Your Outreach Librarian – **Sarah Barrett**

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**Lunchtime Drop-in Sessions**

*All sessions last one hour*

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Radiation therapy techniques in cancer treatment
Author: Timur Mitin, MD, PhD; Section Editor: Jay S Loeffler, MD; Deputy Editor: Michael E Ross, MD
All topics are updated as new evidence becomes available and our peer review process is complete.
Literature review current through: Apr 2017. | This topic last updated: Apr 26, 2017.
https://www.uptodate.com/contents/radiation-therapy-techniques-in-cancer-treatment?source=search_result&search=radiotherapy&selectedTitle=1~150

Adjuvant radiation therapy for women with newly diagnosed, non-metastatic breast cancer
Author: Jennifer F De Los Santos, MD; Section Editors: Daniel F Hayes, MD; David E Wazer, MD; Deputy Editor: Sadhna R Vora, MD
All topics are updated as new evidence becomes available and our peer review process is complete.

Radiation therapy for the management of painful bone metastases
Authors: Lisa A Kachnic, MD; Steven J DiBiase, MD; Section Editor: Steven E Schild, MD; Deputy Editor: Diane MF Savarese, MD
All topics are updated as new evidence becomes available and our peer review process is complete.
https://www.uptodate.com/contents/radiation-therapy-for-the-management-of-painful-bone-metastases?source=search_result&search=radiotherapy&selectedTitle=8~150
Radiation therapy of pituitary adenomas
Authors: Jay S Loeffler, MD; Helen A Shih, MD; Section Editor: Peter J Snyder, MD; Deputy Editor: Kathryn A Martin, MD
All topics are updated as new evidence becomes available and our peer review process is complete.
Literature review current through: Apr 2017. | This topic last updated: May 19, 2017.
https://www.uptodate.com/contents/radiation-therapy-of-pituitary-adenomas?source=search_result&search=radiotherapy&selectedTitle=11~150

Guidelines

Royal College of Radiologists

Introducing iRefer8 - updated diagnostic imaging guidelines for referring clinicians
Wednesday 24 May 2017
The Royal College of Radiologists is proud to unveil the newest version of its radiology guidelines entitled iRefer: Making the best use of clinical radiology, designed to help primary and secondary care clinicians choose the most appropriate imaging tests for patients.

https://www.rcr.ac.uk/posts/introducing-irefer8-updated-diagnostic-imaging-guidelines-referring-clinicians

Society and College of Radiographers

Diagnostic Radiography: A Survey of the Scope of Radiographic Practice 2015
The Scope of Practice Survey 2015 was conducted by the Society and College of Radiographers to garner information in order to update the Scope of Radiographic Practice Survey 2012 Report. The aim was to identify any practice developments over the past four years and to quantify the scope of current practice [Publisher].


Census of the Radiotherapy Radiographic Workforce in the UK, 2016
This report has been produced by the Society and College of Radiographers (SCoR). It is intended to update the UK national radiotherapy workforce annual surveys from 2010 to 2015. This report provides a summary of the UK radiotherapy radiographic workforce in the National Health Service (NHS) and private/independent healthcare sector [Publisher].

# Current Awareness Database Articles

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

- **Bladder filling and Image Guided Radiotherapy**

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

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1. **Associations between volume changes and spatial dose metrics for the urinary bladder during local versus pelvic irradiation for prostate cancer.**

   **Author(s):** Casares-Magaz, Oscar; Moiseenko, Vitali; Hopper, Austin; Pettersson, Niclas Johan; Thor, Maria; Knopp, Rick; Deasy, Joseph O; Muren, Ludvig Paul; Einck, John

   **Source:** Acta oncologica (Stockholm, Sweden); Jun 2017; vol. 56 (no. 6); p. 884-890

   **Publication Date:** Jun 2017

   **Publication Type:** Journal Article

   **Abstract:** BACKGROUNDEnter-fractional variation in urinary bladder volumes during the course of radiotherapy (RT) for prostate cancer causes deviations between planned and delivered doses. This study compared planned versus daily cone-beam CT (CBCT)-based spatial bladder dose distributions, for prostate cancer patients receiving local prostate treatment (local treatment) versus prostate including pelvic lymph node irradiation (pelvic treatment). MATERIAL AND METHODeventy-seven patients (N = 15 local treatment; N = 12 pelvic treatment) were treated using daily image-guided RT (1.8 Gy@43-45 fx), adhering to a full bladder/empty rectum protocol. For each patient, 9-10 CBCTs were registered to the planning CT, using the clinically applied translations. The urinary bladder was manually segmented on each CBCT, 3 mm inner shells were generated, and semi and quadrant sectors were created using axial/coronal cuts. Planned and delivered DVH metrics were compared across patients and between the two groups of treatment (t-test, p < .05; Holm-Bonferroni correction). Associations between bladder volume variations and the dose-volume histograms (DVH) of the bladder and its sectors were evaluated (Spearman's rank correlation coefficient, rs). RESULTSBladder volumes varied considerably during RT (coefficient of variation: 16-58%). The population-averaged planned and delivered DVH metrics were not significantly different at any dose level. Larger treatment bladder volumes resulted in increased absolute volume of the posterior/inferior bladder sector receiving intermediate-high doses, in both groups. The superior bladder sector received less dose with larger bladder volumes for local treatments (rs ± SD: -0.47 ± 0.32), but larger doses for pelvic treatments (rs ± SD: 0.74 ± 0.24). CONCLUSIONSSubstantial bladder volume changes during the treatment course occurred even though patients were treated under a full bladder/daily image-guided protocol. Larger bladder volumes resulted in less bladder wall spared at the posterior-inferior sector, regardless the treatment received. Contrary, larger bladder volumes meant larger delivered doses to the superior bladder sector for pelvic RT but smaller doses for local treatments.

   **Database:** Medline

2. **Dose tracking assessment for image-guided radiotherapy of the prostate bed and the impact on clinical workflow.**

   **Author(s):** Orlandini, Lucia Clara; Coppola, Marianna; Fulcheri, Christian; Cernusco, Luna; Wang, Pei; Cionini, Luca

   **Source:** Radiation oncology (London, England); Apr 2017; vol. 12 (no. 1); p. 78

   **Publication Date:** Apr 2017

   **Publication Type:** Journal Article

   Available in full text at Radiation Oncology - from EBSCOhost
Abstract: BACKGROUND The cumulative dose was compared with the planned dose among fourteen patients undergoing image-guided, intensity-modulated radiotherapy of the prostate bed. Moreover, we investigated the feasibility of adding dose tracking to the routine workflow for radiotherapy. METHODS Daily cone beam computed tomography was conducted for image-guided radiotherapy, and weekly cumulative delivered doses were calculated for dose tracking. Deformable image registration was applied to map weekly dose distributions to the original treatment plan and to create a cumulative dose distribution. The dose-volume histogram (DVH) cut-off points for the rectum and bladder and the planning target volume (PTV), were used to compare the planned and cumulative delivered doses. The additional time required by the departmental staff to complete these duties was recorded. RESULTS The PTV coverage of the delivered treatment did not satisfy the expected goal for three patients (V98% >98%). In another three patients, the DVH cut-off point for the bladder was higher than the limits, while for the rectum, treatment was as expected in all cases (two patients failed both their bladder constraints and the PTV coverage). Overall, four patients did not satisfy one or more criteria at the end of their treatment. CONCLUSION A well-defined strategy for dose tracking assessment is feasible, would have minimal impact on the workload of a radiotherapy department, and may offer objective information to support radiation oncologists in making decisions about adaptive procedures.

Database: Medline

3. Post-prostatectomy image-guided radiotherapy: The invisible target concept

Author(s): Vilotte F.; Bobin M.; Richaud P.; Thomas L.; Leduc N.; Sargos P.; Antoine M.; Latorzeff I.; Supiot S.; Guerif S.; Iriondo-Alberdi J.; de Crevoisier R.

Source: Frontiers in Oncology; Mar 2017; vol. 7

Publication Date: Mar 2017

Publication Type(s): Review

Abstract: In the era of intensity-modulated radiation therapy, image-guided radiotherapy (IGRT) appears crucial to control dose delivery and to promote dose escalation while allowing healthy tissue sparing. The place of IGRT following radical prostatectomy is poorly described in the literature. This review aims to highlight some key points on the different IGRT techniques applicable to prostatic bed radiotherapy. Furthermore, methods used to evaluate target motion and to reduce planning target volume margins will also be explored. Copyright © 2017 Vilotte, Antoine, Bobin, Latorzeff, Supiot, Richaud, Thomas, Leduc, Guerif, Iriondo-Alberdi, de Crevoisier and Sargos.

Database: EMBASE


Author(s): Mukherjee, A.; Rai, B.; Ghosal, S.; Robert, N.

Source: European Journal of Cancer; Feb 2017; vol. 72

Publication Date: Feb 2017

Publication Type(s): Academic Journal

Database: CINAHL

5. Impact of prone versus supine positioning on small bowel dose with pelvic intensity modulated radiation therapy

Author(s): Gonzalez V.J.; Hullett C.R.; Burt L.; Rassiah-Szegedi P.; Sarkar V.; Tward J.D.; Huang Y.J.; Salter B.J.; Gaffney D.K.; Hazard L.J.

Source: Advances in Radiation Oncology; Jan 2017

Publication Date: Jan 2017

Publication Type(s): Article In Press

Abstract: Purpose: To report the results of a prospective study that compares small bowel doses during prone
and supine pelvic intensity modulated radiation therapy. Methods and materials: Ten patients receiving pelvic radiation therapy each had 2 intensity modulated radiation therapy plans generated: supine and prone on a belly board (PBB). Computed tomography on rails was performed weekly throughout treatment in both positions (10 scans per patient). After image fusion, doses to small bowel (SB) loops and clinical target volume were calculated for each scan. Changes between the planned and received doses were analyzed and compared between positions. The impact of bladder filling on SB dose was also assessed. Results: Prone treatment was associated with significantly lower volumes of SB receiving >20 Gy. On average, prone on a belly board positioning reduced the volume of SB receiving a given dose of radiation by 28% compared with supine positioning. Target coverage throughout the treatment course was similar in both positions with an average minimum clinical target volume dose of 88% of the prescribed prone dose and 89% of the supine (P = .54). For supine treatment, SB dose was inversely correlated with bladder filling (P = .001-.013; P > .15 for prone). For 96% of treatments, the volume of SB that received a given dose deviated >10% from the plan. The deviation between the planned and delivered doses to SB did not differ significantly between the positions. Conclusions: Prone positioning on a belly board during pelvic IMRT consistently reduces the volume of SB that receives a broad range of radiation doses. Prone IMRT is associated with interfraction dose variation to SB that is similar to that of supine positioning. These findings suggest that prone positioning with daily image guided radiation therapy is an effective method for maximizing SB sparing during pelvic IMRT.

Database: EMBASE

6. Organ at risk dose in cervical cancer HDR Brachytherapy-Correlation between predicted dose on mri scan and calculated dose on CBCT

Author(s): Klitgaard D.; Juhler-Nottrup T.

Source: Brachytherapy; 2016; vol. 15

Publication Date: 2016

Publication Type(s): Conference Abstract

Abstract: Purpose: MRI based IGRT is widely used for cervical cancer brachytherapy. This allows individual dose planning taking into account both optimal target coverage and reduced dose to organs at risk. During the time gap between MRI and dose delivery the organs at risk may change shape and then alter the actual delivered dose. We hypothesize that the actual delivered dose to the organs at risk is a better predictor for toxicity than the predicted dose. Materials and Methods: The evaluated cases were obtained from our local brachytherapy database from 2013. Our doseschedule was based on EBRT 25 or 30 F, 2Gy/fx, 5f/w (all IMRT) and BT with HDR, 5F, 2f/w. Doseplanning aim for HR-CTV was D95>90Gy in EQD2. Our planning and algorithm was to make an MRI scan before the first treatment without an applicator for the purpose of a preplan. At the first treatment the preplanned dose was delivered and afterwards the patient was transferred immediately to the MRI scanner with the applicator in place. This MRI scan was used to evaluate if the preplan had sufficient target coverage and organ at risk sparing. Often modifications were made for the following four fractions. At every fraction immediately before treatment a CBCT was performed on the treatment couch with a C-arm. Contrast fluid was installed in the bladder (40 ml) and in the rectum (40 ml). The MRI scans and CBCT scans were imported into the Oncentra(TM) planning system. Organs at risk were contoured on the CBCT scan. All contours were made by the same observer. Results: 11 consecutive patients were evaluated retrospectively. Two patients only had an MRI scan without applicator and this scan was used for the predicted dose to OAR. Six patients had an MRI scan without applicator and one MRI with applicator at the first treatment. For these six patients the preplan was applied on the MRI with the applicator and the actual dose to OAR was measured for fraction no. 1. If the plan was adapted then the adapted dose to OAR was used to predict OAR dose for fraction no. 2, 3, 4 and 5. Three patients had additional MRI scans because plan modifications were needed and the doses to the OAR from the modified plans were used in the calculations. Nine patients had CBCT scans before each of the 5 fractions, two patients missed one CBCT due to malfunctioning of the equipment. In the attached graph the predicted dose from the MRI scans and the actual delivered dose to the OAR are depicted. The predicted median dose to the bladder was 88.1Gy, the actual dose was 81.4Gy, for all but two patients the predicted dose was higher than the delivered dose. The median difference in bladder dose was +9.2Gy. The predicted median dose to the rectum was 72.1Gy, the actual dose was 71.1Gy, there were an even distribution of over and under prediction of doses. The median difference in rectum dose was -0.4Gy. The predicted median dose to the sigmoid was 72Gy, the actual dose was 72.3Gy, there were an even distribution of over and under prediction of doses. The median difference in sigmoid dose was -0.3Gy. We found that bladder volume was very variable and might be the reason why the bladder dose was the most difficult to predict. Due to the small no. of patients and the retrospective design we did not correlate the toxicity to our findings. Conclusions: We found that predicted doses to rectum and sigmoid were closely correlated from planning MRI scans to CBCT at dose delivery in
HDR for cervical cancer. We also found that predicted doses to bladder were higher than actual delivered doses in HDR for cervical cancer. This study leads us to optimize our bladder filling protocol and we are redoing our measures using more reproducible settings combined with prospective evaluations of Patient Reported Outcomes. (Figure Presented).

**Database:** EMBASE

7. Bag and loop small bowel contouring strategies differentially estimate small bowel dose for post-hysterectomy women receiving pencil beam scanning proton therapy.

**Author(s):** Xu, Melody J; Kirk, Maura; Zhai, Huifang; Lin, Lilie L

**Source:** Acta oncologica (Stockholm, Sweden); Jul 2016; vol. 55 (no. 7); p. 900-908

**Publication Date:** Jul 2016

**Publication Type(s):** Comparative Study Clinical Trial Journal Article

**Abstract:** Background Small bowel (SB) dose-volume relationships established during initial computed tomography (CT) simulations may change throughout therapy due to organ displacement and motion. We investigated the impact of organ motion on SB dose-volume histograms (DVHs) in women with gynecologic malignancies treated with pencil beam scanning (PBS) proton therapy and compared PBS SB DVHs to intensity-modulated radiation therapy (IMRT). Material and methods Post-hysterectomy patients (n = 11) treated for gynecologic cancers were enrolled on an image-guided proton therapy protocol involving CT simulation with full (CTF) and empty (CTE) bladders and weekly/biweekly on-treatment scans. IMRT plans were generated for comparative analysis. SB was contoured as bowel loops or bowel bag. Wilcoxon signed-rank tests were used for matched-pair comparisons of SB, bladder, and rectum dose-volumes between CT scans and between PBS and IMRT plans. Results In PBS loops analysis, on-treatment DVH was significantly higher than CTF for doses <45 Gy (p < 0.05), and not significantly different than CTE. Specifically, V15 for loops was higher on-treatment (median 240 cm(3)) compared to CTF (median 169 cm(3), p = 0.03). In PBS bag analysis, on-treatment DVH was not significantly different from CTF across all dose ranges. Bowel bag V45 was not significantly different between on-treatment (median 540 cm(3)) and CTF (median 499 cm(3), p = 0.53). Decreasing bladder volume was associated with increasing V15 for loops and V45 for bowel bag (p < 0.005, both). Comparing PBS and IMRT, PBS resulted in significantly lower DVHs at low dose regions (<38 Gy) and higher DVHs at high dose regions (42.5-45.5 Gy) in both loops and bag analysis. IMRT plans demonstrated higher on-treatment SB loop DVHs and only minimal differences in bowel bag DVHs compared to CTF. Conclusions SB DVHs were well estimated by CTF bowel bag and underestimated by CTF loops in the setting of inconsistent bladder filling. Verifying bladder filling prior to treatment or using CTE for planning may more conservatively estimate SB dose-volume relationships.

**Database:** Medline

8. Plan of the day approach in post prostatectomy radiation therapy

**Author(s):** Lac C.; Sims A.; Eade T.; Kneebone A.

**Source:** Radiotherapy and Oncology; Apr 2016; vol. 119

**Publication Date:** Apr 2016

**Publication Type(s):** Conference Abstract

**Abstract:** Purpose or Objective: Our primary aim is to investigate the frequency of using smaller margins for post prostatectomy radiotherapy (RT) in conjunction with daily soft tissue image guided radiotherapy (IGRT). Our secondary aim is to assess the feasibility of implementing an adaptive, ‘plan of the day’, treatment approach by selecting an appropriate plan on a daily basis which will highly conform to the target and minimise rectal and bladder toxicities. Material and Methods: Retrospectively identified 19 post prostatectomy patients. Soft tissue matching guidelines were created and split into two categories; patients with or without surgical clips. Soft tissue match was performed on cone-beam CT (CBCT) in offline review program by two radiation therapists and reviewed by two radiation oncologists. The frequency of geographic miss was measured using a planning target volume (PTV) small with a 5 mm clinical target volume (CTV) expansion and PTV large with 10 mm (15 mm anteriorly) CTV expansion. To implement a ‘plan of the day’ treatment approach, a post prostatectomy soft tissue training module was developed to educate the radiation therapists to perform daily soft tissue alignment. Radiation therapists will then apply an adaptive RT regime that selects from a plan library to account for internal organ inconsistencies of the bladder and rectum. Results: A total of 135 CBCTs were reviewed on 19 radical post prostatectomy patients including those with lymph node involvement. Retrospective soft tissue match analysis determined that PTV small covered the target for 84% of CBCTs while the PTV large covered
the target for 16%. There was no geographic miss outside PTV large in this retrospective analysis. In the matches that resulted in the selection of PTV large, 12% of CBCTs were due to variations in bladder filling and 4% from rectal filling. Conclusion: PTV small is suitable for use on most CBCTs with PTV large selected for only a small portion of CBCTs. Very small bladders caused a greater amount of bladder and small bowel to fall in the target and increases the chance of side effects but rarely causes a geographic miss. Over filling bladders on CBCTs was undesired as it caused internal pelvic tilt in the superior portion resulting in a selection of the plan with PTV large. A dangerous combination is present if there are inconsistencies to both the bladder and rectum filling causing the CTV prostate bed region to tilt and fall outside of the target. With a high frequency of using PTV small, and a better understanding of the effect of bowel and bladder filling, implementation of 'plan of the day' is feasible. This will result in a highly targeted treatment delivery in conjunction with soft tissue IGRT that will reduce toxicities and increase local control.

**Database:** EMBASE

**9. Effect of daily variation in rectal and bladder filling: An analysis of planned versus actual dose**

**Author(s):** Abhishek A.; Kataria T.; Gupta D.; Ghosh T.; Basu T.; Bisht S.; Goyal S.; Tayal M.; Ramu M.

**Source:** Radiotherapy and Oncology; Apr 2016; vol. 119

**Publication Date:** Apr 2016

**Publication Type(s):** Conference Abstract

**Abstract:** Purpose or Objective: In the era of Image guided radiotherapy (IGRT), ensuring accurate delivery of planned high dose is very important. Daily variations in organ volume may result in difference between planned and actual dose delivered to an organ. In the present study we planned to analyze the daily variations in bladder and rectal filling and its effect on actual dose delivered when compared with original planned dose. Material and Methods: Five consecutive cases of carcinoma prostate, who recently concluded their IGRT, were selected for the study. All cases were high risk prostate cancer, planned for radical IGRT for a dose of 50 Gy in 25 fractions to prostate and pelvic nodes, followed by Cyberknife boost for 3 fractions. Daily cone beam CT - XVI (X-ray volume imaging) acquired during daily treatments for each patient was exported to planning systems and after fusion with original planning CT, daily bladder and rectal contours were delineated on each 125 scans (B1-B25 and R1 - R25). Using superimposition of all new 250 contours on respective original plan, dose delivered daily to partial volumes of these organs was recorded using new actual DVH (dose volume histogram) and then statistically compared with their respective original bladder and rectal (B0 and R0) DVH using SPSS v18. Results: Even with strict bladder and rectal protocols, daily volumes varied in all individual cases. The range of bladder volume variation (B1-B25) recorded for 5 cases were: 30.7%- 211.1%, 26.9%-119.1%, 27.8%-107.2%, 15.4%-305.8% and 27% - 92.6% of B0, respectively. Overall actual mean volumes were within 25% variation range (mean actual 76% of B0). For rectum, R1-R25 volumes varied from 30.9%-205.9%, 47.5%- 155.1%, 33.8%-150.2%, 44.6%-208.1% and 43.4%- 140.2%, of R0, respectively. Overall mean actual rectal volume were very similar to original rectal volume (101.6% of R0). Overall actual bladder dose (D1-D25) was lesser than original bladder (D0) dose. Statistically significant lower actual mean dose (range 13 to 30%) was observed when recorded for 25cc to 85 cc of bladder volume (p<0.05). For lower volumes less than 20 cc, difference was not significant. For rectum, difference between delivered and planned dose was statistically non significant for any volume. A comparison of volume to dose data showed a difference in planned and mean actual V15, V20 and V25 for bladder and V5 to V30 for rectum, which was statistically significant (p< 0.05). Conclusion: Strict bladder and rectal protocols both for simulation and delivery is important in planning pelvic radiotherapy due to physiological variations in their daily volumes. Exact duplication of bladder and rectal volumes is difficult, however by using image guidance and ensuring at least 25% concordance of daily with original planning volumes of these organs, possible differences in actual delivered dose can be mitigated and accurate delivery of planned dose can be ensured.

**Database:** EMBASE

**10. Implementation and clinical use of a digital log regarding the Traffic Light Protocol in daily IGRT**

**Author(s):** Verhage R.; Van Beek S.; Smit A.; Broekhof M.; Remeijer P.

**Source:** Radiotherapy and Oncology; Apr 2016; vol. 119

**Publication Date:** Apr 2016

**Publication Type(s):** Conference Abstract

**Abstract:** Purpose or Objective: With the introduction of a decision protocol for anatomical changes as observed on ConebeamCT (CBCT) images (traffic light protocol (TLP)), data such as, for example, actions in response to
certain anatomical changes have been recorded in the open text area of the patient's electronic treatment chart on a daily basis. Recording the data in this way is manageable for keeping track of changes during a treatment, but this method cannot easily be used for retrospective analysis for e.g. research purposes. Therefore, we have introduced a dedicated digital TLP log within the patient's dossier, that enabled a clear and structured overview of the information gathered from the CBCT scans. In a retrospective study, the efficacy of this log was evaluated. Material and Methods: The TLP digital log was implemented and accommodated in the Mosaic Oncology Information Management System. The log contains a separate format for each of the major target areas on which the TLP is used and does not contain any free text entry fields. For every CBCT acquisition a log entry is created. Within the log the user can register the relevant anatomical changes seen on the CBCT, by using drop down lists with fixed entries (e.g. bladder filling or tumour regression and the action taken (see figure). The actions are categorised by colour: Green (no action), Yellow (notification of the Medical Doctor (MD) optional), Orange (action needed by the MD before next fraction) and Red (immediate action needed from the MD). During the period of data gathering the digital TLP was made available for five target areas: Breast, Sarcoma, Lung, Gynaecology and Urology. The digital log was retrospectively evaluated on 120 patients (40 for urology, 20 for all other target areas) with a CBCT imaging protocol treated from January 2013 to December 2013. The use of the digital log in clinical practice was evaluated using a questionnaire filled in by the RTTs. During the data gathering, a total of 1806 CBCT scans were reviewed and registered in the digital log. All of these scans were assessed with the TLP to determine the course of action. In this period, all action codes were registered and recorded. Results: Using the digital log, the data concerning the TLP can be stored in a structured way, rather than in open text parts of a patient's dossier. The action codes regarding the anatomical changes that are present in the log showed a clear overview of possible variations during treatment. The RTTs scored an average of 7.8/10 in the questionnaire on the digital log overview. In succession, this overview showed a clear course of action regarding these anatomical changes using the TLP. Conclusion: The implementation and use of a digital log improves the overview of the anatomical changes observed on CBCT during radiotherapy. Moreover, the data gathered within the log can retrospectively be used for clinical or research questions regarding clinical IGRT decisions for a specific target area. (Table presented).

**Database:** EMBASE

11. Organ motion: Is it an obstacle to the use of IMRT as a standard technique for gynecological cancers?

**Author(s):** Barillot I.

**Source:** Radiotherapy and Oncology; Apr 2016; vol. 119

**Publication Date:** Apr 2016

**Publication Type(s):** Conference Abstract

**Abstract:** Intensity-modulated radiotherapy (IMRT) has been introduced in a number of diseases in the late nineties for treating complex treatment volumes and avoiding close proximity organs at risk (OAR) that may be dose limiting. Fifteen years later, in many countries, IMRT is still not considered as a standard technique for treating gynaecological cancers. It is well accepted that, if reducing acute and chronic toxicity are the main endpoints, IMRT may be considered as the ideal technique. By contrast, if disease-related outcomes are considered, there are still insufficient data to recommend IMRT over three-dimensional conformal radiotherapy. Moreover, with the increased accuracy of treatment delivery comes the need for greater accuracy in incorporation of organ motion to prevent geographical misses. Uterus significantly moves according to the bladder and rectal filling. The majority of motion occurs in the anterior-posterior and superior-inferior directions, with mean interfraction movements of 4–7 mm, but very large displacements up to more than 2 cm may occur with the inherent risk of poor coverage of the posterior part of the cervix or of the uterine fundus. Similarly, during postoperative irradiation, the vaginal CTV changes its position with standard deviation of 2.3 cm into the anterior or posterior direction, 1.8 cm to left or right and 1.5 cm towards the cranial. According to the majority of studies a uniform CTV planning treatment volume margin of 15 mm would fail to encompass the CTV in 5% of fractions in post-op. It rises up to 32%, when the CTV includes the entire uterus. For intact cervical cancer, where gross disease is present, the significant shrinkage in tumour volume of 62% in mean, also contributes to potential unintended doses to normal tissues, but the risk is rather low. How to deal with motion uncertainties? It can be helpful to attempt to control rectum and bladder filling, although the compliance with instructions for bladder filling and for rectal emptying does not always result in adequate reproducibility. The construction of an ITV from CT images acquired with empty and full bladder is also another way to account for interfraction motion of the CTV. The implementation of IGRT on a daily basis is essential for judging the effectiveness of the measures previously outlined. However, one must never forget that the cervix or vaginal cuff and surrounding tissues are mobile relative to the bony pelvis, while the pelvic lymph nodes which are also part of the target are relatively fixed. Thus, the shifts to account for motion of the mobile target may move the pelvic lymph nodes out of the PTV. Consequently, care should be taken when shifting to ensure that nodal
targets are still within PTV, but keeping CTV to PTV margins to 10-15 mm helps to find a good compromise without jeopardizing the OAR’s sparing. The risk of geographical misses does exist, but its level must be appreciated in the light of the dose contribution brought by the additional brachytherapy. Brachytherapy still plays a major role in the treatment of cervix carcinomas. The important dose gradient and the absence of target movements in relation to the inserted radioactive sources allow for dose escalation and 3D image guided adaptive procedure allows for accurate definition of target volumes with definition of dose volume parameters. Consequently a moderate under dosage of a part of CTV during IMRT may be compensated by the high dose delivered by brachytherapy. The concept of adaptive IMRT seems to be applicable for the management of the complex deformable target motion that occurs during radiation of gynecological cancers. The cervix-uterus shape and position can be predicted by bladder volume, using a patient-specific prediction model derived from pre-treatment variable bladder filling CT scans. Based on that, a strategy called “plan of the day” has been elaborated and is under investigation. In conclusion, organ motion is not an obstacle to the use of IMRT as standard technique for gynecological cancer, especially when combined with brachytherapy, provided that PTV margins are not reduced and IGRT is adequately used. The participation to prospective studies and/or the registration of patients in database are strongly encouraged.

**Database:** EMBASE

### 12. 3D-Transabdominal Ultrasound and ConeBeam-CT: Comparison of prostate positioning

**Author(s):** Boschetti A.; Bartoncini S.; Fiandra C.; Cavallin C.; Arcadipane F.; Trino E.; Levis M.; Ragona R.; Ricardi U.; Guaneri A.

**Source:** Radiotherapy and Oncology; Apr 2016; vol. 119

**Publication Date:** Apr 2016

**Publication Type(s):** Conference Abstract

**Abstract:** Purpose or Objective: External beam radiotherapy (EBRT) is a mainstay therapeutic option for prostate cancer and hypofractionated schedules were proposed as a suitable approach. Image guidance procedures are strongly needed to provide adequate accuracy precision, minimize geometric uncertainties and further diminishing unintended normal tissue irradiation. The Elekta ClarityTM platform allows the acquisition of three-dimensional ultrasound scans (3DUS) of the pelvic regions to perform image-guided radiotherapy. In our department, 3DUS is the reference IGRT modality and is used into daily clinical practice for prostate cancer radiotherapy (since from 2009) with optimal clinical results in terms of biochemical control and a good toxicity profile on 160 patients. Moreover 3DUS is a non invasive method with avoidance of extra radiation. In this study 3DUS was compared to grey-based positioning in kilovoltage Cone-Beam Computed Tomography (CBCT) during radiotherapy sessions. Material and Methods: 10 patients affected with organconfined prostate cancer were included. All patients should have a reliable ultrasound visualization of the prostate gland within the Clarity Platform. All patients received 61.1 Gy/26 fractions to the prostate gland and seminal vesicles and 70.2 Gy/26 fractions to the only prostate gland. The prostate positioning was controlled by 3DUS and CBCT. Patients were aligned to skin marks before all of the 260 treatment sessions. Control of the remaining inter-fractional setup error by 3DUS was successfully employed 147 times. During the remainder of fractions, insufficient bladder filling and patient movement were the most frequent obstacles to 3DUS. In total, 210 3DUS scans were compared to CBCT. Results: The average differences in the anterior-posterior (AP), superior-inferior (SI) and lateral (LL) directions from CBCT were 0.25+/-.053 cm, -0.08+/-.052 cm, -0.16+/-.057 cm for 3DUS. Student’s t-test was used to test the difference between this US modality against CBCT and the distribution of the differences is reported in Figure 1. Conclusion: Based on the obtained results, significative differences with CBCT were found in all directions. However the average value of the differences is always less than 3 mm in all directions. Differences greater than 1 cm were observed in the AP direction (5%) showing that CBCT imaging modality is not safely interchangeable with 3DUS. (Figure Presented).

**Database:** EMBASE

### 13. Assessment of PTV margins accounting for prostate intrafraction motion in SBRT with online IGRT

**Author(s):** Magli A.; Titone F.; Malisan M.R.; Crespi M.; Guernieri M.; Moretti E.; Foti C.; Fontanella C.; Sacco C.T.

**Source:** Radiotherapy and Oncology; Apr 2016; vol. 119

**Publication Date:** Apr 2016

**Publication Type(s):** Conference Abstract

**Abstract:** Purpose or Objective: There is little consensus on the magnitude of PTV margins for IGRT of the
prostate cancer when a hypofractionation scheme is applied and daily correction is required, rather than averaging over many fractions. The aim of this work was to assess PTV margins suitable for SBRT of prostate cancer uncertainties after daily online correction. Moreover, intra-fraction prostate motion is analyzed with the aim to identify its main causes (bladder filling, rectum distension, elapsed treatment time). Material and Methods: Between 2013 and 2014, 43 patients with low or intermediate risk prostate cancer were treated with 7-fraction SBRT in supine position, with implanted fiducial markers (FM), empty rectum and full bladder. To reduce organ motion, patients were premedicated with butylscopolamine and rectum gas was removed before the treatment. At each session pre-treatment kV/kV imaging was acquired to align the patient by matching the FM's, while additional CBCT imaging was performed after treatment delivery to assess the intra-fraction motion. The van Herk's formula was applied to calculate the PTV margins of prostate/seminal vesicles. To investigate the causes of organ motion, the bladder volume and the rectum wall distension were estimated from each CBCT with respect to the simulation CT images. Correlation between these anatomical factors and intrafraction PTV motion was assessed for each axis, as well as for the composite shift of the prostate volume. The treatment time elapsed from pretreatment kV/kV to post-treatment CBCT imaging was also included in the statistical analysis. Results: 301 pre-treatment kV/kV images and 301 posttreatment CBCTs were analyzed. After daily IGRT correction, margins accounting for residual uncertainties are estimated 3 mm for AP, 3 mm for Longitudinal axis and 2 mm for Lateral intra-fraction motion. A systematic increase of bladder filling with respect to simulation images was observed; however, these changes did not influence the prostate displacement (p = 0.55). Similarly, variations of the prostate position occurred independently from changes of the rectal distension (p = 0.32). A trend between internal prostate motion in the AP direction and elapsed treatment was observed (p = 0.057). Finally, a significant correlation was observed between the intrafraction composite shift of the prostate volume and the elapsed treatment time (p = 0.036). Conclusion: Our data suggest a good control of intrafraction motion with butylscopolamine medication and by careful emptying of the rectum before treatment. The prostate intrafraction motion is shown to be dependent on elapsed treatment time. In conclusion, in image-guided SBRT with online correction, PTV margins can be kept in the range of 3 mm provided that the elapsed treatment time is kept as low as possible.

Database: EMBASE

Author(s): Botti A.; Palorini F.; Carillo V.; Improta I.; Fiorino C.; Gianolini S.; Iotti C.; Rancati T.; Cozzarini C.
Source: Radiotherapy and Oncology; Apr 2016; vol. 119
Publication Date: Apr 2016
Publication Type(s): Conference Abstract
Abstract:Purpose or Objective: Bladder is a hollow and flexible organ exposed to high doses in RT for prostate cancer. Its absorbed dose can be properly described by the dose surface maps (DSM) however, due to its flexible nature, the discrepancy between the planned dose and the dose absorbed during the treatment is a major issue. Present work aims at verifying the robustness of DSMs relative to the daily inter-fraction movement of bladder during RT of prostate cancer. Material and Methods: 18 patients treated with moderately hypofractionated Tomotherapy were considered (prescription of 70 Gy at 2.5 Gy/fraction in 28 fractions and full bladder). All patients underwent daily Image Guided Radiotherapy (through MVCT) with rigid registration on the prostate. After matching, bladder contours were delineated on each MVCT by a single observer and copied on the planning CT: the planned dose distribution was employed to generate DSMs. For each patient, the bladder DSMs from the planned treatment and from each fraction were then computed by unfolding the bladder contours on a 2D plane: they were anteriorly cut at the points intersecting the sagittal plane passing through the center of mass. The DSMs were then laterally normalized and aligned at the bladder base, while cranially they were cut at the minimal extension of the planned DSMs. Discrepancies between planned and treatment DSMs were analyzed through the average map of individual systematic errors, the map of population systematic errors (standard deviation of individual systematic errors) and that of population random errors (average of individual random errors) of dose. Results: 472 normalized DSM were considered (cranial extension 34 mm): the mean number of available daily MVCTs was 25 (18-28) per patient. The Figure shows the average planned map (panel A), the average map of individual systematic errors (B), the map of population systematic errors (C) and that of population random errors (D). Two main regions can be recognized: 1) the central posterior bladder base (light/dark blue in D) and 2) the region that surrounds it, involving the lateral and the more cranial portion of bladder (orange/red in D). Region 1), which absorbs the highest doses (see A), appears to be the most stable one during the treatment: panel B shows mean values between ~1 Gy and 1 Gy in region 1) and around 2-3 Gy in 2). Population systematic (C) and random errors (D) are below 4 and 3 Gy respectively in region 1), while they reach values between 6-11 Gy and 5-7 Gy, respectively, in 2). (Figure Presented) Conclusion: The results show
that DSMs are quite stable with respect to changes occurring during daily IGRT for prostate cancer in the high-dose region, in the first 1-2 cm from bladder base. Larger systematic variations occur in the anterior portion and cranially 2.5-3.5cm from the base: these effects may be due to systematic differences in bladder filling and to systematic shifts of bladder base between planning and treatment.

Database: EMBASE

15. A retrospective evaluation of the feasibility of automatic prostate matching in IGRT

Author(s): Campbell Z.; Mullaney L.; O'Neill B.; O'Sullivan L.; Keaveney M.
Source: Radiotherapy and Oncology; Apr 2016; vol. 119
Publication Date: Apr 2016
Publication Type(s): Conference Abstract

Abstract: Purpose or Objective: The current practice for prostate localisation in some centres is an automatic match to the bony anatomy of the pelvis. The prostate moves independently of bone and so its true motion may not be accounted with this method. An automatic match to the prostate may be more accurate. The purpose of this research it to identify if automatic prostate matching is more accurate than automatic bony matching and assess the impact on CTVPTV planning margins. Material and Methods: A retrospective review of CBCT data for 30 consented prostate patients was undertaken (9 CBCT each, n=270). All patients followed a bladder filling and rectal emptying protocol. Using Varian's On-Board Imager software, the random; systematic and population mean translational shifts was calculated based on 3 different registration techniques: automatic bone matching; automatic bone matching followed by an automatic volume of interest (VOI) match using CTV and an expert manual CTV match (gold standard). A comparison was made of the CTV-PTV margins required for the two automatic registration methods. Results: No significant difference in the mean translational shifts was reported between the automatic bone match and gold standard match. A significant difference was seen between the population mean shift of the gold standard match and the automatic prostate match in the anteroposterior direction only (p=0.007). A larger CTV-PTV margin was required for the automatic prostate match when compared with the automatic bone match. Conclusion: Automatic bone matching is comparable to expert manual matching in this patient group. Automatic prostate matching is not as accurate in the anteroposterior direction and does not allow for a reduction in planning margins. (Table Presented).

Database: EMBASE

16. Drinking instructions does not significantly influence interfraction bladder volume stability

Author(s): Berg M.; Thellesen K.; Jensen H.; Wee L.; Nielsen L.M.; Wasilevska H.
Source: Radiotherapy and Oncology; Apr 2016; vol. 119
Publication Date: Apr 2016
Publication Type(s): Conference Abstract

Abstract: Purpose or Objective: Bladder preparatory protocols are used in prostate cancer (PCa) radiotherapy (RT) prior to simulation (Sim) imaging, and thereafter prior to each fraction of RT. Patients are asked to drink, and hold without voiding, a constant volume of water. Distension of the bladder reduces the volume of the bladder irradiated to high doses. A study of online image-guided radiotherapy (IGRT) in bladder cancer showed that inter- and intra-fraction reproducibility was mostly insensitive to degree of bladder filling. Radiographer students were asked to test the analogous hypothesis for inter-fraction reproducibility in bladder volume over 7 weeks of PCa IGRT. Material and Methods: An audit of PCa IGRT found 96 cases within 1 year of study commencement. 56/96 were locally advanced PCa homogeneously treated with bladder preparation instructions, daily online cone-beam CT (CBCT) verification and 28Gy sequential boost to gland only following 50Gy to gland plus seminal vesicles by normo-fractionated IMRT. 42 were complete cases in which bladders had been consistently outlined at Sim and 7 CBCTs weekly. 30/42 men agreed to hold 300mL of water each session, but in practice only 26/42 were able to comply throughout treatment. 12/42 men declined the drinking instructions outright. Results: Sim and weekly CBCT volumes were tested for nonnormality and leverage. 4 men had Sim volumes that were well in excess of 500mL, and by mid-course, had greatly reduced. The extreme cases exerted strong leverage. In 38 men, bladder volumes were log-normally distributed. Compliant men had bladder volumes (162 mL) statistically significantly larger (p 500mL). Volumes at Sim are statistically significantly different between groups, so there may be implications for dose planning. We have proposed a follow-on project to measure the effect of changing the drinking instructions, so men are advised to drink and practice holding as much water as they can comfortably tolerate without voiding for 1 hour.

Database: EMBASE
17. Assessment of Uterine Fundus Coverage with IGRT using daily CBCT in cervical cancer

Author(s): Ozen Z.; Kayalilar N.; Arifoglu A.; Gunhan B.; Ibrahimov R.; Karakose F.; Gurdalli S.; Abacioglu M.U.

Source: Radiotherapy and Oncology; Apr 2016; vol. 119

Publication Date: Apr 2016

Publication Type(s): Conference Abstract

Abstract: Purpose or Objective: Inclusion of uterine fundus in the pelvic CTV for definitive treatment of cervical cancer is controversial. We aimed to demonstrate the fundus coverage by using daily CBCT with a rigorous bladder filling protocol. Material and Methods: Five patients with cervical cancer without uterine fundus involvement were scanned by 2.5 mm slice thickness CT after a 30 minute, 500 cc water consumption. PET/CT and MR fusion was performed to delineate GTV and used as surrogates to see the potential motion of uterus at different imaging modalities due to bladder and rectal fillings. CTV1 was contoured to include GTV+cervix+uterus modified to be covered in simulation CT, PET/CT and MR. PTV margin of 15 mm was added according to guidelines. VMAT IMRT plans were performed to give 45 Gy in 25 fractions. Image guidance with daily kV CBCT was performed on TrueBeam STx and Trilogy linacs (Varian, Palo Alto) throughout the external phase of the treatment, which was followed by HDR brachytherapy. When the CTV1 was missed on CBCT, the bladder filling was modified accordingly; CBCT was repeated and treated after ensuring the coverage. Results: Uterine fundus was contoured on a total of 125 CBCT images of 5 patients. Overall on 24 of 125 fractions (19.2%) CTV1 was out of PTV. Mean volume of CTV1 out of PTV was 0.92 cc (range 0.02-2.78 cc). Mean Dmin for fundus was 133 cGy when the CTV1 was out of PTV, while it was 176 cGy when CTV1 was covered on CBCT. Conclusion: Although the inclusion of the uterine fundus in the CTV for the definitive treatment of cervical cancer without fundus involvement is controversial, potential microscopic spread is a concern. Rigorous bladder filling is a way to minimize the interfraction motion of the uterus, however daily image guidance with CBCT still showed a residual replacement of the uterus in up to one fifth of the fractions in this study. Further studies on managing this problem like adaptive treatment by using plan of the day concept to cover the CTV are ongoing.

Database: EMBASE

18. Bladder dose-surface maps and urinary toxicity: Robustness with respect to motion in assessing local dose effects

Author(s): Palorini F.; Carillo V.; Improta I.; Fiorino C.; Botti A.; Gianolini S.; Iotti C.; Rancati T.; Cozzarini C.

Source: Physica Medica; Mar 2016; vol. 32 (no. 3); p. 506-511

Publication Date: Mar 2016

Publication Type(s): Article

Abstract: The purpose of this study was to quantify the impact of inter-fraction modifications of bladder during RT of prostate cancer on bladder dose surface maps (DSM). Eighteen patients treated with daily image-guided Tomotherapy and moderate hypofractionation (70-72.8 Gy at 2.5-2.6 Gy/fr in 28 fractions and full bladder) were considered. Bladder contours were delineated on co-registered daily Megavoltage CT (MVCT) by a single observer and copied on the planning CT to generate dose-volume/surface histograms (DVH/DSH) and bladder DSMs. Discrepancies between planned and daily absorbed doses were analyzed through the average of individual systematic errors, the population systematic errors and the population random errors for the DVH/DSHs and DSMs. In total, 477 DVH/DSH and 472 DSM were available. DSH and DVH showed small population systematic errors of absolute surfaces (2) and volumes (3) at the highest doses. The dose to the posterior bladder base assessed on DSMs showed a mean systematic error below 1 Gy, with population systematic and random errors within 4 and 3 Gy, respectively. The region surrounding this area shows higher mean systematic errors (1-3 Gy), population systematic (8-11 Gy) and random (5-7 Gy) errors. In conclusion, DVH/DSH and DSMs are quite stable with respect to inter-fraction variations in the high-dose region, within about 2 cm from bladder base. Larger systematic variations occur in the anterior portion and cranially 2.5-3.5 cm from the base. Results suggest that dose predictors related to the high dose area (including the trigone dose) are likely to be sufficiently reliable with respect to the expected variations due to variable bladder filling. Copyright © 2016 Associazione Italiana di Fisica Medica.

Database: EMBASE
19. Prostate movements analysis during radiotherapy using volumetric intraprostatic gold coils information

**Author(s):** Miceli R.; Ingrosso G.; Ponti E.; Di Cristino D.; Lancia A.; Santoni R.; Bove P.L.; De Pasquale F.

**Source:** Physica Medica; Feb 2016; vol. 32

**Publication Date:** Feb 2016

**Publication Type(s):** Conference Abstract

**Abstract:**

**Introduction:** We analyzed the correlation between prostate movements and rectum and bladder filling during the treatment course.

**Materials and Methods:** Ten patients affected by prostate cancer underwent image-guided radiotherapy using CBCTs, after the insertion of 3 intraprostatic fiducial markers (FMs). All patients underwent planning CT and radiotherapy with empty rectum and full bladder. Planning CTs (CTref), compared to CBCTs, were used to estimate the reference intermarker distances. For every patient, after the registration between CTref and CBCTs, FMs, rectum and bladder were contoured. We recorded the centre of mass (CM) coordinate of each FM, and computed the differences between the coordinates (x, y, z) of the CM for each respective FM of the two studies: CTref and CBCT. In order to check the dependence between the prostate shift and rectal and bladder volumes we computed a Pearson correlation coefficient and a linear regression analysis.

**Results:** 120 CBCTs were analyzed. The mean of prostate displacements (+/-SD) along the three axes averaged over the 10 patients, and evaluated by the shifts of the FMs, were: 0.90 +/- 0.84 mm in x, 0.00 +/- 2.07 mm in y, -0.80 +/- 1.28 mm in z; absolute shifts were: 1.20 +/- 0.65 mm in x, 2.10 +/- 0.71 mm in y, 1.50 +/- 0.80 mm in z. We obtained significant shifts in the left-right direction (x) in 4 patients (+1 / +2.7 mm), in the anterior-posterior direction (y) in 5 patients (-2.8 / +2.7 mm), and in the superior-inferior direction (z) in 4 patients (-3.5 / +1 mm). Using the Pearson correlation and the linear regression analysis, we obtained the following statistically significant anti-correlation: in the y-axis, between prostate displacements and bladder volume variations (p < 0.001); in the z-axis, between prostate displacements and rectal volume variations (p < 0.05).

**Conclusions:** In empty rectum conditions, prostate displacements are minimal, oriented in the y direction, and are mainly due to bladder volume changes.

**Database:** EMBASE
Exercise: Creating a Search Strategy

Scenario: A 64 year old obese male who has tried many ways to lose weight presents with a newspaper article about ‘fat-blazer’ (chitosan). He asks for your advice.

1. What would your PICO format be?

<table>
<thead>
<tr>
<th>Population/problem</th>
<th>Intervention/indicator</th>
<th>Comparator</th>
<th>Outcome</th>
</tr>
</thead>
</table>

2. What would your research question be?

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