Acute Computed Tomography Findings in Patients with Acute Confusion of Non-traumatic Aetiology

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ABSTRACT

Background: *A retrospective review was undertaken of all patients referred for computed tomography (CT) scans of the head for acute onset of confusion, not consequent on head trauma, during the period June 1, 2004 to May 31, 2007.*

Method: *Data were obtained by Microsoft Word search of the reports of the Radiology Department of the University Hospital of the West Indies, Kingston, Jamaica. Two hundred and twenty-one patients were reviewed: 103 men and 118 women. The mean age of the sample was 64 years; 168 patients (76%) were 50 years old or older.*

Result: *Computed tomography scans were reported normal in 170 (76.9%) patients; 45 patients (20.4%) had definite acute intracranial CT findings. Findings were equivocal in three patients (1.4%) and unavailable for three (1.4%); 23.2% and 15.6% of patients above and below the age of 50 years respectively showed acute abnormalities on CT.*

The most common acute finding on CT scan was an ischaemic infarct (68%). Other abnormalities included intracerebral haemorrhage and metastases 6.2% each, toxoplasmosis and primary brain tumour 4.2% each and subdural haematoma and meningitis 2.1% each. The diagnoses of toxoplasmosis were made based on appearances typical of toxoplasmosis on CT scans in patients whose request stated that they were HIV positive.

Conclusion: *In the sample reviewed, most patients who presented with acute confusion were above the age of 50 years. Overall, 20.4% of patients from all age groups had acute abnormalities on CT with a relative higher proportion, 23.2% versus 15.6% of those over 50 years, having acute pathology. The most common abnormality was an ischaemic infarct. This finding is similar to that in developed countries and unlike that seen in other developing countries where infectious aetiologies predominate.*

Keywords: Acute confusion, brain, CT scan, infarct

Hallazgos Agudos con Tomografía Computarizada en Pacientes con Confusión Aguda de Etiología no Traumática

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RESUMEN

Antecedentes: *Durante el período de junio, 2004 a mayo 31, 2007, se llevó a cabo una revisión retrospectiva de todos los pacientes remitidos para escaneos mediante tomografía computarizada (TC escáner) de la cabeza, en casos de ataques de confusión aguda, no originados por traumas en la cabeza.*

Método: *Los datos fueron obtenidos mediante búsqueda con Microsoft Word de los informes del Departamento de Radiología del Hospital Universitario de West Indies, Kingston, Jamaica. Se revisaron doscientos veintiún pacientes: 103 hombres y 118 mujeres. La edad promedio de la muestra fue 64 años; 168 pacientes (76%) tenían 50 años de edad o más.*

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Resultado: *Los escaneos mediante tomografía computarizada fueron reportados como un procedimiento normal en 170 (76.9%) pacientes; 45 pacientes (20.4%) tuvieron hallazgos agudos intracraneales definidos por TC. Los hallazgos fueron equívocos en tres pacientes (1.4%) y no disponibles en tres (1.4%); 23.2% y 15.6% de los pacientes por encima y por debajo de la edad de 50 años respectivamente, mostraron anormalidades agudas en la TC. El hallazgo agudo más común con el escaneo de TC fue el infarto isquémico (68%).*

Otras anormalidades incluyeron hemorragias intracerebrales y metástasis, 6.2% respectivamente; toxoplasmosis y tumor primario del cerebro, 4.2% respectivamente, y hematoma subdural y meningitis, 2.1% respectivamente.

Conclusión: *En la muestra revisada, la mayoría de los pacientes que presentaron confusión aguda se hallaban por encima de 50 años de edad. En general, 20.4% de los pacientes de todos los grupos etarios presentaban anormalidades agudas en la TC en una proporción relativamente más alta, siendo el caso que el 23.2% frente al 15.6% de aquéllos por encima de 50 años, presentaban patologías agudas. La anormalidad más común fue el infarto isquémico. Este hallazgo es similar al de los países desarrollados, y diferente al que se observa en otros países en vías de desarrollo, dónde predominan las etiologías infecciosas.*

Palabras claves: Confusión aguda, cerebro, escaneo mediante TC, infarto

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INTRODUCTION

Acute confusional state (ACS) is a common presentation to the Accident and Emergency (A&E) Department and is thought to affect up to 30% of all older patients admitted to hospital. Patients who developed delirium have high mortality, institutionalization and complication rates and have longer lengths of stay than non-delirious patients (1). The condition is multi-factorial and may be due to psychiatric or organic causes. Organic causes may be primary brain pathology or consequent on any of several systemic diseases.

Hardy *et al* reviewed 106 consecutive patients over 70 years of age who had a computed tomography (CT) brain scan for a presentation of acute confusion. Fifteen patients (14%, 95% CI 7.51, 20.79) had acute abnormalities on CT scan. There were ten acute ischaemic strokes, four cerebral haemorrhages and two meningiomas. Patients with a history of trauma were included in their sample. They concluded that their findings "added further support to guidelines developed by Australian Health authorities that suggest that CT scans of the brain for confused elderly patients should only be performed for those with acute neurological findings, head trauma or a fall" (2).

In clinical practice, the term "confusion" is used loosely to describe lack of orientation to place, person or date but while disorientation is noted in both ACS and delirium, additional diagnostic features distinguish delirium from ACS. Delirium is a neuro-psychiatric syndrome characterized by a fluctuating mental and behavioural condition with reduction in alertness, global cognitive decline, and, frequently, by the presence of delusional-hallucinatory phenomena, disturbances in the circadian rhythm as expressed by insomnia and daytime sleepiness, mood swings and gross disturbances of behaviour, mainly in the hyperactive form of the syndrome. It is a precisely defined condition and as such its presence is determined by tools such as the Delirium Rating Scale (DRS), often administered by someone with special training *eg* psychiatrist or psychologist (3). In developed countries it has been estimated that 14.9% of patients seen in a neurological ER are diagnosed with delirium (4, 5).

Computed tomography scans are frequently requested in patients presenting with acute confusion; however, our search of the literature (Pubmed) revealed no publications detailing CT findings in a series of such patients. Rothrock *et al* conducted a prospective, observational study of a case series of adults who underwent cranial CT scanning for non-traumatic causes performed at the Emergency Departments (EDs) of an urban teaching hospital and an affiliated community hospital with a combined annual census of 110 000 to examine the pattern of non-trauma cranial CT use in an urban ED, to identify the rate of significant CT abnormalities in this setting, and to develop criteria for restricting the ordering of CT scans. They found only 61 (8%) of 806 CT scans revealed clinically significant abnormalities and that altered mental state was useful in predicting the presence of an acute abnormality on CT (6). To our knowledge, no studies have been published reviewing acute CT changes in patients with acute confusion in the English-speaking Caribbean.

This retrospective descriptive study was undertaken to document the patient profile and acute CT findings in all patients presenting with acute confusion, with no history of head trauma and who had cranial CT scans at the 500-bed University Hospital of the West Indies, Kingston, Jamaica, during the three-year period June 1, 2004 to May 31, 2007.

METHODS

The report database of the X-ray Department of the University Hospital of the West Indies for the three-year period, June 1, 2004 to May 31, 2007, was reviewed using the Microsoft Word search option. Searches were made for "confusion" and "delirium" and "CT Brain". The data collected were subject to statistical analysis (means for age and significance test (Chi-square) for the difference in the means).

RESULTS

Two hundred and twenty-one patients were referred for CT scans; 103 (46.6%) males and 118 (53.4%) females. Forty-eight patients (21.7%): 31 females and 17 males, had acute intracranial pathology on CT scan. One hundred and seventy patients (76.9%) showed no acute changes. Results were not available for three patients (1.3%).

For patients with acute abnormalities, CT diagnoses were ischaemic infarct 33 (68.7%), intra-parenchymal haematoma 3 (6.3%), metastases 3 (6.2%), toxoplasmosis 2 (4.2%), primary brain tumour 2 (4.2%), subdural haematoma 1 (2.1%), meningitis 1 (2.1%) and possible diffuse cerebral oedema 3 (6.3%). The findings are illustrated in Table 1. The diagnoses of toxoplasmosis were made based on appearances typical of toxoplasmosis on CT scans in patients whose request forms stated that they were HIV positive.

Acute infarctions were seen in all age groups except the 0−9-years (Table 2).

The largest percentage of positive studies was in the 10−19-year age group, however, there were only four patients in this group. The 70–79-year age group had the largest number of referrals, 52, 13.5% of which were positive for acute CT findings (Table 3). Patients 50 years and older accounted for 81% of positive CT scans. The largest percentage of positive scans, 33.3%, were found in the 80−89-year age group (Table 4). Ischaemic infarct was the most common finding in all age groups.

Analysis revealed no significant difference in age between sexes (male: mean = 64.94, female: mean = 63.79; t (1) = 0.393, $p = 0.695$). There was a marginally significant increased tendency for males (compared to females) to be positive (83.3% *vs* 73.3%; χ^2 (1) = 3.20, $p = 0.74$). No significant differences in rates of acute CT changes between sexes were found (χ^2 (6) = 6.64, $p = 0.355$).

Computed tomography diagnoses were made based on typical appearances of the various pathologies on imaging taken in the context of the clinical information. Of the 48 patients with acute abnormalities on CT, 16 patients (33.3%) had associated chronic changes, nine patients had age-related atrophy, seven had old infarcts, two had previously diagnosed hydrocephalus and two had both cerebral atrophy and old infarcts.

Table 1: Patient profile and pathology

Patient	Sex	Age	Acute CT changes
1	f	10	diffuse cerebral oedema
2	m	19	infarct – left thalamus
3	f	24	toxoplasmosis – left frontal lobe
4	f	28	infarct – MCA territory
5	f	30	infarct – lt lentiform, ant limb internal capsule, corona radiata
6	m	34	toxoplasmosis
7	f	44	diffuse cerebral oedema
8	f	47	infarct – right lentiform
9	f	48	enhancement of ventricular wall
10	f	50	infarct – post rt temporal and rt occipital lobe
11	f	50	infarct – tiny – both occipital lobes
12	m	50	infarct – left frontal and occipital/rt cerebellar hemis
13	m	54	infarct – bilateral temporal, parietal and occipital
14	f	57	mets – rt cerebellar hemisphere and vermis
15	m	58	ich – left parietal lobe
16	f	58	infarct – tiny-head of lt caudate nucleus
17	f	59	infarct – right temporo-occipital junction
18	m	59	infarct – right internal capsule
19	f	61	infarct – left internal capsule
20	f	61	infarct – left lentiform nucleus
21	f	63	ich – cerebellar
22	m	63	infarct – bilateral thalami
23	m	64	ich – left parietal
24	f	69	infarct – left frontal lobe
25	f	72	infarct – left internal capsule
26	f	75	infarct – head left caudate nucleus
27	f	77	mets – frontal and parietal lobes/ cerebellum
28	f	78	infarct – left patietal lobe (posterior)
29	f	78	infarct– right frontal lobe
30	m	79	infarct – left frontal lobe
31	m	79	mets – diffusely in both cerebral hemispheres
32	f	80	infarct – left parietal lobe
33	f	80	infarct – right frontal lobe
34	m	80	infarct – left frontal lobe, right corona radiata and cerebellum
35	m	80	Subdural – bilateral
36	f	82	infarct – right cerebellar hemisphere
37	f	82	infarct – left occipito-parietal
38	f	83	diffuse cerebral oedema
39	f	83	infarct – left frontal and temporal lobe
40	m	83	tumour – left parietal lobe
41	m	84	infarct – left internal and external capsules
42	f	85	infarct – right lentiform nucleus
43	m	85	infarct – left thalamus
44	m	86	infarct – left parietal lobe
45	f	87	infarct – right corona radiata
46	m	87	infarct – left cerebellar hemisphere
47	f	89	tumour – left thalamus and midbrain
48	f	94	infarct – left frontal lobe and thalamus

mets = metastases, ich = intracerebral haemorrhage, rt = right, lt = left, hemis = hemisphere

DISCUSSION

The patients in this study were identified as having "confusion" or "delirium" without the application of standardized methodology and likely included those with stupor or lesser degrees of coma rather than being strictly delirious. Further, data were not available on the patients' pre-existent mental

Table 2: Acute CT findings in acute confusion by age

Age (years)	CT findings							
	infarct	**DCO**	**ICH**	**toxo**	**tumour**	**meningitis**	**mets**	**subdural**
0 – 9	–	–	–	–	–	–	–	–
10 – 19	1	1	–	–	–	–	–	–
20 – 29	1	–	–	1	–	–	–	–
30 – 39	1	–	–	1	–	–	–	–
40 – 49	1	1	–	–	–	1	–	–
50 – 59	7	–	–	1	–	–	1	–
60 – 69	4	–	2	–	–	–	–	–
70 – 79	5	–	–	–	–	–	2	–
80 – 89	12	1	–	–	2	–	–	1
90 – 99	1	–	–	–	–	–	–	
Total	**33**	**3**	**2**	**3**	**2**	**1**	**3**	**1**

Legend: DCO = diffuse cerebral oedema, ICH = intracerebral haemorrhage, toxo = toxoplasmosis, mets = metastases

Table 3: Positive CT scans by age group as a percentage of all CT scans done per age group

Age (years)	No. of studies	Positive studies	%
0 – 9	3	0	0%
10 – 19	4	2	50%
20 – 29	12	2	16.6%
30 – 39	17	2	11.7%
40 – 49	15	3	20.0%
50 – 59	30	9	30.0%
60 – 69	25	6	24.0%
70 – 79	52	7	13.5%
80 – 89	46	16	34.8%
90 – 99	15	1	6.6%
Totals	**219**	**48**	

Table 4: Positive CT scans per age group as a percentage of all positive CT scans

Age	Positive studies	% of all +ve
0 – 9	0	0%
10 – 19	2	4.2%
20 – 29	2	4.2%
30 – 39	2	4.2%
40 – 49	3	6.3%
50 – 59	9	18.4%
60 – 69	6	12.5%
70 – 79	7	14.6%
80 – 89	16	33.3%
90 – 99	1	2.1%
Total	**48**	**100%**

status, in particular elderly patients, who often may have a background dementia that may predispose to the development of an acute superimposed encephalopathy.

Acute confusional state is a common cause of presentation to the ER and one of the commonest causes of admission to the acute medical ward or neurological unit, particularly in the elderly who comprised the majority of patients in this study (7). It is also well-known that one of the commonest causes of acute encephalopathies is an acute systemic disturbance; nonetheless, neuro-imaging has become a standard method of evaluation of these patients though little data exist on the value of this tool in the care of patients with acute confusion.

Alteration in sensorium occurs when disease of the brainstem and/or diencephalon result in compromise of the function of the reticular activating system (RAS) or when there is bi-hemispheric cortical dysfunction as in metabolic encephalopathies, with cerebral oedema or when mass lesions are associated with mass effect bilaterally (8).

The acute changes observed in this study, bilateral involvement in 50% of patients, involvement of the diencephalic structures and involvement of structures in the posterior circulatory territory (which includes the thalami), are consistent with the aforementioned mechanisms of alteration in consciousness.

The findings also correlate with the known clinical observation that the location of lesions rather than their specific pathology determine the clinical signs produced, including the presence or absence of alteration of sensorium and cognitive derangements, as can be seen in a delirious patient (8).

That these acute changes may be a 'tipping point' in some patients was suggested by the observation that pre-existent chronic changes were present in one-third of patients. Computed tomography scan is not as sensitive as magnetic resonance imaging (MRI) in the diagnosis of lesions in the diencephalon or limbic system and may not detect subtle pathology which may contribute to a patient's

acute encephalopathy. However, both the availability and cheaper cost of CT and risks of physical injury with MRI in patients who are unable to give adequate history make CT a more practical initial investigative tool in patients with acute confusion.

The elderly are more likely to present with acute confusion, suggesting that pre-existent brain damage from antecedent disorders including cerebrovascular disease may make an individual more likely to 'tip' into encephalopathy. However, it has been demonstrated that, even in the elderly, CT scans done at presentation for patients in acute delirium result in little alteration in management (2). The question then arises whether CT should be reserved for special clinical situations such as in patients with delirium and lateralizing or localizing neurological signs or to permit the safe performance of a lumbar puncture to exclude or confirm a meningitic syndrome.

In conclusion, in the population reviewed, most patients with acute confusion had negative CT scans. The most common acute change on CT was an infarct. This pattern is similar to that seen in developed countries and contrasts with the more common infectious aetiology seen in most developing countries. There is no significant difference in the mean age of males and females with acute confusion but males show a marginally increased tendency to have positive findings.

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