Role of Computed Tomography in the Evaluation of Intracranial Posterior Fossa Lesions

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Abstract

Background : The prime imaging modality available for imaging the posterior fossa are CT and MRI. CT is non-invasive, provides 3-D cross sectional anatomy of brain, which can be reformatted in multiple planes. CT provides more detail about the nature of calcification.

The posterior fossa lesions can be broadly classified into 1) **Mass lesions** 2) **Inflammatory lesions** 3) **Traumatic lesions** 4) **Vascular lesions** 5) **Congenital malformations**. Objective is to evaluate the computed tomography features of various types of lesions in the posterior fossa, their appearances and to determine the age and sex distribution.

Materials and Methods: This was a prospective study carried out on 60 patients, age range was 0-80 years, who were referred to the Department of Radio-Diagnosis for CT at Rohilkhand Medical College and Hospital for a period of one year from November 2018 to October 2019 using 16 slice GE Brightspeed Elite third generation CT machine.

Results & Conclusion: CT was highly accurate and efficient in diagnosing various posterior fossa lesions. It has an upper hand over MRI in characterization of bony changes and calcification.

Keywords: - *Cerebellum, Computed Tomography, Paraganglioma, Pilocytic astrocytoma, Pons, Posterior Fossa.*

Introduction

The posterior fossa lies below the tentorium cerebelli and contains the cerebellum, pons and medulla oblongata. It is bounded anteriorly by posterior surface of petrous part of temporal bone, posteriorly by occipital bone and laterally by squamous and mastoid parts of temporal bone, and inferiorly by the foramen magnum.

The prime imaging modality available for imaging the posterior fossa are computed tomography and magnetic resonance imaging. Computed tomography is non-invasive and provides three-dimensional cross sectional anatomy of brain, which can be reformatted in multiple planes. Computed tomography provides more detail about the nature of calcification and can characterize soft tissue abnormalities with high contrast and good spatial resolution. Now-a-days, many modern CT scanners are equipped with artifact reduction algorithm. Magnetic resonance imaging is excellent in depiction of soft tissue anatomy of the brain in multiple planes.

The posterior fossa lesions (Table 1) can be broadly classified into 1) **Mass lesions** (benign or malignant), 2) **Inflammatory lesions** (Tuberculoma, Neurocysticercosis, abscess etc.), 3) **Traumatic lesions** (Hematoma, Cerebellar Hemorrhage, Contusion), 4) **Vascular lesions** (Arteriovenous malformation, aneurysm) 5) **Congenital malformations** (Dandy Walker malformation, Chiari malformation, arachnoid

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cyst, mega cisterna magna etc.).[1]

Medulloblastoma, astrocytoma and brainstem gliomas are the most common pediatric posterior fossa neoplasms whereas in adults metastatic lesions are most commonly encountered. Other less common lesions include schwannomas, arachnoid cysts, meningiomas, etc. Pilocytic astrocytoma is the most common pediatric central nervous system glial neoplasm and the most common pediatric cerebellar tumor.[2,3]

Aim and Objectives

· To evaluate the computed tomography features of the various types of lesions in the posterior fossa region and their appearances.

· To determine the age and sex distribution of various lesions in posterior fossa.

Materials and Methods

This was a prospective study, carried out on 60 patients (33 female and 27 male) who were referred to the Department of Radio-Diagnosis for CT at Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh, India. This study was conducted for a period of one year from November 2018 to October 2019 using 16 slice GE Brightspeed Elite third generation CT machine.

Inclusion Criteria - Patients of both sexes of all age groups who were found to have posterior fossa lesions on computed tomography for relevant symptomatology. Only patients willing to participate and ready for follow up were included.

Risk of contrast reaction was explained to the patient and consent was taken. Contrast was not given to patients with history of hypersensitivity to i.v. contrast agent, eGFR <40ml/kg body weight.

Exclusion Criteria - Pregnant women and uncooperative patients.

CT scan of the head was done in supine position with axial sections of 3 mm thickness with pitch of 1, taken from the level of second cervical vertebra to vertex. Plain scan was followed by contrast scan when needed. Iohexol (350 mgI/ml) with dose of 1-2 ml/kg body weight was given as intravenously. Pre and post contrast attenuation values, size, location of masses, presence of calcification, mass effect and other associated findings were studied.

Results

Patients included in our study ranged from 5-80 years of age with a mean age of 45 years. Out of the total 60 patients, 33 were females and 27 males. Male-female ratio was 9:11. Out of 60 patients, 12 were children (20%) and 48 were adults (80%). Most of the patients presented with non-specific symptoms of headache, vertigo and vomiting.

Topographically, most lesions were located in the cerebellum, consisting 60% of the total cases. 8.33% cases were found in the pons. Rest 31.66% cases were extra-axial. Cerebellum was involved in 9 cases out of 12 (75%) in pediatric age group and 24 cases out of 48 (50%) in adults.

Hypodense lesions were noted in 31 cases, hyperdense lesions in 17 cases, 4 lesions were isodense with mixed density lesions in only 8 cases, out of total 60 cases.

Hydrocephalus was noted in 23 cases out of 60, corresponding to 38.3% of total cases. Adults constituted most of the cases with hydrocephalus, being 65.2% and children formed the rest 34.8% cases. 65.2% of cases with hydrocephalus were females and 34.8% males.

Calcification was seen in 7 out of 60 cases, i.e. 11.6% of total cases. Male-female ratio was 6:1. 62% of cases with calcification were adults and 38% were pediatric patients.

Spectrum of posterior fossa lesions in pediatric age group was – cerebellar abscess – 1 (8.33%), pilocytic astrocytoma – 1 (8.33%), medulloblastoma – 1 (8.33%), tectal plate glioma – 1 (8.33%), NCC - 2 (16.66%), tuberculoma - 2 (15.38%), cavernoma - 1 (8.33%), infarct – 1 (8.33%), mega cisterna magna – 1 (8.33%), arachnoid cyst - 1 (8.33%).

Spectrum of posterior fossa lesions in adults was – pilocytic astrocytoma -1 (2.08%), brainstem glioma – 1 (2.08%), ependymoma – 1 (2.08%), schwannoma – 5 (10.41%), meningioma - 2 (4.16%), cerebellar metastasis – 2 (4.16%), glomus jugulare – 1 (2.08%), epidermoid cyst - 2 (4.16%), mega cisterna magna – 3

(6.25%), arachnoid cyst – 2 (4.16%), ADEM – 1 (2.08%), tuberculoma – 2 (4.16%), NCC – 3 (6.25%), infarct- 10 (20.83%), traumatic hemorrhage/contusion – 5 (10.41%), hypertensive bleed – 7 (14.58%).

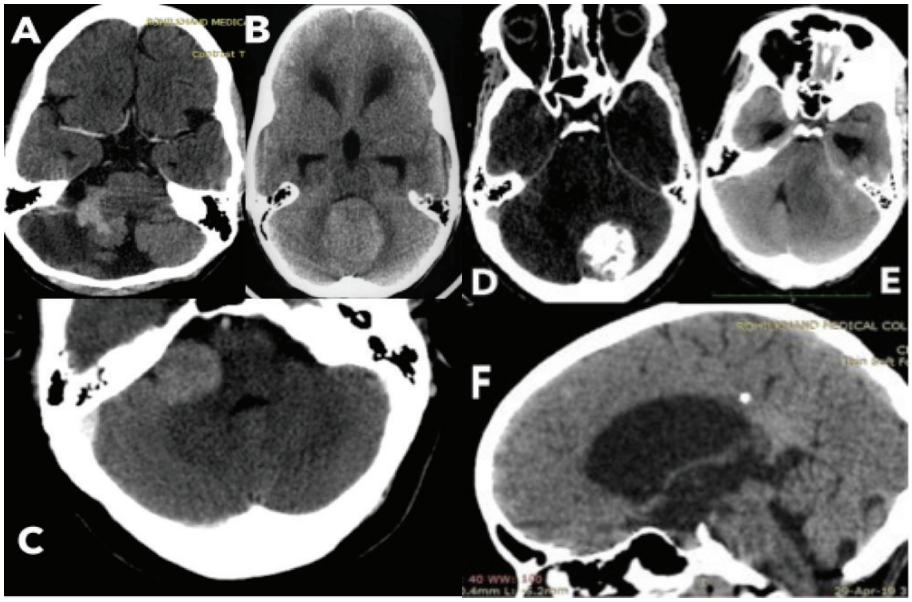


Fig.1. MASS LESIONS: A) PILOCYTIC ASTROCYTOMA - Large cystic lesion in the right cerebellar hemisphere having irregular peripheral enhancing solid component and causing obstructive hydrocephalus. B) MEDULLOBLASTOMA – Midline well defined hyperdense mass with effacement of 4th ventricle. C) SCHWANNOMA - Well-defined extra-axial mass lesion showing homogenous contrast enhancement in right cerebello-pontine angle. D) MENINGIOMA - Well defined extra-axial lobulated heterogeneously enhancing mass lesion along the left cerebellar convexity posteriorly with dense calcification and subtle hyperostosis of the overlying occipital bone. E) BRAINSTEM GLIOMA - Mass lesion having its epicenter in the left middle cerebellar peduncle causing obstructive supratentorial hydrocephalus. F) TECTAL PLATE GLIOMA - Non-visualization of aqueduct of sylvius with enlarged tectal plate.

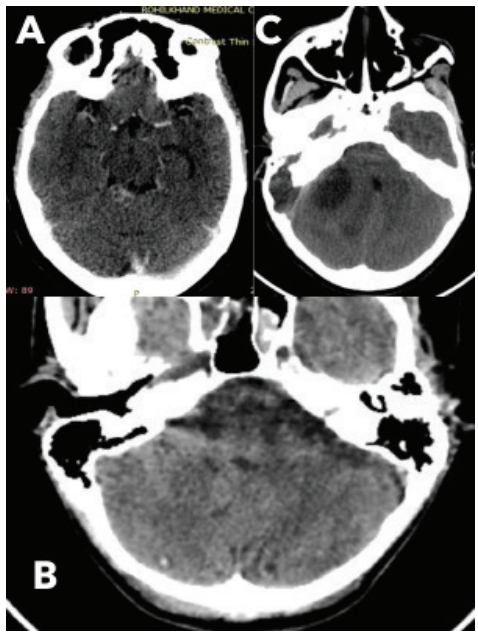
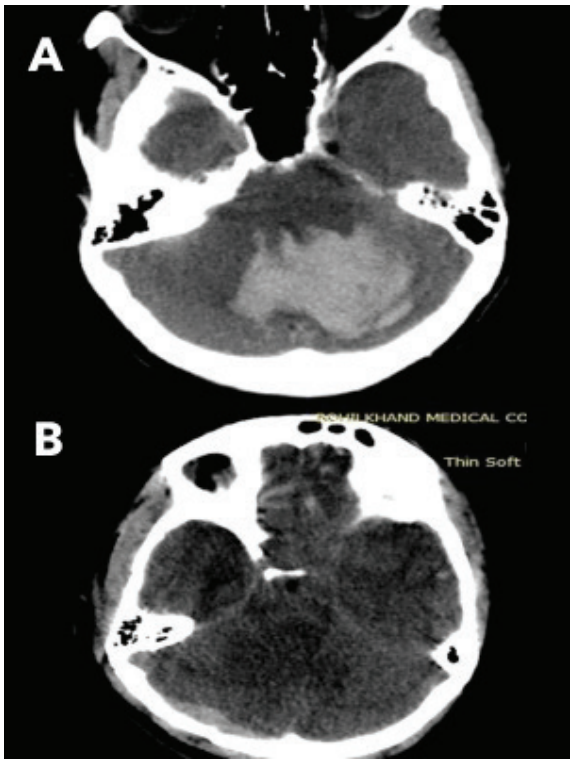


Fig.2. INFECTIVE LESIONS: A) TUBERCULOMA – Conglomerated ring enhancing lesions in vermis on right side. B) NCC - Small cystic lesions showing eccentric hyperdense nidus in bilateral cerebellar hemispheres. C) CERBELLAR ABSCESS - Cystic lesion in the right cerebellar hemisphere with destruction of sinus plate on the right side, right sigmoid sinus thrombosis and effacement of 4th ventricle.



3. TRAUMATIC LESIONS: A) CEREBELLAR HEMORRHAGE - Large hyperdense intraparenchymal bleed in the left cerebellar hemisphere with compression of brainstem and fourth ventricle. **B) EXTRADURAL HEMATOMA** – Lentiform shaped hyperdense collection along the right occipital convexity.

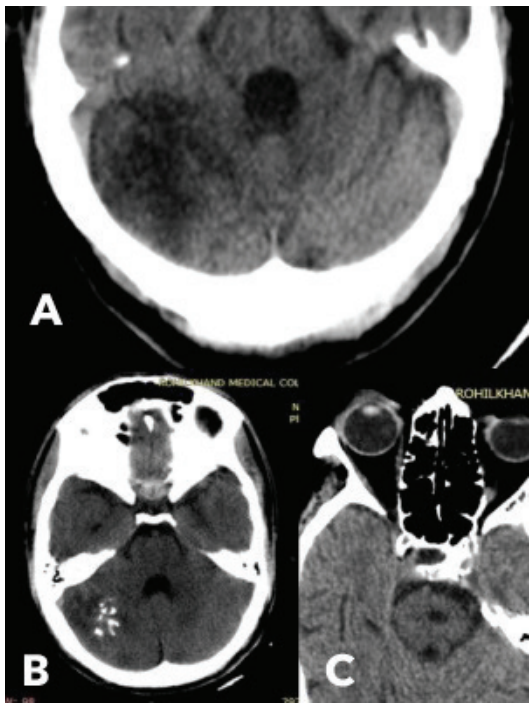


Fig.4. VASCULAR LESIONS: A) SUBACUTE CEREBELLAR INFARCT - Focal hypodense lesion in right cerebellar hemisphere. **B) CAVERNOMA** - Heterogeneous calcified non-enhancing lesion in the right cerebellar hemisphere. **C) PONTINE INFARCT –** Small hypodense lesion in left hemipons.

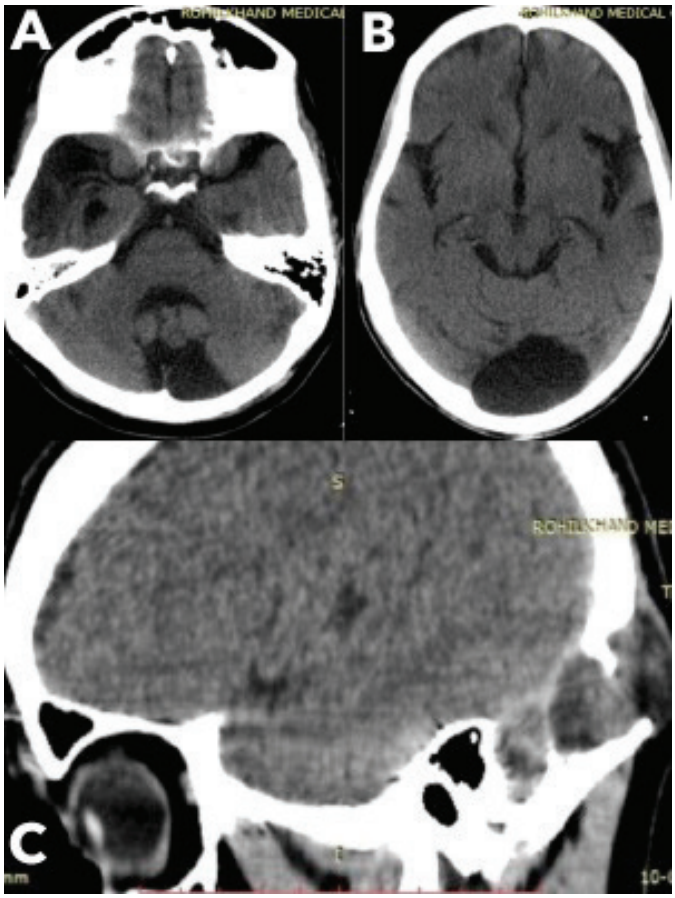


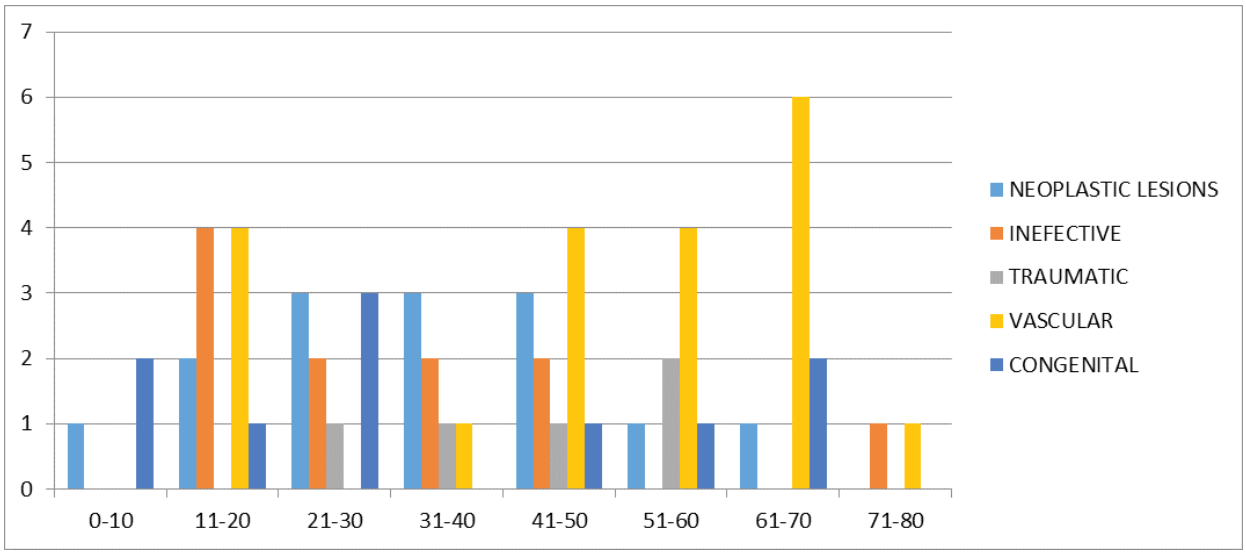
Fig.5. CONGENITAL LESIONS: A) MEGA CISTERNA MAGNA - Large retro-cerebellar CSF space B) ARACHNOID CYST - Large thin-walled fluid-density lesion in the midline, extending towards the left causing mild scalloping of overlying occipital bone and underlying cerebellar parenchyma. C) EPIDERMOID CYST – Well-defined hypodense osteolytic lesion in the region of right occipito-parietal suture, abutting the right cerebellar hemisphere intracranially.

TABLE 1 – CT DIAGNOSIS OF VARIOUS POSTERIOR FOSSA LESIONS

CT DIAGNOSIS	SUB-CATEGORY	NO. OF CASES	PERCENTAGE (%)
1) Neoplastic lesions (Benign & malignant)	· Brainstem Glioma	2	3.33%
	· Astrocytoma	2	3.33%
	· Ependymoma	1	1.66%
	· Metastasis	2	3.33%
	· Meningioma	2	3.33%
	· Schwannoma	5	8.33%
	· Medulloblastoma	1	1.66%
	· Paraganglioma	1	1.66%
2) Inflammatory/infective lesions	· Tuberculoma	4	6.66%
	· Neurocysticercosis	5	8.33%
	· Abscess	1	1.66%
	· ADEM	1	1.66%
3) Traumatic lesions	· Hematoma/ Contusions	5	8.33%

Cont... **TABLE 1 – CT DIAGNOSIS OF VARIOUS POSTERIOR FOSSA LESIONS**

4) Vascular lesions	· Arteriovenous Malformation · Infarcts · Intraparenchymal hemorrhage	1 11 7	1.66% 18.33% 11.66%
5)Congenital malformations	· Arachnoid cyst · Mega cistern magna · Dermoid/Epidermoid cysts	3 4 2	5% 6.66% 3.33%



Bar chart 1 - showing age-wise distribution of posterior fossa lesions with predominance in 2nd and 5th decades.

Discussion

Before the advent of CT as an imaging modality, diagnosis of intracranial lesions was a tedious process. CT has been a prime imaging modality for diagnosing various posterior fossa lesions among other intracranial lesions. In this study the relative frequencies and gamut of CT features of various intracranial posterior fossa lesions are presented.

Groswasser RI *et al*[4] in their study on CT findings of various posterior fossa lesions found a female prevalence with 57% of total cases and males forming 43% cases, very close to that found in the current study.

Most of the patients presented with non-specific symptoms of headache, vertigo and vomiting. In children, clinical manifestations of increased intracranial pressure were seen. Most common presenting feature was headache. Other symptoms were projectile vomiting, seizures, blurring of vision, limb weakness etc. Clinical symptomatology found was similar to a study done by Haque *et al*.[3] Otologic symptoms were associated with schwannoma and meningioma.

Groswasser RI *et al*[4] found vascular and metastatic lesions to be more prevalant with increasing age. They also concluded that extra-axial lesions were commoner in adult population. This is in coherence with results obtained in our study.

Neoplastic Lesions

Brain tumours are the most common neoplasms in the pediatric population. Infratentorial tumours (Fig.1) comprise 45-60% of total brain tumors.[4] Common

pediatric posterior fossa tumors are juvenile pilocytic astrocytoma, medulloblastoma, ependymoma and brainstem glioma.[5]

In current study, mass lesions formed 27% of the total cases of posterior fossa lesions. We found an equal prevalence of intra-axial and extra-axial mass lesions in-toto. Pilocytic astrocytoma was more common than Medulloblastoma, which is in coherence with various studies done by Haque *et al*[3], Poretti *et al*[6] and Aquillina *et al*.[7] Two cases of PCA were found in our study group with children-adult ratio of 1:1.

Ependymomas show a bimodal peak with most of the cases seen in children <5 years of age and the second peak in the fourth decade.[8] Brainstem gliomas comprise 10-20% of pediatric CNS tumours.[7,8] Among brainstem gliomas, diffuse glioma is the most common type, accounting for 60-75%.[6]

In adults, schwannomas and meningiomas were found to be more prevalent, as was also found by Saleh EA *et al*.[9] Wrensch M *et al*[10] stated that meningiomas are 80% more common in females. We also found both the patients with meningioma being female.

Metastases were stated as the commonest intra-axial mass lesions in posterior fossa in adults, in a study done by Ghods AJ *et al*.[11] In our study, 50% of intra-axial masses in adults were metastases, making them the most common entity in adults. We found two cases of cerebellar metastases, in known cases of lung carcinoma.

Infective Lesions

Neurocysticercosis (Fig.2b) and tuberculoma (Fig.2a) were the most common infective lesions in our study, which is in coherence with a study done by Maheshwarappa RP *et al*[12] and Chander R *et al*[1]. In adults, most cases of neurocysticercosis were of stage IV disease, as also found by Chander R *et al*.[1] Manjunath MN *et al*[13] in their study on CNS tuberculosis found predilection for younger population in 60-70% of cases. Our results were similar with 66% cases appearing in the first two decades. Nathoo N e*t al*[14] in their study on 973 patients with brain abscess found otorhinogenic sepsis to be the commonest cause in the first two decades. Our findings also revealed otomastoiditis being the commonest cause of cerebellar abscess (Fig.2c).

Traumatic Lesions

Loli V *et al*[15] stated that traumatic brain injuries (Fig.3) are a major health issue responsible for mortality and morbidity worldwide. They concluded that CT is the modality of choice for traumatic brain injury, allowing better detection of acute intra-axial and extra-axial hematomas. Traumatic lesions comprised 8.3% of total cases in the current series. Cerebellar hemorrhage/ contusions formed 40% of traumatic lesions.

Loli V *et al* [15] and Gentry LR[16] found parenchymal hemorrhage/contusions to be the most common intracranial post-traumatic injuries. Sub-arachnoid hemorrhage, epidural hemorrhage and cerebellar contusion formed 20% each of total traumatic cases in our study. We found cerebellar hemorrhage to be more common than other traumatic lesions with 50% of cases associated with overlying bone fracture.

Vascular Lesions

Vascular lesions (Fig.4) formed the bulk of cases in our study, comprising 32% of total cases. Out of total 19 cases, 11 were infarcts, 7 were parenchymal hemorrhage/contusions and 1 case was of arteriovenous malformation. Infarcts constituted 57.89% of total vascular lesions, parenchymal hemorrhage/contusions formed 36.8% cases and arteriovenous malformation rest 5.2% of cases. Arora R[17] in their study also found infarcts to be more common than hemorrhage, comprising ~1.5-2.3% of all strokes.

In a study done by Amarenco P[18], cerebellar infarcts were commoner than cerebellar hemorrhage and had a male predominance. We found similar results in our study. Intraventricular extension of hemorrhage was found in 42% of parenchymal hemorrhage of posterior fossa region. Most patients with infarcts presented with sudden onset posterior headache with vertigo, ataxia and dysarthria, similar to the clinical presentation found in a study by Amarenco P[18]. Intraventricular extension of hemorrhage was found in 2 cases of cerebellar hemorrhage and one case of pontine hemorrhage, forming 66.6% and 33.3% of total such cases respectively.

Congenital Lesions

Mega cisterna magna formed 44.4% of total cases of congenital lesions, arachnoid cyst and epidermoid cysts

formed 33.3% and 22.2% cases respectively (Fig.5). Kollias *et al*[19] had concluded that mega cisterna magna forms about 54% of total cyst-like posterior fossa lesions and are mostly detected incidentally. Incidence of mega cisterna magna was close to that found by Kollias *et al*[19]. Bosemani *et al*[20] have stated similar findings in their study. We found 33.3% cases of epidermoid cysts which is consistent with the study done by Chander R *et al*.[1]

Conclusion

· The role of CT in the diagnosis of posterior fossa lesions is crucial regarding localization, characterization, extension pattern and typical features.

· CT has advantage over MRI when it comes to evaluation of bony changes and characterization of intralesional calcification.

· A reliable prediction of tumor histology or grade by neuroimaging is not yet possible for posterior fossa tumors.

· CT is widely available imaging modality when compared with MRI.

· CT still plays an indispensable role in neuroimaging in developing countries because of easy accessibility and cost effectiveness.

Conflict of Interest – None.

Source of Funding – Self

Ethical Clearance – was taken for the study.

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