TREATMENT OF DEEP-SEATED CEREBRAL LESIONS BY STEREOTACTIC CRANIOTOMY

DERİN YERLEŞİMLİ SEREBRAL LEZYONLARIN STEREOTAKSİK KRANİOTOMİ İLE TEDAVİSİ

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ABSTRACT

Purpose: *To investigate the role of stereotactic craniotomy in the management of deep-seated cerebral lesions.* ***Method:*** *Between March 1998 and April 2001 stereotactic craniotomy and microsurgical lesion resection was performed in 11 patients with intracranial lesions that were deep-seated. There were 6 males and 5 females and their ages ranged from 6 to 56 years. All procedures were done with a Fischer stereotactic system.* ***Results:*** *Astrocytoma was diagnosed pathologically in 4 patients, abscess in 2 patients, germinoma in 2 patients, cavernoma in 2 patients and small cell carcinoma (ca) metastasis in 1 patient. Total resection was accomplished in all cases, with postoperative imaging confirming complete removal. There were no surgical mortalities or serious complications.* ***Conclusion:*** *Stereotactic craniotomy and microsurgical resection is a reliable method to obtain good outcomes in the treatment of deep-seated cerebral lesions.*

Key Words: *Deep-Seated Cerebral Lesion, Microsurgery, Stereotactic Craniotomy, Stereotaxy.*

ÖZET

Amaç: *Derin yerleşimli serebral lezyonların tedavisinde stereotaksik kraniotominin rolünü araştırmak* ***Metod:*** *Mart 1998 ile Nisan 2001 tarihleri arasında intrakranial derin yerleşimli lezyonlu 11 hastada stereotaksik kraniotomi ve mikroşirürjikal lezyon rezeksiyonu uygulandı. 6 erkek ve 5 kadın vardı ve yaşları 6 ile 56 arasında değişmekteydi. Tüm prosedürler Fischer stereotaksik sistemle yapıldı.* ***Bulgular:*** *Patolojik olarak astrositoma 4 hastada, abse 2 hastada, germinoma 2 hastada, kavernoma 2 hastada ve küçük hücreli karsinom metastazı 1 hastada saptandı. Tüm olgularda tam çıkarılımın operasyon sonrası görüntülemeyle konfirme edildiği total rezeksiyon gerçekleştirildi. Ne cerrahi mortalite ne de ciddi komplikasyon olmadı.* ***Sonuç:*** *Stereotaksik kraniotomi ve mikroşirürjikal rezeksiyon derin yerleşimli serebral lezyonların tedavisinde iyi bir sonuç elde etmede güvenilir bir metoddur.*

Anahtar Kelimeler: *Derin Yerleşimli Serebral Lezyon, Mikrocerrahi, Stereotaksik Kraniotomi, Stereotaksi.*

INTRODUCTION

Deep-seated cerebral lesions are generally considered inoperable or difficult to operate on. Little is known about the nature of these lesions. Stereotaxy-guided craniotomy and microsurgical resection of cerebral deep-seated lesions does not require expensive, specially designed equipment, and it is easy and cheap to perform. With stereotactic guidance deep-seated cerebral lesions can be localized and removed without morbidity.

This study reports on the excision of deep-seated cerebral lesions by using stereotaxy-guided craniotomy and microsurgical resection techniques.

PATIENTS AND METHODS

Eleven patients who were admitted to the Department of Neurosurgery, Gazi University

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School of Medicine, Ankara, Turkey between March 1998 and April 2001 with a diagnosis of cerebral deep-seated lesion, and all were treated by stereotactic craniotomy. Patients had both computed tomography (CT) and magnetic resonance (MR) scans suggestive of a cerebral deep-seated lesion in either the thalamic or basal ganglia localization (Fig. 1). Glasgow coma scores at the time of surgery and Glasgow outcome scores at 3 months follow-up were noted (1,2).

A Fischer stereotactic frame was applied with four pins under local anesthetic (Fig. 2a and b) and the patient was then transferred to the CT scanning unit where contrast-enhanced CT images were obtained (Fig. 3). The trajectory was calculated with the help of cartesian coordinates x, y and z on the CT image by using the software of the stereotactic system. The patient was taken to the operating room and the operation was performed under general anesthetic with endotracheal intubation (Fig. 4a). With the help of the trajectory a linear skin incision and a small craniotomy of 4 cm diameter was performed. The dura was opened and a minimal transsulcal-subcortical incision was made (Fig. 4b). The lesion was totally resected microsurgically with the help of an inserted trajectory probe. All patients had total microsurgical resection of their tumors, and this was confirmed by immediate postoperative contrast-enhanced images (Fig. 5a). Subsequent images were reviewed for

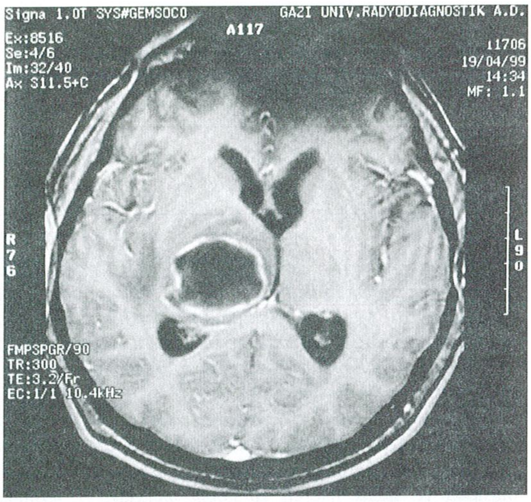

Fig. 1: Right thalamic cystic lesion showing marked surrounding enhancement after infusion of contrast agent on axial T-1 weighted MRI.

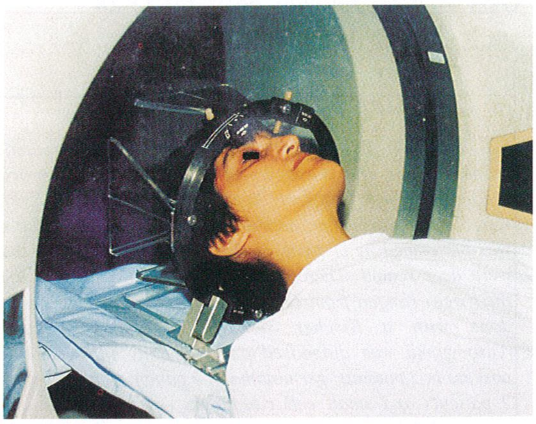

Fig. 3: Patient in a CT scanner.

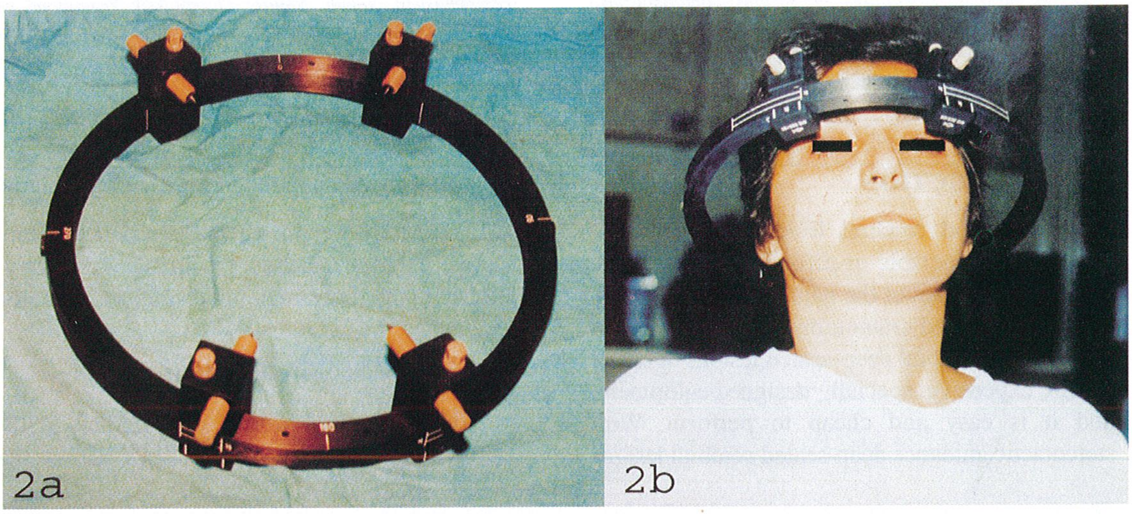

Fig. 2: Fischer stereotactic frame with four pins (A). Fischer stereotactic frame was placed on the patient's head with four pins under local anesthesia (B).

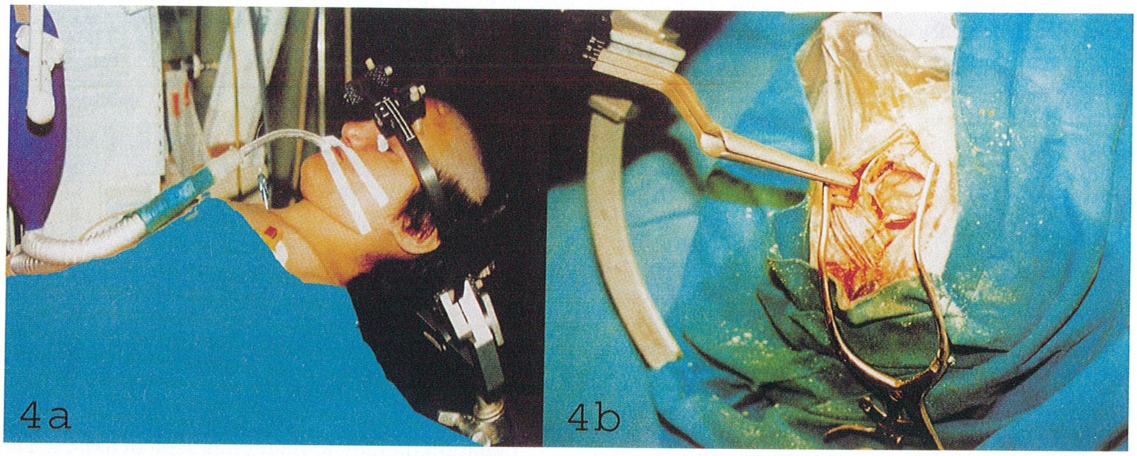

Fig. 4: The patient is under general anesthesia with endotracheal intubation during the operation (A). After draping the patient the stereotactic aiming bow was placed and the stereotactic probe was used to plan the craniotomy. The scalp was opened with a linear incision and a 4-cm craniotomy was performed and the dura was opened. A transsulcal-subcortical incision is then made microsurgically (B).

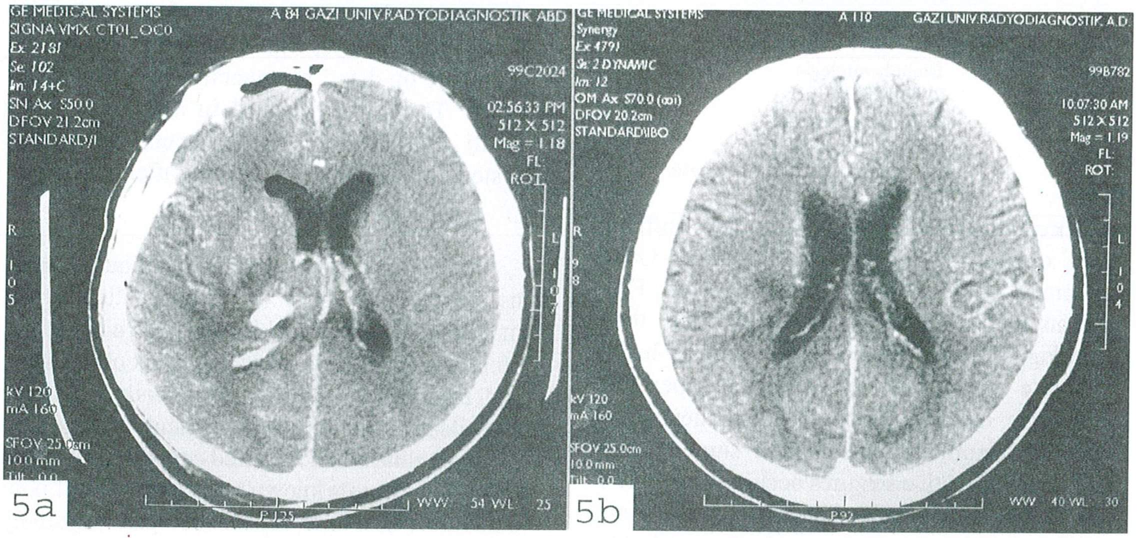

Fig. 5: Immediate postoperative CT image showing microsurgical total resection of the lesion and a silicon drainage catheter. Since the diagnosis indicated an abscess, we positioned a silicon drainage catheter postoperatively for 3 days (A). No sign of abscess was seen on 3-month follow up CT (B).

evidence of recurrence (Fig. 5b).

Pathological diagnosis was made both based on the intraoperative analysis of smear preparations and postoperative studies. Pus was sent for immediate microbiological analysis and culture in 2 patients with the suspicion of abscess.

RESULTS

Eleven patients ranging in age 6 to 56 years, with a median age of 31 years, were enrolled in this study. There were 6 men and 5 women. The deep-seated lesions of 11 patients were in either thalamic (5 right, 3 left) or basal ganglia (2 left, 1 right) localization. Glasgow coma scores at the time of surgery and Glasgow outcome scores at 3 months follow up are shown in Table 1. Presenting symptoms included hemiparesis in 7 patients, hemiplegia in 2 patients, lower extremity paresis in 2 patients and epilepsy in 4 patients (Table 2).

In all cases the lesion was quickly localized and all patients had total microsurgical resection of their lesions after stereotactic craniotomy, confirmed by immediate postoperative contrast-

Table-1: Age (year), sex, Glasgow coma score (GCS), Glasgow outcome score (GOS) and follow up period (month) of the patients are shown. The location and the pathological diagnosis of the lesions are also shown.

Patient	Age/Sex	GCS	Location	Pathology	GOS	Follow up
1	15/F	14	Left thalamic	Giant cell astrocytoma	5	50
2	16/M	15	Right thalamic	Cavernoma	5	45
3	9/F	14	Left basal ganglia	Pleomorphic astrocytoma	5	41
4	25/F	13	Right thalamic	Pleocytic astrocytoma	5	12
5	43/M	14	Right thalamic	Abscess	5	37
6	48/M	12	Left basal ganglia	Abscess	4	34
7	41/M	15	Left thalamic	Germinoma	5	30
8	50/M	14	Left thalamic	Germinoma	4	27
9	28/F	15	Right thalamic	Cavernoma	5	8
10	56/M	11	Right basal ganglia	Small cell ca metastasis	3	16
11	6/F	14	Right thalamic	Pleocytic astrocytoma	5	9

Table-2: Presenting symptoms of patients on admission.

Patient	Neurological examination
1	Right hemiparesis
2	Left hemiparesis
3	Epilepsy, right hemiparesis
4	Left lower extremity paresis
5	Left hemiparesis
6	Epilepsy, right hemiparesis
7	Right hemiplegia
8	Right hemiparesis
9	Left hemiparesis
10	Epilepsy, left hemiplegia
11	Epilepsy, left lower extremity paresis

enhanced images (Fig. 5a). No patient suffered from residue or recurrence (Fig. 5b). Good outcomes were achieved in all patients. Five patients had a significant improvement in their neurological examinations and 6 patients had a complete resolution of their preoperative neurologic deficits. None of the patients had increased neurologic deficit after surgery. In 1 patient, preoperative seizures occurred but after 1 year follow-up no further seizures occurred while on anticonvulsants. Non-neurologic morbidity includes 1 case of deep venous thrombosis.

The pathological diagnosis was astrocytoma in 4 patients, cavernoma in 2 patients, abscess in 2 patients, germinoma in 2 patients and small cell ca metastasis in 1 patient. Bacteriological culture revealed *Staphyllococcus aureus* in 1 case and a Gram-negative anaerobic bacillus in the other. Antibiotic treatment was then adjusted according to the relevant antibiogram. In patients with the diagnosis of abscess, no source of infection could be identified.

Three patients with the diagnosis of germinoma and small cell ca metastasis received postoperative cranial radiation therapy. Patients with a diagnosis of germinoma also received radiation therapy to their craniospinal axises. The site of primary disease was the lung in the patient with small cell ca metastasis.

Follow-ups were performed between 8 and 50 months. The median hospital stay following surgery was 4 days, with most patients ready for discharge on day 3 postoperatively. There was 1 death. The death occurred in a patient with a small cell ca metastasis because of severe systemic malignancy 16 months after surgery.

DISCUSSION

Stereotactic neurosurgical techniques can be used to obviate many of the difficulties in the management of cerebral lesions (3). In our study, 10 of the 11 patients made an excellent recovery, and managed to return to their daily activities. The death occurred in a patient with severe systemic illness and impaired conscious levels on admission, factors known to be indicative of poor outcome (4). These figures compare favorably with the results of extensive surgery. Our results show no operative mortality or morbidity, an improvement in quality of life and shorter hospitalization period.

There are two kinds of stereotactic techniques for guiding surgical approaches to intracranial lesions: functional stereotaxy and morphologic stereotaxy (5). Functional stereotaxy aims at movement disorders, epilepsy, pain and psychosurgery, while morphologic stereotaxy is for tumors, epilepsy, hydrocephalus, aneurysms and pain. In morphologic stereotaxy, the target (the lesion) is calculated with the help of a CT scanner along with an appropriate software package. Then the surgical approach is performed according to this target. Frameless stereotactic systems and frame-based stereotactic systems are the two stereotactic systems used when performing surgical approaches (6). Many surgical approaches have been used for deep tumor locations, such as transsulcal, transsylvian, transcortical and interhemispheric approaches. The selection of the approach to thalamic and basal ganglia tumors depends on whether they are located anteriorly, posterodorsally or posteroventrally. The issue is the preservation of normal brain structure. We selected a transsulcal-subcortical incision. A convenient sulcus was split microsurgically, and then a cortical incision was made at the bottom of this sulcus. Frame-based stereotactic systems provide stereotactic localization within a standard stereotactic frame. Frame-based stereotactic systems have the advantage of proven clinical utility and instrument carriage with a high degree of mechanical stability. Frame-based stereotactic systems remain the gold standard for the accurate targeting of lesions less than 10 mm and for functional procedures (7). Frameless stereotactic systems are more complex, because of the need for expensive imaging systems and special equipment, but they are also more flexible (6). Since frame-based stereotactic systems use pins to apply the frame to a patient's head, the risk of frame-related complications such as superficial infections, osteomyelitis at the pin insertion sites and epidural hematomas can occur. These did not occur in our study. In frame-based systems, expensive and special equipment is not needed. For good surgical orientation and precise localization, frame-based systems are useful because of their accuracy (8). In our study, for the microsurgical resections of deep-seated lesions we used frame-based stereotactic systems and morphologic stereotaxy.

The stereotaxy-guided craniotomy and microsurgical resection of cerebral deep-seated lesions is simple to perform and relatively inexpensive. It requires no specially designed equipment, only a standard stereotactic apparatus, an operating microscope and the usual microsurgical instruments (9). Stereotaxy is cost effective for the surgical treatment of cerebral lesions (10). Stereotaxy and microsurgery have reduced surgical trauma by allowing surgeons to plan the least damaging route to operative sites (11). The use of stereotaxy allows the microsurgical treatment of abscesses, establishing the diagnosis and enabling microbiological evaluation and appropriate antibiotic therapy (12).

Combining the power of stereotaxy with open craniotomy in a stereotaxy-guided craniotomy decreases surgical time, morbidity and postoperative hospitalization. Using a Fischer stereotactic system allows a) precisely planned cortical entry, b) minimal cortical damage, c) minimal neurologic morbidity, d) accurate localization, e) total lesion excision and f) small craniotomies through linear incisions.

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