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COMPUTED TOMOGRAPHY (CT) SCAN;
RING ENHANCING LESIONS ON BRAIN

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ABSTRACT… Ring enhancing lesions are a common neurological problem seen in either gender and in all age groups. **Objectives:** To determine the clinical presentations and etiological factors in patients with ring enhancing lesion on CT scan brain. **Design:** Case series study. **Period:** One year. **Setting:** Department of medicine, Liaquat University Hospital, Hyderabad. **Patients and methods:** Subjects of either sex ≥12 years of age, presented with seizures, fever, focal neurological signs and deficit, headache, weight loss and vomiting and had single or multiple ring enhancing lesions on computed tomography (contrast CT brain film) were enrolled and entered in the study. CT scan brain was advised to evaluate any identified lesion and then certain specific biochemical tests were also advised to detect the particular existence etiological factor. The data was analyzed in SPSS 16 and the frequency and percentage was calculated. **Results:** During one year study period, total 50 subjects were detected as ring enhancing lesion on CT scan. The mean age ±SD of the over all population was 28.87±4.84 whereas the mean age ±SD of male and female population was 27.76±6.53 and 30.76±5.83 respectively. Ring enhancing lesions were right sided in 30 patients (60%), on the left side in 15 (30%) and bilateral lesions were identified in 6 subjects (10%) on brain imaging. Majority of the ring enhancing lesions were single 45 (90%) and the parietal lobe was observed as the commonest site. The headache, seizures, fever, pyramidal signs and papilledema was identified the common clinical features whereas the common etiological factors responsible for ring enhancing impression on brain CT scan were tuberculoma 17(34%), brain tumor 12(24%), metastasis 05(10%) and brain abscess 04(08%). **Conclusions:** The male population was predominant while the seizure was observed as common clinical feature whereas the tuberculoma, brain tumour and metastasis are the common etiological factors responsible for ring enhancing lesion on brain imaging.

Key words: Ring lesion, Ring enhancing, tuberculoma, brain tumour, metastasis, brain abscess, neurocysticercosis and toxoplasmosis

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INTRODUCTION

Ring enhancing lesions are a common neurological problem seen in either gender and in all age groups[1]. The computed tomography (CT) is important to diagnose the lesion thru imaged structures of anatomical site at the particular focus revealing bones, soft tissue, brain and blood vessels[2]. The neuroradiology has a key role in understanding of the pathophysiology of disease and improving the sensitivity to its identification and extent as well as the specificity to particular pathogens[3]. The contrast enhances various images of the CT scan and helps the radiologist to study the images. Contrast uptake in the shape of 'ring enhancement' on CT scan brain is found in various disorders with damage to the blood brain barrier. Even in contrast to magnetic resonance imaging (MRI), in patients with ring enhancing lesion, thin (2-5 mm) slice contrast CT is a cost-effective tool alternative to MRI[4].

Ring enhancing lesion in brain imaging is a common feature and without detail history, it is confusing to differentiate between neoplastic and non-neoplastic disorders[5]. The shape, size, border thickness of 'ring enhancing' lesions, surrounding edema, clinical history, physical examination and age of the patient may help to distinguish the various disorders[6]. In a developing country, the etiological pattern seems to be changed from that reported in western countries, with infections like tuberculomas, neurocysticercosis predominantly to cause ring enhancing lesions and in relation to AIDS; fungal

infections (cryptococcosis, histoplasmosis) and toxoplasmosis are increasingly associated with ring enhancement[7]. Ring enhancement also observed in primary brain tumours, abscesses, metastases, granulomas, infarcts and resolving hematomas. Less common conditions include multiple sclerosis and thrombosed aneurysms. Brain abscess is a focal suppurative process in the brain tissues and Hippocrates found that health care provider should pay attention in acute ear pain associated with fever because the patient can become delirious and in a short time die. Neurosurgical treatment techniques have been described while advances in antibiotic therapy, radiological and surgical technique have played a remarkable role to drastically improve outcomes of such a devastating disorder[8]. The progress in immunodiagnostic methods and stereotactic biopsy technology facilitated most accurate diagnosis of lesions thru histopathological examination (tissue biopsy) and also helped the diagnosis of infective etiology[9]. Nuclear imaging especially SPECT (single photon emission computed tomography) brain studies is fast, non-invasive technique and great importance tool in distinguishing between neoplastic and non-neoplastic diseases,[10] while small single enhancing CT lesion (SSECT) in the brain is the commonest cause of epilepsy affecting thousands of people worldwide[11].

The present study was conducted at tertiary care teaching hospital of Hyderabad / Jamshoro to evaluate the clinical presentations and etiological factors in patients with ring enhancing lesion on CT scan brain.

PATIENTS AND METHODS

This one year case series study was conducted in the department of medicine on subjects of either sex ≥12 years of age, presented with seizures, fever, focal neurological signs and deficit, headache, weight loss and vomiting and had single or multiple ring enhancing lesions on computed tomography (contrast CT brain film) were enrolled and entered in the study while the exclusion criteria of the study were homogenous nodular enhancements, streaky / patchy enhancements without definite rim pattern, and the non cooperative subjects / attendants were not interested to participate in the study. The detailed history was taken and relevant clinical examination was performed. All patients underwent for hematological, biochemical and serological tests including HIV, VDRL and chest X-ray, mantoux test, EEG and CT scan brain with contrast studies. All CT scans images were discussed with whole research team and also interpreted in consultation with radiologist and / or neurologist and if inconclusive MRI was advised. MRI was resorted to especially in cases where the patient had neurological deficits unexplained by the CT scan lesion or when the ring enhancing lesion was not clear on CT scan. The subjects also underwent certain specific investigations like CSF examination with special stains like India ink was done for fungal detection and also fungal cultures accordingly. The specific investigations like analysis for neurocysticercal antigens was done by ELISA technique, antituberculous antibodies estimation consisted of IgG to lipoarabinomannan (Anti LAM-B), IgM antibodies, immune complexes, toxoplasma IgM and IgG estimation from serum and antigen and stereotactic biopsy of the ring enhancing lesion was done or open biopsy when resection was indicated were also advised whenever required. All the maneuvers were performed by the cooperation fo whole research team and were under medical ethics and regarding the ethical justification all the expenses of the study were bear by the research team. The data was collected on pre-designed proforma and was entered, saved and analyzed in SPSS version 16. The frequency and percentage (%) was calculated in relation to etiology and gender distribution. The mean ±SD was calculated for numerical variables and the stratification was done for age, gender, site of lesion, clinical presentation and etiological factors.

RESULTS

During one year study period, total 50 subjects were detected as ring enhancing lesion on CT scan. The mean age ±SD of the over all population was 28.87±4.84 whereas the mean age ±SD of male and female population was 27.76±6.53

and 30.76±5.83 respectively. Ring enhancing lesions were right sided in 30 patients (60%), on the left side in 15 (30%) and bilateral lesions were identified in 6 subjects (10%) on brain imaging. Majority of the ring enhancing lesions were single 45 (90%) and the parietal lobe was observed as the commonest site. The age distribution in relation to gender and the gender distribution in relation to clinical presentation are shown in Table I and II whereas the gender distribution in relation to site of ring enhancing lesion and the etiology of ring enhancing lesion in relation to gender are shown in Table III and IV.

Age (years)	Male	Female	Total
12-19	03	02	05 (10%)
20-29	10	05	15 (30%)
30-39	04	02	06 (12%)
40-49	02	02	03 (06%)
50-59	01	03	05 (10%)
60-69	03	03	06 (12%)
70 +	08	02	10 (20%)
Total	31	19	50 (100%)

Table-I. The age distribution in relation to gender

		GENDER		Total
		Male	Female	
SYMPTOMS	Headache	4	3	7
		12.9%	15.8%	14.0%
	Vomiting	3	2	5
		9.7%	10.5%	10.0%
	Fever	5	2	7
		16.1%	10.5%	14.0%
	Limb weakness	4	2	6
		12.9%	10.5%	12.0%
	Confusion	3	2	5
		9.7%	10.5%	10.0%
	Visual complaint	2	2	4
		6.5%	10.5%	8.0%
	Seizures	7	4	11
		22.6%	21.1%	22.0%
	Asymptomatic	2	1	3
		6.5%	5.3%	6.0%
	Others	1	1	2
		3.2%	5.3%	4.0%
Total		31	19	50
		100.0%	100.0%	100.0%

Table-II. The gender distribution in relation to presentation of the patients

		GENDER		Total
		Male	Female	
SIGNS	Seizure	7	4	11
		22.6%	21.1%	22.0%
	Cranial nerve palsy	7	3	10
		22.6%	15.8%	20.0%
	Pyramidal signs	8	6	14
		25.8%	31.6%	28.0%
	Cerebellar signs	2	2	4
		6.5%	10.5%	8.0%
	Papilledema	4	3	7
		12.9%	15.8%	14.0%
	Others	3	1	4
		9.7%	5.3%	8.0%
Total		31	19	50
		100.0%	100.0%	100.0%

Table-III. The gender distribution in relation to clinical signs

		GENDER		Total
		Male	Female	
SITE	Parietal lobe	13	10	23
		41.9%	52.6%	46.0%
	Frontal lobe	8	4	12
		25.8%	21.1%	24.0%
	Temporal lobe	3	2	5
		9.7%	10.5%	10.0%
	Occipital lobe	7	3	10
		22.6%	15.8%	20.0%
Total		31	19	50
		100.0%	100.0%	100.0%

Table-IV. The gender distribution in relation to site of ring enhancing lesion on brain ct scan

		GENDER		Total
		Male	Female	
ETIOLOGY	Tuberculoma	12	5	17
		38.7%	26.3%	34.0%
	Brain Tumour	8	4	12
		25.8%	21.1%	24.0%
	Metastasis	3	2	5
		9.7%	10.5%	10.0%
	Abscess	2	2	4
		6.5%	10.5%	8.0%
	Vascular Lesion	2	1	3
		6.5%	5.3%	6.0%
	Neurocysticercosis	1	1	2
		3.2%	5.3%	4.0%
	Toxoplasmosis	2	2	4
		6.5%	10.5%	8.0%
	Idiopathic	1	2	3
		3.2%	10.5%	6.0%

Total		31	19	50
		100.0%	100.0%	100.0%

Table-V. The etiology of ring enhancing lesion in relation to gender

DISCUSSION

Ring enhancing lesions is a major neurological problem and responsible for various complications. In present study ring enhancing lesions were maximum observed in the 21 to 30 age group with male predominance.

The mean age ±SD of the over all population was 28.87±4.84 whereas the mean age ±SD of male and female population was 27.76±6.53 and 30.76±5.83 respectively. Bharucha et al found that the age specific prevalence ratio's had small peak in the group 21 - 30 years[12]. Seizure was clearly the most common presentation - 22% (11 subjects), Wadia et al 52 observed that 26% of patients with focal seizures have an enhancing ring or disc lesion on CT scan[13]. Puri V, et al studied 67 patients with seizures and had isolated enhancing lesions on computed tomography (CT) scan[14]. In contrast to mention in Western literature, infective causes clearly were the dominant cause of ring enhancing lesions.

The present study clearly showed the dominance of infective causes for ring enhancing lesions on CT Brain in our population. Expert opinion plays a major role in neuroradiological diagnosis of ring enhancing lesion. Radiology consensus criteria had to be the mainstay in the diagnosis of neurocysticercosis. The size of lesion (<20mm), absence of systemic diseases, absence of raised ICP and absence of midline shift, extent of perilesional edema, clinical presentation as focal or generalized seizures were important criteria favoring the diagnosis of neurocysticercosis. An MRI of the brain was usually advised wherever needed specially when CT contrast was inconclusive or patient had neurological deficits regardless of the lesions identified on CT image. MR spectroscopy served as an important tool in the diagnosis of tuberculoma. A feature of ring enhancing lesion found to differ from former studies in the multiplicity of the lesions. This study found the dominance of small solitary enhancing lesions in our population. It is the lack of multiplicity of lesions that is cited as the reason for low sensitivity of immunodiagnostic tests in our context. Reviews with neuropathologists and neuromicrobiologists thru discussion also point out that antigenic variation could be the reason for less detection of ring enhancing lesion by immunodiagnostic methods. Stereotactic brain biopsy is the most accurate diagnostic tool for ring enhancing lesions. It needs to be highlighted that stereotaxic biopsy which was not thought to be feasible at the onset of the study was the conclusive diagnostic tool. With the help of an expert neurosurgeon Stereotactic brain biopsy was advised in clearly indicated subjects without significant morbidity. The indications for stereotactic biopsy included refractory seizures, progression of neurological lesion despite of antituberculous or antineurocysticercal regimen. This procedure was done uneventfully in 05 subjects. But two patients died within five days of the procedure due to advance primary disease rather than biopsy induced complications. One patient subsequently presented with a stroke and CT contrast revealed a ring enhancing lesion in the middle cerebral artery territory which was identified as an infarct and was diagnosed as the case of Takayasu arteritis. Two subjects developed advance neurological disability and developments of new ring enhancing lesions of thick walled morphology diagnosed as toxoplasmosis by histopathological and immunodiagnostic methods both were not immunocompromised.

Sempere AP, et al in a prospective study of adults with a first seizure found that the proportion of idiopathic seizures decreased with age and that of symptomatic seizure increased with age, 55% in people below 45 years increasing to 85% in people over 45 years[15]. Dam et al studied 221 patients with epilepsy and found that amongst the structural brain lesions, brain tumor was the cause in 16% followed by cerebrovascular infarctions in 14%[16]. Russo ME et al discovered structural lesions in 25% of adult patients with a first seizure but in only 5.9% of patients with nonfocal findings

in the neurologic examination[17]. In the series of Ramirez - Lassepas M, et al CT scan identified structural lesions in 37% of patients. In the group of patients with nonfocal findings 15% had structural lesions in CT scan[18]. Bhargava S, et al observed that such CT lesions were tuberculomas based on histopathologic findings or were associated with tubercular meningitis[19]. Brismar J, et al concluded that plausible arguments may be made for obtaining routine early CT scan and reserving MRI for patients with seizures not controlled by antiepileptic drugs[20]. The study published in 1999 evaluate the clinical and CT data from patients with histologically proven small solitary tuberculomas and patients with histologically proven solitary cysticercus granulomas. Based on the clinical findings (evidence of raised intracranial tension and a progressive neurological deficit) and CT criteria (size, shape, and association with a midline shift) [21].

CONCLUSIONS

The tuberculoma, brain tumour and metastasis are the common etiological factors of ring enhancing lesion on brain imaging. The male population was predominant and the seizure was observed as common clinical feature. A clinical picture of seizures, fever, focal neurological signs and deficit, headache, weight loss and vomiting should be carefully worked up for appearance of ring enhancing impression on computed tomography of the brain to detect the exact etiology because early identification and appropriate management of etiological factor can save the patients to acquire life threatening complications.

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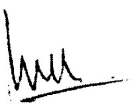
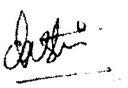
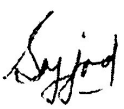
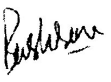
AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author-s Full Name	Contribution to the paper	Author=s Signature
1	Dr. Irfan Murtaza Shahwani	Contributions to bconecption and design, acquisition of data, analysis and interpetation of data	
2	Dr. Mashooque Ali Dasti	Drafting the article and share its expert research opinion and experience in finalizing the manuscript	
3	Dr. Muhammad Amjad Kalhoro	Contributed in coneption and interpetation of data and give his expert view of manuscript designing	
4	Dr. Ali Sajjad	Drafting the manuscript and contribution in the data collection	
5	Dr. Bushra Waseem	Drafting interpeting and analyzing the data	
6	Dr. Suneel Arwani	Data collection and manipulation of data	
7	Dr. Syed Zulfiquar Ali Shah	Analysis and interpetation of data Contribution in conception and share its exprt research opinion