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The cost-effectiveness of surgery for trigeminal neuralgia in surgically naïve patients: A retrospective study

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ABSTRACT

Objective: For 75% of patients with trigeminal neuralgia (TN), the pain can be controlled with medication. For those who fail medication therapy, surgical options include microvascular decompression (MVD), percutaneous radiofrequency rhizotomy (RFR), and stereotactic radiosurgery (SRS). Few studies have explored the relative cost-effectiveness of these interventions, particularly in surgically naïve patients.
Methods: A retrospective chart review performed between January 2003 and January 2013 identified a total of 89 patients who underwent surgical treatment for TN (MVD = 27, RFR = 23, SRS = 39). Outcome measures included facial pain (excellent = no pain, no medications; good = no pain, medications required; fair = >50% decrease in pain; and poor = <50% decrease in pain/secondary surgery), numbness, cost, and the need for a subsequent procedure.
Results: The average age of patients for each procedure was MVD = 53.9 ± 16, RFR = 76.2 ± 16, and SRS = 74.5 ± 12 ($p < 0.001$ MVD vs. other modalities). Total charges for the procedures (US dollars) were MVD = 50,100 ± 9600, RFR = 4700 ± 2200, and SRS = 39,300 ± 6000 ($p < 0.001$). Actual collections varied by insurance. Percentages of postoperative facial numbness were MVD = 11%, RFR = 52%, and SRS = 28% ($p < 0.01$). At two years, the rates of recurrence requiring a second procedure were MVD = 22%, RFR = 74%, and SRS = 31% ($p < 0.01$). Average times to secondary procedure in months were MVD = 26 ± 29, RFR = 59 ± 76, and SRS = 35 ± 25. Mean quality adjusted pain-free years were MVD = 1.58, RFR = 2.28, and SRS = 0.99. Cost-effectiveness calculations in US dollars showed MVD = 31,800, RFR = 2100, and SRS = 39,600 ($p < 0.001$).
Conclusion: There are significant cost differences among the three most common surgical procedures for TN. MVD was the most expensive procedure, was more likely to be performed on younger patients, had the lowest rate of facial numbness, and had the lowest rate of recurrence requiring a secondary procedure. SRS was slightly less costly, more likely to be performed on an older population, and had a rate of recurrence similar to MVD. RFR was the least expensive procedure, provided immediate relief, but was associated with the highest rates of facial numbness and recurrence. Based on cost-effectiveness, considering both cost and outcome, RFR was the most cost-effective, followed by MVD, and finally SRS.

1. Introduction

Trigeminal neuralgia has an incidence rate of approximately 12 per 100,000 people in the United States. Fortunately, for about 75% of patients who suffer with this disease, the frequent lancinating pain that they suffer can be controlled with medications alone [1]. However, this still results in a large proportion of people who continue to experience ongoing painful symptoms. For this group of patients, surgical options for their disease are available and often sought. Surgical options include microvascular decompression (MVD), percutaneous radiofrequency rhizotomy (RFR), and stereotactic radiosurgery (SRS). There have been numerous previous studies that have investigated the functional and pain outcomes of patients who underwent these procedures [2–5]. However, there

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A: QAPFY = (Length from surgery to last follow up or secondary surgery) X (Outcome factor)

B: Cost Effectiveness = $\frac{\text{Average cost of operation including hospital and surgeon fees}}{\text{QAPFY}}$

C: Cost Effectiveness = $\frac{\text{Average cost of operation including hospital and surgeon fees}}{\text{(Length from surgery to last follow up or secondary surgery) X (Outcome factor)}}$

Fig. 1. Fig. 1A displays in equation form how Quality Adjusted Pain-Free Years (QAPFY) is calculated. Cost-effectiveness was determined using the equation shown in Fig. 1B. Fig. 1C combines these two equations into one complete equation for cost-effectiveness.

have been surprisingly few studies that have investigated the overall cost-effectiveness of these surgical options [6–8]. The authors of this report sought to investigate and review these prior studies as well as explore and attempt to determine the cost-effectiveness of these surgical options for trigeminal neuralgia, particularly in those patients who had never undergone a prior surgical intervention for their disorder.

2. Materials and methods

A retrospective chart review of patients of a single provider at a single academic institution who had undergone surgical treatment for trigeminal neuralgia between January 2003 and January 2013 was performed. A total of 169 patients were identified with TN who had undergone one of the three surgical procedures: 70 with microvascular decompression (MVD), 33 with radiofrequency rhizotomy (RFR), and 86 with stereotactic radiosurgery (SRS). Patients who had undergone previous surgical treatment for their trigeminal neuralgia were excluded. Patients who did not have adequate follow-up, defined as at least two years or time to secondary procedure, were similarly excluded from the study. Using these exclusion criteria, 89 surgically naïve patients were identified for analysis. Patients treated with RFR and SRS were discharged the same day.

Elderly patients with risk factors such as cardiac history or on anticoagulants were swayed to SRS, which was felt to be the lease invasive. This was accomplished with a CT-compatible stereotactic ring affixed to the skull under local analgesia. The root entry zone of the trigeminal nerve was identified on fused CT and MRI images. The target was irradiated with 10 arcs using a single isocenter with a 5-mm collimator prescribing, 90 Gy to the 100% isodose line. Patients suffering from severe pain with difficulty eating, drinking, and talking were offered radiofrequency lesioning. This was performed in the angiography suite under monitored local analgesia and sedation. The foramen ovale was engaged using an electrode with a 5-mm exposed tip. The position of the electrode was adjusted to produce paresthesia using low-frequency stimulation covering the affected area of the face. Once the position of the electrode was deemed satisfactory, 4–6 lesions were made to 50–90 °C for 50–90 s each. The position of the electrode was adjusted between every 2–3 lesions for optimal coverage. Patients without risk factors who did not wish to contend with facial numbness and were good surgical candidates underwent MVD by choice. This was performed in the decubitus position with facial nerve monitoring and intraoperative osmotic diuresis. Three to seven Teflon felt (Medline Industries, Mundelein, IL) sponges (1 × 5 mm each) were placed between the trigeminal nerve and offending vessel. The 1-inch bone flap was replaced and affixed with titanium "I" plates, and the bony defect filled with hydroxyapatite cement. Patients were generally discharged the following day.

Patients were monitored with preoperative and postoperative visual analog scores (VAS) for facial pain, preoperative and postoperative use of medications, presence or absence of facial numbness, the need for a second procedure, and charges. Hospital and physician charges were collated separately. For the MVD patients, hospital charges included hospital stay. Outcome measures included facial pain defined as excellent (no pain, no medication use), good (no pain, medication required), fair (>50% decrease in pain, medication required or presence of numbness), or poor (<50% decrease in pain, second procedure required). Other outcomes determined were facial numbness and cost-effectiveness.

Cost-effectiveness was defined utilizing a prior formula developed in a previous study by Pollock and Ecker to make our study comparable. To complete the formula, quality adjusted pain-free years (QAPFY) was first defined. QAPFY was calculated by multiplying the length of last known follow-up or time to next surgical intervention by an adjustment factor determined by outcome. This adjustment factor was as follows: excellent (1.0), good (0.7), fair (0.5), or poor (0.1) (Fig. 1A). Cost-effectiveness was then calculated by dividing the average total costs of the operation, including hospital fees, surgeon fees, fees surrounding complications, and cost of secondary procedures, by the QAPFY (Fig. 1B and C). The costs of medications were not included given the high variability of costs based on prescription and insurance plans [7].

Table 1
Demographics.

Demographic	MVD	RFR	SRS
Number of Patients	27	23	39
Mean age (years)	53.9**	76.2	74.5
Standard deviation of age	16	16	12
Male/female	10/17	11/12	13/26
Side (% right)	56	52	47

** $p < 0.01$.

3. Results

Demographic results of our 89 participants are summarized in Table 1. There were slightly higher rates of females (62% overall) and right-sided disease (51% overall). There was a significant difference in the average age of patients who underwent MVD ($p < 0.001$) compared to the other groups. The average age of a patient who underwent MVD was 53.9 ± 16, while the average age of patients undergoing RFR and SRS were 76.2 ± 16 and 74.5 ± 12 years, respectively.

Secondary outcomes are summarized in Table 2. Statistically, RFR had a significantly higher rate of post-procedure numbness at 52% than MVD and SRS, with rates of 11% and 28% respectively ($p < 0.01$). Only the infrequent patient was bothered by numbness.

Table 2
Secondary Outcomes.

Secondary outcome	MVD	RFR	SRS
% Numbness	11	52**	28
% Required second procedure	22	74**	31

** $p < 0.01$.