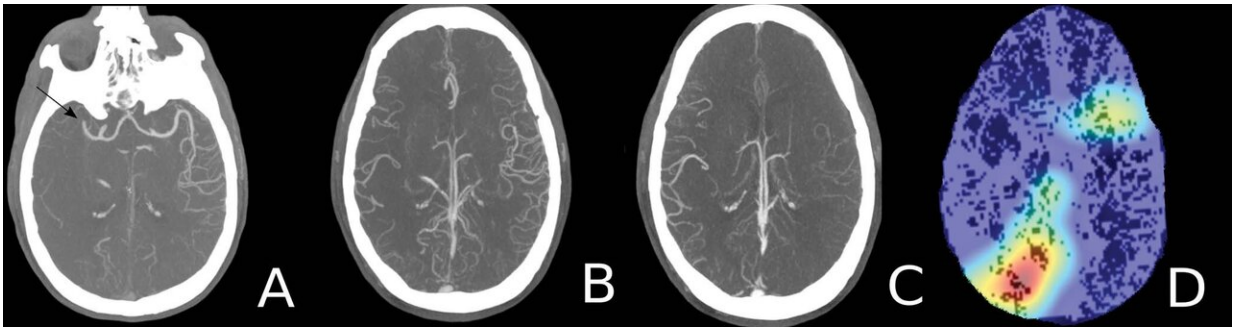
Deep learning model provides rapid detection of stroke-causing blockages

September 29 2020



Axial maximum intensity projection images and a heat map in a 60-year old man who presented to the emergency department with new onset left-sided weakness. A, Arterial (phase 1) image shows an abrupt occlusion of the distal M1 branch of the right middle cerebral artery (arrow) with paucity of distal vasculature. B, Venous (phase 2) image shows subtle asymmetry with minimal increased vascularity in the contralateral left hemisphere. C, Late venous (phase 3) image shows prominent increased opacification of the ipsilateral right hemispheric vasculature downstream from the occlusion. D, Heat map shows the most discriminative region (red) that the model used for the correct prediction. Credit: Radiological Society of North America

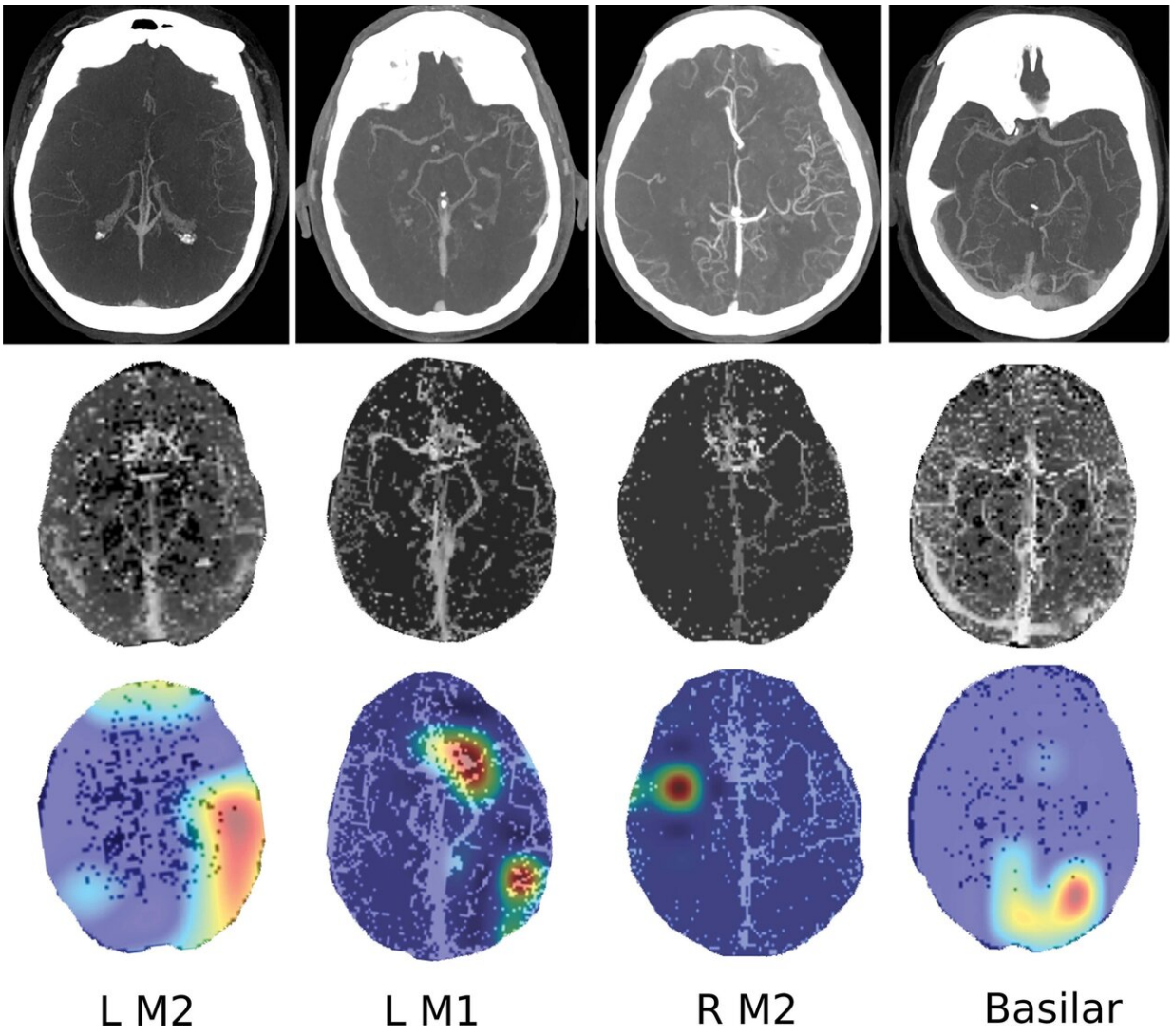
A sophisticated type of artificial intelligence (AI) called deep learning can help rapidly detect blockages in the arteries that supply blood to the head, potentially speeding the onset of life-saving treatment, according to a study published in *Radiology*.

Large vessel occlusions are blockages in the arteries that supply oxygenated blood to the brain. These occlusions account for a significant proportion of ischemic strokes, the most common type of stroke. Prompt diagnosis is critical in order to begin recanalization, or opening of the blocked artery, through a treatment known as endovascular therapy.

"Minutes matter in this time-sensitive diagnosis," said study lead author Matthew T. Stib, M.D., a radiology resident at the Warren Alpert Medical School at Brown University in Providence, Rhode Island. "Every minute that we reduce the time to recanalization extends the patient's disability-free life by a week."

CT angiography (CTA), a three-minute exam that provides detailed views of the blood vessels, is the gold standard for detecting these occlusions. Radiologists are highly accurate at identifying large vessel occlusions on CTA, but they are not always available, and any backlogs at the hospital can further delay care.

Dr. Stib and his colleagues at Brown explored the use of deep learning to help provide rapid detection of large vessel occlusions on CTA and reduce time to treatment.



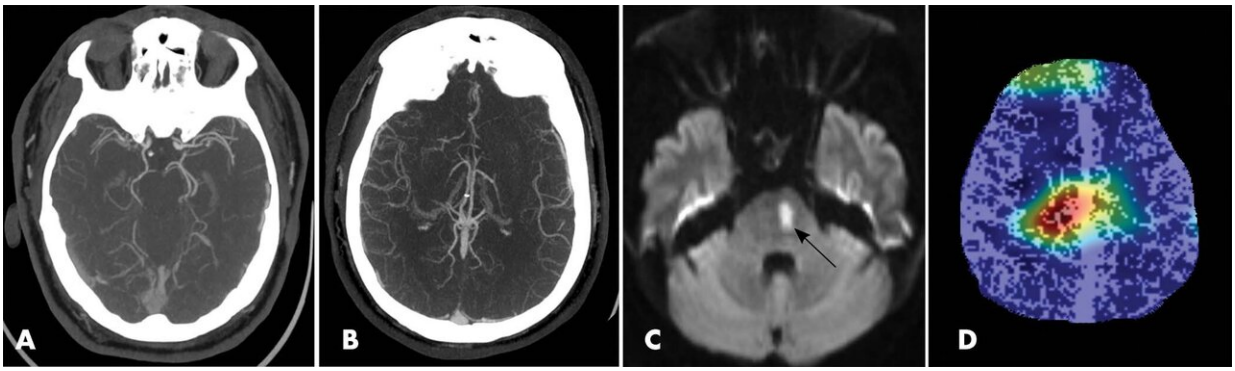
Images show four separate patients with large vessel occlusions correctly predicted by the algorithm. The top row shows a representative CT slice from the delayed venous phase CT angiography. The middle row shows the preprocessed maximum intensity projection images that function as the input to the model. The bottom row are overlaid heat maps, with areas in red showing the most discriminative regions. Notice these so-called hot regions correlate with the occlusion location (respectively: left [L] M2, L M1, right [R] M2, basilar) in each patient. Credit: Radiological Society of North America

Working closely with Brown's computer science department, the researchers developed a deep learning model from scratch. They used a large sample of CTA examinations for patients with suspected acute ischemic stroke to train the algorithm to recognize the appearance of large vessel occlusions and distinguish it from other conditions. Preprocessing of the CTA exams included the creation of maximum intensity projection images to emphasize the contrast-enhanced vasculature. The researchers also used multiphase CTA, a newer approach that provides more comprehensive information than the single-phase technique.

When they tested the deep learning model on multiphase CTA examinations of 62 patients, the model detected all 31 large vessel occlusions for a sensitivity of 100%, a statistically significant improvement over the 77% sensitivity rate of single-phase CTA. The use of multiphase CTA contributed to the improved performance.

"These results are quite promising," Dr. Stib said. "We really wanted to optimize the sensitivity of the model so that we were sure that we picked up every single case because missing a case has pretty dire consequences."

The study is the first to use multiphase CTA to look at occlusions in both the arteries of the front, or anterior, part of the head and neck and those in the back, or posterior.



Images show false-positive finding prediction in a 52-year-old man who presented with acute stroke symptoms to the emergency department. A, Axial arterial phase CT angiography and, B, axial venous phase CT angiography images show no evidence of a large vessel occlusion. Additional noncontrast-enhanced brain CT images (not shown) did not show evidence of acute infarct. C, Diffusion-weighted MRI performed 6 hours after presentation shows an area of restricted diffusion consistent with an acute infarct in the left paramedian pons (arrow). D, Heat map overlay shows focal activity projecting over the central brain. Credit: Radiological Society of North America

"Posterior circulation occlusions have not been discussed much in machine learning literature," Dr. Stib said. "They're less common but have pretty profound clinical consequences if missed. It's important to have an algorithm that detects all categories of occlusion, both anterior and posterior."

The next step in the research is to validate the results using the algorithm in real time and see if it can improve outcomes for patients. If the results hold up, then the deep learning model could be a useful asset in medical centers or hospitals that don't have the expertise for reading large vessel occlusion CTA images.

"This algorithm is not replacing the ability of radiologists to do their job;

rather, it's trying to speed up the time to diagnosis," Dr. Stib said. "So if the radiologist isn't around or there is a large workflow that is preventing someone from looking at the exam results quickly, there will be an alert that says an occlusion may be present and someone should look at this. That's where the value is in this kind of a model."

The team worked under the direction of the study's senior author Ryan A. McTaggart, M.D., a neuroradiologist specializing in interventional neuroradiology at Rhode Island Hospital in Providence, Rhode Island, and proponent of decreasing the time to treatment for large vessel occlusions.

More information: Detecting Large Vessel Occlusion at Multiphase CT Angiography by Using a Deep Convolutional Neural Network, *Radiology*, 2020.

Provided by Radiological Society of North America

Citation: Deep learning model provides rapid detection of stroke-causing blockages (2020, September 29) retrieved 10 April 2024 from https://medicalxpress.com/news/2020-09-deep-rapid-stroke-causing-blockages.html