**ORIGINAL ARTICLE**

# Sensitivity of Magnetic Resonance Imaging in Detecting Abnormality in Posterior Cranial Fossa in Children

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## ABSTRACT

**Background:** The posterior cranial fossa is part of the cranial cavity, located between the foramen magnum and tentorium cerebelli. The gross anatomic relationships of the posterior fossa contents are best evaluated on sagittal images. Ependymoma is the third most common posterior fossa tumor in children. No specific causes for posterior fossa tumors exist.
**Aim:** To find the sensitivity of magnetic resonance imaging in detecting abnormality in posterior cranial fossa in children taking histopathology as gold standard.
**Design:** It was a cross-sectional survey.
**Study Settings:** This study was conducted at the Department of Radiology, The Children's Hospital, Lahore, for a period of 6 months from November 2017 to April 2018.
**Methods:** After meeting the inclusion criteria 95 patients were enrolled in this study. Demographic information was taken. Then patients underwent MRI by using 1.5-T systems. Routine MRI brain sequences included FSE (Fast Spin Echo) T1 weighted images T2 weighted images, FLAIR, GRE & CISS. All collected data was analyzed with SPSS version 20. From parents of all the patients, an informed written consent was taken.
**Results:** The mean age of the patients was 6.73±3.49 years with minimum and maximum ages of 1 & 12 years respectively. The posterior cranial fossa was diagnosed positive by MRI in 91(95.8%) patients and it was diagnosed negative in 4(4.2%) patients. Thus, the sensitivity of MRI in diagnosing abnormal posterior cranial fossa was 95.8%.
**Conclusion:** MRI is highly sensitive for detecting abnormality in posterior cranial fossa in children taking histopathology as gold standard. Thus, recommended in future practice.
**Keywords:** Histopathology, MRI, Posterior Cranial Fossa, Children, Abnormality

## INTRODUCTION

In children 45-60% of brain tumors is infratentorial tumors and among them most common tumor are brainstem glioma, medulloblastoma, juvenile pilocytic astrocytoma and ependymoma.[1] Occurrence of posterior fossa tumors is high in children than in adults. In children more common tumors are central nervous system tumors that account for 54-70% of total brain tumors originating from posterior fossa at childhood.[2]

In children common types of posterior fossa tumors are primitive neuroectodermal tumors, astrocytomas, pineoblastoma, medulloblastoma and ependymomas of cerebellum and brain stem. Usually benign in nature and mostly located in cerebellum, tumors like gliomas are unique (67%).[3] On the basis of involvement of posterior fossa, two types of posterior fossa malformations are those with small or normal posterior fossa and those with larger poster fossa.[2] Among disorders associated with larger posterior fossa are posterior fossa arachnoid cyst, Blake's pouch cyst, classic Dandy-Walker malformation and mega cisterna magna. Various types of small or normal fossa disorders are Joubert syndrome, neocerebellar hypoplasias, Dandy-Walker variant, rhombencephalosynapsis, tecto-cerebellar dysraphia, and cerebellar atrophy[4,5].

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A multidisciplinary approach is necessitated for diagnosis of children central nervous system tumors and its treatment besides expertise of the surgical team and diligence of all parties involved in the treatment also have vital role. Over the past decade, in treatment of these tumors, imaging has emerged as a classical component.[6,7] Sagittal images are considered best in evaluation of gross anatomic association of the posterior fossa contents. Midsagittal image should recognize landmarks like medulla oblongata, cerebellar vermis, mesencephalon, fourth ventricle and foramen magnum, as defined by the line linking the basion to the position[8,9].

In usual practice, abnormality of poster cranial fossa in children is determined clinically and it is used as decision making tool for biopsy which is a burden on health care system owing to unwanted and unnecessary surgeries which can be avoided by using MRI as a diagnostic tool. Parker et al. (1985)[10] reported 96% sensitivity of MRI in detecting posterior cranial fossa abnormality in previously diagnosed cases. Moreover, diagnostic accuracy of MRI in posterior cranial fossa abnormality was reported 98.57% by Goyani et al. (2015).[11] But there was no local evidence available which showed the extent of problem and can help in implementing the use of MRI for early detection of posterior cranial fossa instead of biopsy or other interventional method. Moreover, previous studies were conducted on small sample size which hampers applicability of the findings at mass level.

## PATIENTS AND METHODS

This cross-sectional study was conducted at the Department of Radiology, The children's Hospital & Institute, Lahore for six months duration for a period of 6 months from November 2017 to April 2018. Sample size of 95 cases was calculated with 95% confidence level, 4% margin of error and taking expected percentage of sensitivity of MRI i.e. 96% for detection of posterior cranial fossa.[10] The patients meeting inclusion criteria of both the genders with age between 1-12 years having medical record of histopathologically proven abnormal posterior cranial fossa as per operational definition were included in the study. On MRI, it was labeled as positive if glioma or tumor is present in posterior cranial fossa region and were labeled as negative, if no tumor detected on MRI. On histopathology, it was labeled as positive if astrocytes found in tumor are fibrillary, with some cytoplasmic pleomorphism in round-to-oval nuclei, Rosenthal fibers, necrosis, and anaplasia. All cases positive on histopathology were included. While patients with malignancy or operated for malignancy in other part of body and metastasis for that malignancy were excluded. An informed written consent was taken from parents of all the patients. Then patients underwent MRI by using 1.5-T systems. Routine MRI brain sequences included FSE (Fast Spin Echo) T1 weighted images T2 weighted images, FLAIR, GRE & CISS. Injection Dexamethasone 2mg IV and Diazepam 0.3mg/kg was given to the children. Presence or absence of abnormal posterior cranial fossa was noted. All MRI was performed by researcher herself. All this information was recorded on a uniform peforma. All data was entered and analyzed in SPSS version 20.0. The quantitative variables i.e. age has been presented as mean ± standard deviation. The qualitative variable i.e. gender and sensitivity of MRI have been presented as frequency and percentage. Data has been stratified for age and gender. Chi-square test was used to stratify data and p-value≤0.05 was taken as significant and sensitivity of MRI was also calculated.

## RESULTS

The patients had mean age of 6.73±3.49 years ranging between 1-12 years as shown in table 1. Total 46(48.42%) patients were male and 49(51.58%) patients were females. The male to female ratio of the patients was 0.9:1. The posterior cranial fossa was diagnosed positive by MRI in 91(95.8%) patients and it was diagnosed negative in 4(4.2%) patients.

Table 1: Demographic characteristics

| Characteristics | Participants (n=95) |
|---|---|
| Age (years) | 6.73±3.49 |
| • Minimum Age | 1-year |
| • Maximum Age | 12 Years |

Table 2: Sensitivity of MRI against positive cases on histopathology.

| MRI | Frequency | Percent (%) |
|---|---|---|
| Positive | 91 | 95.% |
| Negative | 4 | 4.2% |
| Total | 95 | 100.0% |

Thus, the sensitivity of MRI in diagnosing abnormal posterior cranial fossa was 95.8%. In male patients, the sensitivity of MRI was 97.8% while in female patients, the sensitivity of MRI was 93.9%. The difference was insignificant (P>0.05) regarding sensitivity of MRI in both genders as given in Table 3. In patients of age ≤6years, the sensitivity of MRI was 93.9% while in patients of age>6years, the sensitivity of MRI was 97.8%. The difference was insignificant (P>0.05) regarding sensitivity of MRI in both age groups as shown in table 4.

Table 3: Comparison of MRI with histopathology stratified by gender

| MRI | Gender | | | |
|---|---|---|---|---|
| | Male | Female | Total | P-value |
| Positive | 45 (97.8%) | 46 (93.9%) | 91 (95.8%) | 0.338 |
| Negative | 1 (2.2%) | 3 (6.1%) | 4 (4.2%) | |
| Total | 46 (100%) | 49 (100%) | 95 (100%) | |
| Sensitivity | 97.8% | 93.9% | 95.8% | |

Chi-square test value was 0.917.

Table 4: Sensitivity of MRI against positive cases on histopathology stratified by age

| MRI | Age | | | |
|---|---|---|---|---|
| | ≤6 | >6 | Total | P-value |
| Positive | 46 (93.9%) | 45 (97.8%) | 91 (95.8%) | 0.338 |
| Negative | 3 (6.1%) | 1 (2.2%) | 4 (4.2%) | |
| Total | 49 (100%) | 46 (100%) | 95 (100%) | |
| Sensitivity | 93.9% | 97.8% | 95.8% | |

Chi-square test value was 0.917.

## DISCUSSION

Among most common abnormalities of brain posterior fossa malformations are identified by present fetal imaging technique. Advancements in MRI has provided important insights during fetal and early postnatal life both in abnormal and normal development of the cerebellum and brainstem. Among imaging tools, MRI is modality of choice for the investigation of disorders of posterior cranial fossa. Accurate interpretation of MR examinations requires an understanding of the anatomy, histology and spectrum of pathology affecting the posterior cranial fossa[9,10]. Mean age of the patients in this study was 6.73±3.49. A similar mean age among such patients was 6.80±3.51 was observed by Calandrelli et al. (2017).[12] Male to female ratio observed in this study was 0.9:1 which matches with the ratio of 0.88:1 observed by Raybaud et al. (2015) among such patinets.[13] However, Parizal et al. (2010)[14] and Bosemani et al. (2015)[3] reported bit lower ratio of 0.75:1 and 0.76:1 in these patients, respectively.

This study found sensitivity of MRI for detecting posterior cranial fossa abnormality in children was 95.8% taking histopathology as gold standard. Findings of this study are quite similar to the findings of Packer at al. (1985)[10] and Raybaud et al (2015)[13] who reported sensitivity of MRI 96% and 98.57% respectively for detection posterior cranial fossa abnormality in children. Limperopoulos et al. (2008)[15] showed that in comparison with postnatal MRI, MRI of posterior fossa anomalies had limitations both in sensitivity and specificity. In posterior fossa anomalies cases the accuracy with which fetal MRI predicted findings on postnatal MRI was modest at best, with only 60% of prenatal diagnoses confirmed postnatally. Another study, conducted by Pugash et al (2008)[16]. in the

US showed 33% false-positive prenatal rate in comparison with MRI. The two cases of Dandy-Walker complex and Joubert syndrome and associated disorders emphasize superiority of MRI in evaluation of aplasia or vermian dysplasia, the shape of fourth ventricle, the insertion of the tentorium cerebelli and the presence of the pontine bulge. However, Borja et al. (2013)[17] reported that advanced imaging techniques like functional MIR, tractography, perfusion MRI, diffusion-tensor imaging and MR spectroscopy are helpful in developing highly accurate differential diagnosis that has vital role in treatment of tumor. In a study conducted by Zimmerman et al. (1992)[18], 114 patients out of 115 total enrolled patients had initial diagnosis of brain tumor on initial magnetic resonance diagnosis and in only one case less than 1-cm2 area of gadolinium enhancement, thus importance of initial findings remained uncertain.

The present study is fist of its kind in local population and adds to the limited existing evidence on the role of MRI in detection abnormality in posterior fossa in children. The results of the study confirm diagnostic efficacy of MRI. It can be thus advocated that in future, MRI should be used as a diagnostic tool for detecting abnormality in poster cranial fossa in children.

There was a strong limitation to the present study in shape of comparatively small sample size and availability of large number of such patients at one center study. In future, multi center and larger sample size studies are recommended.

## CONCLUSION

Magnetic resonance imaging is highly sensitive for detecting abnormality in posterior cranial fossa in children taking histopathology as gold standard that advocates its preferred use in future practice.

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