Performance of computed tomography in diagnosis and evaluation of traumatic intracerebral hemorrhage

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Summary:

Background: The intracerebral hemorrhage (ICH) can be classified as traumatic and spontaneous. The frontal and temporal lobes are classic sites for traumatic ICH, which are less commonly affected by spontaneous episodes. Computed tomography (CT) scanning is the most accurate radiological method for demonstrating the acute lesion of intracerebral hemorrhage (ICH). Both types are of high density, but traumatic bleeding is more frequently multifocal, in this study we are dealing with traumatic type of intracerebral hematoma. Aim of the study is to identify the accuracy and performance of CT scan in diagnosis and evaluation of intracerebral hemorrhage.

Patients and methods: 60 patients were examined, their ages range from 30-70 years with means age 48 years old, they were 36 males (60%), and 24 females (40%).

Results: Our study reveals, the male patients (36 patients) were more affected than female patients (24 patients). Most affected age group in our study was 60-70 years old, 18 patients (30%) with no gender difference. Acute ICH was more than other ICH types, patients with acute ICH were 24 patients (40%) 15 male patients and 9 female patients, patients with subacute ICH were 20 patients (33%) and patients with chronic ICH were 16 patients (27%). In our study, the RTA was the most causative mechanism of ICH, 27 patients with RTA were seen in our study (45%), followed by shell injury which were 24 patients (40%) and then the fall from hight (FFH) which were 9 patients (15%). The most common CT feature noted in our study is the brain edema and it is seen in 27 patients (45%). Basal ganglia were most affected brain region (45%) of cases.

Conclusion: CT is available, rapid imaging modality in the diagnosis of ICH, so it is suitable for diagnosis and evaluation of ICH as emergency cases in casualty department and it is valuable in evaluation of traumatic I.C.H. especially in acute stages.

Keywords: Traumatic intracerebral hemorrhage, CT performance.

Introduction:

In adults, the intracerebral hemorrhage (ICH) can be classified as traumatic and spontaneous ICH. The vast majority of spontaneous hemorrhage occurs in the elderly and middle aged subjects and they are due to rupture of micro aneurysm on small intracerebral artery, hypertension and atheroma are most common predisposing factors. Spontaneous intracerebral hemorrhage may also occur in patient on anticoagulants or with hemorrhagic blood disorders, neoplasm which is rare cause of spontaneous ICH and malignant melanoma deposits which are particularly liable to hemorrhage. The frontal and temporal lobes are classic sites for traumatic ICH, which are less commonly affected by spontaneous episodes. On CT scan, both types of ICH (spontaneous and traumatic) are of high density value (hyperdense), but the traumatic bleeding is more frequently multifocal and in cases with a poor prognosis it may be seen to involve the brainstem. ICH occur most commonly at the time of injury, however, it may be delayed, with most appearing within 48 hours following head injury. Initially the ICH is hyperdense from clotted blood with surrounding edema and mass effect. The enhancement may be evident within or around the ICH with administration of intravenous contrast material. The ICH gradually becomes isodense with brain parenchyma over several weeks to a month. Decreased density appears over one to several months. Subsequently, encephalomalacia is evident as low-density with compensatory sulcal enlargement and ventricular dilatation. [1 2, 3]. According to the WHO classification, all haemorrhages are divided into cerebral, subarachnoid, subdural and intraventricular. Some authors itemize by splitting the cranial supratentorial haemorrhages into lateral (outside the internal capsule), lobar, medial (medially from the internal capsule) and mixed, while the subtentorial haemorrhages are divided into the haemorrhages in cerebellum or in brainstem, and all membranous are split into subarachnoid, subdural and epidural haemorrhages. Because of the clear distinction between high attenuation value of extravasated blood and the attenuation value of the surrounding brain tissues, the CT scanning is by far the most accurate, specific and more sensitive radiological method for demonstration of the lesion of acute stage of intracerebral hemorrhage (ICH) but in subacute and chronic ICH, the MRI becomes more informative than CT when the ICH becomes

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isodense in later ICH stages. Around 60% of ICH occurs in the basal ganglia or in the center of Sylvain area the remaining 40% involve the Pons (20%), cerebellum (10%), and less commonly the cerebral white matter. The mass effect of the ICH depends on the size of the bleeding but it is frequently less than that of comparable sized tumors, the increase in the size of the ICH causing compression on the surrounding brain structures leading to midline shifting of these structures to the contra-lateral side. A hematoma which is 48 hours old may develop slightly higher attenuation values than were present initially because of loss of fluid during clot retraction. Bone fracture is mostly associated with traumatic ICH which usually surrounded by vasogenic brain edema. CT with its clear visualization of blood within the brain tissue and the subarachnoid space, it remains the method of choice of early cerebral hemorrhage diagnosis. The acute extravasated blood has hyperdense on CT scans (40-90HU). Later on in subacute stage, the hemorrhage density gradually decreases, first, on the periphery, the zone of density decreases due to globulin molecules disintegration and vasogenic edema. Then, the density decreases extends on the central parts of hematoma so that by the end of subacute phase, the hemorrhage becomes isodense or even hypodense. At the end of the subacute and the beginning of the chronic stage, an area of low signal density starts on the periphery of the hemorrhage, this hypodensity caused by iron depositions in the hydrophobic centers of the ferritin. Gradually it will have density close to those of CSF in the lateral ventricle [4].

Aim of the study: is to identify the accuracy and performance of CT scan in diagnosis and evaluation of acute traumatic intracerebral hematoma.

Patients and methods:

Sixty patients were radiologicaly analyzed by CT scan of Toshiba system type (Aquilion), the patient is placed in supine position on the CT table and head first, taking care to position the head symmetrically in a head holder of the CT system. The examination is performed as brain CT scan, the scan slice thickness which is used in our study was 3 mm. and the number of slices per each patient was 15 slices. The axial scan is the basic scan of CT examination and we can reconstruct the resulting images on the other desired planes (sagittal and coronal planes) by using the multi-planer reconstruction (MPR) technique of the CT system, patient's age range from 30-70 years with mean age 48 years old. All patients were examined by CT scan without contrast media (native study), the contrast media may be used to enhance the affected area or its surrounding, and needed also if any concomitant abnormality is suspected like tumor which is revealed by native CT scan. Data was put in the computer system for storage analysis; SPSS (statistical package for social sciences) version 15 was used. Chi $(\chi)^2$ test was used to test the association between the variable. P value was considered significant when $p \leq 0.05$ [5].

Results:

Sixty patients were radiologicaly analyzed by CT scan, 36 patients were males and 24 patients were females, whose age range from 30-70 years old and mean age was 48 years old.

Table1: The distribution of patients according to their age and gender.

Gender / Age	Male	Percentage	Female	Percentage	Total	Percentage
30-39y	9	15%	6	10%	15	25%
40-49y	12	20%	3	5%	15	25%
50-59y	6	10%	6	10%	12	20%
60-70y	9	15%	9	15%	18	30%
Total	36	60%	24	40%	60	100%

χ= 7.65 , df=3 , p= 0.05

Table2: The distribution of patients according to the type of I.C.H.

Type / Gender	Superacute &Acute 4hours-3days		Subacute (3days to 14days)		Chronic 14 days) (>		Total	
Male	15	25%	12	20%	9	15%	36	60%
Female	9	15%	8	13%	7	12%	24	40%
Total	24	40%	20	33%	16	27%	60	100%

χ=0.16 , df= 2 , p=0.9

Table3: The distribution of patients according to the mechanism of injury.

Mechanism of injury	Male		Female		Total	
RTA	15	25%	12	20%	27	45%
FFH	6	10%	3	5%	9	15%
Shell injury	18	30%	6	10%	24	40%
Total	39	65%	21	35%	60	100%

χ= 2.12 , df=2 , p=0.34

Table 4: The distribution of patients according to the CT features

Gender / CT feature	Male		Female		Total	
Midline shifting	6	10%	3	5%	9	15%
Non depressed Skull fracture	3	5%	3	5%	6	10%
Depressed skull fracture	6	10%	6	10%	12	20%
Brain edema	15	25%	12	20%	27	45%
Intra-ventricular Hemorrhage	3	5%	3	5%	6	10%
Total	33	55%	27	45%	60	100%

χ=0.74 , df=4, p=0.94

Table5: The distribution of patients according to ICH site.

Site if ICH	Male		Female		Total	
Basal ganglia	18	30%	9	15%	27	45%
Lobar region	12	20%	6	10%	18	30%
Thalamus	9	15%	3	5%	12	20%
Pons &Brainstem	3	5%	0	0%	3	5%
Total	42	70%	18	30%	60	100%

χ=0.61 , df=3, p=0.05

Discussion:

This prospective study was done on 60 cases referred as suspected cases with traumatic ICH, these cases analyzed radiologicaly by CT scan, they were 36 male (60%) and 24 cases (40%) were female as shown in table.1, these results agree with findings of Wong G.K., et al study [6] in which 464 patients with head injury were examined with CT and found the male were more affected than female by 2:1 ratio. In our study, the most affected age was (60-70y), 18 patients (30%) were affected. In our study, the number patients with acute type of ICH were 24 patients, 15 male patients and 9 female patients (40% of total) which is higher than other types of ICH (20 patients with subacute ICH (33%) and 16 patients with chronic ICH (27%), these results agree with results of M. Latfor [7] where 49 patients suffered from ICH were examined with CT scan, 24 patients (49%) of them were with acute ICH, 20 patients (41%) were with subacute ICH and 5 patients (10%) of them with chronic ICH. The RTA was the most causative mechanism of ICH, 27 patients with RTA are seen in our study (45%), the number of male patients was 15 (25%) and female patients were 12 (20%). Patients with shell injury were 24 patients (40%) [Male patients were 18 (30%) and Female patients were 6 (10%). The number of cases with FFH were 9 patients (15%), male patients were 6 (10%) and female patients were 3 (5%), these findings do not agree with findings of Marchio P.S. [8] where 65 patients were examined, the number of cases with RTA were 14 patients (22%), FFH cases were 27 patients (42%) and the shell injury seen in 24 patients (37%). The most common CT feature noted in our study is brain edema, 27 patients (45%), it is noted in male patients more than female patients [male patients 15 (25%) and female patients 12(20%)].Results of our study agree with the results of study of Sofia Khan, et al [9] were the total number of examined patients were 98 patients, 65 patients (66.3%) of them have brain edema. Another CT feature is depressed skull fracture, seen in 12 patients (20%), 6 male patients (10%) and 2 female patients (10%), the parietal region of the skull was mostly involved. The midline shifting is seen in 9 patients (15%), male patients were more than female patients (6 male patients and 3 female patients), while in a study of S.C. Wei [10], the midline shifting are seen in 18 of 32 patients (56%). The Intraventricular hemorrhage (IVH) is seen in 6 patients (10%), 3 male patients (5%) and 3 female patients (5%), these results were comparable with those of the Hallevi H. et al. study [11], the intraventricular hemorrhage was seen in 30% of patients. Regarding the site of ICH, in our study, the most affected site was basal ganglia, 27 patients (45%) followed by lobar region (30%), thalamus (20%) and brainstem and Pons affected in (5%) of cases In David S. Liebeskind [12]study the basal ganglia was most affected (45%), lobar region (25%), thalamus (15%), pons(10%), cerebellum (4%) and brainstem (1%).

Conclusion:

The CT is a valuable, highly accurate, and informative imaging modality in diagnosis and evaluation of intracerebral haematoma especially with reformatted coronal and sagittal planes. The CT scan differentiating between acute, subacute and chronic I.C.H depending on the attenuation value (density and CT number) of the hematoma. In addition, it is more informative about bony lesion, like skull fracture which usually accompanied them. The CT is faster than MRI so, it can be used in emergency rooms (ER) in the hospitals to deal with cases in traumatic and accidental situation. The CT has no contra-indication apart from risk of radiation

and allergy to the contrast medium which may be used. The CT gives diagnostic information superior to the MRI in the diagnosis and evaluation of ICH, beside that, the CT is superior in detection of bony lesion (fracture) and calcification so we recommend that the CT is a good imaging modality in the early diagnosis of acute intracerebral haematoma in comparison with MRI, in addition to that, it is a faster imaging modality than MRI, so it can be used in casualty departments.

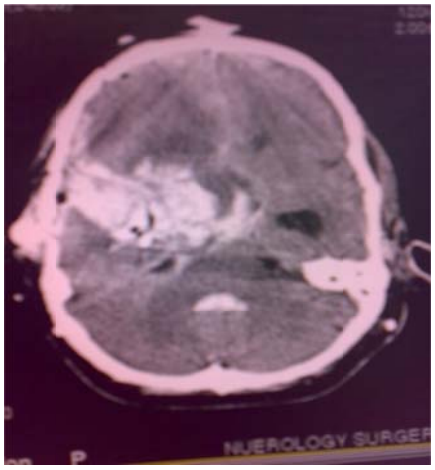

Fig.1: ICH causes midline shifting

fig.2 Rt. Basal ganglia ICH

Fig.3: Right and left lateral IVH

Fig. 4: Acute IVH with evident skull fractures

References:

1. D Sutton. Intracerebral haemorrhage. Textbook of Radiology & imaging.Vol.2. London, Churchill Livingstone, 2002:Pp. 1767-80.

2. J John Wasenko, Leo Hochhauser. Central nervous system trauma. CT and MRI of the whole body. Vol.1, 5th ed. Mosby. 2009:Pp.298-301.

3. W Ralph, J Mark, W Jack. Intracranial hemorrhage. Primer of diagnostic imaging. Second edition. Mosby. 1997:Pp.464-465.

4. VN Kornienko, IN Pronin. Intracerebral haemorrhages. Diagnostic neuroradiology. Springer-Verlag Berlin Heidelberg, 2009:Pp..176-188.

5. Daniel. Statistical analysis in medical research. 4th edition. 2008. Pp.155.

6. GK Wong, BY Tang. Traumatic ICH is the CT pattern related to outcome. British journal of neurosurgery. Dec.2009; 23(6):Pp.601-5.

7. R Latfor, M Shafique, A Intekhab, AK Mohinddin, MA Karim. Surgery in hypertensive Intracerebral hematoma: Journal of Teacher Association: 2007:20(2):127-128.

8. PS Marchio. Sequel of severe head injury. Minimally invasive neurosurgery and multidisciplinary neurotraumatology. Japan, Kobe; vol.5.2008:Pp.431-95.

9. Khan S, Khan N, Sameer M, Abdul Qayyum R. Evolution of traumatic intracerebral hemorrhage captured with CT imaging. Emergency radiology, 2010, vol. 17, no.6, Pp.493-6.

10. Wei SC, Ulmer S, Lev MH. Value of coronal-reformations in the CT evaluation of acute head trauma. AJNR (am.j. neuroradiology), 2010; 31:Pp.334-9.

11. Hallevi H., Dar NS. The intraventricular hemorrhage score: a novel tool for estimating IVH volume: clinical and research implication. Critical care medicine. March, 2009; 37(3):Pp.969-74.

12. Liebeskind DS. Neurological emergencies/ intracranial haemorrhage. (Http//www. emedicine.com). Oct 2010.