IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 19, Issue 7 Ser.5 (July. 2020), PP 29-32
www.iosrjournals.org

Evaluation of the Effect of Hemoglobin or Hematocrit Level on Dural Sinus Density Using Unenhanced Computed Tomography

Dr. Pankaj Kumar Nitharwal[1], Dr. Reena Mathur[2], Dr. Om Prakash[3], Dr. Suresh Jat[4]

[1] MBBS,DNB (Radiodiagnosis), [2] MBBS, MD (Radiodiagnosis), [3,4] Resident Doctor (Radiodiagnosis)
Department of Radio Diagnosis, J L N Medical college, Ajmer
Correspondence author- Dr. Pankaj Kumar Nitharwal

Abstract
Background- To identify the relationship between hemoglobin (Hgb) or hematocrit (Hct) level and dural sinus density using unenhanced computed tomography (UECT).
Methods-100 Patients who were performed UECT and had records of a complete blood count within 24 hours from UECT were included. We measured the Hounsfield unit (HU) of the dural sinus at the right sigmoid sinus, left sigmoid sinus and 2 points of the superior sagittal sinus.
Results-The mean densities of the dural sinuses ranged from 26.00 to 58.75 HU (mean= 48.13 HU). There was a strong correlation between mean density and Hgb level (r=0.52) and between mean density and Hct level (r=0.84).
Conclusion- Dural sinus density on UECT is closely related to Hgb and Hct levels. Therefore, the Hgb or Hct levels can be used to determine whether the dural sinus density is within the normal range or pathological conditions such as venous thrombosis.
Key Words- *Dural sinus, density, CT, hemoglobin, hematocrit*

Date of Submission: 23-06-2020 Date of Acceptance: 11-07-2020

I. Introduction

Computed tomography (CT) uses a computer to reconstruct a cross-sectional image of the body from measurements of x-ray transmission through thin slice of patient tissue. [1] One or more detectors [2] are used for detection of the x-ray beam attenuated by absorption and scatter as it passes through the patient. CT numbers are assigned to each pixel in the image by a computer algorithm that uses as data these measurements of transmitted x-rays [3]. CT pixel numbers are proportional to the difference in average x-ray attenuation of the tissue within the voxel and that of water. A Hounsfield unit (H) scale, named for Sir Godfrey N. Hounsfield, the inventor of CT, is used. Water is assigned a value of 0 H, with the scale extending from 1,024 H for air. [4]

Pathological conditions involving the dural sinuses are uncommon, but cases of dural sinus thrombosis (DST) or cerebral venous thrombosis (CVT), with an annual incidence of 3 to 4 cases per million adults, are not unusual. These cases account for approximately 1-2% of all strokes in adults and affect all age groups. DST often presents with highly variable symptoms such as headache, dizziness, visual disturbance, focal neurologic deficits, seizures, and impaired consciousness. DST has a wide clinical spectrum and onset is often subacute; therefore, the average delay from the onset of symptoms to diagnosis is 7 days[5]

In this study, we quantitatively measured the density of dural sinus including the sigmoid sinuses (SS) in normal populations and evaluated the effect of hemoglobin (Hgb) or hematocrit (Hct) on variability of dural sinus density on UECT.

II. Material And Methods

Inclusion and exclusion criteria

The 100 patients included in this study were admitted to JLN Medical College, Ajmer. Inclusion criteria consisted of patients with UECT of the brain and a complete blood count (CBC) test acquired within a 24-hour period, regardless of patient symptoms or signs. However, patients who were clinically suspected to have DST were excluded.

Exclusion criteria included intracranial hemorrhage or skull fracture adjacent to dural sinuses, an increased intracranial pressure condition such as hydrocephalus, severe brain swelling, intra-axial or extra-axial mass, recent interventional or surgical treatment, intravenous or intraarterial iodinated contrast media administration within the previous 24 h. Patients receving a blood transfusion within the previous 24 h were also excluded.

UECT imaging protocol UECT was performed using a 16-detector row CT scanner (Philips CT machine) using axial or helical methods. In the axial method, the gantry tilt was parallel to the orbito-meatal line, and in helical method, the images were reconstructed parallel to the line. The following parameters were used: a peak kilovoltage of 120 kVp, variable tube currents (179-450 mA) from an automatic exposure system, section thickness of 5 mm, and a reconstruction increment of 5 mm.

Image interpretation

Axial UECT scan were retrospectively reviewed. Axial scans that showed the fewest beam hardening artifacts were selected for analysis. The dural sinus densities were measured using the circle regions of interest (ROI) method at 3 or 4 points including the right SS, left SS and 2 points of the SSS (upper 1/2 and lower 1/2 of dorsal SSS) on axial sections. One or both SS were required for use in the ROI measurement. The ROI area was set to a limit of 10-20 mm2 and we used a circular ROI area as large as possible that could be measured at three or more points. Identical circular ROIs in one patient were used by copying and pasting. The exclusion criteria of UECT during image interpretation were as follows: cases in which the ROI could not be measured in both SS and in at least 3 points because of significant artifacts such as beam hardening or partial volume, undifferentiated sinuses with brain parenchyma, or small dural sinuses.

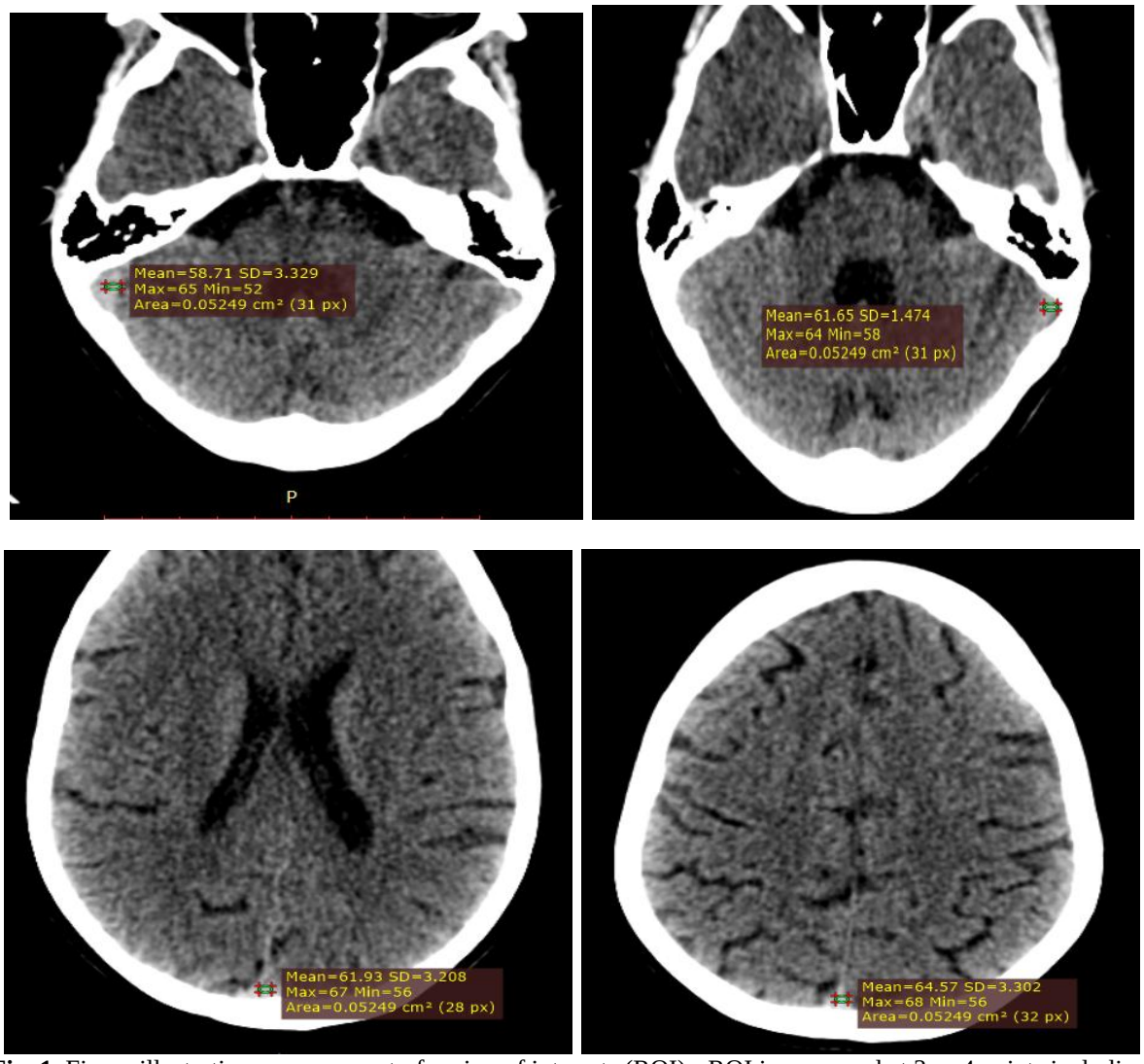

Fig. 1. Figure illustrating measurement of region of interests (ROI) - ROI is measured at 3 or 4 points including right sigmoid sinus (SS), Lt. SS and 2 points of superior sagittal sinus.

III. Results

Table 1. Demographic profile

Mean age ± SD in years	51.23± 12.35 Yrs
Male : Female	68 : 32

The total population (n=100) consisted of 68 men and 32 women (range, 16-78 years; mean age, 51.23 years).

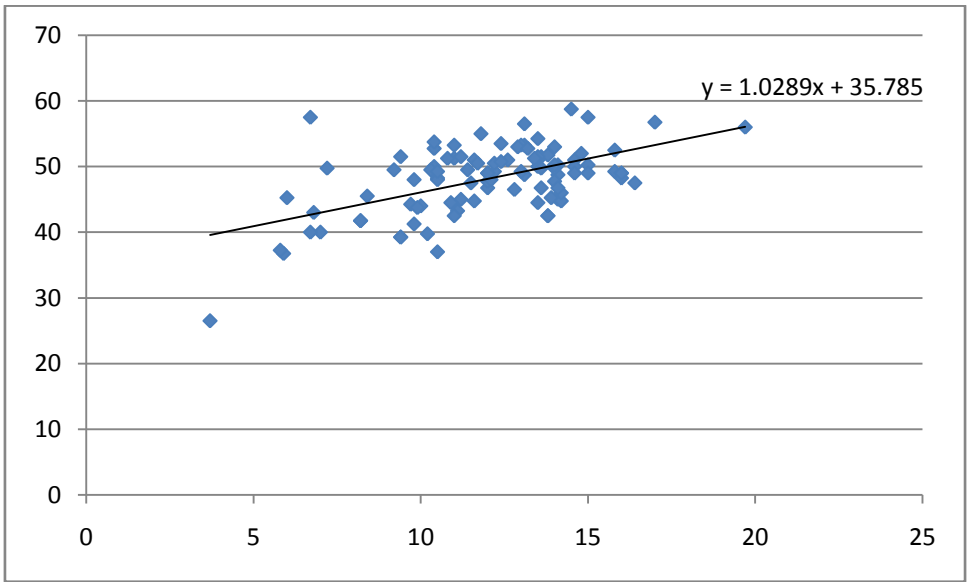

Fig. 2. Graph illustrating the correlation between mean HU and Hgb. There was a strong correlation between mean HU and Hgb levels (r=0.0.52).

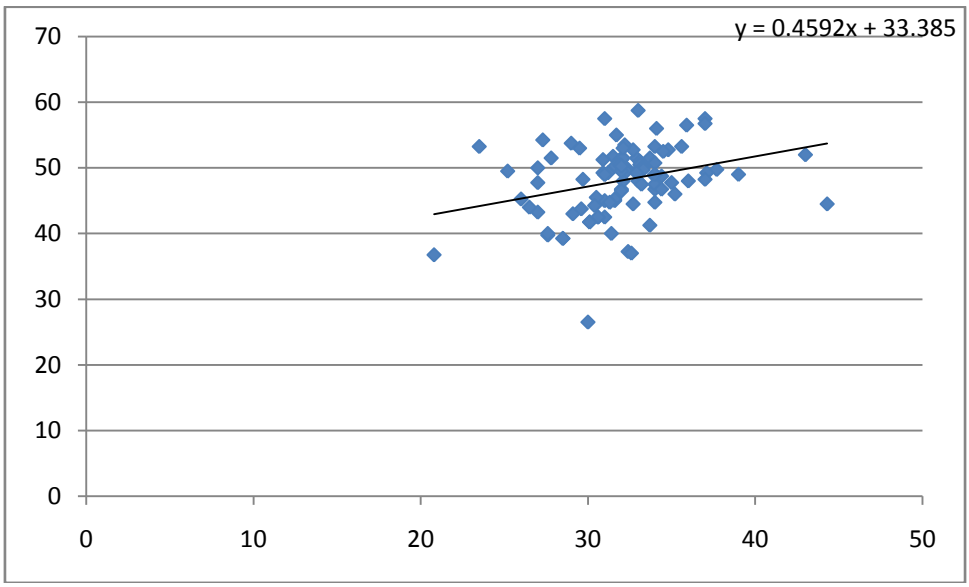

Fig. 3. Graph illustrating the correlation between mean HU and Hct. There was a strong correlation between mean HU and Hct levels (r=0.84).

IV. Discussion

MRI with MR venography is commonly considered, the noninvasive "gold standard" in diagnosing CVT However,[6] DST often presents with highly variable symptoms, so UECT is usually the first imaging modality for most of them. The hyperattenuating signs in UECT are occasionally observed when an acute clot has formed in a vessel and can be seen in various vascular diseases, including acute arterial occlusion, acute arterial dissection, aneurysm rupture and acute venous thrombosis.[7] As a thrombus retracts, water content decreases, Hct concentration increase, and its attenuation value subsequently increase to 50-80 HU.[8,9] In our study, the mean densities ranged from 26.0 to 58.75 HU with a mean of 48.13, and these results showed a relatively low attenuation compared with previous quantitative study of SSS (32-69 HU) by Black, et al.[10] One

study of a pediatric population found that SSS attenuation measurements ranged between 50 and 68 HU.[11] Another study of adults revealed the attenuation values were distributed with a mean of 50 HU and SD of 7.5.[12] Fanous, et al.[13] suggested that the lack of a strong correlation between attenuation values and Hgb levels may be due to the dural sinus complexity. The lateral venous lacunae and cavernous spaces contribute to structural heterogeneity. Therefore, if the dural sinus attenuations are measured at larger and more numerous points, then the mean values will be more precise.

V. Conclusion

In conclusion, dural sinus density on UECT is closely related to Hgb and Hct levels. Therefore, Hgb or Hct level can be used to determine whether the dural sinus density is within the normal range or pathologic conditions such as venous thrombosis, polycythemia vera or severe anemia. Quantitative assessment of the dural sinuses is easy and less time-consuming work in clinical practice without additional radiation exposure, therefore, when grossly hypodense or hyperdense dural sinuses are observed on UECT, radiologists should measure dural sinus attenuation and check Hgb or Hct levels.

References

[1]. Brant, William E. Fundamentals of Diagnostic Radiology. [ed.] William E. Brant and Clyde A. Helms. 3rd. s.l. : Lippincott Williams & Wilkins, 2007:7-10.
[2]. J. Rydberg, et al. Multisection CT: scanning techniques and clinical applications. RadioGraphics 2000;20:1787-1806.
[3]. DD Cody. Image processing in CT. RadioGraphics 2002;22:1255-1268.
[4]. CT. Rachel S. Title, Keith Harper, Erik Nelson, Tom Evans, and Richard Tello. Observer Performance in Assessing Anemia on Thoracic. American Journal of Roentgenology, 2005;185:1240-1244 .
[5]. Measurements, International Commission on Radiation Units and. Tissue Substitutes in Radiation Dosimetry and Measurement. ICRU. Bethesda: s.n., 1989. 44.
[6]. New PF and Aronow S. Attenuation measurements of whole blood and blood fractions in computed tomography. Radiology 1976;121:635-40.
[7]. AJ Collins, S Gillespie and BE Kelly. Can computed tomography identify patients with anaemia? Ulster Med J. 2007;116-18.
[8]. Patronas NJ, Duda EE, Mirfakhraee M, Wollmann RL. Superior sagittal sinus thrombosis diagnosed by computed tomography. Surg Neurol 1981;15:11-4.
[9]. Virapongse C, Cazenave C, Quisling R, Sarwar M, Hunter S. The empty delta sign: frequency and significance in 76 cases of dural sinus thrombosis. Radiology 1987;162:779-85.
[10]. Black DF, Rad AE, Gray LA, Campeau NG, Kallmes DF. Cerebral venous sinus density on noncontrast CT correlates with hematocrit. AJNR Am J Neuroradiol 2011;32:1354-7.
[11]. Morita S, Ueno E, Masukawa A, Suzuki K, Machida H, Fujimura M. Hyperattenuating signs at unenhanced CT indicating acute vascular disease. Radiographics 2010;30:111-25.
[12]. New PF, Aronow S. Attenuation measurements of whole blood and blood fractions in computed tomography. Radiology 1976; 121(3 Pt. 1):635-40
[13]. Fanous R, Leung A, Karlik S. Quantitative assessment of the superior sagittal sinus on unenhanced computed tomography. Eur J Radiol 2010;75:336-42

Dr. Pankaj Kumar Nitharwal, et. al. "Evaluation of the Effect of Hemoglobin or Hematocrit Level on Dural Sinus Density Using Unenhanced Computed Tomography." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 19(7), 2020, pp. 29-32.