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Radiotherapy

Evidence Update

July 2017

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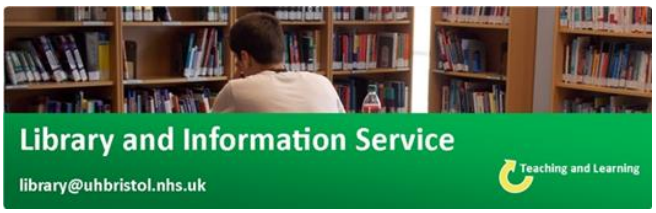

Lunchtime Drop-in Sessions

All sessions last one hour

July (13.00-14.00)

3rd (Mon) Interpreting Statistics
12th (Wed) Critical Appraisal
21st (Fri) Literature Searching
26th (Wed) Interpreting Statistics

August (12.00-13.00)

4th (Fri) Critical Appraisal
9th (Wed) Literature Searching
15th (Tues) Interpreting Statistics
24th (Thurs) Critical Appraisal

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Contents

Current Journals: Tables of Contents

Click on journal title (+ Ctrl) for hyperlink

Journal	Month	Volume	Issue
Radiotherapy and Oncology	June 2017	123	3
International Journal of Radiation Oncology Biology and Physics	August 01 2017	98	5
Clinical Oncology	August 2017	29	8

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Latest Evidence

NICE National Institute for Health and Care Excellence

Radiotherapy episodes report

Source: Public Health England - 27 June 2017
...Analysis Service (NCRAS) Radiotherapy Episodes – England. © Crown copyright 2017

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Society and College of Radiographers

Annual Radiotherapy Conference 2018

Newcastle

26-28 January

Call for Proffered Papers and Posters

Abstract submission deadlines:
Non-students: Friday 21 July 2017
Students*: Friday 1 September 2017
The SCoR would welcome proffered papers and posters from students, assistant practitioners, clinical radiographers at all tiers, service managers, research radiographers, educationalists, and other members of the multiprofessional oncology team, within the topic areas of:

- Innovative Radiotherapy
- Accuracy and Safety
- Effectiveness of Technical Approaches
- The Patient Experience
- Service Delivery and Organisation
- Clinical Education at all levels

Institute of Physics and Engineering in Medicine

The Roles of the Scientist and Technologist in Radiotherapy Physics
First published: 1999; Reviewed: June 2017; Next Review: June 2020

Current Awareness Database Articles

Below is a selection of articles recently added to the healthcare databases, grouped in the categories:

- **Immobilisation techniques for radiotherapy**
- **Protons**

If you would like any of the articles in full text, or if you would like a more focused search on your own topic, please contact us: library@bristol.nhs.uk

Immobilisation techniques for radiotherapy

1. Clinical benefits of new immobilization system for hypofractionated radiotherapy of intrahepatic hepatocellular carcinoma by helical tomotherapy.

Author(s): Hu, Yong; Zhou, Yong-Kang; Chen, Yi-Xing; Shi, Shi-Ming; Zeng, Zhao-Chong

Source: Medical dosimetry : official journal of the American Association of Medical Dosimetrists; ; vol. 42 (no. 1); p. 37-41

Publication Type(s): Journal Article

PubMedID: 28126475

Abstract: OBJECTIVE A comprehensive clinical evaluation was conducted, assessing the Body Pro-Lok immobilization and positioning system to facilitate hypofractionated radiotherapy of intrahepatic hepatocellular carcinoma (HCC), using helical tomotherapy to improve treatment precision. METHODS Clinical applications of the Body Pro-Lok system were investigated (as above) in terms of interfractional and intrafractional setup errors and compressive abdominal breath control. To assess interfractional setup errors, a total of 42 patients who were given 5 to 20 fractions of helical tomotherapy for intrahepatic HCC were analyzed. Overall, 15 patients were immobilized using simple vacuum cushion (group A), and the Body Pro-Lok system was used in 27 patients (group B), performing megavoltage computed tomography (MVCT) scans 196 times and 435 times, respectively. Pretreatment MVCT scans were registered to the planning kilovoltage computed tomography (KVCT) for error determination, and group comparisons were made. To establish intrafractional setup errors, 17 patients with intrahepatic HCC were selected at random for immobilization by Body Pro-Lok system, undergoing MVCT scans after helical tomotherapy every week. A total of 46 MVCT re-scans were analyzed for this purpose. In researching breath control, 12 patients, randomly selected, were immobilized by Body Pro-Lok system and subjected to 2-phase 4-dimensional CT (4DCT) scans, with compressive abdominal control or in freely breathing states, respectively. Respiratory-induced liver motion was then compared. RESULTS Mean interfractional setup errors were as follows: (1) group A: X, 2.97 ± 2.47mm; Y, 4.85 ± 4.04mm; and Z, 3.77 ± 3.21mm; pitch, 0.66 ± 0.62°; roll, 1.09 ± 1.06°; and yaw, 0.85 ± 0.82°; and (2) group B: X, 2.23 ± 1.79mm; Y, 4.10 ± 3.36mm; and Z, 1.67 ± 1.91mm; pitch, 0.45 ± 0.38°; roll, 0.77 ± 0.63°; and yaw, 0.52 ± 0.49°. Between-group differences were statistically significant in 6 directions ($p < 0.05$). Mean intrafractional setup errors with use of the Body Pro-Lok system were as follows: X, 0.41 ± 0.46mm; Y, 0.86 ± 0.80mm; Z, 0.33 ± 0.44mm; and roll, 0.12 ± 0.19°. Mean liver-induced respiratory motion determinations were as follows: (1) abdominal compression: X, 2.33 ± 1.22mm; Y, 5.11 ± 2.05mm; Z, 2.13 ± 1.05mm; and 3D vector, 6.22 ± 1.94mm; and (2) free breathing: X, 3.48 ± 1.14mm; Y, 9.83 ± 3.00mm; Z, 3.38 ± 1.59mm; and 3D vector, 11.07 ± 3.16mm. Between-group differences were statistically different in 4 directions ($p < 0.05$).CONCLUSIONS The Body Pro-Lok system is capable of improving interfractional and intrafractional setup accuracy and minimizing tumor movement owing to respirations in patients with intrahepatic HCC during hypofractionated helical tomotherapy.

Database: Medline

2. Utility of intraoral stents in external beam radiotherapy for head and neck cancer.

Author(s): Doi, Hiroshi; Tanooka, Masao; Ishida, Toshihisa; Moridera, Kuniyasu; Ichimiya, Kenji; Tarutani,

Kazuo; Kitajima, Kazuhiro; Fujiwara, Masayuki; Kishimoto, Hiromitsu; Kamikonya, Norihiko

Source: Reports of practical oncology and radiotherapy : journal of Greatpoland Cancer Center in Poznan and Polish Society of Radiation Oncology; 2017; vol. 22 (no. 4); p. 310-318

Publication Date: 2017

Publication Type(s): Journal Article

PubMedID: 28515675

Abstract: AIM This study aimed to assess the utility and stability of intraoral stent during intensity-modulated radiation therapy (IMRT). BACKGROUND The benefits of intraoral stents in radiotherapy are unclear .MATERIALS AND METHODS We analyzed 386 setup errors in 12 patients who received IMRT for head and neck cancers without intraoral stents (intraoral stent [-]) and 183 setup errors in 6 patients who received IMRT with intraoral stents (intraoral stent [+]). All patients were matched according to the immobilization method (masks and boards). Setup errors were measured as the distance from the initial setup based on the marking on the skin and mask to the corrected position based on bone matching on cone beam computed tomography. RESULTS The mean interfractional setup errors in the right-left, craniocaudal, anterior-posterior (AP), and three-dimensional (3D) directions were -0.33, 0.08, -0.25, and 2.75 mm in the intraoral stent (-) group and -0.37, 0.24, -0.63, and 2.42 mm in the intraoral stent (+) group, respectively (P = 0.50, 0.65, 0.01, and 0.02, respectively). The systematic errors for the same directions were 0.89, 1.46, 1.15, and 0.88 mm in the intraoral stent (-) group and 0.62, 1.69, 0.68, and 0.56 mm in the intraoral stents (+) group, respectively. The random errors were 1.43, 1.43, 1.44, and 1.22 mm in the intraoral stent (-) group and 1.06, 1.11, 1.05, and 0.92 mm in the intraoral stents (+) group, respectively. CONCLUSION Setup errors can be significantly reduced in the AP and 3D-directions by using intraoral stents.

Database: Medline

3. European Organization for Research and Treatment of Cancer (EORTC) recommendations for planning and delivery of high-dose, high precision radiotherapy for lung cancer.

Author(s): De Ruysscher, Dirk; Faivre-Finn, Corinne; Moeller, Ditte; Nestle, Ursula; Hurkmans, Coen W; Le Péchoux, Cécile; Belderbos, José; Guckenberger, Matthias; Senan, Suresh; Lung Group and the Radiation Oncology Group of the European Organization for Research and Treatment of Cancer (EORTC)

Source: Radiotherapy and oncology : journal of the European Society for Therapeutic Radiology and Oncology; Jun 2017

Publication Date: Jun 2017

Publication Type(s): Journal Article

PubMedID: 28666551

Abstract:PURPOSETo update literature-based recommendations for techniques used in high-precision thoracic radiotherapy for lung cancer, in both routine practice and clinical trials.METHODSA literature search was performed to identify published articles that were considered clinically relevant and practical to use. Recommendations were categorised under the following headings: patient positioning and immobilisation, Tumour and nodal changes, CT and FDG-PET imaging, target volumes definition, radiotherapy treatment planning and treatment delivery. An adapted grading of evidence from the Infectious Disease Society of America, and for models the TRIPOD criteria, were used.RESULTSRecommendations were identified for each of the above categories.CONCLUSIONRecommendations for the clinical implementation of high-precision conformal radiotherapy and stereotactic body radiotherapy for lung tumours were identified from the literature. Techniques that were considered investigational at present are highlighted.

Database: Medline

4. Development of the breast immobilization system in prone setup: The effect of bra in prone position to improve the breast setup error.

Author(s): Kawamura, Mariko; Maeda, Yoshikazu; Yamamoto, Kazutaka; Takamatsu, Shigeyuki; Sato, Yoshitaka; Minami, Hiroki; Saga, Yusuke; Kume, Kyo; Tameshige, Yuji; Sasaki, Makoto; Tamamura, Hiroyasu; Ohta, Kouji; Itoh, Yoshiyuki; Naganawa, Shinji

Source: Journal of applied clinical medical physics; Jun 2017

Publication Date: Jun 2017

Publication Type(s): Journal Article

PubMedID: 28594079

Abstract: PURPOSE/OBJECTIVE(S)Accurate and reproducible positioning of the breast is difficult due to its deformability and softness; thus, targeting a breast tumor or tumor bed with fractionated radiotherapy using external beam radiation is difficult. The aim of this study was to develop a novel bra to aid in breast immobilization in the prone position. MATERIALS & METHODS To assess the accuracy of prone position fixation of breast tumors, 33 breast cancer patients with 34 lesions were recruited. The bra used in this verification was customized from a commercially available bra. Duplicate MRI were acquired in the prone position, alternating with and without the bra, and for each series, patients were asked to step off the MRI table and re-set up in the prone position. Patients were also asked to remove and re-fit the bra for the second MRI. Each pair of images were superimposed to match the shape of the skin surface, and the maximum difference in tumor geometric center in three axes was measured. The required set up margin was calculated as: required margin = mean difference in geometric center + 2.5 standard deviation. The volumetric overlap of the tumor, as well as contouring uncertainties, was evaluated using contour analysis software. RESULTS The median breast size was 498 cc. The required margins for the lateral, vertical, and longitudinal directions were estimated to be 4.1, 4.1, and 5.0 mm, respectively, with the bra, and 5.1, 6.9, and 6.7 mm, respectively, without the bra. These margins covered the dislocation of more than 33 lesions in total. With the bra, 33 lesions had achieved an objective overlap of 95% and 99% with 2 and 4 mm margins, respectively, whereas 4 and 8 mm, respectively, were needed without the bra. CONCLUSION The use of an immobilizing bra reduced the setup margin for prone position fixation of breast tumors.

Database: Medline

5. Cost-effective immobilization for whole brain radiation therapy.

Author(s): Rubinstein, Ashley E; Ingram, W Scott; Anderson, Brian M; Gay, Skylar S; Fave, Xenia J; Ger, Rachel B; McCarroll, Rachel E; Owens, Constance A; Netherton, Tucker J; Kisling, Kelly D; Court, Laurence E; Yang, Jinzhong; Li, Yuting; Lee, Joonsang; Mackin, Dennis S; Cardenas, Carlos E

Source: Journal of applied clinical medical physics; Jun 2017

Publication Date: Jun 2017

Publication Type(s): Journal Article

PubMedID: 28585732

Abstract: To investigate the inter- and intra-fraction motion associated with the use of a low-cost tape immobilization technique as an alternative to thermoplastic immobilization masks for whole-brain treatments. The results of this study may be of interest to clinical staff with severely limited resources (e.g., in low-income countries) and also when treating patients who cannot tolerate standard immobilization masks. Setup reproducibility of eight healthy volunteers was assessed for two different immobilization techniques. (a) One strip of tape was placed across the volunteer's forehead and attached to the sides of the treatment table. (b) A second strip was added to the first, under the chin, and secured to the table above the volunteer's head. After initial positioning, anterior and lateral photographs were acquired. Volunteers were positioned five times with each technique to allow calculation of inter-fraction reproducibility measurements. To estimate intra-fraction reproducibility, 5-minute anterior and lateral videos were taken for each technique per volunteer. An in-house software was used to analyze the photos and videos to assess setup reproducibility. The maximum intra-fraction displacement for all volunteers was 2.8 mm. Intra-fraction motion increased with time on table. The maximum inter-fraction range of positions for all volunteers was 5.4 mm. The magnitude of inter-fraction and intra-fraction motion found using the "1-strip" and "2-strip" tape immobilization techniques was comparable to motion restrictions provided by a thermoplastic mask for whole-brain radiotherapy. The results suggest that tape-based immobilization techniques represent an economical and useful alternative to the thermoplastic mask.

Database: Medline

6. Reproducibility of a Noninvasive System for Eye Positioning and Monitoring in Stereotactic Radiotherapy of Ocular Melanoma.

Author(s): Iskanderani, Omar; Béliveau-Nadeau, Dominique; Doucet, Robert; Coulombe, Geneviève; Pascale, Deborah; Roberge, David

Source: Technology in cancer research & treatment; Jun 2017; vol. 16 (no. 3); p. 352-356

Publication Date: Jun 2017

Publication Type(s): Journal Article

PubMedID: 28168935

Abstract: PURPOSE Our preferred treatment for juxtapapillary choroidal melanoma is stereotactic radiotherapy. We aim to describe our immobilization system and quantify its reproducibility. MATERIALS AND METHODS Patients were identified in our radiosurgery database. Patients were imaged at computed tomography simulator with an in-house system which allows visual monitoring of the eye as the patient fixates a small target. All patients were reimaged at least once prior to and/or during radiotherapy. The patients were treated on the CyberKnife system, 60 Gy in 10 daily fractions, using skull tracking in conjunction with our visual monitoring system. In order to quantify the reproducibility of the eye immobilization system, computed tomography scans were coregistered using rigid 6-dimensional skull registration. Using the coregistered scans, x, y, and z displacements of the lens/optic nerve insertion were measured. From these displacements, 3-dimensional vectors were calculated. RESULTS Thirty-four patients were treated from October 2010 to September 2015. Thirty-nine coregistrations were performed using 73 scans (2-3 scans per patient). The mean displacements of lens and optic nerve insertion were 0.1 and 0.0 mm. The median 3-dimensional displacements (absolute value) of lens and nerve insertion were 0.8 and 0.7 mm (standard deviation: 0.5 and 0.6 mm). Ninety-eight percent of 3-dimensional displacements were below 2 mm (maximum 2.4 mm). The calculated planning target volume (PTV) margins were 0.8, 1.4, and 1.5 mm in the anterior-posterior, craniocaudal, and right-left axes, respectively. Following this analysis, no further changes have been applied to our planning margin of 2 to 2.5 mm as it is also meant to account for uncertainties in magnetic resonance imaging to computed tomography registration, skull tracking, and also contouring variability .CONCLUSION We have found our stereotactic eye immobilization system to be highly reproducible (<1 mm) and free of systematic error.

Database: Medline

7. Technical Note: The design and function of a horizontal patient rotation system for the purposes of fixed-beam cancer radiotherapy.

Author(s): Feain, Ilana; Coleman, Lloyd; Wallis, Hue; Sokolov, Richard; O'Brien, Ricky; Keall, Paul

Source: Medical physics; Jun 2017; vol. 44 (no. 6); p. 2490-2502

Publication Date: Jun 2017

Publication Type(s): Journal Article

PubMedID: 28295385

Abstract: PURPOSE Cancer radiation therapy treatment is performed by delivering a 3D dose distribution to the tumor via the relative rotation between beam and patient. While most modern machines rotate the radiation beam around a still patient, the treatment can also be delivered by rotating the patient relative to a fixed beam. Fixed-beam, patient rotation radiotherapy machines show promise for reducing the size, surface area footprint, and shielding requirements compared with rotating gantry machines. In this Technical Note, we describe the development of a bespoke horizontal patient rotation system for the purposes of a fixed-beam cancer radiotherapy architecture. METHODS A horizontal Patient Rotation System was designed in accordance with the appropriate standards pertaining to performance and safety of medical electrical equipment and medical linear accelerators (ISO 9001, IEC 60601-1, IEC 60601-2-1, ISO 14971, ISO 13485, 21CFR820, IEC 62304, Machinery Directive 98/37/EC). The principal criteria for the design were safety, patient comfort, real-time control and the ability to be integrated with other radiation therapy componentry (including a linear accelerator and kV imaging systems).RESULTSA first of its kind device for securing, immobilizing, translating, and rotating patients has been designed and built and tested against 161 different design, safety, and usability specifications. The device has real-time control for all critical applications. CONCLUSIONS We designed and built a bespoke device which can translate and rotate patients 360° around a horizontal axis. The device meets all design and safety criteria with early usability tests indicating a high degree of comfort and utility. The system has been installed in a clinical bunker, integrated with a fixed-beam linear accelerator and is currently being commissioned for the purposes of cancer radiotherapy treatment.

Database: Medline

8. Comparison of set up accuracy among three common immobilisation systems for intensity modulated radiotherapy of nasopharyngeal carcinoma patients.

Author(s): Lin, Cheng-Guang; Xu, Sen-Kui; Yao, Wen-Yan; Wu, Yu-Qi; Fang, Jian-Lan; Wu, Vincent W C

Source: Journal of medical radiation sciences; Jun 2017; vol. 64 (no. 2); p. 106-113

Publication Date: Jun 2017

Publication Type(s): Journal Article

PubMedID: 27741377

Abstract: INTRODUCTION In intensity modulated radiotherapy (IMRT) of nasopharyngeal carcinoma (NPC) patients, an effective immobilisation system is important to minimise set up deviation. This study evaluated the effectiveness of three immobilisation systems by assessing their set up deviations. METHODS Patients were randomly assigned to one of the three immobilisation systems: (1) supine on head rest and base plate (HB); (2) supine with alpha cradle supporting the head and shoulder (AC); (3) supine with vacuum bag supporting the head and shoulder (VB). CBCT was conducted weekly for each patient on the linear accelerator. Image registration was conducted at the nasopharynx (NP) and cervical regions. The translational displacements (latero-medial, antero-posterior and cranio-caudal), rotational displacements (pitch, yaw and roll) and 3D vectors obtained at the NP and cervical regions were recorded and compared among the three systems. RESULTS The mean translational and rotational deviations were within 3 mm and 2°, respectively, and the range of 3D vector was 1.53-3.47 mm. At the NP region, the AC system demonstrated the smallest translational and rotational deviations and 3D vector. The differences were significant except for the latero-medial, yaw and roll directions. Similarly, at the cervical region, the AC system showed smaller translational and rotational deviations and 3D vector, with only the cranio-caudal and yaw deviations that did not reach statistical significance. CONCLUSIONS Set up deviation was greater in the neck than the NP region. The set up accuracy of the AC system was better than the other two systems, and it is recommended for IMRT of NPC patients in our institution.

Database: Medline

9. A randomised comparison of three different immobilisation devices for thoracic and abdominal cancers.

Author(s): Hubie, Catherine; Shaw, Maddison; Bydder, Sean; Lane, Jonny; Waters, Gemma; McNabb, Megan; Kearvell, Rachel; Concannon, Alicia; Bharat, Chrianna; Appleyard, Rob

Source: Journal of medical radiation sciences; Jun 2017; vol. 64 (no. 2); p. 90-96

Publication Date: Jun 2017

Publication Type(s): Journal Article

PubMedID: 27998039

Abstract: INTRODUCTION Patient immobilisation is critically important for both highly conformal conventionally fractionated radiotherapy and for stereotactic body radiotherapy. Different immobilisation devices are available to maintain patient position for radiotherapy but the most suitable one remains unknown .METHODS Forty-five patients were randomly allocated to one of three immobilisation devices; the Q fix arm shuttle, BodyFIX without wrap or BodyFIX with wrap. Patients were imaged before and after treatment to ascertain intra-fraction and inter-fraction motion. Bony anatomy was used for matching to determine the positional accuracy of each device. Treatments were timed using a standard method. Patient comfort and staff satisfaction questionnaires were also issued to determine comfort, ease of use and preferences for each device.RESULTS The BodyFIX without wrap was the more accurate device; however, the differences between the devices were not statistically significant. The BodyFIX with wrap was found to take significantly longer to set up and set down compared to the arm shuttle and the BodyFIX without wrap (all $P < 0.001$). Patients (37%) marginally preferred the BodyFIX with wrap. Most (81%) staff preferred the BodyFIX without wrap. CONCLUSION Immobilisation using the BodyFIX without wrap was deemed to be suitable for clinical use. It was a clinically accurate device, the more efficient in terms of set up and set down time, the most preferred by staff and was accepted by patients.

Database: Medline

10. Positional Accuracy of Treating Multiple Versus Single Vertebral Metastases With Stereotactic Body Radiotherapy.

Author(s): Chang, Joe H; Sangha, Arnjeet; Hyde, Derek; Soliman, Hany; Myrehaug, Sten; Ruschin, Mark; Lee, Young; Sahgal, Arjun; Korol, Renee

Source: Technology in cancer research & treatment; Apr 2017; vol. 16 (no. 2); p. 231-237

Publication Date: Apr 2017

Publication Type(s): Journal Article

PubMedID: 28279146

Abstract: The aim of this study is to determine whether stereotactic body radiotherapy for multiple vertebral metastases treated with a single isocenter results in greater intrafraction errors than stereotactic body radiotherapy for single vertebral metastases and to determine whether the currently used spinal cord planning

organ at risk volume and planning target volume margins are appropriate. Intrafraction errors were assessed for 65 stereotactic body radiotherapy treatments for vertebral metastases. Cone beam computed tomography images were acquired before, during, and after treatment for each fraction. Residual translational and rotational errors in patient positioning were recorded and planning organ at risk volume and planning target volume margins were calculated in each direction using this information. The mean translational residual errors were smaller for single (0.4 (0.4) mm) than for multiple vertebral metastases (0.5 (0.7) mm; P = .0019). The mean rotational residual errors were similar for single (0.3° (0.3°) and multiple vertebral metastases (0.3° (0.3°); P = .862). The maximum calculated planning organ at risk volume margin in any direction was 0.83 mm for single and 1.22 for multiple vertebral metastases. The maximum calculated planning target volume margin in any direction was 1.4 mm for single and 1.9 mm for multiple vertebral metastases. Intrafraction errors were small for both single and multiple vertebral metastases, indicating that our strategy for patient immobilization and repositioning is robust. Calculated planning organ at risk volume and planning target volume margins were smaller than our clinically employed margins, indicating that our clinical margins are appropriate.

Database: Medline

11. Does motion assessment with 4-Dimensional computed tomographic imaging for Non-Small cell lung cancer radiotherapy improve target volume coverage?

Author(s): Ahmed N.; Venkataraman S.; Johnson K.; Sutherland K.; Loewen S.K.

Source: Clinical Medicine Insights: Oncology; Mar 2017; vol. 11

Publication Date: Mar 2017

Publication Type(s): Article

Available in full text at Clinical Medicine Insights. Oncology - from ProQuest

Available in full text at Clinical Medicine Insights. Oncology - from National Library of Medicine

Abstract: Introduction: Modern radiotherapy with 4-dimensional computed tomographic (4D-CT) image acquisition for non-small cell lung cancer (NSCLC) captures respiratory-mediated tumor motion to provide more accurate target delineation. This study compares conventional 3-dimensional (3D) conformal radiotherapy (3DCRT) plans generated with standard helical free-breathing CT (FBCT) with plans generated on 4D-CT contoured volumes to determine whether target volume coverage is affected. Mat erials and methods : Fifteen patients with stage I to IV NSCLC were enrolled in the study. Free-breathing CT and 4D-CT data sets were acquired at the same simulation session and with the same immobilization. Gross tumor volume (GTV) for primary and/or nodal disease was contoured on FBCT (GTV_3D). The 3DCRT plans were obtained, and the patients were treated according to our institution's standard protocol using FBCT imaging. Gross tumor volume was contoured on 4D-CT for primary and/or nodal disease on all 10 respiratory phases and merged to create internal gross tumor volume (IGTV)_4D. Clinical target volume margin was 5 mm in both plans, whereas planning tumor volume (PTV) expansion was 1 cm axially and 1.5 cm superior/inferior for FBCT-based plans to incorporate setup errors and an estimate of respiratory-mediated tumor motion vs 8 mm isotropic margin for setup error only in all 4D-CT plans. The 3DCRT plans generated from the FBCT scan were copied on the 4D-CT data set with the same beam parameters. GTV_3D, IGTV_4D, PTV, and dose volume histogram from both data sets were analyzed and compared. Dice coefficient evaluated PTV similarity between FBCT and 4D-CT data sets. Results : In total, 14 of the 15 patients were analyzed. One patient was excluded as there was no measurable GTV. Mean GTV_3D was 115.3 cm3 and mean IGTV_4D was 152.5 cm3 (P =.001). Mean PTV_3D was 530.0 cm3 and PTV_4D was 499.8 cm3 (P =.40). Both gross primary and nodal disease analyzed separately were larger on 4D compared with FBCT. D95 (95% isodose line) covered 98% of PTV_3D and 88% of PTV_4D (P =.003). Mean dice coefficient of PTV_3D and PTV_4D was 84%. Mean lung V20 was 24.0% for the 3D-based plans and 22.7% for the 4D-based plans (P =.057). Mean heart V40 was 12.1% for the 3D-based plans and 12.7% for the 4D-based plans (P =.53). Mean spinal cord Dmax was 2517 and 2435 cGy for 3D-based and 4D-based plans, respectively (P =.019). Mean esophageal dose was 1580 and 1435 cGy for 3D and 4D plans, respectively (P =.13). Concl usi ons : IGTV_4D was significantly larger than GTV_3D for both primary and nodal disease combined or separately. Mean PTV_3D was larger than PTV_4D, but the difference was not statistically significant. The PTV_4D coverage with 95% isodose line was inferior, indicating the importance of incorporating the true size and shape of the target volume. Relatively less dose was delivered to spinal cord and esophagus with plans based on 4D data set. Dice coefficient analysis for degree of similarity revealed that 16% of PTVs from both data sets did not overlap, indicating different anatomical positions of the PTV due to tumor/nodal motion during a respiratory cycle. All patients with lung cancer planned for radical radiotherapy should have 4D-CT simulation to ensure accurate coverage of the target volumes.

Database: EMBASE

12. Reproducibility of patient setup in the seated treatment position: A novel treatment chair design.

Author(s): McCarroll, Rachel E; Beadle, Beth M; Fullen, Danna; Balter, Peter A; Followill, David S; Stingo, Francesco C; Yang, Jinzhong; Court, Laurence E

Source: Journal of applied clinical medical physics; Jan 2017; vol. 18 (no. 1); p. 223-229

Publication Date: Jan 2017

Publication Type(s): Journal Article

PubMedID: 28291911

Abstract: Radiotherapy in a seated position may be indicated for patients who are unable to lie on the treatment couch for the duration of treatment, in scenarios where a seated treatment position provides superior anatomical positioning and dose distributions, or for a low-cost system designed using a fixed treatment beam and rotating seated patient. In this study, we report a novel treatment chair that was constructed to allow for three-dimensional imaging and treatment delivery while ensuring robust immobilization, providing reproducibility equivalent to that in the traditional supine position. Five patients undergoing radiation treatment for head-and-neck cancers were enrolled and were setup in the chair, with immobilization devices created, and then imaged with orthogonal X-rays in a scenario that mimicked radiation treatments (without treatment delivery). Six subregions of the acquired images were rigidly registered to evaluate intra- and interfraction displacement and chair construction. Displacements under conditions of simulated image guidance were acquired by first registering one subregion; the residual displacement of other subregions was then measured. Additionally, we administered a patient questionnaire to gain patient feedback and assess comparison to the supine position. Average inter- and intrafraction displacements of all subregions in the seated position were less than 2 and 3 mm, respectively. When image guidance was simulated, L-R and A-P interfraction displacements were reduced by an average of 1 mm, providing setup of comparable quality to supine setups. The enrolled patients, who had no indication for a seated treatment position, reported no preference in the seated or the supine position. The novel chair design provides acceptable inter- and intrafraction displacement, with reproducibility equivalent to that reported for patients in the supine position. Patient feedback will be incorporated in the refinement of the chair, facilitating treatment of head-and-neck cancer in patients who are unable to lie for the duration of treatment or for use in an economical fixed-beam setup.

Database: Medline

Protons

1. Recent advances in intensity modulated radiotherapy and proton therapy for esophageal cancer.
Author(s): Xi, Mian; Lin, Steven H

Source: Expert review of anticancer therapy; Jul 2017; vol. 17 (no. 7); p. 635-646

Publication Date: Jul 2017

Publication Type(s): Journal Article

PubMedID: 28503964

Abstract: INTRODUCTION Radiotherapy is an important component of the standard of care for esophageal cancer. In the past decades, significant improvements in the planning and delivery of radiation techniques have led to better dose conformity to the target volume and improved normal tissue sparing. Areas covered: This review focuses on the advances in radiotherapy techniques and summarizes the availably dosimetric and clinical outcomes of intensity-modulated radiation therapy (IMRT), volumetric modulated arc therapy, proton therapy, and four-dimensional radiotherapy for esophageal cancer, and discusses the challenges and future development of proton therapy. Expert commentary: Although three-dimensional conformal radiotherapy is the standard radiotherapy technique in esophageal cancer, the retrospectively comparative studies strongly suggest that the dosimetric advantage of IMRT over three-dimensional conformal radiotherapy can translate into improved clinical outcomes, despite the lack of prospective randomized evidence. As a novel form of conventional IMRT technique, volumetric modulated arc therapy can produce equivalent or superior dosimetric quality with significantly higher treatment efficiency in esophageal cancer. Compared with photon therapy, proton therapy has the potential to achieve further clinical improvement due to their physical properties; however, prospective clinical data, long-term results, and cost-effectiveness are needed.

Database: Medline

2. First Clinical Report of Proton Beam Therapy for Postoperative Radiotherapy for Non-Small-Cell Lung Cancer.

Author(s): Remick, Jill S; Schonewolf, Caitlin; Gabriel, Peter; Doucette, Abigail; Levin, William P; Kucharczuk, John C; Singhal, Sunil; Pechet, Taine T V; Rengan, Ramesh; Simone, Charles B; Berman, Abigail T

Source: Clinical lung cancer; Jul 2017; vol. 18 (no. 4); p. 364-371

Publication Date: Jul 2017

Publication Type(s): Journal Article

PubMedID: 28162946

Abstract: BACKGROUND AND PURPOSE The characteristic Bragg peak of proton beam therapy (PBT) allows for sparing normal tissues beyond the tumor volume that may allow for decreased toxicities associated with postoperative radiation therapy (PORT). Here we report the first institutional experience with proton therapy for PORT in patients with non-small-cell lung cancer (NSCLC) and assess early toxicities and outcomes. MATERIALS AND METHODS We identified 61 consecutive patients treated from 2011 to 2014 who underwent PORT for locally advanced NSCLC for positive microscopic margins and/or positive N2 lymph nodes (stage III), with 27 patients receiving PBT and 34 receiving intensity-modulated radiation therapy (IMRT).RESULTS Median follow-up time was 23.1 months for PBT (2.3-42.0 months) and 27.9 months for IMRT (0.5-87.4 months). The median radiation dose was 50.4 Gy for PBT (50.4-66.6 Gy) and 54 Gy for IMRT (50.0-72.0 Gy). Grade 3 radiation esophagitis was observed in 1 and 4 patients in the PBT and IMRT groups, respectively. Grade 3 radiation pneumonitis was observed in 1 patient in each cohort. Dosimetric analysis revealed a significant decrease in the V5 and mean lung dose (P = .001 and P = .045, respectively). One-year median overall survival and local recurrence-free survival were 85.2% and 82.4% (95% confidence interval, 72.8%-99.7% and 70.5%-96.2%, P = .648) and 92.3% and 93.3% (82.5%-100%, 84.8%-100%, P = .816) for PBT and IMRT cohorts, respectively .CONCLUSIONS Postoperative PBT in NSCLC is well-tolerated and has similar excellent short-term outcomes when compared with IMRT. Longer follow-up is necessary to determine if PBT has a meaningful improvement over IMRT for PORT.

Database: Medline

3. A gas scintillator detector for 2D dose profile monitoring in pencil beam scanning and pulsed beam proton radiotherapy treatments.

Author(s): Vigdor, S E; Klyachko, A V; Solberg, K A; Pankuch, M

Source: Physics in medicine and biology; Jun 2017; vol. 62 (no. 12); p. 4946-4969

Publication Date: Jun 2017

Publication Type(s): Journal Article

PubMedID: 28402289

Abstract: In order to address dosimetry demands during proton therapy treatments utilizing pencil beam scanning and/or pulsed beam accelerators, we have developed a xenon-filled gas scintillation detector (GSD) that can monitor delivered dose and 2D beam centroid position pulse-by-pulse in real time, with high response linearity up to high instantaneous dose rates. We present design considerations for the GSD and results of beam tests carried out at operating proton therapy clinics. In addition to demonstrating spatial resolution with σ of a few hundred microns in each transverse dimension and relative dose precision better than 1% over large treatment areas, the test beam results also reveal the dependence of the GSD dose normalization on dose rate, beam energy, and gas impurities. The results demonstrate the promise of the GSD technology to provide an important addition to dosimetry approaches for next-generation ion beam therapy.

Database: Medline

4. Optical Coherence Tomography-Angiography of Macular Features after Proton Beam Radiotherapy for Small Choroidal Melanoma.

Author(s): Sellam, Alexandre; Coscas, Florence; Lumbroso-Le Rouic, Livia; Dendale, Rémi; Lupidi, Marco; Coscas, Gabriel; Desjardins, Laurence; Cassoux, Nathalie

Source: American journal of ophthalmology; Jun 2017

Publication Date: Jun 2017

Publication Type(s): Journal Article

PubMedID: 28647462

Abstract:PURPOSE To describe the macular features of patients treated with proton beam therapy for choroidal melanoma (CM), using the optical coherence tomography-angiography (OCTA).DESIGN Retrospective case-control study. METHODS This study included patients treated with proton beam radiotherapy (PBR) for a small CM. Only patients that had received 100% of the dose 60 GyEBR to the macular area were included in the analysis. All the patients have undergone a full ophthalmological examination including: visual acuity, OCT B-scan and OCTA. Qualitative and quantitative vascular features of the retinal plexus and the choriocapillaris were analyzed on OCTA and compared to healthy subjects matched on age and sex.RESULTS37 patients had undergone an OCTA following PBR for a small CM. 17 patients (9 men and 8 women) were included. The mean age of the patient was 56.6 years (28-86). At presentation, the mean tumor thickness was 3.39 mm (1.3-7.0 mm). The mean follow up duration was 35.8 months (11-72 months). 13 patients (76.5%) had a clinical radiation maculopathy, 8 patients (47.1%) had macular cysts on OCT-B scan. All the patients (100%) had abnormalities on OCTA. Some "signal void" spots were detected at the level of the choriocapillaris in 15 patients (88.2%). The mean vascular density (regarding the full retina) was significantly lower in the patients treated with PBR than healthy subjects ($p<0.0001$).CONCLUSION Patients treated with PBR for CM (with 100% of the dose given to the macula), present major changes at both plexuses but also a vascular rarefaction of the choriocapillaris.

Database: Medline

5. Impact of physiological breathing motion for breast cancer radiotherapy with proton beam scanning - An in silico study.

Author(s): Flejmer, Anna M; Chehrazi, Behnaz; Josefsson, Dan; Toma-Dasu, Iuliana; Dasu, Alexandru

Source: Physica medica : PM : an international journal devoted to the applications of physics to medicine and biology : official journal of the Italian Association of Biomedical Physics (AIFB); Jun 2017

Publication Date: Jun 2017

Publication Type(s): Journal Article

PubMedID: 28606833

Abstract: This study investigates the impact of breathing motion on proton breast treatment plans. Twelve patients with CT datasets acquired during breath-hold-at-inhalation (BHI), breath-hold-at-exhalation (BHE) and in free-breathing (FB) were included in the study. Proton plans were designed for the left breast for BHI and subsequently recalculated for BHE or designed for FB and recalculated for the extreme breath-hold phases. The plans were compared from the point of view of their target coverage and doses to organs-at-risk. The median amplitude of breathing motion determined from the positions of the sternum was 4.7mm (range 0.5-14.6mm). Breathing motion led to a degradation of the dose coverage of the target (heterogeneity index increased from 4-7% to 8-11%), but the degraded values of the dosimetric parameters of interest fulfilled the clinical criteria for plan acceptance. Exhalation decreased the lung burden [average dose 3.1-4.5Gy (RBE)], while inhalation increased it [average dose 5.8-6.8Gy (RBE)]. The individual values depended on the field arrangement. Smaller differences were seen for the heart [average dose 0.1-0.2Gy (RBE)] and the LAD [1.9-4.6Gy (RBE)]. Weak correlations were generally found between changes in dosimetric parameters and respiratory motion. The differences between dosimetric parameters for various breathing phases were small and their expected clinical impact is consequently quite small. The results indicated that the dosimetric parameters of the plans corresponding to the extreme breathing phases are little affected by breathing motion, thus suggesting that this motion might have little impact for the chosen beam orientations with scanned proton beams.

Database: Medline

6. Comparison of gastric-cancer radiotherapy performed with volumetric modulated arc therapy or single-field uniform-dose proton therapy.

Author(s): Mondlane, Gracinda; Gubanski, Michael; Lind, Pehr A; Ureba, Ana; Siegbahn, Albert

Source: Acta oncologica (Stockholm, Sweden); Jun 2017; vol. 56 (no. 6); p. 832-838

Publication Date: Jun 2017

Publication Type(s): Journal Article

PubMedID: 28281357

Abstract: BACKGROUND Proton-beam therapy of large abdominal cancers has been questioned due to the large variations in tissue density in the abdomen. The aim of this study was to evaluate the importance of these variations for the dose distributions produced in adjuvant radiotherapy of gastric cancer (GC), implemented with photon-based volumetric modulated arc therapy (VMAT) or with proton-beam single-field uniform-dose (SFUD) method. MATERIAL AND METHODS Eight GC patients were included in this study. For each patient, a VMAT- and an SFUD-plan were created. The prescription dose was 45 Gy (IsoE) given in 25 fractions. The plans were prepared on the original CT studies and the doses were thereafter recalculated on two modified CT studies (one with extra water filling and the other with expanded abdominal air-cavity volumes).RESULTS Compared to the original VMAT plans, the SFUD plans resulted in reduced median values for the V18 of the left kidney (26%), the liver mean dose (14.8 Gy (IsoE)) and the maximum dose given to the spinal cord (26.6 Gy (IsoE)). However, the PTV coverage decreased when the SFUD plans were recalculated on CT sets with extra air- (86%) and water-filling (87%). The added water filling only led to minor dosimetric changes for the OARs, but the extra air caused significant increases of the median values of V18 for the right and left kidneys (10% and 12%, respectively) and of V10 for the liver (12%). The density changes influenced the dose distributions in the VMAT plans to a minor extent. CONCLUSIONS SFUD was found to be superior to VMAT for the plans prepared on the original CT sets. However, SFUD was inferior to VMAT for the modified CT sets.

Database: Medline

7. Immune-optimized photon and proton planning to minimize immunosuppressive effects of radiotherapy on circulating lymphocytes

Author(s): Basler L.; Andratschke N.; Ehrbar S.; Weber D.C.; Guckenberger M.; Tanadini-Lang S.; Lucconi G.; Bolsi A.; Lomax A.

Source: Strahlentherapie und Onkologie; Jun 2017; vol. 193 (no. 1)

Publication Date: Jun 2017

Publication Type(s): Conference Abstract

Abstract: Aim: Tumor immune escape may be major reason for failure of immunomodulatory therapies and has been shown to be potentially overcome by radiotherapy. However, radiation also has detrimental effects on tumor infiltrating and circulating lymphocytes (CLs). This in silico planning study aimed to model the low-dose effects of photon- and proton- irradiation on CLs depending on dose, fractionation and treatment technique in the context of cancer immunotherapy. Methods: A model has been implemented in MATLAB to estimate the dose delivered to CLs during stereotactic body radiotherapy of a liver metastasis treated with 3 x 15 Gy. Three scenarios were evaluated, with a virtual liver metastasis positioned at different intra-hepatic locations. Eighteen photon and six proton treatment plans were generated: Volumetric modulated arc therapy (VMAT) and 3D conformal radiotherapy (3DCRT) with and without flattening filter, and proton radiotherapy with either single field uniform dose (SFUD) or intensity modulated proton therapy (IMPT) techniques using a pencil beam scanning delivery paradigm. Cumulative dose to CLs was then calculated using a DVH based convolution algorithm. It considers the hepatic blood flow and velocity, hepatic transition time, total body blood volume, heart-to-heart circulation time, treatment delivery time, dose rate and beam energy. A dose of >=0.5 Gy was considered effective in inactivating or killing CLs. Results: Differences between treatment modalities were comparable in each metastatic site. All photon plans resulted in comparable mean liver doses (MLD, see table), whilst the proportion of CLs receiving >=0.5 Gy (CL0.5) showed substantial and significant differences: beamon time (BOT), which is associated with photon energy and dose rate, was most closely correlated with CL0.5. In the apical liver metastasis (Table), 7-field 3D-CRT with 10MV FFF followed by VMAT with 10MV FFF resulted in lowest CL0.5 values of 12% and 14%, respectively. 2-field proton plans resulted in lower MLD's and further reduced CL0.5 to 8% for both the SFUD and the IMPT plan. Conclusion: A model has been established to estimate immunosuppressive effects of radiotherapy through inactivation of circulating lymphocytes. In contrast to our initial assumption that integral dose might be the most important factor influencing the proportion of lymphocytes receiving >0.5 Gy, treatment delivery time had the strongest impact with 10MV FFF VMAT and 3D techniques. Proton therapy further improved lymphocyte sparing.

Database: EMBASE

8. Conventional echocardiographic parameters in oncological patients undergoing a new radiotherapeutic treatment: Proton beam versus photon radiotherapy

Author(s): Bruno G.; Di Stefano C.; Pellikka P.A.; Herrmann J.; Villarraga H.R.; Mutter R.W.; Laack N.N.;

Kahila M.M.; Whitaker T.J.; Pumper G.M.

Source: Journal of the American Society of Echocardiography; Jun 2017; vol. 30 (no. 6)

Publication Date: Jun 2017

Publication Type(s): Conference Abstract

Abstract: Background: Radiotherapy represents an important therapeutic modality for patients with breast cancer and thoracic malignancies. Unintended exposure of the adjacent heart from photon treatment (PhT) has been associated with a wide range of chronic cardiac effects. Proton beam therapy (PBT) is being investigated in the clinic as the Bragg Peak of protons may be exploited in order to reduce the dose to non-target normal tissues including the heart compared with PhT, while achieving similar target coverage. However, the acute and subacute effects of PBT on heart function are unknown. Methods: 50 consecutive patients with breast cancer or thoracic neoplasia (lung, esophageal cancer and thymoma), were prospectively evaluated with transthoracic echocardiography (TTE) prior to radiotherapy, mid-treatment (13+/-3 days), at the end of treatment (24+/-5 days) and three months after the completion of radiotherapy. 27 patients received pencilbeam scanning PBT and 23 PhT. The aim of our study was to compare left ventricular systolic and diastolic function between PBT and PhT. Results: Mean age was 54+/-12 years, 88% were female and 80% received previous chemotherapy. No differences in age, sex, anthropometric variables, cardiovascular comorbidities, chemotherapy receipt and preload conditions or other baseline conventional echocardiographic values were found between the two groups. Mean heart radiation dose was lower in the PBT than the PhT group (85+/-96 cGy (Relative Biological Effectiveness 1.1) vs 696+/-952 cGy respectively, p=0.007). Left ventricular volumes and ejection fraction were with in normal limits and did not change throughout radiotherapy in either group. Echocardiographic parameters to evaluate diastolic function did not significantly vary from the baseline to the three month follow up (Table). However, a significant progressive reduction in septal Tissue systolic velocity (S') was seen with PhT (from 0.080+/-0.014 m/s at baseline TTE to 0.068+/-0.013 at three-month follow up TTE, $p < 0.001$) but not with PBT. Conclusion: In patients that underwent PhT, systolic tissue velocities decreased during follow up suggesting impairment in systolic function, while no changes were seen following PBT. These findings should be confirmed with other methods of detection of subclinical systolic dysfunction. (Table Presented).

Database: EMBASE

9. Proton beam radiotherapy as part of comprehensive regional nodal irradiation for locally advanced breast cancer.

Author(s): Verma, Vivek; Iftekaruddin, Zaid; Badar, Nida; Hartsell, William; Han-Chih Chang, John; Gondi, Vinai; Pankuch, Mark; Gao, Ming; Schmidt, Stacey; Kaplan, Darren; McGee, Lisa

Source: Radiotherapy and oncology : journal of the European Society for Therapeutic Radiology and Oncology; May 2017; vol. 123 (no. 2); p. 294-298

Publication Date: May 2017

Publication Type(s): Journal Article

PubMedID: 28457577

Abstract:PURPOSEThis study evaluates acute toxicity outcomes in breast cancer patients treated with adjuvant proton beam therapy (PBT).METHODSFrom 2011 to 2016, 91 patients (93 cancers) were treated with adjuvant PBT targeting the intact breast/chest wall and comprehensive regional nodes including the axilla, supraclavicular fossa, and internal mammary lymph nodes. Toxicity was recorded weekly during treatment, one month following treatment, and then every 6months according to the Common Terminology Criteria for Adverse Events (CTCAE) v4.0. Charts were retrospectively reviewed to verify toxicities, patient parameters, disease and treatment characteristics, and disease-related outcomes.RESULTSMedian follow-up was 15.5months. Median PBT dose was 50.4 Gray relative biological effectiveness (GyRBE), with subsequent boost as clinically indicated (N=61, median 10 GyRBE). Chemotherapy, when administered, was given adjuvantly (N=42) or neoadjuvantly (N=46). Grades 1, 2, and 3 dermatitis occurred in 23%, 72%, and 5%, respectively. Eight percent required treatment breaks owing to dermatitis. Median time to resolution of dermatitis was 32days. Grades 1, 2, and 3 esophagitis developed in 31%, 33%, and 0%, respectively.CONCLUSIONSPBT displays acceptable toxicity in the setting of comprehensive regional nodal irradiation.

Database: Medline

10. MEASUREMENT OF NEUTRON AMBIENT DOSE EQUIVALENT IN PROTON

RADIOTHERAPY WITH LINE-SCANNING AND WOBBLING MODE TREATMENT SYSTEM.

Author(s): Lee, Sangmin; Lee, Chaeyeong; Shin, Eun Hyuk; Cho, Sungkoo; Kim, Dae-Hyun; Han, Youngyih; Choi, Doo Ho; Ye, Sung-Joon; Kim, Jin Sung

Source: Radiation protection dosimetry; Apr 2017 ; p. 1-7

Publication Date: Apr 2017

Publication Type(s): Journal Article

PubMedID: 28444374

Abstract: The primary objective of this study was to measure secondary neutron dose during proton therapy using a detector that covers the entire neutron energy range produced in proton therapy. We analyzed and compared the neutron dose during proton treatment with passive scattering and line scanning. The neutron ambient dose equivalents were measured with a 190 MeV wobbling and line-scanning proton beam. The center of a plastic water phantom (30 × 30 × 60 cm3) was placed at the isocenter. A Wide-Energy Neutron Detection Instrument (WENDI-2) was located 1m from the isocenter at four different angles (0°, 45°, 90° and 135°). Both wobbling and line-scanning modes of a multipurpose and pencil beam scanning dedicated nozzles were used to obtain a spread-out Bragg peak with 10-cm-width for the measurements. The ambient dose equivalent H*(10) value was normalized by the proton therapeutic dose at the isocenter. For wobbling mode and line-scanning mode, the highest H*(10) values were 1.972 and 0.099 mSv/Gy, respectively. We successfully measured the neutron ambient dose equivalents at six positions generated by a 190 MeV proton beam using wobbling and line-scanning mode with the WENDI-2. These reference data could be used for neutron dose reduction methods and other analysis for advanced proton treatment in the near future.

Database: Medline

11. Comparing the dosimetric impact of interfractional anatomical changes in photon, proton and carbon ion radiotherapy for pancreatic cancer patients.

Author(s): Houweling, Antonetta C; Crama, Koen; Visser, Jorrit; Fukata, Kyohei; Rasch, Coen R N; Ohno, Tatsuya; Bel, Arjan; van der Horst, Astrid

Source: Physics in medicine and biology; Apr 2017; vol. 62 (no. 8); p. 3051-3064

Publication Date: Apr 2017

Publication Type(s): Journal Article

PubMedID: 28252445

Abstract: Radiotherapy using charged particles is characterized by a low dose to the surrounding healthy organs, while delivering a high dose to the tumor. However, interfractional anatomical changes can greatly affect the robustness of particle therapy. Therefore, we compared the dosimetric impact of interfractional anatomical changes (i.e. body contour differences and gastrointestinal gas volume changes) in photon, proton and carbon ion therapy for pancreatic cancer patients. In this retrospective planning study, photon, proton and carbon ion treatment plans were created for 9 patients. Fraction dose calculations were performed using daily cone-beam CT (CBCT) images. To this end, the planning CT was deformably registered to each CBCT; gastrointestinal gas volumes were delineated on the CBCTs and copied to the deformed CT. Fraction doses were accumulated rigidly. To compare planned and accumulated dose, dose-volume histogram (DVH) parameters of the planned and accumulated dose of the different radiotherapy modalities were determined for the internal gross tumor volume, internal clinical target volume (iCTV) and organs-at-risk (OARs; duodenum, stomach, kidneys, liver and spinal cord). Photon plans were highly robust against interfractional anatomical changes. The difference between the planned and accumulated DVH parameters for the photon plans was less than 0.5% for the target and OARs. In both proton and carbon ion therapy, however, coverage of the iCTV was considerably reduced for the accumulated dose compared with the planned dose. The near-minimum dose ([Formula: see text]) of the iCTV reduced with 8% for proton therapy and with 10% for carbon ion therapy. The DVH parameters of the OARs differed less than 3% for both particle modalities. Fractionated radiotherapy using photons is highly robust against interfractional anatomical changes. In proton and carbon ion therapy, such changes can severely reduce the dose coverage of the target.

Database: Medline

12. Advances in radiotherapy techniques and delivery for non-small cell lung cancer: benefits of intensity-modulated radiation therapy, proton therapy, and stereotactic body radiation therapy.

Author(s): Diwanji, Tejan P; Mohindra, Pranshu; Vyfhuis, Melissa; Snider, James W; Kalavagunta,

Chaitanya; Mossahebi, Sina; Yu, Jen; Feigenberg, Steven; Badiyan, Shahed N

Source: Translational lung cancer research; Apr 2017; vol. 6 (no. 2); p. 131-147

Publication Date: Apr 2017

Publication Type(s): Journal Article Review

PubMedID: 28529896

Abstract: The 21st century has seen several paradigm shifts in the treatment of non-small cell lung cancer (NSCLC) in early-stage inoperable disease, definitive locally advanced disease, and the postoperative setting. A key driver in improvement of local disease control has been the significant evolution of radiation therapy techniques in the last three decades, allowing for delivery of definitive radiation doses while limiting exposure of normal tissues. For patients with locally-advanced NSCLC, the advent of volumetric imaging techniques has allowed a shift from 2-dimensional approaches to 3-dimensional conformal radiation therapy (3DCRT). The next generation of 3DCRT, intensity-modulated radiation therapy and volumetric-modulated arc therapy (VMAT), have enabled even more conformal radiation delivery. Clinical evidence has shown that this can improve the quality of life for patients undergoing definitive management of lung cancer. In the early-stage setting, conventional fractionation led to poor outcomes. Evaluation of altered dose fractionation with the previously noted technology advances led to advent of stereotactic body radiation therapy (SBRT). This technique has dramatically improved local control and expanded treatment options for inoperable, early-stage patients. The recent development of proton therapy has opened new avenues for improving conformity and the therapeutic ratio. Evolution of newer proton therapy techniques, such as pencil-beam scanning (PBS), could improve tolerability and possibly allow reexamination of dose escalation. These new progresses, along with significant advances in systemic therapies, have improved survival for lung cancer patients across the spectrum of non-metastatic disease. They have also brought to light new challenges and avenues for further research and improvement.

Database: Medline

13. Human papillomavirus status and the relative biological effectiveness of proton radiotherapy in head and neck cancer cells.

Author(s): Wang, Li; Wang, Xiaochun; Li, Yuting; Han, Shichao; Zhu, Jinming; Wang, Xiaofang; Molkentine, David P; Blanchard, Pierre; Yang, Yining; Zhang, Ruiping; Sahoo, Narayan; Gillin, Michael; Zhu, Xiaorong Ronald; Zhang, Xiaodong; Myers, Jeffrey N; Frank, Steven J

Source: Head & neck; Apr 2017; vol. 39 (no. 4); p. 708-715

Publication Date: Apr 2017

Publication Type(s): Journal Article

PubMedID: 28039958

Available in full text at Head and Neck - from Ovid

Abstract: BACKGROUND Human papillomavirus (HPV)-positive oropharyngeal carcinomas response better to X-ray therapy (XRT) than HPV-negative disease. Whether HPV status influences the sensitivity of head and neck cancer cells to proton therapy or the relative biological effectiveness (RBE) of protons versus XRT is unknown. METHODS Clonogenic survival was used to calculate the RBE; immunocytochemical analysis and neutral comet assay were used to evaluate unrepaired DNA double-strand breaks. RESULTS HPV-positive cells were more sensitive to protons and the unrepaired double-strand breaks were more numerous in HPV-positive cells than in HPV-negative cells (p 1.06). Cell line type and radiation fraction size influenced the RBE.CONCLUSIONHPV-positive cells were more sensitive to protons than HPV-negative cells maybe through the effects of HPV on DNA damage and repair. The RBE for protons depends more on cell type and fraction size than on HPV status. © 2016 Wiley Periodicals, Inc. Head Neck 39: 708-715, 2017.

Database: Medline

14. Cost of New Technologies in Prostate Cancer Treatment: Systematic Review of Costs and Cost Effectiveness of Robotic-assisted Laparoscopic Prostatectomy, Intensity-modulated Radiotherapy, and Proton Beam Therapy.

Author(s): Schroeck, Florian Rudolf; Jacobs, Bruce L; Bhayani, Sam B; Nguyen, Paul L; Penson, David; Hu, Jim

Source: European urology; Mar 2017

Publication Date: Mar 2017

Publication Type(s): Journal Article Review

PubMedID: 28366513

Abstract: CONTEXT Some of the high costs of robot-assisted radical prostatectomy (RARP), intensity-modulated radiotherapy (IMRT), and proton beam therapy may be offset by better outcomes or less resource use during the treatment episode. OBJECTIVE To systematically review the literature to identify the key economic trade-offs implicit in a particular treatment choice for prostate cancer. EVIDENCE ACQUISITION We systematically reviewed the literature according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement and protocol. We searched Medline, Embase, and Web of Science for articles published between January 2001 and July 2016, which compared the treatment costs of RARP, IMRT, or proton beam therapy to the standard treatment. We identified 37, nine, and three studies, respectively. EVIDENCE SYNTHESISRARP is costlier than radical retropubic prostatectomy for hospitals and payers. However, RARP has the potential for a moderate cost advantage for payers and society over a longer time horizon when optimal cancer and quality-of-life outcomes are achieved. IMRT is more expensive from a payer's perspective compared with three-dimensional conformal radiotherapy, but also more cost effective when defined by an incremental cost effectiveness ratio <$50 000 per quality-adjusted life year. Proton beam therapy is costlier than IMRT and its cost effectiveness remains unclear given the limited comparative data on outcomes. Using the Grades of Recommendation, Assessment, Development and Evaluation approach, the quality of evidence was low for RARP and IMRT, and very low for proton beam therapy. CONCLUSIONS Treatment with new versus traditional technologies is costlier. However, given the low quality of evidence and the inconsistencies across studies, the precise difference in costs remains unclear. Attempts to estimate whether this increased cost is worth the expense are hampered by the uncertainty surrounding improvements in outcomes, such as cancer control and side effects of treatment. If the new technologies can consistently achieve better outcomes, then they may be cost effective. PATIENT SUMMARY We review the cost and cost effectiveness of robot-assisted radical prostatectomy, intensity-modulated radiotherapy, and proton beam therapy in prostate cancer treatment. These technologies are costlier than their traditional counterparts. It remains unclear whether their use is associated with improved cure and reduced morbidity, and whether the increased cost is worth the expense.

Database: Medline

15. Quantifiable dosimetric benefits of proton radiotherapy

Author(s): Dalfsen R.

Source: Journal of Medical Radiation Sciences; Mar 2017; vol. 64 ; p. 34

Publication Date: Mar 2017

Publication Type(s): Conference Abstract

Abstract: Objectives: It is widely acknowledged that Intensity Modulated Proton Therapy (IMPT) is becoming the gold standard treatment for many difficult to treat cancer sites.1 The characteristic beam profile is ideal for challenging target volumes adjacent to critical structures and organs at risk (OAR),2 yet practical exposure in Australia has until recently been limited. Circa 2015, the Royal Adelaide Hospital implemented a preliminary study to analyse and compare dosimetric quality of Intensity Modulated Radiation Therapy (IMRT), Volumetric Arc Therapy (VMAT) and IMPT techniques. This presentation aims to provide an in depth focus on a small cohort of plans, which were particularly interesting due to the location of their tumor volumes. Method: Phillips Pinnacle 9.100, (a trial version of Proton planning software), was used to generate and dosimetrically evaluate IMRT, VMAT and IMPT plans. As of August 2016, 41 data-sets have been analysed, and were considered highly challenging using traditional planning methods. The subjectivity apparent in planning was removed from this study, with data-set specific plan-quality metrics. These were designed using Sun Nuclear PlanIQ software and was utilized in plan quality analysis. Results: The results of this study highlighted apparent dosimetric benefits of Proton Therapy. The analysis observed substantial decreases in OAR dose, while adequately maintaining target coverage in most cases. Conclusion: From the results shown in this preliminary analysis, it can be extrapolated that IMPT treatments lead to clinical benefits for patients. Currently, patient recruitment for the study is ongoing, with plan analysis continuing for patients with appropriate disease sites.

Database: EMBASE

16. Multi-Institutional Prospective Study of Reirradiation with Proton Beam Radiotherapy for Locoregionally Recurrent Non-Small Cell Lung Cancer.

Author(s): Chao, Hann-Hsiang; Berman, Abigail T; Simone, Charles B; Ciunci, Christine; Gabriel, Peter; Lin, Haibo; Both, Stefan; Langer, Corey; Lelionis, Kristi; Rengan, Ramesh; Hahn, Stephen M; Prabhu, Kiran; Fagundes, Marcio; Hartsell, William; Mick, Rosemarie; Plastaras, John P

Source: Journal of thoracic oncology : official publication of the International Association for the Study of Lung Cancer; Feb 2017; vol. 12 (no. 2); p. 281-292

Publication Date: Feb 2017

Publication Type(s): Journal Article

PubMedID: 27826034

Abstract: OBJECTIVES The management of recurrent NSCLC in the setting of prior radiation therapy is challenging. Proton radiotherapy (PRT) is ideally suited to minimize toxicity to previously irradiated organs. We report the safety/feasibility of PRT for NSCLC reirradiation in a prospective multi-institutional study. MATERIALS AND METHODS Between October 2010 and December 2015, 57 patients with recurrent NSCLC in or near their prior radiation field were treated at three proton centers. Patients were classified by tumor volume, location, and clinical characteristics. Toxicities were scored using the National Cancer Institute Common Terminology Criteria for Adverse Events, version 4.0. Survival outcomes were estimated by using Kaplan-Meier analysis. RESULTS Fifty-two patients (93%) completed the reirradiation course. Their median age was 65 years (41-86). Patients with high tumor volume (clinical target volume-to-internal target volume ratio ≥250 cm3) were closed to enrollment owing to infeasibility in August 2012. Concurrent systemic therapy was delivered to 67% of patients. Fourteen patients (25%) had evidence of local (n = 9) or regional (n = 5) recurrence. Distant metastases after reirradiation developed in six patients (11%). The 1-year rates of overall and progression-free survival were 59% and 58%, respectively. In total, grade 3 or higher acute and/or late toxicity developed in 24 patients (42%), acute toxicity developed in 22 (39%), and late toxicity developed in seven (12%). Six grade 5 toxicities were observed. Increased overlap with the central airway region, mean esophagus and heart doses, and concurrent chemotherapy were associated with significantly higher rates of grade 3 or higher toxicity. Decreased overall survival was seen with increased mean esophagus dose (p = 0.007).CONCLUSIONS In this prospective study, PRT for recurrent NSCLC is feasible but can be associated with significant toxicity. Providers should remain cautious in reirradiating NSCLC, paying close consideration to tumor volume, location, and relevant dosimetric parameters. Further research is needed for optimal patient selection to improve overall outcomes.

Database: Medline

17. A randomized trial of 15 fraction vs 25 fraction pencil beam scanning proton radiotherapy after mastectomy in patients requiring regional nodal irradiation

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Publication Type(s): Conference Abstract

Available in full text at Cancer Research - from Highwire Press

Abstract: Background: Post-mastectomy radiotherapy improves survival in women with node-positive breast cancer. Pencil beam scanning proton therapy is attractive due to potential to reduce the dose to the heart and lungs compared with traditional photon techniques while improving conformality and limiting skin dose compared with passively scanned proton therapy. The optimal dose and fractionation for pencil-beam scanning proton therapy remains unknown. Trial Design: This is a multi-center open label phase II randomized controlled trial to determine the safety of 15 fraction vs 25 fraction pencil beam scanning proton radiotherapy after mastectomy in patients requiring regional nodal irradiation. Eligibility Criteria: Patients >= 18 years with primary, non-inflammatory invasive breast cancer who have undergone mastectomy with or without immediate reconstruction and chest wall and regional nodal irradiation planned. Aims: To determine whether the 24 month complication rate (defined as grade 3 or greater late adverse events, and unplanned surgical intervention in patients who undergo mastectomy with reconstruction) of 15 fraction chest wall and regional node pencil beam scanning proton radiotherapy is acceptable relative to 25 fraction chest wall and regional nodal pencil beam scanning proton radiotherapy and worthy of further investigation. Statistical methods: The study is designed as a non-inferiority/superiority "hybrid" design using the approach of Freidlin et al. It is Using a one-sided type I error rate of 0.05 (corresponding equivalently to constructing a 1-sided 95% confidence limit), 72 evaluable patients will have 80% power to reject the null VR Hector Mayo Clinic, Rochester, MN Find this author on Google Scholar Find this author on PubMed Search for this author on this site hypothesis that the 24-

month complication rate in the experimental arm is higher than that of the control arm by more than 10% (i.e. rule out inferiority) under the alternative hypothesis that the complication rate in the experimental arm is 5% less than that of the control arm (i.e. superiority). However, the design will have only 41% power when the two treatment arms are equivalent (i.e. the complication rate is 10% for both arms). Accrual: The study opened in June 2016. Five of a planned eighty-two patients have been accrued to date.

Database: EMBASE

18. Modern treatment techniques in lung cancer: The advantages of conformal radiotherapy, IMRT and proton therapy

Author(s): Ishikura S.

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Publication Type(s): Conference Abstract

Abstract: As technology has advanced, modern radiotherapy (RT) techniques, such as conformal radiotherapy (CRT), intensity- modulated radiation therapy (IMRT), and proton therapy (PT), have become available. In this session, the advantages of these techniques in the treatment of earlystage and locally-advanced lung cancer will be presented, along with their uncertainties. Conformal RT uses CT scans to create 3-dimensional images of the tumor and normal tissues, which leads to more accurate treatment planning. It also uses multiple radiation beams from various angles to concentrate the radiation dose to the tumor while reducing the dose to normal tissues. Furthermore, conformal RT improves tumor control and reduces toxicity compared to 2-dimensional RT.1 IMRT is a sophisticated form of CRT, which enables us to more exactly concentrate and shape the dose distribution to the tumor and spare normal tissues. It can also partially intensify doses to individual areas deemed to be more aggressive or radioresistant. PT uses charged particles, which have a unique physical characteristic called the Bragg peak. The Bragg peak describes a certain tissue depth at which the protons stop just after transferring most of their energy. This feature is particularly convenient for tumors located close to critical normal tissues. PT is commonly adopted for pediatric, central nervous system, and intraocular malignancies. Stereotactic body radiation therapy (SBRT), also called stereotactic ablative radiation therapy (SABR), is characterized by accurate target definition, precise tumor positioning, steep dose gradients outside targets, and very high dose per fraction. SBRT can be delivered using either CRT or IMRT. In the treatment of peripheral early-stage lung cancer, SBRT is widely adopted as a standard treatment and is considered better than conventional fractionated RT. PT can also be used in this setting, despite similar outcomes as SBRT2; however, a recent systematic review of costeffectiveness analyses did not support the use of PT.3 To improve outcomes in locally-advanced lung cancer, IMRT and PT have been actively investigated. Several in silico studies have suggested the superiority of IMRT over CRT, and PT over IMRT, but this remains to be demonstrated clinically. Subgroup analyses of RTOG 0617, which compared a high dose (74 Gy) vs. a standard dose (60 Gy) and allowed both CRT and IMRT, showed similar efficacy, less radiation pneumonitis, and better compliance of consolidative chemotherapy favoring IMRT over CRT, despite there being more advanced cases in the IMRT group.4 The study authors generated a hypothesis that dose intensification by IMRT may result in better efficacy with less toxicity. However, we could not determine the true difference between IMRT and CRT among patients who received the standard dose, which is our current practice, because their analysis included both high- and standard-dose arms; the differences might be more prominent in the high-dose arm. These investigators also suggested that increasing the radiation dose to the heart may worsen survival, so dose constraints to the heart became stricter thereafter. Results of a Bayesian phase II randomized trial of IMRT vs. PT were reported at the ASCO Annual Meeting earlier this year.5 The primary endpoint was incidence and time to protocol failure, defined as Grade 3 or higher pneumonitis or local failure. The observed local failure rates at 12 months were similar (13% vs. 12%). The investigators assumed Grade 3 or higher pneumonitis of 15% in the IMRT arm and 5% in the PT arm; however, they observed 6.5% in the IMRT arm, which was lower than the assumed probability, and 10.5% in the PT arm, higher than expected. Because this was a phase II trial with some limitations, firm conclusions could not be drawn. However, PT failed to suggest a clinical benefit over IMRT. A meta-analysis of the phase III trials conducted by the Radiation Therapy Oncology Group between 1968 and 2002 showed that new treatments were demonstrated to be better than existing ones in only 6 of 59 comparisons. In addition, overall survival of all of the accrued patients did not differ between groups, while the odds ratio of 1.76 for treatment-related death was significantly higher for the new treatments.6 These results clearly showed that "New is not always better." We need to identify the subpopulations for whom new techniques are more effective and to demonstrate these have true value with scientifically strong evidence, instead of just believing in their efficacy, complaining about the challenges associated with evaluating them, or advertising them directly to patients.

Exercise: Heterogeneity

Heterogeneity is the extent to which studies brought together in a systematic review demonstrate variation across a range of key variables.

Match the different types of heterogeneity:

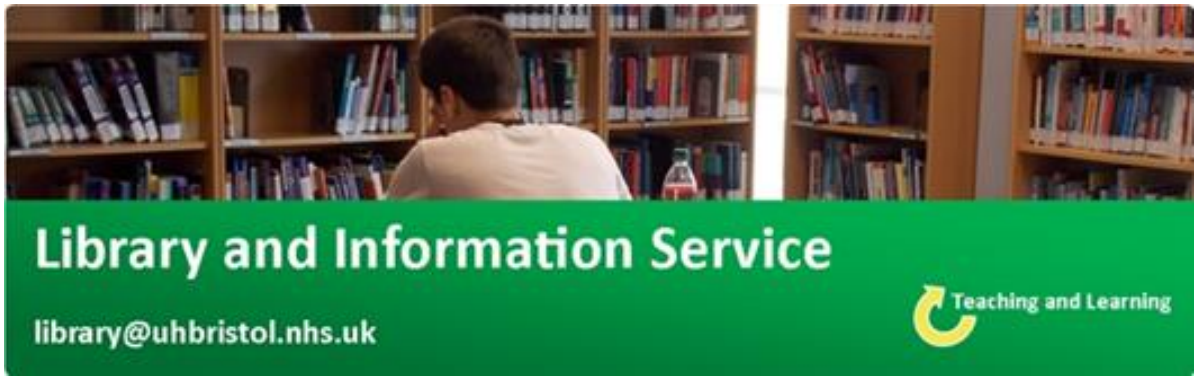
1. Statistical heterogeneity (conventionally just known as 'heterogeneity')
2. Methodological heterogeneity
3. Clinical heterogeneity

A. Variability in the participants, interventions and outcomes studied

B. Variability in study design and risk of bias

C. Variability in the intervention effects being evaluated in the different studies

Answers: 1C, 2B, 3A



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