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Evaluation of Brain Computerized Tomography Scan in Patients with Acute Ischemic stroke

تقييم مشاهدات مفراس الدماغ في حالات الصدمة الدماغية الأحتشائية الحادة .

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Abstract;

Background: Stroke remains one of the leading cause of the death in the world and despite the advance in neuroimaging, computerized tomography (CT) is still widely used in evaluation of patients with ischemic stroke in emergency unit which should be done before giving thrombolytic therapy in the first 3-4.5 hour of stroke onset .**Aim of this study** is to evaluate early brain CT findings among ischemic stroke which is of great help in deciding early stroke management. **Patients and methods**: A cross-sectional descriptive study was done at Middle Euphrates Neuroscience center; AL-Sadder Medical City at Annajaf city – Iraq, in the period from may 2012 to December 2014. A total of 108 patients whom clinically diagnosed as stroke were referred for CT scan of brain within 48 hours of the stroke onset. Twelve patients with intracranial hemorrhages were excluded and the remaining 96 patients were studied for early brain CT findings. **Results:** The prevalence of ischemic infarction was 85%, with slight male predominance (male: female ratio=1.25:1) and most affected patients with ischemic type were in range of 60-69 years. The sensitivity of CT scan in detection of the ischemic changes increased linearly with time from onset of stroke. The prevalence of the hyperacute signs of middle cerebral artery infarction (insular- ribbon sign and hypodense basal ganglia) in acute ischemic stroke were seen in 33.3%, no case reported to show hyper dense middle cerebral artery sign in our study. **Conclusion**: CT remains the initial imaging modality of choice for the early diagnosis and management of acute stroke especially in making the diagnosis within the therapeutic window for thrombolytic therapy where the time is crucial for detectability. Specific signs of hyperacute infarction should be carefully scrutinized for early detection.

Key wards: Stroke, brain, computerized tomography.

المقدمة :

ماتزال الجلطة الدماغية من الأسباب الرئيسية للموت في العالم وهو من الأمراض السريرية الشائعة التي يستخدم فيها فحص المفراس الدماغي بصورة كبيرة لغرض تقييم المرض بالرغم من التطور الكبير لأنواع الفحوص المستخدمة حديثاً. الغاية من هذه الدراسة هو لتقييم الدور الذي يلعبه المفراس الدماغي في الكشف المبكر عن حالات الجلطة الدماغية الاحتشائية الحادة. المرضى و طريقة العمل : من بين 108 مريض (60 ذكر، 48 أنثى)، مشخصين بالجلطة الدماغية تشخيصاً سريرياً، كانو قد أحيلو إلى شعبة المفراس في مركزالفرات للعلوم العصبية في مستشفى الصدر التعليمي في النجف خلال اليومين الأولى من تاريخ الإصابة بالجلطة الدماغية، تم استبعاد 12 مريض مصابين بالنزف الدماغي و تم اجراء الدراسة علي العدد المتبقي (96 مريض) .النتائج :بالنسبة للعمر،فإن أعلى فئة عمرية كانت متعرضة للإصابة بالاحتشاء الدماغي هو العقد السادس من العمر وزيادة طفيفة في الذكور على الاناث. تزايدت حساسية المفراس في الكشف عن الجلطة بشكل خطي مع زيادة المدة الزمنية من تاريخ الاصابة. العلامات الحادة لمرضى الجلطة الدماغية بسبب إصابة الشريان الدماغي الوسطي متمثلةً بعلامة الشريط الدماغي العازل و علامة قلة وضوح العقدة القاعدية للدماغ (في المفراز الدماغي) شكلت نسبة 33,3% بينما لم تظهر أي حالة في الدراسة علامة ازدياد كثافة الشريان الدماغي الوسطي.الإستنتاج : يبقى المفراس الدماغي وسيلة فعالة ومهمة للتشخيص الأولي للمرضى المصابين بالجلطة الدماغية الاحتشائية. بالرغم من ندرتها ، فانه بالبحث الدقيق عن علامات الجلطة الحادة المعروفة بالمفراس يمكن الكشف المبكر عن الجلطة الاحتشائية.

Introduction

A stroke or cerebrovascular accident (CVA) is defined as the abrupt onset of a focal neurological deficit that is attributable to a focal vascular causes[1]. Stroke incidence and mortality are increasing along with modernization and advancing longevity worldwide. Stroke are classified into ischemic (infarction) and hemorrhagic type [(2)]. One of great challenge in management of ischemic type is the early diagnosis (within first few hour) in order to give thrombolytic therapy within first 3-4.5 hour of stroke onset. Pathologically speaking, the ischemic stroke produces cerebral changes, which can be divided accordingly to time, into: (a) Hyper acute Infarct: (up to 6 hours), (b) Acute Infarct: (6-24 hours), (c) Subacute: (1-7 days) and (d) Chronic: (more than one week) [(2)]

The evolution of modern neuroimaging has revolutionized in diagnosis and management of stroke. However in acute stroke, imaging, with non-enhanced CT being the commonest modality[(3)], is directed mainly to confirm the clinical diagnosis, identify any intracranial haemorrhage, detect other lesions which may clinically mimic an infarct, (like tumour, vascular malformation, subdural hematoma) and detect early complications such as subfalcine/ transtentorial herniation and haemorrhagic transformation [(4)]. Many authors describes the CT findings during the first 6 hour (hyperacute) as loss of gray-white matter differentiation of cortical gyrus, basal ganglia or insula; loss of cortical sulci or narrowing of the Sylvian fissure; compression of ventricular system and basal cisterns; area of hypodensity; and hyperdensity in a circle of Willis vessel [(5, 6, 7, 8)]. Thereafter, the cardinal sign of infarction on non-enhanced head CT scans would be an area of decreased attenuation within the cerebral substance often triangular in shape, involving both the white and superficial grey matter[(9)]. However, significant variability in the detection sensitivity of early signs of infarction on CT had been reported ranging between 20% and 87% [(5)].

Objectives:

1-To evaluate early brain CT scan findings in acute ischemic stroke

2- To assess the prevalence of hyperacute CT signs of acute cerebral ischemia.

Patients and methods

This cross-sectional descriptive study included patients who were referred with clinical diagnosis of stroke for brain CT scan at Middle Euphoarates neuroscience center in Al-Najaf city, about 160 km south west to the capital, during 8 months period. A total of 108 patients whom presented with clinical diagnosis of stroke during first 48 hours (the acute stage) after the stroke onset were studied; 12 patients with intracranial hemorrhages were excluded, while the remaining 96 patients (24 having negative CT scan and 84 patients having positive scan) were included, as shown in figure 1. CT examination was carried out using 64 multidetector helical CT scan (Philips, brilliance, 2010) with the following parameters: KV 120, MAS 300m.As, slices thickness 3mm and time 12 seconds. All patients were examined in supine position with scanner gantry parallel to radiographic baseline, and without the administration of intravenous contrast medium. Patients who needed contrast to prove their diagnosis were excluded from the study. Images of CT were reviewed by specialist radiologists and clinical data were obtained from patients directly and from their neurologist requests. Statistical analysis was done using statistical package for social sciences (SPSS) version 20 and the chi square test was used for numerical data and P value less than 0.05 was considered to be significant.

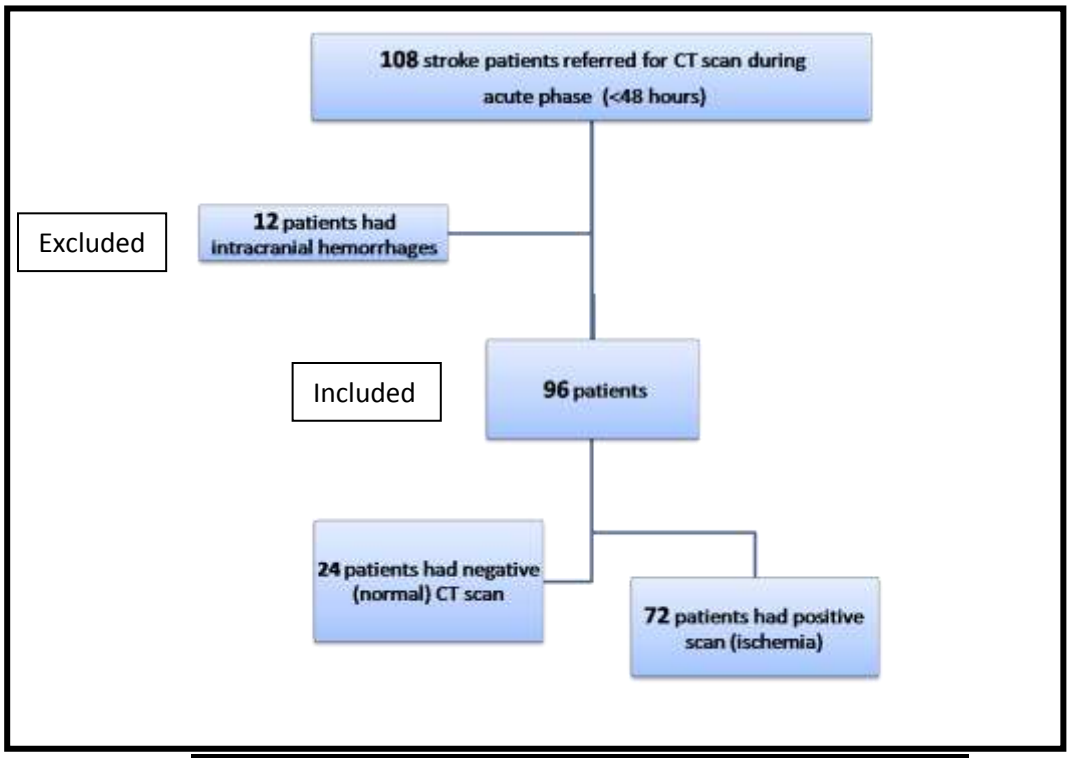

Figure 1: Flow chart of study participants. (CT=computerized tomography).

Results

- Age and gender distribution:

Of the 96 patients, 72 patients shows CT findings of ischemic infarction with age range of 34- 84 years and mean of 64.42 years, standard deviation (SD) ± 12.87. Forty patients were males and 32 females with 1.25: 1 male: female ratio.

Table-1: Age range and mean age of patients with positive CT scan for ischemic infarction.

Age group (years)	Ischemic infarction	
	Male	female
10-19	0	0
20-29	0	0
30-39	2	2
40-49	3	4
50-59	7	4
60-69	16	15
70-79	7	5
80-89	5	2
Total gender	40	32
Total	72	

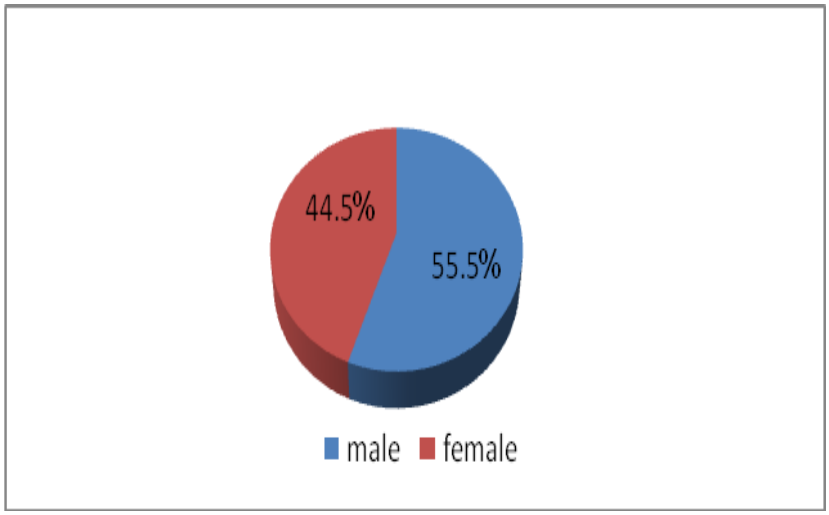

Figure (2): Gender distribution of patients with positive CT scan

Among 94 patient with clinical diagnosis of acute ischemic stroke, 24 patient had negative CT scan and 72 patient had positive CT scan as shown in figure 3. The detectability of ischemic infarction by CT scan was linearly related to the time from onset of stroke (figure 4) with the highest rate of detection being at 24-48 hours (92.5%) as shown in table 3.

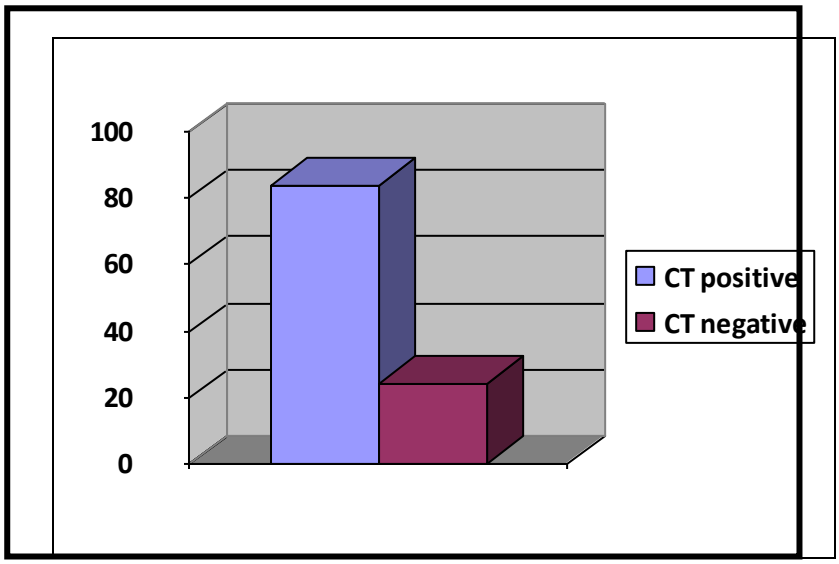

Figure (3): Frequency of stroke patients with positive and negative brain CT scan.

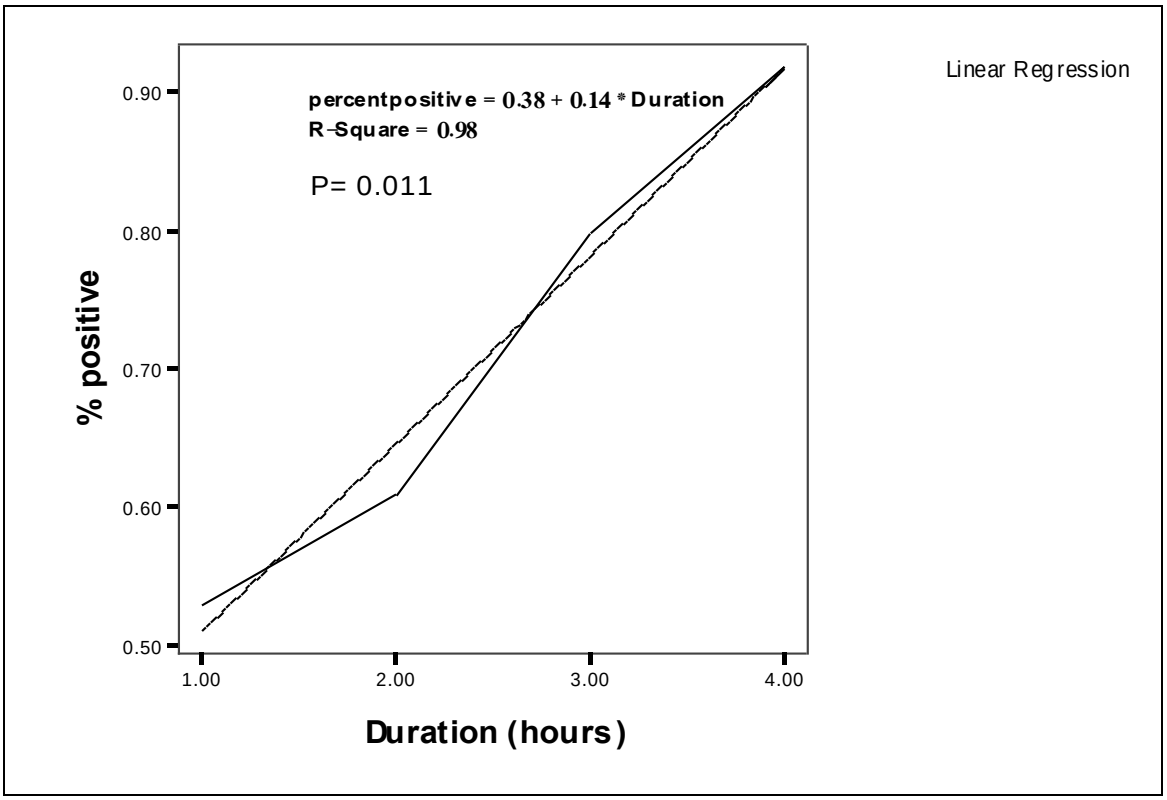

Figure (4): Correlation between CT detectability and duration of ischemic infarction.

Table 3: The detectability of CT-scan in detection of ischemic infarction

Duration (hours)	Total patients with clinical stroke	Patients with positive CT for ischemia	Patients with negative CT scan
≤ 6 h	15	8 (53.3%)	7 (46.7%)
>6h- ≤12h	18	11 (61.1%)	7 (38.9%)
>12h- ≤24h	35	28 (80%)	7 (20%)
>24h-≤48h	40	37 (92.5%)	3 (7.5%)

R=0.989 P=0.011

The measured Hounsfield density of the area of ischemic infarction decreased with increasing duration between onset of stroke and CT examination as shown in table 5.

Table 5: CT Hounsfield of ischemic infarction in relation to the kinds of stroke.

Phase (duration in hours)	Ischemic infarction	
	Number	Density (HU*)
Hyper-acute (≤6-12)	15 (20.8%)	29-31
Acute-sub stage I (>12-24)	24 (33.4%)	22-28
Acute-sub stage II (>24-48)	33 (45.8%)	18-20
Total	72	

***HU= Hounsfield units**.

Discussion

CT is considered the imaging of choice in the diagnosis of stroke, as it is simple, quick and straight forward for the patient; it is widely available and readily identifies the presence of hemorrhages [(10)].

Age and gender distribution of stroke

In this study, the peak prevalence was the 6th decade that is one decade earlier than European and USA population [(11)].The gender distribution of the patients with stroke (figure 2) showed male predominance by a factor of 1.24 which is lower than European countries (1.5) but higher than the figure in USA (1.0) [(11)].The prevalence of ischemic infarction in current study sample (85%) was comparable to studies by Scott and Jeffery [(12)] (80%) in 2006 and Davis [(13)] (80%) in 2007.

Detectability of CT in the detection of ischemic stroke

Beside the prognostic value of CT scanning in detecting acute brain ischemia, it also affects the therapeutic decision in particular regarding the risk of possible thrombolytic therapy [(14)]. In this study, the sensitivity for early signs of infarction was 53% in the first 6 hours increased to 92% during first 48hour, a finding that was considered comparable to the previous study depending on the time of examination [(14)]. Regarding the 24 CT-negative cases (figure 3), CT scan can be normal in acute setting of stroke [(13, 15)] and most cases of TIA [(16)]. In this study, 24 patients out of total 108 (22.2%) had a normal CT scan in acute presentation and it appears that the cerebral lesion although producing transient clinical symptoms, is not severe enough to produce early detectable focal CT changes [(9)].

Considering the relation between duration of stroke and density (HU) on CT scan, the decrease in CT density noticed in our study in the acute stage of ischemic infarction as shown in figure 5 from 30 HU during the first 12th hour to 25 HU in the second 12 hour with mean of 25-50% is supported by the fact that an increase in brain water content by 1% will result in a CT attenuation decrease by 2.5 HU [(15)] and this corresponds to a reduction in the density of normal grey matter by 11% in acute stage to 50% during the next 24-48hours after the onset of infarction [(17)].

Analysis of 24 patients with negative CT scan:

It is well known that CT scan can be normal in acute setting of stroke (2,21) and proved to be normal also in most cases of TIA [(7)]. This was also noticed in this study, as 24 patients out of total 108 (22.2%) found to have a normal CT scan in acute presentation in spite of the positive clinical finding, because it was presumed that the cerebral lesion although producing transient clinical symptoms is not sever enough to produce detectable focal CT changes. [(10)].

Figure (5) Hypodense wedged shaped Lt. parietal acute infarction.

Signs of hyperacute MCA infarction.

The cardinal sign of infarction on non-enhanced head CT scans is decreased attenuation within the cerebral substance often of triangular shape, involving both the white and superficial grey matter[9]. However, there are signs that can be seen in early (hyperacute) stage which have both diagnostic and prognostic impacts [18].

Figure (6) Non-enhanced CT scan, axial section of the brain, showing "blurred basal ganglia" sign on right side in patient with acute left sided hemiplegia.

Joanna M. and Orell M. in their systematic study on early infarction signs on CT done in 2005[5], found that no sign is more detectable than other and these early signs tend to be more specific than sensitive i.e. they are not easily detected but when seen they do indicate presence of infarction. The same review [5] reported a significant variability in detection sensitivity range between 20% and 87%.

The prevalence of insular ribbon sign (hypodensity and swelling of insular cortex) which said to be indicative early CT sign of infarction of MCA [19] was slightly higher than that of Petel et al study[18] (33.3% vs 31% respectively).

Similar prevalence (33.3%) was also observed in this study regarding the blurred basal ganglia sign (one of the earliest and most frequently seen sign), where two patients among the six patients having acute MCA infarction showed this sign.

Hyperdense MCA (HDMCA) sign, representing hyperacute thromboembolism within the MCA, has been associated with severe neurological deficit, extensive brain damage and poor clinical outcome [5] but its reliability is uncertain as thrombosis can be confused with calcified artery walls, particularly in the elderly. Consequently, the incidence of has been reported to be as high as 41% [18]. In our study, no patient demonstrated HDMCA sign, which could be attributed to the small size of our sample.

Conclusion

Special attention should be paid by neuroradiologist for early CT finding in acute stroke this will give enough space, time and confidence to the neurologist in starting thrombolytic therapy at emergency unit. CT was valuable in assessing patients with the clinically diagnosed stroke regarding type and site of ischemic infarction and time was crucial for increasing its sensitivity. Of the hyperacute signs of MCA infarction, HDMCA sign was the least delectable one in our population study. Although not commonly seen, these signs need to be carefully scrutinized during evaluation of CT scan for patients presented with acute stroke.

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