DISSERTATION ON

EVALUATING THE RADIOPATHOLOGIC CORRELATION OF COMMONLY OCCURING CNS TUMOURS

M.Ch., Degree Examination

Branch II - Neurosurgery

THE TAMILNADU Dr.M.G.R. MEDICAL UNIVERSITY
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CERTIFICATE

This is to certify that the dissertation entitled **EVALUATING THE RADIOPATHOLOGIC CORRELATION OF COMMONLY OCCURING CNS TUMORS** was done under our supervision and is the bonafide work of **Dr.R.Raghavendran**. It is submitted in partial fulfillment for the M.Ch. Neurosurgery Examination.

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CONTENTS

AIM OF THE STUDY

To study the correlation between the Pathological nature and the radiological appearance of primary Central Nervous System neoplastic lesions based on the two most commonly used and easily available investigations namely CT Brain plain and contrast and MRI Brain plain and contrast. To identify the specificity of CT Vs MRI in achieving the same. To assess the cost effectiveness of the imaging methods and find out which had better specificity.

INTRODUCTION

Neoplasms of the central nervous system are comparatively infrequent, though it is not as rare a condition as it was once assumed to be.

From the very early days of very high mortality and morbidity rates, due to CNS tumours, substantial improvement in survival and outcome has been made because of several factors. These are:

a) The development of advanced, state of the art, imaging modalities which have made early diagnosis possible.

b) improvement in neurosurgical equipments and techniques that allowed greater accessibility permitting a greater chance of gross total surgical resection.

c) the implementation of the advanced radiation therapy to counter the rapid growth of the tumour.

d) the advent of modern cross-sectional imaging techniques especially MR imaging have completely changed the method of assessment for follow up in affected patients.

e) the development of chemotherapy protocols that strive to optimise prevention of recurrence and minimise the chance of metastatic dissemination.

Detection and correct interpretation of the imaging appearances of these lesions assume prime importance because cross sectional imaging represents the first step in the successful treatment of these patients.

Under these circumstances, the ability to do reasonable prediction regarding the pathological nature of the tumours from the imaging studies will further greatly help in fine tuning the surgical approach and method; so that an optimal result can be obtained from the treatment modality as a whole, for a given patient. This will also help in giving prognostic information to the patient and his family.

Towards this goal, using case material from the Institute of Neurology, Government General Hospital and Madras Medical College, Chennai, I represent the spectrum of cross sectional imaging manifestations of commonly occuring primary central nervous system neoplasms like astrocytoma, meningioma, medulloblastoma, ependymoma and craniopharyngioma. A comprehensive summation of the correlation between the radiological appearances of these tumours and their pathological nature is presented here.

REVIEW OF LITERATURE

There are many studies conducted by pioneering authors on the radiologic and pathologic correlation of CNS tumours. Across the World various papers have been published at various points of time from some of the premier institutes in neurosciences.

In India, the article (27) by Purohit et al. studied radiopathalogic correlation of haemangioblastomas on 25 cases in the Nizam's institute of medical sciences at Hyderabad. They concluded that solid haemangio blastomas showed histopathologic correlation with abundant stromal cells with eosinophilic cytoplasm and cystic lesions with mural nodule had vacoulated cytoplasm with micro cysts. Two other studies on haemangioblastomas, (1) Adair et.al. of ten cases and the other by Ho VB et. al. (10) of a single case concluded on high correlation with Radiologic appearances of a high quality CECT and haemangioblastoma pathologically.

Among gliomas, a study by Daumas et.al. (6) on 100 astrocytomas correlating between CECT and stereotactic biopsy done in 1987, concluded strong correlation between contrast enhancement and malignancy. Earnest et al. (8) concluded that contrast enhancement is indistinguishable between radiation necrosis and recurrence.

Iwama et al. (11) concluded that T_1 and T_2 signal intensities correlate poorly with the malignant nature of glioma. WuRH and co-authors concluded (29) that it is impossible to distinguish histopathological subtypes of astrocytomas by CT findings. Mellisian AG (15) in a study correlated the CT

densitometry with contrast amplification and predicted enhanced positivity in choosing areas for stereotactic biopsy.

One study by Munari and Co (19) correlated tumour volume of gliomas by CT finding and stereo EEG and found no correlation in 11 patients. Another study conducted on Children with recurrent gliomas (17) concluded that changes in findings on CECT reflected malignant transformation. Two other studies by castillo (4) and Actinus (2) were one case studies correlating well with low grade glioma.

Peirallini A et al. (21) concluded that necrosis of more than 35% of the mass resulted in a shorter survival time when compared to less than < 35%. Rees JH (24) concluded that CT Brain findings correlated poorly with glio blastoma resulting from necrotic, irregular walled lesion with extensive edema to thin walled cystic lesion with scant edema in 1996.

A similar study by Rao et al. (23) concluded that, differentiation of multicentric glioblastoma with metastatic deposits can be difficult with CECT a finding, echoed in various other studies.

A study by Russel EJ et al.(25) in 1980, concluded that meningiomas produce a significant number of atypical images and lead to spurious histopathological diagnosis to an extent of 17%. One study on ependymoma by Centeno RS et al. in 1986 (5), observed no correlation between Radiological appearance and pathological diagnosis.

One study correlating lesion size with CT findings in 1977 by Messina AV, concluded that one third of lesions between 1 to 2 cms were not demonstrated in CECT when compared with autopsy findings. Similar study by Mori H et al. in 1977 concluded that when only good quality CECT was considered the threshold was a minimum 1.5 cms.

On review of literature, it is found that there has been no study correlating the radiologic appearance of various commonly occurring CNS tumours with their pathologic nature in a single study. Each studied only a particular tumor type. Hence this is a small attempt to correlate the radiology of commonly occurring primary CNS tumours based on both CT and MRI with their pathologic nature.

STUDY MATERIALS AND METHODS

The study was conducted on all the patients admitted in the concerned admitting unit with a diagnosis of a central nervous system tumour between May 2002 to June 2005 at the Institute of Neurology, Madras Medical College, Chennai-600 003, a total number of 243 patients were enrolled for the study.

Exclusion Criteria

1. Patients who died before surgery.

2. Patients admitted with recurrence.

3. Patients who were admitted with a proved pathological diagnosis at some other institute and later referred here.

4. Tumours which were not routinely biopsied at the institute like, brain-stem gliomas.

5. Patients who presented with haemorrhage at the tumour site were not included because of their distorted radiological appearance.

6. All the patients had CT Brain plain and contrast. Patients who had only plain MRI without contrast were included in the CT Brain group, their MRI was not taken into consideration for the study.

7. Patients who had multiple lesions were excluded from the study.

8. After admission patients who were diagnosed with a primary lesion elsewhere in the body were excluded from the study.

9. Patients who were not willing for surgery were excluded from the study.

1. Patients who died before surgery - (1)
2. Patients not willing for surgery - (6)
3. Patients admitted with recurrence or with established pathological diagnosis - (9)
4. Patients who had a primary lesion - (7)
5. Lesions not biopsed - (16)
6. Patients who presented with haemorrhage - (6)
7. Multiple lesions - (7)

A total of 52 patients were excluded from the study.

The remaining 191 patients were selected for conducting the study.

The above 191 patients were divided into two groups.

Group I - Only CT Brain plain and contrast.

Group II - CT Brain and MRI Brain plain and contrast.

Group I - Contained 191 patients

Group II - Contained 82 patients

Radiology criteria for the 6 types of tumours to be studied were formulated.

I. Low Grade Glioma: Intrinsic lesion.

CT NECT

- Ill defined homogenous hypodense or isodense mass.
- minimal or no surrounding oedema

CECT

- very minimal or no contrast enhancement.

MRI TIWI

- Homogenous hypointense mass
- Well circumscribed.
- Minimal or no surrounding edema.

T_2WI

- Homogenous hyperintense mass.
- Circumscribed.
- Minimal or no surrounding oedema.

FLAIR: Homogenous hyperintense mass

T_1 Contrast: no enhancement.

II. High Grade Glioma: Intrinsic Lesion

CT NECT

- Irregular ISO or hypodense mass
- necrosis (+)
- marked mass effect and surrounding edema.

CECT

- strong heterogenous, irregular ring enhancement.

MRI T_1WI

- Irregular isointense to hypointense mass
- necrosis (+)

T_2WI

- heterogenous, hyperintense mass.
- necrosis, cyst, fluid levels or flow voids may be seen.

FLAIR: heterogenous, hyperintense mass with surrounding vasogenic edema.

T1C+: Thick irregular ring of enhancement surrounding areas of central necrosis - enhancement may be solid, ring, nodular or patchy.

III. EPENDYMOMA - midline posterior fossa lesion.

CT NECT

- 4th Ventricle Tumour
- hypodense
- Calcification

CECT

- variable heterogenous enhancement.

MRI **T_1WI**

- heterogenous iso to hypointense
- cystic changes common

T_2WI

- heterogenous iso to hyperintense
- hyperintense cystic foci

T_1C+

- Variable enhancement

IV. MEDULLOBLASTOMA: midline posterior fossa lesion.

CT NECT

- Solid mass in midline vermian region
- hyperdense
- necrosis and cystic changes commonly seen

CECT

- patchy or homogenous enhancement.

MRI **T_1WI**

- hypointense to gray matter

T_2WI

- iso intense to gray matter

FLAIR - hyperintense to gray matter.

T_1C+ - heterogenous enhancement.

V. CRANIOPHARYNGIOMA

CT **NECT**

- mixed cystic and solid component iso to hypodense
- calcification common

CECT

- enhancement of nodule and rim

MRI

T_1WI

- iso to hyperintense cystic contents and solid component.

T_2WI

- hyperintense cysts
- hypointense calcification

FLAIR : hyperintense cyst contents.

T_1C : heterogenous enhancement of solid component, cyst wall enhance strongly.

VI. MENINGIOMA extrinsic lesion

CT NECT

- iso to hyperdense
- homogenous lesion
- hyperostotic or sclerotic bone changes.

CECT

- homogenous, strong, uniform enhancement.

MRI

T_1WI

- iso to hypointense
- homogenous lesions

T_2WI

- iso to hyperintense
- homogenous lesion

T_1C : strong homogenous enhancement dural tail

Based on the above criteria the 191 patients were classified

Only tumours unambigously falling into any one of the above six types were selected and all other patients were excluded.

Finally

Group I had 153 patients

Group II had 67 patients

Group I had the following number of patients in each category.

Low Grade Glioma	-	27
High grade Glioma	-	47
Medulloblastoma	-	24
Ependymoma	-	7
Craniopharyngioma	-	17
Meningioma	-	31
Total	**-**	**153**

Group II had the following number of patients in each category.

Low Grade Glioma	-	15
High grade Glioma	-	17
Medulloblastoma	-	11
Ependymoma	-	2
Craniopharyngioma	-	7
Meningioma	-	15
Total	**-**	**67**

After surgery, the hispathological diagnosis of all the selected 153 patients were entered. Based on the above data a master chart was prepared. The correlation and measure of agreement were analysed statistically and the results are discussed in the following pages.

For Histopathological examination, light microscopy with routine eosin and haemotoxylin stains were used.

For the statistical analysis chi-square pearson formula was used.

PROFORMA

NAME	:	DATE OF SURGERY	:
AGE	:	HPE NO.	:
SEX	:	CASE NO.	:
IP NO.	:		

CT DIAGNOSIS :

MRI DIAGNOSIS :

PATHOLOGICAL DIAGNOSIS :

CORRELATION

CT BRAIN :

MRI BRAIN :

CT + MRI BRAIN :

MASTER CHART

Sl.No.	CT Diagnosis	MRI Diagnosis	Pathological Diagnosis
1.	Medulloblastoma	Not Available	Medulloblastoma
2.	Ependymoma	Not Available	Medulloblastoma
3.	Craniopharyngioma	Craniopharyngioma	Craniopharyngioma
4.	Medulloblastoma	Not Available	Medulloblastoma
5.	High Grade Glioma	High Grade Glioma	High Grade Glioma
6.	Meningioma	Meningioma	Tuberculoma
7.	Meningioma	High Grade Glioma	High Grade Glioma
8.	Medulloblastoma	Medulloblastoma	Medulloblastoma
9.	Low Grade Glioma	Not Available	Low Grade Glioma
10.	Craniopharyngioma	Craniopharyngioma	Craniopharyngioma
11.	Ependymoma	Not Available	Ependymoma
12.	Low Grade Glioma	Low Grade Glioma	Low Grade Glioma
13.	Ependymoma	Ependymoma	Ependymoma
14.	High Grade Glioma	High Grade Glioma	Low Grade Glioma
15.	High Grade Glioma	Not available	Abscess
16.	Meningioma	Not available	Meningioma
17.	Medulloblastoma	Medulloblastoma	Medulloblastoma
18.	Meningioma	Not Available	Secondaries
19.	High Grade Glioma	Not Available	High Grade Glioma
20.	Low Grade Glioma	Not Available	Low Grade Glioma
21.	Craniopharyngioma	Craniopharyngioma	High Grade Glioma
22.	High Grade Glioma	Not Available	High Grade Glioma
23.	Low Grade Glioma	Not Available	Low Grade Glioma
24.	Low Grade Glioma	Not Available	Low Grade Glioma
25.	High Grade Glioma	Not Available	High Grade Glioma

Sl.No.	CT Diagnosis	MRI Diagnosis	Pathological Diagnosis
26.	High Grade Glioma	Not Available	High Grade Glioma
27.	Meningioma	Not Available	Meningioma
28.	Craniopharyngioma	Not Available	Craniopharyngioma
29.	Meningioma	Not Availbale	Meningioma
30.	Meningioma	Not Available	Low Grade Glioma
31.	Craniopharyngioma	Not Available	Craniopharyngioma
32.	Medulloblastoma	Not Available	Medulloblastoma
33.	High Grade Glioma	High Grade Glioma	High Grade Glioma
34.	Low Grade Glioma	Low Grade Glioma	Low Grade Glioma
35.	Medulloblastoma	Not Available	Medulloblastoma
36.	High Grade Glioma	Not Available	High Grade Glioma
37.	Low Grade Glioma	Low Grade Glioma	Low Grade Glioma
38.	Meningioma	Meningioma	Tuebrculoma Enplaque
39.	Low Grade Glioma	Not Available	Low Grade Glioma
40.	High Grade Glioma	High Grade Glioma	High Grade Glioma
41.	Medulloblastoma	Medulloblastoma	Medulloblastoma
42.	High Grade Glioma	Not Available	High Grade Glioma
43.	High Grade Glioma	Not Available	High Grade Glioma
44.	Medulloblastoma	Not Available	Medulloblastoma
45.	High Grade Glioma	Not Available	High Grade Glioma
46.	Craniopharyngioma	Craniopharyngioma	Craniopharyngioma
47.	High Grade Glioma	High Grade Glioma	High Grade Glioma
48.	Meningioma	Not Available	Meningioma
49.	Meningioma	Meningioma	Meningioma
50.	High Grade Glioma	High Grade Glioma	High Grade Glioma
51.	Low Grade Glioma	Low Grade Glioma	Low Grade Glioma
52.	High Grade Glioma	High Grade Glioma	Low Grade Glioma

Sl.No.	CT Diagnosis	MRI Diagnosis	Pathological Diagnosis
53.	Ependymoma	Not Available	Low Grade Glioma
54.	Medulloblastoma	Not Available	Medulloblastoma
55.	Low Grade Glioma	Low Grade Glioma	Low Grade Glioma
56.	Meningioma	Meningioma	Meningioma
57.	High Grade Glioma	Not Available	High Grade Glioma
58.	High Grade Glioma	Not Available	High Grade Glioma
59.	Meningioma	Meningioma	Meningioma
60.	Ependymoma	Not Available	Medulloblastoma
61.	Ependymoma	Not Available	Medulloblastoma
62.	Ependymoma	Not Available	Ependymoma
63.	Low Grade Glioma	Low Grade Glioma	Low Grade Glioma
64.	Medulloblastoma	Not Available	Low Grade Glioma
65.	High Grade Glioma	Not Available	High Grade Glioma
66.	High Grade Glioma	Not Available	High Grade Glioma
67.	High Grade Glioma	Not Available	High Grade Glioma
68.	Low Grade Glioma	Low Grade Glioma	Low Grade Glioma
69.	High Grade Glioma	High Grade Glioma	High Grade Glioma
70.	Meningioma	Meningioma	Schwannoma
71.	Medulloblastoma	Medulloblastoma	Medulloblastoma
72.	Medulloblastoma	Not Available	Low Grade Glioma
73.	Meningioma	Meningioma	Meningioma
74.	Craniopharyngioma	Not Available	Craniopharyngioma
75.	Low Grade Glioma	Not Available	Low Grade Glioma
76.	Medulloblastoma	Not Available	Medulloblastoma
77.	High Grade Glioma	Not Available	High Grade Glioma
78.	High Grade Glioma	High Grade Glioma	High Grade Glioma
79.	Meningioma	Not Available	Meningioma

Sl.No.	CT Diagnosis	MRI Diagnosis	Pathological Diagnosis
80.	Low Grade Glioma	Not Available	Haemangioblastoma
81.	Medulloblastoma	Medulloblastoma	Medulloblastoma
82.	Meningioma	Not Available	Meningioma
83.	Ependymoma	Ependymoma	Ependymoma
84.	High Grade Glioma	High Grade Glioma	High Grade Glioma
85.	Low Grade Glioma	Low Grade Glioma	Low Grade Glioma
86.	Craniopharyngioma	Craniopharyngioma	Craniopharyngioma
87.	Meningioma	Meningioma	Meningioma
88.	Low Grade Glioma	Not Available	Low Grade Glioma
89.	Medulloblastoma	Medulloblastoma	Ependymoma
90.	Meningioma	Meningioma	Meningioma
91.	Meningioma	Meningioma	Meningioma
92.	Craniopharyngioma	Craniopharyngioma	Craniopharyngioma
93.	Craniopharyngioma	Not Available	Craniopharyngioma
94.	Low Grade Glioma	Low Grade Glioma	Low Grade Glioma
95.	Craniopharyngioma	Not Available	Craniopharyngioma
96.	High Grade Glioma	Not Available	High Grade Glioma
97.	Meningioma	Meningioma	Meningioma
98.	Craniopharyngioma	Not Available	Craniopharyngioma
99.	Medulloblastoma	Not Available	Medulloblastoma
100.	High Grade Glioma	High Grade Glioma	High Grade Glioma
101.	Low Grade Glioma	Not Available	Low Grade Glioma
102.	Meningioma	Not Available	Meningioma
103.	High Grade Glioma	Not Available	High Grade Glioma
104.	Medulloblastoma	Not Available	Medulloblastoma
105.	High Grade Glioma	Not Available	High Grade Glioma
106.	Meningioma	Meningioma	Meningioma

Sl.No.	CT Diagnosis	MRI Diagnosis	Pathological Diagnosis
107.	Craniopharyngioma	Not Available	Craniopharyngioma
108.	Meningioma	Not Available	Meningioma
109.	Low Grade Glioma	Low Grade Glioma	Low Grade Glioma
110.	Meningioma	Not Available	Meningioma
111.	Meningioma	Not Available	Meningioma
112.	High Grade Glioma	Not Available	High Grade Glioma
113.	Craniopharyngioma	Not Available	Craniopharyngioma
114.	Medulloblastoma	Not Available	Medulloblastoma
115.	High Grade Glioma	High Grade Glioma	High Grade Glioma
116.	Craniopharyngioma	Not Available	Craniopharyngioma
117.	High Grade Glioma	High Grade Glioma	High Grade Glioma
118.	Medulloblastoma	Not Available	Medulloblastoma
119.	Meningioma	Not Available	Meningioma
120.	High Grade Glioma	Not Available	High Grade Glioma
121.	High Grade Glioma	Not Available	High Grade Glioma
122.	Low Grade Glioma	Low Grade Glioma	Low Grade Glioma
123.	Craniopharyngioma	Not Available	Low Grade Glioma
124.	Medulloblastoma	Medulloblastoma	Medulloblastoma
125.	Meningioma	Meningioma	Meningioma
126.	High Grade Glioma	Not Available	High Grade Glioma
127.	High Grade Glioma	Not Available	Secondaries
128.	Low Grade Glioma	Not Available	Low Grade Glioma
129.	Low Grade Glioma	Low Grade Glioma	Low Grade Glioma
130.	High Grade Glioma	Not Available	High Grade Glioma
131.	Medulloblastoma	Medulloblastoma	Medulloblastoma
132.	High Grade Glioma	High Grade Glioma	High Grade Glioma
133.	High Grade Glioma	High Grade Glioma	High Grade Glioma

Sl.No.	CT Diagnosis	MRI Diagnosis	Pathological Diagnosis
134.	Meningioma	Meningioma	Meningioma
135.	Meningioma	Meningioma	Meningioma
136.	Meningioma	Not Available	Meningioma
137.	Low Grade Glioma	Not Available	Low Grade Glioma
138.	Low Grade Glioma	Low Grade Glioma	Low Grade Glioma
139.	High Grade Glioma	Not Available	High Grade Glioma
140.	High Grade Glioma	High Grade Glioma	High Grade Glioma
141.	Medulloblastoma	Medulloblastoma	Medulloblastoma
142.	Low Grade Glioma	Low Grade Glioma	Low Grade Glioma
143.	High Grade Glioma	Not Available	High Grade Glioma
144.	Medulloblastoma	Medulloblastoma	Medulloblastoma
145.	Low Grade Glioma	Not Available	Haemangio blastoma
146.	Low Grade Glioma	Low Grade Glioma	Low Grade Glioma
147.	High Grade Glioma	Not Available	High Grade Glioma
148.	Meningioma	Not Available	Meningioma
149.	High Grade Glioma	Not Available	High Grade Glioma
150.	High Grade Glioma	Not Available	Tuberculoma
151.	High Grade Glioma	Not Available	Low Grade Glioma
152.	Medulloblastoma	Medulloblastoma	Medulloblastoma
153.	High Grade Glioma	Not Available	High Grade Glioma

RESULTS AND ANALYSIS

Table – 1

Table showing Correlation between MRI and Pathology.

MRI Diagnosis	Pathology						
	Low Grade Glioma	High Grade Glioma	Medulloblastoma	Ependymoma	Craniopharyngioma	Meningioma	Total
Low grade Glioma	15						15
High Grade Glioma	2	15					17
Medulloblastoma			10	1			11
Ependymoma				2			2
Craniopharyngioma					6		6
Meningioma						12	12
Total	17	15	10	3	6	12	63

Kappa (measure of agreement) = 94.0% ($p < 0.001$)

Table – 2

Table showing Correlation between MRI and Pathology (Including Other Diagnosis)

MRI Diagnosis	Pathology							
	Low Grade Glioma	High Grade Glioma	Medulloblastoma	Ependymoma	Craniopharyngioma	Meningioma	Others	Total
Low grade Glioma	15							15
High Grade Glioma	2	15						17
Medulloblastoma			10	1				11
Ependymoma				2				2
Craniopharyngioma		1			6			7
Meningioma						12	3	15
Not available	16	27	12	3	9	13	6	86
Total	33	43	22	6	15	25	9	153

Table – 3

Correlation between CT and Pathology

CT Diagnosis	Pathology						
	Low Grade Glioma	High Grade Glioma	Medulloblastoma	Ependymoma	Craniopharyngioma	Meningioma	Total
Low grade Glioma	25						25
High Grade Glioma	3	41					44
Medulloblastoma	2		21	1			24
Ependymoma	1		1	5			7
Craniopharyngioma	1				15		16
Meningioma	1	1				25	27
Total	33	42	22	6	15	25	143

Kappa (Measure of Agreement) = 90.3% ($p < 0.001$)

Table – 4

Correlation between CT and Pathology (Including other Diagnosis)

CT Diagnosis	Pathology							
	Low Grade Glioma	High Grade Glioma	Medulloblastoma	Ependymoma	Craniopharyngioma	Meningioma	Others	Total
Low grade Glioma	25						2	27
High Grade Glioma	3	41					3	47
Medulloblastoma	2		21	1				24
Ependymoma	1		1	5				7
Craniopharyngioma	1	1			15			17
Meningioma	1	1				25	4	31
Total	33	43	22	6	15	25	9	153

Table – 5

Low Grade Glioma

CT Vs Pathology

CT Diagnosis	Pathology Confirmed	Agreement %
27	25	92.59%

Table – 6

Low Grade Glioma

MRI Vs Pathology

MRI Diagnosis	Pathology Confirmed	Agreement %
15	15	100%

Table 7

Low Grade Glioma – Positive percentage

CT Diagnosis	MRI Diagnosis
92.59%	100%

Table – 8

High Grade Glioma

CT Vs Pathology

CT Diagnosis	Pathology Confirmed	Agreement %
47	41	87.23%

Table – 9

High Grade Glioma

MRI Vs Pathology

MRI Diagnosis	Pathology Confirmed	Agreement %
17	15	88.24%

Table – 10

High Grade Glioma - Positive Percentage

CT Diagnosis	MRI Diagnosis
87.23%	88.24%

Table – 11

Medulloblastoma

CT Vs Pathology

CT Diagnosis	Pathology Confirmed	Agreement %
24	21	87.5%

Table – 12

Medulloblastoma

MRI Vs Pathology

MRI Diagnosis	Pathology Confirmed	Agreement %
11	10	90.91%

Table – 13

Medulloblastoma – Positive Percentage

CT Diagnosis	MRI Diagnosis
87.5 %	90.94%

Table – 14

Ependymoma

CT Vs Pathology

CT Diagnosis	Pathology Confirmed	Agreement %
7	5	71.43%

Table – 15

Ependymoma

MRI Vs Pathology

MRI Diagnosis	Pathology Confirmed	Agreement %
2	2	100%

Table – 16

Ependymoma - Positive Percentage

CT Diagnosis	MRI Diagnosis
71.43 %	100 %

Table – 17

Craniopharyngioma

CT Vs Pathology

CT Diagnosis	Pathology Confirmed	Agreement %
17	15	88.24%

Table – 18

Craniopharyngioma

MRI Vs Pathology

MRI Diagnosis	Pathology Confirmed	Agreement %
7	6	85.71%

Table – 19

Craniopharyngioma – Positive Percentage

CT Diagnosis	MRI Diagnosis
88.24 %	85.71%

Table – 20

Meningioma

CT Vs Pathology

CT Diagnosis	Pathology Confirmed	Agreement %
31	25	80.65%

Table – 21

Meningioma

MRI Vs Pathology

MRI Diagnosis	Pathology Confirmed	Agreement %
15	12	80%

Table – 22

Meningioma – Positive Percentage

CT Diagnosis	MRI Diagnosis
80.65%	80.00%

Table – 23

MRI Correlation for the Selected Tumours

MRI	Positive	Negative
Low Grade Glioma	100.00	0.00
High Grade Glioma	88.24	11.76
Medulloblastoma	90.91	9.09
Ependymoma	100.00	0.00
Craniopharyngioma	85.71	14.29
Meningioma	80.00	20.00

Table – 24

CT Correlation for the Selected Tumours

CT	Positive	Negative
Low Grade Glioma	92.59	7.41
High Grade Glioma	87.23	12.77
Medulloblastoma	87.50	12.50
Ependymoma	71.43	28.57
Craniopharyngioma	88.24	11.76
Meningioma	80.65	19.35

Table – 25

Correlating CT Diagnosis with MRI Diagnosis

CT Diagnosis	MRI Diagnosis							
	Low Grade Glioma	High Grade Glioma	Medulloblastoma	Ependymoma	Craniopharyngioma	Meningioma	Not Available	Total
Low grade Glioma	15						12	27
High Grade Glioma		16					31	47
Medulloblastoma			11				13	24
Ependymoma				2			5	7
Craniopharyngioma					7		10	17
Meningioma		1				15	15	31
Total	15	17	11	2	7	15	86	153

Significance of the difference in measures of agreement between CT and MRI

Table – 26

For Low Grade Glioma

CT	MRI
25	15
2	0
27	15

Not Significant

Table – 27

For High Grade Glioma

CT	MRI
41	15
6	2
47	17

Not Significant

Table – 28

For Medulloblastoma

CT	MRI
21	10
3	1
24	11

Not Significant

Table – 29

For Ependymoma

CT	MRI
5	2
2	0
7	2

Not Significant

Table – 30

For Craniopharyngioma

CT	MRI
15	6
2	1
17	7

Not Significant

Table – 31

For Meningioma

CT	MRI
25	12
6	3
31	15

Not Significant

Radiological Wrong Diagnosis

Table – 32

Wrong Radiological Diagnosis for Low grade glioma

Group –1 - CT

Wrong Diagnosis	Case No.	Total
Haemangioblastoma	80 and 145	2
Total		2

Table – 33

Group – 2 - MRI

Wrong Diagnosis	Nil
Total	Nil

Table – 34

Wrong Radiological Diagnosis for High Grade Glioma

Group – 1 -CT

Wrong Diagnosis	Case No.	Total
Low Grade Glioma	14, 52 and 151	3
Abscess	15	1
Secondaries	127	1
Tuberculoma	151	1
Total		6

Table – 35

Group – 2 - MRI

Wrong Diagnosis	Case No.	Total
Low Grade Glioma	14 and 52	2
Total		2

Table – 36

Wrong Radiological Diagnosis for Medulloblastoma

Group – 1 -CT

Wrong Diagnosis	Case No.	Total
Low Grade Glioma	64 and 72	2
Ependymoma	89	1
Total		3

Table –37

Group – 2 - MRI

Wrong Diagnosis	Case No.	Total
Ependymoma	89	1
Total		1

Table –38

Wrong Radiological Diagnosis for Ependymoma

Group – 1 - CT

Wrong Diagnosis	Case No.	Total
Low Grade Glioma	53	1
Medulloblastoma	60	1
Total		2

Table –39

Group – 2 - MRI

Wrong Diagnosis	Nil
Total	Nil

Table –40

Wrong Radiological Diagnosis for Craniopharyngioma

Group - 1 - CT

Wrong Diagnosis	Case No.	Total
High Grade Glioma	21	1
Low Grade Glioma	123	1
Total		2

Table –41

Group – 2 - MRI

Wrong Diagnosis	Case No.	Total
High Grade Glioma	21	1
Total		1

Table – 42

Wrong Radiological Diagnosis for Meningioma

Group – 1 - CT

Wrong Diagnosis	Case No.	Total
Tuberculoma	6 and 38	2
High Grade Glioma	7	1
Secondaries	18	1
Low Grade Glioma	30	1
Schwannoma	70	1
Total		6

Table – 43

Group – 2 - MRI

Wrong Diagnosis	Case No.	Total
Tuberculoma	6 and 38	2
Schwannoma	70	1
Total		3

Table 44

CT Diagnosis Malignant –Vs Benign

CT Diagnosis	Pathology				Total	
	Malignant		Benign			
	Count	%	Count	%	Count	%
Malignant	101	95.28	4	8.51	105	68.63
Benign	5	4.72	43	91.49	48	31.37
Total	106	100.00	47	100.00	153	100.00

Table 45

MRI Diagnosis Malignant –Vs Benign

MRI	Pathology				Total	
	Malignant		Benign			
	Count	%	Count	%	Count	%
Malignant	45	97.83			45	67.16
Benign	1	2.17	21	100.00	22	32.84
Total	46	100.00	21	100.00	67	100.00

Table 46

Positivity Agreement for Malignant Lesions CT Vs MRI

CT	MRI
95.28	97.83

Table 47

Positivity Agreement for Benign Lesions CT Vs MRI

CT	MRI
91.49	100

Table 48

Correlation between CT and MRI for the Group II Patients

CT	MRI	%
67	66	98.50

DISCUSSION

GROUP I PATIENTS - CT BRAIN

The pathological evaluation for the 153 patients were as follows:

Low Grade gliomas	-	33
High grade Gliomas	-	43
Medulloblastoma	-	22
Ependymoma	-	6
Craniopharyngioma	-	15
Meningioma	-	25
Others	-	9
Tuberculoma	-	3
Abscess	-	1
Secondaries	-	2
Schwannoma	-	1
Haemangioblastoma	-	2

GROUP II: PATIENTS - MRI BRAIN

The pathological evaluation for the 67 patients were as follows:

Low Grade gliomas	-	17
High grade Gliomas	-	16

Medulloblastoma	-	10
Ependymoma	-	3
Craniopharyngioma	-	6
Meningioma	-	12
Others	-	3
Tuberculoma	-	2
Schwannoma	-	1

Among group II patients, of the 15 patients with a radiological diagnosis of Low grade glioma, all the 15 has been reported as low grade glioma in histopathology study giving a measure of agreement of 100% for MRI (Table 6).

Among group I patients, of the 27 patients with a radiological low grade glioma diagnosis, 25 were low grade glioma on pathological examination, and the remaining two, were reported as haemangioblastomas. The measure of agreement was 92.59%, when compared with the 100% for MRI. The difference was not statistically significant (Table 25). The only radiological wrong diagnosis for low grade glioma among Group I patients was haemongioblastomas occurring in both patients, Cases No. 80, 145 (Table 32).

For the 47 patients in Group I with a radiological appearance of high grade glioma, 41 were reported as high grade glioma with a positive measure of 87.23% (Table 8). Among the different pathological diagnosis, three were low grade gliomas, (Cases No. 14, 52, 151), one was an abscess (case no. 15), one

secondaries brain (case no.- 127) and one was a tuberculoma (case no.151), having a common radiological wrong diagnosis of low grade glioma occuring 50% (Table 34).

As per table (9), a positive measure of 88.24 was found among Group II patients which was not significant when compared with group I patients (Table 26). Among the two radiological wrong diagnosis both were low grade gliomas cases 14 and 52 (Table 35).

So, low grade gliomas were the commonest radiological wrong diagnosis encountered in both group I and group II patients.

On evaluating the correlation for medulloblastoma, group one had 87.5% Table (11) agreement as against 90.9% for Group II patients Table (11). Among Group I, Low grade glioma was the common radiological wrong diagnosis with two out of three cases (Case No. 64 and 72), the other being an ependymoma (Case No. 89, Table 36). In group II, the only radiological wrong diagnosis was an ependymoma (Case No.89, Table 37) which occurred in Group I also. The agreement percentage between Group I and Group II patients was not significant statistically (Table 27).

The measure of agreement of Group I was 71.43% among the 7 patients (Table 14) as compared with 100% for Group II patients (Table 15) among ependymoma. But statistically considering, the difference was not significant (Table 28).

The two patients with radiological wrong diagnosis in the Group I were one low grade glioma-(Case No. 53) and one medulloblastoma-(Case No. 60, Table 38).

On considering craniopharyngioma there was a positive measure of 88.24% for Group I (Table 17) and 85.71% for Group II (Table 18) with the difference of agreement measure being not significant (Table 29).

The two radiological wrongly diagnosed lesions in Group I were one high grade astrocytoma (Case No. 21), and the other was a low grade glioma (Case No. 123 Table 40).

In group II the radiological wrongly diagnosed case was a high grade astrocytoma Case No. 21 as in Group I (Table 41).

On evaluating Meningioma, the positive measure of Group I was 80.65 (Table 20) and for Group II it was 80.00 (Table 21).

In Group I, among the six radiologically wrong diagnosis for meningiomas there were two-tuberculomas, one - high grade glioma, one-secondaries brain, one - low grade glioma and a schwannoma, resulting in a wide spectrum of varied diagnosis when compared with all other tumors which had a very frequently occurring radiological wrong diganosis (Table 42).

In Group II, there were two tuberculomas and one schwannoma, the same cases that occurred in group I also (Table 43).

The measure of agreement between the two groups was not significant (Table 30).

Among the above results group II had higher correlation percentage when compared with Group I for all tumours except Craniopharyngioma and meningioma although the differences were marginal and not significant (Tables 22 and 23).

Overall group II had a kappa value of 94% ($p<0.001$) where kappa is a measure of agreement.

Group I had a kappa value of 90.3% ($p < 0.001$)

On considering meningioma and craniopharyngioma as benign lesions and the remaining four as malignant, the positive predictive value for Group II was 97.83 for malignant and 100% for Benign, slightly higher than that of Group I patients with 95.28 in malignancies and 91.49 for benign lesions. Considering these two groups statistically, it was not significant (Tables 44 and 45).

Among wrong diagnosis, Haemangioblastoma occurred in two patients when radiologically it was diagnosed as low grade gliomas and both cases on CT only.

The maximum radiological wrong diagnosis occurred in both High grade gliomas and meningioma patients among group I patients. Low grade gliomas occurring often in Group I and tuberculomas in Group II and all the frequent radiological wrong diagnosis occurred in Group II, with the same frequency as in group I.

Secondaries were reported in two cases one each in high grade glioma and Meningioma group among group I patients.

Among radiologically diagnosed meningiomas, tuberculoma occurred in two cases followed by schwannoma, secondaries, high grade glioma and low grade glioma once each. Interestingly both the tuberculomas were enplaque varieties, when both the radiological diagnosis were enplaque meningiomas.

Abscess and schwannoma occurred once each as pathological diagnosis when radiological diagnosis of the former was High grade glioma and the latter was meningioma. The latter especially belonging to Group II.

Low grade glioma occurred as pathological diagnosis for both radiologically diagnosed ependymona and medulloblastoma with no statistical significance.

Finally considering correlation among CT and MRI, the radiological diagnosis differed only once among 67 patients, (Case No.7) when MRI diagnosed High grade glioma and CT appearance resembled a meningioma. But, Pathologically it was a high grade glioma. The measure of agreement between CT and MRI as far as radiological diagnosis was concerned was 98.50, which showed not much of difference between the two common modes of investigations available, although CT has high affordability when compared with MRI.

CONCLUSION

In all groups MRI had a higher or equal predictive value when compared to CT but statistically not significant.

MRI had a higher predictive value for benign lesions than CT brain.

Malignant lesions had more or less equal value for both CT and MRI.

Haemangioblastomas occurred as a common pathological correct diagnosis for CT diagnosed low grade glioma cases whereas all MRI diagnosed low grade gliomas were pathologically correct. Hence in CT Brain suggestive of low grade glioma, Haemangioblastoma should be considered as a close differential diagnosis.

Low grade glioma was a common histological diagnosis for all the remaining tumours diagnosed radiologically as high grade glioma, medulloblastoma, ependymoma and Craniopharyngioma except meningioma in both Group I and II patients. So low grade glioma is an important differential diagnosis for all the intrinsic tumours.

Two enplaque meningiomas diagnosed radiologically, both were pathologically proved to be enplaque tuberculomas. Meningioma and high grade glioma were associated with higher number of radiological wrong diagnosis for a variety of lesions occurring in six cases each. So meningioma and high grade gliomas had the least measure of agreement in both the groups.

The agreement value between CT and MRI is 98.5%. Although MRI had a higher kappa value than CT, the difference was marginal. When considering the cost, affordability and availability, though CT is slightly inferior to MRI, it is still comparable with MRI as far as pathological diagnostic aspect alone is considered.

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