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FRAME-BASED CT GUIDED STEREOTACTIC BIOPSY IN TREATMENT OF DIFFERENT BRAIN TUMORS

Abstract: *Introduction:* Frame-based stereotactic brain biopsy is a way for acquiring histological diagnosis as an important step in decision making process how to treat patients with different brain tumors.

Aim: This study present analysis of clinical, radiological and histological data in order to evaluate the reliability, accuracy and efficacy of the stereotactic brain biopsy.

Material and Methods: This retrospective study included a total of 108 patients who were hospitalized because of the intracranial tumors at the Department of Neurosurgery, Clinical Center of Vojvodina, Novi Sad, Serbia from January 2009 to December 2014. Age ranged from 16 to 81 with the mean age of 61, 15 years. All patients underwent CT guided stereotactic brain biopsy in the general anesthesia.

Results: Most frequent by location were deep seated tumors (thalamus/basal ganglia) in 58%. Multiple lesions were represented in 23%. In whole group we performed frozen section histological examination during the stereotactic procedure and later histological and immunohistochemical analysis. We achieved almost 100% diagnostic value in histopathology analysis with average 9 sample bits per single biopsy. There was only one transient and one permanent neurological deficits after the procedure. Patients were discharged from our clinic usually on the 4th or 5th postoperative day.

Conclusion: Through past decades frame-based stereotactic biopsy is established as a safe and reliable procedure, with minimum or without any complications, in the diagnosis and further therapy management of brain lesions.

Key words: *Frame-based stereotactic brain biopsy, brain tumor, reliability and accuracy, histological diagnosis*

INTRODUCTION

Stereotactic technique was first used couple centuries ago and stereotactic brain biopsy was one of the first minimally invasive procedures adopted in the field of neurosurgery (1). It makes possible procedures such as diagnostic biopsies, cystic lesion aspirations and brachytherapy instillation with maximum accuracy (2, 3).

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A rapid advance in neuroimaging techniques allow us to obtain early working diagnosis but accurate noninvasive diagnosis is not yet feasible based on imaging studies alone. Despite all technical improvement and regardless of lesion location, size or appearance, a histological diagnosis is indispensable for any effective and rational treatment in patients with different brain lesions (4). Stereotactic biopsy is referred as an effective procedure with high diagnostic yield and low complication rate (5). In the era of neuronavigation and frame-less biopsy, frame-based biopsy still provides a safe way to achieve diagnosis especially in lesions located in high-risk areas (6). This research aimed to evaluate the safety and diagnostic efficacy of CT-guided stereotactic biopsy procedures performed for histological diagnosis of intracranial lesions.

MATERIAL AND METHODS

This study included a total of 108 patients who were hospitalized because of the intracranial lesions between January 2009 and December 2014, at the Department of Neurosurgery, Clinical center of Vojvodina. Clinical, radiological and histological data in patient records were retrospectively examined. The following were the indications for CT-guided stereotactic biopsy requiring histological diagnosis: deep-seated lesion, lesion localized in eloquent area, multifocal lesions, a cystic lesion suggestive of infection, lesions possibly better treated using noninvasive methods after histological diagnosis such as lymphoma or germ cell tumor and co-morbidities posing a high-risk for general anesthesia.

A CL Instruments Stereotactic System (modification of the standard Leksell system) was used for biopsy procedures in all subjects and after fixation of the basal frame onto the cranium patients were secured to the computerized tomography table. One-millimeter thick axial cross-section images were obtained native and following the administration of intravenous contrast medium. After that patient is transferred to the operating room and the rest of the stereotactic apparatus was applied in sterile conditions. A burr-hole site and the trajectory were selected according to location of the lesion. It was prepared at the nearest point to the lesion for superficial lesions, while an ipsilateral coronal or precoronal burr-hole was used for deeply located lesions. The tissue samples were obtained using a side cutting needle along the trajectory in three different zones and three times at the same place thus providing samples of perilesional tissue, lesion edge, and central contents. Frozen section histological analysis was performed every time to confirm whether tissue satisfactory for eventual diagnosis has been obtained. After that histological and immunohistochemical analysis were performed to obtain specific histopathological diagnosis. Tumors were diagnosed as per the criteria of the World Health Organization (WHO) classification of central nervous system (CNS) tumors (2007) (7). Diagnostic yield was assessed by success in obtaining of histological diagnosis. Complications were assessed both clinically and by CT scan immediately or after 24 hours.

RESULTS

Median patient age was 60.15 years with a range from 18–82 years. There were 61 men and 47 women. One hundred and seven lesions were approached for diag-

nostic biopsy and only one was simple therapeutic cyst aspiration. On average, nine (range: 3–12) tissue samples were taken during each procedure. Of the 107 diagnostic biopsies performed, a definitive histological diagnosis was obtained in 106 cases. So we obtained diagnosis in all but one case, therefore the diagnostic value in this series was 99%. This unsuccessful biopsy was followed by craniotomy and removal of the metastatic lung carcinoma. Most frequent location were deep seated lesions – thalamus and basal ganglia in 62 (58%), followed by multiple lesions in 25 (23%) and lobar lesions were represented in 20 cases (19%). The informations about location of a lesions are summarized in Table 1.

Table 1: Localizations of the Lesions

Localization	n (%)
Hemispheric lesions	*20 (19%)*
Frontal	1 (0,9%)
Frontotemporal	3 (2,9%)
Temporal	3 (2,9%)
Temporoparietal	4 (3,8%)
Parietal	6 (5,7%)
Parieto-occipital	2 (1,9%)
Occipital	1 (0,9%)
Deep-seated lesions	*62 (58%)*
Thalamus	21 (20%)
Corpus callosum	13 (12%)
Basal ganlion	27 (25%)
Brain stem	1 (0,9%)
Multiple lesions	25 (23%)

Of the tumoral lesions, 83 (77,6%) were primary central nervous system tumors, 15 (14%) were metastatic and 9 (8,5%) primary CNS lymphoma. Histopathological diagnoses of the lesions are depicted in Table 2.

Table 2: Histopathological Diagnoses of the Lesions

World Health Organization classification	n (%)
WHO Grade IV Astrocytoma	56 (51,8%)
WHO Grade III Astrocytoma	17 (15,6%)
WHO Grade II Astrocytoma	8 (7,5%)
Oligodendroglioma	2 (1,9%)
CNS Lymphoma	9 (8,4%)
Metastatic brain tumor	15 (14%)

Clinically, only two patients developed new neurological symptoms or signs and only one developed permanent new neurological deficit. This patient with a

malignant glioma was operated after biopsy procedure due to postprocedural intratumoral and intracerebral hematoma. Transient focal neurological deficit occurred in one patient who had mild deterioration of hemiparesis. There was no mortality. Patients were discharged from out clinic usually on the fourth or fifth postoperative day.

DISCUSSION

Stereotactic biopsy of brain lesions is a safe and accurate technique for obtaining tissue samples for histological evaluation and thus provide possibility to organize further adequate treatment of patients (8). Particularly malignant gliomas largely depends on obtaining a reliable histopathological diagnosis (9). Multiple sampling from different sites of the tumor provides valuable information on tissue characteristics as well as the internal structure of the lesion thus increasing diagnostic potential (10). The reported figures for the diagnostic value of stereotactic biopsy, defined as the ability to reach a diagnosis, vary between 89% and 100% (11). In our series with the use of CT guided stereotactic biopsy the diagnostic value was 99%, and there was only one patient for whom a diagnosis could not be established with biopsy. This high diagnostic value is probably because we take biopsy bites along the trajectory in several places. Therefore we avoid taking samples only from the central hypo-dense areas but also do not take it only from well-enhanced regions that can result in undergrading. Also, frozen section histological evaluation is always used for intraoperative evaluation of tissue satisfactory for eventual diagnosis.

It should be kept in mind that in our clinic we perform stereotactic biopsy predominantly for the patients in purpose of diagnosis and due to the „inoperability" of the lesion. Therefore, we have more deep seated and multiple lesions than hemispheric lesions because most of glial lesions can benefit more from mass removal and/or cytoreduction.

Stereotactic biopsy has generally been regarded as a safe procedure, with minimal associated morbidity and mortality as compared to other cranial surgical procedures (12). Overall, the morbidity rate in our study population was 0,8%, respectively with corresponding figures of 0.0% – 3.7% (13). Variables that have been assessed for a possible association with increased risk of operative complications include patient factors such as age, Karnofsky performance score and comorbid conditions such as hypertension, diabetes mellitus… (14). These conditions were first addressed to achieve adequate control, then the biopsy was performed. Detection and management of coagulation disorders before operation might lessen the risk of a major postoperative hemorrhage (15). Lesion location has been suspected to be important in conferring differential risk with stereotactic biopsy. Some authors reported that biopsy of deep lesions (basal ganglia or thalamic lesions) was associated with increased hemorrhage risk and in our case with postoperative intratumoral and intracerebral hematoma we performed biopsy of the thalamic lesion (16).

Several studies found that increasing the number of biopsy samples did not independently impact morbidity if the samples were collected along a single needle

trajectory. Some authors does not recommend routine use of CT imaging following stereotactic biopsy; however, a head CT scan may be required when a bleeding is suspected during the procedure or to verify the target direction (17).

CONCLUSION

Frame based-stereotactic biopsy is established as a safe and reliable procedure in cases of good indication, with minimum or without any complications, in the diagnosis and further therapy management of brain lesions. It is an effective surgical technique that allows the neurosurgeon to assess accurately almost any region in the intracranial space, and to obtain tissue samples for histopathological diagnosis. Furthermore, it is a safe procedure with minimal associated morbidity and mortality.

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