Stereotactic Open Craniotomy and Laser Resection of Brain Tumours
A Five Years Experience.

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Summary

In 23 cases of deep-seated brain tumours stereotactically guided laser vaporization has been done, using a 60 watts CO₂ laser. The experiences and results of the 18 first cases with a follow-up of 10 months to 5 years are presented. The technique is described.

Keywords: Brain tumour; CO₂ laser vaporization; stereotactic guidance; results.

Introduction

Surgical treatment of deep-seated tumours, has been associated with high morbidity and incomplete removals. It is especially true with small neoplasms in the subcortical white matter due to difficulties in localization, poor spatial orientation and the unclear delineation of the neoplastic tissue boundaries.

The introduction of stereotactic techniques to guide the open surgical procedures when dealing with small and deep-seated lesions is quite old¹³,¹⁴, but in recent years it has been associated with microsurgical techniques and CT-compatible stereotactic frames¹,²,³,¹¹,¹⁴. More sophisticated technical advances include the vaporization of the tumour with lasers⁴,⁶, determination of volume and shape with computers, data acquisition from the MRI⁷,¹²,¹⁵ and the use of endoscopy or ultrasounds in the surgical field¹,⁴,¹⁵.

In the present paper, we report our experience, current methodology and results obtained in eighteen cases of intracerebral small deep-seated tumours, treated with a 60 watts CO₂ laser vaporization (Sharplan Ind.) stereotactically guided with the data from CT and MRI.

Material and Methods

A. Surgical Procedure

Under local anesthesia a CT-compatible stereotactic frame built in plastic material is fixed to the patient’s skull by three aluminium alloy screws. The frame is a third prototype derived from a Riechert-Mundinger device and is also MRI compatible. Fiducial marks in the CT scan are obtained from metallic wires with a “N” disposition included in a plastic hollow cylinder as in other stereotactical systems (Fig. 1). The marks used for the MRI study are obtained from 3 mm paraffin-filled tubes. The X, Y and Z, coordinates of the target point, other reference points, trajectory, volume and shape of the tumour are calculated by computer and transferred to a phantom. The patient, is then anaesthetized in the operating room.

Our guide holder system permits without new calculations—biopsies in an area of 2.5 cms radius around the initial trajectory, changes of the biopsy cannula for an endoscope or the adaptation of cylindrical brain retractors.

A craniotomy with a 3–4 cm of diameter is centered around the entry point. The CO₂ laser, coupled with the microscope, is moved to the operating field and the He-Ne aiming beam of the laser is aligned in the biopsy-cannula direction. The microscope arms are strongly fixed in order to avoid deviations in the trajectory to the target point.

A linear corticotomy is performed using a mean power of 4 watts, moderately defocused and in continuous mode. Small retractors can be used manually to spread the brain incision. We have developed a set of cylindrical plastic and metallic retractors of various lengths and diameters which fits into the guide holder. To get down into the tumour, a cannula with an inflatable balloon in the tip is placed in the “mouth” of the cylindrical retractors in order to dilate the wound and avoid damage in the subcortical white matter (Fig. 2). The wound depth can be read on the retractors or assessed by replacing the cannula or by biplane radiology. Such corticotomy can be also done in a standard way or guided by a plastic catheter down to the tumour’s surface.

The tumour surface is coagulated with 3–5 watts and its core is vaporized with powers of 10 to 30 watts. In hypervascularized tumours, the superpulsed mode use avoids the oozing usually seen with the CO₂ laser. The tubular retractors can be moved to follow...
Fig. 1. (a) CT slice with the stereotactic frame and localization system in a case of subcortical tumour. The metallic marks engraved in the plastic hollow cylinder gives six fine reference points. (b) MRI slice with the stereotactic frame. The fiducials are obtained from 3 mm. paraffin filled tubes.

The irregular borders of the tumour but a return to the target point is always possible by centering the He-Ne beam in the microscope photographic reticula, replacing the biopsy cannula or using biplane radiological facilities.

In cystic lesions an endoscope can be introduced through a burr hole, replacing the cannula, to visualize the lesion, to perform a biopsy or to vaporize the tumour by coupling with the CO₂ laser arm. This technique was used in two of our patients.

B. Clinical Material

Since 1985, 23 patients have been operated on with this technique, though only the first 18 with a follow up ranging from 5 year to 10 months will be discussed in this paper.

There were 11 men and 7 women, with ages ranging from 11 to 64 years. Initial symptoms were convulsive seizures in 9, in 4 progressive intracranial hypertension due to obstructive hydrocephalus, in 4 hemiparesis and in 1 case subarachnoid haemorrhage.

In every case the CT and MRI demonstrated a deeply placed expansive process with size ranging from 1 × 1 × 1 to 3 × 5 × 4 cms, mean size 3 × 2 × 3 cms. The mean estimated volume was 16.4 c.c. In 12 cases the tumour was in the dominant hemisphere, in 3 it was medially placed and in 3 cases it was located in the non dominant side.

The preoperative radiological assessment suggested a low grade astrocytoma in 10 cases.

Results

No neurological deficit appeared after the surgical procedure in 11 patients, in 5 cases mild and transient motor weakness was detected, in 2 cases transient speech disturbance and in one case of left parieto-occipital astrocytoma a visual field defect was the only neurological sequela. No patient died as a result of the surgical intervention.

The accuracy of the surgical resection was evaluated as “high” when the tumour removal was complete or over 80% of the presumed preoperative volume, “medium” when it was over 50% and “minimal” when it was under 50%. In 16 cases the precision was high, in 2 medium and minimal in none.

Tolerance to the surgical trauma was evaluated in relation to postoperative complaints, resting time and days of hospital stay. It was considered “very good” in 15 cases, “normal” or similar to a conventional procedure in 2 and “bad” in 1 patient of 61 years with a III ventricle astrocytoma.

The final pathological diagnosis was in 10 cases astrocytomata (7 fibrillary, 3 grades II-III) in 2 cases...