Print ISSN: 2321-6379
Online ISSN: 2321-595X
DOI: 10.17354/ijss/2016/321

Original Article

Diagnostic Accuracy of Magnetic Resonance Imaging in Characterizing Intracranial Space Occupying Lesions: A Cross-sectional Study

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Abstract

Introduction: Intracranial space occupying lesion (ICSOL) is one of the common indications in patients undergoing magnetic resonance imaging (MRI) brain. ICSOL can be due to varied etiology such as neoplastic, inflammatory, infective, and vascular.

Purpose: An accurate diagnosis is essential to avoid unnecessary interventions and follow-up. In this study, we try to evaluate the role of MRI in providing an accurate diagnosis.

Materials and Methods: A total of 100 consecutive patients who underwent MRI brain in our institution and came up with a diagnosis of ICSOL were included in our study. The radiological diagnoses were correlated with histopathological/biochemical studies, wherever applicable. Clinico-radiological correlation is made in rest of the cases.

Results: Out of the 100 cases, 63 cases were of neoplastic origin, 24 cases were infective, and rest were of inflammatory/vascular origin. Of the neoplastic cases, 55 cases were malignant and 8 cases were benign. Correct MRI diagnoses were made in 52 of the 55 malignant cases. Sensitivity of 94.5%, specificity of 75%, positive predictive value of 96.29%, and negative predictive value of 66.66%. Among the 24 cases of infective origin, correct MRI diagnoses were made in 20 cases.

Conclusion: MRI is invaluable in characterizing the ICSOLs. Addition of CT and magnetic resonance spectroscopy increases the specificity of diagnosing malignant ICSOL to 87% from 75% when MRI alone is used.

Key words: Brain, Data accuracy, Diagnosis, Magnetic resonance imaging, Pathology

INTRODUCTION

Intracranial space occupying lesions (ICSOLs) are a collective term for any lesion which occupies space within the intracranial fossa and causes raised intracranial pressure. An ICSOL is usually due to malignancy, but it can be caused by other pathologies such as infective, inflammatory, vascular, and traumatic. The lesion can cause focal brain damage, obstruction of cerebrospinal fluid flow, or general symptoms related to raised intracranial pressure such as seizures or false localizing signs. The high morbidity and mortality associated with them necessitate their early diagnosis so as to plan the intervention that is required.[1] Magnetic resonance imaging (MRI) provides excellent soft tissue contrast, which makes MRI the imaging modality of choice for ICSOLs. MRI has helped in the early diagnosis and localization of the ICSOL and has brightened the prognosis of mass lesions.[2]

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www.ijss-sn.com

Month of Submission : 04-2016
Month of Peer Review : 05-2016
Month of Acceptance : 05-2016
Month of Publishing : 06-2016

Aims of the study are:

1. To assess the accuracy of MRI in the characterization of ICSOLs when compared with histopathological/clinico-radiological correlation.
2. To assess the diagnostic accuracy of MRI in differentiating benign from malignant lesions.
3. To assess the role of MRI in differentiating neoplastic and other etiologies.

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MATERIALS AND METHODS

About 100 consecutive patients who underwent MRI Brain in Chettinad health and research institute from January 2013 to April 2016 and came up with a diagnosis of ICSOLs were included in our study. MRI was performed on GE 1.5 tesla MRI Scanner. Routine MRI sequences such as axial T1W, T2W fast spin echo, Fluid-attenuated inversion recovery axial and coronal, Sagittal T1 were acquired on all patients. Fat-saturated T1W images were acquired in axial, coronal, and sagittal planes after administration of 10 ml of Gadolinium contrast. MR Angiogram, MR venogram, Magnetic resonance spectroscopy (MRS), and correlative CT were done whenever required. Those ICSOLs which were caused by trauma were excluded from the study.

Evaluation of all images was performed by two experienced neuroradiologists. Each ICSOL were assessed for signal characteristics, size, shape, location, margins, and associated ancillary findings. And a radiological diagnosis was made, taking into consideration, all the imaging findings and clinical history. Later, ICSOLs were subjected to histopathological examination/surgery wherever possible. Those patients who were not subjected to histopathological examination or surgery were followed up and evaluated for response to appropriate treatment. Obtained results were tabulated and subjected to statistical analysis using IBM SPSS software version 20.0.

RESULTS AND OBSERVATION

Out of the 100 patients included in the study, 41 were females and 59 were males. Age of the patients ranged from 2 to 71 years as illustrated in Graph 1.

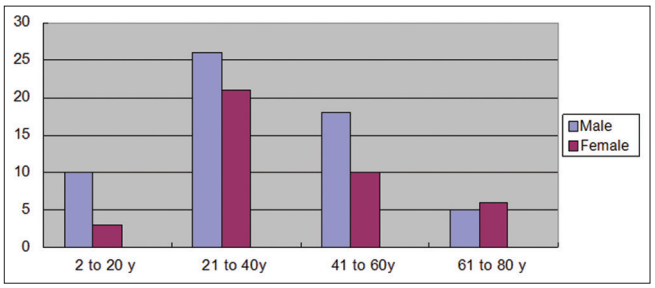
Out of the 100 cases, 63 cases were of neoplastic origin, 24 cases were infective, and rest were of inflammatory/vascular origin. Of the neoplastic cases, 55 cases were malignant and 8 cases were benign. Metastasis was the most common diagnosis among the malignant intracranial ICSOLs which was followed by supratentorial glioma. Meningioma was the most common benign ICSOL. Correct MRI diagnoses were made in 52 of the 55 malignant cases. Sensitivity of 94.5%, specificity of 75%, positive predictive value of 96.29%, and negative predictive value of 66.66%.

Among the 24 cases of infective origin, correct MRI diagnoses were made in 20 cases. Sensitivity of 80%, specificity of 50%, positive predictive value of 90.9%, and negative predictive value of 33.33%. Among the infective causes of ICSOLs, the most common diagnosis was tuberculoma. All the cases of cerebral abscesses were correctly diagnosed in MRI. Two cases were wrongly diagnosed as en plaque meningioma in MRI was later found to be hypertrophic pachymeningitis. Two cases were diagnosed in MRI as granulomatous lesions, later turned out to be tumefactive demyelination.

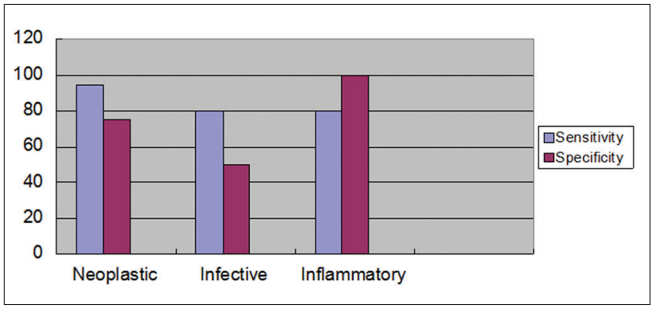
MRI correctly diagnosed 8 out of the 10 inflammatory cases of ICSOLs. The sensitivity of 80%, specificity of 100%, positive predictive value of 100%, and negative predictive value of 0%. Three cases were due to vascular causes such as cavernoma, which were correctly diagnosed by MRI. The results obtained in various categories of ICSOLs are tabulated here in Graph 2.

DISCUSSION

Conventional MR sequences provide mainly anatomical and structural information about the relation of a brain tumor to the surrounding tissue and may help to differentiate brain tumors from other central nervous system (CNS) pathologies.[3] Neoplasms form more than 50% of the ICSOLs. There is a reported tendency toward a higher incidence of gliomas in highly developed, industrialized countries and some reports indicate that Caucasians are more prone than African or Asian populations.[4] In the recent past, the incidence of patients with CNS tumors appears to be somewhat increasing.[5] CNS tumors are the second commonest overall and the most common solid tumors in the pediatric population.[6] In our study, MRI shows high sensitivity (94.5%) for diagnosing neoplastic lesions but lesser specificity (75%).



Graph 1: Age distribution



Graph 2: Comparison of sensitivity and specificity among specific categories

In our study, non-neoplastic etiologies contributed to 37% of cases of ICSOLs. The differentiation of neoplastic from non-neoplastic etiologies is the most clinically relevant challenge. Heterogeneity within and overlap between the neoplastic and non-neoplastic spectral patterns inevitably contribute to false-positive and false-negative errors.[7] These lead to the decreased specificity of MRI in diagnosing infective causes of ICSOLs.

Infective and inflammatory causes of non-neoplastic etiologies show similar sensitivities (80%) on MRI. However, specificity was far less (50%) for infective causes when compared with specificity for inflammatory causes (100%). All the cases with vascular etiology were correctly diagnosed with MRI. Even though MRI is the most sensitive modality for diagnosing ICSOLs, its specificity is low, especially among the infective etiologies. The most important aspect of imaging diagnosis is the differentiation between neoplastic and non-neoplastic lesions.

In some cases, the addition of MRS has aided in arriving at the correct diagnosis. MRS limits the use of established invasive diagnostic approaches such as brain biopsy, which is the gold standard for evaluating brain tumor, as brain biopsy is a heavily invasive technique.[8]

CONCLUSION

MRI has emerged as the most sensitive study in categorizing ICSOLs according to their etiology. However, its specificity is relatively poor, especially in diagnosing infective etiologies of ICSOLs. Addition of CT and MRS increases the specificity of diagnosing malignant ICSOL to 87% from 75% when MRI alone is used.

ACKNOWLEDGMENTS

We thankfully acknowledge the support and co-operation of Department of Radiology, Department of Neurosurgery and Department of Pathology, Chettinad Health and Research Institute in conducting this Study.

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How to cite this article: Kumar R, Pitchai ADP, Mudali S. Diagnostic Accuracy of Magnetic Resonance Imaging in Characterizing Intracranial Space Occupying Lesions: A Cross-sectional Study. Int J Sci Stud 2016;4(3):70-72.

Source of Support: Nil, **Conflict of Interest:** None declared.