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ORIGINAL ARTICLE

SPACE OCCUPYING LESIONS OF CENTRAL NERVOUS SYSTEM: A RADIOLOGICAL AND HISTOPATHOLOGICAL CORRELATION

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ABSTRACT

Introduction: Space occupying lesions (SOLs) of the Central nervous system (CNS) can pursue a serious clinical course even when they are inflammatory lesions or benign neoplasms. Radiology is the only means of assessment prior to a surgical diagnosis. Increasingly sophisticated radiological techniques are available for diagnosis and precise localization for a stereotactic biopsy. The radiological impression of an SOL, however, requires confirmation by histological examination of a tissue biopsy. Hence histopathology remains the gold standard for diagnosis.

Materials and Methods: This cross sectional, comparative study included one hundred and two consecutive cases of SOLs. Their clinical history and radiological findings were noted. The histopathological diagnosis was correlated with radiological diagnosis using Cohen's kappa with the former as the gold standard.

Results: Using Cohen's kappa a value of 0.05 was obtained when the collective data was compared, implying a 'poor' agreement between the two modalities of diagnosis. Similar results were obtained when only glial neoplasms were compared (kappa = 0.03). However meningiomas showed a kappa value of 0.40 indicating 'moderate' agreement. Cohen's kappa showed the superiority of the histopathological diagnoses in accurately categorizing lesions.

Conclusion: Our study showed that histopathological diagnosis remains more definitive as compared to radiological diagnosis in the context of SOLs of brain. Hence it is concluded that a multidisciplinary approach is ideal for space occupying lesions of the central nervous system. The neurosurgeon, neuroradiologist and neuropathologist form a triad that is essential for diagnosis, management and follow up of these cases. However, histopathology remains the yardstick against which all emerging techniques must be measu-red.

Keywords: Space occupying lesions, brain tumors, multimodal imaging, histopathological – radiological correlation, multidisciplinary approach.

INTRODUCTION

Intracranial space occupying lesions (SOLs) are important cause of neurological morbidity.[1] The SOLs of the central nervous system (CNS) pursue a serious clinical course even when they are inflammatory lesions or benign neoplasms.[2] Their potentially life – threatening behaviour results from their growing in a confined space as well as their proximity to vital structures.[3]

The rigidity of the cranial cavity makes it impossible to make a pre-operative assessment by clinical examination. Radiology is the only means of assessment prior to a surgical diagnosis.[4]

Increasingly sophisticated radiological techniques are available such as Computed – tomography (CT) scan, Magnetic resonance imaging (MRI), MRI with contrast, Magnetic resonance spectroscopy (MRS), Diffusion – weighted imaging (DWI), Perfusion – weighted imaging (PWI) etc.[5] These imaging techniques can tell us whether an SOL is solid or cystic, it's vascular pattern and the presence or absence of necrosis. Hence an estimate of the probable diagnosis, behavior and prognosis can be made. Radiological techniques can help us to plan surgery e.g. the precise localization of a stereo-tactic biopsy.[6,7]

The radiological impression of an SOL, however, requires confirmation by histological examination of a tissue biopsy. Hence histopathology remains the gold standard for diagnosis.[8,7]

Radiological examination is supportive for an accurate histological diagnosis. Hence the importance of a liaison between neurosurgeon, neuro-radiologist and neuro-pathologist cannot be overlooked.[4]

MATERIALS AND METHODS

This cross sectional, comparative study included one hundred and two consecutive cases of SOLs diagnosed

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in Pathology Department, PGMI, Lahore, from 1st January 2013 to 31st May 2014. These cases were referred from Lahore General Hospital, Lahore. Relevant demographic data such as age, gender was recorded in study proforma along with clinical history and radiological findings. While every effort was made to obtain the pre-operative radiological findings like CT scan, MRI and MRS scan in a few cases it was not retrieved.

Most of the specimens were totally processed, while of the larger specimens representative areas were processed. Sections were stained with Haematoxylin and Eosin initially. Some cases were also stained with Periodic Acid Schiff (PAS) and Ziehl Neelsen (ZN) stains if indicated.

The histopathological diagnosis was correlated with radiological diagnosis using Cohen's kappa. The former served as the gold standard against which the latter was assessed. The Cohen's Kappa is an index that measures inter - rater agreement for categorical or qualitative variables when two different observers or methods are employed. The value of K ranges between -1 and +1, a value of kappa equal to +1 implies perfect agreement between the two raters, while that of -1 implies perfect disagreement.[9] Only cases for which radiological data was available were subjected to this analysis.

RESULTS

The results are given in Table and Figures 1 – 3.

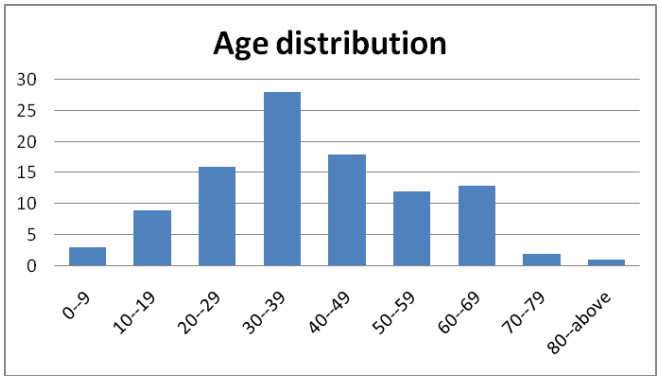

Fig. 1: *Age distribution of patients with SOLs of central nervous system.*

The details of age groups affected are given in Fig. 1; the highest number of cases were seen in the fourth decade. There was a marked male predominance male: female ratio being about 3:2 (Fig. 2). The commonest presenting complaints were headache and vertigo, but varied with nature and location of lesion. The duration of symptoms was wide-ranging being as short as a few hours in some cases to as long as six years, before medical help was sought. The most frequently involved area was parietal lobe followed by the temporal lobe. Glial neoplasms were the commonest followed by meningiomas (Table 1, Fig. 3).

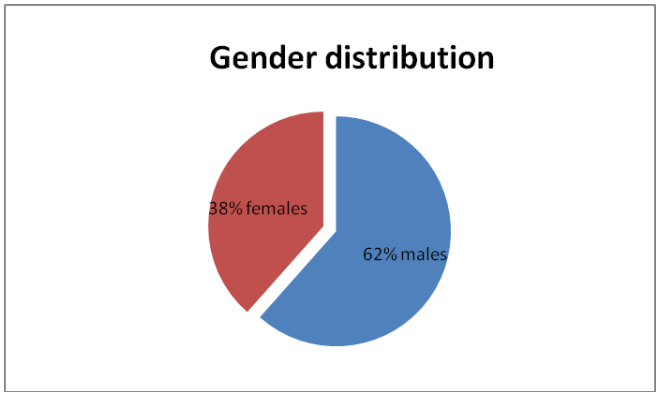

Fig. 2: *Gender distribution of patients with SOLs of central nervous system.*

Table also shows the details of histopathological diagnoses and their comparison with radiological impressions. Cohen's kappa showed the vast superiority of the former in accurately categorizing lesions. A value of 0.05 was obtained when the collective data was compared, implying a 'poor' agreement. The similar result when only glial neoplasms were compared (kappa = 0.03) underlines the importance of histopathological examination when encountering these common neoplasms. The cases where radiologists can give the histopathologists a run for their money is in the diagnosis of meningiomas. Here the value of Cohen's kappa was 0.41, indicating a 'moderate' agreement. Of the various radiological modalities MRS was found to be the most concordant to histopathological diagnosis. It was able to pick glial neoplasms fairly accurately.

DISCUSSION

Neoplasms form the large majority of space occupying lesions of the brain and spinal cord.[1,10] In our study of 102 cases, there were 91 neoplastic (89%) and 11 non neoplastic (11%) lesions. Alam et al (2011)[8] found 43 (81%) neoplastic and 10(19%) non-neoplastic lesions. A retrospective study of a 60 year record carried out in China in 2013 found the proportion of SOLs to be 63.8% neoplastic lesions.[11] The above Chinese study showed the gender distribution to be 3530 males (56%) and 2734 females (44%). In a study at Aga Khan University Hospital, Chishty et al in (2010)[5] found a distribution of 113 (72%) males and 45 (28%) females. Our study showed 64 (62%) males and 40 (38%) females (Fig. 2). In spite of some difference in ratios all these studies show a higher affliction of the male gender.

In our study the commonest symptoms were headache and vomiting. These results were corroborated by the findings of Chishty et al (2010).[5]

Neoplasms of the brain are rising in incidence. In 2002, the International Agency for Research on Cancer reported a worldwide incidence of 3.7 per 100,000

Table 1: *Table showing frequency breakdown of different histopathological variants and comparison with their radiological diagnoses.*

Histopathological Diagnosis (n)	*Same as Histopathological Diagnosis*	*Different from Histopathological Diagnosis*
Astrocytoma Grade 2 (11)	4	4
Astrocytoma Grade 3 (9)	1	1
GBM (13)	7	3
Pilocytic Astrocytoma (3)	0	1
Oligodendroglioma (5)	2	0
Oligoastrocytoma (2)	1	1
Gemistocytic Astrocytoma (2)	1	1
Ependymoma (2)	1	0
Meningioma (16)‡	11	0
Sellar Lesions		
Pituitary Adenoma (9)	5	2
Craniopharyngioma (3)	1	0
Dermoid cyst (1)	1	0
Haemangioblastoma (2)	1	1
Central Neurocytoma (1)	1	0
Eosinophilic Granuloma (1)	1	0
Colloid Cyst (2)	2	0
Arachnoid Cyst (1)	1	0
Metastatic Tumor (1)	0	1
Schwannoma (6)	2	3
Neurofibroma (2)	1	1
Inflammatory Lesions		
Abscess with non-specific inflammation (4)	2	2
Fungal Infection (2)	0	2
Tuberculosis (4)	4	0
Total	50	23

*Kappa = 0.05 – strength of agreement 'poor' †kappa = 0.03 – strength of agreement 'poor'
‡Kappa = 0.41 - strength of agreement 'moderate'

for males and 2.6 per 100,000 for females. These figures rose to 3.8 per 100,000 in males and 3.1 per 100,000 in females in 2008.[11]

The greatest numbers of the patient were in the fourth decade of age (Fig. 1). This finding was at variance with those of Chen et al (2013) who found the greatest number of cases in the fifth decade.[11]

The commonest neoplasms in our study were gliomas with 47 cases (46%), followed by 13 cases (13%) of meningiomas (Table, Fig 3). Petrovic et al (2010)[12] also found gliomas to be the commonest neoplasms in their series as did Jaffar et al (2011)[3] with an incidence of 54%.

Infectious diseases decreased in frequency with

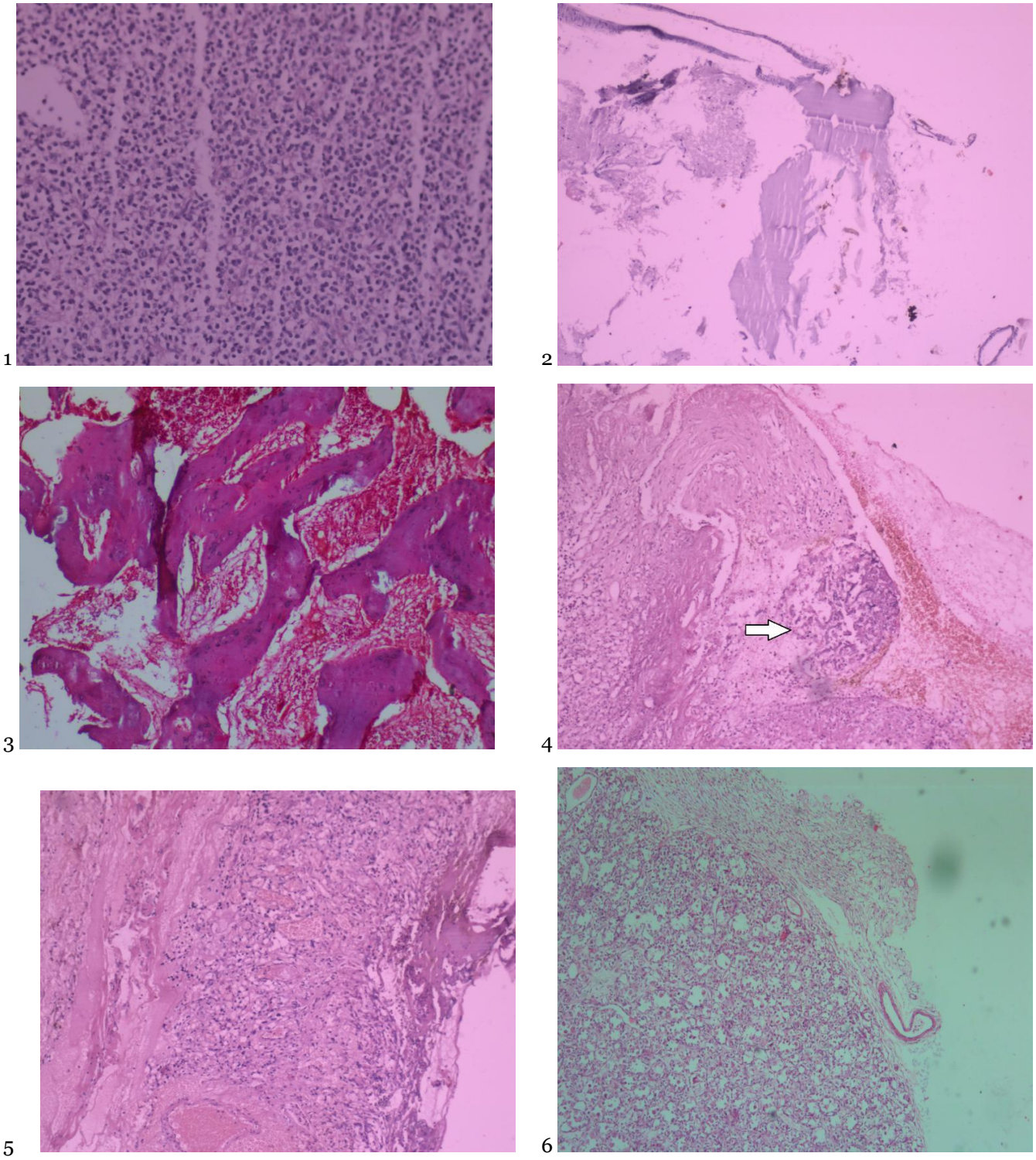

Figure 3: *Interesting cases that formed part of our study.*
1. *Central Neurocytoma:* Sheets of monotonous cells with cytoplasmic halo and bland nuclei. **2.** *Colloid Cyst:* Identification of colloid material and lining epithelium renders the diagnosis of a colloid cyst straightforward. **3.** *Eosinophilic Granuloma:* Bony spicules are interspersed with sheets of cells comprised of Langerhans cells, eosinophils, lymphocytes and neutrophils. **4.** *Fungal Abscess:* Fungal hyphae stand out even in this section stained with H & E stain (arrow). **5.** *Hemangioblastoma:* The tumor is comprised of blood vessels of variable sizes with large intervening cells that have pink or clear foamy cytoplasm. **6.** *Metastatic deposit brain:* Well - formed glands hint at the origin of the tumor and a sharp interface with surrounding brain is visible. (H & E, various magnifications).

the advent of the antibiotics. However, tuberculosis and fungal infection, shows a resurgence owing to the AIDS as well as immunosuppressive therapy given to transplant recipients and cancer patients.[13-15]

Both tuberculoma and fungal infection can present as space occupying lesions of the CNS with imaging techniques. The final diagnosis rests on histopathology especially special stains like ZN, PAS and GMS.[16]

Our study showed 4 cases (3.9%) of tuberculosis. The incidence of CNS tuberculosis was found to be 0.15% of SOLs in the UK and 20% to 30% in India.[17] 02 cases (1.9%) of fungal infection were seen in our study (Fig. 3). Butt et al in 2005,[17] found tuberculosis to make-up 3% and fungal infection to comprise 2% of their study of 100 cases. These figures are close to what we found in our patients. In our study there were 4 cases (3.9%) of congenital cysts. Although acquired cyst are more commonly encountered by most observers they did not form part of our data.[19]

Since the introduction of radiography in the 19th century, imaging techniques are being used for the pre-operative diagnosis and assessment of brain lesions.[20]

CT scan and conventional MRI are able to provide a provisional diagnosis as well as localization of CNS lesion, however, their accuracy is less than ideal. Kasim et al (2013)[7] in their study found the preoperative MRI diagnosis to be correct in 39 % of patients (using histopathology for confirmation). However these observers found that when multimodal imaging methods like MRS and PWI were added the preoperative diagnostic accuracy increased to 93%.

It has been established by several studies that multimodality magnetic resonance methods greatly increase the efficacy of preoperative assessment of CNS lesions.[7] These sophisticated techniques, however, have the disadvantages of being expensive, time consuming and requiring specially trained personnel for interpretation.[8] This makes them impractical for widespread use with our limited local resources. In our study the preoperative diagnoses based on CT and conventional MRI showed a concordance of only 68% with the histopathological diagnoses. Using Cohen's kappa with histopathology as the gold standard, an overall k value of 0.05 was obtained, which showed 'poor' agreement only. This implies that radiological diagnosis lags behind histopathological diagnosis in accuracy. Similar values of kappa (0.03) were obtained when radiological diagnoses of gliomas were compared with histopathological diagnoses. The strength of agreement was again graded as ‘poor’ with similar implications regarding the diagnostic accuracy of radiological modalities. The various meningiomas were picked up by the radiologists with a fair degree of accuracy. Here the k-value was 0.40 indicating a 'moderate' agreement (Table). Similar findings have been reported by earlier workers.[5,7] However, the few cases where an MRS was done showed 100% concordance even in cases of gliomas. This reinforces the previously expressed view that a multi-modality approach greatly improves the accuracy of radiological diagnosis; though the already listed constraints prevent it from being practiced more widely.[8]

It is ***concluded*** that our study shows that histopathological diagnosis remains superior to radiological diagnosis in the context of SOLs of brain. Hence it is concluded that a multidisciplinary approach is the ideal for space occupying lesions of the central nervous system. The neurosurgeon, neuroradiologist and neuropathologist form a triad that is essential for diagnosis, management and follow up of these cases. Nuclear medicine may become the fourth pillar of this estate in the future. However, an extensive review of the prevailing literature reveals that histopathology remains the yardstick against which all emerging techniques must be measured.

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