Barriers to receiving proton-craniospinal irradiation for pediatric medulloblastoma patients in a state without proton access

M. PASLI[1], M. GOINS[1], M.LARKINS[1], G. EDWARDS[1], D. GONZALEZ[1], C. COOK[2], A. JU[3], A. BURKE[3]

1 – East Carolina University (ECU) Brody School of Medicine (BSOM)

2 – ECU Department of Pediatrics, Division of Pediatric Hematology/Oncology

3 – ECU Department of Radiation Oncology

PURPOSE / OBJECTIVES

- Medulloblastoma is the most common pediatric brain malignancy, representing approximately 20% of all brain tumors found in children (1) and 40% of all posterior fossa tumors (2)
- Treatment of medulloblastoma is multi-modal, including surgery, chemotherapy, and craniospinal irradiation (CSI) (3)
- Long term toxicities of CSI include ototoxicity, cardiotoxicity, endocrine, neurocognitive dysfunction, and growth impairment (4)
- The standard of care for CSI has evolved to favor proton beam therapy over photon-based CSI (4-8)
- Meta-analysis of studies comparing photon and proton-CSI predicted better dose distribution, decrease in organ dysfunction, and less secondary malignancy with proton-based CSI (4)
- Here, we conducted a retrospective study identifying access barriers to proton-CSI for medulloblastoma patients in a tertiary care center serving patients in a state without a proton center

MATERIAL & METHODS

- We conducted an IRB-approved retrospective study using patients diagnosed with medulloblastoma from a pediatric tumor registry at a tertiary care center which serves surrounding rural counties
- Eligible patients were diagnosed with medulloblastoma at our institution between 2000-2022 and were aged ≤ 25 at the time of diagnosis
- Dichotomous variables were compared to outcomes using the Fisher's Exact test. Continuous variables were compared using the Kruskal-Wallis test
- All statistical analyses were conducted in IBM SPSS Statistics for Windows (Version 28.0. Armonk, NY: IBM Corp) with 95% CIs

RESULTS

- Of 18 total patients, 3(17%) received proton-CSI and 15(83%) did not. Of these 18 patients, 11(61%) patients had documented discussions about proton-CSI in their medical records, while 7(39%) did not
- Four (22%) experienced insurance approval barriers, 3(17%) could not afford travel, 3(17%) had lack of transportation, 1(6%) had parents unable to travel with them, 4(22%) had family care conflicts, 4(22%) had inpatient medical needs, 5(28%) had outpatient medical needs, and 3(17%) had a delay of therapy
- No significant associations were found between sex, race, estimated travel distance, median household income based on county, parent employment and marital status, tumor classification, and risk stratification and the reception of proton-CSI or its discussion
- Although Fischer's test demonstrated a non-significant association (p=0.22), chi-square analysis demonstrated that both employment status (p=0.09) and marital status (p=0.09) approached significance
- Median distance from our institution approached significance (p=0.07) by race, with Caucasians having longer travel distances

SUMMARY / CONCLUSION

- This is the first exploratory analysis on barriers to proton-CSI for patients in a state without access to this treatment modality
- This study provides insight into barriers, including marital status and parent employment encountered by pediatric patients and their families and, therefore, may aid clinicians in mitigating these barriers
- Overcoming these barriers may allow for optimal treatment and may reduce the risk of CSI-induced secondary malignancy and toxicity

Although studies have analyzed barriers to pediatric patients receiving proton therapy, these are studies from authors at proton centers. This study analyzes barriers from the perspective of a population in a state that does not have adequate access to protons

Median distance from our institution approached significance upon stratification by race *(p=0.07)*

RESULTS

Table 1. Selected barriers to proton-CSI based on radiotherapy modality

Sub-group of Interest	Sex	Race	Median Distance from our Institution	Median Household Income	Parent Marital Status	Parent Employ-ment Status	Tumor Class-ification	Risk Stratificatio n
Received proton-CSI (n = 3)	2 Males 1 Female	3 Caucasian 0 Non-Caucasian	71.8 miles 82 minutes	$52,124	3 Married 0 Divorced/ Separated	0 Both employed 3 Other	2 Classic 1 Non-Classic	3 Standard 0 High
Did not receive proton-CSI (n = 15)	9 Males 6 Females	10 Caucasian 5 Non-Caucasian	57.9 miles 68 minutes	$52,124	7 Married 8 Divorced/ Separated	8 Both Employed 7 Other	5 Classic 10 Non-Classic	13 Standard 2 High
Significance of Association	Fisher's p = 1.00	Fisher's p = 0.52	Kruskal-Wallis p = 0.44	Kruskal-Wallis p = 0.81	Fisher's p = 0.22	Fisher's p = 0.22	Fisher's p = 0.53	Fisher's p = 1.00

Table 2. Selected barriers to proton-CSI based on race

Sub-group of Interest	Median Distance from our Institution	Median Household Income	Parent Marital Status	Parent Employment Status	Tumor Classification	Risk Stratification
Caucasian (n=13)	72.1 miles 85 minutes	$54,732	8 Married 5 Divorced/ Separated	5 Both Employed 8 Other	5 Classic 8 Non-Classic	11 Standard 2 High
Non-Caucasian (n=5)	21.5 miles 26 minutes	$45,766	2 Married 3 Divorced/ Separated	3 Both Employed 2 Other	2 Classic 3 Non-Classic	5 Standard 0 High
Significance of Association	Kruskal-Wallis p = 0.07	Kruskal-Wallis p = 0.197	Fisher's p = 0.61	Fisher's p = 0.61	Fisher's p = 1.00	Fisher's p = 1.00

REFERENCES

1.Mahapatra S, Amsbaugh MJ. Medulloblastoma. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2022. Available from: http://www.ncbi.nlm.nih.gov/books/NBK431069/. Accessed March 10,2023.
2. Gurjar OP, Arya R, Goyal H, et al. Craniospinal irradiation in medulloblastoma using high energy medical linear accelerator: an innovative approach to planning technique. J Biomed Phys Eng. 2019;9(2):151–60.
3. Sreeraman R, Indelicato DJ. Proton therapy for the treatment of children with CNS malignancies. CNS Oncol. 2014;3(2):149–58.
4. Ho ESQ, Barrett SA, Mullaney LM. A review of dosimetric and toxicity modeling of proton versus photon craniospinal irradiation for pediatrics medulloblastoma. Acta Oncol Stockh Swed. 2017;56(8):1031–42.
5.Liu SM, Brooks ED, Rubin ML, et al. Referral patterns and treatment delays in medulloblastoma: a large academic proton center experience. Int J Part Ther. 2021;7(3):1–10.
6.St. Clair WH, Adams JA, Bues M, et al. Advantage of protons compared to conventional X-ray or IMRT in the treatment of a pediatric patient with medulloblastoma. Int J Radiat Oncol. 2004;58(3):727–34.
7.NAPT. National Association for Proton Therapy. Available from: https://www.proton-therapy.org/. Accessed March 10, 2023
8.Swisher-McClure S, Hahn SM, Bekelman J. Proton beam therapy: the next disruptive innovation in healthcare? Postgrad Med J. 2015;91(1075):241–3.