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Acute Ischemic Stroke and CT Cerebral Angiography: Management and Relationship

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Abstract

In general, stroke is the second leading cause of mortality and a leading cause of morbidity. The most common type is thrombotic which responsible for 65-85%. Treatments that are approved by guidelines include supportive care in an emergency unit, and reperfusion through use of intravenous recombinant-tissue plasminogen activator (r-tPA), intra-arterial fibrinolysis and mechanical thrombectomy. A prospective study carried out in two years enrolled patients with acute ischemic stroke who have done CT angiography of cerebral circulation to assessment of the collateral arterial state. A total number of 50 patients (25 males and 25 females). The main age was 53.7±11.56 years. Each patient was neurologically and clinically evaluated, underwent NCCT followed by CT cerebral angiography to assess large vessel occlusion, collateral circulation status according to Tan scale (0-3). Good state of the cerebral collaterals in patients with AIS was associated with good clinical outcome, good reperfusion, symptomatic ICH rate is low, mortality rate decline and stroke severity be less.

Keywords: Angiography; Acute Ischemic Stroke; Recombinant-Tissue Plasminogen Activator; Mechanical Thrombectomy

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Introduction

Ischemic stroke is the leading cause of disabling disease and mortality worldwide [1]. Rapid evaluation including clinical examination and radiological investigations of patients with suspected AIS are mandatory to confirm detection, exclude common stroke mimics, determine the contraindications to revascularization, and localised site of occlusion [2]. Management decision (IV thrombolysis and/or mechanical revascularization) is dependent on the time window and imaging sings: parenchymal lesion and arterial occlusion site [3]. Multimodal CT includes CTA of head and neck, CT perfusion (CTP), multimodal MRI includes various sequences, such as DWI, ADC, FLAIR, GRE, and perfusion-weighted imaging in addition to MRA of head and neck help making a decision of acute management [4,5]. CTA is used to localised the site of vascular occlusion and quality of the collateral flow, which is an important prognostic factor for good outcome of management [6]. CTA can display collateral supply at the level of Willis' circle arteries and the retrograde filling of the cortical arteries by leptomeningeal junctions. The development of arterial collaterals lowers the speed of infarction growth and increases the chance of a good clinical outcome with timely recanalization [7].

The reperfusion treatment including intravenous (r-tPA) and mechanical thrombectomy are approved, so this study aimed to evaluate the relation of collateral status in CTA to the clinical outcome of AIS management.

Methods

A prospective study conducted in our hospital from June 2018 to June 2020 for determination the impact of the collateral status in cerebral CT angiography on the clinical outcome of AIS management. A total of 5o patients: 25 males and 25 females. The age of the patients ranged from 30 to 70 years, and the mean was 53.7 years. All patients were presented with symptoms of AIS and underwent CTA to assess arterial occlusion and the state of collateral circulation.

All patients who fulfilled the inform consent were included and the study was approved by the ethical committee. Inclusion criteria are individuals with AIS (within 6-24 hours from the time last seen well) according to criteria of DAWN or DEFUSE III trials [8], patients aged ≥18, and patients with not history of allergy to contrast, whereas exclusion criteria are patients out the time window, age below 18, CT features of hemorrhage, hemorrhagic diathesis on oral anticoagulant with INR>3, and severe hypertension.

Data collected including gender, age, smoking, history of chronic disease, presenting symptoms and clinical evaluation according to NIHSS [9]. Previous history or recent surgery or intracranial tumors.

General examination was performed including pulse rate, blood pressure and random blood sugar.

CTA with Gadolinium was performed on a multislice scanner (Sensation 64; Siemens, Germany). Coverage was from aortic arch to vertex, with continuous axial sections parallel to the orbitomeatal

line. Acquisitions were obtained after single bolus intravenous contrast injection of nonionic contrast media into an antecubital vein. All involved patients in our study had serum creatinine, however according to American guidelines of AIS management, it is reasonable to proceed with CTA if indicated in patients with suspected intracranial LVO before obtaining a serum creatinine concentration in patients without a history of renal impairment [10].

Each patient who presented with AIS was clinically evaluated using NIHSS and transferred into CT machine. Non contrast CT was followed by CTA with the using helical scan technique. Eligible patients within the time window, IV r-tPA was given with total dose 0.9 mg/kg, during IV thrombolysis. CTA was used to assess large vessel occlusion and state of collateral circulation. Diagnostic conventional cerebral angiography to evaluating collateral circulation used. Endovascular mechanical thrombectomy guided was done using either aspiration or stent retriever or combined techniques.

Assessment of cerebral circulation involving vessel occlusion and visual collateral score using Tan scale (0 –3): 0 (absent collaterals), 1 (collateral filling 0-50%), 2 (collateral filling >50 but <100%) and 3 for 100% collateral filling compared to opposite side [11].

Data was coded and entered using the statistical package for the Social Sciences (SPSS) version 20 (IBM Corp., NY, USA). Data was summarized using mean, standard deviation, and median in quantitative data and using frequency and percentage for categorical data. Correlations between quantitative variables were done using Spearman correlation coefficient. P-values less than 0.05 were considered as statistically significant.

Results

There were 25 males (50%) and 25 females (50%), with a mean age of 53.7 years (range 30-70 years). Thirty-nine patients (78%) had DM and forty (80%) were hypertensive while only twenty-five (50%) were smokers, and twenty (40%) patients had history of heart disease as showed in (Table 1).

The relation of visual collateral score on CT cerebral angiography and clinical status on admission represented by NIHSS as shown in (Table 2), this relation demonstrates the impactions of the collateral on the progress of AIS, the better the collateral state the better the NIHSS; this may be justified by the ability of good collaterals to decrease transformation of ischemic penumbra to core.

Table 1: Patients demographic.

		No.	%
Sex	M	25	50
	F	25	50
DM	Yes	39	78
	No	11	22
HTN	Yes	40	80
	No	10	20
Smoker	Yes	25	50
	No	25	50
Heart disease	Yes	20	40
	No	30	60

Table 2: Relation between CTA and NIHSS score.

Score		**CTA**			
		0	**1**	**2**	**3**
		No. (%)			
NIHSS	1-5	0	1 (2)	3 (6)	2 (4)
	6-10	0	2 (4)	5 (10)	8 (16)
	11-15	0	7 (14)	5 (10)	4 (8)
	16-20	2 (4)	3 (6)	2 (4)	3 (6)
	21-25	0	1 (2)	0	2 (4)

Discussion

There were multiple risk factors for stroke in this study including diabetes, hypertension and smoking, these results were corresponding to the risk factors published in literature as in [12]. The advanced imaging techniques including diffusion, perfusion and angiography are used and they are of outmost importance in patients presenting out time window to assess their chance for management. Currently in early acute stage of stroke, the concept of management is going with fast recanalization as soon as possible either by using thrombolytic therapy, or mechanical thrombectomy or combination to rescue salvageable penumbral tissue and retain cerebral blood circulation according to Powers WJ, et al. (2018) [5].

Many grading systems were used to assess collateral cerebral circulation in case of acute stroke CT angiography. In this study Tan scale system (0-3) was used. A score of zero indicated absent collateral supply to the occluded middle cerebral artery (MCA) territory. A score of 1 indicated collateral supply filling < 50% but >0% of the occluded MCA territory. A score of 2 was given for collateral supply filling >50% but <100% of the occluded MCA territory. A score of 3 was given for 100% collateral supply of the occluded MCA territory; these findings were corresponding to literature published in [11].

Visual assessment of collateral cerebral circulation in baseline CTA was the corner stone of our study. Good collateral state (2/3) was associated with potential compensation in downstream perfusion, reduction of the extent of infarct growth, decrease rate of hemorrhagic transformation and improvement of the clinical outcome with thrombolysis or endovascular revascularization, these findings were corresponding to results in [13].

In this study, good pretreatment collateral status for patients with AIS receiving endovascular therapies was associated with higher rates of favorable functional outcome, and lower rates of symptomatic intracranial hemorrhage and mortality. These findings were matched with literature published by [14].

We guided the American guidelines for AIS management in our study where intravenous thrombolysis was given as soon as possible, and endovascular mechanical thrombectomy for large vessel occlusion for treatment of all patients with AIS presenting within <6 hours of symptom onset as published by [5]. Mechanical thrombectomy in this study improved reperfusion and functional outcome at three months without an increase in mortality after using CTA to assist in selecting patients who would most likely benefit from combined endovascular and intravenous thrombolysis, which was consistent with [7].

At this moment, this work may open the screen for further studies with a larger population, more prospective studies on collateral grading and application of other selection criteria. The studying of other factors that could affect and modify the clinical outcome of stroke management is mandatory.

Conclusion

AIS is a medical and interventional emergency which requires fast solution including ambulance paramedics, emergency physician, radiologist, and neurosurgeons. The main obstacle against stroke management in our country is to overcome time; raising public

awareness, regulating transport and the availability of radiological equipment and neurosurgeons units, which are the tools for saving the brain. Once diagnosis is confirmed of AIS, IV r-tPA should be administered as soon as possible.

Conflict of Interest

None.

Funding

None.

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