

S8-Factors Associated with the Success in Trial Spinal Cord Stimulation in Patients with Chronic Pain from Failed Back Surgery Syndrome

**Byung-chul Son, Deog-ryung Kim, Hyung-suk Kim,
Woo-young Jang, Sang-won Lee**

Department of Neurosurgery, St. Vincent's Hospital, The Catholic University of Korea. Suwon, Korea

Objective: Spinal cord stimulation (SCS) is a safe and effective treatment option for selected patients with medically intractable chronic pain syndromes such as failed back surgery syndrome (FBSS). Although there has been reports dealing the factors related to the long-term success of SCS in FBSS, the study regarding the factors associated with the success of the trial stimulation is rare. We investigated the factors associated with the success for trial stimulation during SCS in patients with chronic pain from FBSS.

Methods: We retrospectively investigated the medical records of 44 patients who underwent trial of SCS for chronic pain from FBSS. There were 26 females (59%) and the mean age was 58.3 years (range, 35-83). The mean preoperative visual analogue scale (VAS) was 76.91 (range 55-94, ± 10.27 , SD). The mean number of operation was 1.7 (range 1-4, ± 0.9 , SD) and the mean duration of pain prior to SCS was 72.4 months (range 8-432 months, ± 87.74 SD). Successful trial stimulation was possible in twenty-eight of these patients (26 of 44, 63.6%) and permanent stimulating systems were implanted.

To investigate the factors associated with successful trial stimulation, the patients were classified into two groups (success and failure in trial stimulation). We investigated the factors; age, sex, predominant pain areas (axial, limb, axial combined with limbs), number of operation, duration of preoperative pain, type of electrode (cylindrical/ paddle), predominant types of pain (nociceptive, neuropathic, mixed), degree of sensory loss in painful area (no, mild, moderate to severe loss), presence of motor weakness, and preoperative VAS.

All statistical analyses were performed with SPSS (ver. 15.0, Chicago, IL, USA). Statistical significance was accepted at a probability value of less than 0.05.

Results: There was no significant differences between the two groups (success or failure in trial stimulation) in terms of age, degree of pain (preop. VAS), number of operation, duration of pain ($p > 0.05$, independent t-test). There was also no differences between the two groups in terms of age, sex, location of predominant pain (axial or limb), location of electrode (T8/9 or T12/L1), type of pain, presence of motor weakness, degree of pain duration (chi-square test, $p > 0.05$). However, there were differences between the two groups in terms of type of electrode, degree of sensory loss, and presence of severe sensory loss (chi-square test, $p < 0.05$). Univariate analysis revealed that sex, age, loca-



tion of predominant pain, location of electrode, type of pain, presence of motor weakness, degree of duration of preoperative pain were not associated with success in trial stimulation. However, 3 covariates (type of electrode, degree of sensory loss, and presence of severe sensory loss) were associated with the success in trial stimulation.

Conclusions: Our results showed that the type of electrode (paddle rather than cylindrical), degree of sensory loss in painful area, and presence of severe sensory loss could influence the results of trial SCS in patients with FBSS.



S9-Clinical Outcomes of Pulsed Radiofrequency Neuromodulation for the Treatment of Occipital Neuralgia

최혁재¹, 양진서¹, 강석형¹, 조용준¹, 임영진²

한림대학교 춘천성심병원 신경외과¹, 경희대학교병원 신경외과²

Objective: Occipital neuralgia is characterized by paroxysmal jabbing pain in the dermatomes of the greater or lesser occipital nerves caused by irritation of these nerves. Although several therapies have been reported, they have only temporary therapeutic effects. We report the results of pulsed radiofrequency treatment of the occipital nerve, which was used to treat occipital neuralgia.

Methods: Patients were diagnosed with occipital neuralgia according to the International Classification of Headache Disorders classification criteria. We performed pulsed radiofrequency neuromodulation when patients presented with clinical findings suggestive occipital neuralgia with positive diagnostic block of the occipital nerves with local anesthetics. Patients were analyzed according to age, duration of symptoms, surgical results, complications and recurrence. Pain was measured every month after the procedure using the visual analog and total pain indexes.

Results: From 2010, ten patients were included in the study. The mean age was 52 years (34-70 years). The mean follow-up period was 7.5 months (6-10 months). Mean Visual Analog Scale and mean total pain index scores declined by 6.1 units and 192.1 units, respectively, during the follow-up period. No complications were reported.

Conclusion: Pulsed radiofrequency neuromodulation of the occipital nerve is an effective treatment for occipital neuralgia. Further controlled prospective studies are necessary to evaluate the exact effects and long-term outcomes of this treatment method.



S10-Gammaknife Radiosurgery for the Treatment of Brain Metastasis: A Review of 52 Patients

Joon Cho¹, Jong-Gon Lee¹, Young-Cho Koh¹, Sang-Woo Song¹, Hong-Ki Roh²

Departments of Neurosurgery¹, Radiology², Konkuk University Medical Center, Seoul, Korea

Objective: Brain metastasis occurs in 20-40% of cancer patients and the prevalence is likely to increase as new systemic treatments become available to prolong the lifespans of patients. Historically, whole brain radiation therapy has been the main treatment for brain metastasis. Stereotactic radiosurgery delivers high-dose focused radiation and is being increasingly utilized to treat brain metastasis. We investigated the result of GKS in 52 brain metastasis patients who were treated from October, 2008 to June, 2012.

Methods: The medical records of 52 patients (Male: 10, Female: 42) with brain metastasis who underwent stereotactic radiosurgery from Oct. 2008 to Jun. 2012 were reviewed retrospectively. The duration of mean follow-up was 9.98 months ranging from 1 months to 43 months. The patients were categorized by their duration of disease free period, average life span, and complications from the point they underwent GKS were investigated. All patients were followed-up post-operatively by taking brain MRI periodically. In patients with symptomatic change, additional image study was done at the point of symptomatic change. The first follow-up brain MRI was taken 3 months after GKS, then every 9 to 12 months. The results of the follow-up brain MRI were evaluated in terms of change in size of the lesion.

Results: Among 52 patients with brain metastasis who underwent gamma knife radiosurgery, 34 patients had expired. Average survival duration of expired patients was 8 months (from 1 months to 29 months). Primary tumor of origin included lung cancer (39%), breast cancer (30%), colorectal cancer (19%), Liver (2%) and etc (10%). Average disease free duration was 7.7 months (from 1 month to 19 months). In the follow-up MRI, there were 32 cases in which the tumor size decreased, and 7 cases where no change or size increment were noted. 13 patients were expired before first MRI follow-up.

Conclusion: The average life span of patients with metastatic brain tumor is increasing due to the advance in the management of cancer. In the past days when the life expectancy of such patients was short, whole brain radiotherapy was recognized as the standard treatment regardless of the prognosis. Along with the increase in their life expectancy, increasing their life quality has been taken into consideration. GKS can be said to be a safe and effective means of treatment in patients with metastatic brain tumor.



S11-Gamma Knife Radiosurgery of the Brainstem Cavernous Angioma

김병섭, 연제영, 김종수, 홍승철, 이정일

성균관대학교 의과대학 삼성서울병원 신경외과학교실

Objective: 이 연구는 반복적으로 rebleeding 할 위험도가 높고 수술의 난이도가 높은 brainstem cavernous angioma 환자에서 Gamma knife radiosurgery (GKRS)의 안전성과 효용성을 알아보기 위해 임상기록을 후향적으로 분석하였다.

Methods: 2002년 6월부터 2012년 10월 사이에 본원에서 brainstem cavernous angioma로 진단받고, GKRS를 받은 40명의 환자(남자 17명, 여자 23명)를 대상으로 하였다. 진단시 평균연령은 43.6세였다. radiosurgery 시행 전 5명(12.5%)에서 수술을 시행받았다. Brainstem cavernous angioma의 MRI에서 측정된 vol.의 평균값은 541.4 mm^3 (range: $36.8\text{-}1322 \text{ mm}^3$)였고, prescribed marginal dose의 평균값은 13.6 Gy (11-18 Gy) 였다.

Results: GKRS 후 평균 추적 관찰기간은 3.71년(range: 1.2개월-114.2개월)이었다. GKRS 시행 전의 총 hemorrhage 수는 36회로, 환자당 평균 0.9번의 출혈 병력(range: 0-4 events)이 있었다. GKRS 후 추적 관찰기간 중에는 총 6회의 출혈(6 episodes of bleeding/114.2 patient year, 5.3%/patient year))이 관찰되었다..

GKRS 시행 후 마지막 추적관찰시에 총 40명 중 34명에서 증상의 호전을 보였고, 3명에서 증상의 큰 변화가 없었으며, 3명에서 증상이 악화되었다. 증상이 악화된 3명의 환자 중 한명은 MRI상 크기가 감소하였고, 한명은 큰 변화가 없었으며, 나머지 한명은 GKRS 시의 F/U MRI 자료가 없는 환자이다.

Conclusions: 수술적 치료가 어려운 brainstem cavernous angioma의 치료에 있어서 GKRS는 비교적 안전하며, 대다수의 환자에서 병변의 크기 감소 및 신경학적 증상의 호전을 기대할 수 있다. GKRS 후의 annual hemorrhage rate는 5.3%로 계산되어 크게 호전이 없는 것 같으나, latency period가 지나기 전의 annual hemorrhage rate가 포함된 때문으로 생각되며, 이후의 위험도는 훨씬 낮을 것으로 추정된다.



S12-Stereotactic Radiosurgery for Metastatic Brain Tumors in the Motor Cortex

In-Young Kim, Shin Jung, Tae-Young Jung, Woo-Youl Jang, Kyung-Sub Moon, Seung-Jin Park, Sa-Hoi Lim

*Brain Tumor Clinic & Gamma knife Center, Department of Neurosurgery, Chonnam National University
Hwasun Hospital, Chonnam, Korea*

Objective: The result of stereotactic radiosurgery (SRS) for metastatic brain tumors (Mets) is reported to be favorable in the point of tumor control and the patients' survival. However, on the functional outcomes after SRS for Mets, only a few papers have been reported. Mets in the motor cortex could induce contralateral hemiparesis which worsens the patients' functional status. We managed the patients with Mets in the motor cortex with SRS, and investigated the clinical results including the functional outcome as well as the local control and the patients' survival.

Methods: Between June 2004 and November 2011, total 172 patients with motor cortex metastasis underwent gamma knife radiosurgery (GKR). The mean age was 61.6 years (range, 16 to 86). The most common primary cancer type was nonsmall cell lung cancer (n=112). The number of patients with single motor cortex metastasis was forty-five (26%), and others had multiple metastases including a motor cortex metastasis. Most of the patients were RPA class I (33%) and II (62%). At GKR, the mean tumor volume in the motor cortex was 3.32 cc and the median prescription dose was 22 Gy (range, 12 to 24) prescribed to the tumor margin.

Results: The clinical and imaging follow-up was done in 121 patients. The tumor control rate of the motor cortex metastasis was 78.5% (95 out of 121 tumors), and the median progression-free survival was 6.0 months. The favorable outcome was found in (1) dose >18 Gy, (2) tumor volume <5 cc, and (3) lung cancer primary, but they were not statically significant. The locally recurred tumors were managed with second GKR (n=14), whole brain radiation therapy (WBRT) (n=6), simple palliation (n=5), and resection (n=1). Newly developed metastases were detected in 73 patients, and they were managed with second GKR (n=48), simple palliation (n=29), WBRT (n=18), and resection (n=1).

On the functional results at 3 months after the GKR, Karnofsky performance score (KPS) was preserved in 83 patients, improved in 20, worsened due to the motor cortex metastasis 14, worsened due to systemic cancer aggravation 5, and worsened due to other brain metastasis 1.

The overall median survival after the SRS was 8.6 months. The statistically significant prognostic factors related to overall survival were single motor cortex metastasis (p=0.021) and improved or stable KPS at 3 months after GKR (p=0.053).



Conclusions: SRS for motor cortex Mets is not only a good treatment option for local tumor control, but also can provide higher performance state during survival, which could lead to active systemic chemotherapy for prolonged overall survival. We believe that SRS can give great effect on the quality of life of the patients with motor cortex metastasis.



S13-Treatment Outcome of Gamma Knife Radiosurgery for Intracanalicular Vestibular Schwannomas: Focused on Hearing Preservation

In Ho Oh, Chang Kyu Park, Seok Keun Choi, Won Seop Seo, Young Jin Lim

Department of Neurosurgery, School of Medicine, Kyung Hee University, Seoul, Korea

Objective: Improvement of diagnostic technique gives more trouble about the treatment of intracanalicular vestibular schwannomas with hearing disturbance. Recently, low dose gamma knife stereotactic radiosurgery is an excellent alternative treatment modality than conservative or microsurgical treatment. The authors evaluated tumor control and clinical outcomes after gamma knife radiosurgery in such patients.

Methods: 28 patients (13 men and 15 women) with intracanalicular vestibular schwannomas underwent gamma knife radiosurgery at Kyung Hee medical center between 1997 and 2011. Chief complaints of patients were hearing disturbance, tinnitus, dizziness and headache. The mean patient age was 47.4 years (range, 18-63 years). The mean tumor volume was 0.198 mm³ (range, 0.028-0.385 mm³), and the mean margin dose was 13.4 Gy (range 11-16.8 Gy). Gardner-Robertson (GR) classification was used for hearing evaluation and all tumors were Koos Grade I lesions.

Results: The median follow up period was 18months and tumor control rate was 100% (28 of 28). At the time of gamma knife radiosurgery was done, serviceable hearing was observed only 25% (7 patients) of all patients. Among these patients, serviceable hearing was preserved in all patients but worsening was seen in 2 patients. Between all 28 patients, hearing grade improvement was seen in 6 patients. No other radiosurgery related complication was seen.

Conclusions: The result of these study shows that low dose gamma knife radiosurgery is an excellent treatment tool for intracanalicular vestibular shwannomas without complications.



S14-Influence of Radiofrequency on Cerebral Function: Secretory Function of Melatonin in Rat

Young Hwan Ahn¹, Hye Sun Kim¹, Hyung Do Choi², Jeong-Ki Pack³, Nam Kim⁴

¹Department of Neurosurgery, Ajou University School of Medicine, ²Electronics and Telecommunications Research Institute,
³Department of Radio Sciences and Engineering, College of Engineering, Choongnam National University, and ⁴School of
Electrical and Computer Engineering, Chungbuk National University

As a part of investigation of the potential risks of Radiofrequency (RF) to human health, we studied whether the 915 MHz radiofrequency identification (RFID) exposure to rats can cause any changes in secretion of melatonin. For this trial, a reverberation chamber as a whole-body exposure system was used for animal study at 915 MHz RFID and its validity has been verified. The animals were exposed for 1 or 8 hrs during the day-time or the night (5 days a week, whole body SAR 2W/kg) for 2 weeks. The urine of rats was collected separately during the daytime and the night. Urinary level of melatonin was evaluated by simultaneous analysis of melatonin and its precursors by gas chromatography-mass spectrometry (GC-MS). Our preliminary results suggests that extremely high energy long-duration RFID exposure during the night may induce suppression of melatonin synthesis of melatonin significantly, although changes under the same-level exposure during the day-time did not reach significance.



memo

