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Original Research Paper

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ROLE OF HU & H:H RATIO ON UNENHANCED CT BRAIN IN DIAGNOSIS OF CEREBRAL VENOUS SINUS THROMBOSIS

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ABSTRACT

BACKGROUND: Cerebral venous sinus thrombosis (CVST) is characterized by a highly variable clinical spectra, difficult diagnosis, variable etiologies and prognosis. CT brain is usually the first investigation in suspected cases of acute-onset intracranial pathology including CVST. Purpose of this study was to assess HU (Hounsfield Unit) & H:H (HU:Hematocrit) ratio on unenhanced CT brain in patients with CVST and to compare them with values in patients without CVST.

MATERIALS & METHODS: This prospective study was done in our institute B.J. Medical college & Civil Hospital, Ahmedabad, Gujarat, India. Study included 100 patients of unenhanced CT brain with application of inclusion & exclusion criteria. Patients were divided into two groups (Group A: with CVST & Group B: without CVST). HU value & H:H ratio were compared between Group A & Group B.

RESULTS: The mean HU in patients with CVST was 75, which was higher than that of patients without CVST (56 HU). Statistical analysis by using t-test showed that the difference between HU values of both groups (i.e., with CVST and without CVST) was statistically significant. Difference between H:H ratios of both groups was also statistically significant.

CONCLUSION: We have found that average sinus density > 70 HU & H:H ratio > 1.8 are highly specific findings of acute CVST on unenhanced CT brain. We have also found that H:H ratio is slightly better indicator of acute CVST than HU value in few cases (particularly in cases having HU value 60-70). Radiologists should be aware of false positive & false negative findings on unenhanced CT brain for CVST.

KEYWORDS : Hounsfield Unit, H:H ratio, Unenhanced CT brain.

INTRODUCTION:

Cerebral venous sinus thrombosis (CVST) is characterized by a highly variable clinical spectra, difficult diagnosis, variable etiologies and prognosis.[1] There is sex predominance (hormonal?); 75% of all CSVT patients are women, with a 3:1 ratio compared to men.[2]

Headache, seizure and focal neurologic deficit are the most frequent symptoms in these patients, whereas headache as the most commonly reported complaint occurring in up to 90% of all patients.[3,4,5,6] CT Brain is usually the first investigation in suspected cases of acute-onset intracranial pathology including CVST. Purpose of this study was to assess HU (Hounsfield Unit) & H:H (HU:Hematocrit) ratio on unenhanced CT brain in patients with CVST and to compare them with values in patients without CVST.

MATERIALS & METHODS:

Study Type: Prospective study

Study Period: January 2019 to December 2019

Study Setting: Department of Radiology, B.J. Medical college & Civil Hospital, Ahmedabad, Gujarat, India.

Sample Size: 100 patients

Study Procedure: For selection of patients, we had formulated inclusion & exclusion criteria.

Inclusion Criteria:

All patients who had fulfilled following two criteria were included in our study:

- Patient had undergone unenhanced CT brain followed by CT venography or MR venography within period 3 days
- Patient's blood sample for complete blood count had been drawn within 24 hours of (before or after) unenhanced CT brain

Exclusion Criteria:

All patients who had fulfilled one or more of the following criteria were excluded from our study:

- Hypoplastic sinus/sinuses
- Recent neurosurgery (within 7 days)
- Recent head injury (within 7 days)
- Past history of CVST
- Artifact interfering in evaluation of sinus/sinuses

CT scans were done using SIEMENS SOMATOM Definition AS 128 slice CT scanner. Axial scan of brain was performed in all patients. Sinus density (HU value) was measured by placing ROI (region of interest) within the lower part of superior sagittal sinus [Figure 1] or confluence of sinuses without including sinus wall or artifact from the adjacent calvarium. Mean/average density (HU) of ROI was recorded. In cases of apparent hyperdensity confined to limited part of sinus system, ROI was placed at site of maximum apparent hyperdensity. Hematocrit of all patients were recorded. Sinus density (HU) was divided by hematocrit to obtain H:H ratio. Patients were divided into two groups (Group A: with CVST & Group B: without CVST) on basis of findings of CT venography or MR venography. HU value & H:H ratio were compared between Group A & Group B.

RESULTS:

In our study, age of patients were in range of 10 to 92 years. After analysis of data of 100 patients, following results were obtained.

Table 1: Gender Wise Distribution

Group	No. of Male Patients	No. of Female Patients	Total No. of Patients
Group A (with CVST)	4	11	15
Group B (without CVST)	50	35	85
Total	54	46	100

Table 2: Range & Mean Of Hu & H:h Ratio In Both Groups

Group	Range of HU	Mean HU	Range of H:H ratio	Mean H:H ratio
Group A (with CVST)	68-85	75	1.8-2.3	2.14
Group B (without CVST)	45-70	56	1.21-1.73	1.48

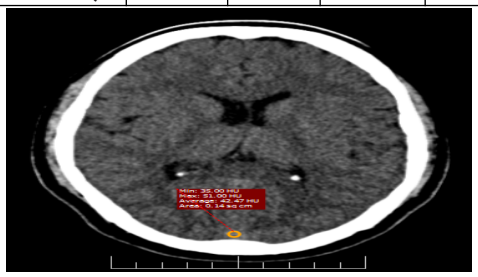
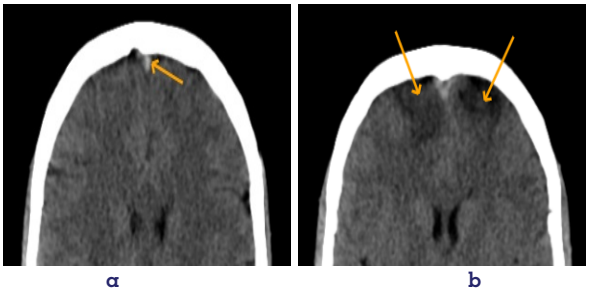


Figure1. Unenhanced Ct Brain Showing Roi Placed In Lower Part Of Superior Sagittal Sinus.



a b

Figure2. Axial Unenhanced Ct Brain : Hyperdense Thrombus In Anterior Part Of Superior Sagittal Sinus (arrow In Figure 'a') & Resultant Hypodensity In Bilateral Anterior Frontal Lobe (Arrows In Figure 'b').

Out of 15 cases of CVST, 10 cases were having secondary changes in brain parenchyma in form of hypodensity (oedema or infarct) with or without haemorrhage on CT scan [Figure 2]. Statistical analysis by using *t*-test showed that the difference between HU values of both groups (i.e., with CVST and without CVST) was statistically significant. Difference between H:H ratios of both groups was also statistically significant. Linear regression analysis showed positive correlation between Hematocrit & HU value in patients without CVST.

DISCUSSION:

In our study, out of 15 cases of CVST, 4 were male & 11 were female. It correlates with high F:M ratio in CVST mentioned in literature. In our study, the mean HU in patients with CVST was 75, which was higher than that of patients without CVST (56 HU). We found that average sinus density > 70 HU & H:H ratio > 1.8 were highly specific findings of acute CVST. In few cases (particularly in cases having HU value 60-70), H:H ratio was slightly better indicator of acute CVST than HU value. There was one limitation of our study; all 15 patients of CVST in our study were having acute CVST as their unenhanced CT brain was performed within 3 days of onset of symptoms. Subacute & chronic CVST shows lower density on unenhanced CT brain.

Few studies have been conducted about CVST in the past.

In a study conducted by Buyck *et al.*[7], they reported that the mean of attenuation in thrombosed venous sinuses was 73.9 HU. They reported that H: H ratio in patients with and without CVST is 1.91 and 1.33, respectively. They reported a cutoff value of 1.52 as a threshold to suspect the presence of thrombosis.

In a study conducted by Black *et al.*[8], 7 of 8 cases with sinus thrombosis showed the attenuation value >70 HU. They calculated the H: H ratio on CT scans in patients with CVST and showed that the mean of H:H in patients with CVST (2.20 HU) is more than in patients without CVST (1.44 HU). They reported that H: H ratio >1.8 can be strongly related to the presence of thrombosis.

In a study conducted by Alsafi *et al.*[9], the mean of attenuation in patients with CVST was 68 HU, and they reported that attenuation of the venous sinus ≥67 is associated with a high probability of CVST.

The H:H ratio can be useful when the increase in attenuation may be misleading by other causes. The hemoconcentration may cause CT attenuation to appear as if patients have thrombosis when they in fact do not. Few case reports indicate that patients with high Hematocrits, usually those with polycythemia vera, may have very high attenuation within the dural sinuses on unenhanced CT, mimicking the appearance of sinus thrombosis.[10] Still other case reports demonstrate that patients with low Haemoglobin or Hematocrit values may exhibit unexpectedly low HUs within areas of intracranial hemorrhage.[11]

In our study, a statistically significant correlation was found between Hematocrit values & HUs in patients without CVST. Results of our study also support the previously suspected correlation between sinus density and hematocrit. H:H ratio is other valuable measurement to diagnose acute CVST. It is important to point out that a normal HU does not exclude the presence of a clot in the venous sinuses and that in the proper clinical setting of a patient with unexplained symptoms and possible risk factors for clot, further definitive imaging studies should be used despite a negative head CT.[8]

CONCLUSION:

HU value and H:H ratio are reliable indicators on unenhanced CT brain for diagnosis of acute CVST, however confirmatory study is required in few cases. From our study, we have found that average sinus density > 70 HU & H:H ratio > 1.8 are highly specific findings of acute CVST on unenhanced CT brain. We have also found that H:H ratio is slightly better indicator of acute CVST than HU value in few cases (particularly in cases having HU value 60-70). Radiologists should be aware of false positive & false negative findings on unenhanced CT brain for CVST. Confirmatory study should be performed in case of mismatch between clinical features of patient and radiological findings on unenhanced CT brain.

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