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Multifractional Versus Two-Sessions Robotic Stereotactic Radiosurgery for Larger THAN >3 cm Brain Metastases, Dosimetry Comparison Regarding Sparring of Undamaged Tissue

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Categories: Radiation Oncology
Keywords: two-sessions, brain metastases

How to cite this abstract
Blanco Saborío A, Mejias Gamboa R, Lovo E E, et al. (April 02, 2020) Multifractional Versus Two-Sessions Robotic Stereotactic Radiosurgery for Larger THAN >3 cm Brain Metastases, Dosimetry Comparison Regarding Sparring of Undamaged Tissue. Cureus 12(4): a505

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Introduction: Two sessions radiosurgery in large symptomatic brain metastases has recently been demonstrated as a treatment modality that can avoid upfront surgery in most patients. Objectives: To analyze the amount of undamaged brain tissue according to usual constraints for organ at risk such as volume tissue receiving 12 Gy (V12) for single dose or (V18) for multifractional radiosurgery in large symptomatic brain metastases treated with Cyberknife or Rotating Gamma Ray.

Methods: Dose regarding unaffected brain tissue receiving V12 with single fraction versus V18 with multifractional radiosurgery treatment were compared. Initially, three patients were treated using two-sessions radiosurgery with Cyberknife or Rotating Gamma Ray. Single dose received was 12 Gy during first session and 15 Gy during the second session; separated by a 30-days interval. On the other hand, two hypothetical multifractional treatments were designed with Multiplan® where prescription doses were 9 Gy (9 Gy x 3) and 8 Gy (8 Gy x 3) in every session for three consecutive days.

Results: The tumor volume irradiated during session one for the first patient treated with single fraction modality received a Gross Total Volume (GTV) one 74cc and GTV two 9cc. Furthermore, the second patient received a GTV of 47cc, and a GTV 36.5cc the third patient. Subsequently, during session two (after 30 days interval), the GTV one volume for the first patient was GTV one 8.7cc and GTV two of 0.6cc, 32cc the second patient, and 14cc the third patient. Alternatively, two hypothetical treatments were exclusively planned with a robotic linear accelerator in a multifractional modality for the tumor volume during the first session as this would be the original tumor that would have been irradiated in this modality. The amount of undamaged brain tissue volume V18 for the fractionated plan prescribing 27Gy was 109.45 cc for the first patient, 43.60 cc the second patient, and 51.40 cc the third patient. Whereas, with a 24Gy prescription, the amount of undamaged brain tissue volume V18 was 88.74 cc, 32.20 cc, and 38.3cc for patient one, two, and three respectively. In contrast, the amount of intact brain tissue receiving V12 in two radiosurgery sessions was 15.00 cc during the first session and 7.60

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Published 04/02/2020

cc during the second session for the first patient; 4.78 cc and 19.27cc for the second patient, and 4.24 cc and 3.44 cc for the third patient.

Conclusions: Two-sessions radiosurgery consistently traduce into significantly smaller tumor volumes for the second session. Smaller volumes present steeper dose gradients than larger volumes, the amount of healthy brain spared receiving excessive dose is significantly more in two-sessions versus typical three days fractionations schemes. In addition, the time interval (4 to 6 weeks) between sessions can provide potential benefits for healthy brain tissue, larger clinical experience will be needed necessary.