ASK THE EXPERTS

AI-Assisted Stroke Triage

Reviewing the pressing questions and unknowns of the role of artificial intelligence in stroke triage and communications, including the potential impact on futile transfer, key data unknowns, and implementation challenges.

With Dorothea Altschul, MD, FAHA, FSVIN, and Stav Tjoumakaris, MD, FAANS, FACS, FAHA

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What are the practical ramifications of a futile transfer for acute ischemic stroke (AIS)?

Dr. Altschul: Overloading higher-level stroke centers with patients who do not benefit from transfer may negatively affect the care for patients who did need that transfer bed. Taking patients who do not need a higher level of care out of their community, with long transportation times, may cause stress to the patients and their families and is associated with increased health care costs.

Dr. Tjoumakaris: Futile transfer of AIS is disadvantageous to patient care and the health system. Transfer futility can be further classified as transfer delay and unnecessary transfer. Delay in transfer can be a life-altering or life-threatening event for the patient. Prompt artificial intelligence (AI) evaluation allows for expedited stroke triage and emergent transfer to a tertiary care center for mechanical thrombectomy. As we know, stroke care is time sensitive, and therefore, any delay in transfer could be detrimental for patient care and recovery. Unnecessary patient care transfer can overwhelm tertiary care centers and limit resources for the care of high-acuity stroke patients.

In terms of hard data, what do we know about the impact of AI-based triage, whether on reducing futile transfers or expediting times to treatment?

Dr. Altschul: In the STRATIS registry, interhospital transfer before thrombectomy was associated with delayed treatment and worse outcomes.[1] Early evidence supports that automated large vessel occlusion (LVO) detection is associated with a reduction in time to treatment and improved clinical outcomes in a hub-and-

spoke model. However, data comparing outcomes pre- and postincorporation of AI-based triage protocols are derived retrospectively.[2] Faster treatment of LVO-based strokes leads to better outcomes; hence, if AI-based protocols can improve time to treatment, this is a huge win to the patients. To my knowledge, there are no randomized or prospective data available.

Dr. Tjoumakaris: AI provides an excellent platform to increase efficiency in acute stroke triage. Prompt clinical evaluation and access to radiographic studies are key steps in patient evaluation that determine whether a patient requires urgent transfer for mechanical thrombectomy. In our paper describing a telestroke program at Thomas Jefferson University Hospital in Philadelphia, Pennsylvania, early implementation of AI in patient triage increased the percentage of patients receiving intravenous alteplase thrombolysis by a mean of 55% compared to pre-AI triage.[3] In addition, there was a notable decrease in patient transfers to tertiary care centers from 44% to 19%. Therefore, implementation of AI in triage for AIS optimizes patient care from diagnosis to medical and surgical treatment and improves overall functional outcome and neurologic recovery.

What was the most challenging aspect of implementation of AI-based triage or a learning curve element that might help new adopters?

Dr. Tjoumakaris: One of the most challenging aspects of AI in clinical practice is the lack of direct patient contact and interaction. There is a learning curve in getting accustomed to telecommunication with the local caring team, patients, and their families. Furthermore, performing a clinical examination is more challenging and requires active participation by the local medical team. However, after AI system implementation and education and training of all involved personnel, this ultimately becomes a seamless process and part of the daily routine in stroke care.[4]

Dr. Altschul: In my case, the most challenging aspect of implementation was getting all key stakeholders to the table as early as possible and finding a way to clearly articulate the value of AI-based stroke triage. Stroke is a multidisciplinary field, and many disciplines are involved: emergency department, neurology, neuroendovascular, neuroradiology, and hospital administration. Each area has unique concerns as to how an AI-based stroke software would affect workflow. For example, the radiology department may face different challenges than the neurology department, but in the end, they must all buy in and accept this tool as a work-process improvement rather than a disruption of the status quo.

AI-based triage enhances communication between team members and should be expected to be an addition and/or enhancement of the already developed stroke protocols. In larger health care systems, there may be apprehension toward adapting to a completely new AI-based stroke process, particularly in a nonteaching health system. However, this should not be thought of as a barrier. The software can integrate into the stroke evaluation process on many distinct levels and can cater to the specific needs of the health system.

What are the key unknowns that should be addressed in future trials or studies?

Dr. Tjoumakaris: Despite the advancements in AI and telemedicine, especially throughout the COVID-19 pandemic, there are still several unknowns that need to be addressed in future studies. As technology requirements increase, the optimal internet bandwidth for successful, uninterrupted connection and patient consultation needs to be determined. This process is dynamic and will need to be updated in a timely fashion. Additionally, the interaction and joint decision-making/clinical evaluation with the local medical team raises both ethical and legal questions. Lack of medical expertise and understanding of AIS at the local hospital could affect the AI physician team recommendations and patient care. Assumption of legal liability is also uncertain and may potentially hinder physician participation in AI.

Dr. Altschul: The key unknown for me is how many reiterations and differences in stroke models the health care system will be able to handle, particularly since the health care system faces huge challenges after enduring a pandemic.

We are still searching for many answers that could have huge implications in stroke treatment and stroke workflow (eg, drip and ship vs bypass, direct to angiography, the role of CT perfusion imaging in stroke triage). More recently, a new concept is emerging as well: transferring the neurointerventionalists to outside spokes as opposed to the patient transferring to the hub. AI could have a significant impact in helping answer any of these questions.

What is the next AI-related innovation you want to see to improve patient care? Do you think AI has the potential to accurately suggest which therapy would be most beneficial to a patient?

Dr. Altschul: In my opinion, AI is here to stay and will only be expanding, especially for hyperacute and

extremely time-dependent stroke therapies. I believe health care should be more checklist driven, and I would appreciate an automatic algorithm that would rapidly screen imaging, laboratory results, and prior and current medical history; match it against current indications for treatment; and then automatically alert the team and cath lab of an anticipated intervention or recommend other therapies.

Dr. Tjoumakaris: The marked technologic advancement of our era has sparked interest in applications of AI in patient care. I believe that the next level of innovation in AI is a platform that provides a holistic approach to the diagnosis, triage, medical management, surgical intervention, and functional recovery of AIS patients. In this platform, a medical team will be able to not only accurately evaluate and triage the patient remotely as can be done now but also allow experienced neurointerventional physicians to treat patients remotely and robotically. As an example, remote percutaneous coronary intervention has been successfully completed in India by Dr. Tejas Patel and his team.[5] Such advancement in stoke care requires significant software upgrades and intense medical team training, including of the local hospital physicians and nursing staff. Finally, incorporation of AI in stroke recovery with the use of programs that facilitate patient rehabilitation in both an inpatient and, primarily, outpatient setting could enhance patient clinical outcome and ongoing recovery.

AI technical paradigms in the diagnosis of acute stroke have been introduced, such as in the automatic radiographic calculation of a LVO and ischemic penumbra. However, physician interpretation of radiographic results and correlation with the clinical condition remain paramount in the decision-making process. AI could be an outstanding adjunct in the treatment recommendation, but to ensure patient safety, the leading role should always be held by the treating physician and the clinical team.

Although provider burnout is multifactorial, and it is challenging to monitor and determine its sources and effects, what are your thoughts or experiences regarding whether AI has a role in reducing triage-related stressors?

Dr. Altschul: The single most time-saving, quality-of-life–improving feature of AI-based stroke triage is the ability to view images on a phone without having to log in to the PACS (picture archiving and communication system).

It has improved my lifestyle dramatically as a neurointerventionalist. Most strokes are not LVOs. Before AI-based triage, stroke notification lacked the positive predictive value that is, in fact, needed to swiftly activate the cath lab. Neurointerventional teams want to be notified when they are needed, and delays/cancellations in that process can lead to frustrations, as well as delays in the care of other, less emergent patients. Now, we can very quickly assess if a patient is a candidate for thrombectomy and quickly be ready when needed. Often, it is just as important to know whether a patient does not meet thrombectomy criteria in our type of practice model where the neurointerventionalist travels to the patient as opposed to the patient being transferred in. The ability to easily communicate with many different health care providers simultaneously decreases redundancies in communication, which increases productivity.

Dr. Tjoumakaris: Certainly, automating the triage process could relieve part of the workload of treating stroke physicians. Although not all aspects of triaging are amenable to this technology, patient demographics, urgent film interpretation, data collection for thrombolysis exclusion criteria, and direct communication with the transfer center are all elements of the stroke triage that could be facilitated by automated technology. This will certainly reduce physician stressors and allot them more time for the clinical interpretation and decision-making process.

Overall, AI has significant potential in enhancing and facilitating acute stroke care, from diagnosis to treatment to recovery, under the vigilant clinical supervision of the medical team and led by the treating physician. ■

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