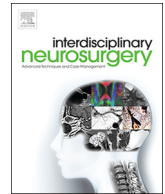




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Technical notes & surgical techniques

The efficiency of the prescribed dose of the gamma knife for the treatment of trigeminal neuralgia ^{☆, ☆ ☆}



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ABSTRACT

Background: This study designed to evaluate the clinical response of the gamma knife (GK) treatment of primary trigeminal neuralgia (TN) with two modalities of radiation doses. We tried to determine the best of these modalities for the treatment.

Patients and methods: A randomized clinical prospective study conducted in the Gamma Knife Center, Neuroscience Hospital, Baghdad, Iraq. It extended from July 2016 to June 2017. Forty-five patients with essential TN included in this study. All the patients had either IV and V score of Barrow Neurological Institute Pain scale (BNI) before the Gamma Knife (GK) therapy. Twenty Patients treated with a dose of 80 Gy and twenty-five patients exposed to 89 Gy. The clinical response monitored at fixed time intervals. Imaging evaluation of the nerve thickness used with 3 Tesla MRI before and following the GK therapy.

Results: 32% of the patients treated with 89 Gy reached pain-free status after one year of GK treatment, while no one of the treated patients with the dose 80 Gy reached that scores. A significant increase in nerve thickness was obtained by the radiation dose 89 Gy as compared to the effect of 80 Gy six-month post GK. After twelve months 32% of those patients treated with 80 Gy had a recurrence, while 19.5% recurrence found in patients treated with 89 Gy.

Conclusion: The clinical outcome for a longer duration is better when applying the dose 89 Gy.

1. Introduction

Trigeminal neuralgia (TN) or “Tic Doloureux” is one of the major pain disorders that appears middle ages older [1]. It characterized by intense paroxysmal episodic pain [2]. This condition described as a “suicide disease” because of pain severity [3]. The medication can be considered as the first line of treatment mainly Carbamazepine, Ox-carbazepine, Gabapentin, Baclofen, Clonazepam, Estrogen, Topiramate, tramadol, and non-steroidal anti-inflammatory drugs (NSAID). The doses of the drugs differ from patient to another according to their pain severity. If medication fails to control the pain, then surgical intervention or Gamma Knife Stereotactic Radiosurgery (GKSR) could be done to maintain pain relief [4–6].

Radiosurgery is a neurosurgical procedure whereby radiation is delivered using stereotactic coordinate system [7]. In this study, we compared the clinical effectiveness of two doses of radiation doses to treat TN patients with GK.

2. Patients and methods

A randomized clinical prospective study conducted in the Gamma Knife Center, Neuroscience Hospital, Baghdad, Iraq. The study extended from July 2016 to July 2017. Forty-five patients with TN underwent GKRS treatment. Twenty patients treated with a dose of 80 Gy and twenty-five patients with a dose of 89 Gy. All the patients followed for 12 months. Table 1 summarizes the characteristics of patients who treated with GK. All patients diagnosed by neurologists and neurosurgeons as having essential TN, they showed no response to medications (full dose of drugs). Four patients previously treated with GK or microvascular decompression (MVD) and had pain recurrence. The psychologically unstable patients excluded from this study.

2.1. Radio-surgical technique

Patients treated with Gamma Knife Perfexion. The procedure

[☆] Conflict of interest: All the authors have nothing to disclose.

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Table 1
Characteristics of patients included in the study.

Age range	20–77 years, mean 49.31 years
Range of duration of symptoms	5–48 months, mean 17.37 months
Gender	
Male	17 (39%)
Female	27 (61%)
Irradiation dose	
80 Gy	20 patients
89 Gy	25 patients
Previous treatment	
Glycerol injection	1 patient (2.2%)
Previous GK	Two patients (4.4%)
Surgery	Two patients (4.4%)
Follow-up duration of study	12 months

included applying the Leksell stereotactic frame to the patients by Neurosurgeon and nursing team; then they underwent a 3.0 Tesla MRI study. The treatment planning was done using Leksell Gamma-Plan software system (Elekta). A single shot using 4-mm collimator isocentre used to target the Trigeminal Root entry zone of the nerve. The radiation dose prescribed at the 100% isodose line for patients who treated with the dose 89 Gy and 100% for those who treated with 80 Gy.

On both groups the target was 4.2 mm away from the exit point of the trigeminal nerve, so that the margin of brain stem received only 15 Gy of the dose especially for the group who received 89 Gy, the brain stem as a volume received 18% of the radiation dose (Fig. 1).

Two tangential blocks used in all the cases either 4,8 sectors for the left trigeminal nerve and 2,6 sectors for the right trigeminal nerve.

2.2. Patients follow-up

Patients evaluated initially three weeks after GK treatment. They instructed to use medication only if needed. Later we followed up them

every three months looking for any change in their pain state using the Barrow Neurological Institute (BNI) pain intensity score. The nerve thickness measured after six, twelve months post irradiation.

The use and any change in medication type or dose during follow up assessed.

2.3. Treatment response of TN to radiation

The (BNI) pain intensity score recorded for all patients before, during and post GK therapy periods of follow up. This score gathers the severity of pain with the use of medication. The patient is regarded as pain free in have score I, and in pain control if have scores from I to III. Before the treatment; only the patients with scores IV or V included in the study.

2.4. Measurement of trigeminal nerve thickness

The nerve thickness was measured by the Line option of the Gamma-Plan software through the 3 Tesla MRI imaging and recorded before GK therapy. During follow up periods a new MRI obtained, and the image fused to specify the target point on the nerve to measure the nerve thickness on that point.

2.5. Statistical analysis

Data analysis carried out using the statistical package of Statistical Packages for Social Sciences-version 23 (SPSS-23). Data presented in simple measures of percentage, mean, standard deviation, and range (minimum-maximum values). The significance of the difference of different means (quantitative data) tested using Students-*t*-test for the difference between two dependent means or Paired-*t*-test for difference of paired observations test. Pearson correlation calculated for the correlation between two quantitative variables with its *t*-test for testing the

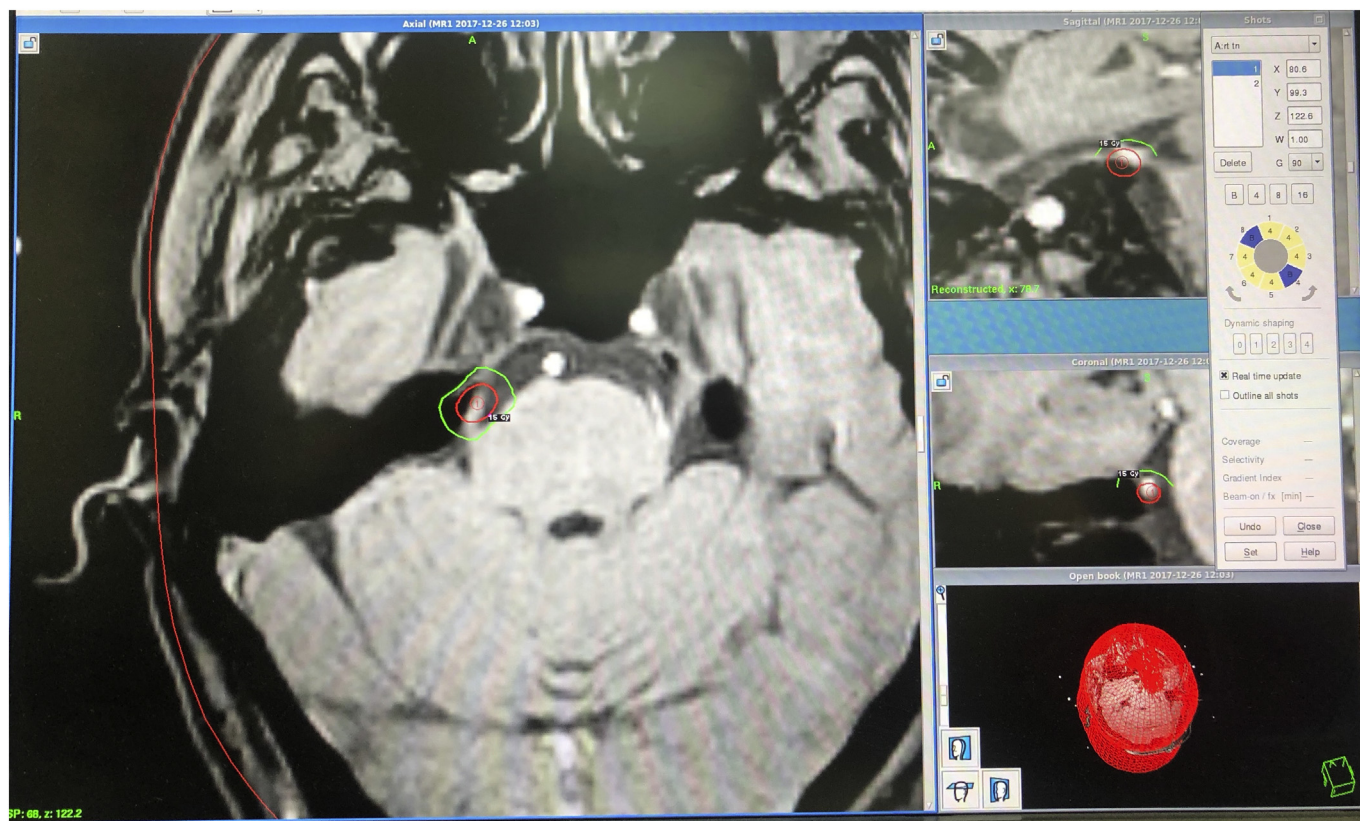


Fig. 1. Targeting the right trigeminal nerve with 89 Gy making the margin of the brain stem receiving 15 Gy only.

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