CT-GUIDED STEREOTACTIC BIOPSY OF INTRINSIC BRAINSTEM LESIONS

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ABSTRACT
Although radiographic and clinical appearance may suggest the pathological diagnosis of a mass lesion located within vital areas of the brainstem, surgeons frequently have elected to treat patient without the benefit of a tissue diagnosis. Such an empirical approach often leads to inappropriate therapy. We present five patients with intrinsic brainstem lesions who underwent CT guided stereotactic biopsy using CRW stereotactic frame. Positive diagnosis was achieved in all cases. There was no operative morbidity, however, one patient died of postoperative intratumoral haematoma.

Key Words: CT Scan, Stereotactic biopsy, Brainstem lesions.

INTRODUCTION
In 1980, Bosch, an expert on stereotactic surgery in Netherland, had pronounced brainstem as "surgically inaccessible region" to currently available stereotactic biopsy technique; however Coffey and Lunsford from university of Florida, USA, dispelled this notion in 1985 when they reported 12 cases of stereotactic brainstem biopsy without any complications. Later on Bosch himself had taken back his statement by publishing a case report of successful stereotactic evacuation of a pontomedullary haematoma. Stereotactic biopsy of brainstem lesions, is now a well established surgical technique and has become a routine Neurosurgical procedure in many centers.

MATERIAL AND METHODS
Between January 1997 – June 1999 five patients with brainstem mass lesions underwent CT guided stereotactic biopsy at Department of Neurosurgery, Jinnah Postgraduate Medical Institute, Karachi, Pakistan. The patients' age ranged from 14 – 48 years. There were 3 males and 2 females. All patients had preoperative CT scan and MRI. Three lesions were located in the pons and one in diencephalon and another in mesencephalon. CRW stereotactic frame III system (Radionics, Burlington, MA, USA) and Helical CT scan (Toshiba, TSX – 002A Series, Toshiba Corporation, Japan) were used for stereotactic procedures. Nashold side cutting needle was used for biopsy, which produces a core of tissues of approximately 10 x 1.5 mm.

All the procedures were carried out under local anaesthesia. Transfrontal trajectory was chosen in four cases where lesions were anteriorly and centrally located and transcerebellar trajectory was chosen in one case where the lesion was located posteriolaterally over the cerebral peduncle. Biopsy specimens were immediately sent for histological examination.

RESULTS
Histological diagnosis was made in all five cases. Two patients were diagnosed as pilocytic astrocytomas, two as astrocytoma grade III and one as tuberculoma. (Table I). One patient developed diabetes insipidus postoperatively which was managed with vasopressin. One lady with tuberculoma was shunted who developed hydrocephalus after stereotactic procedure. One patient died after 48 hours of surgical procedure due to intratumoral haematoma.
### Table I: CT Guided Stereotactic Surgery of Intrinsic Brainstem Lesions

<table>
<thead>
<tr>
<th>Case no</th>
<th>Age/Sex</th>
<th>Presentation</th>
<th>Location</th>
<th>Trajectory</th>
<th>Histology</th>
<th>Complication</th>
<th>Post op treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22/M</td>
<td>Hemiparesis</td>
<td>Pons</td>
<td>Transcerebellar</td>
<td>Pilocytic astrocytoma</td>
<td>DI</td>
<td>Radiotherapy</td>
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<td></td>
<td></td>
<td>Cerebellar signs</td>
<td>Middle cerebral peduncle</td>
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<td></td>
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<tr>
<td>2</td>
<td>26/F</td>
<td>B/L 6\textsuperscript{th} nerve palsy</td>
<td>Pons</td>
<td>Transfrontal</td>
<td>Tuberculoma</td>
<td>Hydrocephalus</td>
<td>ATT VP shunt</td>
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<tr>
<td></td>
<td></td>
<td>Cerebellar signs</td>
<td>? Gag reflexes</td>
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<tr>
<td>3</td>
<td>23/M</td>
<td>? mental status</td>
<td>Mesencephalon</td>
<td>Transfrontal</td>
<td>Pilocytic astrocytoma</td>
<td>None</td>
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<tr>
<td></td>
<td></td>
<td>B/L papilloedema</td>
<td>Diencephalon</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>14/M</td>
<td>? mental status</td>
<td>Pons</td>
<td>Transfrontal</td>
<td>Astrocytoma grade III</td>
<td>None</td>
<td>Radiotherapy</td>
</tr>
<tr>
<td></td>
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<td>Hemiparesis</td>
<td>Mesencephalon</td>
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<tr>
<td>5</td>
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<td>Optic atrophy</td>
<td>Mesencephalon</td>
<td>Transfrontal</td>
<td>Astrocytoma grade III</td>
<td>Haematoma</td>
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<td></td>
<td>Blindness</td>
<td>Diencephalon</td>
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<td>Hemiparesis</td>
<td>Mesencephalon</td>
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</table>

**Fig. 1:** Patients positioned and draped for transfrontal stereotactic biopsy. The CRW frame has been mounted over the base ring.

**Fig. 2:** Contrast CT scan of a 26 year old lady showing ring enhancing lesion of the brainstem. Histology confirmed tuberculoma.

**Fig. 3:** The CT scan of a 12 year old boy showing diffuse low density areas over the brainstem. The histological diagnosis was astrocytoma grade III.

**Fig. 4:** The CT scan of a 24 year old boy showing low density brainstem mass extending to Rt. Cerebral peduncle. Transcerebellar trajectory was chosen in this case. The histological diagnosis was astrocytoma grade III.
DISCUSSION

High resolution CT and MRI visualize small lesions of brain and brainstem and are highly sensitive and provide excellent information on the topographic relationships of lesion within brainstem, however, they do not provide enough information on the histological diagnosis. Without a histological verification, diagnostic errors can occur and may lead to inappropriate treatment. Thus, surgical biopsy of brainstem lesions is justifiable.

Open surgical approaches to the brainstem including subtemporal, retromastoid or midline suboccipital represent major surgical undertakings. In already morbid patients the risk of prolonged general anaesthesia and additional potential neurological morbidity is there. Such operations provide limited operative exposure even with microsurgical techniques. If a clearly exophytic or surface lesion is not visualized, biopsy of the brainstem may miss the lesion1 or can be hazardous.

Alternatively stereotactic biopsy of brainstem lesion is a well established surgical procedure in many centers.9-20 Stereotactic trajectories to brainstem are either transfrontal or trans cerebellar and the later technique is advised for posteriolaterally situated brainstem lesion.12,17,19,20 These trajectories avoid intracranial vessels and cranial nerves.1,6,17 Image guided stereotactic brainstem biopsy is highly reliable in terms of positive histological diagnosis and low incidence of morbidity and mortality.6,7,8,10,15,16,19 In our series histological diagnosis was made in 100% of cases. In Kondziolka and Lunsford’s series of 40 patients pathological diagnosis was achieved in 95%.10 Similarly in Ryken’s series of 11 patients positive histological diagnosis was made in 9 patients.16

Over all postoperative complications related to stereotactic procedure of brainstem lesion is 0–3%.7,9,15,16 Kondziolka and et al reported 2.5% morbidity in their series and there was no mortality.10 There was no morbidity and mortality in Ryken’s series of 11 patients.16 No complication was observed in Coffey and Lunsford’s series9 where as in Frank’s series permanent morbidity was occurred in 3%.7 Although the mortality is 20% in our series, the number of cases is too small to draw such conclusion.

CONCLUSION

Emperic treatment of brainstem lesions without tissue diagnosis based upon the radiological and clinical findings may result in inappropriate therapy. Alternatively, open operative procedures to obtain tissues require a visible surface abnormality to guide biopsy needle and carry the risk of a major surgical procedure in already compromised patients. For these reasons we consider stereotactic biopsy for intrinsic brainstem lesion which is safe and reliable method to confirm histological diagnosis and further management strategy.

REFERENCES