Range uncertainties in proton beam therapy for paranasal cancer in a UK service – a narrative review

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Rationale for this work

- New NHS High Energy Proton Beam Therapy (PBT) facility opening in Manchester autumn 2018
- Within the outline business case, identified that patients with paranasal cancer would be one of a number of cancers which would benefit from PBT
  - Anticipate potential improvement in local control and reduction in complications
- Although advantageous with respect to normal tissue toxicity, the increased conformity from PBT is vulnerable to considerable error as a result of uncertainties in beam range
  - PBT more sensitive to anatomical changes than with photon therapy
- MSc Dissertation of David Kirk (A Superintendent Radiographer (RTT) for the Christie PBT facility)
Frontal Sinuses
Ethmoidal Sinuses
Maxillary Sinuses
Sphenoid Sinuses
Aims and Objectives

- Examine in a systematic way the evidence base for the various known range uncertainties which might affect paranasal cancer treatments for the new UK PBT service
  - Explore the extent of the uncertainty
  - Extract the effectiveness of proposed corrective actions
Methods used

- PubMed database used for key searches related to range uncertainty in PBT in general and for PBT for paranasal sinus treatments in particular
- Initial search in April/May 2015 and monthly thereafter; using appropriate keywords, inclusion and exclusion criteria
- Follow-up search in Feb 2018
- Papers were filtered and appraised critically for relevance and robustness
- From an initial search result of over 220 papers...
  - 97 papers were reviewed for range uncertainty (16 in Feb 2018)
  - 7 papers specific to paranasal cancer (8 in Feb 2018)
Main Results Found

- Patients should ideally undergo prep/planning without a fluid filled sinus
  - Adequate drainage, if possible, provided surgically beforehand
  - Status monitored throughout treatment – volumetric imaging (CBCT) or verification CT
- Impact of weight change can be less problematic for well-optimised plans
  - Distal end of SOBP never against an OAR if significant weight change anticipated
- Variations in RBE across peak are of concern; of current debate – tomorrow’s teaching lecture!
  - Std value of 1.1; literature 1.07 – 1.18 for mid-SOBP
- Margin of uncertainty should be examined for each site/individual cases
Clinical Impact

- Establish clinical protocols which are informed by..
  - Experience from current, global PBT centres and their treatment for these cancers
  - Evidence base and review for Paranasal cancer patients treated with PBT

- Potentially provide a platform for more effective treatment with this cohort of patients and.....

- Establish foundation for further development of the clinical techniques – e.g. for Intensity Modulated Proton Therapy
Future directions

- The NHS UK PBT Service has opted for the Varian ProBeam system and Eclipse TPS; due for clinical implementation in 2018 (Manchester) and 2020 (London)

- This work is helping to inform the set-up and establishment of clinical protocols for the new service

- Part of the training and education for all staff involved with PBT, especially Radiographers (Radiation Therapists)
  - Especially of note is the development of an understanding and knowledge base for the critical differences between photon and proton therapy
Any questions?

Thanks for your attention!