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Contribution Of Stereotaxic Biopsy in the Brain Tumors Management: About 101 Cases

Badache K[1*], Habchi N[1], Guenane L[1], Abdelaoui W[3], Ioualalen N[3] and Djaafer M[1,4]

[1]*Neurosurgery Department, MUSTAPHA PACHA University Hospital, Algiers, Algeria*
[2]*Neurosurgery Department ALI AIT IDIR Hospital Health Establishment, Algiers, Algeria*
[3]*Neurology Department ALI AIT IDIR Hospital Health Establishment, Algiers, Algeria*
[4]*Head of Neurosurgery Department, MUSTAPHA PACHA University Hospital, Algiers, Algeria*

[*]Corresponding author: Badache Kenza, Neurosurgery Department, MUSTAPHA PACHA University Hospital, Algiers, Algeria

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Abstract

Introduction: *The advent of stereotaxic biopsy (STB) and the development of CT and MRI have improved the management of brain tumors. The aim of this study is to evaluate the role of STB in the management of brain tumors.*

Material and Methods: *Retrospective study from 2000 to 2020 concerning 101 consecutive patients with brain tumours, having benefited from a STB, collected in the neurosurgery departments of the the public hospital establishment of AIT IDDIR and Mustapha and Mustapha BACHA university hospital center. The seat of the lesion is deep or functional (the Rolondic region, hemispherical, basal ganglia, lateral ventricles and brainstem and pineal region). STB was performed under CT guidance in all cases. For pineal tumours, arteriography with venographic time and preoperative MRI has been deemed useful to avoid hemorrhagic complications.*

Results: *In 101 cases, the STB was conclusive on the first attempt (90%). The repetition of the STB made it possible to re-establish a precise diagnosis in (5.94%) It was malignant lesions (70% of the cases). The average age of the patients was 46 years (3 to 72) with a male predominance.*

The topography of the lesions is: 75.13% in the Rolondic region, Central Gray Nuclei, Brainstem and pineal region; 12.87% in the corpus callosum and lateral ventricles and 12.5% in the eloquent superficial lesion. Postoperative complications are dominated by mortality 5.9% followed by partial epileptic seizure 2.98% and severe neurological disorders 1.98%, bilateral ptosis 1.98% and hemiplegia 0.99%. Perioperative mortality fell from 10.45% before 2005 to 1% after 2006 (Chi-square; p = 0.010).

Conclusion: *STBs should be staged and repeated in case of inconclusive histology. For small deep lesions STB under MRI conditions is necessary. For pineal tumours, it must be performed by the transtemporal orthogonal approach.*

Keywords: Stereotaxic Biopsy, Brain Tumor, Pineal Tumors

Introduction

The advent of stereotactic biopsy (STB) with the development of CT and MRI has improved the management of brain tumors. The constant evolution of this procedure and the modification of the therapeutic strategy have resulted not only in the reduction of complications and mortality, but also in the limitation of the rate of blank biopsies. The aim of this study is to evaluate the role of BST in the management of brain tumors.

Material and Method

This is a retrospective study from 2000 to 2020 concerning 101 consecutive patients, collected from the Neurosurgery departments of the public hospital establishment of AIT IDDIR (2000-2018) and the Mustapha PACHA university hospital (2018-2020) for brain tumors, having benefited from a STB.

The mean age was 46 years (range 3 to 72 years). 25% were over 60 years old. 47% of patients were female and 53% were male.

All recruited patients underwent brain CT, and 101 of them underwent MRI (71%).

The surgical procedure

99 patients underwent STB under local anesthesia, and two patients under general anesthesia.

Stereotactic frames

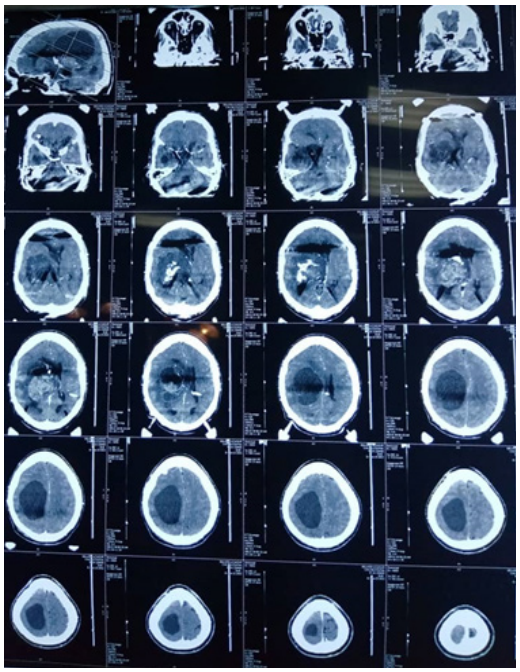
The scanner-compatible LEKSEL®-type stereotactic frame (CT) was used.

The stereotactic procedure can be performed under local anesthesia (patients over 60 or presenting an anesthetic risk) or under conventional general anesthesia. Attaching the stereotactic frame is simple; it is carried out by means of four points which rest, through the skin, on the external table of the vault of the skull. The stereotaxic frame is itself attached to the scanner table. The identification of the lesion is carried out directly on the scanner's display console. The coordinates of height (Z), of position in the anteroposterior direction (coordinate Y) and of laterality (coordinate X) with respect to the geometric center of the frame are recorded in a very simple way.

Once the stereotactic frame was attached to the patient's head, tumor localization required CT identification in 101 cases. The target, the trajectory and the staggered sampling zone are calculated with precision, using suitable computer software (Figures 1 B and C). The STB is then performed in the operating room. Through a trephination, the probe is inserted to the target. The number of fragments made was on average 5.7 fragments (1 to 8) (Figures 1 and 2).

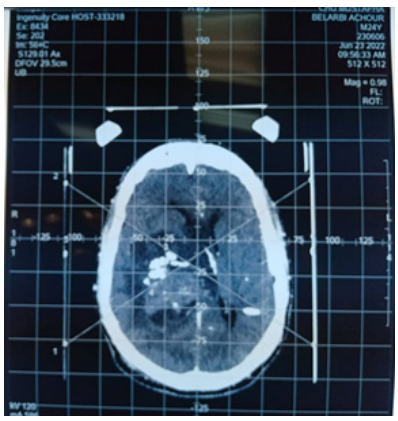
For pineal tumors, an arteriographic study with phlebographic times and a preoperative MRI have been deemed useful in order to reduce the risk of bleeding.

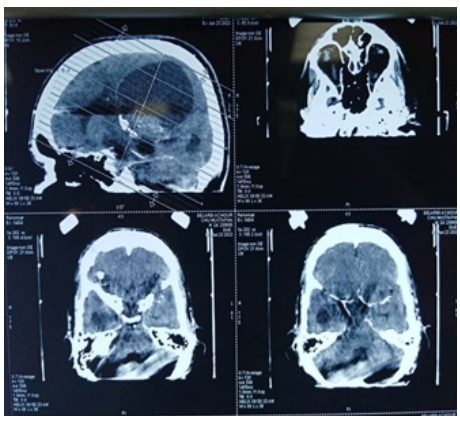
At the same time, a certain number of non-biopsy stereotactic gestures including in particular the evacuation of cysts were carried out



(A)

(B)





(C)

Figures A , B, C : Cerebral CT scan to identify the lesion is performed directly on the scanner display console

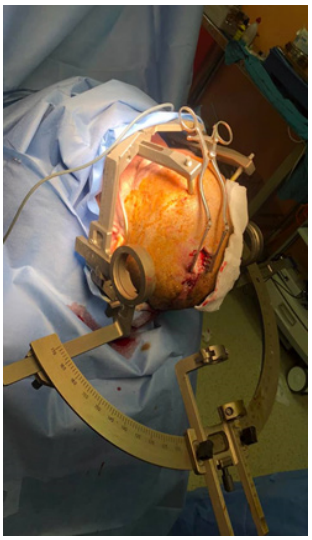
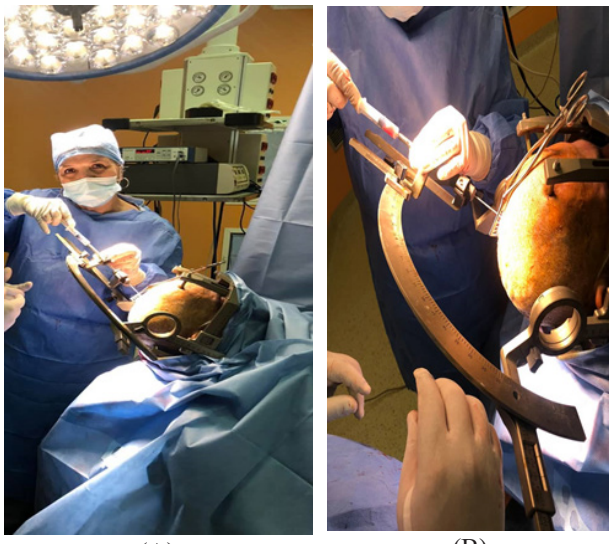


Figure 1: Realization of a burr hole in stereotactic condition



(A) (B)

Figure 1: Collection of the tumor sample under stereotactic condition (A, B)

Results

The clinical data were studied (Table 1). Headaches were the main symptom found in 75% of cases. A neurological deficit was found in 55% of cases. 14% of patients presented with comitiality. The decrease in visual acuity was found in 14% of patients.

The average size of the processes measured on MRI or, if necessary on CT, was 35.5 mm on average with extremes varying from 9 to 100 mm.

Table 1: clinical data of patients

Clinical data	Percentage
Headaches	75%
Neurological deficit	55%
Comitiality	14%
Reduced visual acuity	14%

Tumor location

Analysis of the tumor site showed that STB was performed for deep lesions (pineal region, corpus callosum, III ventricle). And in 23% of cases, for lesions located in a highly functional zone (language areas, internal capsule, Rolandic region, insula, etc.) (table 2).

Table 2: Location of brain tumors

Location of brain tumors	Percentage
Rolandic region, basal ganglia, brain stem and pineal region	75,13 %
Corpus callosum and lateral ventricles	12,87 %
Eloquent superficial lesion	12,5 %

Histological results

In 101 cases, the sampling allowed a conclusive anatomopathological examination on the first attempt (90%).

In 6 cases, the BST had to be repeated at least once before obtaining a conclusive histological study. In these cases, two STB procedures were necessary (5.94%).

The various histological diagnoses established after stereotactic biopsy (101 cases) are shown in Table 3. In the majority of cases, these were malignant lesions, most often malignant gliomas (37% of cases).

Table 3: Histopathological results

Histopathological results	Percentage %
Glioma	37%
Fibrillary astrocytoma Grade II and III	25,74%
High Grade Astrocytoma	17,82%
Low Grade Astrocytoma	13,86%
Tuberculoma, brain abscess	3%
brain metastasis	1%
Inconclusive	10%

Biopsy reliability

The biopsy proved reliable in 91 cases (90%). In 06 cases, the result proved to be imprecise the diagnostic doubt remained too great, the STB had to be repeated at least once before obtaining a conclusive histological study. A second biopsy was performed in 06 cases.

A repeat biopsy in all cases made it possible to establish a precise diagnosis.

The staggered nature or not and the number of samples appear as obvious factors of the reliability of the biopsy.

Complications of STB:

The overall mortality rate in the series was 5.9%. Perioperative mortality fell from 10.45% before 2005 to 1% after 2006 (Chi-square; $p = 0.010$). The other postoperative complications are: partial epileptic seizures 2.98%, severe neurological disorders 1.98%, bilateral ptosis 1.98% and hemiplegia 0.99% (Table 4).

Table 4: Postoperative complications of STB

Post-operative complications	Perrcentage
Mortality	5,9 %
Partial epileptic seizure	2,98%
Severe Neurological Disorders	1,98 %
Bilateral Ptosis	1,98 %
Hemiplegia	0,99%.

Because of these incidents, the therapeutic strategy as well as the technical modalities of STB have been modified for pineal tumors. Indeed, an angio-MRI and an angiography with phlebographic times were systematically performed for these locations, in order to visualize the course of the internal cerebral veins, which generally cover the tumor, and which make any frontal biopsy risky. The entry point and the trajectory of the probe were made by an orthogonal transtemporal approach. Since then, no bleeding incident has been reported. In the event of a highly vascularized pineal process, the STB is abolished in favor of an open biopsy which makes it possible to control any intraoperative bleeding.

Three other deaths occurred following STB in patients whose preoperative Glasgow score was < or = 7. Since this incident, STB has been abolished in comatose patients.

Discussion

The main interest of stereotactic biopsy is to obtain a histological diagnosis when a conventional surgical approach is considered highly risky. It is understood that these situations are frequent in the practice of neurosurgery. It is also important to weigh the indications according to the technical difficulty of the biopsy, and the material possibilities available.

Stereotactic frames

Several types of stereotactic frames can be used: Leksell, Brown Roberts Well (BRW) , Komai, or Radionics (CRW) frames, mainly [1,2]. These systems are very simple to use and can be used in daily practice, even in centers with little specialization. The Talairach frame lends itself well to stereotaxic arteriography, but its use on CT is more complicated, usually requiring an additional frame [3,4].

Choice of biopsy site

The work of Kelly and Daumas-Duport clearly demonstrated that the pathological areas gaining contrast practically always corresponded to tumor tissue (84.2% of cases) [5,6]. The hypodense zones appear less homogeneous; they correspond in 75.5% of cases to cerebral parenchyma infiltrated with isolated tumor cells, in 12.7% of cases to necrosis or edema and in 11.8% of cases only to tumor tissue itself.

On 184 biopsy samples, Greene found that centrotumoral hypodensity (61 samples) corresponded to tumor tissue in 55.7% of cases and to necrosis in 21.3% of cases. When the sample involves peripheral contrast uptake, the sample corresponds in 67.3% of cases to tumor tissue and in 3.9% of cases to necrosis [7].

In the case of a lesion of homogeneous density (without or after injection of contrast), it is the center of the lesion which usually constitutes the target. In the case of a lesion with a hypodense center (cystic or necrotic), it is preferable to choose an additional target at the periphery of the lesion, at the level of contrast uptake [8].

The actual biopsy is usually performed in the operating room. In the absence of arteriographic control, some authors prefer to make a classic burr hole 10 mm in diameter, in order to open the dura mater and puncture the cortex under visual control, limiting the risk of superficial hemorrhage [8]. For our part, we believe that a simple percutaneous trephination (orifice of 2 to 3 mm) can be considered for a frontal approach because the superficial venous network is relatively poor at this level.

Moreover, the rate of hemorrhage per cortical lesion is low. This trepanation can therefore be carried out with relative safety.

Special cases of tumors of the brain stem, pineal region and III ventricle

Depending on their exact location, brainstem tumors can be approached by several routes. Lesions of the cerebral peduncle as well as lesions located in the middle part of the pons, or even certain bulbar lesions can be biopsied by a frontal approach, following the long axis of the brainstem [8,9]. To minimize sequelae lesions related to crossing the brainstem, it is recommended to use small diameter trocars (1.5 mm in diameter for Hood [9]. Lateral lesions of the brainstem or lesions of the cerebellar hemispheres are usually approached via the suboccipital transcerebellar approach [8].Tumors of the pineal region can be approached by a lateral orthogonal approach or in double obliquity (anterior or posterior) [10].

The frequency of complications related to the biopsy of tumors in this region varies according to the series [10-12]. Mortality (1.3%) and morbidity (8%) of stereotaxis in the pineal region are identical to those of the rest of the brain [13]. This relatively high morbidity is transient in half of the cases and there is only 0.8% of severe morbidity [14-16]. In addition, stereotactic biopsy is criticized for not being representative, especially in mixed tumors with multiple components for which the prognosis and management can be quite different [17]. In fact, we can consider that the stereotactic biopsy is indicated in the cases where the clinic (especially the age), the imaging and the dosage of the markers are in favor of a radio- or chemosensitive tumor, or in the cases of invasive or disseminated tumors [18].

Third ventricle colloid cysts are usually approached frontally [19-22]. The trajectory is calculated to pass through Monro's hole, avoiding the internal cerebral and thalamo-striatal veins. An evacuation, even partial, can be enough to restore the circulation of cerebrospinal fluid and represent a definitive therapeutic method.

Biopsy trocars and histological examination

The biopsy trocar most commonly used today is the Sedan suction trocar [23]. Its external diameter is 2.5 mm. It allows to take cylindrical samples of 1.5 mm in diameter and 5 to 10 mm long. To increase the reliability of the biopsy, it is recommended to take several samples. This can be achieved by taking several samples from the same biopsy site by simply rotating the trocar on itself each time ('rosette sampling'). The samples can be

staged along the trajectory, leaving an interval of 2 mm between each biopsy site [8].

MRI

The Radionics (CRW) frame, like most recent frames, is compatible with this type of imaging, and the tracking systems are also suitable for all types of MRI coils.

MRI identification is particularly useful when tumor boundaries are poorly defined on CT [24]. The better visualization of anatomical structures – especially vascular ones – compared to the CT scan, is also an important element for the choice of certain difficult approaches [25]. However, the possibility of errors related to MRI identification should not be underestimated. The interpretation of the actual tumor areas is still not always obvious and measurement errors related to the deformation of the images by the magnetic field still exist [14,26].

Study of the main series of the literature

The French series published in 1985 represents the largest series of stereotactic biopsies found in the literature (11 centres, 3052 cases) [27]. The biopsy was negative (missed target) in 1 to 15% of cases, imprecise (false or uncertain result) in 1 to 27% of cases. The correlation between the histological result of the biopsy and that of the surgical specimen (in the case of secondary excision) was found to be good in 60 to 93% of cases. Postoperative mortality varied from 0 to 2.5% of cases (0.65% on average). Mortality has almost always been linked to a hemorrhagic stroke. Transient neurological worsening was observed in 4.5% of cases; permanent neurological deteriorations appeared in 1% of cases.

Out of 302 stereotactic biopsies performed by Ostertag, postoperative mortality was 2.3% of cases; transient neurological worsening was observed in 3% of cases [28].

Daumas-Duport insists on the interest of staged biopsies which make it possible to specify the spatial configuration of tumours [6].

Chandrasoma reported a series of 30 patients who underwent surgical excision after stereotactic biopsy [17]. There was a perfect correlation between the histological results in 19 cases out of 30 (63% of cases). There were 2 cases of true misdiagnosis (6.6% of cases). In 9 cases, the diagnosis turned out to be simply imprecise.

The management of intracranial expansive processes is closely linked to the histological nature of the tumour. At the cost of a reduced risk compared to open-air STB and despite Neuroradiological explorations.

Mortality remains high due to severe complications occurring in a context of tumors difficult to biopsy; hence the use of tumor markers and immunohistochemistry in the CSF which can give a diagnosis.

Conclusion

The improvement in STB strategy and procedure has made this technique safe and effective for the diagnosis of brain tumors even in case of pineal or brainstem tumor.

In order to improve efficiency, the authors recommend performing staged biopsies, multiplying STBs in the event of inconclusive histology and performing guidance under MRI conditions for small deep lesions.

Pineal lesions require a precise study of their vascularization by MRI and angiography with phlebographic times. The STB of these tumors must be performed by orthogonal transtemporal approach. For this location, the anterior frontal approach is prohibited.

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