

Review of Proton Beam Therapy in Cancer Treatment



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Background

- Proton beam, unlike conventional radiotherapy which uses photon, involves particles (protons) which are heavier and are less prone to scattering.⁽¹⁾
- This results in a more focused beam with deeper penetration and less damage to surrounding tissue

Conventional X-ray therapy



Because conventional radiation doesn't release its energy at a specified depth, as it travels through the body it can cause more damage to the tissue surrounding the tumor.

Proton radiation therapy



By adjusting the speed of the protons, a physician can control how deep they will penetrate into the body. The protons then release their energy at the tumor and cause less damage to the surrounding tissue.

Current Application for Proton Beam

Centre Nervous System <ul style="list-style-type: none"> Adult low-grade glioma Pediatric glioma Acoustic neuroma Pituitary adenoma Meningioma Craniopharyngioma Chordomas Brain metastases Optic glioma Arteriovenous malformation 	Abdomen <ul style="list-style-type: none"> Paraspinal tumour Soft tissue Sarcomas, chordomas, low-grade chondrosarcomas 	Pelvis <ul style="list-style-type: none"> Early stage prostate carcinoma Locally advanced prostate carcinoma Locally advanced cervix carcinoma Sacral chordoma Rectal carcinoma (recurrent or unresectable) Pelvic masses
Eye and Orbit <ul style="list-style-type: none"> Choroidal melanoma Retinoblastoma Choroidal metastases Orbital rhabdomyosarcoma Lacrimal gland carcinoma Choroidal hemangiomas 	Head and Neck Tumours <ul style="list-style-type: none"> Local advanced oropharynx Local advanced nasopharynx Soft tissue sarcoma Misc recurrent or unresectable carcinomas 	Chest <ul style="list-style-type: none"> Local advanced oropharynx Paraspinal tumour Soft tissue sarcomas Chordomas Low-grade chondrosarcomas

Aims

- To review the safety, efficacy and cost-effectiveness of Proton Beam Therapy (PBT).

POPULATION: Patients which require radiotherapy for treatment

INTERVENTION: Using PBT on patients who require radiotherapy treatment

CONTROL: Conventional radiotherapy

OUTCOME: Safety, effectiveness, cost

Methodology

- Databases: PubMed search from 2000 to June 2008
- Search terms: proton beam therapy, proton beam cancer, proton therapy cancer
- Searches that were not of clinical relevance were excluded.

Results

- 26 publications (4 systematic reviews, 1 RCT, 18 case series, 3 economic evaluations) were reviewed.⁽²⁻²⁷⁾
- The 4 systematic reviews highlight the lack of evidence (mainly case series) to support the use of PBT for most cancers except in patients who stand to benefit the most from the tissue-sparing properties of PBT (eye, head and neck, central nervous system, paediatric cases)
- The 18 case series examined cancers of the eye (9), liver (3), brain (2), CNS (1), bone (1), prostate (1), lung (1), connective tissue (1).
- Most case series reported acceptable toxicity profiles with good local tumour control although they have not been rigorously compared with other forms of treatment.
- Although PBT may result in lower toxicity profile, there is no evidence to suggest better response benefits.
- All 3 economic evaluations found PBT to not be cost-effective for most cancers including the prostate and breast tumours (i.e. PBT cost/QALY = € 25,000-65,000; RT cost/QALY = € 10,500-40,000)

Conclusion

- PBT, although promising, still has many barriers to overcome before it becomes a modality that is commonly used for treatment (i.e. conventional radiation therapy and Intensity-Modulated Radiation Therapy (IMRT)).
- However its potential to improve healthcare quality significantly cannot be denied because of its likely superior toxicity profile even though PBT remains a more expensive option (i.e. less cost-effective).

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