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Research Article

CT Angiography Source Image ASPECTS Correlates Better Than NCCT-ASPECTS With 24-Hour DWI-ASPECTS in Patients Undergoing Revascularization for Emergent Large Vessel Occlusion

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Abstract

Background and Aims: ASPECTS score is a semi quantitative measure of infarct core in patients with acute ischemic stroke (AIS). Literature suggests CTA-SI ASPECTS predicts core better than DWI images. However, studies on correlation of ASPECT scores across the imaging modalities are limited. In this study we aim to correlate CTA-SI ASPECT and CTA-NCCT ASPECT with 24 hour DWI-ASPECT in patients who have undergone acute stroke revascularisation for Emergent Large Vessel Occlusion (ELVO).

Methods: Patients with middle cerebral artery (MCA) territory ischemic stroke who had NCCT and CTA imaging were included. We excluded patients whose age was <18years, patients with posterior circulation stroke, patients in whom intervention has failed (TICI <2), patients whose follow up MRI imaging is not available, Stroke mimics, renal failure and other contraindications for CTA. The primary objective of the study was to compare the interobserver variability of NCCT ASPECTS and CT-SI ASPECTS. The secondary objective was to correlate the core in NCCT

Results: We received 332 patients with symptoms of stroke, out of which 294(88.5%) turned out to be acute ischemic stroke. Among the patients with LVO, 117(77.7%) underwent successful recanalization(>mTICI2b). In our cohort, males predominated (66%). Interobserver reliability (Cronbach's alpha) was very good for both the modalities (0.91 for CTA and 0.83 for NCCT). The concordance of CTA-SI ASPECTS was significantly better than NCCT ASPECTS (0.89vs 0.81). It is found that CTA SI ASPECTS correlates better with DWI ASPECTS (0.74 vs 0.58, p<0.001) than NCCT

Conclusion: CT angio-SI ASPECTS has the highest correlation with DWI ASPECTS when compared to NCCT-ASPECT.

Keywords: *Acute ischemic stroke; ASPECTS; CT angiography; Emergent large vessel occlusion*

Introduction

CT is the imaging modality of choice for acute ischemic stroke in therapeutic window due to wide availability and faster acquisition time. ASPECTS widely used in selecting patient for thrombectomy, is a semiquantitative measure of infarct volume. It is conventionally assessed in NCCT (ref). There are studies which demonstrate that CT angiogram source images is able to detect the cerebral blood volume abnormalities before the changes is appreciated on NCCT. Interobserver variability is known in NCCT ASPECTS assessment of early ischemic changes especially when assessed by amateur readers(ref). This his study aims to compare the interobserver variability of NCCT-ASPECT with SI-CTA ASPECT and compared them with the final infarct volume as detected in post-intervention DWI-MRI in patients who achieved rapid recanalization. [1,2,3,4]

Methodology

The study was conducted in in a tertiary care hospital in Bengaluru, India. Acute ischemic stroke (AIS)atients from – month 2020 till month 2022 were taken for the study. We included patients with anterior circulation stroke who had NCCT and CTA imaging. We excluded patients whose age was <18years, patients with posterior circulation stroke, patients in whom intervention has failed (TICI <2), patients whose follow up MRI imaging is not availablesThe primary objective of the study was to compare the interobserver variability of NCCT ASPECTS and CT-SI ASPECTS. The secondary objective was to correlate the core in NCCT ASPECTS and CTA SI ASPECTS with the DWI ASPECTS.

CT scans were performed in Siemens 128 slices CT scanner 130kvp as a part of routine institutional stroke protocol. Continuous axial slices parallel to the orbitomeatal line were obtained from the skull base to vertex. NCCT was followed by CTA with a helical scan technique. Acquisitions were obtained after single bolus intravenous contrast injection of 90 to 120 mL nonionic contrast media into an antecubital vein at 3 to 5 mL/s. Imaging was autotriggered by the appearance of contrast media in the ascending aorta. Standard coverage included area from the arch to the vertex. Source images were reconstructed at 1.25-, 2.5-, or 4.0-mm thickness in axial planes at half-thickness intervals. MRI obtained on Day 2 of admission was used for DWI ASPECTS assessment.

Before the start of the study, experts in neurology and radiology reviewed images to establish a perfect window for viewing images for the observers. It was decided to view the images in free wheeling window after consensus. Three observers included primary investigator, one neurology resident and one radiology resident. Early ischemic change was considered to be present when there is blurring of grey, white junction or sulcal effacement. Definite hypoattenuation will be considered to be present when infarct is as hypo attenuated as white matter. Old lesion is considered to be present when well circumscribed hypodense area is present without any mass effect or edema. ASPECTS was scored by each observer separately and values were tabulated. The patients routinely underwent MRI on the next day of procedure to determine the final core volume and to prognosticate as a part of hospital protocol. For the retrospective part of the study, ICD code was used to identify the files. Demographic data, presentation, etc., were taken from case files. Institutional ethics committee clearance was taken before the start of the study.

Statistics

Continuous variables were expressed as mean and SD or median with 1st and 3rd quartile. Categorical variables were expressed as frequency and percentages. To determine interrater reliability, Cronbach's alpha was used to measure interobserver reliability, and intraclass coefficient was used to determine concordance. To determine the correlation, Spearman coefficient was used. P-value $\leq$ 0.05 was used to determine significance.

Results

Table 1 shows the demographic profile of the cohort. We received 332 patients with symptoms of stroke, out of which 294(88.5%) had acute ischemic stroke. Among 294 patients, 151(51%) had large vessel occlusion, 95(32%) had small vessel disease. Only 184 (62.5%) patients had MRI at 24 hours to compare. Among the patients with LVO, 117(77.7%) underwent successful recanalization(>mTICI2b).

Table1 - Demography

Sno	Variables	N (%)
1	Total number of patients visited ER with symptoms of stroke	332
2	Total number of acute stroke patients	294 (88.5%)
3	No of patients with small vessel disease	95(32%)
4	No of patients with LVO	151(51%)
5	Recanalization time (min) (Groin puncture-recanalization)	62.6(42.5)
6	Total number of patients with at least one MRI within 24 hours	184 (62.5%)
7	No of patients underwent successful intervention	117(77.7%)
8	Age(years)	52.4(SD-15.1)
9	Male Female	198(66%) 96(33%)
10	Risk factors a) Diabetes b) Hypertension c)Smoking d)Alcohol consumption e) Ischemic heart disease f) RHD g) AF h) ICAD i) ECAD	96(34.7%) 110(40%) 96(34.7%) 66(24.7%) 23(11.5%) 11(5.4%) 8(3.9%) 98(50.1%) 105(54.1%)

LVO- large vessel occlusion, ER-Emergency room, RHD-Rhematic heart disease, IHD -Ischemic heart disease, AF- atrial fibrillation.

In our cohort, males predominated (66%). Mean Age was 52.4$\pm$15.1 years. Extracranial carotid atherosclerotic disease (ECAD) was the common risk factor followed by intracranial atherosclerosis (50%).

Table 2. Interobserver reliability and concordance between CTA and NCCT for total ASPECTS score.

Variables	CTA	NCCT	P value
ASPECTS mean (SD)	7.7(2.4)	8.0(2.1)	
Interobserver reliability (Cronbach's alpha)	0.91	0.83	
Intraclass coefficient (ICC)	0.89(0.86-0.91)	0.81(0.76-0.85)	p<0.001

As shown in table 2, Interobserver reliability (Cronbach's alpha) was good for both the modalities (0.91 for CTA and 0.83 for NCCT). The concordance between the modalities were also good (0.89vs 0.81) for ASPECTS as a whole. However, the concordance of CTA-SI ASPECTS was significantly better than NCCT ASPECTS. [7,9,11]

Table 3. Interobserver reliability and concordance between CTA and NCCT for regional ASPECTS score

Area of infarct	Cronbach alpha of NCCT	Cronbach alpha of CTA	Intraclass coefficient (95% CI) - NCCT	Intraclass coefficient (95% CI) - CTA
PUTAMEN	0.837	0.882	0.632 (0.572 - 0.687)	0.714 (0.661 - 0.762)
CAUDATE	0.872	0.764	0.694 (0.641 - 0.742)	0.495 (0.421 - 0.566)
INSULA	0.758	0.686	0.511 (0.442 - 0.578)	0.422 (0.343 - 0.499)
INTERNAL CAPSULE	0.749	0.749	0.499 (0.429 - 0.567)	0.498 (0.424 - 0.570)
M1	0.631	0.864	0.363 (0.288 - 0.439)	0.679 (0.620 - 0.733)
M2	0.759	0.776	0.513 (0.444 - 0.579)	0.536 (0.466 - 0.604)
M3	0.569	0.818	0.305 (0.229 - 0.384)	0.600 (0.536 - 0.660)
M4	0.717	0.873	0.458 (0.385 - 0.529)	0.695 (0.633 - 0.752)
M5	0.651	0.874	0.383 (0.308 - 0.459)	0.697 (0.642 - 0.748)
M6	0.788	0.931	0.553 (0.485 - 0.618)	0.817 (0.778 - 0.852)

Further we tried to analyse the reliability and concordance of ASPECTS in various regions of ASPECTS. We identified that NCCT ASPECTS at Caudate and Insula had more reliability and concordance than CTA SI ASPECTS, but CTA SI ASPECTS outperformed NCCT ASPECTS in other areas. [7,9,11]

Table 4- Correlation of core between CTA and NCCT with DWI- MRI.

S.no	Variables	CTA	NCCT	P value
1	Correlation of core with MRI (Spearman rho)	0.74	0.58	P<0.001

Table 4 shows the correlation between CTA SI ASPECTS and NCCT ASECTS with DWI ASPECTS. It is found that CTA SI ASPECTS correlates better with DWI ASPECTS (rho-0.74) than NCCT. [3,5,6,10]

Discussion

Non contrast CT and CT angiogram of neck and intracranial vessels are the main imaging modalities in acute stroke in view of easy availability and the ability of the scanners to image faster. ASPECTS is a semi quantitative estimate of infarct core. CTA-SI ASPECTS provides a better estimation of core as the amount of enhancement is equivalent to the cerebral blood volume. Venous phase of CTA correlates better with core. There are a limited number of studies in literature comparing the interobserver variability across the imaging modalities. [3,4,5,6,12] [14]

In our study, we found that both NCCT ASPECTS and CTA SI ASPECTS had good interobserver reliability and concordance. However, the concordance of CTA SI ASPECTS was significantly better than NCCT ASPECTS. CTA SI ASPETCS Correlated significantly better than NCCT ASPECTS with DWI ASPECTS. We also observed that NCCT was more helpful for caudate and insula regions of ASPECTS when compared to CTA, but CTA SI ASPECTS outperformed NCCT in other regions.

Our study results are concordant with previous studies in literature (B Coutts,olga finylson). The reason for our observation of significantly better concordance for CTA SI ASPECTS may be because of the contrast, the grey, white differentiation was well made out by the interpreters in CTA SI. [4,10,15]

Our study is one of the few studies trying to compare the interobserver variability across imaging modalities. The results indicate that ASPECTS could be better madeout in CTA-source images than NCCT and CTA SI ASPECTS correlates with core. The short comings of our study may be retrospective nature of the study, lack of follow up for 3months outcome.

Conclusion

We conclude by pointing out that CTA-SI ASPECTS has less interobserver variability when compared to NCCT and CTA-SI correlates with core better than NCCT. We recommend using CTA-SI ASPECTS in adjunct with NCCT ASPECTS in deciding the eligibility of acute stroke patients for EVT.

Conflict of Interest Statement

The authors declare no competing interests.

References

1. Barber PA, Demchuk AM, Zhang J, Buchan AM. Validity and reliability of a quantitative computed tomography score in predicting outcome of hyperacute stroke before thrombolytic therapy. Lancet. 2000;355:1670-1674.

2. Pexman JH, Barber PA, Hill MD, Sevick RJ, Demchuk AM, Hudon ME, et al. Use of the Alberta Stroke Program Early CT Score (ASPECTS) for assessing CT scans in patients with acute stroke. AJNR Am J Neuroradiol. 2001;22:1534-1542.

3. Schramm P, Schellinger PD, Fiebach JB, Heiland S, Jansen O, Knauth M, et al. Comparison of CT and CT angiography source images with diffusion-weighted imaging in patients with acute stroke within 6 hours after onset. Stroke. 2002;33:2426-2432. doi:10.1161/01.STR.0000032244.03134.37.

4. Coutts SB, Lev MH, Eliasziw M, Roccatagliata L, Hill MD, Schwamm LH, et al. ASPECTS on CTA source images versus unenhanced CT: added value in predicting final infarct extent and clinical outcome. Stroke. 2004;35:2472-2476. doi:10.1161/01.STR.0000145330.14928.2a.

5. Camargo ECS, Furie KL, Singhal AB, Roccatagliata L, Cunnane ME, Halpern EF, et al. Acute brain infarct: detection and delineation with CT angiographic source images versus nonenhanced CT scans. Radiology. 2007;244:541-548. doi:10.1148/radiol.2442061028.

6. Lin K, Rapalino O, Law M, Babb JS, Siller KA, Pramanik BK. Accuracy of the Alberta Stroke Program Early CT Score during the first 3 hours of middle cerebral artery stroke: comparison of noncontrast CT, CT angiography source images, and CT perfusion. AJNR Am J Neuroradiol. 2008;29:931-936. doi:10.3174/ajnr.A0975.

7. Pulli B, Hakim A, Heit JJ, Ahlhelm F, von Kummer R, Wintermark M. Reliability of visual assessment of non-contrast CT, CT angiography source images and CT perfusion in patients with suspected ischemic stroke. PLoS One. 2013;8:e75615. doi:10.1371/journal.pone.0075615.

8. Aviv RI, Shelef I, Malam S, et al. Early stroke detection and extent: impact of experience and the role of computed tomography angiography source images. Clin Radiol. 2007;62:447-452. doi:10.1016/j.crad.2006.11.019.

9. Hanning U, Thomalla G, Diedler J, et al. ASPECTS interobserver agreement of 100 investigators from the TENSION study. Clin Neuroradiol. 2021;31:789-797.

10. Bhatia R, Bal SS, Shobha N, Menon BK, Tymchuk S, Puetz V, et al. CT angiographic source images predict outcome and final infarct volume better than noncontrast CT in proximal vascular occlusions. Stroke. 2011;42:1575-1580. doi:10.1161/STROKEAHA.110.603936.

11. Sundaram VK, Goldstein J, Bag AK, et al. Automated ASPECTS in acute ischemic stroke: a comparative analysis with CT perfusion. AJNR Am J Neuroradiol. 2019;40:2033-2038. doi:10.3174/ajnr.A6303.

12. Kloska SP, Nabavi DG, Gaus C, et al. Acute stroke assessment with CT: do we need multimodal evaluation? Radiology. 2004;233:79-86.

13. Parsons MW, Pepper EM, Chan V, et al. Perfusion computed tomography: prediction of final infarct extent and stroke outcome. Ann Neurol. 2005;58:672-679.

14. Wang X-C, Gao P-Y, Xue J, Liu G-R, Ma L. Identification of infarct core and penumbra in acute stroke using CT perfusion source images. AJNR Am J Neuroradiol. 2010;31:34-39.

15. Ebrahimzadeh SA, Du E, Ivanovic V, et al. Comparing the benefit of ASPECTS on maximum intensity projection images of computed tomography angiography to source images and noncontrast computed tomography in predicting infarct volume and collateral extent. J Stroke Cerebrovasc Dis. 2023;32:107091. doi:10.1016/j.jstrokecerebrovasdis.2023.107091.