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A Descriptive Study of Patients with Posterior Cranial Fossa Space - Occupying Lesions Undergoing MRI

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Abstract

Background: Posterior fossa tumors have a wide range of differential diagnosis.

Accurate radiological differentiation by magnetic resonance imaging, which is the imaging technique of choice in assessing the site and the extent of the tumor, is important for determining the correct treatment plan.

Methods: Cross sectional study was carried out under the department of Radio diagnosis at SP Medical College & Hospital, Bikaner on patients of any age and gender presenting with posterior cranial fossa space occupying lesions who undergo MRI

Results: The sensitivity (S) of MR to diagnose glioma, acoustic neuroma, meningioma, pilocytic astrocytoma, medulloblastoma, ependymoma and hemangioblastoma were 100%, 100%, 100%, 92.00%, 84.00%, 71.00% and 50%, in descending order. However, specificity values showed 100% for meningioma and hemangioblastoma, 98% for each ependymoma, acoustic neuroma, and medulloblastoma as well as 94.00% for glioma and pilocytic astrocytoma, respectively. Therefore, the accuracy of MR to diagnose meningioma, acoustic neuroma, medulloblastoma, glioma, hemangioblastoma, ependymoma and pilocytic astrocytoma were 100 %, 98.00 %, 96.00 %, 96.00 %, 96.00%, 94.00 % and 92.00 %, respectively.

Conclusion: It was found that the MRI is a golden tool in characterization of these masses as it revealed the exact extent of the tumor as well as the involvement of surrounding tissues, assisting in tumor management. In most cases, the histopathologic diagnosis and the MR diagnostic imaging are correlated.

Keywords: MRI, Tumor, Sensitivity.

Introduction

Magnetic Resonance Imaging (MRI) has revolutionized the field of neuro imaging, especially for evaluating posterior cranial fossa (PCF) space-occupying lesions. The PCF is a small yet complex anatomical compartment that houses vital structures including the brainstem, cerebellum, and cranial nerve nuclei. Because of the compact nature of this region, even small lesions can cause significant clinical symptoms, necessitating precise imaging for diagnosis and treatment planning[20]. MRI has emerged as the gold standard modality for evaluating PCF lesions, offering superior soft-tissue contrast and multi planar imaging without ionizing radiation[12]. This advantage makes MRI indispensable for detecting and characterizing lesions that may be missed or poorly defined on computed tomography (CT).[1] Adult patients with PCF lesions present with a diverse spectrum of pathologies.

Common tumors in this population include vestibular schwannomas, meningiomas, metastases, hemangioblastomas, and ependymomas[13]. Vestibular schwannomas account for the majority of tumors arising in the cerebellopontine angle, while meningiomas typically appear as extra-axial masses with characteristic Dural attachments[7]. Intra-axial lesions, such as ependymomas and hemangioblastomas, demonstrate distinct imaging features that aid in differentiation. Metastases to the PCF are also frequent in adults, particularly from primaries like lung and breast carcinoma[23]. Hence, MRI evaluation provides an essential diagnostic roadmap for both intra-axial and extra-axial pathologies.[2]

Advanced MRI sequences significantly enhance diagnostic accuracy. Diffusion-weighted imaging (DWI) and apparent diffusion coefficient (ADC) values are particularly useful in differentiating highly cellular tumors, such as medulloblastomas and lymphomas, from necrotic or cystic lesions[3]. Susceptibility - weighted imaging (SWI) detects minute calcifications, hemorrhages, or vascular malformations with greater sensitivity than conventional sequences[4]. Perfusion MRI allows assessment of vascularity and angiogenesis, which is crucial in distinguishing benign from malignant lesions[8]. Furthermore, functional techniques such as diffusion tensor imaging (DTI) provide tractography that helps neurosurgeons assess displacement or infiltration of brainstem tracts, thereby guiding surgical approaches and reducing postoperative morbidity[3].

The clinical presentation of PCF lesions in adults is largely influenced by the limited space and proximity to critical neural pathways. Patients frequently report headache, nausea, vomiting, and unsteadiness due to raised intracranial pressure or cerebellar involvement[2]. Cranial nerve involvement, especially sensori neural hearing loss, tinnitus, and facial numbness, is common in vestibular schwannomas[11]. Large lesions compressing the brainstem can result in life-threatening symptoms such as dysphagia, respiratory irregularities, or cardiovascular disturbances. Early and accurate MRI diagnosis thus has direct implications for prognosis and timely intervention.[4]

MRI also plays a pivotal role in postoperative and follow-up evaluation. Post-surgical imaging helps in detecting residual or recurrent tumors, differentiating scar tissue from active disease, and assessing complications such as pseudomeningocele or ischemia[6]. In cases treated with stereotactic radio surgery, MRI assists in evaluating therapeutic response and distinguishing radiation necrosis from tumor recurrence. Longitudinal MRI surveillance is critical in hereditary syndromes such as von Hippel – Lindau disease, where patients are predisposed to developing multiple hemangioblastomas.[5]

The broader significance of MRI in PCF lesions lies in its contribution to multidisciplinary patient care. Surgeons depend on high-resolution imaging to delineate lesion margins and their relationship with critical vessels and nerves. Oncologists use MRI to stage tumors and monitor treatment response, while anesthetists consider the presence of mass effect and brainstem compression for perioperative planning. Thus, MRI findings are central to the entire continuum of patient management, from diagnosis to treatment planning and long-term follow-up. MRI is the imaging modality of choice for evaluating posterior cranial fossa space-occupying lesions in adults. Its unparalleled ability to visualize soft-tissue details, advanced functional capabilities, and role in guiding both diagnosis and treatment make it indispensable in clinical practice. The comprehensive information it provides helps clinicians achieve accurate diagnosis, informed decision-making, and improved patient outcomes in this challenging anatomical region.[6-8]

Material and Methods

Study type: Descriptive type of observational study

Study design: Cross sectional Study

Study location: This study was carried out under the department of Radio diagnosis at SP Medical College & Hospital, Bikaner

Study population: All patients of any age and gender presenting with posterior cranial fossa space occupying lesions who undergo MRI

Inclusion Criteria

1. Patients of all ages (children, adults, elderly) suspected to have posterior cranial fossa lesions on basis of clinical history and examination findings
2. Patients already detected to have posterior fossa lesions on other imaging modalities, like CT scan, USG, Plain radiographs, and were advised MRI for better evaluation
3. Patients who will come for follow up MRI after receiving treatment of posterior fossa lesion
4. Newly detected or uncharacterized PCF space-occupying lesion on MRI.
5. MRI performed on standard sequences (T1, T2, FLAIR, DWI/ADC, SWI, contrast-enhanced as indicated).
6. Consent obtained from patient/parent/guardian as applicable.

Exclusion Criteria

1. Patients with contraindications to MRI (e.g., pacemakers, cochlear implants, metallic foreign bodies, severe claustrophobia).
2. Clinically unstable patients.
3. Severe renal impairment (eGFR <30 mL/min/1.73 m^2) if contrast is indicated.

4. Patients with non-mass posterior fossa conditions (e.g., demyelinating plaques, metabolic disorders) where discrete lesion characterization is not feasible.

Statistical analysis

Data thus collected was entered in Microsoft Excel Sheet by investigator herself on same day so as to minimize data entry bias if any.

1. Linear variables were summarised as mean and standard deviation whereas nominal/categorical variables was presented as proportions (percentage). Ordinal variables were described as median and inter quartile range.
2. Unpaired T test, one-way ANOVA test and other parametric tests was used for analysis of linear variables while nominal/categorical variables was analysed by using chi square test and fisher exact test. Man Whitney U test and Kruskal Wali′s tests was used for ordinal variables.
3. P value <0.05 was taken as significant.
4. SPSS 26.0 version software was used for all statistical calculations.

Results

Table 1: Sensitivity, specificity as well as accuracy of MRI

Item	Sensitivity	Specificity	Diagnostic accuracy
Pilocytic astrocytoma	92.00%	94.00%	92.00%
Ependymoma	71.00%	98.00%	94.00%
Glioma	100.00%	94.00%	96.00%
Acoustic neuroma	100.00%	98.00%	98.00%
Medulloblastoma	84.00%	98.00%	96.00%
Meningioma	100.00%	100.00%	100.00%
Hemangioblastoma	50.00%	100.00%	96.00%

The sensitivity (S) of MR to diagnose glioma, acoustic neuroma, meningioma, pilocytic astrocytoma, medulloblastoma, ependymoma and hemangioblastoma were 100%, 100%, 100%, 92.00%, 84.00%, 71.00% and 50%, in descending order. However, specificity values showed 100% for meningioma and hemangioblastoma, 98% for each ependymoma, acoustic neuroma, and medulloblastoma as well as 94.00% for glioma and pilocytic astrocytoma, respectively. Therefore, the accuracy of MR to diagnose meningioma, acoustic neuroma, medulloblastoma, glioma, hemangioblastoma, ependymoma and pilocytic astrocytoma were 100 %, 98.00 %, 96.00 %, 96.00 %, 96.00%, 94.00 % and 92.00 %, respectively.

Discussion

The age of the patients in our study range from 7 years to 74 years. The majority of the patients were children. Pilocytic astrocytoma was the most common tumor among children. Among adults, the most common tumor was acoustic neuroma and metastasis.

Mohammed (2021)[9] studied 46 patients who presented with posterior fossa tumors and discovered similar incidences. MRI features of variable lesions were evaluated including their location, morphology and signal characteristics on multiple sequences T1W, T2W, FLAIR, and post-contrast images. There were 16 cases of pilocytic astrocytoma in our study. The most of the patients were male. Most 16 cases showed hypointense signal on T1WI and hyperintense signal on T2WI/FLAIR imaging and intense enhancement was seen.

Bose et al., 2023[10], found that Pilocytic astrocytoma was the most common tumor in among the included 30 patients.

In the study of Di-Napoli et al., 2021[11], MRI was used to stay the characters of Pilocytic astrocytoma. They found that the target appearance with a T1- hypo intense and was actively homogenous and slightly hyper intense signal T2- weighted images. Also, the tumor appeared as an enhanced on Coronal T2-FLAIR.

Conclusion

It was found that the MRI is a golden tool in characterization of these masses as it revealed the exact extent of the tumor as well as the involvement of surrounding tissues, assisting in tumor management. In most cases, the Histopathologic diagnosis and the MR diagnostic imaging are correlated.

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