Original Article

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Clinical Experience With Frameless Neuronavigation Guided Biopsy For Intracranial Space Occupying Lesion

Biopsy is mandatory for histological diagnosis of non-resectable brain tumors. Of various techniques, neuronavigation guided biopsy provides intraoperative real-time reference and allows biopsy from multiple trajectories.The aim of this study is to assess the efficacy and accuracy of frameless neuronavigation biopsy.

We retrospectively reviewed the medical archives of patients with intracranial space occupying lesion who underwent frameless neuronavigation biopsy at our institute between 2016 to 2018. All operations were performed under general anesthesia. Data were analyzed by SPSS version 20. P value of <0.05 was considered significant.

There were 46 patients who underwent neuronavigation guided biopsy over the period of two years. Median age of patients was 46.5 years. Supratentorial tumors accounted for 95.8% of cases. Mean tumor diameter was 3.35 cm. Accuracy was 89.1%. More than half were glial tumors. Histopathology was inconclusive in 10.9% cases. Complication rate was 4.3%: one tract hematoma and one new neurological deficit.

Frameless neuronavigation guided biopsy of intracranial space occupying lesion is safe and efficacious procedure with high diagnostic yield.

Keywords: Biopsy, Frameless, Neuronavigation, Space occupying lesion

Radiological imaging techniques provide early detection of neurological lesions but they do not always provide an adequate and reliable diagnosis. Hence, biopsy is mandatory for histological diagnosis of non-resectable brain tumors found on imaging studies by modern radiological technique. Both frame-based and frameless image-guided stereotaxy have provided the means to sample tissue from small or deeply seated intracranial lesions for histological analysis. Therefore, empirical therapy without histological verification is rarely indicated.[12] Of the various technique, neuronavigation guided biopsy provides intraoperative real-time reference and it also allows us to perform multiple biopsy from multiple trajectories.[1] Neuronavigation guided frameless stereotactic biopsy (NSTB) by using magnetic resonance imaging (MRI) is also an accurate and less invasive method of diagnosis.[5-7,12,13,16] There have been limited studies to gauze at the procedural efficacy and accuracy
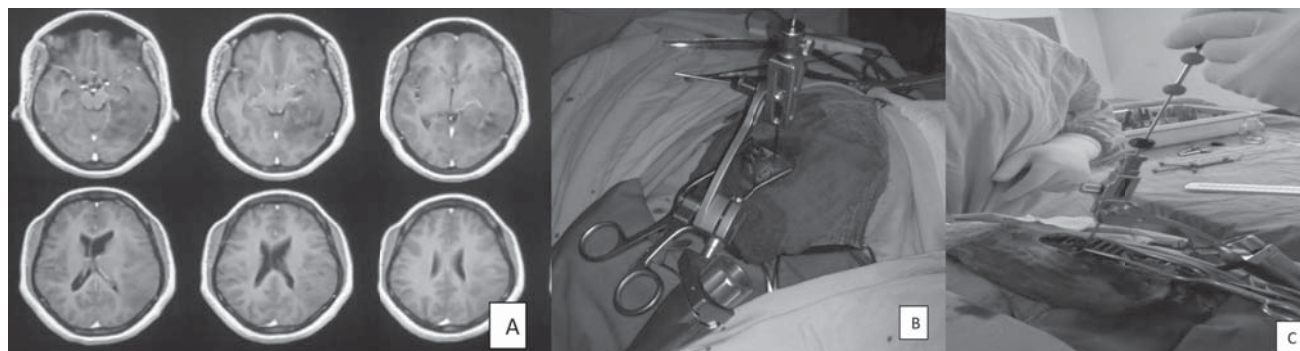
Figure 1: A: Pre-operative MRI; B: Neuronavigation biopsy technique- Target lesion is navigated and locked for biopsy from shortest safe route;C: Delivering Biopsy specimen.

of neuronavigation technique. The aim of this study is to assess the efficacy and accuracy of frameless neuronavigation technique and analyze the characteristics of the pathology subjected to such technique.

Materials and Methods:

We retrospectively reviewed the medical archives of 46 patients with intracranial space occupying lesion who underwent frameless neuronavigation biopsy at our institute from 2016 to 2018. Biopsy for tissue diagnosis of lesions located in inaccessible locations were taken. Biopsies were also taken from patients who cannot withstand major surgical procedure irrespective of location of the lesions. Those cases were excluded where lesions were located in superficial and accessible locations with good Karnofsky scoring. In these circumstances, regular surgical procedures were performed; hence they were not included in our study. All operations were performed under general anesthesia. Data were analyzed by SPSS ver 20. Proportion and Mean were deduced for categorical data and continuous variables respectively. P value of <0.05 was considered significant

Technique of Stealth neuronavigation frameless biopsy:

Image acquisition was done from MRI image loaded compact disc and patient registered in Stealth, neuronavigation system, an infrared led based system. Head of patient was shaved after general anesthesia and head fixed with three pins clamp on Mayfield. Taylor Haughton line drawn and tumor marked on scalp with neuronavigation guidance. Entry point selection done to achieve shortest safe path toward target lesion (Figure 1B). All the calculations were done to avoid vascular structure along the trajectory. Skin incision done and burr hole created with manman air driven drill. Durotomy done and specimens were retrieved with the help of 14-gauge navigation cannula (Figure 1C). Biopsy specimens sent for histopathological analysis. Wound closed with one

or two stitches and observed in intensive care unit for monitoring.

Results:

Out of 46 patients who underwent neuronavigation guided biopsy of intracranial space occupying lesion, most of them were male (30 patients) with male to female ratio of 1.15:1. Median age of patients was 46.5 years with range from 5 to 82 years. Supratentorial tumor accounted 95.8% (45 patients). Most tumors were observed in right side (56.5%) while 41.3% tumors were in left side and 2.2% tumor being in midline (Pineal tumor). Lobar location was found in 24 patients (52.2%) while 22 tumors (47.8%) were in deep location. Most common location was frontal (23.9%) followed by Thalamic (13%)/Periventricular (13%). Mean size of lesion was 3.35±0.92cms ranged from 2 to 7 cm. 41 patients had tumor size more than 2 cm while 6 patients had tumor size ≤2cms. (Table 1)

Location of lesion	Frequency	Percent
Frontal	11	23.9
Parietal	7	15.2
Periventricular	6	13.0
Thalamic	6	13.0
Multi focal	4	8.7
Diffuse	3	6.5
Temporal	3	6.5
Occipital	2	4.3
Callosal	2	4.3
Cerebellar	1	2.2
Pineal	1	2.2
Total	46	100.0

Table 1: Location of lesion

Biopsy was accurate to retrieve target in 89.1% (41 patients). (Table 2) Histopathology revealed glial tumor in 52.2% of cases. Out of 46 biopsies, 20 were Glioblastoma WHO Grade IV (43.5%), 6 were Lymphoma (13%), 5 were abscess (10.9%) followed by few cases of diffuse astrocytoma, WHO Gr II, Anaplastic astrocytoma WHO grade III, tuberculoma, cryptococcal lesion etc. (Table 3)

Histopathological diagnosis	Frequency	Percent
TUMOR		
Glioblastoma WHO Gr IV	20	43.5
Lymphoma	6	13.0
Diffuse astrocytoma, WHO Gr II	2	4.3
Anaplastic astrocytoma WHO grade III	2	4.3
Metastatic Adenocarcinoma	1	2.2
Metaplastic meningioma Grade I	1	2.2
Pleomorphic Xanthoastrocytoma WHO II	1	2.2
INFECTIVE		
Abscess	5	10.9
Tuberculoma	2	4.3
Cryptococcal lesion	1	2.2
Inconclusive	5	10.9
Total	46	100.0

Table 2: Final diagnosis of brain biopsy via frameless neuronavigation technique

Frameless neuronavigation biopsy	
No. of Biopsy	46
Positive	41
Negative	89.1%

Table 3: Diagnostic yield of frameless neuronavigation biopsy

In five cases, HPE was inconclusive (10.9%). Among the inconclusive diagnosis, Gliosis was reported in 3 cases and normal brain in 2 patients. (Table 4)

Negative reports	Frequency
Gliosis	3
Normal brain	2
Total	5

Table 4: INCONCLUSIVE DIAGNOSIS (N = 5)

With Neuronavigation technique, new diagnosis was revealed in 26.1% (12) patients while diagnosis was static to preoperative diagnosis in 63 patients (29%). (Table 5)

Change in diagnosis	Frequency	Percent
Preoperative diagnosis static	29	63.0
Diagnosis revised	12	26.1
Inconclusive	5	10.9
Total	46	100.0

Table 5: Alteration in preoperative diagnosis following neuronavigation biopsy

Overall morbidity was observed in 2 (4.3%) patients, of which one patient had tract hematoma while another patient had seizure and both were managed conservatively. There is no procedure related mortality in this study during study period.

Post operatively, we decided further management based upon the histopathologic analysis. Patients with diagnosis of brain tumor were referred to neuro-oncologist for chemo-radiotherapy, infected cases were managed with intravenous antibiotics and some were operated for revision of diagnosis.

Discussion

Stereotactic biopsy of brain lesions has been a widely and safely performed procedure with high accuracy procedure since it was first introduced in the late 1970s.[4,15] Literature comparing diagnostic yield of neuronavigation technique is sparse. Hence this study was undertaken to evaluate diagnostic yield of frameless neuronavigation.

The diagnostic accuracy of neuronavigation biopsy was reported from 87% to 97.6%.[1,8] in different literatures. In our study, diagnostic accuracy of frameless neuronavigation technique was 89.1%. Among 46 patients, HPE revealed accurate diagnosis in 41 patients (89.1%) and inconclusive among 5 patients (10.9%). In a study done by Jain D et al.among 15 patients, conclusive diagnosis was made in 13 patients (86.6%) while in a study done by Barnett et al.[1,8] among 208 supratentorial lesion, diagnostic yield was 97.6% while Dorward et al.had diagnostic yield of 98.6%.[6]

Mean diameter of tumor in our study was 3.35±0.92 cm and ranged from 2 to 7 cm. In a study done by Dorward et al., the mean size of tumor was 3.87 ±1.9 cm with range from 0.7 cm to 10.2 cm among frameless biopsy group.[6] Various literature suggested the volume of brain lesion influences the diagnostic yield. The larger the lesion, the greater the likelihood to result in diagnostic biopsy and vice versa.[11,16] However, we didn't find any significant

difference in diagnostic yield among tumors ≤2cm or >2cm size.

In our study, histopathology revealed glial tumor in 52.2% of cases. Out of 46 biopsies, 20 were Glioblastoma WHO Grade IV (43.5%), 6 were Lymphoma (13%), 5 were abscess (10.9%) followed by few cases of diffuse astrocytoma WHO Grade II, Anaplastic astrocytoma WHO grade III, Tuberculoma and Cryptococcal lesion. In a study done by Tsermoulas G et al. among 124 patients, diagnostic accuracy of 93.5% with Glioblastoma was most common (41.12%) followed by B cell lymphoma (17.74%) which was comparable to our study.14 Among inconclusive report, 2 were normal brain and 2 were gliosis. Reason for negative report was due to missed target acquiring normal brain for histology or retrieval of glial tissue/nonspecific chronic inflammatory tissue from target. In our study, there were 26% new cases diagnosed with neuronavigation guided biopsy. Study done by Jain D et al. had overall negative result in 16% (21 patients out of 130) cases.[8] Histological analysis showed normal brain in 8.5%, gliosis in 3% and inadequate tissue in 3% cases.[8]

The overall morbidity of needle biopsy is reported from 0.9% to 15% in different literature.[2, 9] In our study, overall morbidity was observed in 2 (4.3%) patients. Kreth et al. highlighted hematoma related complication as a common.[9] Most common complication following needle biopsy was reported to be hemorrhage.[10] We had one case of tract hematoma in our series which was managed conservatively.

Conclusion: Neuronavigation guided biopsy of intracranial space occupying lesion is safe and efficacious procedure with high diagnostic yield. This study has limitations of being a retrospective study. We recommend future prospective study to compare neuronavigation technique with other needle biopsy technique to ascertain the accuracy and efficacy of the neuronavigation technique.

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