Computerised Tomography Features in Gliomas

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Abstract

106 cases of intracranial tumours were evaluated, out of which 42 cases (39.6%) were histologically confirmed as gliomas. Computerised tomography (CT) imaging characteristics of glioma were studied with respect to morphology and contrast enhancement to find a possible correlation between CT appearance and the grade of malignancy. It was found that there is a range of patterns both before and after intravenous contrast, which allows an assessment of grading of the tumour with a fair degree of reliability.

Introduction

Primary cerebral gliomas are the largest single group (40-45%) of all intracranial tumours [1]. They are derived from glial cells which are of three basic types : astrocytic, ependymal, and oligo-dendrocytic. In addition epithelial lining of choroid plexus which is derived from the ependyma may be considered a fourth type of glial cell. Among these, astrocytic neoplasms are the commonest.

Gliomas can occur at any site in both children and adults, but gliomas of the optic chiasma and the brain-stem are particularly common in children, where they have a peak incidence at one to six years and one to four years of age respectively. Cerebellar astrocytoma is also common in children, with a peak incidence at five to ten years. In adults, the age group commonly affected is 30-65 years and supratentorial gliomas outnumber posterior fossa gliomas by a ratio of 7:3 [2]. CT plays an important role in the diagnosis of these tumours and differentiating them from other intracranial space occupying lesions. CT remains the initial modality of choice for assessment of intracranial space occupying lesions. The aim of this study was to find a possible correlation between CT appearances and the grade of malignancy of gliomas.

Material and Methods

Patients attending the service hospital, suspected of having intracranial space occupying lesions clinically were subjected to both plain and contrast CT. Each case was examined in detail with particular reference to history and symptoms followed by plain and contrast CT of head which were analysed systematically for : a) normal anatomical landmarks, b) size and shape of ventricular system, c) pre-contrast morphology of the lesion with reference to site, size, number, satellite lesions, density, mass effect, surrounding edema and intratumoral calcifications, d) postcontrast morphology and pattern of enhancement and e) associ-ated bony changes.

Results

Out of 106 cases of intracranial tumours studied, 42 cases (39.6%) were histologically confirmed to be gliomas. 34 (32%) cases were other primary tumours and 30 (28.3%) cases were metastatic tumours (Fig 1). Peak incidence of 33.3% cases was found in 31-40 years age group. Second peak (23.8%) was found in 51-60 years age group (Table-1). The commonest histological type was low grade astrocytoma in 31% cases, followed by glioblastoma multiforme in 28.6% cases (Table-1). Majority (81%) of the lesions were hypodense (Table-2). 42.8% of cases showed rim enhancement, 26.2% of cases revealed no enhancement following contrast administration (Table- 3). Intratumoral calcification was found in 16.6% of cases (Table-4). Majority of cases (81%) showed perilesional edema and 19% of cases had no surrounding edema (Table 5). 88% of cases were associated with evidence of mass effect and 12% of cases had no obvious mass effect (Table-6).

Discussion

Incidence of gliomas in this study was 39.6% whereas Russell [1] found the incidence of cerebral gliomas to be 40-45%. In adults, commonest histological type was low grade astrocytoma (31%) followed by glioblastoma multiforme (28.6%), whereas in children, pilocytic astrocytoma, ependymoma and choroid plexus papilloma were found to be more common (Table-1). According to a study by Rees [3] in 1996, glioblastoma was the commonest tumour in adults. These differences could well be explained by the fact that the service hospitals attend to a clientele which is generally young and the stringent policy of routine medical examination of all service personnel leads to early detection of any disease process.

The majority of the gliomas presented as low attenuating lesions with exception of ependymoma and choroid plexus papilloma, and two cases each of grade

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TABLE 1

Age and grade wise Incidence

Age (in years)	Pilocytic astrocytoma	Low grade astrocytoma	Anaplastic-astrocytoma	Glioblastoma multiforme	Oligodendro-glioma	Ependymoma	Choroid plexus papilloma	Total (% in parenthesis)
0-10	02	00	00	00	00	01	01	04 (9.53)
11-20	01	00	00	00	00	01	00	02 (4.77)
21-30	00	02	01	01	00	00	00	04 (9.53)
31-40	00	08	03	02	01	00	00	14 (33.3)
41-50	00	00	02	02	01	00	00	05 (11.9)
51-60	00	02	02	05	01	00	00	10 (23.8)
61-70	00	01	00	02	00	00	00	03 (7.14)
Total	03	13	08	12	03	02	01	42
%	7.1	31	19	28.6	7.1	4.8	2.4	100

TABLE 2

CT densities of intracranial gliomas

Type	Decreased	Increased	Isodense
Grade I gliomas	03	00	00
Grade II astrocytoma	11	02	00
Grade III anaplastic astrocytoma	07	01	00
Grade IV glioblastoma multiforme	10	02	00
Oligodendroglioma	03	00	00
Ependymoma	00	01	01
Choroid plexus papilloma	00	01	00
Total	34	07	01

TABLE 3

Contrast enhancement

Type	Rim enhancement	Non homogeneous	Homogeneous	None
Grade I gliomas	02	00	00	01
Grade II astrocytoma	01	03	00	09
Grade III anaplastic astrocytoma	02	04	01	01
Grade IV glioblastoma multiforme	10	02	00	00
Oligodendroglioma	03	00	00	00
Ependymoma	00	01	01	00
Choroid plexus papilloma	00	00	01	00
Total	18	10	03	11

TABLE 4

Intratumoral calcification

Type	Present	Absent
Grade I gliomas	00	03
Grade II astrocytoma	02	11
Grade III anaplastic astrocytoma	01	07
Grade IV glioblastoma multiforme	00	12
Oligodendroglioma	03	00
Ependymoma	01	01
Choroid plexus papilloma	00	01
Total	07	35

TABLE 5

Vasogenic edema

Type	Mild	Moderate	Marked	None
Grade I gliomas	03	00	00	00
Grade II astrocytoma	05	01	00	07
Grade III anaplastic astrocytoma	02	05	01	00
Grade IV glioblastoma multiforme	20	4	06	00
Oligodendroglioma	02	01	00	00
Ependymoma	02	00	00	00
Choroid plexus papilloma	00	00	00	01
Total	16	11	07	08
%	38.1	26.2	16.7	19.0

II and grade IV and one case of grade III astrocytoma which showed increased density either due to haemorrhage or calcification. The well defined, rounded, low density lesion of the pilocytic astrocytoma (Fig-2) was distinctly different in appearance from the poorly defined low density lesion seen in low grade and anaplastic astrocytoma (Fig-3). Though the low density of low grade glioma can be confused with infarct, clinical presentation and careful examination can help in arriving at an accurate diagnosis.

The enhancement in the neoplasm in CT scan after intravenous contrast administration is thought to be due to increased tumour vascularity and disruption of the blood-brain barrier [4]. Post contrast CT scan is required for better visualisation of the tumour itself and to demarcate it from the surrounding edema. The appearance of the enhancement pattern may be highly characteristic and enable us to predict the grade of malignancy of the glioma with confidence.

Enhancement in a ring like fashion with thick irregular margins surrounding a central area of low density was never present in low grade and anaplastic astrocytoma and is virtually diagnostic of glioblastoma

TABLE 6

Mass effect

Type	Marked	Moderate	Slight	None
Grade I gliomas	00	01	02	00
Grade II astrocytoma	00	01	07	05
Grade III anaplastic astrocytoma	02	04	02	00
Grade IV glioblastoma multiforme	07	05	00	00
Oligodendroglioma	00	01	02	00
Ependymoma	00	01	01	00
Choroid plexus papilloma	00	01	00	00
Total	09	14	14	05
%	21.4	33.3	33.3	12
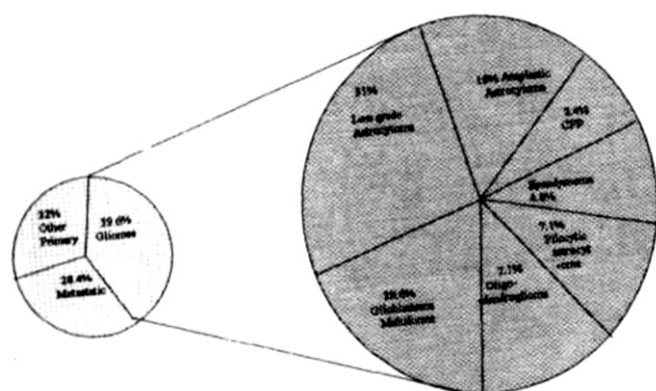
Fig. 1 :   Incidence of intracranial tumours

multiforme (Fig-4). Homogenous enhancement of the lesion may occur in any group and is a non-specific finding. The enhanced mural nodule in the wall of a cystic lesion with decreased density [5] is quite suggestive of pilocytic astrocytoma. Complete absence of enhancement may occur in any group, particularly in very cellular and avascular lesions.

In the present day scenario of aggressive approach for arriving at an early diagnosis, the presence of calcification should always raise the suspicion of oligodendroglioma. All cases of oligodendroglioma in this study showed evidence of intratumoral calcification (Table-4). Vonofakos et al found intratumoral cal-

Fig. 3 :   Axial CECT reveals a non enhancing low attenuating area (arrow) in the left frontal lobe with no mass effect in a case of low grade astrocytoma
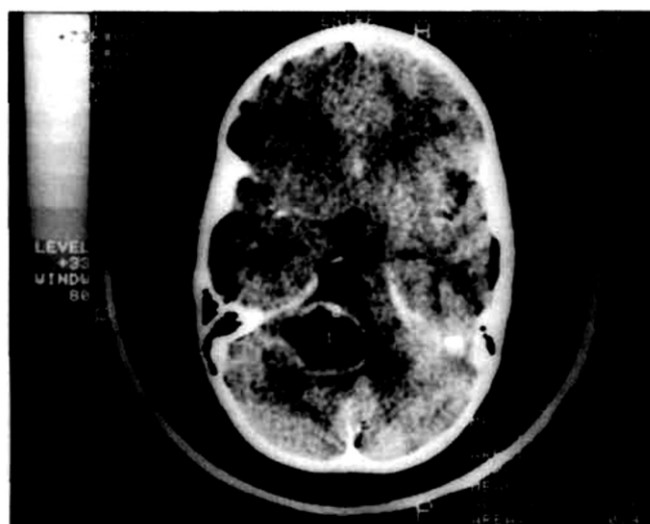

Fig. 2 :   Axial contrast enhanced CT showing well defined low density lesion with rim enhancement in a case of pilocytic
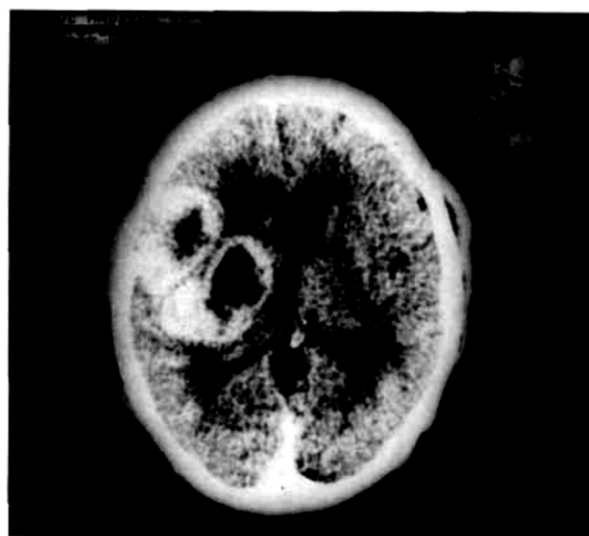

Fig. 4 :   Axial CECT showing thick irregular peripherally enhancing lesion with central necrosis, surrounding edema and mass effect in a case of glioblastoma multiforme

Fig. 5 : Axial non contrast CT showing hypodense area in the right frontal lobe with eccentric nodular calcification in oligodendroglioma

cification in 90% of cases [6]. The pattern commonly seen in oligodendroglioma was of nodular calcification (Fig-5) which can be mimicked by low grade glioma. The calcification in a lesion arising in the fourth ventricle especially in children should raise the possibility of ependymoma or choroid plexus papilloma. Choroid plexus papilloma occurs primarily within the first two years of age. The lateral and third ventricles are affected more frequently in children under two years (Fig-6), while the fourth ventricle is more often affected in adolescents [7,8].

Posterior fossa tumours generally caused obstructive hydrocephalus and supratentorial lesions generally resulted in effacement of ipsilateral lateral ventricles with shift of midline structures.

Vasogenic edema was a feature of all the grades of gliomas except the low grade glioma, which can present without any perilesional edema (Table-5) and lead to confusion with infarct (Fig-2). But the useful clinical sign described by Scally [9] in diagnosing low grade glioma can be helpful in arriving at a diagnosis. It consists simply of observing whether the patient moves on to the CT table of his own accord. This indicates the diagnosis of a low grade astrocytoma rather than infarction, cerebritis or oedema of another cause.

Mass effect is produced by all grades except the low grade gliomas, which can sometimes present without any appreciable mass effect (Table-6). Mass effect was commonest and more pronounced in cases of glioblastoma (Fig-3). Oligodendroglioma and low grade astrocytomas had minimal mass effect com-

Fig. 6a & b : Axial NCCT & CECT in a child reveals a large lobulated densely enhancing mass arising from the roof of the third ventricle with resultant hydrocephalus

pared to other grades. Mass effect has no relation with the grade of malignancy as the large cystic astrocytoma can also produce an appreciable mass effect.

In most cases, diagnosis of glioma can be made on the CT imaging in conjunction with the clinical history. Increasing experience and expertise indicates that there is a range of patterns on CT both before and after intravenous enhancement, which allows an assessment of the grading of the tumour with fair degree of reliability. Presently magnetic resonance imaging (MRI) is considered superior to CT in detecting and localizing tumours due to its multiplanar capability and better characterization of lesion in various sequences. But it lags behind CT in detection of calcification, which is of diagnostic importance in the differential diagnosis

of brain tumours. In detecting acute intratumoral bleed CT is again considered superior to MRI.

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