Comparing the Use and Survival Outcome of Stereotactic Radiosurgery and Stereotactic Radiation Therapy

Garett Ostdiek-Wille, Sabir Amin M.D., Ph.D., and Chi Lin M.D., Ph.D.
Department of Radiation Oncology, University of Nebraska Medical Center, Omaha, NE 68198

OBJECTIVES

Brain metastases are common in many types of cancer. Treatment for this condition is usually through surgical resection, whole brain radiation treatment (WBRT), stereotactic radiosurgery (SRS), or stereotactic radiation therapy (SRT). SRS (15 to 24 Gy in 1 fraction) and SRT (21, 24 or 30 Gy in 3 fractions or 25, 30 Gy in 5 fractions) have similar biological equivalent doses but differ in the number of treatments the radiation is delivered over. The objective of this study is to use national cancer database (NCDB) to examine the factors associated with receiving SRS as compared to SRT, and to compare overall survival between patients who received SRS to those who received SRT after adjusting for all potential prognostic factors.

INTRODUCTION

Brain metastases (BM) are a result of advanced stage cancer that pose a threat to the life of an individual. This can be treated using surgical resection with aims to help improve neurological functioning and mass reduction (1). Other treatments possible include whole brain radiation treatment (WBRT), stereotactic radiosurgery (SRS), stereotactic radiation therapy (SRT), systemic steroids, as well as combinations of these treatments (2). WBRT has been the traditional approach to treating BM; however, targeted treatments such as SRT can be more beneficial clinically, as well as present less risk for radiation toxicity (2). This is because SRT can provide high doses of radiation in a small number of fractions to a specific area (3). Comparatively, SRS utilizes a single fraction of high dose radiation to an area (4), but does come with some radiation toxicity concerns itself (3). SRT attempts to branch this gap by continuing to deliver high doses of radiation, but spread out over several fractions to help reduce the radiation being delivered in a single treatment period. SRT could even help in specific areas of the brain. A study found that some areas of the brain may exhibit the different levels of sensitivity to radiation. The visual pathway has been found to be more sensitive to radiation, meaning risk for damage as a result of treatment is higher around this cranial nerve (6). With these options of treatments and concerns, it is important to look into the data in recent years to see the factors leading to receiving SRT treatment as compared to SRS treatment. Observing how these variables, including treatment type, affect the overall survival of patients diagnosed with BM is also critical.

METHODS

Descriptive statistics for categorical and continuous variables are reported. Predictors of SRS use as compared to SRT were identified using the logistic regression model. The OR was reported as the measure of association with likelihood of using SRS. Survival time was measured in months from the date of diagnosis to the date of death. We used the Kaplan-Meier (KM) method to generate survival curves and analyzed the differences between groups using the log-rank test. Cox proportional hazards regression analysis was conducted to estimate the hazard ratio (HR). We used SAS 9.4 (SAS Institute Inc.) for the analysis.

CONCLUSIONS

In conclusion, SRT and SRS were not found to have a significant difference in survival. Further study is warranted to determine if SRT is less toxic than SRS.

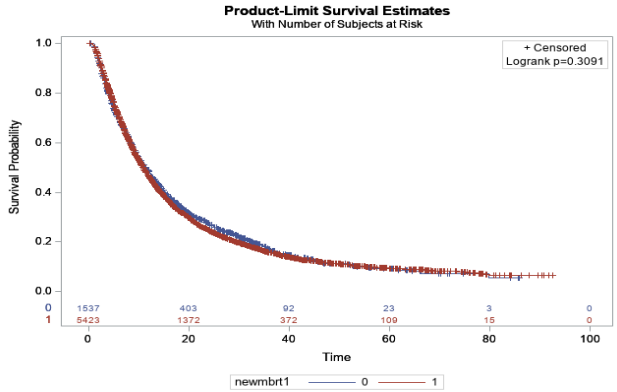

Figure 1: In this figure, the 0 represents SRT data, and the 1 represents SRS data. The median survival for patients undergoing SRS treatment is 10.91 months, and the median survival for patients undergoing SRT treatment is 11.30 months. No significant difference in overall survival between these two groups.

Variables		Multivariable Analysis	P-value
		OR (95% CI)	
Charlson/Deyo Score	0	Ref	
	1	0.836 (0.728-0.961)	0.011
	>=2	0.780 (0.647-0.940)	0.009
Chemotherapy	Yes	Ref	
	No	0.823 (0.722-0.938)	0.003
Primary Cancer	Breast	0.703 (0.438-1.129)	0.15
	NSCLC	0.898 (0.648-1.245)	0.52
	SCLC	0.951 (0.592-1.528)	0.84
	Other Lung	0.628 (0.407-0.972)	0.04
	Melanoma	0.650 (0.443-0.955)	0.03
	CRC	0.499 (0.270-0.922)	0.03
	Renal Cell	Ref	
Year of Diagnosis	2010-2013	1.357 (1.208-1.523)	0.001
	2014-2015	Ref	

Table 1 Multivariable logistic regression analysis of factors associated with receipt of SRS as compared to SRT. Other variables that were included but not found to hold significance are as follows: age, sex, race, education, income, place of living, hospital type, insurance status.

Variables		Multivariable Analysis	P-value
		HR (95% CI)	
Age		1.015 (1.012-1.018)	0.001
Sex	Male	Ref	
	Female	0.819 (0.775-0.865)	0.001
Race	White	Ref	
	Black	0.907 (0.829-0.992)	0.03
	Other	0.750 (0.645-0.872)	0.002
Income	>=$35,000	Ref	
	<35,000	1.109 (1.048-1.172)	0.003
Hospital Type	Academic	Ref	
	Community	1.086 (1.029-1.146)	0.003
Charlson/Deyo Score	0	Ref	
	1	1.136 (1.066-1.211)	0.001
	>=2	1.207 (1.106-1.318)	0.001
Chemotherapy	Yes		
	No	1.681 (1.578-1.791)	0.001
Primary Cancer	Breast	0.647 (0.513-0.816)	0.002
	NSCLC	0.790 (0.689-0.906)	0.008
	SCLC	0.970 (0.794-1.185)	0.76
	Other Lung	0.977 (0.802-1.189)	0.81
	Melanoma	0.501 (0.418-0.600)	0.001
	CRC	0.988 (0.731-1.335)	0.94
	Renal Cell	Ref	
Year of Diagnosis	2010-2013	1.075 (1.017-1.137)	0.010
	2014-2015	Ref	

Table 2 Multivariable Cox proportional hazards regression analysis of factors associated with overall survival. Other variables that were included but not found to have a significant effect include treatment combination, education, and place of living.

References

1. Arita H, Narita Y, Miyakita Y, Ohno M, Sumi M, Shibui S. Risk factors for early death after surgery in patients with brain metastases: reevaluation of the indications for and role of surgery. *J Neurooncol.* 2014;116(1):145-152. doi:10.1007/s11060-013-1273-5
2. Gu L, Qing S, Zhu X, et al. Stereotactic Radiation Therapy (SRT) for Brain Metastases of Multiple Primary Tumors: A Single Institution Retrospective Analysis. *Front Oncol.* 2019;9:1352. Published 2019 Dec 10. doi:10.3389/fonc.2019.01352
3. Jimenez RB, Alexander BM, Mahadevan A, et al. The impact of different stereotactic radiation therapy regimens for brain metastases on local control and toxicity. *Adv Radiat Oncol.* 2017;2(3):391-397. Published 2017 Jun 6. doi:10.1016/j.adro.2017.05.008
4. Shaw E, Scott C, Souhami L, et al. Radiosurgery for the treatment of previously irradiated recurrent primary brain tumors and brain metastases: initial report of radiation therapy oncology group protocol (90-05). *Int J Radiat Oncol Biol Phys.* 1996;34(3):647-654. doi:10.1016/0360-3016(95)02106-x
5. Leber KA, Berglöff J, Langmann G, Mokry M, Schröttner O, Pendl G. Radiation sensitivity of visual and oculomotor pathways. *Stereotact Funct Neurosurg.* 1995;64 Suppl 1:233-238. doi:10.1159/000098784