Published in final edited form as:

Stroke. 2016 July ; 47(7): 1965–1967. doi:10.1161/STROKEAHA.115.011149.

Suspected Large Vessel Occlusion - Should EMS transport to the nearest PSC or bypass to a CSC with Endovascular Capabilities?

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Keywords

stroke; large vessel occlusion; emergency medical services; endovascular therapy; debate

THE CASE

A patient calls 911 for acute onset of stroke-like symptoms. EMT arrives within 2 hours of stroke symptoms onset; NIHSS = 14.

THE QUESTION/CONTROVERSY

Should the EMT take the patient to the nearest primary stroke center or should they bypass the primary stroke center to take the patient directly to a comprehensive stroke center with endovascular capabilities?

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Disclosures: Dr. Southerland acknowledges research support from the Health Resources and Services Administration (GO1RH27869-01-00), Virginia Alliance of Emergency Medicine Research, and speakers honoraria from the Virginia College of Emergency Physicians and America's Essential Hospitals. Dr. Johnston receives research support from the NIH-NINDS U01 NS069498. Dr. Goyal receives research support from Covidien (Medtronic) for the SWIFT-PRIME and ESCAPE trials.

YES. EMT should take patients to the nearest primary stroke center. Andrew M. Southerland and Karen C. Johnston

There is no debate that new data demonstrating significant efficacy of endovascular therapy in acute ischemic stroke is a paradigm shift. For select patients with anterior circulation stroke, proximal large vessel occlusion (LVO), and supportive brain imaging, timely reperfusion using stent retriever thrombectomy substantially increases the odds of a favorable outcome[1]. However, the suggestion that emergency medical services (EMS) should bypass primary stroke centers (PSC) to proceed to comprehensive stroke centers (CSC) for patients with suspected moderate/severe acute ischemic stroke is premature.

"If you don't know where you going, you might wind up someplace else." - Yogi Berra—This case highlights the challenge of accurate prehospital diagnosis. In the scenario, an EMT arrives to find the patient with an NIHSS=14, but this is misleading. Numerous prehospital stroke scales have been validated for EMS use, but are not measures of stroke severity and lack the requisite sensitivity/specificity for diagnosing anterior circulation LVO[2–4]. Even more compelling is the discrepancy in number of stroke patients screened compared to the small fraction who are ultimately eligible for endovascular therapy (Extend-IA trial reported <1%).[5] Using our current tools, selective bypass to a CSC would result in many endovascular ineligible patients triaged to facilities where no additional therapy can be offered, who are subjected to delays in initial intravenous (IV) tPA and other standard of care potentially resulting in worse outcomes, and who are unnecessarily uprooted from their local communities and hospitals.

IV-tPA, rapidly administered at PSCs, remains a highly efficacious and proven treatment for acute ischemic stroke[1]. The odds of favorable outcome increases substantially with shorter time to treatment; every 15 minute acceleration in start of IV-tPA results in a 4% increased likelihood of independence.[6–7] Current guidelines state that delays in IV-tPA and diversion adding more than 15–20 minutes to transport should be avoided.

"When you come to a fork in the road, take it." – Yogi Berra—In a scenario where a PSC and CSC are equidistant, or when an absolute contraindication to tPA is known in the field (e.g. fully anticoagulated), we would agree that either transport path at the fork is reasonable. However, in rural and underserved areas with greater geographic disparities and time obstacles[8], then selective diversion ultimately delays acute evaluation and treatment. Ambulance telemedicine and mobile stroke units are exciting new developments to assist with prehospital triage, but are not yet generalizable for clinical practice. Thus, our focus should be on the development of local and regional systems of care to maximize efficient collaboration between providers and stroke centers and to work together, not against, on behalf of our patients.

"The future ain't what it used to be." – Yogi Berra—Truly, we are at a crossroads in the evolution of acute stroke treatment. There is no argument against the impact of endovascular therapy to vastly improve outcomes for our stroke patients meeting appropriate eligibility criteria. However, we are not yet ready to bypass our *primary* responsibility to patients until we have a better idea of where we're going. First, do no harm.

NO. EMT should bypass primary stroke centers. Noreen Kamal and Mayank Goyal

The recent success of five endovascular randomized control trials has changed best practice guidelines[1] to include endovascular therapy for acute ischemic stroke patients with a large vessel occlusion with effect sizes in some studies as high as 25%. However, endovascular therapy is only offered in Comprehensive Stroke Centers (CSC), which makes access to this highly beneficial therapy difficult for patients that are outside the catchment area of a CSC. Should the EMT bypass a closer Primary Stroke Center (PSC) to ensure that the patient has access to endovascular therapy sooner?

Here are some facts: 1. IV tPA is not that effective in large vessel occlusion (LVO) 2. Time is brain: the faster we can achieve reperfusion, the higher is the likelihood of a good outcome 3. Endovascular treatment is safe and highly effective (NNT of 2.5–7 in recent trials). Also it is quite likely that expertise, efficiency and workflow are likely related to volume of patients treated and as such, likely better at the CSC. Most CSCs have better 24/7 service not only for giving tPA but also for imaging, decision making and management of complications. It is also important to note that CSCs can administer tPA as needed.

If a patient is to be transported to a PSC to get tPA early before going to a CSC for endovascular therapy (i.e. drip and ship), they could potentially benefit from early thrombolysis. But result in delayed endovascular treatment. We should keep in mind that the modeled benefits of early tPA is based on the entire stroke populations and LVO typically have a much lower reperfusion rate. This benefit is highly dependent on the distances between the scene of the stroke and the PSC, the scene and the CSC, and the PSC and the CSC. In addition to the distances, the benefit is also highly dependent on the ability for the PSC to administer tPA and get the patient out the door quickly for transport to the CSC.

We can model the benefit of going directly to the CSC versus drip and ship. If we use SWIFT PRIME data and initially look at First Medical Contact (FMC) to PSC of 30 minutes, and assume an onset to FMC of 90 minutes. Furthermore, we have needle to CSC arrival of 110 minutes and door to reperfusion at the CSC of 100 minutes. For the direct transport option, we have a FMC to CSC of 90 minutes and the same reperfusion time. This results in a total FMC to endovascular reperfusion for the Drip and Ship of 260 minutes compared to 180 minutes for the Mothership assuming that the door-to-needle time (DNT) of 30 minutes at the PSC. The model will yield a slight benefit for the Drip and Ship of 40% compared to 30% for the Mothership option. However, this will only happen if the times described above are practically achievable. In reality, the DTN at PSCs are much longer and the door-in-door-out (DIDO) times are also considerably longer. The median delay of onset to reperfusion as a consequence of drip-and-ship compared to mothership was approximately two hours in SWIFT PRIME (presented at ESOC, Glasgow, 2015). In this scenario (and in most workflow situations), there would be clear benefit of mothership.

Keeping these variables in mind, we argue for bypassing the PSC until we can improve our systems of care to rapidly perform NCCT followed immediately by a CTA, and administer tPA within 30 minutes of arrival; additionally, the PSC’s need to get the patient out the door within 45 minutes of arrival. It is possible that there is a slight benefit to early tPA when the distance from the scene to the PSC is small; however, this is based on current data based on

tPA response for all comers. It is likely that the curve for decay of tPA response is much shallower in patients with LVO. We will likely have a better understanding of these curves as meta-analysis data from the current trials sheds further light on the subject.

In summary, we argue that we bypass the PSC and transport LVO patients directly to the CSC (in most situations) until we can invest in improving our system of care to ensure rapid DIDO of < 40 minutes at the PSC. Further data from ongoing meta-analyses and improvements in endovascular treatment and workflow will continue to refine the model and in our opinion, continue to tilt the curves in favor of direct to CSC.

Rebuttal (Andrew M. Southerland and Karen C. Johnston)

We agree, that for acute ischemic stroke (AIS) patients with known large vessel occlusion (LVO): (1) endovascular therapy (EVT) is safe and effective, (2) EVT + IV-tPA is superior to IV-tPA alone, and (3) the faster we can achieve reperfusion, the higher the likelihood of a good outcome.

However, based on the data, most AIS patients presenting via EMS will not have an LVO and are ineligible for EVT. Therefore, uniformly bypassing proximate PSCs in favor of CSCs, without more accurate tools for prehospital diagnosis, would be a disservice to the majority of patients with AIS. Additionally, the argument in favor of hospital bypass makes two unjustified presumptions: (1) Only CSCs can effectively perform EVT (note 17/24 US SWIFT-PRIME sites were not CSCs during study enrollment[1]). (2) Stroke systems of care can be optimized while concomitantly bypassing PSCs and stroke ready hospitals. To optimize our stroke systems, we must incorporate all components of the system into the care continuum and not isolate ourselves to a limited number of accessible CSCs.

Thus, once LVO has been accurately determined, we support rapid transport to an EVT capable center. However, for the majority of AIS patients triaged by EMS, the proper course of action is to the nearest PSC that can offer initial stroke management and identify eligibility for the range of acute therapies.

Rebuttal (Noreen Kamal and Mayank Goyal)

Action expresses priorities: Mahatma Gandhi

We as health care professionals should have only one priority in this situation: create systems of care that maximize the chance of this patient who is suffering from a significant stroke to have a good outcome. And with that priority, our actions should correspond to that priority. We agree that while there are limitations of diagnosing in the field and that there can’t be a single solution that would apply to all geographies, however in the overall picture we have to acknowledge that: 1. IV tPA has been around for decades. It is unlikely that its efficacy or workflow is going to change in the near future. 2. In light of recent data and the use of modern technology and communication, our ability to better detect patients with LVO in the field will continue to improve 3. All aspects of endovascular treatment: workflow, quality of reperfusion, complication rate are likely to continue to improve (due to more experience, better technology, increased resources and standardization of processes). As such, we respectfully submit that ultimately Yogi Berra is way out of his league to decide

priorities on systems of care for an otherwise dismal disease. We believe that our Gandhian action of taking the patient direct to the CSC is a much better reflection of our priority: giving this patient the best chance for independence (pun intended).

Commentary (Carlos A. Molina and Magdy Selim)

The recent overwhelming evidence in favour of EVT in patients with LVO are challenging transfer protocols worldwide and novel algorithms are being proposed to improve access to EVT for patients living in geographic areas distant from CSC. This is a reperfusion race starting in an island crowded of swimmers that all look the same. We need to pick good swimmers (with LVO), to start a fast and long swim course directly to the CSC shore, from the crowd of regular swimmers (without LVO), who just need a short swim to the nearest SC beach. However, some “regular” are in fact “good” swimmers, and after a long transition for tPA (DIDO), they need a secondary bike course to the CSC. On the other hand, some “good” swimmers may suffer the direct transfer and die on the shore due to delay or even deny of tPA at the CSC.

Our opponents agreed that current clinical and imaging tools for diagnosing LVO in the field are inaccurate and poorly implemented, respectively. Moreover, direct transfer by EMT to a distant CSC of some unstable severe strokes including ICH patients may raise safety concerns. However, transferring severe stroke patients to the nearest SC leads to an unacceptable delay for an eventual secondary transfer to CSC for EVT and a DIDO time < 30 min seems unrealistic. The benefit of EVT declines dramatically over time and improving workflows represent a major goal. It seems that there is not a single solution that would apply to different scenarios around the world including a variety of geographic and resources barriers, health care systems and reimbursement policies. Direct transfer to CSC bypassing PSC for EVT represents a novel clinical equipoise and a RCT is desperately needed. This trial should define clear processes of care and optimized workflows, use in-ambulance technologies for patient randomization –telemedicine- and establish isochrones to measure the treatment effect. In the meantime, we need to commit ourselves to a continuous development and implementation of reliable tools to optimize the pre-hospital diagnosis of LVO and improving workflows in SC (DIDO) as well as in the CSC!!

“Wheresoever you go, go with all your heart”

-Confucius-

References

1. Powers JW, Derdeyn CP, Biller J, Coffey CF, Hoh BL, Jauch E, et al. 2015 AHA/ASA Focused Update of the 2013 Guidelines for the Early Management of Patients With Acute Ischemic Stroke Regarding Endovascular Treatment: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association. Stroke. 2015; 46:3020–35. [PubMed: 26123479]
2. Higashida R, Alberts MJ, Alexander DN, Crocco TJ, Demaerschalk BM, Derdeyn CP, et al. Interactions within stroke systems of care: a policy statement from the American Heart Association/American Stroke Association. Stroke. 2013; 44:2961–84. [PubMed: 23988638]
3. Asimos AW, Ward S, Brice JH, Rosamond WD, Goldstein LB, Studnek J. Out-of-hospital stroke screen accuracy in a state with an emergency medical services protocol for routing patients to acute stroke centers. Annals of emergency medicine. 2014; 64:509–15. [PubMed: 24746847]

4. Katz BS, McMullan JT, Sucharew H, Adeoye O, Broderick JP. Design and validation of a prehospital scale to predict stroke severity: Cincinnati Prehospital Stroke Severity Scale. Stroke. 2015; 46:1508–12. [PubMed: 25899242]

5. Campbell BC, Mitchell PJ, Kleinig TJ, Dewey HM, Churilov L, Yassi N, et al. Endovascular therapy for ischemic stroke with perfusion-imaging selection. NEJM. 2015; 372:1009–18. [PubMed: 25671797]

6. Hacke W, Donnan G, Fieschi C, Kaste M, von Kummer R, Broderick JP, et al. Association of outcome with early stroke treatment: pooled analysis of ATLANTIS, ECASS, and NINDS rt-PA stroke trials. Lancet. 2004; 363:768–74. [PubMed: 15016487]

7. Saver JL, Fonarow GC, Smith EE, Reeves MJ, Grau-Sepulveda MV, Pan W, et al. Time to treatment with intravenous tissue plasminogen activator and outcome from acute ischemic stroke. Jama. 2013; 309:2480–8. [PubMed: 23780461]

8. Mullen MT, Judd S, Howard VJ, Kasner SE, Branas CC, Albright KC, et al. Disparities in evaluation at certified primary stroke centers: reasons for geographic and racial differences in stroke. Stroke; a journal of cerebral circulation. 2013; 44:1930–5. [PubMed: 23640827]