Intensity Modulated Proton Therapy for the Treatment of Intracanalicular Vestibular Schwannoma: A Dosimetric Investigation

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Introduction

The potential advantage of proton therapy for vestibular schwannoma (VS) remains a focus of investigation due to the rapid falloff advantage and theoretical sparing of normal tissue structures. The aim of the present study was to investigate the potential dosimetric advantages of intensity modulated proton therapy (IMPT) compared to LINAC-based photon treatments, including stereotactic radiosurgery (SRS) and intensity modulated radiation therapy (IMRT) for VS with an intracanalicular component.

Methods

2-field IMPT plans were created on 9 VS patients previously treated with SRS (N = 5) or IMRT (N = 4) to a prescription dose of 48.6 Gy Radiobiological Equivalent (RBE). Dosimetric indices used to compare the techniques included the homogeneity index (HI), conformity index (CI), and mean and maximum dose to selected organs at risk (cochlea, brainstem, semicircular canal, vestibulocochlear nerve, and facial nerve).

Results

The mean tumor volume was 0.833 cm3. The HI and CI were comparable among the IMPT and photon plans. The maximum cochlear dose was improved in all IMPT plans relative to photon therapy. The average maximum cochlear dose among IMPT plans was 7% lower (41.9 Gy RBE vs 45.2 Gy, p = 0.0039); and average mean cochlear dose among IMPT plans was 12% lower (32.2 Gy RBE vs 36.6 Gy, p = 0.098). The mean dose received by the brainstem was decreased by 66% in the IMPT plans (1.39 Gy RBE vs 4.12 Gy, p = 0.0039). IMPT slightly increased the dose to the ipsilateral semicircular canal, vestibulocochlear nerve, and facial nerve, though the differences were not statistically significant.

Conclusions

IMPT is a novel method for treating VS. Despite having intracanalicular tumors in close proximity to the cochlea, IMPT produced improved plans as compared to SRS and IMRT. This has the potential to improve clinical outcomes with regard to hearing preservation and associated toxicities.

Learning Objectives

By the conclusion of this session, participants should be able to:

1) Describe the potential advantages of intensity modulated proton therapy as a treatment for patients with an intracanalicular vestibular schwannoma.

2) Discuss, in small groups the role of intensity modulated proton therapy and its potential to reduce radiation dose to the cochlea, brainstem, semicircular canal, and ipsilateral cranial nerves. Furthermore, discuss how the reduction in radiation dose may translate into improved hearing preservation and less toxicities.

3) Recognize that investigating the dosimetric parameters of intensity modulated proton therapy for treating intracanalicular vestibular schwannoma remains an active area of interest, and further investigation is warranted.