

# MRI Guided Stereotactic Biopsies or Aspirations in Deep Seated Brain Lesions: An Experience of 146 Cases at Nishtar Hospital, Multan

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## ABSTRACT

**Objective:** To determine frequency of positive biopsies or aspirates and safety in deep seated brain lesion, with use of Magnetic Resonance Imaging compatible stereotactic system.

**Study Design:** Prospective cross sectional.

**Setting:** The study was performed at Neurosurgery Department Nishtar Hospital, Multan.

**Duration of Study:** From 01-07-2008 to 30-06-2012.

**Material and Methods:** A total of 146 patients of age between 12 – 18 years of either sex having deep, intrinsic cystic lesion of the brain less or equal to 4 cm<sup>2</sup> in size and excluding the extensively vascular lesion diagnosed on Computed Tomography and Magnetic Resonance Imaging underwent Stereotactic biopsy or aspiration with Magnetic Resonance Imaging compatible Leksell's stereotactic system. The tissue specimens were analyzed by standard histopathological methods. The safety was measured in context of absence of complications i.e. hemorrhage, new onset of neurological deficit and fits. Data was analyzed via computer software SPSS 10 version for windows.

**Results:** Among 146 patients with deep seated cystic brain lesions were selected for aspiration by using MRI guided stereotactic system. Their age ranged from 12 years to 80 years with Mean = 37.73 ± Standard deviation (SD) = 18.12. Among them 86 (58.9%) were male and 60 (41.1%) female. Biopsies or aspirates were positive in 136 (93.2%) cases while negative in 10 (6.8%) cases.

**Conclusion:** We conclude that MRI assisted stereotactic brain aspiration is safe and effective procedure with a high diagnostic yield at our center.

**Key Words:** Stereotactic technique, brains, cyst, MRI guided interventional procedures.

## INTRODUCTION

The word “stereotactic” is derived from the Greek word stereo, or three dimensional and the Latin word tangere, to touch.<sup>1</sup> The technique uses an external apparatus, which helps in directing an instrument to the main target lesion with minimal tissue disruption. Various procedures can be performed safely like tissue biopsies, drainage of abscess and cysts, placement of tissue grafts, functional stereotaxy for movement disorders, brachy-therapy, stereotactic radio-surgery and

laser surgery or deep intracranial lesions.

Horsley and Clark performed first stereotactic brain biopsy on the cerebellum of the rat in 1908.<sup>2</sup> It was Descartes who gave the idea of a point in space by relating it to the three planes (x, y, z) intersecting at right angle to each other. Spiegel and Wycis in 1947 introduced their first human stereotactic technique using three dimensional coordinate system related to intracranial land mark defined by pneumoencephalography.<sup>3</sup> They first published human stereotactic brain

atlas in 1952, which consisted of various sequential brain sections orientated along planes between pineal gland and foramen of Monro.<sup>4</sup>

Leksell Stereotactic System is the most widely used frame in the world. Reliability, flexibility, versatility and ease – of – use are the key features of the Leksell Stereotactic System. The system is based on the center – of – arc principle and the basic components are the Cartesian coordinate frame and a semi – circular arc.<sup>4</sup>

**MATERIAL AND METHODS**

The study was performed at Neurosurgery Department Nishtar Hospital Multan. The study design was descriptive, Cross sectional. The duration of study was four years from July 2008 to June 2012. The sampling technique was Non-probability Purposive type. The objective was to determine the frequency of positive biopsies or aspirates and safety in deep seated brain lesion, with use of Magnetic Resonance Imaging compatible stereotactic system. The lesions which were determined on Computed Tomography and Magnetic Resonance Imaging of size equal or less than 4 cm<sup>2</sup> and located in following parts of brain were considered as deep seated brain lesions: basal ganglia, thalamus, internal capsule, ventricles, pineal region, sellar / parasellar region and brain stem. Safety was determined in terms of absence of complications within 24 hours of the surgery. Haemorrhage which was detected on Computed Tomography and was done routinely in all patients within 24 hours of the surgery. New onset of neurological deficit was assessed on clinical examination i.e. hemiparesis, aphasia, cranial nerve palsies and visual disorders within 24 hours post-surgery. Fits were observed during hospital stay i.e. generalized tonic clonic etc.

**Inclusion Criteria**

The Inclusion criteria were patients of Age 12 years to 80 years, both genders, having deep seated brain lesions and **exclusion criteria** were extensively vascular lesion and lesion near the important vascular structures of brain i.e. near the sylvian region, the area adjacent to cavernous sinus, carotid artery complex, diagnosed on Computed Tomography and Magnetic Resonance Imaging.

**Operative Procedure**

After thorough **counseling** with the patient and his /

her relatives, informed consent for stereotactic procedure was taken. On especially designed proforma, demographic profile was recorded on part A. Using sterile techniques and local anaesthesia, Co-ordinate frame was fixed to head through four fixation posts. The target was localized by obtaining T<sub>2</sub> weighted magnified axial images. The Co-ordinate system measured X, Y and Z axes values which were applied on Co-ordinate frame and semicircular arc. Under aseptic techniques and local anaesthesia, the skin incision was made, burr hole made. Using probe, Sedon biopsy needle or Backlund evacuator biopsy or aspirate was taken. Whole procedure was carried out by the same consultant having more than ten years experience. Biopsy or aspirate material was sent for histo-pathological or cytological examination with written form to the Pathology department of Nishtar Hospital Multan and was done by histo-pathologist having more than ten years experience.

**Data Analysis**

The outcome variable that was the biopsy or aspirate (positive, negative) and complications that are haemorrhage, fits, new onset of neurological deficit (yes, no), were noted by the researcher on the proforma. All the data was entered and analyzed using computer program SPSS – 10. Frequencies and percentages were calculated for gender, biopsy or aspirates and complications. Mean and standard deviation were presented for age and size of lesion. The effect modifiers like site and size of lesion, gender and age were controlled by stratifications.

**RESULTS**

One hundred and forty six patients were selected for stereotactic brain aspirate.

**Age Incidence**

Age ranged from 12 years to 80 years with mean 37.73 ± standard deviation (SD) = 18.12) (Table 1).

**Table 1: Age Distribution.**

N	146
Mean	37.7260
Standard Deviation	18.1248
Age Range	12 – 80 years

**Sex Incidence**

Among them 86 (58.9%) were male and 60 (41.1%) female.

**Area Involved**

The locations of the lesions were n = 44 basal ganglia (30.1), n = 36 thalamus (24.7%), n = 26 internal capsule (17.8%), n = 06 ventricles (4.1%), n = 14 seller / paraseller / supraseller (9.6%), n = 10 brainstem (6.8%) and n = 10 pineal region (6.8%) (Table 2).

**Table 2:** Site of Lesion.

Site	Frequency	Percentage
Basal Ganglia	44	30.1
Thalamus	36	24.7
Internal Capsule	26	17.8
Ventricular	06	4.1
Pineal Region	10	6.8
Sellar / Suprasellar	14	9.6
Brain Stem	10	6.8
Total	146	100.0

**Size of Lesions**

The size of lesions in 146 patients were 56 (38.4) of 2 cm, 68 (46.6) of 3 cm and 22 (15.1) of 4 cm with mean 1.76 ± standard deviation (SD) = 0.69. in 134 patients (91.8%) there was smooth and uneventful recovery while 04 (2.7%) patients developed hemorrhage, 02 (1.4%) was having fits and 06 (4.1%) patient suffered new onset of neurological deficit.

**Biopsy Results**

One hundred forty six of the tissue specimens removed and sent for histopathology or cytology. Biopsies or aspirates were positive in 136 (93.2%) cases while negative in 10 (6.8%) cases. 136 patients (93.2%) had valid tissue diagnosis (Table 3). Patients with positive biopsy or aspirate were stratified on the basis of age, gender, size and site. Patients with age group (31 – 40 years), male, with size of lesion (3 cm) and located at basal ganglia showed high frequency of positive results.

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internal capsule (17.8%), n = 06 ventricles (4.1%), n = 14 seller / paraseller / supraseller (9.6%), n = 10 brainstem (6.8%) and n = 10 pineal region (6.8%).

**Table 3:** Biopsy / Aspiate Positivity and Negativity.

Aspirate / Biopsy	Frequency	Percentage
Positive	136	93.2
Negative	10	6.8
Total	146	100.0

**Table 3:** Biopsies / Aspirates were positive in 146 (93.2%) cases while negative in 10 (6.8%) cases.

**DISCUSSION**

Although advances in the modern imaging techniques provide early detection of brain lesions, they fail to give an accurate histopathological diagnosis which is necessary in the planning of a rational treatment strategy. An accurate diagnosis of intracranial lesion is must for appropriate treatment.<sup>6</sup> Non-neoplastic lesions should be differentiated from neoplastic lesions with histological documented diagnosis for future management plan. MRI and CT scan images help in defining lesions of less than 4 cm in diameter and MRI assisted stereotactic biopsy or aspiration is an accurate method to reach these lesions.<sup>7,8</sup> Deep – seated brain lesions are approached by this method, which is clearly having significant advantage over open craniotomy and brain biopsy. Excellent outcomes have been reported in patients treated with biopsy or aspiration alone. Precise localization is possible with imaging – guided stereotaxy. This method does indeed have a number of advantages. First, it can be done rapidly and safely through a single burr hole with the patient under local anesthesia. This feature makes the procedure particularly attractive in patients who are seriously ill. Second, biopsy or aspiration of the abscess enables pathologic confirmation of the diagnosis, which is helpful because an abscess can be difficult to differentiate from a tumor. Third, the basic stereotactic procedure is minimally invasive. This is beneficial when an abscess is located in deep or eloquent areas of the brain. Fourth, bacterial cultures from samples taken directly from the aspirated abscess are important, especially in immunocompromised patients who may have opportunistic infections not responsive to conventional antibiotic therapy. Fifth, additional biopsy or aspiration may be

necessary and can easily be performed by repeating stereotactic procedures under local anesthesia.<sup>5</sup>

Winkler et al studied 37 consecutive patients with an accurate diagnostic result in 36 cases (97%) with minimal intraoperative bleeding in 3 patients (8.1%) but 04 (2.7%) of our patients suffered such a complication.<sup>9</sup> Past series in a large numbers in the western literature also showed MRI assisted stereotactic biopsy or aspiration as relatively safe procedure.<sup>10,11</sup> Mortality and morbidity following stereotactic biopsy or aspiration was reported to be in the range of 3.1% in 4000 reported cases. Another study conducted by Regis et al in France on 3730 patients with pineal region tumors revealed mortality rate of 1.3% (5 patients of 3730) and 3 patients suffered neurological complications.<sup>12</sup> It suggests that this procedure carries low mortality with a diagnostic yield of 94%, supporting our observations that is 93.2%.<sup>13,14</sup> Avoidance of procedural complications like intra-cerebral hemorrhage is largely dependent upon case selection, pre-operative evaluation of patients and surgical expertise. Infections and convulsions following stereotactic biopsy or aspiration are low. Kreth et al, reported a silent hemorrhage rate of 9.6% and symptomatic hemorrhage rate of 0.9% in their series of 326 patients.<sup>15</sup> A Chinese study carried out on 605 cases with deep intra-cranial lesions that were biopsied or aspirated stereotactically yielded 96.69% positive rate, complications with biopsy occurred in 18 patients (2.9%) and 2 patients (0.33%) died following procedure.<sup>16</sup> These observations are almost similar to ours with positivity rate of 93.2% whereas in our study no major complication or death occurred, reason may be their large study population. These results also indicate that stereotaxy is a safe and reliable method.<sup>17</sup>

A Turkish study carried out on 94 cases that were biopsied or aspirated stereotactically yielded 86.16% positive rate. The gender distribution was 40.43% (n = 38) female and 59.57% (n = 56) male and the mean age was  $43.86 \pm 18.75$  years (range 4 – 77). The localizations of the lesions were n = 13 frontal (13.83%), n = 20 temporal (21.27%), n = 26 parietal (27.66%), n = 4 occipital (4.25%), n = 4 multiple (4.25%), n = 26 deep seated (27.66%) and n = 1 suprasellar (1.06%). But in our study, observations were higher. Age ranged from 12 years to 80 years with mean  $37.73 \pm$  standard deviation (SD) = 18.12. Among them 86 (58.9%) were male and 60 (41.1%) female. The localizations of the lesions were n = 44 basal ganglia (30.1), n = 36 thalamus (24.7%), n = 26 internal capsule (17.8%), n = 06 ventricles (4.1%), n = 14 seller / paraseller /

supraseller (9.6%), n = 10 brainstem (6.8%) and n = 10 pineal region (6.8%). The size of lesions in 146 patients were 56 (38.4) of 2 cm, 68 (46.6) of 3 cm and 22 (15.1) of 4 cm with mean  $1.76 \pm$  standard deviation (SD) = 0.69. Biopsies or aspirates were positive in 136 (93.2%) cases.<sup>18</sup>

MRI assisted stereotactic aspiration is performed under local anesthesia and thus a patient remains all the time awake. Results of brain lesion aspirate are excellent in terms of safety and tissue diagnostic yield, in the hands of experienced neurosurgeon and histopathologist. This method provides a representative sample of the lesion but sometimes inconclusive reports are also obtained. The reason for the non-diagnostic results in our series could be the technical errors during the procedure. Stereotactic brain biopsy or aspiration is a very sensitive procedure and the neurosurgeon relies entirely on adjunctive technologies for guidance. A small error at any stage of the procedure leads to inaccurate lesion targeting.

This possibility can be minimized by meticulous attention to detail and by providing an experienced team of neurosurgeon, neuro-radiologist and neuropathologist.

## CONCLUSION

We conclude that MRI assisted stereotactic brain biopsy or aspiration is safe and effective procedure with a high diagnostic yield in patients with age group 31 – 40 years, male, having lesion of 3 cm in size located at basal ganglia at our center.

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