity that was not reflected by mitotic index.

Conclusions: Human tumor-cell derived canonical RSI and RSI-derived GARD could not be directly extrapolated to canine sinonasal tumors. Instead, transcriptional signatures related to G2/M, mitotic-spindle, spindle-assembly and HR-versus-NHEJ programs were associated with early mortality, particularly within the first-year post radiotherapy. These biologically relevant features were not reliably reflected by the mitotic index, highlighting the potential value of transcriptional profiling for clinical decision-making and, following prospective external validation, for radiotherapy stratification and dose adaptation in canine patients.

SHORT TALK

S 27 THE PROCEDURE FOR EXTRACORPOREAL RADIATION THERAPY IN THE DEPARTMENT OF RADIATION ONCOLOGY AT INSELSPITAL BERN

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Aim: To describe a rarely applied technique of high-dose extracorporeal single-fraction irradiation of a resected bone segment using a TrueBeam (Siemens Healthineers), followed by reimplantation and osteosynthesis. We present the preparation and implementation of this procedure at the Department of Radiation Oncology, Inselspital Bern, in a 63-year-old patient with chondrosarcoma of the superior pubic ramus and infiltration of the right hip joint. This technique enables reimplantation of the patient's own irradiated bone,

avoiding the need for allografts or prosthetic reconstruction. Following reimplantation, new viable bone may develop along the irradiated graft, whereas the irradiated bone itself progressively loses viability over time.

Methods: Prior to surgery, a CT scan (Philips Big Bore) of a Plexiglas box filled with rice was acquired. This dataset was used to generate a simple treatment plan designed to achieve the most homogeneous dose distribution within the box. A single dose of 50 Gy was prescribed to the center of the Plexiglas box. The treatment plan consisted of two opposing 10 MV photon fields delivered at a dose rate of 600 MU/min.

Results: On the day of surgery, the resected bone segment was transported from the operating room to the radiation oncology department under sterile conditions in triple vacuum-sealed packaging. The specimen was positioned centrally within the Plexiglas box filled with rice, maintaining sterility throughout the irradiation process. Correct positioning was verified by kV/kV imaging before irradiation. Treatment delivery on the TrueBeam required approximately 20–25 minutes. Following irradiation, the bone segment was returned to the operating room for reimplantation and fixation by osteosynthesis. The entire workflow was successfully completed while maintaining sterility and allowing accurate dose delivery within the required surgical timeframe.

Conclusion: Meticulous pre-treatment planning enables accurate and efficient extracorporeal single-fraction irradiation of resected bone segments. This workflow facilitates precise dose delivery within a short treatment time while maintaining sterility throughout the procedure, making the technique feasible for intraoperative clinical application.

SHORT TALK

S 28 **WORKFLOW AND EXPERIENCE OF INTRA OPERATIVE RADIATION THERAPY USING FREIBURG FLAP**

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Aims To present the interdisciplinary in-house workflow for intraoperative radiation therapy (IORT) using Freiburg flap applicators at Inselspital Bern and to report the long-term clinical experience with this treatment technique.

Methods At Inselspital Bern, high-dose-rate (HDR) brachytherapy-based IORT is delivered as a boost treatment for selected indications, including sarcomas and recurrent gynecological and gastrointestinal malignancies. The procedure is performed in a dedicated operating room equipped with radiation shielding. The workflow comprises three key steps: preparation, quality assurance (QA), and treatment delivery.

Following surgical tumor resection, the radiation oncology team enters the operating room for applicator preparation and treatment setup. The radiation oncologist customizes the Freiburg flap to match the tumor bed and inserts the applicator catheters. Applicator positioning and fixation are subsequently performed in close collaboration with the surgical team. Treatment planning is carried out by the medical physicist in the adjacent control room using Oncentra (Elekta), with a standard prescription dose of 10 Gy prescribed to a tissue depth of 5 mm. QA procedures include independent dose recalculation, verification of applicator positioning, visual inspection of catheter integrity, and catheter patency testing using a dummy source cable by the radiation therapy technicians.

Results Treatment is delivered using an HDR afterloader by the radiation therapy technicians. The radiation oncologist, medical physicist, and technicians remain present in the control room throughout the procedure to ensure patient safety and allow immediate intervention in the event of technical issues or emergencies.

Between June 2012 and June 2026, 330 patients underwent IORT at our institution, including 242 patients with sarcoma, 29 with recurrent gynecological malignancies, 38 with gastrointestinal malignancies and 21 with other indications. All treatments were completed successfully without major technical complications.

Conclusions HDR brachytherapy-based IORT using Freiburg flap applicators is a feasible and safe treatment modality that relies on close interdisciplinary collaboration among surgeons, operation nurses, radiation oncologists, medical physicists, and radiation therapy technicians. Standardized preparation, QA, and treatment workflows are essential to ensure safe, reliable, and reproducible treatment delivery in the operating room environment.

SHORT TALK

S 29 **IMPLEMENTATION OF A LINAC-BASED STEREOTACTIC WORKFLOW USING A DEDICATED STEREOTACTIC CONE COLLIMATOR, SURFACE-GUIDED RADIOTHERAPY AND CONE-BEAM CT FOR TRIGEMINAL NEURALGIA**

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Aims LINAC-based stereotactic radiosurgery has become an established treatment option for patients with medically refractory trigeminal neuralgia. This work aims to describe the implementation of a LINAC-based stereotactic workflow using a dedicated stereotactic cone collimator for the treatment of trigeminal neuralgia at Hôpital de La Tour. Particular emphasis is placed on MRI-CT image fusion, image-guided patient positioning, intrafraction motion monitoring, and the expanded roles of radiation therapists throughout the treatment process.

Methods Treatment preparation included CT simulation followed by complementary MRI acquisition. Radiation therapists performed MRI-CT image fusion and reviewed AI-generated organ-at-risk contours before treatment planning. Target delineation was subsequently completed by the radiation oncologist in collaboration with the neurosurgeon. Prior to treatment delivery, medical physicists installed the dedicated stereotactic cone collimator on the LINAC and performed quality assurance procedures, including verification of cone alignment. On the treatment day, patients were immobilized using a dedicated thermoplastic mask and positioned with surface-guided radiotherapy (SGRT), followed by cone-beam CT (CBCT) image guidance to verify and correct patient positioning before irradiation. Additional CBCT acquisitions were performed during treatment to confirm treatment accuracy, while continuous SGRT monitoring automatically interrupted beam delivery whenever predefined motion thresholds were exceeded.

Results The workflow was successfully implemented in routine clinical practice and applied to 11 patients with medically refractory trigeminal neuralgia. All treatments were completed as planned. The implementation of this workflow expanded the technical expertise of radiation therapists through the integration of MRI-CT image fusion, AI-assisted contour review, advanced image guidance, and continuous intrafraction motion management into routine clinical practice. For medical physicists, the workflow incorporated dedicated stereotactic cone installation and verification of cone alignment prior to treatment.

Conclusions

The implementation of this LINAC-based stereotactic workflow proved feasible in routine clinical practice and strengthened multidisciplinary collaboration. The integration of MRI-CT image fusion, a dedicated stereotactic cone collimator, CBCT and SGRT enabled a standardized and reproducible workflow while broadening the technical expertise of radiation therapists and introducing dedicated cone setup and alignment verification into the medical physics workflow.

professional role of Radiation Therapy Technologists (RTTs), a structured transition towards RTT-led hyperthermia treatment delivery was initiated in 2025.

Materials and Methods A phased implementation strategy was developed to transfer treatment responsibilities from radiation oncologists to RTTs. Initially, RTTs participated in treatment sessions alongside the radiation oncologist to gain experience with the hyperthermia device, treatment workflow, patient monitoring, and risk management. This was followed by dedicated educational sessions covering the principles of hyperthermia, clinical indications, treatment benefits, and potential complications. To further strengthen competencies, a multidisciplinary team consisting of RTTs, a radiation oncologist, and a medical physicist attended an ESTRO hyperthermia course focused on both technical and clinical aspects of treatment delivery. Following completion of the training programme, RTTs progressively assumed greater responsibility during treatment sessions under physician supervision.

Results Two RTTs successfully completed the training programme and have been independently delivering hyperthermia treatments since March 2026. A third RTT is currently undergoing training using the same structured implementation pathway. The responsible radiation oncologist is informed of all procedures and remains available as a backup for technical, clinical, or medical issues. The transition improved the utilization of physician resources, as the radiation oncologist is now required for approximately 10 minutes per treatment series instead of being present for five treatment sessions of approximately 75 minutes each, while maintaining appropriate clinical oversight. Furthermore, RTTs reported increased professional engagement through the acquisition of additional technical and clinical responsibilities.

Conclusion The transition from physician-led to RTT-led hyperthermia treatment delivery was successfully implemented within our department, demonstrating that RTT responsibilities can be expanded while maintaining close collaboration within the multidisciplinary team.

SHORT TALK

S 30 IMPLEMENTATION OF RTT-LED HYPERTHERMIA TREATMENTS: A PHASED TRANSITION FROM RADIATION ONCOLOGIST TO RADIATION THERAPY TECHNOLOGIST

Mr. Dinant Heuvelman¹

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Purpose/Objective Hyperthermia is an addition to radiotherapy, enhancing treatment effectiveness through controlled heating of target tissues. Since the introduction of hyperthermia in our department in 2022, all treatments were performed by a radiation oncologist, requiring approximately 75 minutes of physician presence per session. To optimize resource use and expand the

P 01* QUANTIFYING POSTURE-DEPENDENT RESPIRATORY MOTION FOR UPRIGHT RADIOTHERAPY USING AI-TRACKED CINE MRI

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Aims: Upright radiotherapy offers potential therapeutic and financial advantages, yet posture-dependent differences in intrafractional respiratory motion remain poorly understood. Characterising these variations is essential for safe upright treatment planning and dose delivery[1]. We hypothesised that posture significantly alters breathing-induced motion, which can be quantified using AI-based diaphragm apex tracking on supine and upright cine 2D MRI.

Methods: Fourteen healthy volunteers underwent torso cine 2D MRI imaging (EKNZ 2023-00764) on a 0.5T open system (HASTE sequence; TR/TE: 750/44ms). Continuous images were acquired in alternating sagittal and coronal planes centred on the liver apex, in both supine and upright positions. Each plane was acquired three times per position (152s each; total session duration 793–1557s). Following a day-one training session, day-two data were analysed. The diaphragm apex was manually identified on the first frame of each sequence and then tracked using CoTracker3 [2] after contrast-limited adaptive histogram equalisation. Tracking accuracy was visually verified for all images, and major errors were manually corrected. Superior-inferior motion was extracted, normalised to the median position, and evaluated. Supine versus upright motion was compared using mean peak-to-peak amplitudes across subjects, with significance assessed via a Wilcoxon signed-rank test.

Results: CoTracker3 provided accurate and robust tracking, including during most large-amplitude motion. We observed considerable inter- and intra-subject respiratory variability. Mean peak-to-peak breathing amplitude was 9.63mm (SD=4.38mm) in supine and 6.20mm (SD=2.05mm) in the upright position. Thirteen of fourteen volunteers showed reduced upright breathing motion compared to supine (reduction range: 2.13-70.51%), while one showed a 14.03% increase. Across the cohort, respiratory motion was significantly lower in the upright position, with mean and median reductions of 35.57% and 30.50%, respectively ($p < 0.001$).

Conclusion: AI-based tracking on 2D MRI effectively quantified a significant reduction in superior-inferior diaphragmatic motion when subjects were positioned upright compared to supine. While these findings suggest that upright positioning could mitigate respiratory motion challenges in radiotherapy, the observed inter-subject variability emphasizes the necessity of personalised motion assessment. Further validation in larger clinical cohorts is warranted to establish safe, posture-aware

treatment planning.

P 02 CLINICAL UTILITY OF PULMONARY FUNCTION TESTING AFTER LUNG STEREOTACTIC BODY RADIOTHERAPY: A SINGLE-CENTRE RETROSPECTIVE STUDY

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Aims: Follow-up pulmonary function testing (PFT) is routinely performed after lung stereotactic body radiotherapy (SBRT), but its clinical utility has not been quantified. We determined the number needed to test (NNT) to identify one clinically actionable follow-up PFT, and how PFT changes relate to respiratory management decisions.

Methods: We retrospectively analyzed patients treated with lung SBRT (2010-2022) for early-stage non-small cell lung cancer or pulmonary oligometastasis ($BED_{\alpha/\beta=10}$ Gy at least 100 Gy), with a baseline and at least one follow-up PFT. Follow-up PFTs were assigned to three pre-specified timeframes: 4-8, 10-14 and 22-26 months after SBRT. A pulmonary clinical action comprised pulmonology referral, change of respiratory medication or oxygen therapy, or respiratory-related hospitalization within the same timeframe. PFT decline was defined a priori as a 10% or greater relative decrease in pre-bronchodilator forced expiratory volume in 1 second (FEV_1) or carbon monoxide diffusing capacity. The primary endpoint was the per-PFT NNT. Predictors were assessed by pre-specified multivariable logistic regression (chronic obstructive pulmonary disease [COPD], baseline FEV_1 , tumor location).

Results: Ninety-six patients (median age 72 years, COPD diagnosis in 87.4%, median baseline FEV_1 50.5% predicted) contributed 174 follow-up PFTs. Clinical actions occurred at 47/174 PFTs (27.0%, 95% confidence intervals [CI]: 20.9-34.1) and in 37/96 patients (38.5%), yielding a per-PFT NNT of 3.7 (95% CI: 2.9-4.8), consistent across timeframes (3.5, 4.0 and 3.7). Median FEV_1 change was -2.0 to -3.0 percentage points and not statistically significant. Only 26-36% of PFTs meeting the decline threshold were followed by a clinical action, whereas 43-55% of actions occurred without a preceding decline. Baseline FEV_1 was the only independent predictor (odds ratio 0.97 per 1% predicted, 95% CI: 0.95-0.99, $p = 0.014$). Median pulmonary action-free survival was 27 months (95% CI: 17-29).

Conclusions: Approximately one in four follow-up PFTs after lung SBRT was temporally associated with a pulmonary clinical action (NNT 3.7). As actions frequently occurred without a threshold decline, this NNT is an upper bound of utility rather than proof of causal benefit. Prospective validation of risk-adapted surveillance, focused on patients with impaired baseline lung function, is warranted.

POSTER PRESENTATION

**P 04 THE ROAD NOT TAKEN:
WILLINGNESS TO ACCEPT PROTON
THERAPY AND THE TOXICITY REDUCTION
DEMANDED BY HEAD AND NECK CANCER
PATIENTS – A PROSPECTIVE STUDY**

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Aims: Model-based selection allocates proton therapy (PT) in head and neck cancer (HNC) according to the predicted reduction in normal tissue complication probability (NTCP), implicitly assuming expected benefits justify the travel and logistical burden at Switzerland's only PT center. Treatment is covered by mandatory health insurance, whereas travel, accommodation, disruptions of daily life and out-of-pocket expenses are not. We quantified willingness to accept referral, the minimum required risk reduction, and whether these preferences changed after treatment.

Methods: In this prospective single-center study, adults with newly diagnosed HNC undergoing curative-intent radiotherapy completed a six-item questionnaire before and four months after treatment, blinded to their baseline answers. Item 1 asked whether they would in principle accept PT. Items 2–6 asked how much lower each of the five NTCP endpoints of the Dutch model (grade $\geq 2/\geq 3$ dysphagia and/or xerostomia; photon anchors 30%/15%/65%/15%/30%) would have to be to accept. The analysis variable was the required absolute risk reduction (Δ = anchor – residual), compared between timepoints with Holm-adjusted Wilcoxon signed-rank tests.

Results: Of 97 patients, 55 were willing (56.7%, 95% CI 46.8–66.1), extrapolating to about 68 referrals per year. The required reduction was substantial (median Δ 25 of the 30-point anchor for grade ≥ 2 dysphagia); only 20–34% were satisfied at current selection thresholds. Δ was concordant with Item 1 (all $p < 0.001$); across 66 paired assessments, it did not change for any item (all adjusted $p = 1.00$) and was reproducible within patients (Spearman ρ : 0.50–0.63). Willingness was equally stable (McNemar $p = 0.109$). Acute toxicity reached grade ≥ 2 in 83% and grade 3 in 33%, yet the change in Δ was unrelated to

experienced toxicity (all $p > 0.30$). Median one-way travel time was 90 minutes and was unrelated to willingness ($p = 0.53$), to Δ , or to citing travel as a reason for declining ($p = 0.36$).

Conclusions: Most HNC patients would accept PT despite the logistical and financial burden, generating a relevant referral volume. The required reduction exceeds current selection thresholds, is internally consistent and stable across the peri-treatment period, so pre-treatment preferences need no time-based adjustment. Objective travel time did not explain willingness. Counselling should address perceived rather than measured burden.

POSTER PRESENTATION

**P 05 A FLEXIBLE DECISION-ANALYTIC
FRAMEWORK FOR EARLY COST-
EFFECTIVENESS EVALUATION:
APPLICATION TO ONLINE ADAPTIVE
RADIOTHERAPY FOR ESOPHAGEAL
CANCER**

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Aims: Online adaptive radiotherapy (oART) enables daily treatment-plan adaptation based on the patient's anatomy and may reduce radiation exposure to organs at risk. However, whether these dosimetric improvements translate into sufficient clinical and economic benefits in esophageal cancer remains uncertain. This study aimed to determine the magnitude of clinical benefit required for oART to be cost-effective compared with non-adaptive radiotherapy (nART) and to identify the outcomes most relevant for future prospective evaluation.

Methods: A flexible decision-analytic model was developed, comprising a short-term decision tree for acute treatment-related toxicities followed by a lifetime Markov model with 3-month cycles. The Markov model included four health states: disease-free remission, locoregional recurrence, distant recurrence, and death. Threshold analyses were used to translate reported dosimetric improvements into hypothetical clinical benefits based on published dose-response relationships. Scenarios included reductions in late toxicity and improvements in locoregional control and overall survival. Cost-effectiveness was assessed against a willingness-to-pay threshold per quality-adjusted life-year (QALY). The model was informed by data from patients with esophageal cancer treated at University Hospital Bern, including 56 patients receiving oART and a nART comparator cohort, supplemented by CROSS trial data for long-term transition probabilities and SEER data for broader oncological outcomes. Selection bias was addressed using propensity-score matching, inverse probability weighting,

and instrumental-variable analysis. Parameter uncertainty was evaluated through one-way and probabilistic sensitivity analyses.

Results: In the hypothetical base-case analysis, oART became cost-effective at an incremental cost-effectiveness ratio below USD 100,000/QALY when it achieved an approximately 11% reduction in treatment-related toxicity. The model also identified the long-term clinical parameters with the greatest influence on cost-effectiveness and, consequently, the outcomes that should be prioritized in prospective studies.

Conclusion: This framework enables early assessment of the clinical improvements required to justify investment in oART despite immature outcome data. It supports evidence-based technology-adoption decisions and informs the prospective collection of clinically and economically relevant endpoints. The framework may also be adapted to evaluate other emerging radiotherapy technologies.

POSTER PRESENTATION

P 06 X-RAY TUBE FOR SUB-MILLIMETER SFRT: INITIAL DOSIMETRIC ASSESSMENT

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Background and Aims:

Spatially Fractionated Radiation Therapy (SFRT) is gaining high interest following the first clinical implementation of X-ray minibeam SFRT at the Mayo Clinic (Rochester, USA). Sub-millimeter SFRT (sm-SFRT) relies on the delivery of arrays of beamlets ≤ 0.5 mm wide, with center-to-center spacing of a few millimeters at most. Peak doses delivered along the beamlet paths reach several tens of Gy per fraction, while valley doses are kept below the toxicity level of a few Gy. High doses delivery in sm-SFRT requires high dose rate radiation sources to reduce the treatment time and minimize the risk of dose smearing due to patient motion. This study provides the initial dosimetry assessment of an X-ray tube capable of dose rates output higher than conventional X-ray tubes used in clinics.

Methods:

Radiochromic film dosimetry was performed using the X-ray tube operating at 40 kW and 145 kVp. Beamlets arrays were generated using multislit collimators (MSC) with aperture widths of 0.5, 0.2, 0.1 and 0.05 mm. Dose rate and peak-to-valley dose ratio (PVDR) curves were measured in plastic phantoms. The source-to-sample distance was 20 cm, with the MSC positioned 3 or 15 mm upstream of the phantom, depending on setup constraints.

Results:

Dose rates at 1 mm depth were 44, 38, 30, and 23 Gy/min for 0.5, 0.2, 0.1, and 0.05 mm apertures, respectively. The

peak-to-valley dose ratio (PVDR) at 1 mm depth ranged from 17 to 10 and was strongly influenced by the beamlet spacing. Owing to the small focal spot size, PVDR values of 5 were maintained down to 5 cm depth, where peak doses remain approximately 20% of the entrance dose.

Conclusion:

The investigated X-ray tube can reduce irradiation time by a factor of five compared to conventional clinical systems in sm-SFRT. This initial assessment establishes baseline performance, although the current configuration was optimized for imaging rather than radiotherapy. (This work was partially funded by Siemens Healthineers. There is currently no product available, and future availability cannot be guaranteed).

POSTER PRESENTATION

P 07 FIRST IRRADIATIONS USING THE CIX FLASH IRRADIATOR FOR SUBMILLIMETER SPATIALLY FRACTIONATED THERAPY

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BACKGROUND AND AIMS: Unlike conventional radiotherapy (BBRT), which delivers homogeneous doses, sub-millimeter Spatially Fractionated Radiotherapy (smSFRT) generates highly heterogeneous dose distributions that improve tumour control while reducing normal tissue toxicity. Until recently, smSFRT required synchrotron facilities, limiting its clinical translation. Our group has adapted the XStrahl CIX FLASH X-ray device for smSFRT delivery, establishing a platform that has not yet been evaluated in biological models. We aim to demonstrate the feasibility of smSFRT with this platform across human and murine systems, enabling robust and reproducible irradiation protocols for multiple models.

METHODS: In vitro, ex vivo, and in vivo models were used to evaluate smSFRT. Irradiations were delivered at 150 kV and ~ 10 Gy/s, using field sizes of 5×5 to 20×20 mm². Samples received either BBRT (2–8 Gy) or smSFRT (200:800 μ m ctc; peak doses 10–50 Gy). HTB-140 and HaCaT cells were used for in vitro studies, ex vivo experiments used BALB/c mouse brain tissue, and in vivo models included 4T1 breast tumours and liver (BALB/c), as well as B16F10 ear melanomas (C57). All samples were fixed and stained for γ H2AX and DAPI for beam path visualization. In vitro cells were additionally used for 2D clonogenic assays.

RESULTS: γ H2AX staining clearly revealed peak and valley beam paths in all models. In vitro, these patterns persisted up to 24 h post-irradiation. Clonogenic assays demonstrated a dose-dependent decrease in surviving fraction for both BBRT and smSFRT. In vivo and ex vivo they were evident across entire organs from entry to exit points.

CONCLUSIONS: Irradiation of biological samples ex vivo using the CIX FLASH irradiation system was successful and enabled clear confirmation of the smSFRT pattern across both time and depth. This facilitates smSFRT research, enabling radiobiological studies to be performed in university settings without reliance on synchrotron facilities.

POSTER PRESENTATION

P 08 INTER-OBSERVER VARIABILITY IN TARGET VOLUME DELINEATION IN PATIENTS WITH EXTREMITY SOFT TISSUE SARCOMA AFTER NEOADJUVANT CHEMOTHERAPY AND HYPERTHERMIA: INSIGHTS INTO THE RT-QA PART OF THE TNT-HYPE (SAKK 57/24) MULTICENTER STUDY

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Aims: Accurate clinical target volume (CTV) delineation is essential in radiotherapy (RT) for extremity soft tissue sarcoma (eSTS), but remains subject to inter-observer variability. Contouring guidelines exist for neoadjuvant and adjuvant RT, but not for neoadjuvant RT after chemotherapy (ChT), where treatment-related anatomical changes must be considered. TNT-HYPE (SAKK 57/24, NCT06835049) is a prospective Swiss multicentre-trial investigating a neoadjuvant treatment-strategy (ChT

combined with hyperthermia, followed by RT and surgery). An RT quality-assurance dummy run evaluated inter-observer variability in target-volume delineation.

Methods: A dummy case showing marked tumor regression during ChT was distributed to sarcoma-specialized radiation oncologists at eight participating centres and an independent reviewer. Longitudinal CTV definition used pre-ChT MRI or post-ChT MRI in case of longitudinal progression or pseudoprogression, whichever showed greater tumor extent. Radial CTV definition considered both MRIs, with attention to initially tumor-contacting structures. After regression, initial tumor-tissue interfaces were identified in the post-ChT anatomy, with a 1.5 cm radial margin applied from these interfaces. All 28 pairwise comparisons between anonymized centre contours were analysed. Volumetric overlap was assessed using the Dice similarity coefficient (DSC), Jaccard index, and generalized conformity index (CIgen); boundary agreement using 3-mm surface DSC, 95th-percentile Hausdorff distance (HD95), and mean surface distance (MSD).

Results: Mean longitudinal CTV extent was 29.15 cm (range, 26.5–33.6) and mean volume was 2356.4 ± 249.5 cm³ (range, 1897.3–2645.3; max/min ratio, 1.39), compared with 2219.3 cm³ for the reference contour. Volumetric agreement was substantial (DSC, 0.86 ± 0.03; range, 0.81–0.93; Jaccard, 0.76 ± 0.05; CIgen, 0.742), whereas surface-based agreement was low (3-mm surface DSC, 0.56 ± 0.11; range, 0.35–0.76; HD95, 23.4 ± 10.3 mm; range, 7.3–50.4 mm; MSD, 4.9 ± 1.4 mm).

Conclusion: Neoadjuvant RT after ChT remains uncommon in adult eSTS. This single-case dummy run highlights inter-observer variability in identifying the original tumor-tissue interfaces after treatment-related anatomical changes and translating the pre-ChT CTV onto post-ChT anatomy, particularly after marked partial response. Despite substantial volumetric agreement, relevant boundary variability persisted. Consensus guidelines for this setting would therefore be desirable. The prospective TNT-HYPE patient cohort may support their development and validation.

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P 09 CORRELATION OF PATIENT-REPORTED TASTE IMPAIRMENT BETWEEN MDASI-HN AND EORTC H&N35 WITHIN THE PROSPECTIVE TASTE COHORT

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Aims: Taste impairment is a common toxicity in head and neck cancer patients undergoing radiotherapy (RT). Well established patient reported outcome measures (PROMs) for those patients include the MD Anderson Symptom Inventory Head and Neck module (MDASI-HN) and the EORTC-H&N35 questionnaire. To compare studies regarding quality of life it is essential that the PROMs used correlate well and that the symptom categories correspond to one another. The goal of this analysis was to evaluate the MDASI-HN and EORTC-H&N35 regarding their correlation in the same patients at the same time point specifically for taste impairment.

Methods: The prospective TASTE (Therapy-Associated Saliva and Taste change Evaluation) study collected MDASI-HN data at multiple time points (baseline, week 4, end of treatment, 6/12/24 months post-RT). A subgroup of patients at Cantonal hospital Aarau und University hospital Bern additionally completed the EORTC-H&N35 at the same visits. The MDASI-HN uses an 11-point Likert scale, with established severity thresholds for symptoms of 0 (none), 1–4 (mild), 5–6 (moderate), and 7–10 (severe). The EORTC-H&N35 rates symptoms across four ordinal categories: not at all, a little, quite a bit, very much. A cross-table was created to correlate the EORTC-H&N35 taste categories to corresponding MDASI-HN scores, with correlation tested using the Spearman rho test (significance threshold: $p < 0.01$).

Results: 102 patients were included in this subanalysis of the TASTE study (median age: 64, 80% male), mainly with oropharyngeal (N=51), oral cavity (N=21), and laryngeal cancer (N=10). Altogether, 313 taste ratings (1-6 per patient) of both, MDASI-HN and EORTC-H&N35 during the same study visit were available. In general, both questionnaires correlate well ($p < 0.001$). When defining the MDASI-HN categories according to the most frequent ratings of the respective EORTC-H&N35 in our patients, then MDASI-HN values of 0(-1) would represent no symptoms, (1-)2-3 mild, 4-7 moderate, and 8-10 severe symptoms.

Conclusions: The EORTC-H&N35 and MDASI-HN correlate well for taste impairment when using the MDASI-HN ratings from 0-10. However, when comparing the severity categories for taste, the adapted MDASI-HN thresholds proposed above should be preferred over the established thresholds, as the PROMs did not fully correspond otherwise in the moderate range.

P 10* A COMBINED GLOTTIC-SUPRAGLOTTIC MODEL OF IPSILATERAL LYMPHATIC SPREAD IN LARYNGEAL SQUAMOUS CELL CARCINOMA FOR ELECTIVE CTV PERSONALIZATION

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Aims: Current guidelines on elective nodal irradiation in head-and-neck squamous cell carcinoma (SCC) are based on population-level prevalence of lymph node involvement, without accounting for a patient's individual state of disease. A hidden Markov model (HMM) for oropharyngeal SCC was introduced, enabling personalized prediction of occult nodal involvement risk. The present work extends this framework to laryngeal SCC, focusing on its two most common subsites: the glottis and the supraglottis. The supraglottis presents much higher lymphatic involvement than the glottis, and in both subsites involvement strongly increases with advanced T-stage. A combined model describing these patterns for both subsites is proposed.

Methods: The model utilizes two mechanisms to describe the difference in involvement across T-categories: (1) advanced tumors are allowed more time to spread and (2) they are assumed to have grown into a space with more lymphatic drainage, which was implemented via a boosting mechanism increasing tumor-to-LNL spread probabilities by a factor upon transition to late T-stage. These mechanisms were also employed to describe higher supraglottic compared to glottic involvement. Motivated by the notion that advanced glottic tumors extend to the supraglottis, late T-stage glottic spread parameters were assumed to coincide with those of early-stage supraglottic tumors. Concretely, early T-stage glottic parameters were boosted to obtain shared late glottic and early supraglottic parameters, and further boosted to obtain late supraglottic parameters, such that a chain of boosting links the two subsites and, together with allowing supraglottic tumors more time on average to spread, enables modelling their involvement difference. Model parameters were inferred from 433 glottic and 360 supraglottic patients from three institutions.

Results: The model captured the involvement patterns for both subsites across early to late T-stage, with predicted

prevalences closely matching observed ones. For instance, for LNL II, the observed (predicted) prevalences were: 4% (3%) for early T-stage glottis, 17% (17%) for late glottis, 28% (25%) for early supraglottis, and 54% (55%) for late supraglottis.

Conclusions: The proposed HMM extension to laryngeal SCC successfully combines glottis and supraglottis into a joint model, capturing their different involvement patterns with a reduced parameter set compared to an individual modelling approach.

POSTER PRESENTATION

P 11 **TREATMENT PATTERNS, TOXICITY, AND ONCOLOGICAL OUTCOMES IN SYNCHRONOUS OR METACHRONOUS HEAD AND NECK AND ESOPHAGEAL SQUAMOUS CELL CARCINOMAS: A SYSTEMATIC REVIEW AND META-ANALYSIS**

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Background: Patients with synchronous or metachronous head and neck squamous cell carcinoma (HNSCC) and esophageal squamous cell carcinoma (ESCC) represent a rare and clinically challenging population. Management is complicated by the need to treat two malignancies, overlapping treatment fields, and cumulative toxicity. Evidence regarding prognosis, treatment patterns, and treatment-related adverse events remains limited. We systematically evaluated oncological outcomes and management strategies in this dual-primary cancer population.

Methods: Systematic review and meta-analysis were conducted according to PRISMA 2020 and registered in PROSPERO (CRD420251240593). PubMed, Embase, and Scopus were searched from 1999 till April 2026 and studies reporting treatment and/or oncological outcomes in patients with synchronous or metachronous invasive HNSCC and ESCC were included. Random-effects meta-analyses estimated pooled overall survival (OS), recurrence and metastatic patterns, treatment-related toxicity, and treatment patterns. Risk of bias was assessed using the Joanna Briggs Institute critical appraisal tool.

Results: Fifty-six studies comprising 2,244 patients were included; 94% were retrospective, 85.8% of patients were treated in East Asia, and 93.6% of patients in studies reporting sex were male. The weighted mean age was 59 years. Pooled OS was 67.8% (95% CI, 61.0–73.9) at 1 year, 48.5% (41.3–55.7) at 3 years, and 36.9% (29.4–44.9) at 5 years. Locoregional recurrence was more frequent than distant metastasis (23.1% vs 16.2%). Grade ≥ 3 treatment-related toxicity occurred in 44.5% of patients. Severe hematologic toxicity, mucositis, and dysphagia/esophagitis occurred in 29.2%, 22.7%, and 21.8%, respectively, while 38.9% required hospitalization. Surgery was the most frequently reported treatment modality (58.3%), followed by definitive concurrent chemoradiotherapy (29.7%). Exploratory analyses suggested differences between synchronous and metachronous disease, although interpretation was limited by small subgroup sizes and heterogeneity.

Conclusion: Patients with synchronous or metachronous HNSCC and ESCC experience poor long-term OS and substantial treatment-related toxicity due to multimodality treatment. Locoregional recurrence is the predominant failure pattern. Careful patient selection and coordinated multidisciplinary treatment planning are essential to balance disease control against toxicity and to optimize long-term outcomes.

POSTER PRESENTATION

P 12* **CEBPB, A POSSIBLE PRIMARY SIGNAL LEADING TO THE FLASH SPARING EFFECT.**

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FLASH radiotherapy is a promising new treatment modality, allowing to reduce side effects while maintaining equivalent tumor control to conventional treatment, by moving from conventional time of delivery (minutes) to ultra-short delivery (< milliseconds). However, the mechanisms of the effect are not elucidated. We recently discovered that FLASH reduces the toxicity induced on zebrafish embryos (ZFE) when irradiated 4 hours post-fertilization (hpf) but not when irradiated at 1.5hpf. Interestingly, right between those two time points, at 3hpf, zygotic transcription onset happens, suggesting that an active transcription is needed for the FLASH sparing. Investigation of the early transcription signature should thus allow the identification of the primary signals leading to the effect.

We performed bulk RNA sequencing at 2 h post-irradiation (hpi) on ZFE irradiated at 1.5hpf or 4hpf with respectively 4Gy and 8Gy using two electron accelerators (eRT6: 5.5MeV, at 0.2 and 6x10⁶ Gy/s; ELF: 7 or 9MeV, at 0.1 and 6x10⁶ Gy/s) to maximize the generalizability of our findings. After purification, library preparation and sequencing read quality was confirmed with fastqc and alignment was done using STAR.

Differentially expressed genes between FLASH (6×10^6 Gy/s) and CDR (0.1-0.2 Gy/s) were identified using DESeq2 and include *igf2a*, *bdnf*, *gadd45aa*, *nfe2l2b* (*nrf2*), 2 hpi. Genes uniquely induced by FLASH (6×10^6 Gy/s) included *fam3a* and *serf2b* at 2 hpi. qRT-PCR revealed that *serf2b* was uniquely induced by FLASH, while *fam3a* was also induced by CDR at 22 hpi but at a lower level. Both returned to base line at 70 hpi. Upstream transcription factors were investigated using AME (MEME Suite) and ChEA3, and led to the identification of a uniquely FLASH-regulated transcription factor called *cebpb*, known to regulate lipid metabolism. In parallel, we compiled available murine RNA sequencing datasets and performed a meta-analysis using a robust ranking aggregation method. This method confirmed enrichment of lipid metabolism genes across all datasets enforcing the possible primary role of *cebpb*. To ultimately demonstrate that *cebpb* is the primary FLASH signal, functional validations are ongoing using genetically modified ZFE, transcription factor activity and metabolic assays.

POSTER PRESENTATION

P 13 CAN FUTURE REIRRADIATION JUSTIFY UPFRONT PROTON THERAPY? A REIRRADIATION-AWARE MODEL-BASED SELECTION APPROACH

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Aims: Current model-based proton therapy selection values dose sparing solely through its predicted reduction in normal tissue complication probability (NTCP) after primary treatment. Considerable normal tissue dose sparing may therefore be undervalued when the primary photon and proton plans lie in the flat, low-dose region of the NTCP curve and differ little in predicted toxicity. However, if reirradiation raises the cumulative doses into a steeper region, the retained dose difference may produce a considerably larger NTCP reduction. This study investigated whether, and under which conditions, this contingent future benefit could justify upfront proton therapy.

Methods: The benefit of upfront proton therapy was estimated as the expected NTCP reduction over two treatment pathways: with probability 1-P, no reirradiation occurs and only the primary NTCP reduction applies; with probability P, reirradiation occurs and the relevant benefit is the cumulative NTCP reduction obtained by adding the same reirradiation dose following either primary modality. Referral required such expected benefit to reach the endpoint-specific threshold T used in current selection. This criterion was evaluated across reirradiation scenarios in 1'000'000 synthetic head-and-neck cancer patients calibrated to published data, using validated primary-treatment NTCP models for xerostomia (T=0.10), dysphagia (T=0.10) and tube-feeding dependence (T=0.05). For this proof-of-principle analysis, these models were assumed applicable to both primary and cumulative doses.

Results: The reirradiation-aware approach identified a small, well-defined additional cohort for whom upfront proton therapy could be justified. At P=0.10 and a mean reirradiation dose of 30 Gy to the NTCP-relevant organs, 0.1%, 1.8% and 2.3% of currently non-referred patients satisfied the criteria for xerostomia, dysphagia and tube-feeding dependence, respectively. Eligibility increased with P, but not consistently with dose as cumulative predictions approached NTCP saturation. Compared with current referrals, additional patients had up to 2.7 Gy greater median dose sparing for NTCP-relevant organs, yet 0.08-0.24 lower primary photon/proton NTCP and 0.014-0.025 lower primary Δ NTCP. Thus, their primary-course exclusion reflected their position in the flat, low-dose region of the NTCP curve rather than limited dose sparing.

Conclusions: Reirradiation-aware assessment may refine upfront proton therapy selection without substantially expanding eligibility. Clinical implementation requires individualized reirradiation probabilities and validated cumulative toxicity models.

POSTER PRESENTATION

P 14* OVERALL SURVIVAL PREDICTION AFTER RADIOTHERAPY IN HEAD AND NECK CANCER: TABULAR FOUNDATION MODEL VERSUS COX MODELS

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Aims: Reliable overall survival prediction in head and neck cancer (HNC) supports risk stratification and counselling, yet clinical datasets are often heterogeneous and incomplete. Cox models remain standard but require feature selection and explicit missing data handling. Tabular foundation models such as TabPFN offer nonlinear modeling with minimal tuning and native missingness handling, but their value in radiotherapy cohorts remains unclear. We compared a TabPFN-based survival model with Cox-based approaches and assessed whether broader clinical information improves performance.

Methods: Overall survival was evaluated in patients with head and neck squamous cell carcinoma treated with radiotherapy using the MD Anderson Cancer Center (MDACC) cohort (n=3009; 635 events) and an independent institutional cohort (n=845; 365 events). We compared: (1) HNC-Predictor, a previously published Cox model developed on the MDACC cohort; (2) a cohort-specific Cox model (Cox-MICE) using forward selection and multiple imputation by chained equations; and (3) SurvivalTabPFN, a time-to-event model jointly modeling event probability and timing with native missing-value handling. Cox-MICE and SurvivalTabPFN used all eligible variables. HNC-Predictor used the four features (age, performance status, tumor stage, pack-years) selected during its development. Five-fold cross-validation assessed concordance index (C-index) and integrated Brier score (IBS). MICE and feature selection were performed within training folds. In the institutional cohort, SurvivalTabPFN was evaluated with progressively enriched demographic/behavioral, radiological, pathological, and treatment feature sets. Permutation importance assessed predictive relevance.

Results: In the MDACC cohort, SurvivalTabPFN showed comparable discrimination to Cox models (C-index 0.73 ± 0.03 versus 0.71 ± 0.01 for Cox-MICE and 0.73 ± 0.02 for HNC-Predictor), while HNC-Predictor achieved the lowest IBS (0.13 ± 0.01 versus 0.16 ± 0.01 and 0.16 ± 0.00). In the institutional cohort, SurvivalTabPFN achieved the highest C-index (0.76 ± 0.02 versus 0.73 ± 0.02 and 0.72 ± 0.04) and lowest IBS (0.17 ± 0.01 versus 0.19 ± 0.02 for both Cox models). With feature enrichment, C-index improved from 0.68 ± 0.03 to 0.76 ± 0.02 and IBS decreased from 0.20 ± 0.00 to 0.17 ± 0.01 . Performance status had the highest permutation importance, followed by tumor stage, pack-years, and HPV status.

Conclusion: SurvivalTabPFN matched Cox-based approaches in MDACC cohort and showed better discrimination in the institutional cohort. Broader clinical information improved both metrics, with performance status most influential. These findings support tabular foundation models for survival modeling in radiation oncology.

POSTER PRESENTATION

P 15 MICROBEAM RADIATION THERAPY SPARES NORMAL LIVER THROUGH SPATIALLY CONFINED PARTHANATOS-LIKE CELL DEATH AND PRESERVED VALLEY REGENERATION: A SINGLE-CELL SPATIAL ATLAS

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Background: RILD remains the principal dose-limiting constraint on hepatic radiotherapy, with no specific therapeutic agents available. MRT has demonstrated remarkable normal tissue sparing; however, the cellular mechanisms underlying hepatic tolerance to extreme peak doses remain unknown. We previously reported absence of fibrosis at 6 months post-MRT with early beam-confined DNA damage and macrophage infiltration (SASRO 2025). Here we present the completed mechanistic characterisation, identifying the cell death pathway, spatiotemporal immune programme, and regenerative dynamics underlying MRT liver tolerance.

Methods: C57BL/6 mouse livers were irradiated with synchrotron MRT (400 Gy peak, ~5 Gy valley, 50 μ m beam width, 400 μ m c-t-c). Multiplex immunofluorescence for PAR, AIF, MIF, γ H2AX, TUNEL, p16, p21, and additional cell death markers was performed across seven timepoints (sham to 6 days). IMC with a 31-marker panel profiled 211,015 cells across 33 ROIs (n=4–6/timepoint). Spatial neighbourhood interactions were analysed using histoCAT. Long-term fibrosis was assessed at 6 months with Masson-Goldner trichrome and α -SMA immunofluorescence, with BB irradiation (10, 25, 50 Gy) as comparator.

Results: MRT induced no RILD at 6 months, while BB 50 Gy produced periportal fibrosis, vascular injury, and α -SMA+ stellate cell activation. A temporally staged parthanatos-like cascade was identified in peak zones: nuclear PAR accumulation at 1 hour, AIF accumulation at 24–72 hours, and AIF-MIF co-localisation at 72 hours, with most classical cell death pathways excluded. IMC revealed a four-phase immune programme: KC depletion with neutrophil influx (1–4 hours), M1 macrophage infiltration (1–3 days), CD8+ T cell and B cell adaptive shift (day 3), and Treg-mediated resolution at day 6. Valley hepatocytes showed a V-shaped Ki67+ recovery from day 3.

Conclusions: This study provides the first mechanistic characterisation of cell death in any form of SFRT. A spatially confined parthanatos-like programme, combined with organised immune resolution and preserved valley

regeneration, explains MRT's remarkable hepatic tolerance: resolving the longstanding paradox of extreme peak doses without RILD. These findings provide the biological foundation for clinical translation of MRT as a liver-safe radiotherapy strategy for patients where conventional RT remains dose-limited.

POSTER PRESENTATION

P 16 FROM MOUSE TO GUINEA PIG: DEVELOPMENT OF A STEREOTACTIC UNILATERAL COCHLEAR RADIOSURGERY MODEL FOR TRANSLATIONAL EVALUATION OF RADIOPROTECTIVE STRATEGIES

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Aims

Hearing preservation remains a clinical challenge in vestibular schwannoma radiosurgery, as cochlear irradiation can result in hearing loss. Radioprotective strategies have shown promise in mouse models but require validation in another well-established auditory model before translation. This study aimed to assess the feasibility of unilateral single-fraction high-dose cochlear irradiation in guinea pigs using standard stereotactic treatment techniques.

Methods

A high-resolution guinea pig computed tomography (CT) dataset (0.1-mm slice thickness) was used for bilateral cochlear contouring by a radiation-oncologist and independently reviewed by an otorhinolaryngologist. The dataset was subsequently resampled to a 0.6-mm slice thickness for treatment planning. Dosimetric planning assessed the feasibility of delivering a single 32 Gy fraction to the left cochlea while minimizing contralateral cochlear dose. The target was defined as a 5-mm diameter sphere encompassing the entire left cochlea and positioned as laterally as possible to maximize contralateral side sparing. The unirradiated cochlear avoidance volume was the right cochlea isotropically expanded by a 0.5-mm. Quality assurance (QA) was performed using a diamond detector and EBT4 film dosimetry.

Results

Both cochleae were accurately contoured following multidisciplinary review. Cochlear volumes were measured at 0.02 cm³ on both sides. A treatment plan was generated using two coplanar 6 MV flattening filter-free (FFF) volumetric modulated arc therapy (VMAT) arcs, avoiding beam entry and exit through a 6 mm diameter spherical region encompassing the right cochlea. The 32 Gy isodose covered 100% of the left cochlea, while the contralateral

cochlear avoidance zone received a maximum dose of 1.93 Gy and a mean dose of 0.49 Gy. Plan maximum point dose was 38.66 Gy. The estimated beam on time was 5 minutes. Quality assurance confirmed plan deliverability, with an absolute point dose difference of -1.5% and excellent agreement in the relative dose distribution.

Conclusions

This work lays the foundation for a stereotactic radiotherapy platform enabling selective unilateral cochlear irradiation in guinea pigs, providing a translational model for investigating radiation-induced hearing loss and evaluating potential radioprotective strategies. Further studies will evaluate image-guided treatment delivery in living animals and determine whether the biological effects observed in mice can be reproduced in guinea pigs.

POSTER PRESENTATION

P 17 PALLIATIVE CARE IMPLEMENTATION AND TREATMENT INTENSITY AT THE END OF LIFE OF PATIENTS WITH HEAD AND NECK CANCER IN A TERTIARY CANCER CENTER

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Aims Tumor-directed therapies and invasive interventions are frequently used in palliative head and neck cancer (HNC) patients in the final months of life, though this should be weighed against remaining life expectancy. We conducted an analysis of head and neck cancer patients receiving inpatient palliative care to understand patient selection and treatment timing.

Methods 141 HNC patients who received inpatient palliative care at our center between 2018 and 2026 were screened. Patients alive at the time of analysis, lost to follow-up, with insufficient end-of-life data, or whose HNC was not the primary reason for palliative care admission were excluded. We analyzed patient and treatment characteristics, frequency and timing of interventions and key time intervals along the palliative care path.

Results The final cohort comprised 112 patients (83 men [74.1%]; median age 71.5 years (range, 42.5–92.8)). Median time from first and last palliative care admission to death was 36 days (range, 0–2475) and 14.5 days (0–568), respectively. Seventy patients (62.5%) received at least one tumor-directed therapy within the last three, eighty (71.4%) within the last six months respectively. 51.9% started a new regimen of systemic therapy within the last three months of life. Fifty-one patients (45.5%) received radiotherapy, (94.1% of cases with palliative intent) within the last three months, 64.0% within the last six months. Prescription was heterogeneous, most delivered as 5 × 4 Gy = 20 Gy (25.0%) or 10 × 3 Gy = 30 Gy (15.6%). Feeding tube was placed in 27.7% within the last three months of life, and a new tracheotomy was performed in 13.4%.

Conclusions Palliative care integration often occurred only in the final weeks of life, while tumor-directed therapies were applied in a relevant proportion of patients until shortly before death. Most radiotherapy indications were symptom-oriented and predominantly delivered with short hypofractionated schemes. On the contrary, a high number of patients received systemic treatment until the final days, even including the start of further line regimens. Feeding tube and tracheotomy interventions were also common. Whether early palliative care integration can reduce invasive interventions near the end of life for this cohort warrants prospective evaluation.

POSTER PRESENTATION

P 18 EXCELLENT LONG-TERM RADIOLOGICAL TUMOR CONTROL AFTER RADIOTHERAPY FOR PITUITARY ADENOMAS USED AS FIRST- OR SECOND-LINE THERAPY: A RETROSPECTIVE STUDY

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Aims

Radiotherapy (RT) is used in patients with non-functioning (NF) pituitary neuroendocrine tumors (PitNETs) unfit for or who decline surgery, and with functioning adenomas resistant to or unable to receive medical therapy. It is also used postoperatively for residual, recurrent, or progressive disease. However, long-term efficacy data of RT for tumor control remain limited. We aimed to evaluate the effectiveness of RT for PitNET radiological tumor control.

Methods

We retrospectively reviewed 48 patients with PitNETs treated with RT between 2002 and 2019. We documented patient and tumor characteristics, time and reason for RT, duration of follow-up and tumor size change after RT.

Results

Forty-eight patients (66% male) received RT as first-line (n=11) or second-line postoperative treatment (n=37).

Among first-line-RT patients, 6 (55%) had NF PitNETs (mean maximal diameter (MMD) 22.4±7.7 mm) and 5 had prolactin-/GH-secreting adenomas (MMD 26.0±11.6 mm). RT was selected because of advanced age, comorbidities, medical resistance or patient preference. Conventional RT was delivered to 8 patients (mean dose 51.7±4.1 Gy) and stereotactic radiosurgery (SRS) to 3 (mean dose 20.0±3.5 Gy). After a mean follow-up of 3.6±3.3 years, tumor size

decreased in 8 patients (73%), while 1 patient (9%) had stable disease and 1 (9%) had non-significant tumor progression. Data were unavailable for one patient.

Among second-line-RT patients, 27 (73%) had NF PitNETs (MMD 17.5±8.1 mm) and 10 had secreting tumors (4 GH-, 2 ACTH-, and 1 prolactin-secreting; MMD 17.0±5.6 mm). RT was administered a mean of 5.1±6.3 years after surgery. Conventional RT was used in 32 patients (mean dose 50.5±7.7 Gy) and SRS in 5 (mean dose 13.6±2.6 Gy). After a mean follow-up of 5.8±4.2 years, 18 patients (49%) demonstrated radiological response, 7 (19%) had stable disease, and 2 (5%) had non-significant tumor progression. Two patients (5%) with NF PitNETs experienced significant tumor progression, with increases in maximal diameter of 57% and 66% at 7.7 and 8.8 years after RT, respectively; one subsequently underwent salvage surgery. Data were unavailable for 8 patients.

Conclusions

Radiotherapy achieves high tumor size stabilization or reduction rates in PitNETs, whether performed as first-line treatment in non-operated patients or as second-line postoperative treatment.

POSTER PRESENTATION

P 19 PERSONALIZATION OF COMMERCIAL APPLICATORS FOR BRACHYTHERAPY IN CHALLENGING CASES: FEASIBILITY AND TOLERABILITY BASED ON OUR CLINICAL EXPERIENCE

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Purpose/Objective Brachytherapy enables delivery of high doses of radiation from the inside of the involved anatomical area, most commonly by using site-specific, commercially available applicators. For rarer implantation sites or anatomical variations, however, pre-manufactured applicators are not always appropriate. Here, we report our preliminary clinical experience with adaptation and customization of commercial applicators. All applicators were personalized using expendable materials approved for clinical use.

Materials/Methods From January 2023 until November 2025, 14 patients were treated using personalized applicators at our institution. Data on patient and treatment characteristics, and acute and late toxicity was retrospectively collected.

Results 11 female and 3 male patients with a median age at diagnosis of 57.5 (range: 42-82) were included. The median follow-up time was 18 months (range: 6-41). Gynecological cancer was most common (n=8, 57.14%), followed by nasal cancer (n=3, 21.43%), and single cases of penile cancer, basal cell carcinoma and melanoma. Reasons for personalization included uncommon tumor locations such as nasal vestibule, anatomical variations, and anatomical changes due to the tumor or previous medical treatment such as hysterectomy or gender affirming surgery. The majority of patients (64.29%) received a combined intracavitary (IC) and interstitial (IS) treatment.

Commercial applicators were personalized using easily accessible and affordable, CE-certified medical devices, for which no additional legal certification is required (e.g. Nelaton female catheter, Rapid Rhino nasal catheter).

All patients successfully completed the brachytherapy treatment as planned. No complications, in particular bleeding or infections were observed. Three patients (21.43%) developed a high-grade acute toxicity (radiation dermatitis CTCAE grade 3). Most common lower-grade acute toxicities were pain (57.14%) and pollakisuria and/or dysuria (42.86%). At present, 10/14 patients are in complete clinical remission. Three patients developed a local recurrence, while one patient with recurrent cervical cancer developed distant metastases, but no local recurrence. High-grade late toxicity (vaginal stricture CTCAE grade 3) was present in three patients (21.43%).

Conclusions Individual customization of commercial applicators for brachytherapy using clinically approved and readily-available disposable medical materials is a feasible strategy with an acceptable radiation toxicity and complication profile in patients for whom an adequate dose coverage is not achievable using unmodified commercial applicators.

POSTER PRESENTATION

P 20 SUBSITE-SPECIFIC BILATERAL PREDICTION OF OCCULT NODAL INVOLVEMENT IN HEAD AND NECK CANCER USING A MIXTURE HIDDEN MARKOV MODEL

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Aims

The ongoing DeEscO trial investigates personalized reduction of elective nodal irradiation volumes in oropharyngeal squamous cell carcinoma based on

individualized estimates of occult nodal risk. Here, we extend this model-based approach beyond the oropharynx to 13 ICD-10-defined subsites of the head and neck. We developed a bilateral mixture hidden Markov model (HMM) for subsite-specific estimates of ipsilateral and contralateral occult nodal involvement.

Methods

We analyzed 2437 HNSCC patients from five European centers, comprising 13 subsites of the oral cavity, oropharynx, hypopharynx, and larynx. Lymphatic tumor spread in the neck is modelled by four HMMs, each representative of one main category: anterior oral cavity, oropharynx, hypopharynx, and glottic larynx. Individual ICD-10-defined subsites are described by mixtures of these HMMs, with mixture coefficients describing anatomical proximity and similarities in lymphatic spread to the four categories. Parameters were inferred by expectation-maximization and uncertainty was estimated from 500 stratified bootstrap samples.

Results

Several subsites showed mixed component assignments, reflecting within-location heterogeneity. For example, supraglottis (C32.1) combined 47% larynx-like, 20% hypopharynx-like, and 33% oropharynx-like spread. Palate (C05) combined 21% oral-cavity-like, 40% oropharynx-like, 10% hypopharynx-like, and 29% larynx-like spread.

Predicted occult metastasis risk in ipsilateral LNL III decreased with increasingly anterior tumor location. In cN0 patients, risk remained below 5% for all oral cavity subsites, exceeded 5% for oropharyngeal tumors, particularly in late T-stage disease, and was above 5% for all hypopharyngeal subsites. For late-stage tumors without midline extension, contralateral risk remained below 5% for all LNLs and subsites. With midline extension, contralateral LNL II exceeded 5% for base-of-tongue (C01) and tonsillar tumors (C09). With clinically involved ipsilateral LNL II, contralateral LNL II risk increased further and exceeded 5% for most subsites except glottis (C32.0) and gums (C03).

Conclusions

The bilateral mixture HMM models lymphatic spread across all head and neck subsites with individualized risk estimation on both sides of the neck. It captures subsite differences and quantifies how T-stage, midline extension, and observed clinical involvement patterns alter occult nodal risk. These estimates may provide the basis for future studies extending the personalized, risk-adapted elective CTV-N approach investigated in DeEscO beyond oropharyngeal cancer.

P 21 RADIOTHERAPY FOR A SPORADIC, SECRETORY VAGAL PARAGANGLIOMA: A CASE REPORT

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Introduction Head and neck paragangliomas (HNPG) are rare neuroendocrine tumours arising from the chromaffin cells of the parasympathetic paraganglia. Incidence is 0.3-1 per 100,000. HNPGs represent about 0.6% of all head and neck tumours, and 95% are non-secretory. Treatment options include surgery, radiotherapy and a wait-and-scan approach, depending on tumour location and symptoms.

Case A 65-year-old man presented with unexplained syncope and a history of medication-controlled hypertension. Diagnostic imaging and biochemical findings (elevated free normetanephrine and free methoxytyramine) confirmed a secretory vagal paraganglioma (VPGL). Stereotactic radiotherapy was administered daily to a total dose of 25 Gy in 5 fractions (prescribed to the 80% isodose line encompassing the PTV).

Results Radiotherapy was well tolerated, with only grade 1 mucositis observed. Blood pressure fluctuated slightly during the first few months after radiotherapy, but did not require therapeutic intervention. No late side effects have been observed to date. The VPGL initially remained stable in size; at 1.5 years after treatment, a slight reduction to 3.6 x 2.3 x 3.6 cm was noted (previously 3.7 x 2.4 x 3.7 cm). Laboratory values showed fluctuating levels above the normal range over time. At the most recent follow-up, two years after treatment, free normetanephrine had decreased to 3.2 times the normal level and free methoxytyramine to 2.3 times the normal level.

Conclusion Due to the rarity of secretory VPGL, robust treatment recommendations are lacking. Radiotherapy nonetheless represents a sensible alternative to surgery in cases of metanephrine secretion. Treatment decisions should be made in an interdisciplinary setting, weighing the expected therapeutic benefit (volumetric and biochemical) against the potential side effects. Systematic investigation of the biochemical response to radiotherapy in this rare subgroup would be valuable.

P 22 A HIDDEN MARKOV MODEL OF BILATERAL LYMPHATIC PROGRESSION IN OROPHARYNGEAL SCC CONSIDERING THE PRIMARY TUMOUR'S DISTANCE TO MIDLINE

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Aims

Elective clinical nodal target volume (CTV-N) definition in the contralateral clinically N0 neck remains an active area of research in oropharyngeal SCC. Current guidelines generally recommend bilateral irradiation, with small lateralised tonsil tumors being the main exception. However, tumour extension is typically classified as binary (lateralised vs. extended), despite the extent of midline crossing likely influencing contralateral nodal risk. We aim to improve personalised CTV-N definition by predicting patient-specific risk of occult contralateral nodal disease based on midline extension distance.

Methods

The distance between the primary tumour (GTVp) and an automatically detected midline was measured on planning CT scans, with negative values indicating lateralised and positive values indicating extended tumours. Patients were stratified into four cohorts: <0 mm, 0-10 mm, 10-20 mm, and >20 mm. A previously presented hidden Markov model (HMM) of bilateral lymphatic metastatic progression was extended by replacing binary tumour extension with these cohorts. Contralateral spread probabilities were modelled as a mixture of ipsilateral spread and contralateral spread for lateralised tumours, with a separate mixing parameter per distance cohort. Model parameters were inferred from 833 oropharyngeal SCC patients, resulting in a model quantifying risk of occult disease based on T-category, clinical nodal involvement and midline extension distance.

Results

Observed contralateral nodal involvement increased continuously with midline extension. For example, in contralateral level II, prevalence increased from 11.3% for lateralised tumours to 19.4%, 32.6%, and 39.1% for extension of <10 mm, 10-20 mm, and >20 mm, respectively, a trend reproduced by the model. Predicted occult disease risk showed the same trend: for early T-category with ipsilateral level II involvement, contralateral level II risk increased from 1.5% for lateralised tumours to 3.8%, 8.2%, and 20.8% with increasing extension.

Conclusions

The HMM captures the relationship between extension distance and contralateral nodal involvement, enabling more personalised estimates of occult disease risk. In early-stage, contralateral N0 cases, predictions suggest that contralateral irradiation could be omitted for slightly extended tumours, whereas for intermediate-stage

disease with increased extension, irradiation could be restricted to contralateral level II. For advanced-stage tumours with substantial extension, levels II and III should be electively irradiated.

POSTER PRESENTATION

P 23 RE-IRRADIATION WITH ROBOTIC STEREOTACTIC BODY RADIOTHERAPY FOR ISOLATED LOCALLY RECURRENT PROSTATE CANCER AFTER PRIMARY EXTERNAL BEAM RADIOTHERAPY: CLINICAL OUTCOMES AND PATTERNS OF RECURRENCE

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Aims: Intraprostatic local recurrence (ILR) occurs in up to 10–40% of prostate cancer patients after primary external beam radiotherapy (EBRT). No standardized salvage treatment exists, and options such as salvage prostatectomy or brachytherapy carry substantial toxicity. Re-irradiation with robotic stereotactic body radiotherapy (reSBRT) offers a non-invasive alternative. We report outcomes and recurrence patterns in patients treated with reSBRT for isolated ILR after primary EBRT.

Methods: Between 2016 and 2025, 33 patients received robotic salvage reSBRT for isolated ILR after primary EBRT. Median time from EBRT to reSBRT was 81 months (24–224), and median PSA before reSBRT was 3.4 ng/mL (0.7–23). ReSBRT was delivered via CyberKnife in 5 fractions every second day to 27.5–32.5 Gy, prescribed to the 80% isodose. ILRs were targeted with a PSMA-PET/CT and multiparametric MRI (mpMRI)-guided approach, using focal, hemi-gland, or whole-gland irradiation in 20 (60.6%), 6 (18.2%), and 7 (21.2%) patients, respectively. Androgen deprivation therapy (ADT) was administered for 6 months in 18 patients (54.5%). Clinical progression-free survival (cPFS) – time from reSBRT to biochemical recurrence (BCR, Phoenix criteria) or radiological progression, whichever occurred first – was calculated. Acute and late grade ≥ 2 gastrointestinal/genitourinary (GI/GU) toxicities were graded per CTCAE v5.0.

Results: At a median follow-up of 38 months (8–113), 13 patients (39.4%) had clinical progression. With concomitant ADT, 1-, 2-, and 3-year cPFS rates were 100%, 93.3%, and 74.7%, versus 93.3%, 72.7%, and 72.7% without ADT. Of the 13 progressing patients, 1 (3%) had BCR only, and 12 (36.4%) had a second ILR, of whom 1 also had nodal recurrence and 1 distant recurrence. These second

ILRs occurred after focal, hemi-gland, and whole-gland reSBRT in 8 (66.7%), 2 (16.7%), and 2 (16.7%) patients, respectively. All 12 second ILRs occurred within the reSBRT irradiation field, with 1 patient (3%) additionally developing an out-of-field relapse. Acute and late grade 2 GU/GI toxicity occurred in 3 (9.1%) and 1 (3%) patients; no grade ≥ 3 toxicity was observed.

Conclusion: Robotic reSBRT for intraprostatic recurrence after primary EBRT achieved favorable cPFS and low toxicity. However, the rate of second ILR remains a challenge, underscoring the need for optimized salvage strategies.

POSTER PRESENTATION

P 24* MR-GUIDED STEREOTACTIC RADIOSURGERY OF A MOBILE INTRACARDIAC TUMORAL THROMBUS: TECHNICAL WORKFLOW AND ONE-YEAR OUTCOME

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Aims: Intracardiac tumoral thrombi are rare and potentially life-threatening manifestations of advanced lung cancer. Delivering stereotactic radiosurgery (SRS) is technically challenging because of the combined respiratory and cardiac motion, particularly in the re-irradiation setting. We report the technical workflow and one-year clinical outcome of MR-guided SRS using comprehensive motion management (CMM) for a recurrent left atrial tumoral thrombus.

Methods: A patient with a recurrent left atrial tumoral thrombus from non-small-cell lung cancer, previously treated with definitive thoracic chemoradiotherapy, underwent MR-guided SRS on a Unity MR-Linac (Elekta AB, Stockholm, Sweden). Cardiac cine MRI was used to quantify cardiac motion and generate the internal target volume (ITV), while respiratory motion was managed using CMM with real-time cine MRI gating. An intensity-modulated radiotherapy plan was generated using Monaco version 6.2.2.0 (Elekta AB). RayStation, version 2024B (RaySearch Laboratories AB, Stockholm, Sweden), was used for cumulative re-irradiation assessment in EQD2.

Results: The patient received MR-guided SRS delivering 18 Gy in a single fraction. The planning target volume (PTV) was entirely covered by at least 95% of the prescribed dose, while the maximum dose reached 125%. The patient had previously received 66 Gy in 33 fractions of definitive thoracic chemoradiotherapy. Cumulative EQD2 assessment confirmed compliance with all predefined organ-at-risk constraints. Online adaptation was performed using an Adapt-to-Position (ATP) workflow and treatment was completed without interruption or

acute toxicity. FDG PET/CT performed 2 months after SRS demonstrated a partial metabolic response of the left atrial lesion (SUVmax 9.5 vs. 13.8 at baseline). Subsequent FDG PET/CT examinations at 4, 7, 10 and 13 months confirmed sustained metabolic response within the treated volume. This response was maintained despite progression of the recurrent pulmonary disease requiring systemic chemotherapy. No treatment-related cardiac toxicity was observed and at the latest follow-up, the patient remained in excellent clinical condition.

Conclusion MR-guided cardiac stereotactic radiosurgery using comprehensive motion management achieved durable local metabolic control of a highly mobile intracardiac tumoral thrombus for more than one year, with excellent tolerability despite progressive extracardiac disease. This case demonstrates the technical feasibility of MR-guided cardiac SRS in a challenging re-irradiation setting.

POSTER PRESENTATION

P 25 REVISITING ACTIVE AND PASSIVE DOSIMETERS FOR PULSED ULTRA-HIGH DOSE RATE BEAMS EXCEEDING TYPICAL PRECLINICAL DOSE-PER-PULSE REGIMES

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1. Federal Institute of Metrology METAS, 2. CHUV

Background and Aims Results from pre-clinical studies utilizing ultra-high dose rate (UHDR) beams critically depend on accurate dosimetry under non-reference conditions. Several detectors for online UHDR dosimetry, including diamond detectors and plastic scintillators, have recently become commercially available. However, testing their performance under UHDR beams is challenged by the lack of appropriate dosimetry standards. Further, some reports indicated potential overresponse of Gafchromic films at high dose-per-pulse (DPP), a common dosimeter in FLASH-radiotherapy. We evaluated suitability of these detectors for pulsed UHDR regimes using alanine.

Methods

The response of two flashDiamond detectors (PTW), Gafchromic EBT4 films (Ashland Inc.) and Hyperscint RP-200 (MedScint) were compared against alanine dosimetry (Harwell) in a 6-MeV electron-beam (Oriatron-eRT6). Alanine was used as a reference due to its well-established dose-per-pulse and dose-rate independence over a wide range of irradiation conditions, including UHDR regimes, and its stable and linear dose response. The detector responses were evaluated as a function of DPP, pulse repetition frequency (PRF) and pulse width (w), including DPP values up to 17 Gy per pulse.

Results The flashDiamond aligned with Alanine up to 4 Gy per 2 μ s pulse but predicted consistently lower doses at higher DPP. Between the two flashDiamond detectors, the measurements revealed different saturation patterns.

Results obtained with different w indicate that this saturation effect is driven by the dose rate in the pulse, rather than DPP itself. Films were consistent with alanine within the combined standard uncertainty ($k=1$), with no deviation observed up to 17 Gy in 2 μ s pulse.

Conclusions

Gafchromic EBT4 films were found to be consistent with alanine within experimental uncertainties and represent a practical option for quality assurance in UHDR conditions, offering a more resource-efficient alternative to alanine dosimetry. The flashDiamond detectors provided accurate measurements up to 4 Gy per 2 μ s pulse but exhibited saturation effects at higher pulse dose rates.

POSTER PRESENTATION

P 26* ARE BROAD BEAM, MINIBEAM RT, AND MICROBEAM RT DOSE-EQUIVALENT? A CONTROLLED CROSS-MODALITY COMPARISON IN MOUSE MELANOMA.

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Background and Aim Sub-millimeter spatially fractionated radiation therapy (smSFRT), including Minibeam (MBRT) and Microbeam (MRT) RT, delivers heterogeneous doses to tumors, yet dose equivalences between broad beam (BB), MBRT, and MRT remain unknown. Using a reverse approach, we irradiated one tumor model with all three techniques across a dose range to find iso-equivalences.

Materials and Methods B16F10 melanoma in the mouse pinna was treated, ten days post tumour implantation, with one of eight conditions: BB (7, 15, 18, or 22Gy); synchrotron MRT (400/7Gy peak/valley, ~105Gy mean, collimator: 50 μ m aperture, 200 center-to-center (ctc) spacing); MBRT alone (36/0.3Gy, ~9.2Gy mean, collimator: 200 μ m aperture, 800ctc); MBRT plus a 7 Gy BB boost (29/0.2Gy + 7 Gy BB, ~14.4Gy mean); or unirradiated controls. MBRT+BB matched MRT's valley at an MBRT-like peak.

Results Median survival was highest for MRT (28 days), then MBRT+BB (24) and 18Gy BB (17). Tumor growth delay (TGD) ranked: 18 days for both MRT and 18Gy BB; 15 days for 15Gy BB; 10 days for MBRT+BB; 7 days for 7Gy BB; and 3 days for MBRT alone. MBRT alone ranked last despite a 36Gy peak and a mean dose (~9.2Gy) exceeding 7Gy BB. Complete ablation occurred exclusively in 4 MRT and 1 of 15Gy BB animals.

Conclusion The answer to our title is negative: clean cross-modality equivalence does not exist. 18Gy BB matched MRT's growth delay yet mice reached the termination point sooner than MBRT+BB (which had worse TGD), indicating toxicity limited survival at 18Gy, with clear toxicity at 22Gy. While valley and mean dose governed growth delay, ablation required a high peak dose that MRT reached but MBRT at 36Gy did not, leaving room to escalate MBRT's peak dose. These results suggest that effective prescription requires both a valley dose floor and a peak dose threshold; parameters that currently only smSFRT can simultaneously deliver while preventing normal tissue toxicity.

POSTER PRESENTATION

P 27 **TOWARDS PERSONALIZED RADIOTHERAPY IN BREAST CANCER: CAN FUNCTIONAL MODELS PREDICT INDIVIDUAL RADIOSENSITIVITY?**

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Aims : Despite major advances in breast cancer radiotherapy, treatment decision-making is still predominantly based on patients' clinicopathological risk rather than their tumor's intrinsic radiation response. In contrast to systemic therapies, for which molecular biomarkers and genomic assays increasingly guide treatment selection, no biomarker of radiosensitivity has yet achieved sufficient clinical utility to routinely guide radiotherapy decisions. To highlight the opportunities in the field, we hereby critically review current approaches to modelling breast cancer radiosensitivity and discuss their potential to support biologically guided, personalized breast cancer radiotherapy.

Methods : We provide an overview of molecular approaches and experimental models used to investigate breast cancer radiation response, focusing on their ability to capture tumour heterogeneity, microenvironmental interactions and tumor-specific radiosensitivity, as well as their potential for clinical translation.

Results : Existing molecular and radiogenomic signatures have demonstrated substantial biological heterogeneity with regard to radiation response and locoregional recurrence risk, and their implementation remains limited by the lack of prospective validation. Functional models provide a complementary strategy that enables direct assessment of tumour response to irradiation. Conventional cell lines remain valuable for mechanistic studies, while three-dimensional spheroids and patient-derived organoids better reproduce tumour architecture and heterogeneity. In vivo models, including patient-derived xenografts, chick chorioallantoic membrane models and zebrafish avatars, additionally enable investigation of tumour-microenvironment interactions, angiogenesis and treatment response. Importantly, these approaches may be particularly relevant in breast cancer, where radiotherapy is generally delivered after surgical

removal of the primary tumour, limiting opportunities to directly assess individual tumour radiosensitivity. However, each model presents trade-offs between biological complexity, throughput, reproducibility, turnaround time and clinical scalability.

Conclusions : No single experimental model currently captures the full complexity of breast cancer radiation response, despite the unmet clinical need. Integrating functional models with molecular profiling and clinical information may provide a new strategy for predicting individual tumor radiosensitivity. Establishing standardized, clinically actionable assays and validating their predictive value against patient outcomes will be critical to translating these approaches into personalized radiotherapy.

POSTER PRESENTATION

P 28 **A PRACTICAL VALIDATION WORKFLOW FOR THE USE OF ALTERNATIVE FIDUCIAL MARKERS IN CYBERKNIFE TRACKING: APPLICATION TO LEGACY CALYPSO TRANSPONDERS**

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Aim:

Following the discontinuation of the Calypso® 4D Localization System, previously implanted electromagnetic transponders remain radiopaque but non-functional. Their reuse as alternative fiducial markers for CyberKnife® (CK) tracking could avoid additional invasive implantation procedures. This study aimed to develop and validate a practical workflow to assess the feasibility, geometric accuracy, and dosimetric reliability of legacy Calypso transponders for CK tracking.

Methods:

A stepwise validation framework was implemented, including: (1) assessment of fiducial visibility and detectability using CK and Calypso phantoms; (2) verification of tracking accuracy through known couch translations; (3) patient-specific quality assurance (PSQA) using SRS MapCHECK equipped with Calypso fiducials; and (4) static and dynamic end-to-end (E2E) testing with IRIS and multileaf collimator (MLC) deliveries. Acceptance criteria included submillimetric targeting accuracy and clinically established gamma pass-rate thresholds. Following successful validation, the workflow was applied in a prostate stereotactic body radiotherapy (SBRT) re-irradiation case.

Results:

Calypso transponders were consistently detected and correctly identified by the CK fiducial tracking algorithm. Phantom testing demonstrated agreement within 1 mm between expected and measured offsets. E2E residual

errors were 0.64 mm for IRIS deliveries (static and dynamic) and 0.42 mm for MLC dynamic deliveries, all within predefined tolerances. PSQA yielded an analyzed gamma (3 %/1 mm) pass rate of 96%, comparable to that achieved with conventional fiducials. Clinical implementation was completed without tracking interruptions, maintaining stable intrafraction localization throughout treatment.

Conclusion:

This validation workflow demonstrates and supports the safe clinical use of these alternative fiducial markers for CK tracking. Legacy Calypso transponders demonstrated adequate visibility, tracking accuracy, and dosimetric performance, enabling their reuse. The proposed framework is practical, reproducible, and potentially applicable to other non-standard fiducial configurations encountered in clinical practice.

POSTER PRESENTATION

P 29 **LINACS: AN ESTRO/OLIGOCARE LIVING SYSTEMATIC REVIEW OF THE SAFETY OF CONCURRENT STEREOTACTIC RADIOTHERAPY AND NOVEL SYSTEMIC THERAPIES**

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Aims: New safety evidence on the combination of stereotactic radiotherapy (SRT) and novel systemic therapies is emerging at an accelerating pace. Conventional systematic reviews quickly become outdated, limiting their value for clinical decision-making. We established the first living systematic review on this topic, providing continuously updated evidence through biannual literature surveillance and immediate online dissemination (<https://linacs.onrender.com/>). This dynamic approach delivers current estimates of high-grade adverse events (AEs) to support evidence-based practice.

Methods: Search terms (including newly approved drugs), searches and analyses are updated biannually. PubMed is searched (from January 1, 2000) for studies reporting original data on patients receiving SRT within 30 days of novel systemic therapy. Current search: April 2, 2026. Studies with a high risk of bias are excluded as per

standard methods. The primary outcomes are pooled estimates of grade ≥ 3 overall treatment-related AEs (OAE) and RT-related AEs (RTAE). PROSPERO registration: CRD42024559453.

Results: 191 studies comprising 7,694 patients were included—nearly tripling the evidence base of the last published conventional systematic review in 2023 and covering 14 additional drug groups (combinations). EGFR-targeting TKIs showed no clear evidence of excess AEs. Substantial RTAE rates were observed for BRAF/MEK inhibitors and trastuzumab emtansine. Although anti-PD(L)1 therapies and multi-target TKIs had low overall RTAE rates, both were associated with high OAEs following liver SRT.

Conclusions: Given the exponential growth of evidence, this living systematic review offers a new model for delivering current clinical guidance by collecting and reanalyzing all available data biannually and making it immediately accessible online (<https://linacs.onrender.com>).

POSTER PRESENTATION

P 30 **PUBLICATION CONVERSION AND FIRST-AUTHOR RETENTION OF ABSTRACTS PRESENTED AT SWISS SCIENTIFIC SOCIETY CONFERENCES: A COMPARATIVE ANALYSIS OF SASRO, SGR-SSR, AND SSH/SSMO**

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Aim: To evaluate publication conversion and first-author retention for SASRO conference abstracts and contextualize SASRO performance relative to Radiology/ Nuclear Medicine (SGR-SSR) and Hematology/Oncology (SSH/SSMO). The goal was to identify SASRO-specific patterns and structural factors influencing publication and authorship continuity.

Methods: A bibliometric analysis included 1,591 abstracts presented at SASRO (n=402), SGR-SSR (n=784), and SSH/SSMO (n=405) from 2017–2019 and 2022–2023. Publication status was determined through structured PubMed searches. First-author retention was assessed for the published abstracts. Associations with specialty, year, presentation type, gender, affiliation, and publication effort, using a simplified Arms Race Comparison Score-inspired classification, were evaluated using chi-square tests, logistic regression, and Kaplan–Meier time-to-publication analysis.

Results: Overall, 467 abstracts (29.4%) were published, with SASRO showing a publication rate (26.6 %) comparable to that of other societies. Oral presentations

were more likely to be published than posters (37.9% vs. 24.5%), and the number of publications increased over time. Institutional affiliation remained an independent predictor, with smaller hospitals having lower likelihoods. Gender differences were minimal once abstracts with unknown gender were excluded.

SASRO demonstrated distinctly lower first-author retention at publication (58%) than SGR-SSR (78.8%) and SSH/SSMO (74.8%) did.

First-author changes typically reflect redistribution of responsibilities and influence academic credit and continuity of contributions. In multivariable regression, SASRO remained the reference group with significantly lower retention; Radiology/Nuclear Medicine (adjusted odds ratio [aOR] 2.65, 95% confidence interval [CI] 1.53–4.58), and Hematology/Oncology (aOR 2.15, 95% CI 1.15–3.99) showed higher retention independent of affiliation. Gender and presentation type did not influence retention.

Gender played no role in SASRO publication or first-author retention.

Male and female first authors had virtually identical outcomes, and gender did not independently predict publication in any model. Radiology/Nuclear Medicine produced the highest proportion of high-effort publications (34.8%), hematology/oncology generated fewer (11.3%), and SASRO predominantly yielded medium-effort publications (68.6%). Most SASRO publications appeared in Radiotherapy and Oncology, Radiation Oncology, Medical Physics, and physics-focused journals.

Conclusion: SASRO exhibits publication rates comparable to those of other Swiss societies but with distinctly lower first-author retention. Targeted initiatives may help strengthen authorship continuity and enhance the visibility of SASRO research results.

POSTER PRESENTATION

P 31 **MANAGING THE «GERIATRIC PATIENT» IN RADIATION ONCOLOGY: RESULTS OF A SWISS-WIDE SURVEY**

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Aims: Age is a strong risk factor for cancer. International guidelines recommend routine frailty screening and, if required, a comprehensive geriatric assessment (CGA) for all elderly adults with cancer. We evaluated the implementation of geriatric screening and assessment in radiation oncology across Switzerland, their impact on treatment decision-making, and the barriers to their routine use.

Methods: An anonymous, 33-question-based national online survey was distributed to 32 radiation oncology clinics across Switzerland between April and May 2026. Survey questions addressed the definition of "geriatric" age, current screening and assessment practices, referral strategies and organizational integration, professional training, perceived benefits and barriers, and financing. Data were analyzed descriptively.

Results: Twenty-six board-certified radiation oncologists responded (81%). Out of these, 62% treated a patient clientele with at least 50% of patients aged 70 years or older. 38.5% did not use a predefined age threshold for screening. Only one respondent (4%) routinely performed a structured geriatric screening. Among the respondents who performed structured geriatric assessments, 91.3% reported that the findings influenced their radiotherapy decision-making, and 85.7% reported modifications to the overall treatment plan because of their findings. However, 87% rarely or never referred elderly "at-risk" patients to a geriatric specialist; none of the clinics reported to have a geriatric specialist on its tumor board, and only 13% of the clinics had an interdisciplinary team for their post-assessment management. The main barriers to the implementation were lack of time (56%), insufficiently trained personnel (40%), and sole reliance on clinical judgement (32%). Institutional support for geriatric oncology was rated poor on average at 3.3 out of 10. Despite these barriers, 88% of the respondents believed that geriatric screening would benefit patients. Furthermore, 77% considered residents insufficiently trained in geriatric oncology.

Conclusions: Swiss radiation oncologists strongly support the implementation of geriatric screenings and assessments. However, structured implementation remains largely absent in routine practice, highlighting a substantial gap between international recommendations and current geriatric oncology practice in Swiss radiation oncology clinics. The identified barriers are predominantly structural but potentially modifiable through training, clinical workflow integration, appropriate reimbursements, and the development of national guidelines.

**P 32 THERMAL DOSE CALCULATIONS
BASED ON SKIN TEMPERATURE DATA IN
RECURRENT BREAST CANCER PATIENTS
TREATED WITH SUPERFICIAL
HYPERTHERMIA IN COMBINATION WITH
ADJUVANT RADIOTHERAPY: A
RETROSPECTIVE ANALYSIS**

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Aim: In breast cancer patients, skin temperature is commonly used to guide superficial hyperthermia (HT) treatment. However, it remains unclear to what extent skin temperature represents the temperature achieved in the planning target volume (PTV). This analysis was performed to evaluate the correlation between maximal PTV depth and thermal dose parameters derived from skin temperature, and to assess the efficacy of combined HT and adjuvant radiotherapy (RT) in patients with recurrent breast cancer.

Methods: A total of 41 patients (median age: 66 years; range: 24–85), with recurrent breast cancer treated between October 2014 and September 2024 at Kantonsspital Aarau, were included in this retrospective analysis. The median prescribed total RT dose was 46 Gy (range: 36–50.4 Gy), and patients received a median of 7 (range: 4–10) weekly HT sessions. The primary endpoint was the correlation between maximal PTV depth and thermal dose expressed as cumulative equivalent minutes at 43 °C (CEM43T_x), where x represents the 10th, 50th, and 90th percentiles of measured skin temperature points during each HT session.

Results: Pearson correlation analysis showed a statistically significant, moderate positive correlation between maximal PTV depth (4.53±2.29 cm) and CEM43T₅₀ (r=0.39, p=0.046) and CEM43T₁₀ (r=0.39, p=0.043). The thermal dose parameter CEM43T₉₀ showed non-significant but moderate positive correlations with maximal PTV depth (r=0.38, p=0.053). There were no significant differences among sessions for CEM43T₁₀ (p=0.6, W = 0.1), CEM43T₅₀ (p=0.3, W=0.2) and CEM43T₉₀ (p=0.2, W=0.2). The median follow up of patients was 50 (95%CI: 43-61) months. The 3-year OS and LC rates were 87% (95% CI:77-98%) and 94% (95%CI: 85%-100%), respectively. There were seven patients who had distant progression, leading to a 3-year PFS rate of 79% (95%CI:65-96%). The rates of acute toxicity of grades 2 and 3 were 19% (46%) and 3% (7%), respectively.

Conclusion: The recurrent breast cancer patients were treated with reproducible thermal dose parameters across HT sessions, which were positively correlated with maximal PTV depth, indicating that deeper target volumes are treated with higher thermal doses and the thermal dose at a given PTV depth may be higher than that monitored or calculated based on skin temperature data.

**P 33* EXPERIMENTAL SKIN DOSE
EVALUATION OF A PERSONALIZED 3D-
PRINTED IMMOBILIZATION SHELL IN
PRONE BREAST RADIOTHERAPY USING
THERMOLUMINESCENT DOSIMETERS**

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Introduction Prone breast radiotherapy faces positioning challenges. Personalized 3D-printed shells may improve reproducibility, but their impact on skin dose requires investigation.

Materials and Methods CT images of an ATOM anthropomorphic phantom with a breast component and personalized 3D-printed shell were used to generate TomoDirect and TomoHelical whole-breast plans with simultaneous integrated boost (BreastLSib) in RayStation 24A   for Radixact   delivery. The prescribed doses were 50 Gy to the whole breast and 60 Gy to the boost in 25 fractions. Each technique was calculated with and without the shell included in the TPS, resulting in four plans.

Surface doses were measured using strips of three TLD-100 dosimeters (LiF:Mg,Ti; 3.2 x 3.2 x 0.9 mm  ) placed on the median and lateral breast surfaces, with TLDs over the boost volume. TLD positions and phantom setup were verified by kVCT imaging and imported into the TPS. Measured and TPS-calculated doses, as well as Shell–NoShell plans, were compared to assess the shell’s dosimetric impact and calculation accuracy. A total of 12 TLDs per treatment technique were used.

Results We found excellent TPS–calculated and TLD-measured doses agreement for both TomoDirect and TomoHelical BreastLSib. The mean absolute TPS–TLD difference for TomoDirect decreased from 5.2% ± 4.9 without the shell to 2.2% ± 1.9% with the shell, whereas for TomoHelical it decreased from 4.2% ± 3.2% to 3.6 ± 2.8% most probably because uncertainties are likely to increase for surface calculated and measured dose.

Shell presence increased measured skin dose by 16% on average. Skin dose increased by $21.3 \pm 5.7\%$ (0.4 ± 0.1 Gy) for TomoDirect and $16.5 \pm 3.4\%$ (0.4 ± 0.1 Gy) for TomoHelical. The increase was relatively consistent for TomoHelical, whereas TomoDirect shows a larger and more variable effect, likely related to the boost location close to the skin surface and tangentiality of the beam.

Conclusion TPS-calculated and TLD-measured doses agreed well with and without the shell. However, as expected, the shell increased skin dose, particularly near the boost surface in TomoDirect. Future planning and new open-shell designs should aim to reduce skin dose while maintaining reproducible immobilization.

POSTER PRESENTATION

P 34 SPATIAL VERSUS TEMPORAL VARIABILITY OF THERMOMETRIC PARAMETERS IN LOCALLY ADVANCED TREATED WITH NEOADJUVANT CHEMORADIOTHERAPY IN COMBINATION WITH DEEP REGIONAL HYPERTHERMIA

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Aim: Thermal dose, expressed as cumulative equivalent minutes at 43°C (CEM43), is considered a predictive parameter of treatment response to combined radiotherapy (RT) and hyperthermia (HT). Thermometry data from locally advanced rectal cancer (LARC) patients enrolled in the Hyperboost REC study were used to assess the spatial and temporal variability of CEM43 thermal dose metrics and correlation with response rates.

Methods: In total, 206 LARC patients treated with neoadjuvant chemoradiotherapy (CRT) and HT (median age: 62 years, male 66%) were included in this analysis. RT was given with a median dose of 50.4Gy (95%CI:50.4–56) combined with 5-FU only (46% of patients) or as different doublets containing oxaliplatin. The median number of HT sessions was 7(1-11). Treatment data files from the BSD-2000 3D/MRI system (Pyrexar Medical Corporation, Salt Lake City, USA) were used to evaluate thermal dose metrics: CEM43T₁₀, CEM43T₅₀, and CEM43T₉₀.

Temporal thermometry was based on a single stationary measurement point (i.e., the tip of the temperature probe inserted in rectum during HT) recorded every 5 seconds, whereas spatial mapping was derived from temperature measurements along the catheter length in 1-cm increments up to a maximum depth of 10 cm, acquired at 5- or 8-minute intervals.

Results: There was no significant difference between spatial and temporal evaluations of the thermal dose parameters CEM43T₁₀ and CEM43T₅₀. However, significant variability was observed for the low-temperature parameter CEM43T₉₀. Subgroup analyses stratified according to the median number of HT sessions revealed similar results for spatial and temporal evaluations. Furthermore, analysis according to treatment period (before versus after 2015) showed that 123 patients treated after 2015 received higher CEM43T₁₀ thermal doses than 124 patients treated before 2015 (5.29 ± 7.88 vs 3.66 ± 3.19 min, $p=0.03$), while CEM43T₅₀ and CEM43T₉₀ were comparable between groups. Patients who had complete responses (40%, 95%CI: 33-46%) tended to receive higher thermal doses (CEM43T₅₀ > 1.3min and CEM43T₁₀ > 3.4 min) and more HT sessions (> 7).

Conclusion: This analysis showed that the thermometry methodology used influences the reported CEM43T₉₀ metric. A trend toward higher complete response rates was observed in patients who received both higher thermal doses and a higher number of HT sessions.

POSTER PRESENTATION

P 35 POSTOPERATIVE IRRADIATION OF HIGH RISK MENINGIOMA- IS 60 GY ENOUGH?

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Aims Postoperative radiotherapy (RT) to 60 Gy is frequently prescribed for high-risk meningioma but the evidence is unclear, particularly following gross total resection (GTR). Recently, dose escalation to 66-70 Gy has been suggested for residual disease. In this single center analysis, clinical outcomes of patients with meningioma WHO grades 2-3 treated postoperatively with 60 Gy were evaluated and compared with the literature.

Methods Patients treated to 59.4 Gy/1.8 Gy per fraction and 60 Gy/2 Gy (2015–2026) were identified from our institutional database. We extracted patient, tumor and treatment characteristics, as well as toxicity and radiological events. Survival analysis using the Kaplan

Meier method was used to calculate the actuarial progression-free survival (PFS), recurrence-free survival (RFS) and overall survival (OS).

Results Thirty-one patients were included. Median age was 67 (IQR 29-85) years and 18 were female. 90.3% of tumors were grade 2 (28/31) and 9.7% (3/31) were grade 3, respectively. 22/31 had GTR and 9/31 had subtotal resection (STR). 17/31 had macroscopic tumor at RT (median GTV 24.5 cm³, range 3.4-86.1). Median time to RT was 3 (1-42) months and median follow-up was 34.4 (4.6-126) months. Five patients developed a local recurrence (LR) at a median of 18 (7-44) months: three had residual tumor, one tumor was upstaged to grade 3, one had had multiple surgeries and prior RT, and one had no recognized risk factors for LR. Two underwent salvage surgery and re-irradiation, one received radionuclide therapy and one is under MRI-based follow-up. There was one grade 3 toxicity (symptomatic radionecrosis).

The absolute local control rate was 80%. 5-year PFS was 59.6% (95% CI: 40.1-87.1%), which appears favorable compared with 38.8%-40.8% reported in larger 60 Gy cohort analyses, and is similar to 64.6%- 64.8% reported following 66-70 Gy. 5-year RFS was 66.2% (95% CI 43.2-100) and 5-yr OS was 68.4% (95% CI 49.6%-94.4%). No deaths were meningioma-related.

Conclusions This analysis showed that postoperative RT with 59.4-60 Gy achieved 5-year PFS similar to that reported following dose escalation to 66-70 Gy. Dose escalation may be able to further improve local control in meningiomas at greater risk of LR.

POSTER PRESENTATION

P 36 **A CASE REPORT OF PALLIATIVE LATTICE RADIOTHERAPY FOR PLEURAL MESOTHELIOMA**

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Aims:

To report an exceptional clinical outcome of palliative lattice radiotherapy (LRT) in an elderly patient with locally advanced pleural mesothelioma.

Methods:

An 86-year-old man was diagnosed with a right-sided low-grade epithelioid pleural mesothelioma, clinical stage cT4

cN0 cM0. The patient declined any systemic therapy. During subsequent surveillance, progressive nodular pleural disease developed with significant locoregional mass effect. Given the progressive disease with pain, an interdisciplinary tumor board recommended analgesic radiotherapy. As 30 Gy in 10 fractions was deemed insufficiently durable, the patient was referred for an LRT approach.

Results: 4DCT showed no tumor motion. Thirteen 1.5-cm spheres were manually positioned within the tumor, with a 2-cm craniocaudal and 7–8-cm axial separation between sphere centres. A single 20-Gy lattice boost was prescribed to the median sphere dose, allowing a maximum dose of 160%, using an optimisation approach adapted from Grams et al., 2023. Three VMAT arcs with 6-MV FFF photons and 7,621 MU were delivered at Inselspital. Conventional fractionated radiotherapy (10 × 3 Gy) was subsequently delivered to a standard PTV with VMAT at ROSOL. Four days after the lattice boost, the patient developed fever.

At approximately three and six months after radiotherapy, he reported no dyspnea or other tumor-related complaints and remained in satisfactory general condition. Follow-up computed tomography approximately eight months after treatment demonstrated a tumor volume reduction, from 1,470 cm³ to 950 cm³, corresponding to a reduction of approximately 35%. The patient remained free of pain. During six-monthly follow-up, the patient remained at home and independent in daily activities. He declined further CT imaging. During the final six months of follow-up, he developed exertional dyspnea but remained under the care of his general practitioner. He died at home approximately 21 months after radiotherapy.

Conclusions:

In this elderly patient with locally progressive pleural mesothelioma, palliative LRT only followed by conventional fractionated radiotherapy without any systemic therapy achieved unexpected durable local tumor control and meaningful symptom palliation while minimizing logistical burden for the patient. The febrile episode occurring four days after the lattice boost may indicate an immune-mediated response and warrants further investigation.

P 37 CBCT-BASED ONLINE ADAPTIVE RADIOTHERAPY FOR ESOPHAGEAL CANCER (ARTEC): PRELIMINARY RESULTS OF A PROSPECTIVE PHASE II TRIAL

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Aims: Chemoradiotherapy (CRT) is a treatment option for esophageal cancer (EC), but cardiopulmonary toxicity and anatomical changes remain major challenges. The prospective Phase II ARTEC trial evaluates CBCT-based online adaptive radiotherapy (oART) on the ETHOS platform. This analysis presents the first preliminary clinical and dosimetric results.

Methods: This analysis included the first 14 of 30 planned patients enrolled in the ARTEC trial. Patients received CBCT-based oART (50.4Gy/28 fractions) with weekly carboplatin/paclitaxel. Planning used 4D-CT, guideline-based contouring, heart/lung-cropped CTVs, and a 5-mm CTV-PTV margin. The primary endpoint was pulmonary toxicity. Patients underwent scheduled toxicity assessments (CTCAE v5.0) and chest CT at 3, 6, and 12 months. Dosimetric comparisons between adapted and scheduled plans included CTV/PTV coverage and heart and lung dose parameters using Wilcoxon signed-rank tests ($p < 0.05$). Pathological response was assessed in patients undergoing surgery.

Results: Adapted treatment plans achieved significant mean absolute improvements compared with scheduled treatment plans in CTV D99% (1.2%, $p = 0.006$), PTV D99% (10.2%, $p < 0.001$), CTV D95% (0.9%, $p = 0.011$) and PTV D95% (3.5%, $p = 0.001$). No significant differences were observed for organs-of-interest (OOI). Grade 3 acute adverse effects (≤ 3 months) occurred in 14.3%, comprising two cases of severe dysphagia, one resolving spontaneously and one requiring balloon dilatation for radiation-induced esophageal stenosis. After a median follow-up of 8 months (range 1–18), only one patient (7.1%) developed grade 1 radiation-induced atelectasis. Following esophagectomy, three patients (21.4%) developed grade 3 aspiration pneumonia and one patient (7.1%) developed additional grade 3 esophageal stenosis. Among the seven patients who underwent surgery, pathological tumor regression was TRG 1a in two patients (28.6%), TRG 1b in one (14.3%), TRG 2 in two (28.6%) and TRG 3 in two (28.6%), demonstrating encouraging early pathological response rates.

Conclusions: This preliminary analysis confirms improved target coverage with CBCT-based oART for esophageal cancer while maintaining a favorable toxicity profile. ¹ Although no significant differences in OOI dose parameters were observed in this interim analysis, early pathological response after neoadjuvant oART is encouraging. Final analysis after completion of the ARTEC trial will provide mature toxicity, dosimetric, pathological response and quality-of-life outcomes.

P 38 RAPID ANALYTICAL MODELLING OF DOSE PROFILES FOR CONVENTIONAL AND MR-LINACS

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Aims Accurate dose calculation is fundamental to beam commissioning, quality assurance and treatment planning in external beam radiotherapy. Conventional convolution/superposition (CS) algorithms rely on numerical implementations and symmetric energy deposition kernels (EDKs), limiting their analytical tractability and their ability to represent magnetic field-induced asymmetries. We developed a fully analytical CS framework for rapid calculation of one-dimensional dose profiles applicable to both conventional linacs and MR-linacs.

Methods The total energy released per unit mass (TERMA) was modelled as a polynomial function of lateral position, while the EDK was described using an asymmetric generalized Lorentzian distribution. This parameterization yields a closed-form analytical expression of the convolution integral in terms of Gaussian hypergeometric functions. Model parameters were determined from dose profiles calculated with commercial treatment planning systems for Varian TrueBeam and Halcyon, Elekta Versa HD and Elekta Unity over multiple beam energies and field sizes. The model was validated against independent measurements.

Results The proposed model accurately reproduced both symmetric and asymmetric dose profiles across all investigated systems. γ -index passing rates exceeded 95% using 2%/1 mm criteria against treatment planning system calculations and 2%/2 mm against measurements. The analytical framework also maintained excellent agreement for Unity profiles over the entire investigated depth range. Execution times remained below 1.5 s for all field sizes, enabling near real-time dose profile evaluation while preserving a physically interpretable separation between primary fluence and lateral energy transport.

Conclusions This fully analytical convolution/superposition framework provides an accurate and computationally efficient approach for modelling dose

profiles in homogeneous media, including magnetic field-induced asymmetries observed in MR-guided radiotherapy. The method offers a compact representation of beam characteristics and may support beam commissioning, quality assurance, inter-machine comparison, rapid dose estimation and investigations of magnetic field effects.

POSTER PRESENTATION

P 39 SINGLE FRACTION RADIOSURGERY FOR SMALL BRAINSTEM METASTASES

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Aim: Brainstem metastases (BSM) are a therapeutic challenge, because ablative radiation doses must be delivered within a functionally critical anatomical region. Radiation-induced radionecrosis may cause neurological impairment and significant morbidity and given concerns regarding treatment-related toxicity, fractionated stereotactic radiotherapy is often favored. As limited data exist for single-fraction radiosurgery (SRS), our aim was to evaluate the clinical outcomes following single-fraction SRS with 18 Gy.

Methods: Eligible patients with BSMs treated with SRS were identified from our institutional database. The gross tumor volume (GTV) was defined as the contrast-enhanced brain metastasis on 1.5T T1 MRI. In 16/18 cases, the planning target volume (PTV) equated to the GTV. The prescription dose was 18 Gy in a single fraction. Treatment plans were generated with dynamic conformal arcs (multiple lesions- single isocenter) or Volumetric Modulated Arc Therapy using SRS Software (Elements, Brainlab). The treatment was delivered with the Novalis radiosurgery platform with 2.5 mm MLC leaves and stereoscopic X-ray imaging guidance (Exatrac, Brainlab). To determine local control (LC) and overall survival (OS) rate a Kaplan-Meier analysis was performed.

Results: Eighteen consecutive patients with 19 BSMs treated between 01/2018 and 04/2026 were evaluated. Median age was 62 years (range, 55-75). One patient had single BSM and 18 were treated as part of multiple metastases plans. All patients had additional brain metastases. One patient previously underwent prior whole brain radiotherapy and 17/18 received de novo SRS. Primary tumors were NSCLC (67%), breast cancer (11%) and other (22%). Median BSM volume was 0.11 cm³ (range, 0.01-0.38). Median OS was 9.8 months (0.39-36.03). LC at 3 months was 100 % and 87.5 % (CI 67.3 – 100) at both 6 and 9 months. Of three neurological deaths, only one was attributable to the BSM four years after initial SRS and following re-irradiation with 10x 3 Gy after two years.

Conclusions: These findings show that single fraction SRS with 18 Gy for patients with BSMs can achieve excellent local control and limited treatment-related toxicity equivalent to SRS for cortical brain metastases. Single-fraction SRS can be considered as treatment option for carefully selected with BSMs on dedicated platforms.

POSTER PRESENTATION

P 40 THE IMPACT OF DIABETES AND ANTIDIABETICS ON OUTCOMES IN PATIENTS TREATED WITH ROBOTIC STEREOTACTIC BODY RADIOTHERAPY FOR PRIMARY PROSTATE CANCER: A MONOCENTRIC, RETROSPECTIVE COHORT STUDY

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Aim: The prevalence of type 2 diabetes mellitus is increasing rapidly worldwide, and there is strong evidence suggesting that diabetes is associated with worse outcomes in prostate cancer (PCa) patients. The aim of this study was to determine the impact of diabetes on oncological outcomes among patients treated with robotic stereotactic body radiotherapy (SBRT) for primary PCa.

Methods: Data from patients treated with robotic SBRT for primary PCa between 2014 and 2025 were retrospectively collected at our center. Risk ratios (RR) for mortality and recurrence, and clinical progression-free survival (cPFS; time from end of SBRT to biochemical recurrence [Phoenix criteria] or local, nodal, or distant recurrence), were compared between non-diabetic and diabetic patients. Acute and late GI/GU toxicities were graded according to CTCAE v5.0 and assessed by antidiabetic medication class (metformin, insulin, SGLT2 inhibitors, and other agents).

Results: A total of 321 patients were included, of whom 229 (71%) were non-diabetic and 92 (29%) were diabetic. BMI was significantly higher among diabetic than non-diabetic patients (28.5 [25.4–31.9] vs. 25.6 [23.4–28.1], $p<0.001$). Diabetic patients had significantly higher mortality (19.6% vs. 9.2%, $RR=2.13$, 95% CI 1.19–3.82, $p=0.001$) and a significantly higher risk of recurrence (22.8% vs. 7.9%, $RR=2.90$, 95% CI 1.62–5.19, $p<0.001$) than non-diabetic patients. At a median follow-up of 24 months (9–44) in non-diabetic and 35.5 months (15–59) in

diabetic patients, 1-, 2-, and 3-year cPFS rates were 98.9%, 94.7%, 87.8% (non-diabetic) vs. 88.7%, 81.6%, 71.8% (diabetic) ($p=0.042$). Stratified by antidiabetic class, acute GU ($p=0.835$), acute GI ($p=0.637$), and late GU toxicity ($p=0.252$) showed no significant differences, but late GI toxicity differed significantly ($p=0.046$), with higher Grade 1–2 rates among insulin users than SGLT2-inhibitor or metformin users.

Conclusions: Among patients treated with SBRT for primary PCa, diabetes was associated with significantly higher mortality, a higher risk of recurrence, and significantly lower cPFS rates compared with non-diabetic patients. Insulin use was associated with increased late GI toxicity, warranting further investigation. These rates are broadly consistent with published SBRT series, in which grade ≥ 2 acute GU and GI toxicity range approximately 5–30% and 2–10%, and late grade ≥ 2 toxicity remains similarly low.

POSTER PRESENTATION

P 41 DEPENDENCE OF DEEP-LEARNING AND PHYSICIAN CONTOURS ON VIRTUAL MONOENERGETIC ENERGY LEVEL (40/55/70 KEV) ON A FAST-KVP-SWITCHING DUAL-ENERGY CT SIMULATOR FOR PROSTATE RADIOTHERAPY

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Purpose. Low-keV virtual monoenergetic images (VMI) can enhance tissue contrast, and deep-learning image reconstruction (DLIR) reportedly offsets their noise penalty; whether this benefits soft-tissue delineation on pelvic planning CT is unknown, and deep-learning segmentation (DLS) may not generalize to VMI. We quantified the dependence of DLS and physician-validated contours of prostate, seminal vesicles (SV), bladder and rectum on 3 VMI energies on a fast-kVp-switching dual-energy CT (DECT) simulator (Revolution Apex, GE).

Methods. Seven planning CTs (two contrast-enhanced) from six prostate radiotherapy patients were acquired in spectral mode (80/140 kVp fast switching). VMIs at 40, 55 and 70 keV were reconstructed with DLIR and imported into Raystation 2024A. On each series, the four structures were segmented by DLS (commercial Raysearch models) and corrected by a radiation oncologist. Dice similarity coefficient (DSC) and 95th-percentile Hausdorff distance (HD95) quantified (1) DLS versus corrected contours per energy (editing burden) and (2) contours at 40/55 keV versus the 70 keV reference, closest to a conventional 120 kVp acquisition.

Results. Bladder and rectum contours were invariant across energies (median DSC ≥ 0.95 , HD95 ≤ 0.21 mm). Physician correction of DLS prostate contours increased at 40 keV (DLS-versus-corrected DSC 0.93 [0.89–0.97], HD95 0.43 mm [0.17–0.52]) versus 70 keV (0.99, 0.15 mm). Versus 70 keV, physician contours deviated most at 40 keV for prostate (DSC 0.89 [0.86–0.90]; HD95 0.49 mm) and SV (DSC 0.81 [0.78–0.91]; HD95 0.48 mm), whereas 55 keV remained close to the reference (prostate 0.91; SV 0.90). DLS contours were more stable across energies than physician contours (prostate 40 vs 70 keV: DSC 0.94).

Conclusion. Pelvic contours are not invariant to VMI energy, even with DLIR: deviations concentrated at 40 keV in the prostate and SV, where manual correction of DLS contours also increased. 55 keV behaved similarly to 70 keV. The low-keV noise penalty in non-enhanced soft tissue persists despite DLIR, supporting standardization of reconstruction energy in DECT-based contouring. Follow-up study is underway to establish comparison with co-registered MRI ground truth.

POSTER PRESENTATION

P 42 COCHLEA SPARING IN RADIOSURGERY OF VESTIBULAR SCHWANNOMA – A DOSIMETRIC COMPARISON OF TWO TECHNIQUES

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Aims

As vestibular schwannoma (VS) is a benign tumor, radiosurgery should not only aim for durable tumor control but also minimize treatment-related morbidity, with hearing preservation as a central objective. Due to the close anatomical relationship between tumor and cochlea, limiting the cochlear dose is one of the most challenging aspects of treatment planning. The aim of this planning study was to compare the cochlear sparing achievable with linac-based volumetric modulated arc therapy (VMAT) and with a dedicated gyroscopic radiosurgery platform (ZAP-X) at equivalent target coverage.

Methods

Treatment plans of 20 patients with VS treated with ZAP-X were re-planned with VMAT without compromising dose coverage of the target volume. Mean and maximum cochlear dose, cochlear D0.03cc, PTV coverage, PTV minimum and maximum dose, conformity index (CI) and

dose to the brainstem were compared between the two techniques. Differences were evaluated using the paired t-test; a p value of <0.05 was considered significant.

Results

The prescription dose was 12 Gy in all treatment plans. With a PTV coverage of 99% and a mean CI of 1.32 (VMAT) vs. 1.25 (ZAP-X), target coverage did not differ significantly between the two techniques ($p=0.148$). Cochlear doses were significantly higher in the VMAT plans than in the ZAP-X plans: mean dose 4.73 Gy vs. 2.74 Gy ($p<0.01$), maximum dose 9.34 Gy vs. 7.49 Gy ($p<0.01$) and D0.03cc 5.95 Gy vs. 3.47 Gy ($p<0.01$). Likewise, brainstem maximum dose (5.57 Gy vs. 4.35 Gy) and D0.03cc (4.74 Gy vs. 3.45 Gy) were significantly higher in the VMAT plans ($p<0.01$).

Conclusion

In this dosimetric planning study, both techniques achieved equivalent target coverage, while cochlea and brainstem doses were significantly lower in ZAP-X plans than in VMAT re-plans, due to the smaller penumbra and smaller distance of the source to the target (100 cm VMAT vs 45 cm ZAP-X). As cochlear dose is an established prognostic factor for hearing preservation after VS radiosurgery, these differences may be clinically relevant. However, being a retrospective planning comparison, this study cannot demonstrate differences in clinical outcome; clinical data are required to determine whether the observed dosimetric differences translate into improved hearing preservation.

POSTER PRESENTATION

P 43 FEASIBILITY OF VESTIBULAR DOSE SPARING IN STEREOTACTIC RADIOSURGERY FOR VESTIBULAR SCHWANNOMAS

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Aims Single-fraction stereotactic radiosurgery (SRS) is a standard treatment for vestibular schwannomas [1]. Recent evidence suggests that higher radiation doses to the vestibular system are associated with an increased risk of post-treatment dizziness and vestibular toxicity [2,3]. This study evaluates the dosimetric feasibility of vestibular sparing during SRS without compromising Planning Target Volume (PTV) coverage or dose constraints to other organs at risk (OARs).

Methods This retrospective dosimetric study includes 45 patients treated for vestibular schwannoma. For each patient, two treatment plans were generated: (i) a standard

plan without vestibular constraints and (ii) a vestibular-sparing plan. All plans were prescribed to 12 Gy in a single fraction to the 80% isodose line and created in Varian Eclipse™ v18.1 using the Analytical Anisotropic Algorithm (AAA v18.1.1). Treatments were planned for delivery on a TrueBeam® linear accelerator with High-Definition MLC and the HyperArc™ non-coplanar stereotactic technique. Vestibular-sparing plans aimed to minimize dose to vestibular sensory organs (VSO, contoured to include the saccule, utricle and semi-circular canal ampullae) while maintaining PTV coverage and OAR constraints within $\pm 5\%$ of the standard plan, including the cochlea, neighbouring cranial nerves, and brainstem.

Results Preliminary analysis of the first 6 patients confirms the dosimetric feasibility of vestibular sparing. Updated results, including all patients analyzed by the time of presentation, will be reported. Vestibular-sparing optimization achieved substantial dose reductions while preserving target coverage. PTV V100% varied by only -0.1% on average, and the Paddick conformity index remained within $\pm 2\%$. Mean and maximum doses to the VSO were reduced by 38% (2.2 Gy) and 19% (2.0 Gy), respectively. These reductions were achieved without clinically relevant changes to other OARs; cochlear mean dose varied by at most +0.1 Gy, while all brainstem and cranial nerve constraints were maintained.

Conclusion Systematic vestibular sparing during single-fraction non-coplanar SRS for vestibular schwannomas is dosimetrically feasible and significantly reduces vestibular dose without compromising PTV coverage or OAR constraints.

POSTER PRESENTATION

P 44 LONG-TERM PATIENT-REPORTED OUTCOMES AFTER PENCIL BEAM SCANNING PROTON THERAPY IN PATIENTS WITH ADENOID-CYSTIC CARCINOMA

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Aims:

Adenoid cystic carcinoma (ACC) is a rare, histologically heterogeneous malignancy that typically arises in close proximity to critical organs at risk, making the delivery of curative radiotherapy particularly challenging. Pencil beam scanning proton therapy (PBSPT) enables highly conformal dose delivery while minimizing irradiation of surrounding healthy tissues, with the potential to reduce treatment-related toxicity and preserve quality of life. This study aimed to evaluate the long-term well-being of patients with ACC treated with PBSPT at our institution using patient-reported outcomes.

Methods:

As part of our institutional follow-up, a self-designed questionnaire addressing treatment sequelae, social

interactions and professional performance was sent to patients at irregular intervals after treatment. From a pool of 83 ACC patients who were treated with PBSPT between January 2001 and March 2026, 29 (35%) returned completed questionnaires. We present the qualitative findings gleaned from the responses; where more than one questionnaire was provided, the responses in the last questionnaire were considered for the analyses.

Results:

Eighteen (62%) female and 11 (38%) male patients with a median age of 50.1 years (range: 27.4-73.1) at time of treatment completed at least one questionnaire. Thereof, 12 patients returned at least 2 questionnaires (41%) and 4 (14%) patients even provided 4 or more completed questionnaires during a median follow-up time from end of PBSPT to the last completed questionnaire of 6.0 years (range: 1.4-24.9). Twenty (72%) patients presented with permanent impairment due to the disease and/or therapy. Thirteen (45%) patients did not experience any problems at work, however 7 (24%) did not work and 6 (21%) were already retired. Twenty-five (86%) patients reported that they do not experience any problems in their social environment, e.g. interacting with friends or members of their families.

Conclusions:

Despite a substantial proportion of long-term disease- or treatment-related sequelae, social and occupational functioning remained largely preserved in this cohort, suggesting a favorable functional outcome profile following PBSPT for ACC. These data support the role of PBSPT as a curative treatment modality in this challenging entity and highlight the need for prospective, standardized PRO assessment to further characterize long-term survivorship in this rare tumor population.

POSTER PRESENTATION

P 45 FEASIBILITY OF RANDOMIZING BETWEEN TRANSORAL CO₂ LASER MICROSURGERY AND SINGLE VOCAL CORD IRRADIATION IN STAGE 0-I GLOTTIC CARCINOMA: SCREENING, ACCRUAL AND SAFETY IN THE PHASE III VOICES TRIAL

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Aims: The previous randomized comparison of laser surgery and (conventional whole-larynx) radiotherapy in early glottic carcinoma closed prematurely for slow accrual, and the feasibility of such trials has since been questioned. VoiceS compares transoral CO₂ laser microsurgery (TLM) with single vocal cord irradiation (SVCI). We report screening, accrual, treatment and safety, to quantify the barriers to randomization in the multicenter, randomized, open-label phase III trial (NCT04057209).

Methods: Patients with untreated unilateral cTis or cT1a glottic carcinoma without anterior commissure involvement (ACI) are randomized 1:1 to TLM or SVCI (58.08 Gy in 16 fractions). Screening logs from all centers until December 2025 were reviewed and reasons for non-inclusion classified. Patients whose disease never met the stage criteria were removed from the denominator. Treatment, oncological events and toxicity (CTCAE v.5.0) are reported for all randomized patients, pooled across arms. The primary voice endpoint was deliberately not analyzed.

Results: Two Swiss centers closed without randomizing a patient; three continue to recruit. Of 90 stage-eligible patients screened until 12.2025, 20 (22%) were randomized, ranging from 38% in Bern to 8% in Zurich and 5% in Mumbai. The other 70 were not randomized because of: refusal of participation or randomization 31 (44%), ACI precluding the protocol-required resection margin 21 (30%), inadequate transoral exposure 12 (17%),

inability to give informed consent 5 (7%), and advanced age 1 (1%). Accrual has since reached 24 patients (71% of the planned 34), 12 per arm. All SVCI patients received 58.08 Gy in 16 fractions without interruption; 5 TLM patients required more than one operation and 1 adjuvant radiotherapy for positive margins. No local or locoregional recurrence has occurred (median follow-up 23.1 months). No adverse event exceeded CTCAE grade 2 and no surgical complication exceeded Clavien-Dindo grade 1.

Conclusions: Randomization between laser surgery and radiotherapy is achievable but slow: one in five patients with eligible disease enters the trial. Patient refusal and the anatomical criteria required for study-specific surgery contribute almost equally, which is worth considering when designing trials comparing surgery and radiotherapy. Delivery and safety are excellent and accrual continues.

POSTER PRESENTATION

P 46 **DE-ESCALATION OF RADIOTHERAPY IN HPV-NEGATIVE NON-NASOPHARYNGEAL HEAD AND NECK SQUAMOUS CELL CARCINOMA: A SYSTEMATIC REVIEW**

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Background: Definitive and postoperative radiotherapy are central components of treatment for head and neck squamous cell carcinoma (HNSCC) but are associated with significant toxicities that can impair long-term function and quality of life. De-escalation strategies, aiming to reduce treatment-related morbidity while maintaining tumor control, have attracted increasing interest. However, most research has focused on HPV-positive oropharyngeal carcinoma. Systematic evidence for HPV-negative disease remains limited.

Methods: PubMed and EMBASE were searched for prospective studies investigating radio(chemo)therapy de-escalation in HPV-negative, HPV-unspecified, or mixed non-nasopharyngeal HNSCC populations. ClinicalTrials.gov was searched for ongoing prospective trials. Data extraction and verification were performed independently by three investigators.

Results: Screening of 3156 records identified 14 published prospective studies, 10 in the definitive and four in the postoperative setting. Strategies included reduction or omission of elective nodal volumes, dose reduction, and combined approaches. Additionally, 23 ongoing prospective trials were identified. Across studies, elective nodal failure rates were consistently low (0-4.6%), with most recurrences occurring within high-dose volumes rather than de-escalated elective regions. Randomized evidence for elective nodal dose reduction is mixed: two trials maintained regional control and reduced acute toxicity, whereas another was stopped for futility.

Conclusion: Available evidence on de-escalation in HPV-negative HNSCC is limited, derived primarily from small, heterogeneous phase II studies with mixed HPV

populations. Although data are promising in selected settings, notably for elective nodal control, the randomized evidence for elective nodal dose reduction is conflicting, and further adequately designed prospective randomized trials are required.

POSTER PRESENTATION

P 47 **A METHODOLOGY FOR THE ASSESSMENT OF AI-BASED AUTO-CONTOURING TOOLS**

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Objective AI-based auto-contouring tools can generate more than 200 different structures on CT datasets. The aim of this work was to develop an effective methodology to assess differences in contours between software versions and/or evaluate their quality at commissioning new tools.

Methods The differences between auto-generated contours on planning CTs from two versions of Therapanacea ART Plan (v2.3 and v3.1) were investigated using 22 clinical cases of different anatomical regions. Similarity metrics (conformity Index (CI), Dice Similarity Coefficient (DICE) and Mean Distance to Conformity (MDC)) for all structure volumes were calculated with ImSimQA (v4.4). For each structure type, mean values of similarity metrics were classified into four categories according to pre-defined thresholds. Classification from 1 to 4 indicated an increased deviation in the metrics.

As mathematical comparisons alone do not necessarily correlate with meaningful endpoints, a scoring system was additionally implemented to account for anatomical correctness [1,2]. For this purpose, contours were rated manually in terms of their quality and clinical relevance by three contouring experts, where focus could be spent on structures with less similarity.

Results The changes between mean values of similarity metrics per structure confirmed differences in auto-segmentation between versions. From the 128 structures examined, 42 were in categories 1 and 2, 40 in category 3 and only 4 showed large differences between the two versions (category 4).

Contouring experts gave high scores to 48 structures and low scores to 12 structures in the new version of the software. From the four structures which exhibited lowest similarity, two structures were rated better by experts in the new version but two were considered of poorer quality.

Summary and conclusion For the assessment of the differences between version of AI-based auto-contouring tools, the evaluation of similarity metrics in combination with manual scoring was shown to be practically feasible and helpful.

References [1] Sheerer et al., Radiother Oncol. 2021 July; 160: 185–191; Metrics to evaluate the performance of auto-segmentation for radiation treatment planning: A critical review

[2] Meyer et al., Radiation Oncology (2024) 19:168; Artificial intelligence contouring in radiotherapy for organs-at-risk and lymph node areas

POSTER PRESENTATION

P 48* **DOSIMETRIC CHARACTERIZATION OF THE FLASH-SARRP FOR RELIABLE PRECLINICAL RADIOBIOLOGICAL STUDIES**

Ms. Michèle Knol¹, Dr. Patrik Goncalves Jorge², Mr. Louis Kunz³, Dr. Pierre Korysko⁴, Mr. Benoit Petit¹, Dr. André Durham³, Prof. Marie-Catherine Vozenin³, Prof. Pelagia Tsoutsou³, Mr. Nikolaos Koutsouvelis², Dr. Julie Lascaud⁵

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FLASH radiotherapy delivers radiation at ultra-high dose-rates, reducing the normal tissue toxicity while preserving anti-tumor efficacy compared to conventional dose-rates. Since photons are the most widely used modality in clinical radiotherapy, photon-FLASH is a critical step toward clinical translation, yet it remains the most technically challenging modality to achieve. Additionally, dosimetric difficulties complicate the matter, since standard detectors often cannot resolve the short pulses and high instantaneous dose-rates of FLASH beams. The FLASH-SARRP (Xstrahl, Inc) is a preclinical small-animal irradiator and offers a valuable platform to advance photon-FLASH research. However, robust characterization is a necessary step before reliable preclinical experiments can be performed. This study characterized the FLASH-SARRP and established a quality assurance (QA) workflow to enable precise and reproducible preclinical irradiations.

A combined dosimetric approach paired Gafchromic film for high-resolution spatial dose mapping with a plastic scintillating fiber for real-time temporal monitoring. Custom 3D-printed spacers ensured reproducible setups. Beam characteristics, including temporal pulse structure and synchronization between the two tubes, were assessed with fiber measurements. A QA workflow was developed via cross-calibration between film and fiber, with the fiber used before each irradiation to correct for system variability.

The FLASH-SARRP delivered ~80 Gy/s with both tubes simultaneously, with a homogeneous field suitable for small-animal irradiation. However, tube desynchronization with an average delay of 10 ms caused temporal dose-rate heterogeneity. Inter-session variability was substantial

(~11%) compared to intra-session variability (~4%), but the use of the developed QA workflow reduced the inter-session variability to 5%.

This work highlights the importance of temporal dosimetry for preclinical FLASH research and proposes a practical QA framework combining real-time fiber monitoring with reference film dosimetry, improving reproducibility and supporting reliable biological studies of the FLASH effect ahead of clinical translation.

POSTER PRESENTATION

P 49 **EVALUATION OF VIRTUAL BOLUS THICKNESS FOR BREAST TUMOR TREATMENT WITH VMAT RADIATION THERAPY**

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Background: Breast inflammation during the course of radiotherapy treatments with Volumetric Modulated Arc Therapy (VMAT) technique may affect the Planning Target Volume (PTV) shape and may lead to the need of replanning during radiotherapy. The introduction of an additional margin (called virtual bolus or auto-flash) with respect to the PTV is a planning technique widely used in radiotherapy practice. The choice of an appropriate virtual bolus thickness bringing to an enlarged PTV (PTV_e) is crucial to optimize the planning time, to reduce extra-radiation due to the *increased size of irradiation volume and to improve plan robustness by reducing the risk of replanning during the course of the treatment.

Purpose: This study evaluates whether a +10 mm margin adequately reflects real-world clinical patterns for breast cancer patients with different fractionation schemes. The feasibility of adapting PTV margins based on fractionation scheme and total treatment duration is also discussed.

Methods: Using retrospective data of 65 breast cancer patients, we investigated the extent of inflammation effects on breast tissues evaluating the Residual Margin (RM) between the PTV_e used during the planning phase and the actual breast volume extracted from daily Cone Beam Computed Tomography (CBCT) positioning images.

Results: An overall RM reduction between the start of the treatments and the end of the treatments has been observed. It is more pronounced between the start and the middle of the treatment course. For patients receiving 15 fractions the difference between the RM at start and at the end is the most pronounced. This can be related to the tendency of inflammation of breast tissues with time. For the patients receiving 5 fractions the effect is less pronounced.

Conclusions: Our findings indicate that while a +10 mm margin provides sufficient coverage in standard workflows, it may be overly conservative in specific cases. Setting fractionation-specific margins may optimize target coverage and dosimetric plan quality while maintaining robustness against breast swelling. Our results support the need for further studies towards the development of margin strategies tailored to fractionation schemes to improve planning efficiency and the delivery precision in breast cancer VMAT treatments.

POSTER PRESENTATION

P 50 **CASE REPORT – DEEP INSPIRATION BREATH HOLD FOR INTERSTITIAL HDR BRACHYTHERAPY OF THE THORACIC WALL: WORKFLOW AND DOSIMETRIC EVALUATION**

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Aims: Deep inspiration breath hold (DIBH) is well established in external beam radiotherapy for cardiac sparing in thoracic treatments. However, its application in interstitial high-dose-rate (HDR) brachytherapy has rarely been described. In this case report, we present workflow feasibility and evaluate dosimetry of DIBH-guided interstitial HDR brachytherapy.

Methods: A 37-year old patient with thoracic wall malignancy was treated after whole breast irradiation using interstitial HDR brachytherapy with 12 flexible catheters implanted in a single plane. Treatment planning was performed using CT-imaging acquired in free breathing. Imaging was repeated in DIBH. Prescription was 3 Gy in 10 fractions to 90.4% of the target volume. Catheter dwell positions were spaced 3 mm apart.

To compare dosimetry in DIBH and free breathing, the target volume was rigidly registered between both CT datasets using implanted catheters as anatomical surrogates. Organ-at-risk near-maximum doses (D0.01 cc) for the LAD coronary artery and ribs were evaluated.

Treatment was performed in repeated DIBH. Prior to source delivery through each catheter, a check cable run (~8 s) was executed during which the patient breathed normally. Immediately before source entry, the patient was instructed by audio to perform deep inspiration and maintain breath hold during source transit within the catheter. Transit times ranged from 6 – 13 s. Continuous audio communication between staff and patient was maintained throughout treatment. Fraction delivery interruption was predefined in case of inadequate breath hold.

Results: DIBH substantially reduced the near-maximum LAD coronary artery dose (approximately 16.2 Gy, free breathing to 7.6 Gy, DIBH). Rib near-maximum dose remained unchanged at approximately 28 Gy. Because the implanted catheters remained within the target volume during DIBH, target coverage was expected to remain stable. All fractions were delivered successfully without interruption.

Conclusion: For this case, DIBH-guided interstitial HDR brachytherapy for thoracic wall irradiation proved feasible in clinical routine. It substantially reduced LAD coronary artery dose. As inter-catheter check-cable runs are performed routinely, regardless of DIBH or free-breathing, and no intra-fraction interruptions were recorded, workflow efficiency remained unchanged. Successful implementation requires close communication and patient instruction by radiation therapists.

POSTER PRESENTATION

P 51* **EXCELLENT RESPONSE AFTER RADIOTHERAPY FOR SYMPTOMATIC CUTANEOUS METASTASES FROM COLORECTAL CANCER: A CASE REPORT**

Dr. Mehdi Belbachir¹

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We report the management of a 36-year-old man presenting with rapidly progressive and highly symptomatic cutaneous metastases (CM) from colorectal cancer (CRC). He was referred to palliative radiotherapy due to painful and pruritic skin metastases involving both thighs and the pubic region. His oncological history was notable for two synchronous primary colorectal adenocarcinomas: a rectosigmoid junction tumor (MMR-proficient) and an ascending colon tumor harboring a BRAF V600E mutation.

Comprehensive next-generation sequencing (NGS) on a metastatic lymph node, then on liquid biopsy identified the rectosigmoid tumor as the origin of metastatic dissemination and revealed a pathogenic germline BRCA1 mutation, allowing a precision-based systemic treatment strategy (olaparib + pembrolizumab) after failure of standard therapeutic lines.

For symptomatic palliation, radiotherapy using a helical tomotherapy technique (Radixact®) was delivered to an extended superficial target volume exceeding 50 cm long. A split-course regimen (30 Gy in 10 fractions; 4 days on, 4 days off) was adopted to optimize skin tolerance, particularly in the pubic region. We deliberately spared a narrow strip of posterior skin in order to preserve lymphatic drainage and reduce the risk of treatment-induced compartment-like syndrome.

Six weeks after treatment, the patient experienced a marked clinical improvement with significant reductions in pain, pruritus, and functional impairment.

This case highlights the value of integrating advanced radiotherapy techniques with comprehensive molecular profiling to deliver effective, high-quality palliative care in patients with extensive cutaneous metastatic disease

POSTER PRESENTATION

P 52* **CBCT-BASED SYNTHETIC CT QUALITY CONTROL USING PLANNING CT: ROI-BASED HISTOGRAM ANALYSIS AND STATISTICAL TOLERANCE INTERVALS**

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Aims Synthetic CT (sCT) generation from daily cone-beam CT (CBCT) aims at providing updated anatomy for adaptive particle therapy, but its clinical implementation requires rigorous quality control (QC) of Hounsfield unit (HU) accuracy. Direct voxel-wise comparison with the planning CT (pCT) is confounded by inter-acquisition anatomical changes. This study investigates whether ROI-based histogram analysis, using the pCT as reference, can provide a practical framework for patient-specific sCT QC.

Methods The dataset comprises pCTs, same-day repeat CT (rCT)-CBCT pairs and RayStation-generated virtual CTs (vCTs) from 20 head and neck cancer patients treated at Paul Scherrer Institute.

ROI-based HU histogram analysis was performed for three tissue classes (bone: $HU \geq 200$; air: $HU \leq -800$; soft-tissue: -800)

The same metrics were calculated between corresponding pCT-rCT pairs. This pCT-rCT analysis which characterizes inherent baseline anatomical and acquisition-specific HU variability was used to establish statistical tolerance intervals (STIs) for each metric. Simulated HU errors were considered detectable when the metric exceeded the STI limits.

Results The mean ROI-based HU differences between vCT and pCT were lowest in soft-tissue ROIs (3.25 HU; 96.7% of ROIs within the STI), followed by air (20.45 HU; 80.0%) and bone ROIs (48.35 HU; 54.2%). Corresponding average WD values were 3.78 HU (98.4% within STI), 21.49 HU (91.7%), and 53.38 HU (83.4%). Both metrics were sensitive to simulated HU errors. The smallest detectable HU errors by the metrics were ± 25 HU for soft-tissue and air ROIs. For bone ROIs, the smallest detectable errors were ± 50 and ± 150 HU for mean and WD, respectively.

Conclusions

ROI-based histogram analysis may enable patient-specific, pCT-based HU QC of CBCT-based sCT without requiring voxel-wise correspondence. The high agreement and sensitivity observed in soft-tissues support the feasibility of this approach, whereas the lower values in bone require further investigation before clinical implementation.

POSTER PRESENTATION

P 53 **GENE POLYMORPHISMS OF TACR1 SERVE AS THE POTENTIAL PHARMACOGENETIC PREDICTORS OF RESPONSE TO THE NEUROKININ-1 RECEPTOR ANTAGONIST-BASED ANTIEMETIC REGIMENS: A CANDIDATE-GENE ASSOCIATION STUDY IN BREAST CANCER PATIENTS**

Dr. Samira Hossaini Alhashemi¹, Dr. Bahman Khalvati², Prof. Ali Dehshahri¹

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Aims

The current candidate gene association study aims to investigate tag SNPs from the TACR1 gene as pharmacogenetic predictors of response to the antiemetic guidelines-recommended, NK-1 receptor antagonist-based, triple antiemetic regimens.

Methods

A set of eighteen tag SNPs of TACR1 were genotyped in breast cancer patients receiving anthracycline and cyclophosphamide (with/without docetaxel) applying real-time PCR-HRMA.

Data analysis for 121 ultimately enrolled patients was initiated by defining haplotype blocks using PHASE v2.1. The association of each tag SNP and haplotype alleles with failure to achieve the defined antiemetic regimen efficacy endpoints was tested using PLINK (v.1.9 and v. 1.07, respectively) based on the logistic regression, adjusting for the previously known chemotherapy-induced nausea and vomiting (CINV) prognostic factors. All reported p-values were corrected using the permutation test ($n = 100,000$).

Results

Four variants of rs881, rs17010730, rs727156, and rs3755462, as well as haplotypes containing the mentioned variants, were significantly associated with failure to achieve at least one of the defined efficacy endpoints. Variant annotation via in-silico studies revealed that the non-seed sequence variant, rs881, is located in the miRNA (hsa-miR-613) binding site. The other three variants or a variant in complete linkage disequilibrium

with them overlap a region of high H3K9ac-promoter-like signature or regions of high enhancer-like signature in the brain or gastrointestinal tissue.

Conclusion

Playing an essential role in regulating TACR1 expression, gene polymorphisms of TACR1 serve as the potential pharmacogenetic predictors of response to the NK-1 receptor antagonist-based, triple antiemetic regimens. If clinically approved, modifying the NK-1 receptor antagonist dose leads to better management of CINV in risk-allele carriers.

POSTER PRESENTATION

P 54 DEEP INSPIRATION BREATH-HOLD DOSIMETRY ON RADIXACT® FOR AN INITIAL COHORT

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1. Gruppo Ospedaliero Moncucco

AIM For the Accuray Radixact® system, an automated deep inspiration breath-hold technique (DIBH), entitled VitalHold™, was recently implemented using the SGRT system Catalyst+ HD (C-RAD). This study reports a preliminary dosimetric evaluation for our single Radixact® system. **METHODS** The dosimetric data were collected and analyzed for the first 13 female patients, receiving a prescription dose of 40.05 Gy in 15 fractions without integrated boost. Plans were optimized using Volo™Ultra. A backup plan using a free-breathing (FB) kVCT was performed for all patients in case of any issues during DIBH treatment. VitalHold™ allows only the TomoDirect™ (TD) technique, whereas FB backup plans used either TomoHelical™ (TH) or TD technique. TD is the department's preferred technique for breast treatment; however, TH plans were selected in case the TD dosimetry did not meet established acceptance criteria. The two samples were compared by Wilcoxon test with a significance cut-off of $p < 0.005$. **RESULTS** All 13 patients completed the DIBH treatments. Plan beam-on times averaged 108.6 ± 5.3 sec. The PTV mean dose was 40.2 ± 0.3 Gy with PTV V95% = $96.9 \pm 2.1\%$. Mean doses to OARs were the following: heart (MHD) = 0.7 ± 0.2 Gy, left ventricle (LV) = 0.8 ± 0.3 Gy, LAD = 2.1 ± 1.4 Gy, left lung (LL) = 4.6 ± 0.9 Gy, right breast (RB) = 0.3 ± 0.1 Gy. Only two FB plans required the use of TH technique. Percent difference in DIBH mean values compared to FB were the following: PTV Dmean = 0.9%, PTV V95% = 1.6%, MHD = -34.8%, LV Dmean = -31.9%, LAD Dmean = -36.6%, LL Dmean = 3.4%, RB Dmean = -81.5%. Significant difference in sample distribution was achieved for MHD ($p = 0.002$), LV Dmean ($p = 0.001$) and RB Dmean ($p = 0.003$). **CONCLUSION** The DIBH technique reduced the dose to the cardiac structures while improving coverage of the target area. Patient compliance with VitalHold™ technique proved to be promising, as all patients were able to complete the entire treatment.

POSTER PRESENTATION

P 55 IDENTIFYING THE POTENTIAL MEDIATORS OF PATHOLOGICAL COMPLETE RESPONSE TO NEOADJUVANT CHEMOTHERAPY AMONG TACR1 GENE POLYMORPHISMS: A STUDY ON BREAST CANCER PATIENTS

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Aims

Recent studies have shown that the truncated isoform of the neurokinin-1 receptor (NK-1R) and its ligand, substance P (SP), are overexpressed in tumor cells playing a crucial role in chemoresistance, leading to proliferation, angiogenesis, and metastasis. Hence, this study aims to assess if the polymorphisms of the NK-1R-encoding gene influence the truncated NK-1R level, chemoresistance, and pathological complete response (pCR) achievement in breast cancer patients.

Methods

The real-time PCR-HRMA was performed to genotype TACR1 eighteen tag SNPs in 153 neoadjuvant chemotherapy-receiving breast cancer patients. Univariate analysis was performed to assess the association of baseline and tumor characteristics with pCR achievement. The association of each variant and pCR achievement was assessed by executing logistic regression while adjusting for covariates and correcting for multiple tests using permutation.

Results

The probability of pCR to neoadjuvant chemotherapy is higher for patients with tumor grade-III as well as stage-I. Assuming the additive, dominant, or recessive models, rs17010664, rs6715729, and rs3771869 were significantly associated with pCR achievement.

Conclusions

Positioned close to the truncation-occurring region, belonging to an exon-splicing enhancer motif, the rs17010664 C allele seems to play a crucial role in enhancing the TACR1 last exon splicing leading to increased truncated NK-1R production, chemoresistance, and decreased pCR achievement. Accordingly, The SP/ truncated NK-1R axis blockade by NK-1R antagonists seems to be a therapeutic approach to overcoming chemoresistance and achieving pCR in the rs17010664 risk-allele-bearing patients. Hence, conducting further studies to determine the required dose of NK-1R antagonists, repurposed as an antitumor agent, is favored.

P 56 BREAST RADIOTHERAPY: HOW CAN CONE BEAM CT (CBCT) IMAGING DOSE BE OPTIMIZED WHILE MAINTAINING SUFFICIENT IMAGE QUALITY FOR PATIENT POSITIONING ?

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Objective The aim of this study was to evaluate whether adapting the CBCT imaging dose according to patient morphology could achieve more homogeneous image quality in breast radiotherapy.

Methods The CBCT images of 20 patients treated for breast cancer were retrospectively analysed. All patients were treated using deep inspiration breath hold (DIBH). For each patient, the CBCT mAs/CT CTDI ratio and image quality, assessed by image noise measured in the breast and pectoral muscle, were evaluated.

Additional measurements were performed using a phantom containing four materials with different densities (bone, cortical bone, breast tissue, and adipose tissue) in order to provide a physical validation of the proposed model.

Subsequently, a cohort of 20 additional patients treated using DIBH underwent CBCT imaging with a constant CBCT mAs/CT CTDI ratio adapted to patient morphology based on the planning CT-scanner parameters.

Results Using the standard parameters, the CBCT mAs/CT CTDIvol ratio ranged from 41.2 to 75.1 mAs/mGy, while image noise ranged from 16.0 to 44.4 HU (SD = 6.6 HU).

Using a model based on constant CBCT mAs/CT CTDIvol ratios adapted to patient morphology and corrected according to the planning CT tube voltage (kV), image quality became more homogeneous across patients, with image noise ranging from 27.4 to 41.0 HU (SD = 3.4 HU).

Conclusion Automatic adaptation of CBCT mAs according to patient morphology based on the planning CT acquisition parameters enables more consistent image quality across patients, individualized CBCT dose optimization, reduced operator-dependent variability, and standardized CBCT imaging protocols while altogether complying with radiation protection principles.

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Moustafa	Elleisy	Poster	P 40	Poster
Lisa Stefanie	Fankhauser	Proffered Paper Session 1	S 03*	Oral
Daisy	Ferreira	Proffered Paper Session 4	S 25*	Oral
Tobias	Finazzi	Proffered Paper Session 1	S 02	Oral
Maksym	Fritsak	Proffered Paper Session 3	S 15	Oral
Damien	Fuligno	Poster	P 56	Poster
Helmut	Härle	Poster	P 47	Poster
Hossein	Hemmatazad	Poster	P 05	Poster
Hossein	Hemmatazad	Poster	P 11	Poster
Hossein	Hemmatazad	Poster	P 37	Poster
Dinant	Heuvelman	Proffered Paper Session 2 - RTT	S 30	Oral
Samira	Hossaini Alhashemi	Poster	P 53	Poster
Lusine	Hovhannisyan	Poster	P 36	Poster
Maud	Jaccard	Poster	P 33*	Poster
Vladislavs	Jansins	Poster	P 35	Poster
Michèle	Knol	Poster	P 48*	Poster
Jakub	Korzeniowski	Poster	P 26*	Poster
Ilya	Kotov	Poster	P 31	Poster
Nikolaos	Koutsouvelis	Poster	P 43	Poster
Reinhardt	Kroek	Proffered Paper Session 4	S 21	Oral
Louis	Kunz	Poster	P 12*	Poster
C.	Leonardi	Poster	P 17	Poster
Hannes	Loebner	Poster	P 08	Poster
Hannes	Loebner	Poster	P 50	Poster
Laurent	Marmy	Proffered Paper Session 1 - RTT	S 19	Oral
Laura	Motisi	Poster	P 19	Poster
Markus	Notter	Proffered Paper Session 2	S 08	Oral

Mikel	Oteiza Fernandez	Poster	P 45	Poster
Paolo	Pelliccioli	Poster	P 06	Poster
Yoel	Pérez Haas	Poster	P 20	Poster
Olivier	Pisaturo	Poster	P 38	Poster
robert	poel	Swiss Treatment Planning Group	S 10	Oral
Sofia	Radi	Poster	P 24*	Poster
Nazanin	Rahnama	Proffered Paper Session 4 -Poster	S 22* / P 03*	Oral - Poster
Varsha	Raveendran	Poster	P 14*	Poster
Sabrina	Reichl	Poster	P 29	Poster
Viktoria Ricarda	Reiser	Poster	P 39	Poster
David	Reparaz Pernaut	Poster	P 07	Poster
Natacha	Ruiz Lopez	Poster	P 28	Poster
Anouk	Sesink	Proffered Paper Session 3	S 16	Oral
Sonja	Stieb	Poster	P 09	Poster
Victor	Strijbis	Swiss Treatment Planning Group	S 09	Oral
Maximilian	Sturz	Proffered Paper Session 2	S 06	Oral
Siavash	Taleghani	Poster	P 52*	Poster
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Nathan	Torelli	Poster	P 13	Poster
Maria Giulia	Toro	Poster	P 10*	Poster
Sébastien	Tran	Poster	P 16	Poster
Sébastien	Tran	Poster	P 18	Poster
Verdiana	Trappetti	Proffered Paper Session 4	S 23	Oral
Philipp	Trueb	Proffered Paper Session 2	S 07	Oral
Patrizia	Urso	Poster	P 54	Poster
Erwin	Vu	Poster	P 42	Poster
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Adam	Zabini	Poster	P 44	Poster
Renée	Zemp	Proffered Paper Session 2 - RTT	S 28	Oral
Björn	Zobrist	Proffered Paper Session 1	S 04*	Oral
Björn	Zobrist	Swiss Treatment Planning Group	S 11*	Oral
Maria Elena	Zuliani	Proffered Paper Session 3	S 13*	Oral