

EDITORIAL

HOW MODERN NEURO IMAGING AND NEURO INTERVENTION IS REVOLUTIONISING THE MANAGEMENT OF ACUTE ISCHEMIC STROKE

Recent advances in modern Neuro diagnostic imaging techniques and Neuro intervention has revolutionized the management of patients with acute ischemic stroke.

In a conventional medical set up with no facility for Neuro intervention, Plain computerized tomography (CT scan) will suffice to differentiate between ischemic stroke or hemorrhagic stroke in a clinically suspected stroke patient and thus the clinicians will decide whether to anticoagulate the patient or not¹. Another useful and better alternative in this setting is an MRI with DWI (Diffusion Weighted Imaging), ADC mapping and GRE (Gradient Recoil Echo) sequence which is a hemorrhage sensitive sequence². MRI has the advantage that it detects the exact extent of stroke on DWI/ADC mapping within minutes of clinical onset of stroke while on the other hand CT scan may be normal or negative up to even 24 hours of clinical onset of stroke.

In the modern well equipped tertiary care medical centers/institutes with facility of Neuro intervention, an acute ischemic stroke patient is completely evaluated by a specific set of advanced Neuro diagnostic imaging techniques. Primarily CT scan based techniques are utilized as CT scan is a faster technique and in acute ischemic stroke management the main slogan is "Time is Brain". Quicker the management, better the prognosis³. Best results are seen around within 3 - 4.5 hours of onset of stroke. These CT techniques include plain CT scan, CT perfusion studies and CT angiography⁴. On the basis of the results obtained by these imaging techniques, it is decided whether Neuro intervention (Mechanical Thrombectomy) should be performed and will it be beneficial to stroke patients or not.

ASPECTS score (Alberta Stroke program early CT score) is calculated on plain CT scan of an acute ischemic stroke patients⁵. It can be calculated for both anterior circulation strokes i.e. MCA (Middle cerebral artery) territory and

posterior circulation strokes i.e. Vertebrobasilar and PCA (posterior artery territory) strokes. It is a quantitative 10 point score and for normal CT the score is 10. As the score reduces, the brain damage is more extensive and irreversible and so neuro intervention will not be useful in such a case.

In cases with good ASPECTS score (≥ 6) on plain CT scan, the exact brain damage at cellular level can be assessed by CT perfusion studies⁶. CT perfusion study is a qualitative and quantitative analysis of brain parenchyma that can differentiate between ischemic brain tissue/penumbra/reversible showing mismatched CBF (cerebral blood flow)/CBV (cerebral blood volume) defect treatable by mechanical thrombectomy and infarcted brain tissue/core/irreversible damage showing matched CBF (cerebral blood flow)/CBV (cerebral blood volume) defect not treatable by mechanical thrombectomy/neuro-intervention⁷. Thus if ischemic tissue is present and of significant volume, neuro intervention will be beneficial. Whereas, if a small volume ischemic tissue or completely infarcted brain tissue is detected on CT perfusion studies, neuro-intervention will not be beneficial.

Finally CT angiography will tell us if a major brain vessel is blocked or not because only large vessel occlusion is amenable by mechanical thrombectomy (clot removal) via micro catheter technique⁸. It also gives an idea about collateral vascular supply. Development in neuro intervention has led to advancement of micro catheter into main brain vessels and mechanical removal and retrieval of blood clot and thus reverses neurological deficit of patients.

Another upcoming development in MRI in acute ischemic stroke especially useful in wake up stroke is diffusion/FLAIR (Fluid Attenuated Inversion Recovery) mismatch⁹. In early cases of acute ischemic stroke, the MRI signal abnormality on DWI (Diffusion Weighted Imaging) will be

much larger than on FLAIR (Fluid Attenuated Inversion Recovery), showing ischemic brain tissue (treatable brain tissue) which is DWI-FLAIR mismatched defect. While Infarcted brain tissue (not treatable brain tissue) will show an equal MR signal abnormality on both DWI and FLAIR sequence which is the DWI-FLAIR matched defect. This differentiates between ischemic (treatable brain tissue) and infarcted (not treatable brain tissue) abnormal in both DWI and FLAIR sequence. The mismatch defect is seen in very early cases of stroke while the matched defect is seen in late cases 3 or more hours after onset of stroke.

Although the advanced diagnostic neuro imaging and neuro intervention in acute stroke has many complex aspects, above is a brief and simplified imaging approach in stroke patients for clinicians in general. In conclusion, advances in neuro-diagnostic techniques and active neuro-intervention has led to a marked improvement in prognosis of acute stroke patients, provided early neuroimaging and neurointervention is done.

REFERENCES

1. Wardlaw JM, Seymour J, Cairns J, Keir S, Lewis S, Sandercock P. Immediate computed tomography scanning of acute stroke is cost effective and improves quality of life. *Stroke* 2004; 35(11): 2477-83.
2. Fiebach JB, Schellinger PD, Gass A, Kucinski T, Siebler M, Villringer A et al. Stroke magnetic resonance imaging is accurate in hyper-acute inter-cerebral hemorrhage: a multicenter study on the validity of stroke imaging. *Stroke* 2004; 35(2): 502-6.
3. RG Gonzalez. Imaging guided acute ischemic stroke therapy: From "Time is Brain" to "Physiology is Brain". *Am J Neuroradiol* 2006; 27(4): 728-35.
4. Hopyan J, Ciarallo J, Dowlatshahi D, Howard P, John V, Yeung R, et al. Certainty of stroke diagnosis. Incremental benefit with CT perfusion over non-contrast CT and CT angiography. *Radiol* 2010; 255(1) 142-53.
5. Barber PA, Demchuk AM, Zhang J, Buchan AM. Validity and reliability of a quantitative computed tomography score in predicting outcome of hyper-acute stroke before thrombolytic therapy. ASPECTS study group, Alberta Stroke Program Early CT score. *Lancet* 2000; 355(9216): 1670-4.
6. Campbell BC, Weir L, Desmond PM, Tu HT, Hand PJ, Yan B et al. CT perfusion improves diagnostic accuracy and confidence in acute ischemic stroke. *J Neurol Neurosurg Psychiatr* 2013; 84(6): 613-8.
7. Prakkamakul S, Yoo AJ. ASPECTS CT in Acute Ischemia: Review of Current Data. *Top Magn Reson Imag* 2017; 26(3): 103-12.
8. Goyal M, Demchuk AM, Menon BK, Eesa M, Rempel JL, Thornton J, et al. Randomized assessment of rapid endovascular treatment of ischemic stroke. *N Engl J Med* 2015; 372(3); 1019-30.
9. Thomalla G, Rossbach P, Rosenkranz M, Siemonsen S, Krützelmann A, Fiehler J, et al. Negative Fluid-attenuated inversion recovery imaging identifies acute ischemic stroke at 3 hours or less. *Ann Neurol* 2009; 65(6): 724-32.

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