of the Yorkshire Cancer Network. PPM, an in-house electronic patient record, has recorded all cancer treatment delivered since 2003 and through links to local and national demographic services is able to relate this to patient outcome. PPM was therefore used to identify patients undergoing external beam radiotherapy in which treatment intent was recorded as radical, adjuvant or palliative. Median survival and cumulative mortality at 7, 14, 30, 60 and 90 days was calculated with comparisons made by year of treatment, treatment intent and the number of fractions of radiotherapy used.

Results: Between Jan 2004 and Dec 2010 a total of 40,607 courses of radiotherapy were delivered with validated survival data on 40,593 (99.9%). Treatment intent was recorded as radical, adjuvant and palliative in 12,045 (30%), 11,757 (29%) and palliative 16,791 (41%) respectively. Median survival and cumulative mortality for each subgroup is shown in the table.

Intent	Median survival (months)	Cumulative mortality (%) at time point (days)				
		7	14	30	60	90
Radical	58 months	0.1	0.3	1.1	3.0	4.8
Adjuvant	85.3 months	0.0	0.0	0.2	0.8	1.7
Palliative	5.1 months	1.3	4.4	12.0	24.5	34.2

No significant differences were observed between each treatment year. The observed 30 day mortality for palliative patients according to fractions received was 16.1% for a single, 9.0% for 2−5, 3.7% for 6−10 and 2.4% for 11−20 fractions respectively.

Conclusions: This large dataset demonstrates reassuringly low 90 day mortality for radical and adjuvant patient groups. The 30 day mortality for palliative patients and the subset analysis of mortality by fractions given, supports appropriate selection of patients for palliative radiotherapy.

2036 POSTER

Voxel Based Analysis of Dose for Prediction of Urinary and Rectal Toxicity in Prostate Cancer Radiotherapy

O. Acosta[1], G. Dréan[1], J.D. Ospina[1], A. Simon[1], P. Haigron[1], R. De Crevoisier[2]. *[1]LTSI, Laboratoire du Traitement du Signal et de l'Image − INSERM U 642, Rennes, France; [2]LTSI − Département de Radiotherapie − Centre Eugène Marquis, Laboratoire du Traitement du Signal et de l'Image − INSERM U 642, Rennes, France*

Background: In prostate cancer radiotherapy the models for prediction of side effects on the ogans at risk (bladder, rectum) are traditionally based on the dose volume histograms (DVH), (NTCP) computed at an organ-basis during the planning step. However, since these models lack spatial accuracy, they may be inappropriate to explain toxicity events related with the local distribution of the dose.

Purpose: To investigate the relationship between toxicity events in bladder (GRAD>2 in two years) and rectum (bleeding in two years) and the dose spatial distribution in prostate cancer radiotherapy. We propose a new voxel based statistical analysis framework, including a non rigid mapping of 3D dose distributions to a common template.

Methods: We selected 121 prostate cancer patients treated with external radiotherapy. Clinical outcomes (rectal bleeding and urinary toxicity GRAD>2) within a two year follow up and 3D dose distributions were available. For each patient the dose was computed on the 512x512x256 pelvic CT scans, using the manual delineations, according to the standard clinical protocol. We first mapped the organs and the dose to a common template using a hybrid organ/intensity non rigid registration method, allowing to align barycentres and neighbouring structures across the population. Finally, two sample t-tests were performed at a voxel-basis leading to the computation of three dimensional maps for both, the dose differences and the p-values. Two comparisons were performed, namely rectal bleeding (20 individuals) vs non bleeding (44 individuals) and urinary toxicity(21 individuals) vs non toxicity (51 individuals). Anatomical regions were the differences were statistically significant were identified and correlated with the corresponding toxicty event.

Results: 3D Dose difference and p-values maps suggest that there is a strong correlation between a higher dose delivered to the organs at risk and the toxicity events. More importantly, the method allowed to highlight the specific regions where the dose was delivered and produced the organ damage. (81.99% of the voxels for the rectum and 50.24% for the bladder).

Conclusion: We proposed a new voxel wise statistical models of toxicity which allows to explain the risks associated with the dose spatial distribution in case of toxicity. The new model may help to find accurate relationships between local dose distribution and the damage to the and organs at risk.

2037 POSTER

Principal Components Analysis of Dose Distribution for Characterizing Toxicity in Prostate Cancer Radiotherapy

B. Chen[1], O. Acosta[1], A. Kachenoura[1], J.D. Ospina[1], G. Dréan[1], A. Simon[1], P. Haigron[1], R. De Crevoisier[2]. *[1]LTSI, Laboratoire du Traitement du Signal et de l'Image − INSERM U 642, Rennes, France; [2]LTSI − Département de Radiotherapie − Centre Eugène Marquis, Laboratoire du Traitement du Signal et de l'Image − INSERM U 642, Rennes, France*

Background: Although image guided radiotherapy (IGRT) is one the most indicated treatment for prostate cancer, severe complications may appear as a consequence of high delivered doses to the neighboring organs at risk, namely the bladder and the rectum. The prediction of this toxicity events are commonly based on clinical data and dose volume histograms through the models such as the NTCP. However different spatial dose distributions may produce the same toxicity prediction using NTCP models and new models for analyzing dose distributions are needed.

The purpose of this work is to study the underlying characteristics of the 3D dose distributions, using a voxel based Principal Component Analysis (PCA), across a population of 120 patients treated for prostate cancer. This method allows to build appearance models of dose and to extract meaningful features that may be used in a further classification step in order to separate individuals with dose related toxicity events.

Data and Methods: 120 patients treated for prostate cancer with external radiotherapy were selected. Their 3D CT scans and planned doses were non-rigidly registered towards a single template based on a hybrid organ/intensity demons algorithm. Thus, all the doses corresponded voxel to voxel to the same anatomical structure. We then applied the PCA method across the whole population, considering each voxel of the warped dose as a feature. The PCA generative model of dose allowed us to decompose them into a new orthogonal space representing the directions where their variation was more significant, therefore reducing the representation of the whole dose distributions to only some features. Using the main eigenvalues, each individual was projected as a point into a new basis leading to a compact representation of the doses. A further classification method may be used to cluster the population into toxicity/non toxicity individuals based on the planned dose distribution.

Results: Reducing the voxel space from 5'954 625 features to only 75 main eigenvalues allowed us to represent the 90% of the dose variation across the whole population. Using these features, for example, we predicted rectal bleeding with a specificity of 62%, and urinary toxicity with 52% of specificity with a simple classifier such as k-means.

Conclusion: PCA Analysis allows to decompose dose distributions and to identify the most meaningful features to further classify individuals with toxicity. Further validation with different models is in progress as well as the implementation of better classifiers and non rigid registration methods to improve the specificity.

2038 POSTER

Investigating the Associations Between Late Rectal Morbidity and Simulated Rectal Motion

M. Thor[1], A. Apte[2], J.O. Deasy[2], M. Væth[3], L.P. Muren[1]. *[1]Aarhus University Hospital, Departments of Medical Physics and Oncology, Aarhus, Denmark; [2]Memorial Sloan-Kettering Cancer Center, Department of Medical Physics, New York, USA; [3]Aarhus University, Department of Biostatistics, Aarhus, Denmark*

Background: Rectum is the main dose-limiting organ in radiotherapy (RT) of prostate cancer (PC). The motion of this organ is extensive which leads to uncertainties in the rectum dose-volume histogram (DVH). This is likely to also influence the associations between rectal DVHs and morbidity. The aim of this study was to investigate the associations between motion-inclusive rectum DVHs and late rectal morbidity and compare to the static DVH as obtained from the treatment planning CT.

Method and Materials: Late rectal morbidity was defined as late gastro-intestinal (GI) toxicity according to the RTOG scoring system in 232 PC patients previously treated to 70 Gy with conformal RT. Rectal motion was simulated over the 35 treatment fractions assuming normally distributed translational random and/or systematic motion of different magnitude by changing the standard deviations (SDs) in steps of 0.1 cm (σ=0.1−1.0 cm). The motion was simulated in both isotropic and anisotropic (anterior-posterior) direction. The associations with dichotomized GI toxicity investigating patients with vs. without GI grade $\geqslant 2$ and the motion-inclusive DVHs as well as the static DVH was explored using Spearman's rank correlation coefficient.

Results: Overall, increased associations with rectal morbidity were obtained for intermediate doses (40−60 Gy) with the motion-inclusive DVHs over the static DVH. These associations peaked with randomly applied motion. For combined random and systematic motion the associations were