The role of computed tomography in intra-axial posterior fossa tumors

Ali I. Sheaa* **MBChB, CABMS- RAD**
Mohammed Al-Hili* **DMRD, FICMS**
Ali K. Al-Shalchy** **MBChB, FIBMS,MRCS, FRCS**

Abstract:

Background: CT (computed tomography) is one of the first noninvasive imaging techniques in diagnosis of intra-axial posterior fossa tumors because it can accurately demonstrate, localize and characterize brain tumors, and can provide important information about the anatomic location, size, shape of the lesions and their mass effect on adjacent structures.

Objectives: To evaluate multi detectors CT characteristics of intra axial posterior fossa tumors and correlation of the CT characteristics of intra- axial posterior fossa tumors with the histopathological findings.

Patients & Methods: This is a cross sectional study including 26 patients with intra-axial posterior fossa tumors,15 males &11 females ,three cases were excluded from the study because no definite histological diagnosis was done so the final included number was 23 cases .The cases were referred from the Department of Neurosurgery in Ghazi Al-Hariri specialized surgical hospital in Medical city complex at the period between January 2012 to January 2013.

Results: The most common intra- axial posterior fossa tumors were astrocytoma, and medulloblastoma (26.1%) for both equally. These tumors are more common in pediatric age group (60.9%) than adult (39.1%). Medulloblastoma was the most common childhood tumors. Hemangioblastoma and metastasis were the most common adulthood tumors. The gender distribution of the total number of patients showed male predominance by a factor 1.5, (60.9%) were males, and (39.1%) were females.

CT scan was sensitive in detection of tumors but it was not specific to give the definite histopathalogical tumors type.

Conclusion: Medulloblastoma and astrocytoma were the most common intra axial posterior fossa tumos. The gender distribution showed male predominance. CT scan was sensitive in detection of tumors but it was not specific to give the definite histopathalogical tumors type. The confidence interval of CT in diagnosis of histopathlogical types is 65.2 % but it is still useful in the detection, localization and characterization of tumors.

Key words: intra axial, posterior fossa, tumors, multi detectors CT.

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Introduction:

Intra-axial or Extra-axial: An intra -axial mass is a mass that is of the brain itself (i.e., it arises from the brain parenchyma). An extra-axial mass refers to everything outside the brain (arachnoid, meninges, dural sinuses, skull, etc.). The intra-axial mass expands the white matter, and blurs the gray matter / white matter junction (1).

Posterior Fossa Tumors:-Medulloblastoma: Is the most common pediatric CNS malignancy. Most cases manifest before 10 years of age, with peak incidence between 4 and 8 years (1). Pilocytic astrocytoma: Most common in pediatric age group (represents 30% of pediatric gliomas). The tumor accounts for 85% of all cerebellar astrocytomas. Most patients present before 20 years of age, and occurs much more commonly in children, with a peak age of birth to 9 years (1).

Ependymoma: Accounts for about 3% to 9% of all neuroepithelial neoplasms and most commonly manifests in children and adolescents (1).

Brainstem glioma: Accounts for about 15% of all pediatric CNS neoplasms .There is no gender predilection and the peak incidence is between 3 and 10 years of age(1).

Capillary hemangioblastomas: Are benign neoplasms of endothelial origin. They are most common in young and middle-aged adults and are the most common primary cerebellar neoplasm in the adult population(1).

Dermoid: Pilosebaceous mass lined with skin appendages originating from inclusion of epithelial cells and skin appendages during closure of neural tube(2).

A Dysplastic Cerebellar Gangliocytoma (Lhermitte-Duclos Disease): Although believed to represent a hamartoma and not a true neoplasm by WHO standards, its imaging appearance is similar to that of many neoplasms arising in this region .The CT appearance is often normal (1).

Metastasis to the CNS from extracranial sites: Accounts for

*Coressponding Auther: Radiology Department
Al-Shaheed Ghazi Al-Hariri Teaching Hospital – Medical City.
E-mail: ali77ibrahim@yahoo.com
**Dept. of Surgery, College of Medicine, University of Baghdad.

about one third of all intracranial neoplasms, (most commonly from lung, breast, melanoma, and colon carcinomas) . They may occur at any age but most frequently present in older age groups (1).

Lymphoma: Primary malignant lymphoma is a non-Hodgkin's lymphoma.

Most occur in the setting of immune suppression related to HIV infection, chemotherapy, or immunosuppressive therapy (1).

Radiological Investigations:Computerized tomography (CT) scanning: With the new technique of multidetectors CT scanners (MDCT) high quality images can be reconstructed in multiple planes from a single volume data set (3), and this technique enables the acquisition of a volume of data, rather than slices. Despite the development of other imaging technologies (as magnetic resonance imaging [MRI]), CT continues to play an important role in the practice clinical neurology (4).

CT is a quicker, more available, and relatively inexpensive in comparison to MRI especially in assessing neurological emergencies. The CT scan demonstrates the size of the lesion and its location, its configuration, and its relationship to the surrounding edema (1). The lesion characteristics predict its nature, looking for the configuration of the lesion, its margins, the presence of calcification, pattern of contrast enhancement and changes in overlying bone contours, may aid diagnosis. In particular, sharpness of the margin is important in distinguishing grossly cystic from non-cystic lesion (5). Brain CT scan Technique: Axial head CT scanning is performed traditionally with the angulation of the gantry parallel to the orbitomeatal line, defined as passing through the lateral canthus and middle of the external ear canal. (5).

The posterior fossa scanned in thin section (2 mm) to minimize beam hardening artifacts (3), (6).

The FOV (field of view) should also be considered. As a general rule, studies done with small FOV and/or small anatomic coverage should be done at the highest resolution setting available on the scanner.

The multi–detector row CT images were acquired with a scanner, which, x-ray tube voltage is (120 kV), and tube current (400 mA). Imaging was performed from the base of the skull to the .vertex.

The mean field of view 24.7 cm for multi–detector row CT (12).

Patients and methods:

The study is a cross sectional study including 26 patients with intra-axial posterior fossa tumors,15 males &11 females ,three cases were excluded from the study because no definite histological diagnosis was done so the final included number was 23 cases, (age range, 3-53 years) , patient was grouped into two age group, children (< 15 years) & adult(≥ 15 years)..

The cases were referred from the department of Neurosurgery in Ghazi Al-Hariri hospital for specialized surgery in Medical city complex at the period between January 2012 to January 2013. The CT radiological examinations were performed in Ghazi Al-Hariri hospital for Specialized surgery by using 64multi-detector scanner. In all patients verbal consent was obtained , then native initial CT images were obtained and then followed by using intra-venous non-ionic water soluble contrast, a canula was inserted into antecubital vein, manual injection of 50 ml of intravenous contrast material (iohexole, 350%, Schering, Berlin, Ireland) was administered slowly , and then repeated CT scan was done after 40 to 60 seconds . A study protocol was done for each patient, and the following CT findings were analyzed in each case (location of lesion ,lesional consistency, the enhancement pattern, any calcification, or mass effect and the edema). All the histopathological examinations were done at the labs of Ghazi Al-Hariri hospital. CT features were interpreted by the researcher and supervised by a consultant radiologist. In some cases the histopathological diagnosis was done by CT as single diagnosis, while in other a differential diagnosis was reported and the first possible differential diagnosis was considered, and the diagnosis was compared with post operative histopathlogical findings.

Results:

The patients were grouped into children 60.9% and adults 39.1%, these tumors are more common in pediatric age group than adult , which is statistically not significant (P value > 0.05) the mean of age = 19.2 years ,the median of age = 12 years, and the Min- Max = 3- 53 years.

There were fourteen males (60.9%), and nine (39.1%) females.

In this study, the total numbers of patients were 23 patients with intra-axial posterior fossa tumors , 26.1% of patients were astrocytoma , 26.1%of patients were medulloblastoma , 13% of patients were hemangioblastoma , 13 % of patients were metastasis , 8,7% of patients were ependymoma , 8,7% of patients were brainstemglioma and 4.4% of patients were dermoid.

Table 1: Distribution of study sample according to tumor histopathological types and to age.

Histopathological Types	N	N	%	N	%
Astrocytoma	6	4	66.7	2	33.3
Medulloblastoma	6	6	100.0	0	0.0
Haemangioblastoma	3	0	0.0	3	100.0
Brain stem Glioma	2	2	100.0	0	0.0
Ependymoma	2	1	50.0	1	50.0
Metastasis	3	0	0.0	3	100.0
Dermoid	1	1	100.0	0	0.0
Total	23	14	60.9	9	39.1

Table 2: Distribution of study sample according to tumor histopathological types and to patients' sex.

	Total	Male		Female	
Histopathological Types	**N**	**N**	**%**	**N**	**%**
Astrocytoma	6	3	50.0	3	50.0
Medulloblastoma	6	4	66.7	2	33.3
Haemangioblastoma	3	2	66.7	1	33.3
Brain stem Glioma	2	2	100.0	0	0.0
Ependymoma	2	1	50.0	1	50.0
Metastasis	3	1	33.3	2	66.7
Dermoid	1	1	100.0	0	0.0
Total	23	14	60.9	9	39.1

Table 3: Radiological findings of study sample.

Location			
Hemisphere	13	56.5	
Vermian /Central	8	34.8	0.019
Brainstem	2	8.7	
Texture			
Heterogeneous	8	34.8	
Solid	10	43.5	0.037
Cystic with Solid Nodules	4	17.4	
Cystic	1	4.3	
Mass Effect	22	95.7	<0.001
Surrounding Edema	10	43.5	0.532
Midline Shift	13	56.5	0.532
Calcification	7	30.4	0.061
Hydrocephaly			
Mild	6	26.1	
Moderate	15	65.2	<0.001
Severe	2	8.7	

All patients with hemangioblastoma , metastasis, dermoid , and majority (83.3%) of patient with astrocytoma are found in cerebellar hemispheres and remaining tumors were central in location near the vemis .

All patients with ependymoma and majority (83.3%) of patients with medulloblastoma are midline in location in close proximity of the vermis .

In this study (66.7%) of astrocytoma were heterogeneous, (83.8%) of medulloblastoma were solid , (66.7%) of hemangioblastoma were cystic with solid nodules , (66.7%) of metastasis were solid , (50%) of ependymoma were solid and heterogeneous equally , and all patients with brain stem glioma were solid , while demoid was cystic .

All patients with astrocytoma ,medulloblastoma , hemangioblastoma, ependymoma , brain stem glioma and dermoid show mass effect , while (66.7%) of patient with metastasis show mass effect.

.All the patients with astrocytoma ,hemangioblastoma , and dermoid show mid line shift , while (66.7 %) of metastasis and (16.7%) of medulloblastoma show midline shift , and this was not clear in case of ependymoma and brain stem glioma .

The surrounding edema was found in all patients with metastasis, (66.7%) of patients with astrocytoma and (50%) of patient with medulloblastoma and also this was not very clear in the other types of tumors .

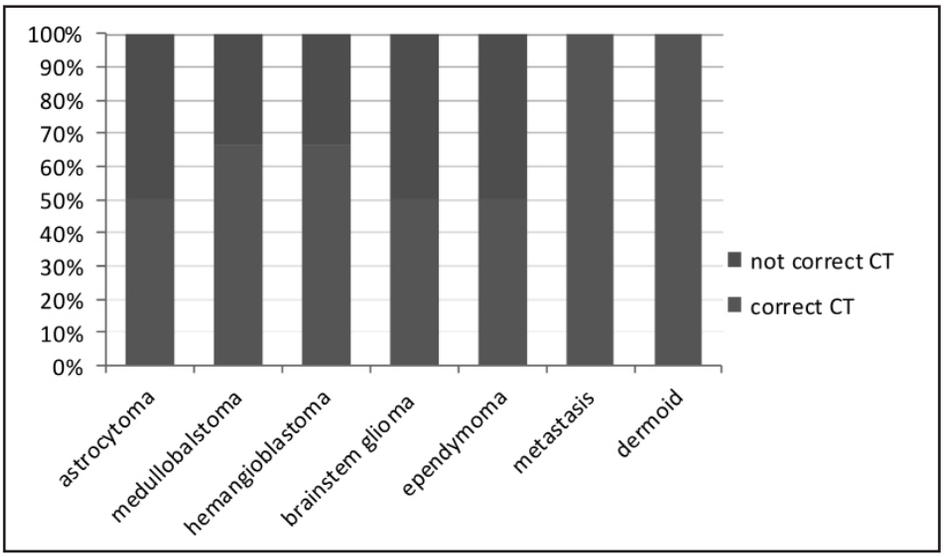

Figure 1 : Distribution of percentage of cases according to provisional CT diagnosis in comparison to histopathological diagnosis

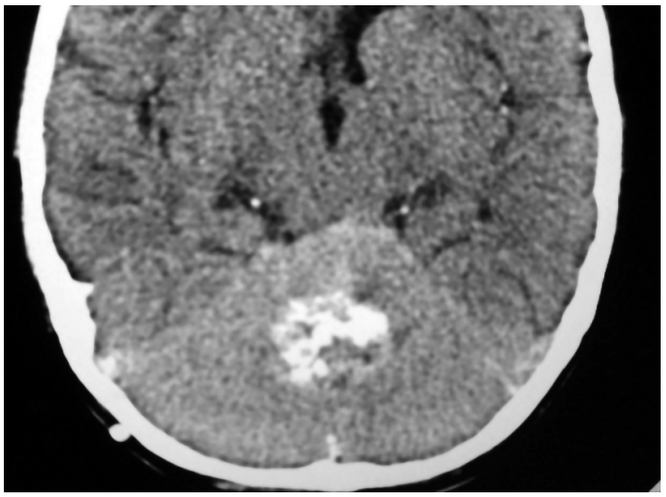

Figure 2: Medulloblastoma in child aged 6 years showing moderate enhancement after IV-contrast.

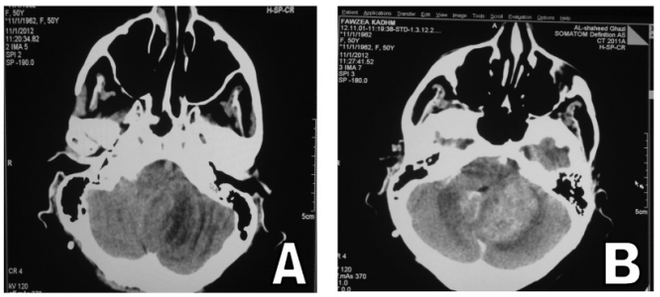

Figure 3: Metastasis in the left cerebellar hemisphere in known case of breast carcinomaA. pre IV contrast B. post IV contrast .

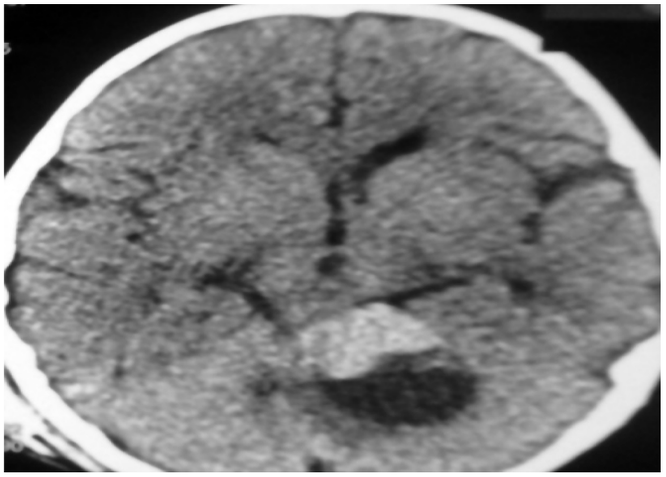

Figure 4: Pilocytic astrocytoma cystic with solid mural nodule in child aged 8 years .

Discussion:

Intra axial posterior fossa tumors are most common tumors in pediatric age groups. The most common location of these tumors is the cerebellar hemisphere (56.5 %) and present in thirteen patients, then the vermis (34.8%)and present in eight patients, and the brain stem(8.7%)and present in two patients (table 3) , and this is statistically significant (P value < 0.05), and consistent with that in literature the cerebellar hemisphere (45%), then the vermis (20%), and the brain stem (13%) (1,2&5). All patients with hemangioblastoma, metastasis, dermoid, and (83.3%) of patient with astrocytoma are found in cerebellar hemispheres, and all patients with ependymoma and (83.3 %) of patients with medulloblastoma are found in center, and this comparable with that mentioned by authors and study done by Safaa Kasim (1,5 &10). Solid tumors were (43.5 %) in ten patients they were five medulloblastomas , two brain stem gliomas , two metastasis and one ependymoma. Heterogeneous tumors were (34.8 %) present in eight patients they were fourastrocytomas ,one medulloblastomas , one metastasis and one ependymoma , and one hemangioblastoma . Cystic lesions with solid mural nodule were(17.4%)found in four patients (two astrocytomas and two hemangioblastomas) (Table 3).

Cystic lesion was present in (4.3%) one patient with dermoid, and this is statistically significant (P value 0.05<)(Table 3) . In this study (66.7%) of astrocytoma were heterogeneous, (83.8%) of medulloblastoma were solid , (66.7%) of hemangioblastoma were cystic with solid nodules , (66.7%) of metastasis were solid , (50%) of ependymoma were solid and heterogeneous equally , and all patients with brain stem glioma were solid , while demoid was cystic, and this comparable with study done by Safaa Kasim(10). Mass effect was the most common radiological feature , which found in (95.7 %) of patients , and this is statistically significant (P value > 0.05) , followed by midline shift in (56.5%) of patients , surrounding edema in (43.5 %) of patients ,and calcification in (30.4%) of patients, which is statistically not significant (P value > 0.05) due to small sample of the study (Table 3). All patients with astrocytoma ,medulloblastoma , hemangioblastoma, ependymoma , brain stem glioma and dermoid show mass effect , while (66.7%) of patient with metastasis show mass effect .All the patients with astrocytoma ,hemangioblastoma , and dermoid show mid line shift , while (66.7 %) of metastasis and (16.7%) of medulloblastoma show midline shift , and this was not clear in case of ependymoma and brain stem glioma . The surrounding edema was found in all patients with metastasis, (66.7%) of patients with astrocytoma and (50%) of patient with medulloblastoma and also this was not very clear in the other types of tumors and this is consistent with that in literatures (1,2,5). Calcification was present in (50%) of patients with medulloblastoma, ependymoam and brain stem glioma , and(33%) of patients with astrocytoma , and not found in the others types of tumors (table 12) and by comparison with other study done by Safaa Kasim, as he reported lower percentage (20 % for astrocytoma , and 18,2 % for medulloblastoam) , but this was comparable with that mentioned by authors (1,2,5). Medulloblastoma and ependymoma show moderate to severe degree of hydrocephaly , the rest tumors show mild to moderate degree of hydrocephaly,and this consistent with authors (1,2,5&8). The pattern of enhancement of intra-

axial posterior fossa tumors show different pattern , except one patient with dermoid tumor (4.3%), which shows no enhancement, heterogeneous enhancement in (52.2%) of patients , homogeneous enhancement and enhancing mural nodule in (17.4 %) of patients , and ring enhancement in (8.7 %) of patients, and this is statistically significant (P value < 0.05) . The degree of enhancement was marked and moderate in (40.9 %) of patient equally , and mild in (18.2 %) of patients , and this is statistically not significant (P value > 0.05). According to these data, CT scan was fully sensitive in detection of tumors but it was not specific to give the definite histopathalogicaltumors type. As regards comparison between CT and histopathology, CT correctly diagnosed 15patients in a proportion of 65.2% with 95% confidence interval of [65.0% - 65.4%](Figure1), and this comparable with Khalid Khan (11). The patients were grouped into children fourteen (60.9%) patients and adults nine (39.1%) patients, so these tumors are more common in pediatric age group than adult , which is statistically not significant (P value > 0.05) due to small sample of the study ,the mean of age = 19.2 years ,the median of age = 12 years, and the Min- Max = 3- 53 years. Medulloblastoma was the most common childhood tumors. Hemangioblastoma and metastasis were the most common adulthood tumors.

All patients with medulloblastoma, brainstem glioma and dermoid were presented in childhood.

All patients with hemangioblastoma and metastasis were presented in adulthood, (66.7%)of astrocytoma were presented in childhood, and ependymoma were present equally in children and adult patients (50%) (Table 1), and this consistent with authors(William E. Brantand Dahnert)and study done by Safaa Kasim(1, 2,8&10). There were fourteen males (60.9%), and nine (39.1%) females. The gender distribution of the total number of patients showed male predominance by a factor 1.5 , except of metastasis which is more common in females, and there is no such difference in sex in astrocytoma and ependymoma (Table 2) , and this is statistically not significant (P value > 0.05)due to small sample of the study , and this consistent with authors and study done by Safaa Kasim(1,2,5 &10). In this study, the total numbers of patients were twenty three patients with intra-axial posterior fossa tumors proved by CT, surgery and histopathology were evaluated(of these twenty three patients six (26.1%) were astrocytoma ,six (26.1%) medulloblastoma ,three(13%) hemangioblastoma, three (13 %) metastasis ,two(8,7%) ependymoma, two(8,7%) brainstemglioma and one(4.4%) dermoid This mean both astrocytoma and medulloblastoma considered the most common intra-axial posterior fossa tumors and this consistent with William E. Brant, Clyde A. Helms, Andy Adamand Karen Goddard(1,8,9), but by comparison with other study done by Dr, Safaa Kasim (2000) ,he reported higher percentage of cerebellar astrocytoma(50%)followed by medulloblastoma (31.4 %),while the frequency of the other tumors is consistent with this study(10).

Conclusions:

This study reveals that intra axial posterior fossa tumors are commoner in children except for hemangioblastoma and metastatic disease which are predominant in adult. The gender distribution showed male predominance. CT was useful in the detection, localization and characterization of tumors and diagnosis of histopathlogical types with high confidence interval. Medulloblastoma and astrocytoma were the most common intra-axial posterior fossa.

Author contributions:

1. Dr. Ali Ibrahim Sheaa : study conception , study design , acquisition of data analysis and drafting of manuscript .
2. Dr. Mohammed Al-Hilli : supervision and critical revision.
3. Dr. Ali K. Al-Shalchy: supervision and critical revision.

References:

1) William E, Brant, Clyde A, Helms. Fundamentals of DiagnosticRadiology.4th ed. Philadelphia: Lippincott Williams &Wilkins ; 2012: 122 -141.

2) Dahnert, Wolfgang. Radiology Review Manual. 7th ed. Philadelphia: Lippincott Williams &Wilkins ; 2011: 228- 281.

3) Thomas JV, Marc H. Neuro Imaging of the Posterior Fossa. Philadelphia: Lippincott Williams &Wilkins; 2009: 84-101.

4) Marchal G, Vogl TJ, Heiken JP, Rubin GD. Multidetector-Row Computed Tomography Scanning and Contrast Protocols . Italia: Springer-Verlag; 2005:1-12.

5) Stephen A. Kieffer, Jeffrey R. Intracranial Neoplasms. In: BraceJohn R. Haaga Ralph J. Alfidi. CT and MRI of the Whole Body. 5th ed. Philadelphia: Mosby Elsevier; 2009: 3-6.

6) Sutton DA, Moseley IF, editors. Computed tomography; CNS. In: Sutton DA (ed). Textbook of radiology and Imaging, 4th edition. London: Churchill Livingstone 2003: 1598.

7) Scott A. Lipson. MDCT and 3D Workstations. New York, USA: Springer Science+ Business Media, Inc; 2006: 1-14.

8) Rolf JH, Gisele BC, Philip MR. Benign and Malignant Intracranial Tumours in Adults. In: Andy Adam, Adrian K. Dixon. Grainger & Allison's Diagnostic Radiology. 5th Ed. UK: Churchill Livingstone, an Imprint of Elsevier; 2008: 7-56.

9) Karen Goddard .Pediatric Oncology Education Materials [internet]. 2010. Available from: http://www.pedsoncologyeducation.com

10) Safaa Kasim. CT pattern of primary intra- axial posterior fossa tumors [thesis submitted to Iraqi council of medical specializations]. Baghdad: ICMS; 2000.

11) Khalid Khan, Ahmed Nadeem, PhoolBibi, Muhammad Jehanzeb. Accuracy of computerised tomography in diagnosisof brain tumours in children .J Ayub Med Coll Abbottabad 2009;21(2):42-44 (IVSL).