Published in final edited form as:

J Neuroimaging. 2015 July ; 25(4): 688–689. doi:10.1111/jon.12257.

The Modern Clinical Neuroimager: Leading the Next Generation in Stroke

David S. Liebeskind, MD

Neurovascular Imaging Research Core and the UCLA Stroke Center, Los Angeles, CA

Abstract

The recent culmination of imaging-endowed endovascular stroke trials has decisively proven the utility of clinically relevant neuroimaging in improving the outcome of patients with potentially debilitating neurological disorders. These large multicenter trials conducted across several continents notably utilized a variety of multimodal CT/MRI modalities to rapidly identify a favorable collateral profile that presages clinically beneficial revascularization. The modern clinical neuroimager may accelerate complex decision-making through rational use of a variety of imaging modalities and an active feedback loop of imaging at the bedside. The modern clinical neuroimager is often the initial care provider for a wide range or type of stroke patients from hemorrhage to ischemia, armed with the incredibly important aspects of clinical history and examination findings and best poised to utilize imaging to guide therapy from acute stroke to recovery and prevention. The next generation in stroke should not exclusively focus on whether to order a CT or MRI counting minutes at the bedside, but actively and efficiently integrate the vast wealth of information available when imaging is used in proper clinical context. The novel endovascular era in stroke provides an ideal venue for the synergistic goals of translating research advances, improving patient outcomes and ongoing education as a modern neuroimager.

Keywords

Neuroimaging; stroke; expertise; CT; MRI

The recent culmination of imaging-endowed endovascular stroke trials has decisively proven the utility of clinically relevant neuroimaging in improving the outcome of patients with potentially debilitating neurological disorders.[1–3] Unlike prior failed attempts to establish the superiority of endovascular therapy for stroke based on time alone without knowledge of essential pathophysiology,[4–6] the imaging in recent randomized endovascular therapy trials guided the selection of optimal candidates, delineating more extensive reperfusion and smaller resultant infarcts without increased hemorrhage. These large multicenter trials conducted across several continents notably utilized a variety of multimodal CT/MRI modalities to rapidly identify a favorable collateral profile that presages clinically beneficial revascularization.[7, 8] This transformation underscores the

Address correspondence: David S. Liebeskind, MD, Neurovascular Imaging Research Core, UCLA Department of Neurology, Neuroscience Research Building, 635 Charles E Young Drive South, Suite 225, Los Angeles, CA 90095-7334, (310) 963-5539, davidliebeskind@yahoo.com.

value of imaging in specific context, enriching clinical diagnoses by qualified stroke care providers, enhancing complex medical decision-making and guiding comprehensive treatment. Clinician imagers have contributed greatly to these recent advances in the field as much of the progress in endovascular stroke therapies has been driven by the involvement of neurologists and neurosurgeons. This epitome of clinically relevant imaging in stroke demarcates the influential role of the modern clinical neuroimager and embodies the mission of the American Society of Neuroimaging.

Approximately two decades ago, an earlier generation witnessed the introduction of intravenous (IV) tissue-plasminogen activator (tPA) for acute stroke and the concomitant emerging concept of the neurologist as neuroimager.[9] Thrombolysis protocols rapidly enacted noncontrast CT to rule out extensive infarction or intracranial hemorrhage, whereas few imaging correlates were implemented to guide therapeutic strategies beyond a go-no go decision for IV tPA. In stark contrast, the recent acclamation of endovascular therapy now requires imaging identification of large vessel occlusion and a favorable collateral profile. Rather than the tacit assumption by some that advanced imaging is useless and that such expertise is unnecessary, the clinical neuroimager actually plays a vital role. Potentially arbitrary metrics of quality, such as the time interval from “picture to puncture” in isolation, may be less valuable than the shrewd judgement of the avid neuroimager. Such stroke specialists must integrate myriad imaging patterns to gauge the subsequent clinical course of the patient. Stroke pathophysiology is often noted to be complex, yet clinical protocols or guidelines are paradoxically simplified to ensure wider generalizability. In addition, modern paradigms via telestroke and the regional distribution or flow of stroke patients within various networks will undoubtedly require individualized approaches or precision medicine to effectively translate recent trials to routine practice.[10] Quality will ultimately be measured by patient outcomes.

Imaging is an extension of the clinical examination, framing the significance of specific findings through clinical correlation with the marked dynamics of stroke pathophysiology. Without proper context or adequate expertise, imaging may be misleading or simply a waste of time and other critical resources. Conversely, the modern clinical neuroimager may accelerate complex decision-making through rational use of a variety of imaging modalities and an active feedback loop of imaging at the bedside. The neuroimager must be acutely aware of the time tradeoff and consider it in all decisions regarding additional imaging modalities. It’s the adaptive expertise garnered by the clinical neuroimager, not the imaging tools or technology alone that fuel such clinical innovation. Rather than mandating strict timelines and the need for speed, perhaps honing expertise in stroke diagnosis and clinically relevant imaging may inherently optimize the speed-accuracy tradeoff.

There is now a tremendous opportunity to stem or reverse the disenfranchisement of the neurologist as neuroimager. Subspecialty interests have splintered vascular neurology and enticed trainees to cultivate skills in neurocritical care, neurointervention, neurosurgery and stroke recovery whereas neuroimaging has lagged. The modern clinical neuroimager is often the initial care provider for a wide range or type of stroke patients from hemorrhage to ischemia, armed with the incredibly important aspects of clinical history and examination findings and best poised to utilize imaging to guide therapy from acute stroke to recovery

and prevention. The adept neuroimager will foster practical approaches, both on and off site, to optimized and clinically relevant imaging across a variety of settings. It is imperative, however, that chart documentation explains the nuances and complexity of medical decision-making, justification for imaging and direct impact on patient outcomes in real time that will drive reimbursement. Delayed interpretation of imaging, beyond the timeframe of rational medical decisions regarding treatment and management of the stroke patient, is not warranted. In contrast to the typical noncontrast CT report of the acute stroke patient that oddly declares “no acute findings”, the neuroimager should explain the clinical significance, rationale and active use of the imaging information available from multimodal CT and MRI that will become essential to identify optimal endovascular therapy candidates. Such active use of neuroimaging by many stroke care providers is not new, yet the documentation must parallel critical care where time spent and the integration of information are essential components to demonstrate added value. Rather than being penalized for lack of conforming to arbitrary time metrics as surrogates for quality, the modern clinical neuroimager should explain why thinking about the clinical and imaging data in tandem is valuable to the patient. Indeed, future reimbursement paradigms may only endorse clinically relevant neuroimaging.

Developing expertise as the modern clinical neuroimager unquestionably requires training and adequate exposure. The next generation in stroke should not exclusively focus on whether to order a CT or MRI counting minutes at the bedside, but actively and efficiently integrate the vast wealth of information available when imaging is used in proper clinical context. The novel endovascular era in stroke provides an ideal venue for the synergistic goals of translating research advances, improving patient outcomes and ongoing education as a modern neuroimager.

Acknowledgments

This work has been funded by NIH-National Institute of Neurological Disorders and Stroke (NIH/NINDS) K24NS072272.

References

1. Berkhemer OA, Fransen PS, Beumer D, et al. A randomized trial of intraarterial treatment for acute ischemic stroke. The New England Journal of Medicine. 2015; 372:11–20. [PubMed: 25517348]
2. Campbell BC, Mitchell PJ, Kleinig TJ, et al. Endovascular therapy for ischemic stroke with perfusion-imaging selection. The New England Journal of Medicine. 2015; 372:1009–18. [PubMed: 25671797]
3. Goyal M, Demchuk AM, Menon BK, et al. Randomized assessment of rapid endovascular treatment of ischemic stroke. The New England Journal of Medicine. 2015; 372:1019–30. [PubMed: 25671798]
4. Broderick JP, Palesch YY, Demchuk AM, et al. Endovascular therapy after intravenous t-PA versus t-PA alone for stroke. The New England Journal of Medicine. 2013; 368:893–903. [PubMed: 23390923]
5. Ciccone A, Valvassori L, Nichelatti M, et al. Endovascular treatment for acute ischemic stroke. The New England Journal of Medicine. 2013; 368:904–13. [PubMed: 23387822]
6. Kidwell CS, Jahan R, Gornbein J, et al. A trial of imaging selection and endovascular treatment for ischemic stroke. The New England Journal of Medicine. 2013; 368:914–23. [PubMed: 23394476]

7. Liebeskind DS. Collateral lessons from recent acute ischemic stroke trials. Neurological Research. 2014; 36:397–402. [PubMed: 24641715]
8. Liebeskind DS. Trials of endovascular therapies or collaterals? International Journal of Stroke. 2013; 8:258–9. [PubMed: 23692483]
9. Brillman J, Kasdan R, Wechsler LR. The neurologist as neuroimager. Neurology. 1997; 48:303–6. [PubMed: 9040710]
10. Feldmann E, Liebeskind DS. Developing precision stroke imaging. Frontiers in Neurology. 2014; 5:29. [PubMed: 24715885]