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The Incidence and Location of Different Types of Ring Enhancing Lesion of Brain

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Abstract **Original Research Article**

Background: Ring-enhancing lesions are one of the most common types of neuroimaging abnormalities. Many different primary and secondary brain tumors, including glioblastomas, low-grade gliomas, and brain metastases, can also manifest as ring-enhancing lesions. ***Aim of the study:*** The objective of this study is to assess the incidence and location of different types of ring enhancing lesion of brain. ***Methods:*** This prospective observational study was carried out from January 2012 to December 2013 at the Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, Department of Radiology and Imaging, in collaboration with the Department of Neurosurgery. 56 cases total were randomly chosen for the study population based on clinical and brain CT results. First, all the pertinent information was gathered on a master chart, after which it was arranged using a scientific calculator and the proper statistical formulas. Finally, using MS Office and SPSS programs as necessary, all data were processed, examined, and disseminated. ***Results:*** The present study was found that among the ring enhancing lesions of brain patients, highest percentage were in the range of 31-40 years (35.7%). Clinical features of different etiologies headache emerged as the most common complaint that the patients presented. Out of 56 patients, 45 (80.4%) complained of headache. Parietal was observed as the most common site of lesion of 31 (57.1%). Parenthesis indicates percentage out of 21 diagnosed Glioma patients, 20 (95.2%) were single number of lesion and the rest 1 (4.8%) was multiple number of lesion. Perilesional Parenchymal changes were observed 45 (80.3%) patients. ***Conclusion:*** The present study was designed and attempted to find out the incidence and location of different types of ring enhancing lesion of brain. This was a single centre study and may limit the ability to reflect the generalized population in our country.

Keywords: Ring enhancing lesion, Brain, Neuroimaging, Metastases.

INTRODUCTION

The most common neuroimaging abnormalities are ring-enhancing lesions. These lesions are detected using widely available imaging techniques such as computed tomography and magnetic resonance imaging (MRI). A variety of etiologies can cause cerebral multiple ring-enhancing lesions [1]. Glioblastomas, low-grade gliomas, and brain metastases are all examples of primary and secondary brain neoplasms that can present as ring-enhancing lesions. On neuroimaging, many non-neoplastic neurological disorders can resemble brain neoplasms. Tuberculosis, cysticercosis, demyelinating disorders, and pyogenic abscess are among these diseases. The researchers examined 221 MRI ring-enhancing lesions and discovered that 40% were gliomas, 30% were metastases, 8% were abscesses, and 6% were demyelinating disease. CT is an effective preoperative imaging modality for ring- enhancing brain lesions [1, 2]. Ring- enhancing lesions can be superficial, but they are usually deep or subcortical. Reviewed 221 MR images of ring- enhancing lesions and found that 40% were gliomas, 30% were metastases, 8% were abscesses, and 6% were demyelinating disease. In their study, 45% of metastases and 77% of gliomas were single lesions, whereas 75% and 85% of abscesses and 85% of multiple sclerosis lesions were multiple [2]. Necrotic metastases and hematogenous abscesses are both characterized by cortical or subcortical lesions with

cavitation. Metastatic lesions are frequently solid nodular lesions that can become ring-enhancing due to necrosis. Multiple cortical or subcortical ring- enhancing lesions in patients with subacute bacterial endocarditis, indwelling catheters, or other implanted devices such as cardiac valves have an infectious etiology (i.e. they represent brain abscesses). Deep white matter ring-enhancing lesions are typically primary neoplasms (e.g., glioblastoma multiforme) or abscesses [2]. The majority of fluid-secreting tumors have enhancement limited to the mural nodule, though some may have a nodule with partial rim enhancement [3]. Multiple sclerosis plaques improve during the active phase, and this improvement usually lasts 2-6 weeks, if not longer [4]. The cause of the increase in demyelination is inflammation, usually perivascular, and is usually limited to the venous side, with no neovascularity, angiogenesis, or necrosis [5]. As a result, the enhancement of multiple sclerosis plaques can be faint, the lesions rarely cause perilesional vasogenic edema, and the enhancing rim is thin and frequently incomplete [6]. In developed countries, intracranial tuberculoma is uncommon. In adults, the most common sites are the cerebral hemispheres and basal ganglia, and in children, the cerebellum.

METHODOLOGY

This was a prospective observational study that was carried out at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, in collaboration with the Department of Neurosurgery, between January 2012 and December 2013. As the study population, 56 cases were chosen at random based on clinical and CT findings of ring- enhancing lesions of the brain. The BSMMU institutional review board approved the study protocol. Clinically suspected patients, regardless of age or gender, with ringenhancing lesions of the brain, suspected or supported by CT, and confirmed by histopathology were included in this study. Cases who did not undergo an operation and thus histopathology was not available for correlation, doubtful cases both radiologically and histopathologically, patients unwilling to give consent for the study, and clinically and radiologically suspected cases of demyelinating disease were all excluded from the study. This prospective observational study was conducted on randomly selected patients who were referred for a CT scan of the brain and discovered a ring-enhancing lesion. Following proper patient counseling, a CT scan of the brain was performed. A brain CT scan was performed from caudal to cephalad level, with an angulation of 15 to 20 degrees to the canthomeatal line. CT scans were viewed in axial slices, with reconstructed coronal and sagittal images being viewed in some cases. Clinical features of the study participants included headache, nausea, fever, seizure, focal neurologic deficit, altered consciousness, drowsiness, neck stiffness, visual disturbance, papilledema, and speech disturbance. CT scan variables included the number of lesions, their location, the involved hemisphere, density, surrounding edema, midline shifting, sulcus and gyrus effacement, ring enhancement, ventricular dilatation, the margin of the lesion, and the presence or absence of calcification. This study's histopathology variables included glioma, abscess, metastasis, and tuberculoma. The biopsy specimen was collected in a 10% formalin container and sent for histopathology. The excised brain mass was examined grossly, with special attention paid to size, consistency, and cut surface appearances. They were processed for routine paraffin section and stained using hematoxylin and eosin staining methods on two or three tissue blocks of 3-5 mm thickness for the specimen. All relevant collected data were first compiled on a master chart and then organized using a scientific calculator and standard statistical formulae.

RESULT

The present study was found that among the ring enhancing lesions of brain patients, highest percentage were in the range of 31-40 years (35.7%) followed by 41- 50 years (28.6%), greater than 50 years (21.4%), 21-30 years (8.9%) and lowest in age group of less or equal to 20 years (5.4%). The peak age incidence of ring enhancing lesions of brain was found 31- 40 years age group. Clinical features of different etiologies headache emerged as the most common complaint that the patients presented. Out of 56 patients, 45 (80.4%) complained of headache. The second most common presenting complaint was that of neurological deficit in 37 (66.1%) and vomiting seen 32 (57.1%) patients as the third most common complaint. Vertigo and convulsion were observed almost identical 28 (50%) and 27 (48.2%) respectively. 22 (39.3%) and 14 (25%) patients complained having fever and blurring of vision. Small number of patients complained having for unconsciousness which was 9 (16.1%). Parenthesis indicates percentage site of lesions of different etiologies are summarized in the table 3. Parietal was observed as the most common site of lesion of 31 (57.1%). Followed by temporal 23 (41.1%), frontal 23 (41.1%), paritooccipital (19.6%), infratentorial 10 (17.9%), occipital 9 (16.1%), frontoparietal and central gray matter 7 (12.5%) and extra-axial 3 (5.4%). Parenthesis indicates percentage Table 4 shows out of 21 diagnosed Glioma patients, 20 (95.2%) were single number of lesion and the rest 1 (4.8%) was multiple number of lesion. Those of eleven Metastasis patients, 9 (81.8%) and 2 (18.2%) were multiple and single number of lesion respectively. Ten diagnosed Tuberculoma patients, 4 (40%) patients were in single and 6 (60%) patients were multiple numbers of lesions. Finally, out of 14 diagnosed as abscess patients, 11 (78.6%) and 3 (21.4%) patients were in single and multiple number of lesion respectively. Parenthesis indicates percentage Table 5 shows out of 21 diagnosed Glioma patients, 15 (71.4%)

patients were as hypo dense and rest 6 (28.6%) patients were as mixed density of lesion. Those of eleven Metastasis patients, 9 (81.8%) and 2 (18.2%) were iso dense and hyper dense of lesion respectively. Ten diagnosed Tuberculoma patients, 7 (70%), 1 (10%) and 2 (20%) patients were in hyper, hypo and iso dense of lesions respectively. Finally, out of 14 diagnosed as abscess patients, 13 (92.9%) patients were hypo and 1(7.1%) was in iso dense of lesion. Perilesional Parenchymal changes are summarized in the table 6. Edema was observed 45 (80.3%) patients. Followed by midline shift 30 (53.6%), hydrocephalus 14 (25%) and meningeal enhancement 3 (5.4%) patients respectively.

Table 1: Age distribution of the study patients (N=56)

Age in years	Number	Percent
≤ 20	03	5.4
21-30	05	8.9
31-40	20	35.7
41-50	16	28.6
>50	12	21.4
Total	56	100

Table 2: Clinical features of different etiologies of the study patients (N=56)

Characteristics	Headache	Vomiting	Blurring of vision	Vertigo	Convulsion	Neurological deficit	Fever	Unconsciousness
Glioma (n=21)	17 (80.9)	15 (71.1)	4 (19.0)	10 (47.6)	13 (61.9)	15 (71.4)	0 (0.0)	0 (0.0)
Metastasis (n=11)	9 (81.8)	4 (36.4)	3 (27.3)	8 (72.7)	6 (54.5)	8 (72.7)	0 (0.0)	5 (45.4)
Tuberculoma (n=10)	6 (60.0)	4 (40.0)	5 (50.0)	4 (40.0)	4 (40.0)	7 (70.0)	8 (80.0)	4 (40.0)
Abscess (n=14)	13 (92.8)	9 (64.3)	2 (14.3)	6 (42.9)	4 (28.6)	7 (50.0)	14 (100.0)	0 (0.0)
Total	45 (80.4)	32 (57.1)	14 (25.0)	28 (50.0)	27 (48.2)	37 (66.1)	22 (39.3)	9 (16.1)

Table 3: CT features of different etiologies according to site of lesion (N=56)

Site	Glioma (n=21)	Metastasis (n=11)	Tuberculoma (n=10)	Abscess (n=14)	Total
Frontal	6 (28.6)	3 (27.3)	5 (50.0)	9(63.9)	23 (41.1)
Temporal	2 (9.5)	8 (72.7)	9 (90.0)	4 (28.6)	23 (41.1)
Parietal	7 (33.3)	8 (72.7)	8 (80.0)	8 (56.8)	31 (57.1)
Occipital	1 (4.8)	2 (18.2)	3 (30.0)	3 (21.4)	9 (16.1)
Fronto-parietal	3 (14.3)	2 (18.2)	0	2 (14.3)	7 (12.5)
Parito- occipital	1 (4.8)	4 (36.4)	2 (20.0)	4 (28.6)	11 (19.6)
Central gray matter	0	2 (18.2)	4 (40.0)	1 (7.1)	7 (12.5)
Infratentorial	0	3 (27.3)	4 (40.0)	3 (21.4)	10 (17.9)
Extra-axial	0	0	3 (30.0)	0	3 (5.4)

Table 4: CT features of different etiologies according to number of lesion (N=56)

Number of lesion	Glioma	Metastasis	Tuberculoma	Abscess
Single	20 (95.2)	2 (18.2)	4 (40.0)	11 (78.6)
Multiple	1 (4.8)	9 (81.8)	6 (60.0)	3 (21.4)
Total	21 (100)	11 (100)	10 (100)	14 (100)

Table 5: CT features of different etiologies according to density of lesion (N=56)

Density	Glioma (n=21)	Metastasis (n=11)	Tuberculoma (n=10)	Abscess (n=14)
Hyper dense	0	2 (18.2)	7 (70.0)	0
Hypo dense	15 (71.4)	0	1 (10.0)	13 (92.9)
Iso dense	0	9 (81.8)	2 (20.0)	1 (7.1)
Mixed	6 (28.6)	0	0	0

Table 6: Perilesional Parenchymal Changes (N=56)

Characteristics	Edema	Midline shift	Hydrocephalus	Meningeal enhancement
Glioma (n=21)	15 (71.4)	16 (76.2)	8 (38.1)	0
Metastasis (n=11)	11 (100.0)	5 (45.5)	1 (9.1)	0
Tuberculoma (n=10)	5 (50.0)	0	3 (30.0)	2 (20.0)
Abscess (n=14)	14 (100.0)	9 (64.3)	2 (14.3)	1 (7.1)
Total	45 (80.3)	30 (53.6)	14 (25.0)	3 (5.4)

DISCUSSION

The goal of this study is to determine the prevalence and location of various types of ring enhancing lesions in the brain. In this study, it was discovered that the highest percentage of ring enhancing lesions in brain patients were in the age range of 31-40 years (35.7%), followed by 41- 50 years 28.6%, greater than 50 years 21.4%, 21-30 years (8.9%), and less than 20 years (5.4%). The age group 31-40 years old had the highest incidence of ring enhancing lesions of the brain. According to a study, patients ranged in age from 16 to 70 years. The majority of patients (37.5%) were between the ages of 31 and 40 [7]. These data were almost similar to present study. The age distribution was from 5 to 80 years (mean age 29.7 years) in a study [8]. Clinical features of different etiologies of the present study in patients with Glioma, headache was the most common presentation (80.9%), followed by neurological deficit (71.4%), vomiting (71.1%), convulsion (61.9%) and vertigo (47.6%). In his thesis Bibekananda [9], found headache was the most common presentation (91.4%), followed by neurological deficit (80%), convulsion (68%), vomiting (63%), and vertigo (28%). These data were almost similar to present study. In patients with metastasis, headache was the most common presentation (81.8%), followed by neurological deficit (73%), vertigo (73%), convulsion (55%), visual problem (27%) and vomiting (36%). Mahato *et al.,* (2012) [7], also found headache (42%), seizures (57%), vomiting (14%), hemiparesis (46%) and visual problem (14%). In patients with tuberculoma, fever was the most common presentation (80%), followed by neurological deficit (70%), headache (60%), visual problem (50%) convulsion (40%), and vomiting (40%). Mahato *et al.,* (2012) [7], also found headache (66%), fever (52%) seizures (47%), vomiting (42%), hemiparesis (46%) and visual problem (38%). These data were also similar to present study. In Abscess, fever was found in all cases (100%), headache was found in (92.8%) cases. Other presentations were: vomiting (64%), neurological deficit (50%), vertigo (43%) and blurring of vision (14%) cases. Mahato *et al.,* (2012, p.513) [7], also found fever (100%) cases. Faraji- Rad [10], found headache (77%) cases. In his thesis Zakir (2007, p. 73) [11], reported headache, fever and focal neurologic deficit in 54%, 50%, and 27.3% of patients respectively. These data were also similar to present study. Site of lesions of different etiologies Parietal was observed as the most common site of lesion of 31 (57.1%). Followed by temporal 23 (41.1%), frontal 23 (41.1%), paritooccipital (19.6%), infratentorial 10 (17.9%), occipital 9 (16.1%), frontoparietal and central gray matter 7 (12.5%) and extra-axial 3 (5.4%). When analysis of site of individual lesions, in Glioma, parietal region (33.3%), frontal site (28.6%), fronto-parietal (14%), temporal (9%) and occipital (4.5%) cases. Osborn (2001) [12], also mentioned common location of glioma in frontal and temporal lobes. In Metastasis, location of lesions parietal region (72%), temporal (72%), frontal (27%), occipital (30%), parito-occipital (20%) and infratentorial(40) cases. Osborn (2001, p.660) [12], also mentioned metastasis all areas of brain may be affected. In Tuberculoma, site of lesions temporal (90%), parietal region (80%), frontal (50%), occipital (30%), parito-occipital (20%), central gray matter (40%), extra-axial (30%) and infratentorial(40%) cases. Mahato *et al.,* (2012, p.514) [7], also found parietal region (57%), temporal (28.5%), frontal (42.8%), occipital (28.5%), extra-axial (7.1%) and infratentorial(28.5%) cases. In Abscess, site of lesions parietal region (57.1), frontal(41.1%),temporal(23%), occipital(16.1%), parito-occipital(19.6%), central gray matter(12.5%),extra-axial(5.4%) and infratentorial(17.9%) cases. Osborn (2001, p.689) [13], also mentioned brain abscess the frontal and parietal lobes are the most frequent sites and less than 15% of intracranial abscess occur in the posterior fossa. Perilesional parenchymal changes, In glioma, edema observed about 71.4%, midline shifting 76.2% and hydrocepalus 38.1%. Bibekananda (2004, P.61) [9], in his thesis edema was found 78% cases. Weisberg (1979, p. 87) [14], observed in their series that most of the high grade astrocytomas had peritumoral edema and the size of the was related to development of perilesional edema. Bibekananda (2004, P.72) [9], in his thesis mass effect was found 74.3% cases and Weisberg (1979, p. 87) [14], found 77% cases which is almost close to present study. Weisberg (1979, p. 87) [14], found hydrocephalus45% cases and Bibekananda (2004, P.73) [9], was found 22% cases and which is almost close to present study.In metastasis, edema found in all cases(100%), midline shifting 45.5% and hydrocepalus 9.1% cases.In a study by Mahato *et al.,* (2012, p.515) [7], reported that incidence of edema 86.5%, midline shifting 57%, and hydrocephalus 42.8% cases which is almost similar to present study. Osborn (2001, p.660) [12], also mentioned edema asociated with metastasis can be striking and in some cases is the only abnormality seen on NECT scans. In tuberculoma, edema found about 50%cases, hydrocephalus 30% cases and meningeal enhancement 20% cases. Mahato *et al.,* (2012, p.515) [7], reported that incidence of edema 61.9%, hydrocephalus 19% cases and meningeal enhancement 19% cases, which was close to present study. In abscess, edema found in all cases (100%), midline shifting 64.3%, hydrocepalus14.3% cases and meningeal enhancement 7.1% cases. Mahato et al., (2012, p.515) [7], found that incidence of edema 100% cases, hydrocephalus 66.6% cases and meningeal enhancement 66.6% cases, which is close to present study. In his thesis Zakir(2007, p.75) [11], also found edema in all cases(100%) and midline shifting 67.3% cases which was also similar to present study.

Limitation of the Study

This was a single centered, prospective, observational study with a small sized sample. So, findings of this study may not reflect the exact scenario of the whole country.

CONCLUSION & RECOMMENDATION

Our study showed that the incidence and location of different types of ring enhancing lesion of brain. For getting more specific information regarding this issue, we would like to recommend for conducting more studies in several places with larger sized samples.

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