Original Article ISSN (O):2395-2822; ISSN (P):2395-2814

Computed Tomography Evaluation of Supratentorial Brain Tumours.

G. Rajalakshi Preethi[1], Mariappan M[1]

[1]Associate Professor, Department of Radiodiagnosis, Velammal Medical College & Research Institute, Madurai.

Received: April 2017
Accepted: April 2017

ABSTRACT

Background: Imaging modalities like CT and MRI may play a vital role in diagnostic evaluation of CNS neoplasms.But the relative superiority of these modalities is intensely debated in the literature. Computed tomography, with it's wider availability, lesser cost and higher efficacy in differentiating calcification/ hemorrhage which can play a vital role in resource-poor settings. **Methods**: The current study was a prospective observational study of 50 patients with supratentorial brain tumours reporting to radiology department for CT brain, in a tertiary care teaching hospital in south India. **Results**: Glioma (48%) was the most common tumour.Pilocyticastrocytomas and low-grade Glioma were seen in younger and middle-age population (<45 years), whereas Anaplastic astrocytoma, GBM and Oligodendroglioma showed incidence after 45 years of age.CT accurately characterized 42 of the total 50 cases. Diagnostic accuracy of CT in characterizing Meningioma, Pilocytic astrocytoma, Craniopharyngioma, Oligodendroglioma and pituitary adenomas was better than anaplastic astrocytoma and glioblastoma multiforme. Glioma mostly presented as hypo-dense lesion in NCCT while majority of Meningioma were hyper dense.Necrosis was seen in metastasis and GBM. Calcifications were seen in meningioma, craniopharyngioma and oligodendroglioma **Conclusion**: Supratentorial tumours can be seen in pediatric age group as well as in adults and elderly population. Glioma was the most common supratentorial brain tumour followed by meningioma and metastases. CT features are fairly characteristic in meningioma, craniopharyngioma and pituitary adenoma with overlap of imaging features in anaplastic astrocytoma, GBM and solitary metastasis.

Keywords: Supratentorial tumours, Computed tomography, Glioma, Central nervous system.

INTRODUCTION

C.N.S. neoplasms are the sixth most common tumours in adults with average incidence of 5-6/100,000 population.[1] In children, the incidence is still higher second only to neoplasm of the hematopoietic system. Since majority of the tumour present with non-specific complaints such as a headache, strokes like syndrome or seizure, often a diagnosis is made or suggested by findings on initial imaging studies like computed tomography (CT). CT and MRI are basic imaging techniques.[2] The patients with neurological symptoms may go with this imaging techniques to get the initial confirmation.[3]

Name & Address of Corresponding Author
Dr. G. Rajalakshi Preethi,
Associate Professor,
Department of Radiodiagnosis,
Velammal Medical College & Research Institute, Madurai.

Computed tomography will provide the added information about calcification/ Haemorrhage which may help to narrow down the differential diagnosis. All these features of CT can identify the location of lesion perfectly.[4] It plays a vital role in detection, localization and characterization of the tumour and shows its secondary effects (hemorrhage, edema, mass effect and herniation) in great details.

CNS neoplasm can be classified in various ways depending upon location (topographical i.e. supratentorial or infratentorial),[5] extra or intra-axial. Further classification is based on histological characteristics. Both location and histology are important determinants of clinical presentation and prognosis. In adults, supratentorial tumours outnumber posterior fossa tumours by a ratio of 7:3 but in children, this ratio is reversed.[1] But the other study observations revealed that supratentorial tumours were more often than the infratentorial tumours in children.[6,7]

CT evaluation of brain tumours is relatively non-invasive therefore easily and rapidly accomplished. CT provides a sensitive and reproducible method for evaluating suspected tumour in brain.[8] Even though magnetic resonance imaging (MRI) is more sensitive imaging in detecting the brain metastases than the computed tomography (CT). CT plays an important role in the initial stage detection and preoperative management.[3,9]

MRI along with its newer advanced techniques like MR perfusion and MR spectroscopy has been established as current modality of choice in characterization of brain tumours and scores over CT

in many aspects.[10] However, CT is still used in evaluation of brain tumours in critically ill patients, when MRI is contraindicated, and also in economically poor population where cost factor and nonavailability of MRI is a major factor of constraint. CT has the advantage of wider availability, being less expensive than MRI and showing calcification in greater details.[11,12] Much faster acquisition capability of current CT units is most helpful in patients who are critically ill or medically unstable.

Our study discussed Computed tomography imaging extensively and its features in supratentorial brain tumours also discussed by the study.

MATERIAL AND METHODS

The present study included 50 cases of supratentorial brain neoplasms detected on CT imaging belonging to different age group between the periods from December 2013 to September 2015.

All the subjects underwent plain CT and contrast-enhanced CT (NCCT& CECT). CECT was done following 40 ml intravenous administration of iodinated contrast.

Diagnosis of the lesions with respect to its anatomical location and characterization and secondary effects to tumour like edema, mass effect, herniation, hydrocephalus were evaluated.

NCCT and CECT imaging findings were correlated with postoperative surgical and histopathological findings. The postoperative histopathological diagnosis was considered as gold standard.

Statistical Analysis

Pathological diagnosis considered as primary outcome variable. Features of CT like hypodense, isodense, hyperdense, necrosis, calcifications and enhancement pattern etc., were considered as primary explanatory variables and age was considered as other explanatory variable.

Descriptive analysis was carried out by frequency and proportion for categorical variables. Data was also represented using appropriate diagrams like bar diagram, pie diagram and box plots.

RESULTS

A total of 50 cases included in the final study. Among them, majority of the supratentorial brain tumours (46%) were seen in 16-45 age group and the proportion of tumours in 46-60 years age group was 34%. The proportion of below 15 yrs and above 60 yrs was 8% and 12% respectively. [Figure 1]

38% of the tumours were hypo dense on CT. whereas equal proportion of the tumours were isodense and hyper dense (32% each). Cystic/ necrotic changes were seen in as high as 56% of the tumours. Calcification was noted in 28% of the tumours. There were 40% of the lesions with mild to moderate enhancement with marked enhancement seen in 42%.The majority of the lesions were Glioma. Whereas the proportion of Craniopharyngioma, Meningioma, metastatic and pituitary adenoma were, 8%, 18%, 16% and 10% respectively. The majority of the histopathological diagnosis (22%) contributed by Glioblastoma multiforme whereas the proportion of other glioma types like pilocytic astrocytoma, diffuse low-grade glioma, oligodendroglioma, anaplastic astrocytoma was 4%, 6%, 6% and 12% respectively. metastasis and meningioma contributed 14% and 18% respectively. The proportion of pituitary adenoma and craniopharyngioma was 8% and 10% respectively. [Table 1]

Among all the radiological diagnosis Glioma contributed more proportion in all age groups but in 16-45 years age group Glioma was the most common tumour type (43.47%), followed by Meningioma (30.43%). In 46-60 years age group Glioma and metastasis were common, 52.94% and 29.41% respectively. [Table 2] Pilocyticastrocytoma and low-grade Glioma were was seen in younger population (< 45 yrs), whereas anaplastic astrocytoma, GBM and oligodendroglioma showed incidence after 45 yrs of age in our study.[Figure 2]

CT accurately characterized 42 of the total 50 cases with sensitivity of 84% and specificity of 86%. Diagnostic accuracy of CT in characterizing Meningioma, Pilocytic astrocytoma, Craniopharyngioma, Oligodendroglioma and pituitary adenomas approached 100% in our study. Whereas, diagnostic accuracy was least in characterizing Anaplastic astrocytoma followed by Glioblastoma multiforme. Two lesions which were incorrectly characterized as Anaplastic astrocytoma in our study turned out to be GBM on histopathology. Out of the three lesions incorrectly characterized as GBM, two were proven to be anaplastic astrocytoma and one to be metastasis on histopathology. Two lesions incorrectly characterized as metastasis were diagnosed as GBM on histopathology.[Table 3]

Glioma (16 / 25 cases) mostly presented as hypo-dense lesion in NCCT while majority of Meningioma were hyper dense. The majority of the Glioma showed variable degree of enhancement in CECT (22 / 25 cases). Necrosis was frequently detected in metastatic lesion (5 / 7 cases).Majority of metastatic lesions and Meningioma were intensely enhancing on CECT. All the 11 cases of GBM showed necrotic areas within the mass. All the four cases (100%) of Craniopharyngioma showed calcifications. The incidence of calcifications in Meningioma was 45%in our study. All the three of the Glioma (3/ 25) showing calcifications were Oligodendroglioma.[Table 4]

Non-enhancing tumours were invariably low-grade Glioma. The majority of the GBM s showed strong enhancement (80%). Mild to moderate enhancement was a nonspecific feature with some percentage of

all the tumour types showing this type of enhancement pattern [Figure 3].

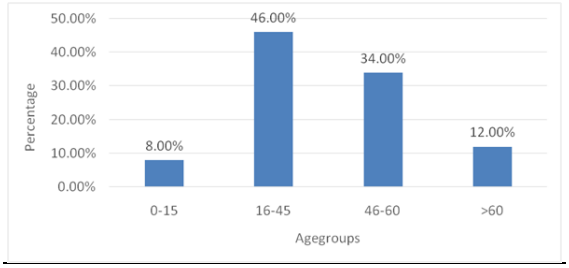

Figure 1: Bar chart of Age groups distribution in study group (N=50).

Table 1: Descriptive analysis of Different parameters in study group (N=50).

Parameter	Frequency	Percentage
I. CT features		
Hypo dense	19	38%
Isodense	16	32%
Hyper dense	16	32%
Cystic /necrotic areas	28	56%
Calcification	14	28%
Mild to moderate enhancement	20	40%
Marked enhancement	21	42%
II. Radiological Diagnosis		
Craniopharyngioma	4	8.00%
Pituitary adenoma	5	10.00%
Metastasis	8	16.00%
Meningioma	9	18.00%
Glioma	24	48.00%
III.Pathological diagnosis		
Glioma		
Pilocytic astrocytoma	2	4.00%
Diffuse low-grade Glioma	3	6.00%
Oligodendroglioma	3	6.00%
Anaplastic astrocytoma	6	12.00%
Glioblastoma multiforme	11	22.00%
Craniopharyngioma	4	8.00%
Pituitary adenoma	5	10.00%
Metastasis	7	14.00%
Meningioma	9	18.00%

Table 2: Association of Age groups with radiological diagnosis in study group (N=50).

Age groups	Radiological Diagnosis				
	Craniopharyngioma	Glioma	Meningioma	Metastasis	Pituitary adenoma
0-15	2 (50%)	2 (50%)	0 (0%)	0 (0%)	0 (0%)
16-45	2 (8.695%)	10 (43.47%)	7 (30.43%)	0 (0%)	4 (17.39%)
46-60	0 (0%)	9 (52.94%)	2 (11.76%)	5 (29.41%)	1 (5.882%)
>60	0 (0%)	3 (50%)	0 (0%)	3 (50%)	0 (0%)

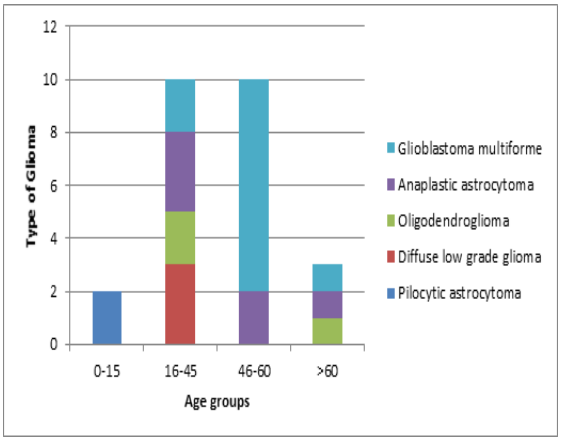

Figure 2: Age distribution of various types of Glioma in study population (N=25).

Table 3: Correlation of radiological and histopathological diagnosis in study population (N=50).

Type of tumour	No. of tumours on CT	No. of tumours on final histopathological diagnosis	Total number of true positives on CT
Meningioma	9	9	9 (100%)
Diffuse low-grade Glioma	4	3	3 (100%)
Pilocyticastrocytomas	2	2	2 (100%)
Glioblastoma multiforme	10	11	7 (63.64%)
Craniopharyngioma	4	4	4 (100%)
Anaplastic astrocytoma	5	6	3 (50%)
Oligodendroglioma	3	3	3 (100%)
Pituitary adenoma	5	5	5 (100%)
Metastasis	8	7	6 (85.71%)
Total cases	50	50	42

Table 4: CT features in study population (N=50).

Tumour	Total no. of histopathological proven cases	Density			Enhancement			Areas of cystic necrotic change	Calcification
		Hypo	Iso	Hyperx	None	Mild to moderate	Strong		
Glioma	25	16	5	4	3	8	14	15	3
Metastasis	7	3	1	3		2	5	5	
Craniopharyngioma	4	1	3			4		4	4
Meningioma	9		2	7		2	7	3	4
Pituitary adenoma	5		2	3	1	4		2	1

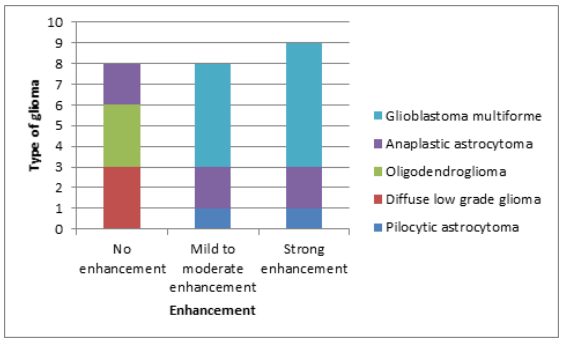

Figure 3: Enhancement characteristics of various types of Glioma in study population (N=25).

DISCUSSION

Singh, H., et al. reported that the adult age group 30-65 years was most commonly affected by Supratentorial tumours (especially gliomas). In children also gliomas can occur in the age group 1-4 years mostly. 31-40 years age group was mostly affected with 33.3% incidence of tumours and 23.8% incidence was present in 61-60 years age group.[10,13] The similar results were observed in the present study as majority of the supratentorial brain tumours (46%) were seen in 16-45 age group and the proportion of tumours in 46-60 years age group was 34%. The proportion of below 15 yrs and above 60 yrs was 8% and 12% respectively.

Out of 50 cases of the supratentorial brain tumours50% were Glioma (25 cases).The present observation correlates well with the study involving a large group, by Baker et al in 1980in which Glioma was the commonest primary supratentorial tumour (50.2%).[8] Glioma mostly presented as hypodense lesion in NCCT and majority of them showed variable degree of enhancement on CECT, (22/25cases).

Next common primary supratentorialtumour in the studied group was meningioma accounting for 18% of all primary supratentorial brain tumours. The majority of meningioma were hyperdense and showed intense homogeneous enhancement (77.8%). Around 44.4% of meningioma showed calcification, cystic change was seen in 40% meningioma. The majority of meningioma (90%) were associated with vasogenic edema of variable degree. All these findings correlate with earlier studies by Rohringer (1989) and Smirinotopolous (2000).[14,15]

Next common supratentorial tumours in the studied group were of metastatic origin accounting for 16% of cases. The incidence is lower as compared to earlier studies by Baker et al (1980) who reported a higher incidence of about 30%. The lower incidence in the present study could be because of inclusion of only supratentorial masses.

The metastatic lesions in this study were iso to hypodense (62.5%) and showed intense contrast enhancement (75%). 75% of metastases showed cystic and necrotic changes. Most of the metastases were multiple (75%). The present observation is similar to that of Potts (1980), JS Nelson and Von Daimiling in 200.[16,17]

The incidence of pituitary adenoma was 10% in the current study. About 80% of macro-adenoma showed mild to moderate enhancement and 40% showed cystic/necrotic changes.Two macro-adenomas showed supra-sellar and para-sellar extensions.

The incidence of Craniopharyngioma in this study was 8% of all supratentorial tumours. Craniopharyngioma detected in child shows cystic component and peripheral calcification whereas adult variety showed heavy calcification which is seen only in 50% adult Craniopharyngioma. Similar findings have been reported in an extensive study on Craniopharyngioma done by Crotty and Young (1995).[18]

In the present study glioma was commonest supratentorial neoplasm (50%). Out of 25 cases 11cases (45%) were glioblastoma multiforme,6 were Anaplastic astrocytomas. Rees in 1996 also reported glioblastoma to be most common primary malignant tumour of adulthood, Walker MD et al in 1975 in a behalf of American cancer society reported GBM incidence as high as 50% of all intracranial glioma.[19] In the current study majority of GBM were hypodense and all showed necrosis and intense enhancement of the solid portion of the tumour. Also, most GBM were unifocal and singular in presentation mostly located in deep supratentorial hemispheric white matter. Most cases were associated with extensive perilesional edema and mass effect

Oligodendroglioma incidence in present study was 6% of all supratentorialtumour and 12.5% of all glioma. The majority of them showed calcification. Most were located in frontal lobe. CT characteristics of this subtype were similar to those reported by Vonofakos (1979).[20]

All the three low-grade gliomas were hypodense and majority was non-enhancing and did not have associated edema. All were located in supratentorial white matter of frontal/temporal/parietal lobe. Similar findings have been reported by NE Leeds and Elkincus (1984).[21] According to Singh, H., et al. there was majority (81%) lesions showed hypo dense as CT feature and 26.2% of the cases with no enhancement in CT imaging. More or less similar results observed in our study as 38% of the tumours were hypo dense on CT. Whereas equal proportion of the tumours were isodense and hyper dense (32% each). There were 40% of the lesions with mild to moderate enhancement with marked enhancement seen in 42%.

CT accurately characterized 42 of the total 50 cases with sensitivity of 84% and specificity of 86%. The diagnostic accuracy of CT in characterizing

meningioma, pilocytic astrocytoma, craniopharyngioma, oligodendroglioma, and pituitary adenomas approached 100% in our study. Whereas, diagnostic accuracy was least in characterizing anaplastic astrocytoma followed by glioblastoma multiforme. This could be because of the higher incidence of these lesions compared to other types of brain tumours.

Two lesions which were incorrectly characterized as anaplastic astrocytoma in our study turned out to be GBM on histopathology. Relatively less enhancement and necrotic changes were the reason for falsely characterizing the above lesions.

Out of the three lesions incorrectly characterized as GBM, two were proven to be anaplastic astrocytoma and one to be metastasis on histopathology. Two lesions incorrectly characterized as metastasis were diagnosed as GBM on histopathology. Overall there is overlap in the imaging features of Anaplastic astrocytoma, GBM and metastasis. The multiplicity of the lesions aids in the diagnosis of metastasis in majority of cases (75%). In cases of solitary metastasis it is difficult to differentiate from GBM based only on CT features.

Singh, H., et al. discussed the occurrence of gliomas as 39.6% of the total 106 cases confirmed as gliomas and other primary tumours contributed 32%. The histopathological findings revealed that Low-grade astrocytoma occupied top proportion with 31% then followed gliblastoma multiforme with 28.6%.[10,22] Our study findings showed similar results as the majority of the histopathological diagnosis (22%) contributed by Glioblastoma multi forme whereas the proportion of other Glioma types like Pilocytic astrocytoma, Diffuse low-grade Glioma, Oligodendroglioma, Anaplastic astrocytoma was 4%, 6%,6% and 12% respectively. Metastasis and Meningioma contributed 14% and 18% respectively. The proportion of Pituitary adenoma and Craniopharyngioma was 8% and 10% respectively.

Overall sensitivity (84%) and specificity (86%) of CT in characterizing various brain tumours is less compared to the reported sensitivity and specificity of MRI. In all cases of supratentorial tumours included in the present study, CT was able to demonstrate the lesion with respect to its location and other associated findings such as edema, mass effect, intratumoral bleed, necrosis, calcification and basing on those characteristics.

CONCLUSION

Supratentorial tumours can be seen in pediatric age group as well as in adults and elderly population. The incidence of supratentorialtumours rises after the age of 40. Glioma was the most common supratentorial brain tumour followed by meningioma and metastases. CT features are fairly characteristic in meningioma, craniopharyngioma and pituitary adenoma with overlap of imaging features in anaplastic astrocytoma, GBM and solitary metastasis. It is important to provide the better information about the features of tumours to give the best choice of treatment for the patients.

REFERENCES

1. Atlas SW. Adult supratentorial tumors. Seminars in roentgenology. 1990;25(2):130-54.
2. Elder JB, Lonser RR. Computed tomography perfusion imaging for the assessment of brain tumors. World neurosurgery. 2014;82(6):e723-4.
3. Fink KR, Fink JR. Imaging of brain metastases. Surgical neurology international. 2013;4(Suppl 4):S209-19.
4. Fouke SJ, Benzinger T, Gibson D, Ryken TC, Kalkanis SN, Olson JJ. The role of imaging in the management of adults with diffuse low grade glioma: A systematic review and evidence-based clinical practice guideline. Journal of neuro-oncology. 2015;125(3):457-79.
5. Amato MC, Madureira JF, Oliveira RS. Intracranial cavernous malformation in children: a single-centered experience with 30 consecutive cases. Arquivos de neuro-psiquiatria. 2013;71(4):220-8.
6. Asirvatham JR, Deepti AN, Chyne R, Prasad MS, Chacko AG, Rajshekhar V, et al. Pediatric tumors of the central nervous system: a retrospective study of 1,043 cases from a tertiary care center in South India. Child's nervous system : ChNS : official journal of the International Society for Pediatric Neurosurgery. 2011;27(8):1257-63.
7. Finizio F. CT and MRI aspects of supratentorial hemispheric tumors of childhood and adolescence. Child's Nervous System. 1995;11(10):559-67.
8. Baker HL, Jr., Houser OW, Campbell JK. National Cancer Institute study: evaluation of computed tomography in the diagnosis of intracranial neoplasms. I. Overall results. Radiology. 1980;136(1):91-6.
9. Ellika SK, Jain R, Patel SC, Scarpace L, Schultz LR, Rock JP, et al. Role of perfusion CT in glioma grading and comparison with conventional MR imaging features. AJNR American journal of neuroradiology. 2007;28(10):1981-7.
10. Singh H, Maurya V, Gill SS. Computerised Tomography Features in Gliomas. Medical journal, Armed Forces India. 2002;58(3):221-5.
11. Brant-Zawadzki M, Badami JP, Mills CM, Norman D, Newton TH. Primary intracranial tumor imaging: a comparison of magnetic resonance and CT. Radiology. 1984;150(2):435-40.
12. Haque MZ, Karim ME, Al-Azad S, Mahmood uz j. Role of computed tomography in the evaluation of pediatric brain tumor. Bangladesh Medical Research Council bulletin. 2010;36(3):89-92.
13. Masters L, Zimmerman R. Imaging of supratentorial brain tumors in adults. Neuroimaging clinics of North America. 1993;3:649-68.
14. Rohringer M, Sutherland GR, Louw DF, Sima AA. Incidence and clinicopathological features of meningioma. Journal of neurosurgery. 1989;71(5 Pt 1):665-72.
15. Smirniotopoulos JG. The new WHO classification of brain tumors. Neuroimaging clinics of North America. 1999;9(4):595-613.
16. Potts DG, Abbott GF, von Sneidern JV. National Cancer Institute study: evaluation of computed tomography in the diagnosis of intracranial neoplasms. III. Metastatic tumors. Radiology. 1980;136(3):657-64.
17. Nelson SJ. Imaging of brain tumors after therapy. Neuroimaging clinics of North America. 1999;9(4):801-19.
18. Crotty TB, Scheithauer BW, Young WF, Jr., Davis DH, Shaw EG, Miller GM, et al. Papillary craniopharyngioma: a

clinicopathological study of 48 cases. Journal of neurosurgery. 1995;83(2):206-14.
19. Walker MD. Diagnosis and treatment of brain tumors. Pediatric clinics of North America. 1976;23(1):131-46.
20. Vonofakos D, Marcu H, Hacker H. Oligodendrogliomas: CT patterns with emphasis on features indicating malignancy. Journal of computer assisted tomography. 1979;3(6):783-8.
21. Leeds NE, Elkin CM, Zimmerman RD. Gliomas of the brain. Seminars in roentgenology. 1984;19(1):27-43.
22. Corti M, Metta H, Villafane MF, Yampolsky C, Schtirbu R, Sevlever G, et al. [Stereotactic brain biopsy in the diagnosis of focal brain lesions in AIDS]. Medicina. 2008;68(4):285-90.

How to cite this article: Preethi GR, Mariappan M. Computed Tomography Evaluation of Supratentorial Brain Tumours. Ann. Int. Med. Den. Res. 2017; 3(4):RD22-RD27.

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