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RESEARCH ARTICLE
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ROLE OF COMPUTED TOMOGRAPHY IN EVALUATION OF SITE, VOLUME OF SPONTANEOUS INTRACRANIAL HAEMORRHAGE

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ABSTRACT

A stroke is a sudden disruption of the cerebral circulation or perfusion. Intracerebral hemorrhages (ICH) account for about 10 percent of strokes. For the treating physician to determine the location and extent of hemorrhages, evaluate the likelihood of an imminent brain injury, and establish a treatment plan, neuroimaging has become a crucial tool.

Objectives: Evaluation of the location, type, and volume of intracranial hemorrhage using CT images. METHODS: It's a prospective observational study conducted among 100 patients with ICH. Patients with intracranial tumors and clotting disorders were excluded. CT serial sections of the brain are taken at an interval of 5 mm.

Results: Of the subjects, 63% are male and 37% are female. Intraventricular hemorrhage was 1%, primary subarachnoid hemorrhage was 21%, and intraparenchymal hemorrhage was 78%. 93% of people had hypertension, and 67% had diabetes. Of the 78 IPH patients, 55 had hemorrhages ranging from 0 to 30 ml, and 19 had hemorrhages ranging from 31 to 60 ml. Four patients had hemorrhages exceeding 60 ml. After six months, the mortality rate was 6%. There were four, one, and one fatality among IPH, SAH, and IVH.

Conclusion: Nontraumatic spontaneous ICH was most prevalent in 40–60-year-olds. Males are more affected. Hypertension is the main reason. CT improves patient treatment by detecting cerebral hemorrhage early. The most prevalent spontaneous, nontraumatic intracranial hemorrhage was intraparenchymal. Most of the hypertensive intracerebral bleeding begins in the thalamus and basal ganglia.

Keywords: Hemorrhage, Intracranial, Hypertensive, Tomography

INTRODUCTION:

A stroke, also known as a cerebrovascular accident (CVA), is a sudden disruption of the cerebral circulation or perfusion.[1] Age-related increases in stroke incidence and mortality are significant. About 16 to 80% of patients die from cerebral hemorrhage, and 15 to 30% die from cerebral infarction. The survivors are mostly permanently disabled. Consequently, stroke turns into a serious medical and social issue. Since newer and more effective medications are currently being implemented, an accurate and timely diagnosis may improve the morbidity and mortality rates in the future.[2] Intracerebral haemorrhages (ICH) account for about 10 percent of strokes.[3] It may cause an ICH, which often necessitates prompt neuroimaging and can exacerbate neurological problems. For the treating physician to determine the location and extent of hemorrhages, evaluate the likelihood of an imminent brain injury, and establish a treatment plan, neuroimaging has become a crucial tool.[4] Before the invention of computed tomography (CT) in 1972, angiographic results were the only way to diagnose spontaneous brain bleeding. Intracranial illness diagnosis was transformed by CT, which is now the main diagnostic method used to assess a patient who has just experienced an acute stroke.[5,6] This study was conducted to evaluate the role of CT in the assessment of ICH.

AIMS AND OBJECTIVES

1. Evaluation of the location, type and volume of intracranial haemorrhage.
2. To identify the following cerebral haemorrhage-related characteristics:

a) Site of the bleeding.
b) Intraventricular extension.
c) Effect of the mass in the form of shift of the midline.
d) Sub arachnoid extension.

MATERIALS AND METHODS:

Study design: prospective observational study.
Study setting: ACS Medical college and hospital.
Study period: 2years
Sample size: 100

Inclusion Criteria

1) Patients of both males and females older than 20.
2) Individuals who have clinical signs of an ICH.

Exclusion Criteria

1) Individuals with a history of head injury.
2) Individuals diagnosed with intracranial tumor.
3) Individuals diagnosed with clotting disorder

DATA COLLECTION:

CT serial Sections of the brain are taken at an interval of 5 mm. Scan times for uncooperative patients are cut by up to one second. For restless patients, sedation with intravenous diazepam (dosages ranging from 5 mg up to 20 mg) was administered.

A straightforward method was used to determine the brain hemorrhage volume. The formula (A B C) / 2 approximates the volume of the ellipsoid, where A is the largest bleed diameter of an axial CT scan and B is the most enlarged diameter 90 degrees from A. C stands for the product of the thickness of the slice and the number of CT slices with hemorrhage. The extent of the cerebral bleeding was divided into the following categories:

1) Volume of zero to thirty cc.
2) Volume of thirty-one to sixty cc.
3) Volume greater than sixty-one cc.

Statistical analyses were performed using SPSS version 28.0 and Prism version 6.0. Descriptive statistics are presented either as mean and SD, or median with interquartile range for continuous variables, and number and percentage of the sub-total for categorical variables. Categorical variables were compared using $\chi 2$ or Fisher exact tests, and continuous variables using the Kruskal-Wallis or Student t test.

RESULTS:

Table 1: subjects' distribution

	Intraparenchymal (N=28)	**Subarachnoid (N=21)**	**Intraventricular** (N=1)
Age distribution (years)			
20 to 39	3 (3.8%)	5 (23.8%)	0 (0%)
40 to 59	24 (30.8%)	12 (57.1%)	0 (0%)
60 to 69	30 (38.5%)	1 (4.8%)	0 (0%)
>70	21 (26.9%)	3 (14.3%)	1 (100%)
Gender			
Male	53 (67.9%)	13 (61.9%)	1 (100%)
Female	25 (32.1%)	8 (38.1%)	0 (0%)
History of hypertension			
Yes	78 (100%)	14 (66.7%)	1 (100%)
No	0(0%)	7 (33.3%)	0 (0%)
History of Diabetes:			
Yes	59 (75.6%)	14 (66.7%)	1 (100%)
No	19 (24.4%)	7 (33.3%)	0 (0%)
Volume of IPH (ml)			
0-30	55 (70.5%)		
31-60	19 (24.4%)	-	-
>60	4 (5.1%)		
Site of IPH			
Lobar	19 (24.4%)		
Basal nuclei	33 (42.3%)	-	-
Thalamo ganglia and thalamus	14 (17.9%)		
Brain stem and cerebellum	12 (15.4%)		
6-months mortality	4 (5.13%)	1 (4.76%)	1 (100%)

37% of the patients in this study are female, whereas 63% of the patients are male. People between the ages of 60 and 69 are more likely to get intraparenchymal hemorrhage. 40–59 age range is the maximal age group for SAH. In the age range over 70, there was only one instance of main IVH. IPH patients were 67 years old on average. In the current study, intraparenchymal hemorrhage occurred in 78% of cases, primary subarachnoid hemorrhage occurred in 21% of cases, and intraventricular hemorrhage occurred in 1% of cases. In total, 67% had diabetes and 93% had a history of hypertension.

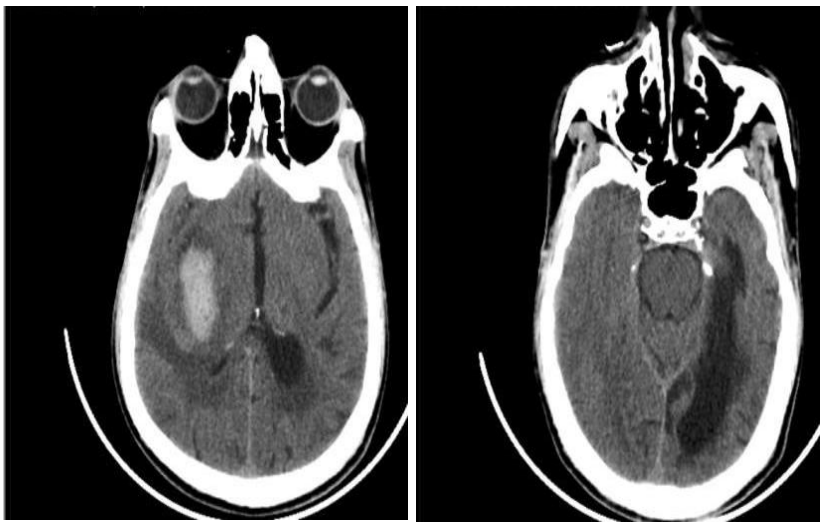

Figure 1 - Acute intraparenchymal haemorrhage of size 4.3x2.2x3.4cm with surrounding edema noted involving right corona radiata, lentiform nucleus, internal, external capsule,superior temporal lobe. Area of gliosis in left occipital lobe with ex vacuo dilatation of left posterior horn of lateral ventricle.

The amount of bleeding in 55 of the 78 IPH patients was between 0 and 30 ml, 19 of them were between 31- and 60 ml. 4 had a bleed volume of more than 60 ml. 34 out of 78 IPH patients with hypertension experienced basal ganglia bleeding, 20 experienced lobar haemorrhages, 9 experienced thalamic bleeding, 5 experienced thalamo ganglia bleeding, 6 experienced cerebellar bleeding, and 4 experienced brain stem bleeding.

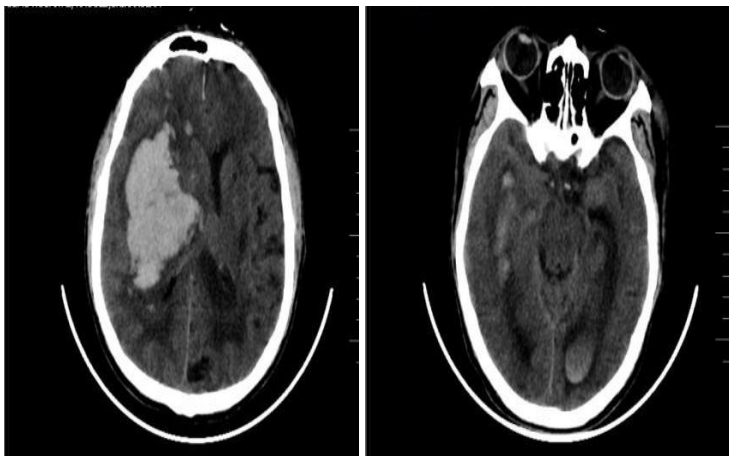

Figure 2: An ill-defined hyperdense area of haemorrhagic attenuation (HU 62-65) measuring 7.6x5.8x5.1cm with surrounding edema involving caudate nucleus, lentiform nucleus, internal capsule, external capsule, insula extending superiorly upto corona radiata and inferiorly upto superior temporal lobe and extending into the temporal horn of ipsilateral ventricle and the occipital horn of contralateral with midline shift of 8.8mm to opposite side Hyperdense haemorrhagic attenuation noted in midline falx-non traumatic subarachnoid haemorrhage.

Over six months of follow-up, the overall death rate was 6%. The number of deaths among IPH, SAH, and IVH was 4, 1, and 1, respectively.

DISCUSSION:

Computer tomography is the best modality to detect the haemorrhage in the brain. In this study, spontaneous intracranial bleeding that is not traumatic was higher among males (63%) as compared to females (37%). A greater frequency of cerebral haemorrhage was discovered in males by Seppo Jevela39 and, when comparing males (61.54%) to females (38.46%), which is similar to our findings.

In present study, we established that intraparenchymal bleeding occurs more frequently than subarachnoid haemorrhage by a factor of more than two. Study carried out by Broderick J.P. et al4 in 1993 intraparenchymal bleeding occurs more frequently than subarachnoid haemorrhage by a factor of more than two.

11 cases out of 21 cases of primary subarachnoid bleeding had their peak occurrence between the ages of 40 to 59. According to a study by Herebert P. Locksley19, people with subarachnoid haemorrhages seem to be between the ages of 40 and 64.

In the present study 32 percent of the cases with intraparenchymal bleeding had an intraventricular extension. In the remaining 68 percent cases, there was no intraventricular extension.

CT in intraparenchymal haemorrhage: Intraparenchymal hemorrhage CT characteristics alter over time and are correlated with neurological and pathological changes. The value of CT has a linear connection with bleeding. Intact RBCs have high protein content which causes a well-marginated hyperdense mass to appear on a non-enhanced CT.

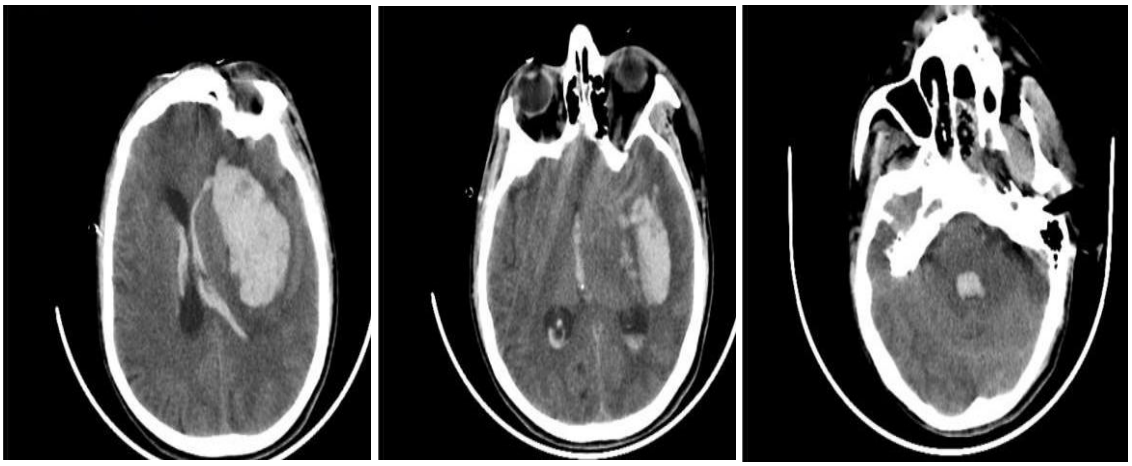

Figure 3 - Hyperdense area of haemorrhagic attenuation (HU-64-72) size measuring 7.6x5.6x3.7cms noted involving left capsuloganglionic region & entire temporal. Hemmoraghe is seen extending into body & occipital horns of bilateral lateral ventricles, third & fourth ventricles with surrounding hypodense area–Acute intraparenchymal haemorrhage with surrounding edema with intra-ventricular extension.

According to New and Avnow's measurements, the attenuation of fresh blood is approximately 56 HU9. A fresh hemorrhage on NCCT displays a homogenous (55–90 HU) circular to oval-shaped lesion with a defined density. A few hours after the bleeding have ceased, the hematoma is surrounded by a distinct, low-density zone. The coagulation of liquid bleeding at the hematoma's edge and the extrusion of low-density plasma produces this rim. After three to four days, an additional low-density region on CT emerges surrounding a hematoma that is growing in the outer reaches of the white matter. Significant midline displacement and brain herniation can result from hemorrhages that are large enough.[7,8]

A hematoma that is not evenly dense should be the consequence of trauma, infection, or internal bleeding within a tumor. CECT aids in the differentiation process by exhibiting abnormally enhanced bleeding. In an anemic patient, acute hemorrhage may develop at the same density as the brain parenchyma.[8]

The density of the hemorrhage entirely disappears during the following two to three months in CT. The hematoma transitions from the isodense stage to the hypodense stage. A well-defined low-density zone that may be significantly smaller than the main lesion at the site of the actual bleeding at its final stage, which can last anywhere from three to six months, based on the starting size. Small hematomas often leave behind a cystic region that looks like a slit. Along with the sulcal expansion the ventricle's surrounding region enlarges. At hematoma sites, calcification seldom happens

When the hematoma is at its isodense stage, NCCT may show no irregularity aside from a slight residual influence of the mass. In contrast, the ring-shaped contrast enhancement on CECT occurs

during the isodense phase and initially during the hypodense phase. The ring pattern that seems to be around a core that is isodense, hypodense, or has no mass impact has improved by the third or fourth week, and the surrounding edema has subsided.[7]

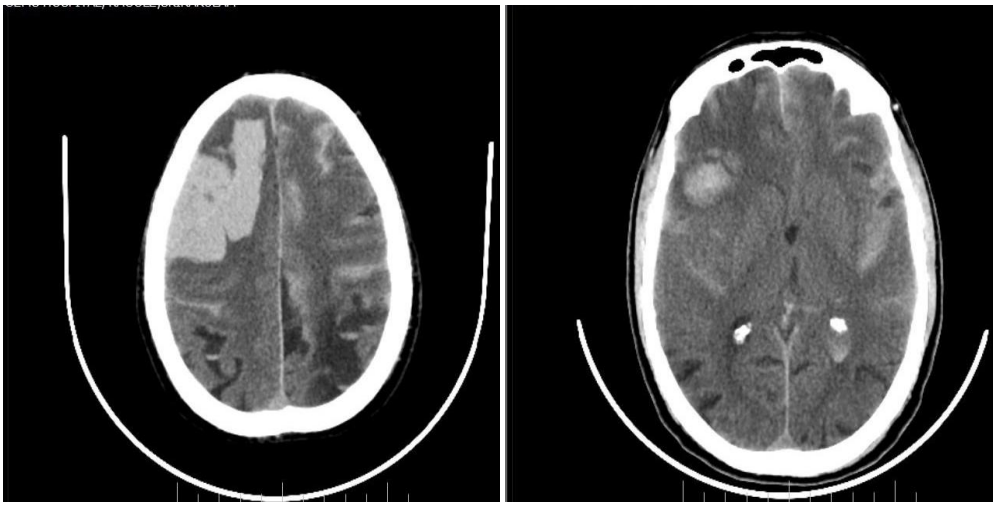

Figure 4 - Area of haemorrhagic attenuation measuring 8.2x4.6x4.5cm (APXCCXML) with surrounding edema noted involving right frontal region and extending into occipital horn of left lateral with midline shift of 5mm to opposite side. Hyperdense haemorrhagic attenuation noted in midline falx, bilateral sulcal spaces, and sylvian fissures- non-traumatic subarachnoid haemorrhage.

HYPERTENSIVE HAEMATOMA

Hypertension is often the cause of spontaneous intracerebral bleeding. Over time, hyaline fibrinoid degeneration brought on by hypertension causes changes in the media of the small cerebral arteries. Furthermore, Charcot-Bouchard microaneurysms are seen in the walls of the tiny arterioles in the autopsies of people with hypertension.[8]

Location of Hypertensive Intracerebral Haematoma:

Of the 78 patients who had intraparenchymal hemorrhage with hypertension, 34 had basal ganglia bleeding, 20 had lobar bleeding, 9 had thalamic bleeding, 5 had thalamic ganglia bleeding, 6 had cerebellar bleeding, and 4 had brain stem bleeding.

According to Tatu L. Maulin T. et al., the lobar 36%, lenticular 32%, caudate 17%, thalamic 15.7%, cerebellar 8.8%, brain stem 2%, and intraventricular 2% are the locations of hypertensive intracerebral hemorrhage.[9]

Another study by Kase C.S. et al. found that hypertensive intracerebral hemorrhage occurred in the putaman 33%, lobar 23%, thalamic 20%, cerebellar 8%, pontine 7%, and miscellaneous 9 percent.[10]

Intraventricular Haemorrhage

A choroid plexus tumor or vascular anomaly may be the source of infrequent primary intraventricular hemorrhage. Paraventricular bleeding, which occurs when blood reaches the ventricles immediately without creating a large parenchymal clot, is the most common cause of these hemorrhages. CT shows intraventricular hemorrhage as a hyperdensity within the ventricles.[11]

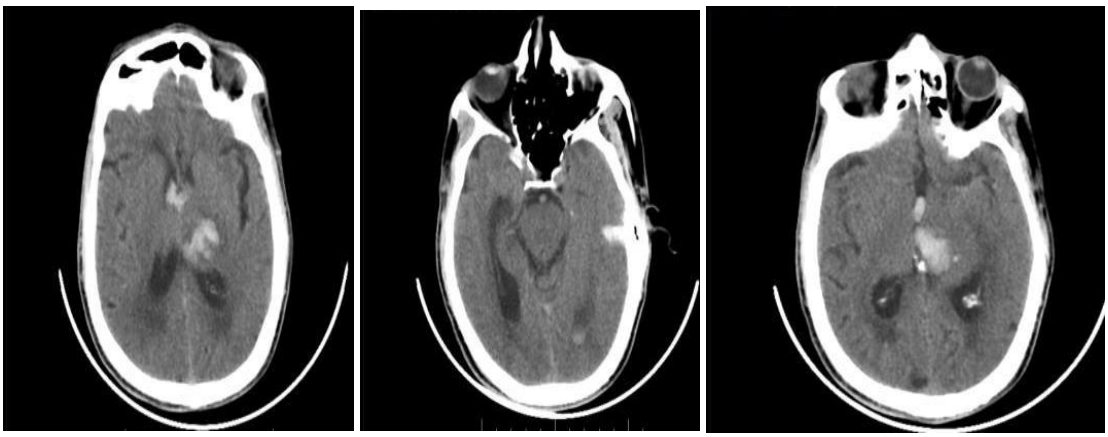

Figure 5- Area of haemorrhagic attenuation measuring 2.3x2.1x1.7cm (APXMLXCC)with surrounding edema noted involving left thalamus and extending into the frontal and occipital horn of bilateral lateral ventricle, third and fourth ventricle

Sub Arachnoid Haemorrhage:

Bleeding into the subarachnoid space is known as SAH. Subarachnoid hemorrhages account for an average of 10% of all brain hemorrhagic episodes. As soon as the patient's history and examination are evaluated, CT scan should be performed. According to a study by Peter Whitefield, all patients with suspected SAH require an early CT brain scan to demonstrate bleeding. If conducted within 24 hours, this research has a high sensitivity of 93%.[12]

Cerebral aneurysms are the most common cause of subarachnoid hemorrhage after trauma. These often show up as subarachnoid hemorrhage. Eighty to ninety percent of non-traumatic subarachnoid hemorrhages are caused by a ruptured cerebral blood artery. Arteriovenous malformation is a much less common cause than aneurysm, accounting for less than 5% of subarachnoid hemorrhages.[6,13]

Because it displays subarachnoid blood and pinpoints the exact location of the ruptured aneurysm, the CT scan usually acts as confirmation. To avoid an unexpected tonsillar herniation downward, the CT scan is typically done before the lumbar puncture. If the CT scan reveals significant ventricular enlargement or a significant influence of the mass from a hemorrhage, then the lumbar puncture operation is dangerous. The scan may also show the impact of the mass from the swelling brought on by the infarction. But usually, this is a delayed effect that doesn't show up until about a week after the hemorrhage and is caused by symptomatic cerebral vasospasm.[14]

To see the CT appearance of subarachnoid blood on the NCCT scan (non-contrast scan), a sizable volume of bleeding in the subarachnoid space will provide adequate spatial and contrast resolution. The length of time the blood maintains its extremely absorbent appearance depends on the bleeding in that specific place. This ranges from a week to as short as a day. The clot will eventually become isodense, with a density similar to that of a nearby brain. Here, the isodense blood could ruin the basal cisterns and subarachnoid space. Cerebrospinal fluid, or CSF, replaces the blood. Cisternal gaps return to their low absorption levels after a week or two. A CT scan may show much more iso-dense bleeding in anemic patients whose hemoglobin level is approximately 5 grams per 100 milliliters.[8]

CONCLUSION:

A total of 100 patients with ICH were analyzed for this study. According to the study, nontraumatic spontaneous ICH was most common in people aged 40 to 60. Males have a higher incidence. Hypertension is the primary cause of non-traumatic spontaneous cerebral hemorrhage. Hypertension affected 93% of the participants. Nontraumatic spontaneous cerebral hemorrhage is quite common above the age of 60.

For the early diagnosis of cerebral bleeding, CT offers an effective imaging modality that enhances patient care. Primary subarachnoid hemorrhage occurred in 21 individuals. Intraparenchymal hemorrhage was the most common form of spontaneous, nontraumatic intracranial hemorrhage. There

was only one patient who experienced an intraventricular hemorrhage. The thalamus and the basal ganglia are the initial and most common locations for hypertensive intracerebral hemorrhage.

CONSENT FOR PUBLICATION

All the authors have checked and approved the manuscript**.**

CONFLICT OF INTEREST

The authors declare no conflict of interest in the study.

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