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Brain Computed Topography Scan in Stroke

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Abstract

In patients came with suspicious stroke, Computed topography (CT) scan can play a major roll for diagnosis and treatment planning. In these patients we can do non contrast enhanced CT scan followed by perfusion CT scan and CT angiography. This three step CT scanning can be called multimodal CT. This strategy can help us to roll out hemorrhage and other differential diagnosis, it is useful to detect the site of vascular occlusion, the infarcted zone and the at risk salvageable tissue, also we can assess collateral circulation. This multimodal CT scan take about 10 to 15minuts.**[GMJ.2016;5(Supp.1):18-23]**

Keywords: Stroke; Computed Tomography; CT angiography

Introduction

Stroke is a major leading cause of disability and death worldwide and therefore, remain an important public health concern. Since increase the rate of stroke-related deaths occur immediately after the onset of symptoms, early and correct detection followed by appropriate treatment can decrease the mortality rate. It is really crucial to determine whether the neurological symptoms of stroke are due to thrombosis, embolism or hemorrhage. Today Computerized tomography (CT) as a noninvasive technique for brain imaging widely used to determine the type and location of the brain lesion.

Since the introduction of CT scanning, several studies have attempted to evaluate its usefulness in diagnosis of stroke [3, 7, 9].

In this study, we reviewed the findings, Benefits and pitfalls of non-contrast enhanced CT scan, perfusion CT scan and CT angiography.

Non contrast enhanced CT scan

First on CT scan unite, non-contrast enhanced CT scan is performed [1-3]. In this CT scan, hemorrhagic Stroke should be looked for, then other differential diagnosis for Stroke such as tumors and AVM should be rule out (Figure-1). Then signs of infarction should be searched; such as blurring of corticomedulary junction differentiation, insular ribbon sign, obscuration of lentiform nucleus and dense vessel sign [4-10]. First images should be reviewed with standard window width and level setting approximately at 80-35 HU, then for improving sensitivity of image interpretation, the CT scan must be reviewed with window width and level setting as 20-35 HU. In the latter setting subtle hypo attenuation and obscuration of the gray white matter differentiation and obscuration of the lentiform nucleus and loss of insular ribbon and visualization of the dot sign or hyper attenuation vessel sign

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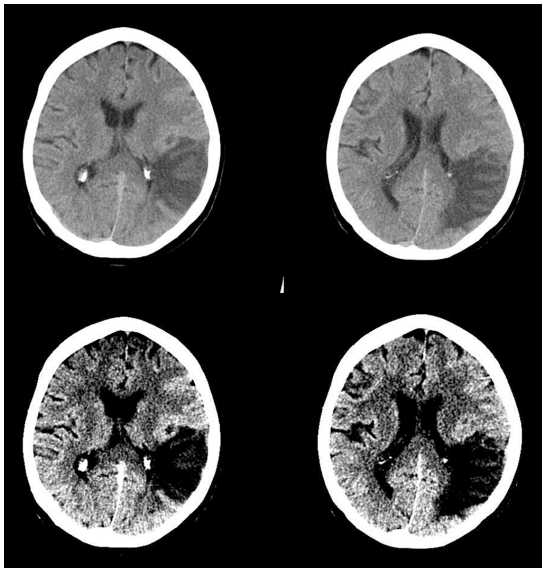

Figure 1. In first row images (64 slice, WW: 80, WL: 35, Slice Thickness 10 mm) hemorrhagic transformation can be seen in infarcted Lt. cerebral hemisphere. In second row images (64 slice, WW: 20, WL: 35, Slice Thickness 10 mm) hemorrhagic transformation and infarcted are can be better seen because of narrower windowing.

can be better seen in the second windowing[9] (Figure-2) . The previous mentioned signs have poor prognosis for thrombolytic treatment but there are not contraindications for treatment [9].

Diagnosis and interpretation of the mentioned known signs are hard for radiologist and they have low sensitivity. Hyper attenuating and dense vessel sign is only seen in about 30% of patient and it is hard to interpret and some conditions such as elevated hematocrit and vessel wall calcification and dolicoectasia are pitfalls. Also the mentioned signs are not helpful for differentiation between ischemic penumbra and the central core of infarction [11-18].

Several methods have proposed for assessment of non-contrast CT scan in patients with Stroke. The most famous one is ASPECTS (Alberta stroke program early Ct score),this CT score is time consuming but it has good inter observer reliability[2,19].

Perfusion CT

Perfusion CT is performed by monitoring first passed bolus of contrast agent in to the brain tissue. In this method continuous imaging for about 45 seconds over the same slab of the brain tissue during dynamic contrast administration was done, the arterial ROI is placed on ACA territory and venous ROI is placed on superior sagittal sinus or over Torcular Herophili. Then color encoded perfusion map was performed by cerebral blood volume mean transit time (MTT) and cerebral blood flow. The relation between these parameters is: cerebral blood flow = cerebral blood volume/ MTT. Then quit visual assessment of the perfusion maps by radiologist was done and the ischemic penumbra can differentiate from central core of infarction [20-26].

One limit of perfusion CT scan is limited field of view, because only about 4cm slap at the level of basal ganglia for depiction of the territory of ACA, MCA and PCA were done in routine perfusion CT scan, so visualization of infra tentorial region is not well possible [22].

Based on the fact that, in cerebrovascular accident the central core of infarction is dead brain tissue but the stunned cells around the central core of infarction is ischemic penumbra and can be saved by early revascularization by performing intravascular thrombolysis

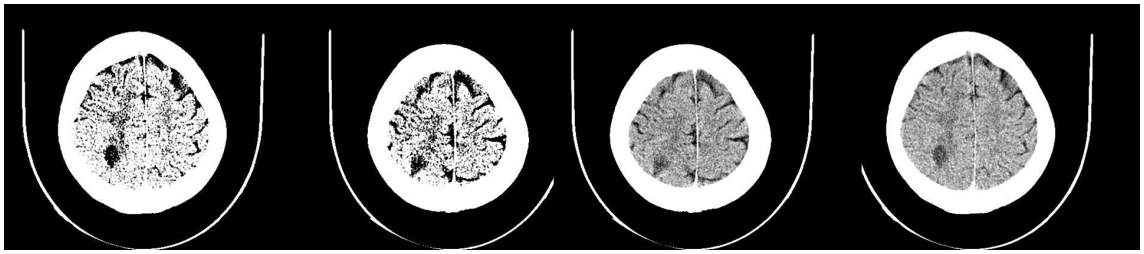

Figure 2. Acute Stroke seen in two different window width and level. First two images are WW: 20, WL: 35. The latter two images have WW: 80, WL: 35

within three to four and a half hours since attack [27].

The CBV map can show infarcted brain tissue that is compatible with diffusion restricted area in DWI image whereas CBF map show the area of reversible ischemia compatible with perfusion MRI. The ischemic tissue shows increased MTT with decreased CBF and normal or mild increased CBV whereas infracted area show significant decreased CBF and increased MTT with significant decreased CBV. The at risk brain tissue is equivalent to CVF-CBV [22, 24,28].

The patient selection for performing IV thrombolysis is: disabling neurological deficit + less than three hours interval between the onset of symptoms and start of treatment + rolled out other criteria such as hemorrhage in non-contrast enhanced CT scan. Findings of perfusion CT scan is still not included in patient selection. Therefore, if no penumbra was detected in perfusion CT scan thrombolysis is still can be done for the patient. In addition, areas of abnormality in CBV and diffusion restricted area are not always irreversible brain tissue damage [12].

CT Angiography

After performing CT perfusion then CT angiography can be done for the patient. The goal of CT angiography is to see cranial arterial system. The site of arterial occlusion can be shown. The site of arterial stenosis can also

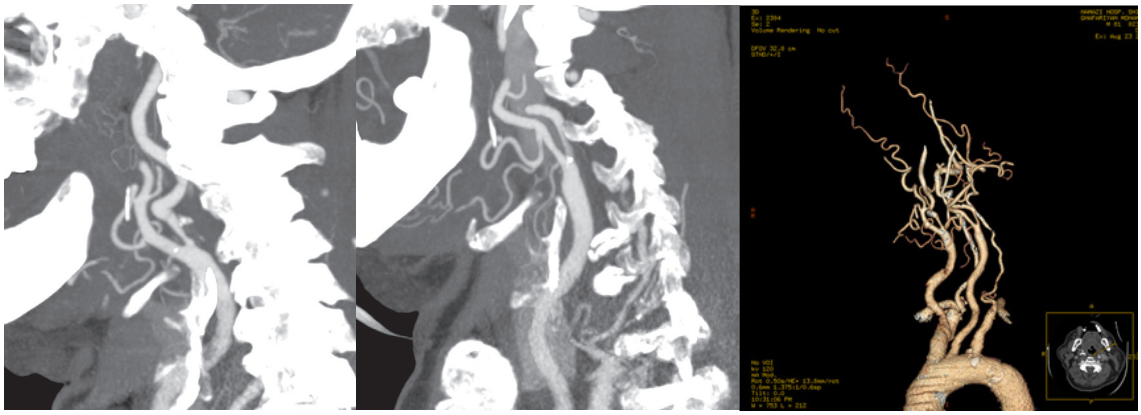

Figure 3. Visualization of exracranial ICA stenosis can be seen in MIP images as well as reconstructed images. (CT 16 slices, 7 mAs, 120 KV, TI 505, 0.62 mm slice thickness, MIP with 20mm thickness)

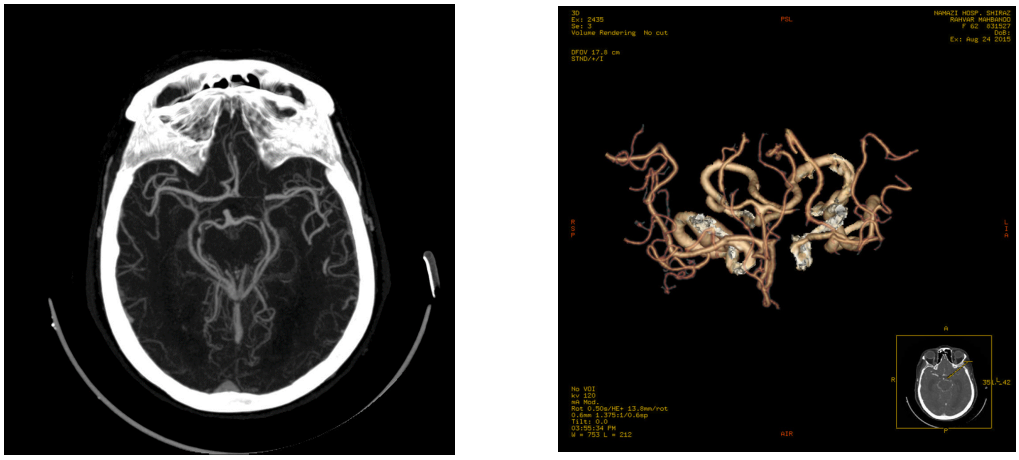

Figure 4. Bilateral PCA stenosis can be seen in both MIP and reconstructed images. (CT 16 slices, 7 mAs, 120 KV, TI 505, 0.62 mm slice thickness, MIP with 20mm thickness)

be seen. We can search for arterial dissection. Collateral blood flow is visible. The state of atherosclerosis can be seen. Ct angiography can be useful guidance for intra-arterial thrombolysis [27].

Intra-arterial thrombolysis is a good modality for occlusion of the ICA, MCA stem and basilar artery occlusion. In addition, it is good modality for treatment planning. Also CT angiography is good modality for evaluation of vertebrobasilar system because posterior fossa can hardly be visible in non-contrast en-

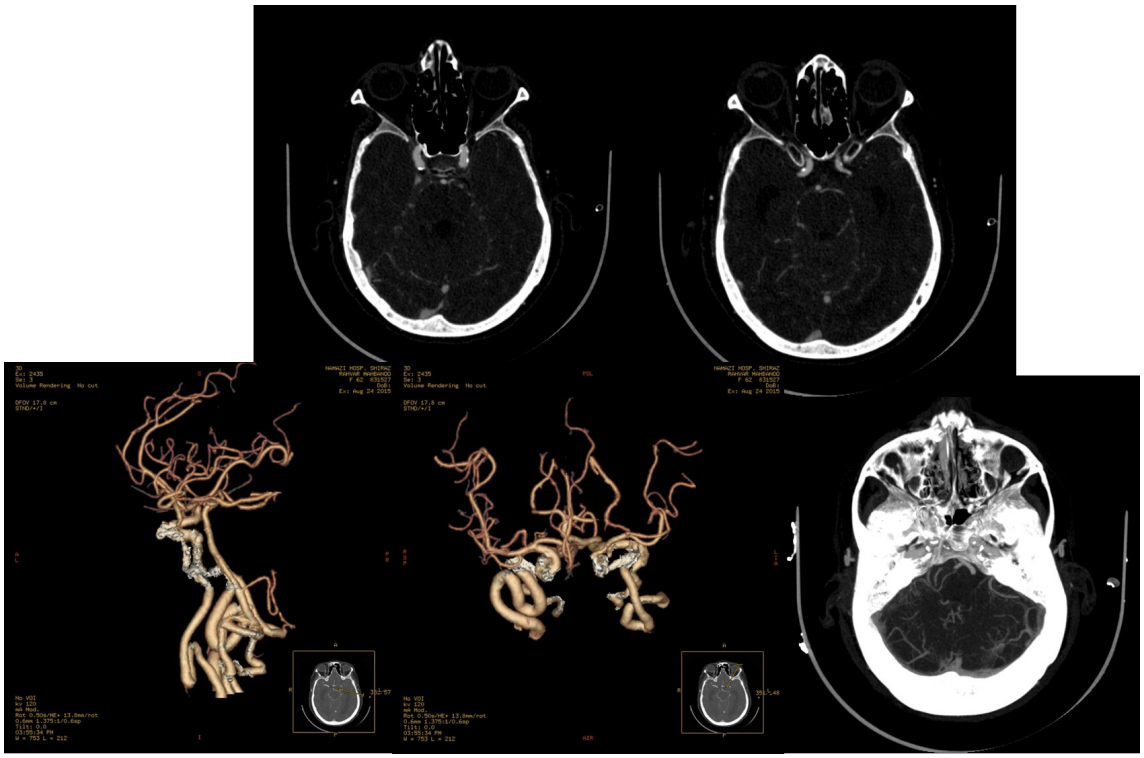

Figure 5. Visualization of intracranial ICA stenosis can be better seen in thin cut slices (first row images) rather than reconstructed or MIP images (second row images). (CT 16 slices, 7 mAs, 120 KV, TI 505, 0.62 mm slice thickness, MIP with 20mm thickness)

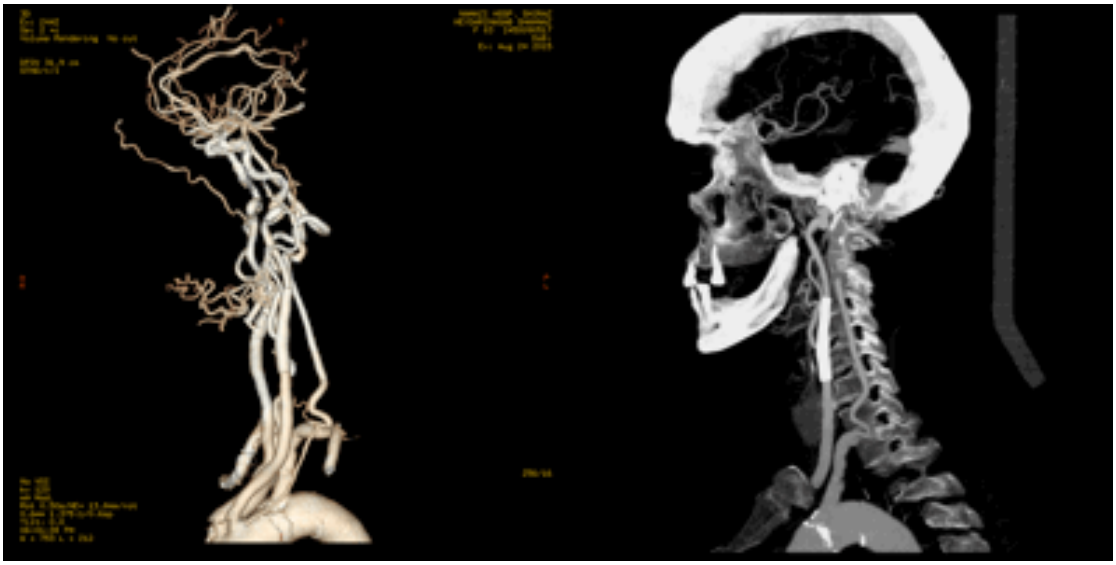

Figure 6. Visualization of stent lumen is not well possible in either reconstructed or MIP images. (CT 16 slices, 7 mAs, 120 KV, TI 505, 0.62 mm slice thickness, MIP with 20mm thickness)

hanced CT scan and usually is not included in CT perfusion [2, 29, 30].

In CT angiography, from aortic arch up to vertex should be seen with thin section slices, especially it is good for evaluation of the carotid arteries and vertebral artery and the circle of Willis (Figure-3 and Figure-4).

The evaluation of the intracranial arteries can be well done by performing reformatting or by MIP (maximum intensity projection with thickness about 20mm). Sometimes source images are better than MIP or reconstructed images (Figure-5). Lumen of stent and its patency cannot well seen by CTA (Figure-6) it is best to make reformatting with MIP scadule in, two axial, one sagittal and two coronal images.

More over leptomeningeal arterial collaterals can be seen in CT angiography because the patients with good collateral circulation from the leptomeningeal vessels have better prognosis. In addition, CT angiography of the cervical vessels can show plaque irregularity or ulceration and also quantification of calcification and vessels stenosis can be well seen.

With assessment of post contrast images, also hypo attenuating hypo vascular areas can be well seen better that noncontract enhanced CT scan. For evaluation of infracted zone, the optimum window width and level for evaluation of post contrast images can be 25-35HU [27, 31, 32].

Conclusion

Cerebrovascular accident is one of major causes for hospital admission. One acceptable treatment is thrombolysis. by performing CT scan early hemorrhage can be seen, if hemorrhage was ruled out then perfusion CT scan for evaluation of penumbra and at risk brain tissue can be done, then CT angiography can be performed for visualization of the site of occlusion and to visualize collateral circulation and for assessment of carotid atherosclerotic disease.

This multimodal CT scanning (non-enhanced CT scan, perfusion CT scan and CT angiography) can be performed rapidly and can be interpret easily by radiologist.

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