**Original Article**

**Usefulness of CT Scan and MRI for the Detection and Evaluation of Brain Tumors**

ISSN (O): 2347-338X; ISSN (P): 2347-3371

# D. Saraswathi 1, G. Srirama Murthy 2

1Professor, Department of Radiology, Narayana Medical College and Hospital, Nellore, Andhra Pradesh, India, 2Associate Professor, Department of Radiology, Shri Sathya Sai Medical College and Research Institute, Kancheepuram, Tamil Nadu, India.

**Abstract**

**Background:** Intracranial tumors can arise from various locations in the brain parenchyma. Computed tomography scan (CT) and magnetic resonance imaging (MRI) are important modalities for diagnosis of intracranial tumors. The aim of the study is to study the usefulness of CT scan and MRI for the detection and evaluation of brain tumors. **Subjects and Methods:** This was a prospective cross sectional study comprising of 95 patients diagnosed with brain tumors clinically. CT scan was done in all the patients and MRI was done in 45 patients. Findings were correlated with histopathology. **Results:** In the present study, age group distribution included from 20 years to more than 50 years.In the present study males were predominant and the male to female ratio was 1.3:1. All the cases, (100%) presented with seizures, followed by headache, hemiparesis and vomiting. **Conclusion:** CT scan and MRI imaging modalities are of utmost importance in diagnosing brain tumors. Early diagnosis is important and the imaging guides the neurosurgeon regarding appropriate surgical approach.

**Keywords:** Brain tumors, CT scan, MRI in brain tumors.

**Corresponding Author:** G. Srirama Murthy, Associate Professor, Department of Radiology, Shri Sathya Sai Medical College and Research Institute, Kancheepuram, Tamil Nadu, India.

E-mail: [pa2director@pkdashospital.com](mailto:pa2director@pkdashospital.com)

**Received: 18 December 2019 Revised: 23 January 2020 Accepted: 01 February 2020 Published: 05 July 2020**

**Introduction**

Intracranial tumors could originate from brain, pituitary gland, skull, embryonic tissues, spinal cord and meninges. They also could be metastasis from other parts of body. The incidence rate is 9.5 in 100000 in United States, of which more than 60% of primary tumors are gliomas. [[1](#_bookmark0)]

These tumors usually have non-specific symptoms like headache, nausea and vomiting. Specific symptoms depend on the location of the tumor, which are paralysis, aphasia, visual field disorders, seizures, etc. [[2](#_bookmark1),[3](#_bookmark2)]

Computed tomography scan (CT) and magnetic resonance imaging (MRI) are important modalities for diagnosis of intracranial tumors. CT scan remains a good choice in diag- nosis of some conditions like bone or vascular involvement and metastases to the skull base. [[4](#_bookmark3),[5](#_bookmark4)]

MRI is the usually recommended choice for diagnosing brain tumors. [[6](#_bookmark5)]

MRI is a gold standard test for diagnosis of glial tumors. When MRI is not available, CT scan with contrast can be used instead. However, it might miss posterior fossa tumors with



Asian Journal of Medical Radiological Research Volume 8 Issue 1 January-June 2020

**154**

false negative report. [[7](#_bookmark6)]

Developed in the mid 70’s the computed tomography (CT) scan revolutionized the diagnosis of brain tumors. CT images show skull, blood clots, and often calcified masses, appears white, while the brain is gray, and the CSF, fat and air appear black. [[8](#_bookmark7),[9](#_bookmark8)]

Magnetic resonance imaging (MRI), which involves a high- powered magnet, became available in mid 1980’s. MRI images are quite distinct, allowing a more detailed examination than is possible with CT. Because MRI gives not only an axial view but also coronal and sagittal views, three-dimensional exami- nation is possible. [[10](#_bookmark9),[11](#_bookmark10)]

Dynamic, contrast-enhanced MR imaging has been imple- mented for the quantification of cerebral blood volume (CBV) and microvascular permeability (PS) (permeability surface area product) both in animal models and, more recently, in human brain tumors as well. [[12](#_bookmark11)–[15](#_bookmark12)]

The identification of a tumoural mass and the assessment of its size and vascularization are best achieved with X- ray CT and MRI, while biochemical imaging can provide additional information that is crucial for tumour classification,

−−

−−

−−

differential diagnosis and follow-up. [[16](#_bookmark13)]

Since MRI provides better contrast than CT while differenti- ating soft tissue delineation of target volumes in MRI images is more accurate and precise but at the same time it has some disadvantages too. [[17](#_bookmark14)]

A CTMRI fused image really helps the radiation oncologists as well as physicists to outline the tumor and OARs for better treatment in radiotherapy. Moreover CT-MRI fusion results in improving the delineation of target volumes in brain gliomas. [[18](#_bookmark15)]

Almost 80% of all intracranial tumors are supratentorial, 40% are metastases and 70% of tumors in 1-year-olds to adolescents are in the posterior fossa. [[19](#_bookmark16)]

Secondary or metastatic tumors spread from another part of the body and are much more common than primary brain tumors. The most common types of cancer that metastasize to the brain are melanoma, breast, colon, and lung.[[20](#_bookmark17)]

# Aim of the study

To study the usefulness of CT scan and MRI for the detection and evaluation of brain tumors.

**Subjects and Methods**

Permission was taken from the Institutional Ethics Committee. Informed consent was taken from all the patients included in the study.

This was a prospective cross sectional study comprising of 95 patients diagnosed with brain tumors clinically. This study was conducted in the department of Radiodiagnosisat Shri Sathya Sai Medical College and Research Institute, Kancheepuram district, Tamilnadu, over a period of one year from January 2018 to February2019.

# Inclusion criteria

* Patients willing to participate in the study
* Both males and females
* Age: 20 years to more than 50 years.
* Clinically diagnosed with brain tumors.
* CT scan and MRI brain findings suggestive of brain tumors.

# Exclusion criteria

* Patients not willing to participate in the study
* Age below 20 years
* Pregnant women

All the cases included in the study attended out patient department of General Surgery and those who were clinically diagnosed as brain tumors were referred to department of Radiology for imaging studies.



Asian Journal of Medical Radiological Research Volume 8 Issue 1 January-June 2020

**155**

−−

−−

−−

**Table 1: Age-wise distribution of the cases**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Age distribution years)** | **(in** | **No. of cases** | **Percent** | **(%)** |
| 20-30 | 01 | | 1.05% | |
| 30-40 | 08 | | 8.4% | |
| 40-50 | 66 | | 69.4% | |
| >50 years | 20 | | 21.05% | |
| Total | 95 | | 100% | |

**Table 2: Gender-wise distribution of the cases**

|  |  |  |  |
| --- | --- | --- | --- |
| **Gender** | **No. of cases** | **Percent** | **(%)** |
| Females | 40 | 42.1% | |
| Males | 55 | 57.8% | |
| Total | 95 | 100% | |

A thorough clinical examination was done including detailed History taking, onset of symptoms, past history of similar complaints.

All the 95 patients were subjected to CT scan to assess size of lesions, location, cystic changes, solid nature, and calcification shifting, edema and enhancement.

Only 45 cases were evaluated by MRI and assessed for ill- defined margins, well defined margins and lobulated margins on conventional T1 and T2WI.

CT machine Toshiba Aquilion (160 slices) was used. The contrast used was water soluble and nonionic (Omnipaque) administered at 300 mg/ml through intravenous injection.

**Results**

In the present study a total of 95 cases were included.

In the present study, age group distribution included from 20 years to more than 50 years. Majority of the patients, ie 69.4% (66/95) were among 40-50 years. Next common was more than 50 years age ie, 21.05% (20/95).

In the present study males were predominant ie, 57.8% compared to femalesie,42.1% and the male to female ratio was 1.3:1.

In the present study, 100% cases presented with seizures, followed by headache ie, 94.7% and 84.2% with hemiparesis, 42.1% with vomiting.

Among Malignant tumors, 62.1% cases showed cystic change, 57.8% showed solid features.

Among Benign tumors 23.1% cases showed cystic change, 34.7% showed solid features.

On CT scan brain, 60/95 (63.1%) reported as benign, 35/95 (36.8%) were reported as malignant.

**Table 3: Clinical symptoms for both benign and malignant cases**

**\***

|  |  |  |  |
| --- | --- | --- | --- |
| **Clinical symp- toms** | **No. of cases** | **Percent** | **(%)** |
| Headache | 90 | 94.7 | |
| Seizures | 95 | 100 | |
| Hemiparesis | 80 | 84.2 | |
| Vomiting | 40 | 42.1 | |

\* The symptoms were not mutually exclusive

**Table 4: CT findings**

|  |  |  |  |
| --- | --- | --- | --- |
| **CT findings** | **No. of**  **cases(Malignant n= 60)** | **No. cases(Benign n=35 )** | **of** |
| Cystic | 59(62.1%) | 22(23.1%) | |
| Solid | 55(57.8%) | 33( 34.7%) | |
| Calcification | 55(57.8%) | 6(6.3%) | |
| Shifting | 58(61%) | 23(24.2%) | |
| Edema | 60(63.1%) | 6(6.3%) | |
| Enhancement | 60(63.1%) | 8(8.4%) | |

**Table 5: Nature oftumor on CT report**

|  |  |  |  |
| --- | --- | --- | --- |
| **CT reports** | **No. of cases** | **Percent** | **(%)** |
| Benign | 60 | 63.1% | |
| Malignant | 35 | 36.8% | |
| Total | 95 | 100% | |

**Table 6: Nature oftumor on MRI report (n=45)**

|  |  |  |  |
| --- | --- | --- | --- |
| **MRI reports** | **No. of cases** | **Percent** | **(%)** |
| Benign | 15 | 33.3% | |
| Malignant | 30 | 66.6% | |
| Total | 45 | 100% | |

A total of 45 cases were subjected to MRI brain, 15/45 (33.3%) reported as benign, and 30/45 (66.6%) were reported as malignant.

**Discussion**

# Sample size

In the present study a total of 95 patients with brain tumors were included. Taghipour et al, [[21](#_bookmark18)] studied about 218 patients with brain tumors in their study.

# Comparative studies based on age and gender distribution

In our study, majority of the patients, ie 69.4% (66/95) were among 40-50 years. Males were predominant (57.8%)



Asian Journal of Medical Radiological Research Volume 8 Issue 1 January-June 2020

**156**

−−

−−

−−

**Table 7: Showing histopathology diagnosis**

|  |
| --- |
| **Histopathology No. of cases Percent (%) diagnosis** |
| Meningioma 7 7.3% |
| Schwannoma 15 15.7% |
| Oligodendroglioma 05 5.2% |
| Astrocytoma 27 28.4% |
| Glioblastoma 39 41% |
| Metastasis 02 2.1% |
| Total 95 100% |

compared to females (42.1%). In Taghipour et al, [[21](#_bookmark18)] study, ninety eight were women (45%) and 120 men (55%) with mean age of 44 years old (SD=20). Shah et al, [[22](#_bookmark19)] studied 76 brain tumors in the age group of 0 to 19 years. Primary brain tumors were more common in males (55.3%) as compared to females (44.7%) with male to female ratio of 1.23:1 in their study. However, their study was focused on paediatric brain tumors. Ahmad et al,[23]studied thirty patients of brain tumours diagnosed on CT scan/ Conventional MRI. The age of the patients in their study ranged from 22 to 63 years. The youngest patient was 22 years. Twenty two patients (73%) belonged in the 30-50 years age and formed the majority in the study group.

# Comparative studies based on etiology

In the present study, 60/95 (63.1%) were reported as benign, 35/95 (36.8%) were reported as malignant., whereas, in Taghipour et al, [[21](#_bookmark18)] study there were 172 cases with definite diagnosis, 13 cases (7.2%) were benign and 159 cases (92.4%) were malignant.

# Comparative studies based on sensitivity

In the study by Taghipour et al, [[21](#_bookmark18)] there were 189 (86.6%) cases of brain tumor diagnosed by CT scan. Sensitivity of CT scan was 83%, specificity was 10%, positive predictive value (PPV) was 93%, negative predictive value (NPV) was 3% and accuracy was 78% when compared to biopsy results.

In their study fifty four patients had MRI also, for which sensi- tivity and specificity were 92% and 25% when compared with biopsy. Positive predictive value (PPV), negative predictive value (NPV) and accuracy in comparison with biopsy were 93%, 2% and 87% respectively.

# Comparative studies based on pathology

In our study, differences between Histopathology diagnosis and CT scan and MRI reports of benign and malignant tumors were not significant. In Taghipour et al, h CT scan and MRI reports for diagnosis of benign or malignant tumors were compared with pathologic findings and they correlated well.

[[21](#_bookmark18)] b*ot*

# Comparative studies based on diagnosis on CT scan

In our study, among Malignant tumors 62.1% cases showed cystic change, 57.8% each showed solid features and cal- cification. Shifting was seen in 61% and 63.1 % showed edema and enhancement. Among Benign tumors 23.1% cases showed cystic change, 34.7% showed solid features and 6.3% showed calcification and edema.24.2% showed shifting and 8.4% showed enhancement.

In the study by Taghipour et al, [[21](#_bookmark18)] there were 44 diagnostic cystic lesions by CT scan, 91.7% were malignant and 8.3% were benign in biopsy reports. Solid reports were 22 cases and 84.6% were malignant. Malignant tumors with calcification, shifting and edema were 94.1%, 91.3% and 95.8% respectively. Hydrocephaly was found in 21 cases by CT scan, of which 76.2% were malignant and it was significant. It means that hydrocephaly may predict malignant lesions. Glioblastoma multiformewas the most frequent type of malignancy in these specimens.

Roberts et al, [[22](#_bookmark19)] in their study observed for a patient, the tumor showed intense enhancement on both early and late contrast- enhanced scans. Region of interest measurements in the tumor revealed an initial contrast peak. The high PS of the tumor resulted in a transendothelial diffusion of the contrast agent into the tissue interstitium, which can be recognized by the very slight decline of the signal intensity after the first pass.

For patient 2, as evident from the CT scans and the region of interest display, the tumor showed a contrast agent enhancement pattern similar to that of the tumor in patient 1: an early peak and then an almost complete lack of density decrease after the first pass, attributable to microvascular hyperpermeability. Permeability, however, was highest in the tumor center on the CT study but highest in the tumor periphery on the MR imaging study.

In the study by Prabhakar et al, MRI showed 1.27 times more volume when compared to CT volume. It showed that MRI volume is larger than CT volume in most of the studied cases.

In the study by Ahmad et al, the patients had chief complaint of headache.60% (n=18) of the patients presented with complaint of seizures, 40% (n=12) of the patients presented with complaint of nausea/vomiting, 10% (n=3) presented with focal neurological deficit and 10% (n=3) presented with visual problems.

# Comparative studies on Histopathology

In the study by Roberts et al, [[22](#_bookmark19)] out of the benign cases, four were meningiomas, two were low grade gliomas, one was pituitary macroadenoma, one was choroid plexus papilloma, one was granulomatous lesion and one was arachnoid cyst. The majority of malignant cases were glioblastomamultiforme (n=14), followed by metastases (n=3), anaplastic astrocytoma (n=2) and nonHodgkin’s lymphoma (n=1).

**Conclusion**

CT scan and MRI imaging modalities are of utmost importance in diagnosing brain tumors. Early diagnosis is important and the imaging guides the neurosurgeon regarding appropriate surgical approach.

**References**

1. Gilman S. Imaging the Brain. N Engl J Med. 1998;338(13):889–896. Available from: [https://dx.doi.org/10.](https://dx.doi.org/10.1056/nejm199803263381307) [1056/nejm199803263381307](https://dx.doi.org/10.1056/nejm199803263381307).
2. Medina LS, Pinter JD, Zurakowski D, Davis RG, Kuban K, Barnes PD. Children with headache: clinical predictors of surgical space-occupying lesions and the role of neuroimaging. Radiology . 1997;202(3):819–824. Available from: [https://doi.](https://doi.org/10.1148/radiology.202.3.9051039) [org/10.1148/radiology.202.3.9051039](https://doi.org/10.1148/radiology.202.3.9051039).
3. Medina LS, Pinter JD, Zurakowski D, Davis RG, Kuban K, Barnes PD. Children with headache: clinical predictors of surgical space-occupying lesions and the role of neuroimaging. Radiology. 1997;202(3):819–824. Available from: [https://dx.](https://dx.doi.org/10.1148/radiology.202.3.9051039) [doi.org/10.1148/radiology.202.3.9051039](https://dx.doi.org/10.1148/radiology.202.3.9051039).
4. Poussaint TY, Gudas T, Barnes PD. Imaging of neuroen- docrine disorders of childhood. Neuroimaging Clin N Am. 1999;9(1):157–75.
5. Scott JN, Brasher PMA, Sevick RJ, Rewcastle NB, Forsyth PA. How often are nonenhancing supratentorial gliomas malignant? A population study. Neurology. 2002;59:947–949. Available from: <https://dx.doi.org/10.1212/wnl.59.6.947>.
6. Saunders W. Single visit endodontics resulted in less pain than multiple visits. Evid Based Dent. 2000;2:12–16. Available from: <https://dx.doi.org/10.1038/sj.ebd.6400008>.
7. Silver AJ, Ganti SR, Hilal SK. Computed tomography of tumors involving the atria of the lateral ventricles. Radiology. 1982;145(1):71–78. Available from: [https://dx.doi.org/10.](https://dx.doi.org/10.1148/radiology.145.1.7122900) [1148/radiology.145.1.7122900](https://dx.doi.org/10.1148/radiology.145.1.7122900).
8. Dandy WE. Ventriculography Following the Injection of Air into the Cerebral Ventricles. Ann Surg. 1918;68(1):5–

11. Available from: [https://dx.doi.org/10.1097/00000658-](https://dx.doi.org/10.1097/00000658-191807000-00002) [191807000-00002](https://dx.doi.org/10.1097/00000658-191807000-00002).

1. Lee YY, Tassel PV, Bruner JM, Moser RP, Share JC. Juvenile pilocytic astrocytomas: CT and MR characteristics. Am J Roentgenol. 1989;152(6):1263–1270. Available from: [https:](https://dx.doi.org/10.2214/ajr.152.6.1263)

[//dx.doi.org/10.2214/ajr.152.6.1263](https://dx.doi.org/10.2214/ajr.152.6.1263).

1. Saleem SN, Said AHM, Lee DH. Lesions of the Hypotha- lamus: MR Imaging Diagnostic Features. Radiographics. 2007;27:1087–1108. Available from: [https://dx.doi.org/10.](https://dx.doi.org/10.1148/rg.274065123) [1148/rg.274065123](https://dx.doi.org/10.1148/rg.274065123).
2. van Dijke CF, Brasch RC, Roberts TP, Weidner N, Mathur A, Shames DM. Mammary carcinoma model: correlation of macromolecular contrast-enhanced MR imaging characteriza- tions of tumor microvasculature and histologic capillary den- sity. Radiology. 1996;198(3):813–818. Available from: [https:](https://dx.doi.org/10.1148/radiology.198.3.8628876)

[//dx.doi.org/10.1148/radiology.198.3.8628876](https://dx.doi.org/10.1148/radiology.198.3.8628876).

1. Schwickert HC, Stiskal M, Roberts TP, van Dijke CF, Mann J, Mühler A. Contrast-enhanced MR imaging assessment of tumor capillary permeability: effect of irradiation on delivery



Asian Journal of Medical Radiological Research Volume 8 Issue 1 January-June 2020

**157**

−−

−−

−−

of chemotherapy. Radiology. 1996;198(3):893–898. Available from: <https://dx.doi.org/10.1148/radiology.198.3.8628889>.

1. Roberts HC, Roberts TP, Brasch RC, Dillon WP. Quantita- tive estimation of microvascular permeability in human brain tumors using dynamic contrast-enhanced MR imaging: correla- tion with histological grade. Am J Neuroradiol. 2000;21:891– 899.
2. Roberts HC, Roberts TPL, Bollen AW, Ley S, Brasch RC, Dillon WP. Correlation of Microvascular Permeability Derived from Dynamic Contrast-Enhanced MR Imaging with Histologic Grade and Tumor Labeling Index. Acad Radiol. 2001;8(5):384–391. Available from: [https://dx.doi.org/10.](https://dx.doi.org/10.1016/s1076-6332(03)80545-7) [1016/s1076-6332(03)80545-7](https://dx.doi.org/10.1016/s1076-6332(03)80545-7).
3. Sole AD, Falini A, Ravasi L, Ottobrini L, Marchis DD, Bom- bardieri E. Anatomical and biochemical investigation of pri- mary brain tumours. Eur J Nucl Med. 2001;28(12):1851–1872. Available from: <https://dx.doi.org/10.1007/s002590100604>.
4. Sannazzari GL, Ragona R, Redda MGR, Giglioli FR, Isolato G, Guarneri A. CT–MRI image fusion for delineation of volumes in three-dimensional conformal radiation therapy in the treatment of localized prostate cancer. Br J Radiol. 2002;75(895):603–607. Available from: [https://dx.doi.org/10.](https://dx.doi.org/10.1259/bjr.75.895.750603) [1259/bjr.75.895.750603](https://dx.doi.org/10.1259/bjr.75.895.750603).
5. Rajasekar D, Datta NR, Gupta RK, Pradhan PK, Ayyagari S. Multimodality image fusion in dose escalation studies of brain tumors. J Appl Clin Med Phys. 2003;4(1):8–16. Available from: <https://dx.doi.org/10.1120/jacmp.v4i1.2545>.
6. Metcalfe P, Liney GP, Holloway L, Walker A, Barton M, Delaney GP, et al. The Potential for an Enhanced Role for MRI in Radiation-therapy Treatment Planning. Technol Cancer Res Treat. 2013;12(5):429–446. Available from: [https://dx.doi.org/ 10.7785/tcrt.2012.500342](https://dx.doi.org/10.7785/tcrt.2012.500342).
7. Taghipour Z, Sadrabadi RM, Dehghani F. Evaluation of Diagnostic Value of CT Scan and MRI in Brain Tumors and Comparison with Biopsy. Iran J Ped Hematol Oncol. 2011;1(4):121–125.
8. Ubhale B, Shah H, Shah J. Demographic and histopathologic profile of pediatric brain tumors: A hospital-based study. South Asian J Cancer. 2015;4(3):146–146. Available from: [https:](https://dx.doi.org/10.4103/2278-330x.173165)

[//dx.doi.org/10.4103/2278-330x.173165](https://dx.doi.org/10.4103/2278-330x.173165).

1. Ahmad MS, Anjum R, Singh A, Singh DK, G DKD. EVAL- UATION OF BRAIN TUMOURS BY MRI TECHNIQUES AND THEIR HISTOPATHOLOGICAL CORRELATION. J Evol Med Dent Sci. 2014;3(70):14971–14984. Available from: <https://dx.doi.org/10.14260/jemds/2014/4013>.
2. Prabhakar R, Haresh KP, Ganesh T, Joshi RC, Julka PK, Rath GK. Comparison of computed tomography and magnetic resonance based target volume in brain tumors. J Cancer Res Ther. 2007;3(2):121–121. Available from: [https://dx.doi.org/ 10.4103/0973-1482.34694](https://dx.doi.org/10.4103/0973-1482.34694).

|  |
| --- |
| **Copyright:** © the author(s), 2020. It is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits authors to retain ownership of the copyright for their content, and allow anyone to download, reuse, reprint, modify, distribute and/or copy the content as long as the original authors and source are cited.  **How to cite this article:** Saraswathi D, Murthy GS. Usefulness of CT Scan and MRI for the Detection and Evaluation of Brain Tumors . Asian J. Med. Radiol. Res. 2020;8(1):154-158.  DOI: [dx.doi.org/10.47009/ajmrr.2020.8.1.28](https://doi.org/10.47009/ajmrr.2020.8.1.28)  **Source of Support:** Nil, **Conflict of Interest:** None declared. |



Asian Journal of Medical Radiological Research Volume 8 Issue 1 January-June 2020

**158**

−−

−−

−−