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Multidetector Computerized Tomography Versus Magnetic Resonance Imaging in Diagnosis of Basal Ganglia Signal Intensity Alteration

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ABSTRACT

Background: the basal ganglia are part of the extrapyramidal motor system, participating in the production of movement, but they are also involved in memory, emotion, and other cognitive functions.

Objective: This work aimed to study the role of multidetector computerized tomography versus magnetic resonance imaging in diagnosis of basal ganglia signal intensity alteration with highlight on accuracy, sensitivity, specificity of each tool in reaching the proper diagnosis.

Patients and Methods: this study was designed to examine the effectiveness of both computed tomography and magnetic resonance imaging in diagnosis of different basal ganglia lesions. It included 50 patients, selected from Al-Azhar University hospital.

Results: sensitivity of CT in diagnosis of basal ganglia lesion was 86.0%, and failed to elicit diagnosis in 14.0% of patients. There was no significant difference between males and females. MRI sensitivity in diagnosis of basal ganglia lesions was 92%, while it was unable to diagnose 4.0%. There was no significant difference between males and females (the sensitivity in males was 94.7% and in females, it was 83.3%).

Conclusion: MRI is superior to CT for diagnosis of different basal ganglia lesions, except for senile calcification, where CT was superior to MRI. However, CT presents a considerable sensitivity. Thus, it is advisable to start with CT examination to avoid high cost of MRI, otherwise start with MRI when the cost is not a matter or the condition is not in an emergency situation. In such emergent situations, MRI must be used as a first choice.

Keywords: CT, MRI, Basal Ganglia.

INTRODUCTION

The basal ganglia consist of a group of related subcortical nuclei, which, together, are responsible for multiple brain functions. Primarily, the function of the basal ganglia is to control and regulate volitional movement to ensure smooth performance. However, there are multiple other functions of the basal ganglia, including procedural learning, routine behaviors, and contributions to cognition and emotion. Anatomically, the basal ganglia are composed of several nuclei: the striatum (consisting of the caudate nucleus, putamen, and nucleus accumbens), the globus pallidus, the substantia nigra, and the subthalamic nucleus. Functionally, the basal ganglia have considerable connections to the cerebral cortex, thalamus, and brain stem; in fact, anatomists consider portions of the thalamus as components of the basal ganglia [(1)].

Most of the basal ganglia are well-demonstrated on cross sectional imaging. Non-contrast CT shows the caudate, putamen, and globus pallidus as having relatively high attenuation compared with white matter. The substantia nigra Most of the basal ganglia are well-demonstrated on cross sectional imaging. Non-contrast CT shows the caudate, putamen, and globus pallidus as having relatively high attenuation compared with white matter. The substantia nigra and the subthalamic nuclei are not as clearly depicted on CT. On MR imaging, the caudate and putamen generally follow cortical gray matter signal intensity. In the healthy adult, the globus pallidus, subthalamic nucleus, and substantia nigra often appear relatively hypointense to cortical gray matter on T2WI, due to higher iron concentration. In a young patient, the substantia nigra is hyperintense on T2WI. With increasing age and higher iron content, there is increasing susceptibility of the substantia nigra on gradient called echo T2 [(2)].

CT and MR imaging are complementary studies, each with unique advantages. CT is the most commonly performed brain imaging and demonstrates calcification, acute hemorrhage, prior ischemic injury, and volume loss. CT is useful in patients with non-MR imaging–compatible implantable devices, including subthalamic and brain stem stimulators in patients with movement disorders. MR imaging is advantageous in delineating anatomy and demonstrating signal-intensity alteration[(3)].

Systemic and metabolic abnormalities often involve the basal ganglia or thalamus on both sides and careful assessment of brain abnormalities occurring simultaneously outside these structures is important [(4)]. In many cases, MRI alone does not usually allow to establish diagnosis, even with its high capability of tissue characterization, but

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together with the knowledge of age and circumstances of onset and clinical course of the disease is a powerful tool of differential diagnosis[5].

AIM OF THE WORK

This work aims to study the role of multidetector computerized tomography versus magnetic resonance imaging in diagnosis of basal ganglia signal intensity alteration with highlight on accuracy, sensitivity, specificity of each tool in reaching the proper diagnosis.

PATIENTS AND METHODS

This prospective study was carried out on fifty (50) patients, 38 male and 12 female. Their age ranged between 8 months and 70 years (mean age 52.29 years). The patients were referred to Radiodiagnosis department in AlAzhar University Hospital (New Damietta), from Neurology and outpatients clinics for role out suspected basal ganglia lesions at the period from February 2016 to January 2019. **The study was approved by the Ethics Board of Al-Azhar University.**

All patients were subjected to the followings:

1. **Detailed history** including personal data, history of the present complain and any related past history.
2. **Clinical and neurological examination** (done by the referring clinician).
3. **Laboratory investigations as**: Serum creatinine, complete blood picture, serum blood glucose, liver function tests, bleeding profile, PH, tumor markers.
4. **Imaging**:

→ Firstly explanation of the examination to all patients.

***Multidetector CT brain examination:**

- CT brain study was carried out by using 160 multidetected scanner (Aquilion PRIME, Toshiba Medical System).
- At least axial non-contrast CT brain, other reformatted plane & IV contrast administration were done according to need.
- Axial section images (1.25 mm slice thickness), with a high spatial frequency reconstruction algorithm.
- On an MDCT scanner, volumetric acquisition of high-resolution CT data sets was performed in the supine position.
- The slices were sent to the workstation, where MRP images were obtained in axial, coronal, and sagittal planes whenever needed.
- CT brain post intravenous water soluble non ionic contrast media administration (1 mal/kg of body weight) was obtained according to the need.
- Shaded surface display (SSD) images were obtained in front, back, right, left, top, bottom, and oblique views when needed (according to the findings from the original images).

***MRI brain examination:**

Brain MRI study was carried out by using PHILIPS (achiva; 1.5T) using the standard head coil.

The 3 orthogonal planes, including T1, T2, and DWI were obtained. In addition, fluid-attenuated inversion recovery (FLAIR)–weighted images. T1-weighted images after intravenous gadolinium-based contrast material administration (0.1 mmol/kg of body weight) was obtained according to the need.

The patients' heads were positioned in a vacuum pillow to avoid head mal-rotation with the following parameters:

Patient Entry: Head First.

Patient Position: Supine.

Coil Configuration: Head coil.

All patients were subjected to the following MRI protocols:

- Axial T1 weighted image utilizing the following parameters: A repetition time (TR) of 400-500 m sec, an echo time (TE) of 15 m sec, TI of 2000 m sec, a slice thickness of 5 mm and FOV= 230 mm.
- Axial T2 weighted image utilizing the following parameters: A repetition time (TR) of 4000 m sec, an echo time (TE) of 100 m sec, a slice thickness of 5 mm, FOV= 230 mm.
- Axial FLAIR utilizing the following parameters: A repetition time (TR) of 6000 m sec, an echo time (TE) of 120 m sec, TI of 2000 m sec, a slice thickness of 5 mm and FOV= 230 mm.
- 4. Axial DWI utilizing the following parameters: A repetition time (TR) of 1000 m sec, an echo time (TE) of 100 m sec, TI of 2000 m sec, a slice thickness of 5 mm and FOV= 230 mm.

Image analysis:

- Identify the lesion.
- Identify being unilateral or bilateral.
- Identify the affected basal ganglia nuclei.
- The symmetry of the nuclear affection.
- Identifying the abnormalities in signal or density.
- Look for the presence or absence of other associated radiological abnormalities of the brain.

Statistical analysis of data:

The collected data were analyzed by statistical package for social science (SPSS) version 20 (SPSS Inc., Chicago, USA). Numerical variables were presented as arithmetic mean and standard deviation when data were distributed normally, otherwise, the median was calculated for non-normally distributed data. Categorical variables were

presented as relative frequency and percent distribution. For comparison between groups, p value < 0.05 was considered significant, and appropriate tests were used (independent samples student (t) test, ANOVA or Mann-Whitney tests for numerical variables and Chi square for categorical data).

RESULTS

Table (1): Age and sex distribution among studied populations

		Statistic
Age	Mean	52.29
	Median	57.00
	SD	16.81
	Minimum	0.667 (8 months)
	Maximum	70.00
Sex	Male	38 (76.0%)
	Female	12(24.0%)

In the present study, age ranged from 8 months to 70 years; the mean age was 52.29 years, while the median age was 57.0 years. Males represented by 38 patients (76%) while females represented by 12 patients (24%) of studied populations.

Table (2): Multidetector computed tomography findings among studied populations

CT Density		Sex				Total	
		Male		Female			
		n	%	n	%	n	%
	No abnormality	3	7.9%	1	8.3%	4	8.0%
	Hypodensity	24	63.2%	6	50.0%	30	60.0%
	Hyperdensity	11	28.9%	5	41.7%	16	32.0%
P value		0.70					

As regard the results of multidetector computed tomography findings, 4 patients (8.0% of patients) had no abnormality, 30 patients (60.0% of patients) showed basal ganglia hypodensity, and 16 patients (32% of patients) showed basal ganglia hyperdensity; and there was no significant difference between males and females.

Table (3): Pattern of enhancement on multidetector computed tomography among studied populations

		Sex				Total (13)	
		Male (6)		Female (7)			
		n	%	n	%	n	%
CT with contrast	Negative	4	50.0%	1	50.0%	5	50.0%
	Mild Homogenous	3	37.5%	0	.0%	3	30.0%
	Marginal	1	12.5%	1	50.0%	2	20.0%
P value		0.39					

As regard the pattern of enhancement (intravenous contrast administration was done in 10 patients), it was negative in 5 patients (50%), revealed mild homogeneous in 3 lesions (30.0%), and marginal in 2 patients (20%). There was no significant difference between males and females. (All patients needed contrast were hypodense in CT).

Table (4): T1 WI signal pattern among studied populations

	Sex				Total	
	Male		Female			
	n	%	n	%	n	%
Low signal	20	52.6%	6	50.0%	26	52.0%
High signal	11	28.9%	4	33.3%	15	30.0%
Iso signal	4	10.5%	0	0.0%	4	8.0%
No abnormal signals	2	5.3%	2	16.7%	4	8.0%
Heterogenous	1	2.6%	0	0.0%	1	2.0%
P value	0.53					

As regard to the results on T1 WI, the signals were low signal in 26 patients (52% of patients), high signal in 15 patients (30% of patients), iso intense signal in 4 patients (8% of patients), no abnormal signals in 4 patients

(8% of patients), heterogenous in 1 patient (2% of patients), and there was no significant difference between males and females as regard to T1 signal intensity.

Table (5): T2 WI signal pattern among studied populations

	Sex				Total	
	Male		Female			
	n	%	n	%	n	%
High signal	26	68.4%	8	66.7%	34	68.0%
Iso signal	6	15.8%	2	16.7%	8	16.0%
No Abnormal signal	2	5.3%	2	16.7%	4	8.0%
Low signal	3	7.9%	0	0.0%	3	6.0%
Heterogenous	1	2.6%	0	0.0%	1	2.0%
P value	0.60					

As regard the results on T2 WI, the signals were high signal in 34 patients (68% of patients), low signal in 3 patients (6% of patients), iso intense signal in 8 patients (16% of patients), no abnormal signals in 4 patients (8% of patients), heterogenous in 1 patient (2% of patients), and there was no significant difference between males and females as regard to T2 WI signal intensity.

Table (6): MRI diffusion pattern among studied populations

MRI diffusion		Male		Female		Total	
		n	%	n	%	n	%
	Not restricted	30	78.9%	9	75.0%	39	78.0%
	Restricted	8	21.1%	3	25.0%	11	22.0%
P value		0.77					

As regard to the MRI diffusion pattern, it was restricted in 11 patients (22% of patients) and not-restricted in 39 patients (78% of patients) and there was no significant difference between males and females.

Table (7): Mass effect in CT and MRI images among studied populations

		Male		Female		Total	
		n	%	n	%	n	%
Mass effect	Positive	11	28.9%	3	25.0%	14	28.0%
	Negative	27	71.1%	9	75.0%	36	72.0%
P value		0.79					

As regard to the mass effect in CT and MRI images, it was positive in 14 patients (28% of patients), and it was negative in 36 patients (72% of patients) and there was no significant difference between males and females.

Table (8): The sensitivity of CT in diagnosis of basal ganglia lesions among studied populations

		Male		Female		Total	
		n	%	n	%	n	%
CT	Diagnostic	32	84.2%	11	91.7%	43	86.0%
	Non-diagnostic	6	15.8%	1	8.3%	7	14.0%
P value		0.51					

As regard sensitivity of CT in diagnosis of basal ganglia lesion, it was sensitive in 43 patients (86% of patients), and failed to elicit diagnosis in 7 patients (14% of patients). There was no significant difference between males and females.

Table (9): The sensitivity of MRI in diagnosis of basal ganglia lesions among studied populations

		Male		Female		Total	
		n	%	n	%	n	%
MRI	Diagnostic	36	94.7%	10	83.3%	46	92.0%
	Non-diagnostic	2	5.3%	2	16.7%	4	8.0%
P value		0.20					

As regard to MRI sensitivity in diagnosis of basal ganglia lesions, it was sensitive in 46 patients (92% of patients), while it was unable to diagnose 4 patients (8.0% of patient). There was no significant difference between males and females.

Table (10): Relation between MRI and CT among studied populations

		MRI final			
		Diagnostic		Non-diagnostic	
		n	% of CT	N	% of CT
CT Final	Diagnostic (43)	39	90.7%	4	9.3%
	Non-diagnostic (7)	7	100.0%	0	0.0%
P value		0.40			

When searching the relation between MRI and CT among studied populations, MRI was able to elicit positive diagnosis in all seven patients (who were non-diagnostic by CT). In addition, it could not elicit diagnosis in four cases who were diagnosed by CT.

Table (11): Diagnostic sensitivity of CT in relation to diagnosis

Diagnosis		CT final			
		Diagnostic		Non-diagnostic	
		n	%	n	%
	Infarction	17	100.0%	0	.0%
	Early subacute hematoma	2	100.0%	0	.0%
	Late subacute hematoma	4	80.0%	1	20.0%
	Masses	3	100.0%	0	.0%
	Senile Calcification	5	100.0%	0	.0%
	Hemorrhagic metastasis	0	0.0%	2	100.0%
	post drowning HIE	1	100.0%	0	.0%
	hepatic encephalopathy	0	0.0%	4	100.0%
	Hypoglycemia	3	100.0%	0	.0%
	Viral encephalitis	1	100.0%	0	.0%
	Abscess	2	100.0%	0	.0%
	Methanol poisoning	1	100.0%	0	.0%
	Fahr Disease	2	100.0%	0	.0%
	Post cardiac arrest HIE	1	100.0%	0	.0%
	Non ketotic hyperglycemic hemochorea	1	100.0%	0	.0%

As regard to diagnostic ability of CT for different diagnoses, it was 100% for infarction, early subacute hematoma, masses, senile calcifications, post drowning HIE, hypoglycemia, viral encephalitis, abscess, methanol poisoning, Fahr disease, post cardiac arrest HIE and non ketotic hyperglycemia hemochorea, while it was 80% for late subacute hematoma, 0% for hemorrhagic metastasis and hepatic encephalopathy.

Table (12): Diagnostic sensitivity of MRI in relation to diagnosis

Diagnosis		MRI final			
		Diagnostic		Non-diagnostic	
		n	%	n	%
	Infarction	17	100.0%	0	.0%
	Early subacute hematoma	2	100.0%	0	.0%
	Late subacute hematoma	5	100.0%	0	.0%
	Mass	3	100.0%	0	.0%
	Senile Calcification	1	20.0%	4	80.0%
	Hemorrhagic metastasis	2	100.0%	0	.0%
	post drowning HIE	1	100.0%	0	.0%
	hepatic encephalopathy	4	100.0%	0	.0%
	Hypoglycemia	3	100.0%	0	.0%
	Viral encephalitis	1	100.0%	0	.0%
	Abscess	2	100.0%	0	.0%
	Methanol poisoning	1	100.0%	0	.0%
	Fahr Disease	2	100.0%	0	.0%
	Post cardiac arrest HIE	1	100.0%	0	.0%
	Non ketotic hyperglycemic hemochorea	1	100.0%	0	.0%

As regard to diagnostic ability of MRI for different diagnoses, it was 100% for infarction, subacute hematoma (early or late), masses, hemorrhagic metastasis, post drowning and post cardiac arrest HIE, hepatic encephalopathy, hypoglycemia, viral encephalitis, abscess, methanol poisoning, Fahr disease, and non-ketotic hyperglycemic hemochorea. However, it was 20.0% for senile calcification.

Table (13): Diagnostic sensitivity of CT in relation to side of the lesion

		CT final			
		Diagnostic		Non-diagnostic	
		n	%	n	%
Side	Bilateral	29	87.9%	4	12.1%
	Right	6	75.0%	2	25.0%
	Left	8	88.9%	1	11.1%

The diagnostic sensitivity of CT was 87.9% for bilateral lesions, 75.0% for unilateral right lesions and 88.9% for unilateral left lesions.

Table (14): Diagnostic sensitivity of MRI in relation to side of the lesion

		MRI final			
		Diagnostic		Non-diagnostic	
		n	%	n	%
Side	Bilateral	29	87.9%	4	12.1%
	Right	8	100.0%	0	0.0%
	Left	9	100.0%	0	0.0%

The diagnostic sensitivity of MRI was 87.9% for bilateral lesions and 100% for unilateral lesions (either right or left sides). The specificity of CT and MRI in diagnosis of basal ganglia lesions in this study will be insignificant as we don't have false positive or true negative cases.

DISCUSSION

The basal ganglia (BG) are subcortical structures primarily involved in motor control and motor learning. The clinical and pathologic observations at the turn of the 20th century shed light on the role of the BG in control of posture, tone, and movement. Furthermore, such observations led to the recognition of the "extrapyramidal motor system" whose lesions, contrary to those of the pyramidal

system, do not paralyze the patient, but instead result in abnormal involuntary movements [6].

The present study was designed to examine the effectiveness of both computed tomography and magnetic resonance imaging in diagnosis of different basal ganglia lesions. It included 50 patients, selected from Al-Azhar University hospital. All were submitted to full history taking, clinical and laboratory examinations with suspicious of basal ganglia lesions. All were undergoing computed tomography and magnetic resonance imaging.

As regard to clinical presentation, the most common was disturbed level of consciousness (56%) followed by left sided weakness, left sided hemiparesis and headache (each in 6% of patients). Interestingly, 14% of cases were asymptomatic (discovered accidently).

Fu *et al.*[7] reported that, the most common symptoms included hemiparesis (n=18), seizures (n=7), and symptoms of increased intracranial pressure such as headache and vomiting (n =14). These are quite different than the present study and this attributed to the fact that, they included only pediatric patients. On the other hand, it was reported that, radiological examination may be the first to discover basal ganglia abnormalities. In addition, diseases of the basal ganglia are characterized by movement disorder associated with damage to the extrapyramidal system. However, not all basal ganglia lesions have been associated with movement abnormalities, and some acute conditions (such as acute deprivation of oxygen or glucose) may be overshadowed by coma or systemic manifestations [8].

In our study, infraction was the most common (34.0%), with CT hypodensity that was 100% diagnostic. MRI examination revealed low signal intensity in T1, high intensity on T2 with variable low and hyperintensity on FLAIR-MRI with non-restricted diffusion (restriction was observed in just one patient). The lesion was bilateral in 15 patients and unilateral in other 2 patients.

In a two case reports, **Boukobza and Baud [9]** reported that, in the first cases, Non-contrast Brain-CT at day 2 revealed symmetric hypodensities of the BG with hemorrhagic components and hypodensity of the tectum of the mesencephalon. In the following days, the neurological state was unchanged. In the second patient, Brain MRI at day 6 was associated with diffuse hypoxic brain damage on FLAIR and diffusion images and hemorrhagic lesions of both LN on T2 GRE images. T1 sagittal paramedian right and left images show the light hyperintense signal in both lenticular nuclei, indicating the subtle hemorrhagic component, highlighted by the ‘‘blooming effect’’ on T2 GRE images. MRI and MR-angiography (MRA) did not reveal underlying cerebro-vascular pathology.

Results of the present study revealed that, hematoma of basal ganglia was early in 2 patients (both were males) (mainly in their 40s), and were unilateral. In addition, 5 patients had late hematoma (3 males and 2 females) and all were unilateral. CT examination showed hyperdensity in all patients with early hematoma, while it showed hyperintensity in 4 patients of late hematoma and the other 1 patient had hypodensity. MRI examination, showed high signal intensity in all patients on T1-weight images, while T2 and FLAIR revealed iso-intensity in early hematoma and high intensity in late hematoma, with restricted diffusion in only 4 patients. MRI was 100% diagnostic, while CT was diagnostic in 100% of early hematoma and 80% of late hematoma, and putamen was affected in all patients with early or late hematoma either separately or with globus pallidus.

Traumatic basal ganglia hematoma (TBGH) is seen in 3% of patients with closed head injury, whereas this number increases up to 10–12 % in autopsy series. Such a higher incidence in autopsy series depicts the malignant course of TBGHs, and low sensitivity of diagnostic modalities [10].

In our study, masses of basal ganglia represent 6.0%. All were unilateral (two on the right side and one on the left) and the mean age 44 years. On CT, all were hypodense, mild homogenous with contrast; while on T1 MRI, there was low intensity, and on T2, there was hyperintensity and high intensity on flair MRI, with no restricted diffusion and both MRI and CT were 100% diagnostic. Putamen and caudate nuclei were the site of mass. The basal ganglia are the most frequent ectopic location for germinoma [11], as the location of germinomas in the brain is almost exclusively within the midline regions (i.e., the pineal gland area and the suprasellar regions) [12].

The median age of basal ganglia germinoma patients ranges from 10.9 (7.9-13.6) to 13.5 (8-28) years, which is younger than in all CNS germinomas [11]. However, **dePemille *et al.*[12]** reported a case report of basal ganglia germinoma in a 21 years old adult (in the present work, one of the three patients age 18 years).

In the study, brain abscess was reported in two patients (a male child aged 8 months and a female age 660 years (both on right side). On CT it was hypodense and with contrast it was marginal. CT is 100% diagnostic of brain abscess. In addition, MRI showed low intensity in T1, hyperintensity on T2 with restricted diffusion and 100% diagnostic sensitivity. The mass effect is positive and both were in caudate nucleus.

The present study included 5 patients with senile calcification, which were bilateral (2 males and 3 females), hyperdense on CT with 100% diagnostic ability, but no abnormality or restriction was observed on MRI (except for one patient) which revealed 20% diagnostic sensitivity of the condition.

Nishimoto *et al.*[13] described a case of basal ganglia calcification with infarction and reported that, brain computed tomography (CT) showed expansive and symmetric high-density lesions involving the bilateral basal ganglia, thalami and cerebellar dentate nuclei. Diffusion-weighted brain magnetic resonance imaging (MRI) showed multiple hyperintense spots in the bilateral cerebral subcortical area, which were indicative of acute infarctions. Magnetic resonance angiography did not show any intra- or extracranial arterial occlusion, stenosis or other vascular abnormality. MRI using susceptibility-weighted imaging (SWI) showed hypointense lesions coinciding with high-density lesions in CT imaging and multiple hypointense spots in the cerebral parenchyma. Hypointense lesions that coincided with the high-density lesions on CT were detected on both minimal intensity projection and phase images on SWI.

In the our study, hepatic encephalopathy was reported in 4 patients (3 males and one female), with bilateral basal ganglia lesions (putamen plus globus pallidus). CT showed no abnormality, while there were high signals on T1, iso intensity on T2 and flair with no restricted diffusion. MRI was 100% diagnostic while CT failed to elicit diagnosis (0% sensitivity). In addition, hypoglycemia were reported in 3 patients (all were males) and revealed hypodensity on CT, iso intensity on T1 and hyperintensity on T2 weight and FLAIR MRI with no restriction. Both MRI and CT were 100% diagnostic. Furthermore, methanol intoxication was reported in 1 male (21 years old), with hypodensity in CT, low intensity in T1 and High signal intensity on T2 and FLAIR MRI with restricted diffusion. Both MRI and CT were 100% diagnostics.

Consistent with these results, **Chokshi *et al.*[14]** reported that, MRI is far superior for visualization of the BG in metabolic and toxic disorders owing to better contrast resolution and the use of distinct pulse sequences to highlight the various physical properties of these nuclei. They concluded that, toxic and metabolic disorders of the BG are an important yet varied group of etiologies for BG pathology on neuro-imaging. Systematic evaluation of imaging patterns in the context of clinical information and presentation can help the radiologist play a valuable role in the diagnosis and management of these often-sick patients.

MRI findings in acute or acute-on-chronic hepatic encephalopathy (HE) are typically those of hyperammonemia, with T1 shortening in the GP and SN, favored to represent manganese deposition **[15].**

In addition, characteristic MR imaging findings of severe hypoglycemia include bilateral T2 prolongation in the cerebral cortex, hippocampi, and basal ganglia. In some cases of milder, reversible hypoglycemia, transient and isolated white matter abnormalities involving the splenium of the corpus callosum, internal capsules, and corona radiata have been reported, with patients making a full recovery without neurologic deficit; however, white matter lesions may also be seen in combination with severe, diffuse gray matter abnormalities **[16].**

The abnormal areas are typically hyperintense on diffusion-weighted MR images and show a reduced apparent diffusion coefficient. Involvement of the basal ganglia seems to portend a poor prognosis. In patients with unexplained coma, determination of blood serum sugar levels can help differentiate this potentially reversible condition from other causes such as hypoxic ischemic encephalopathy (HIE) or acute cerebral infarction **[15].**

CONCLUSION

MRI is superior to CT for diagnosis of different basal ganglia lesions, except for senile calcification, where CT was superior to MRI. However, CT presents a considerable sensitivity. Thus, it is advisable to start with CT examination to avoid high cost of MRI, otherwise start with MRI when the cost is not a matter or the condition is not in an emergency situation. In such emergent situations, MRI must be used as a first choice.

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