Neuroimaging in Acute Stroke

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Stroke is Singapore’s third leading cause of death, a major cause of adult disability and rising hospital admissions. Clinical trials particularly in the last decade have yielded potentially more effective stroke treatments(1). None of these advances would have been possible without matching progress in the field of neuroimaging.

Brain imaging serves the following purposes when performed in the patient suspected to have had a stroke(2):

1. rule out differential diagnoses – neoplasm, abscess, etc
2. distinguish haemorrhage from infarction – clinical scores have at best 70% accuracy
3. indicate the vascular territory involved – basilar artery penetrators, anterior cerebral artery, etc
4. demonstrate the vascular lesion – hyperdense middle cerebral artery sign due to fresh thrombus, intramural blood due to dissection, etc
5. suggest mechanism of stroke – multiple large artery territory infarcts suggest cardioembolism, predominantly inter-hemispheric blood suggests a ruptured anterior communicating artery aneurysm, etc
6. detect complications – “malignant” cerebral oedema, haemorrhagic transformation, etc
7. assess the results of interventions – haematoma evacuation, extraventricular drainage for acute hydrocephalus, etc
8. uncover previous or “silent” strokes

Early neuroimaging would allow the appropriate treatment to be given in a timely manner. The Ministry of Health’s Clinical Practice Guidelines for the management of acute stroke recommend that brain scans be performed as soon as possible, preferably within 24 hours of patient contact.

Non-contrast Computed Tomography (CT) is widely used as the first imaging modality as it is quick, widely available, and relatively inexpensive. However, it may fail to detect small lesions, or lesions in the lower brainstem (due to beam-hardening artifacts). Magnetic Resonance Imaging (MRI) is more accurate, but takes longer to perform than CT, more costly, less likely to be available on a 24-hour basis, and has a number of contraindications.

CT and MR are able to show non-invasively the location of disease, such as a stenosed middle cerebral artery or an occluded internal carotid artery by CT or MR angiography. Catheter digital subtraction angiography remains the “gold standard”. Information on cerebral vasculature is also obtainable inexpensively and non-invasively by extracranial and transcranial ultrasonography.

While hemorrhage is detected in almost 100% of cases, particularly by CT, infarct changes may not be visible in the early hours following
The best predictor of stroke recovery may be the combined measurement of the NIH stroke scale, time between stroke onset and DWI scan, and the volume of ischemic brain tissue on DWI.
in stroke. However these advances still lag far behind positron emission tomography (PET). PET is able to quantitatively demonstrate the range of cerebral responses to ischemia - increased cerebral blood volume, reduced blood flow, increased oxygen extraction, reduced metabolism of glucose and oxygen. Cerebrovascular reserve may be assessed by SPECT, CT perfusion or ultrasonography, using carbon dioxide or acetazolamide challenges.

These new techniques have not yet entered routine clinical practice. Until then, the clinician should continue to maximise the use of currently available technology to assist him in the management of his patient with acute stroke.

REFERENCES