2022 POSTER

Radiotherapy capacity in Europe 2009: results of the EUNICE project

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Background: Within the framework of the European Commission (EC) Health Monitoring Programme, the EC awarded a grant for a project entitled EUNICE (European Network for Indicators on Cancer). The objectives of EUNICE were to establish and operate a network of data providers, to provide the EU with updated and standardized indicators on cancer burden and care.
Materials and Methods: "Europe" is defined as 33 countries: the 27 Members of the European Union, the three candidates for membership and three additional European countries non-EU members. The assessment of radiation therapy capacity in Europe was performed using the IAEA Directory of Radiotherapy Centres (DIRAC) and Globocan-2002. DIRAC is an electronic database maintained by the IAEA since 1995 that describes radiotherapy facilities worldwide.
Results: Europe has a total of 1109 radiotherapy centres registered in DIRAC. These centres operate a total of 2608 teletherapy machines of which 2119 are medical accelerators and 489 are cobalt-60 units. In addition, DIRAC contains data on 766 brachytherapy systems.
Distribution: the countries with the highest number of radiotherapy centres are Germany (214) and France (203) the largest number of teletherapy machines (444) is in France and 439 in Germany. Five countries have one radiotherapy centre and three countries operate with two teletherapy machines. The level of *fragmentation* is variable, with countries that tend to operate an average of 8 teletherapy machines/centre while others tend to have many centres operating 1−2 teletherapy machines. There is an average of 4.44 teletherapy machines per million population, from the lowest of 1.3/million to the highest 9.18/million. Using crude cancer incidence data the average indicator of teletherapy machines per 1000 cancer cases/year is 1.15 for Europe, with the lowest in Estonia (0.38) and the highest in Denmark and Ireland (1.99).
From the staffing viewpoint (more uncertain to quantify) a total of 5046 radiation oncologists, 2717 medical physicists and 7766 radiation therapy technologists are registered in DIRAC.
Nine facilities offer treatment with proton beams or heavy ions. An additional 10 facilities are under construction or upgrading.
Conclusions: The value of an up-to-date database on radiotherapy capacity facilitates projections and planning of radiation oncology services at a national or regional level.
This study was conducted with the sponsorship of the European Commission under the EUNICE project.

2023 POSTER

The impact of 3 dimensional CT planning on radiotherapy for bone metastases

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Background: Fluoroscopy based two dimensional (2D) radiotherapy (RT) planning for bone metastases (BM) is standard practice in many RT centers. Use of 3 dimensional (3D) CT based RT planning is more resource intensive but may provide improved information on disease extent and dose delivery. This report describes the impact of 3D CT based planning on defining the target, and the conformity (shape) of RT dose to the BM target.
Materials and Methods: A prospective study was designed to evaluate the impact of 3D versus 2D based planning for palliative RT of BM using either a single beam or simple 2 beam technique. After clinical assessment and review of diagnostic imaging, an RT planning CT scan was obtained. Oncologists defined two sets of treatment fields. First, using digitally reconstructed radiographs only to represent 2D planning, the study 2D treatment fields were defined. The full 3D CT planning scan was then reviewed, followed by target delineation and actual treatment field generation to represent 3D planning. Changes to the intended target, reasons for change, indices to describe the relative target coverage and dose to normal tissue were compared.
Results: Fifty-one patients receiving RT to 57 sites were accrued. 29/57 (51%) cases were spine metastases. Oncologists documented a change in the intended anatomical target after viewing the 3D data in 31/57 (54%) cases. The reasons for change included extent of local disease (22), significant distant disease not apparent on diagnostic tests (2), shielding modification due to concern of proximity of the kidney to the target (1) and not specified (5). In one case, the degree of bone destruction seen on planning CT prompted an orthopedic consult and surgery. 3D plans were superior to 2D plans with improved target coverage (as measured by the mean target volume coverage factor; 93% vs 77%, $p < 0.001$), but only a trend for reduced dose to normal tissues was observed (as measured by the healthy tissue overdose factor; 2.56 for 3D vs 4.87 for 2D, $p = 0.12$).
Conclusions: 3D CT planning in patients with bone metastases provides improved anatomical details that can influence clinical decision-making and target delineation. It may also permit superior RT dose to the target and limit dose to normal tissues. Technological advances have the potential to improve the effect of palliative radiotherapy for bone metastases and requires further study.

2024 POSTER

Acute radiation effects on cardiac function detected by strain rate imaging in breast cancer patients

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Background: Strain rate imaging (SRI) is an echocardiographic technique that has been shown to detect changes in regional cardiac function before they are notable by conventional techniques. SRI allows measurement of the regional myocardial deformation (strain, S) and deformation rate (strain rate, SR). In this prospective study we assessed the radiotherapy (RT)-induced early changes in cardiac function in breast cancer patients by means of SRI, and correlated these changes with the heart radiation dose.
Methods: We included 20 left-sided breast cancer patients, receiving RT (50 Gy in fractions of 2 Gy) to the breast or chest wall. In 12 patients, the internal mammary lymph nodes were also irradiated. Ten right-sided breast cancer patients served as control. SRI data were obtained pre-RT, immediately post-RT and 2 months post-RT. S and SR were measured in the 18 left ventricular (LV) segments of each patient and the radiation dose to the different segments was calculated. SRI parameters were compared between pre- and post-RT measurements by analysis of variance with Bonferroni post-hoc analysis. Furthermore, the effect of potential confounding factors was tested by univariate analysis with respect to the decrease in S post-RT.
Results: Adequate measurement of S and SR could be done in 522 out of 540 LV segments. The mean dose to the LV in left- and right-sided patients was respectively 6.7 and 0.6 Gy. The mean dose to the apical, mid and basal LV segments in left-sided patients was respectively 12.8, 5.4 and 4.5 Gy. The median LV segmental dose in left-sided patients was 3 Gy. A reduction in S was observed immediately and at 2 months post-RT ($p = 0.0002$) in left-sided patients, but not in right-sided patients. Within the left-sided patient group, S and SR were reduced post-RT for the apical LV segments ($p < 0.0001$ and $p = 0.011$), in contrast to the mid and basal segments. The decrease in S remained significant 2 months post-RT ($p < 0.001$), whereas SR went back to baseline values. We also observed that segments exposed to more than 3 Gy, showed a decrease in S immediately and at 2 months post-RT ($p = 0.0003$), in contrast to segments receiving less than 3 Gy. Furthermore, significant correlations were found between the decrease in S post-RT and the side of irradiation, the BMI, the mean LV segmental dose and the volume of the LV receiving 30 Gy.
Conclusions: SRI allowed the detection of a dose-related regional decrease in myocardial function early after RT.

2025 POSTER

Single institution preliminary experience on dose reduction to organs at risk in thoracic radiotherapy for patients enrolled in EORTC-GELA-IIL H10 study protocol on early stage Hodgkin's Lymphoma

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Background: to retrospectively evaluate the impact of Involved Nodes Radiation Therapy (INRT) on dose reduction to different organs at risk in patients enrolled by our Institution in the EORTC-GELA-IIL H10 protocol for stage I-IIA supra-diaphragmatic Hodgkin's Lymphoma.
Materials and Methods: Nine patients were included in the study, and 5 (4 females and 1 male) randomized to the standard arm A (3−4 ABVD cycles plus INRT 30 Gy independently from PET findings after the first 2