IN AIS EVALUATION, IS MULTIMODAL CT SUPERIOR TO MRI? – PRO

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Non-contrast CT (NCCT) has been the workhorse of acute stroke workup for the entire thrombolysis era. Decreasing costs and increasing capabilities have resulted in exponential expansion of the number of CT scans available worldwide. This applies to both the developed and developing world. The vast majority of patients presenting with acute stroke symptoms will first be imaged in a CT scanner. CT scanners are more economical both to purchase and to operate than MRI. In addition, unlike ultrasound, image quality is not dependent on the experience and training of the operator. Thus, MRI scanners are being placed in the Emergency Departments of hospitals in ever-smaller communities. Combined with telehealth technology, this has facilitated the increased number of patients that can be offered acute stroke treatment, including reperfusion therapies.

The primary disadvantage of NCCT, relative to MRI and in particular Diffusion-Weighted Imaging (DWI), is the lack of sensitivity to early ischemic changes. This is particularly the case in patients with small infarcts and those located solely within white matter. The development of multimodal CT has narrowed the gap between MRI and CT significantly in recent years. CT angiography (CTA) is actually superior to magnetic resonance angiography (MRA) with respect to evaluation of both the extracranial and intracranial vasculature. The spatial resolution of CTA is much higher than MRA and can be used to identify arterial occlusions well beyond the Circle of Willis, to which MRA is largely restricted. Similarly, CT perfusion (CTP) imaging has a number of advantages over MRI based perfusion-weighted imaging (PWI). The relationship between iodinated contrast concentration and CT signal intensity, measured in Hounsfield Units, is known, which permits more reliable assessments of absolute cerebral blood flow and volume. The same is not true for gadolinium concentration and MRI (T2*) signal. Thus, attempts to predict tissue fate based on PWI have been based primarily on time domain measures, such as Mean Transit Time and Tmax. Although qualitatively robust, these perfusion measures are scientifically and clinically less useful than the qualitative values obtained with CTP. The values obtained with CTP permit assessment of not only areas at risk for infarction, but also those areas that are irreversibly injured at the time of the scan (core).

Reliable assessment of core infarct tissue, using DWI, remains the one true strength of MRI. Unfortunately, even when available, acute MRI assessment comes at significant cost to the patient, specifically with respect to time. Multimodal CT can be completed in a matter of minutes. The latest generation scanners permit whole brain perfusion and simultaneous intracranial vasculature assessment, using a single contrast injection. CT scanners are located within or adjacent to the Emergency Departments at most hospitals. CT technicians work in an environment that values speed, due to the fact that they also assess trauma and other medically unstable patients. They are also familiar with triage and scan prioritization protocols. In contrast, MRI scanners are generally located within Radiology Departments, often some distance from Emergency Departments and medical staff. MRI staff are generally more concerned with MRI safety than speed of assessment and are less comfortable with acutely ill or unstable patients. In a condition like stroke, where 'time is brain', delays introduced by MRI have measurable negative consequences. Once in the scanner, even a rapid MRI protocol takes much longer to complete than a complete multimodal CT scan. Finally, approximately 20% of patients either have

absolute contraindications to MRI (metallic foreign bodies, etc…) or will be unable to tolerate a complete exam, generally due to claustrophobia.
Although DWI is sensitive to very small areas of ischemic injury, it has never been shown that identification of these regions alters patient outcome. It has been shown that the presence of a DWI lesion is predictive of early stroke recurrence after minor ischemic events including TIA. More recently, however, it has also been shown that early stroke recurrence can also be reliably predicted using CT and CTA. Thus multimodal CT is likely as effective a risk stratification tool as MRI.
It is therefore evident that CT will always be the primary stroke assessment tool in most of the world. It has a number of advantages over MRI, particularly with respect to vascular imaging and acquisition speed. Multimodal CT has sufficiently closed the gap with DWI, that it is the initial examination of choice in most cases. Multimodal CT will certainly provide the information required to treat the most severe stroke patients, and in the most timely fashion.