Detect Stroke Using AI

UmedMi

Agenda

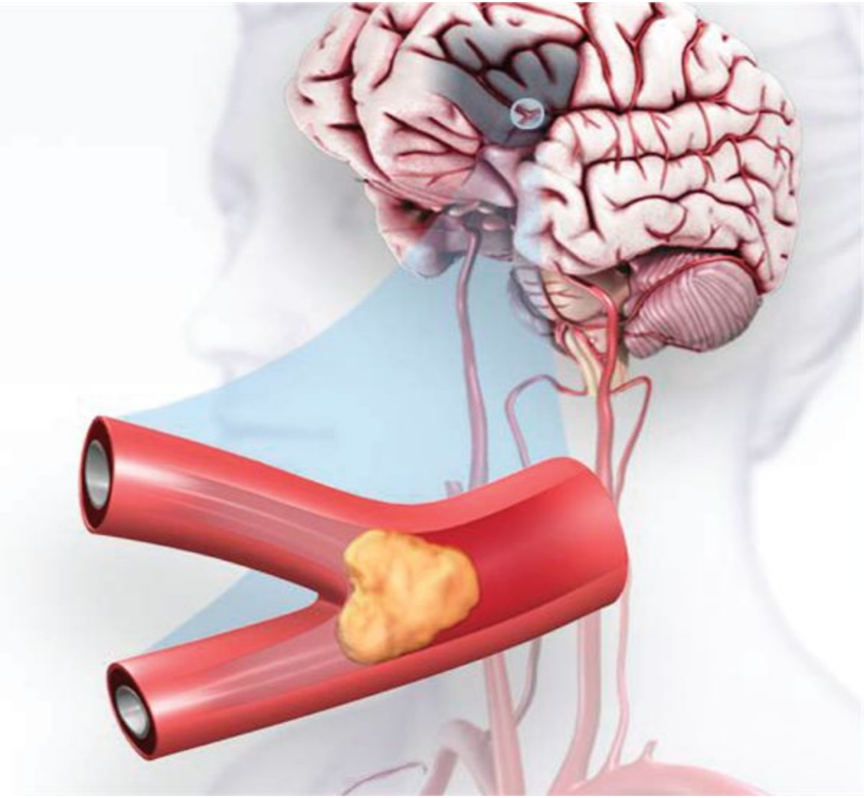
- ❖ What is Stroke
- ❖ How AI can Classify and detect stroke
- ❖ How AI can classify Hemorrhagic and Ischemic Stroke
- ❖ Detect the Time of onset of stroke using AI
- ❖ Detect brain tissue affected using AI
- ❖ Detect vessels affected using AI

What is Stroke

What is Stroke

Stroke

- It occurs when the blood supply to part of your brain is interrupted or reduced, preventing brain tissue from getting oxygen and nutrients. Brain cells begin to die in minutes.



What is Stroke

Stroke according to the WHO

- 15 million people suffer stroke worldwide each year.
- Of these, 5 million die and another 5 million are permanently disabled.

How AI can Classify and detect stroke

How AI can Classify and detect stroke

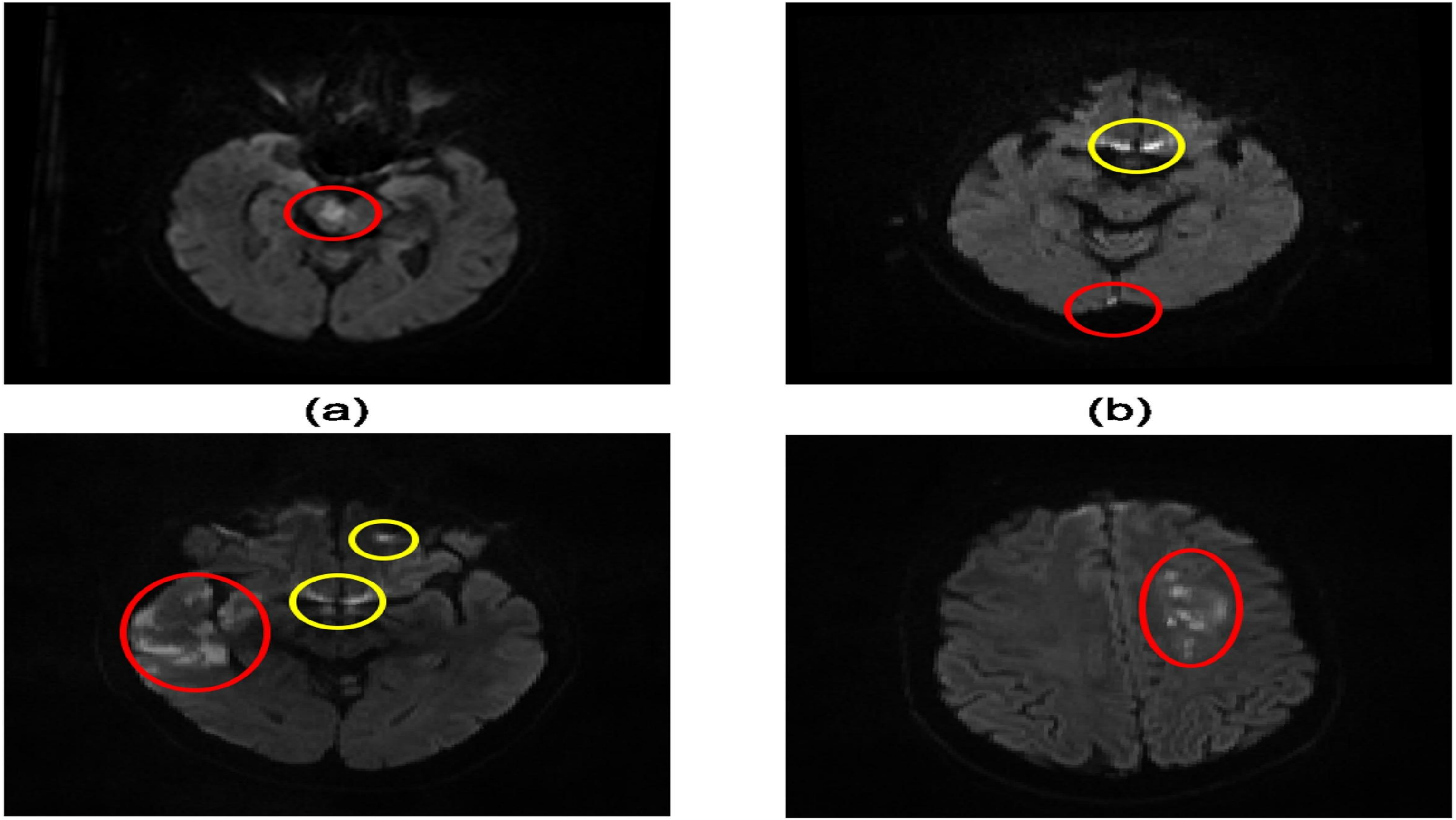
AI Applications and Algorithms in stroke

1. **Fully automatic acute ischemic lesion segmentation in DWI using convolutional neural networks**

- ❖ Using a framework with two CNNs to segment stroke lesions using DWI in MRI.
- ❖ One CNN was a combination of two DeconvNets (EDD Net)
- ❖ The second CNN was a multi-scale convolutional label evaluation net.

How AI can Classify and detect stroke

- ❖ The dataset was **741 subjects**, exhibiting a high lesion detection rate, and accuracy.
- ❖ A mean accuracy of Dice coefficient obtained is **0.67** in total.
- ❖ The mean Dice scores based on subjects with only **small** and **large** lesions are **0.61 and 0.83**, respectively.
- ❖ The lesion detection rate achieved is **0.94.**



(a) (b) (c) (d)

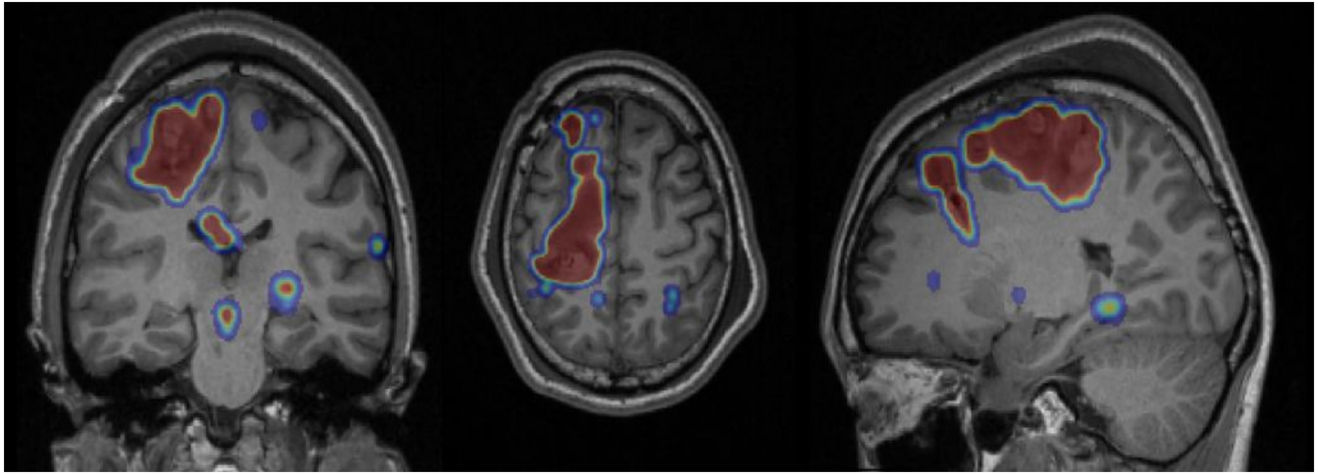
The red circles indicate the acute ischemic lesions and the yellow ones show the artefacts.

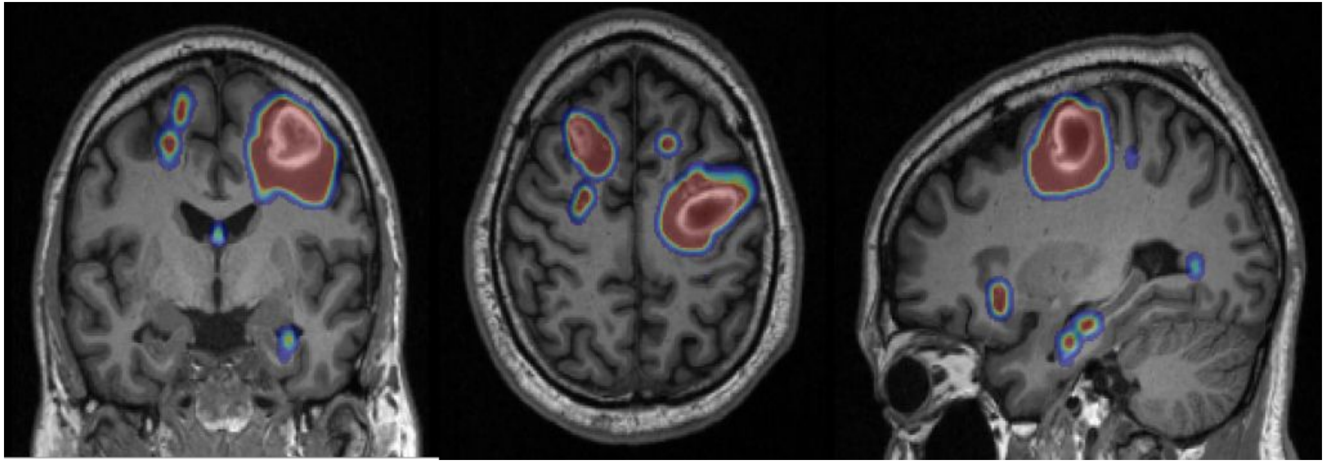
How AI can Classify and detect stroke

DeepMedic

- Is a software for brain lesion segmentation based on a multi-scale 3D Deep CNN coupled with a 3D fully connected Conditional Random Field.
- The system has been shown to yield excellent performance lesion segmentation tasks, including traumatic brain injuries, brain tumors, and ischemic stroke lesions.

DeepMedic Segmentation





How AI can classify Hemorrhagic and Ischemic Stroke

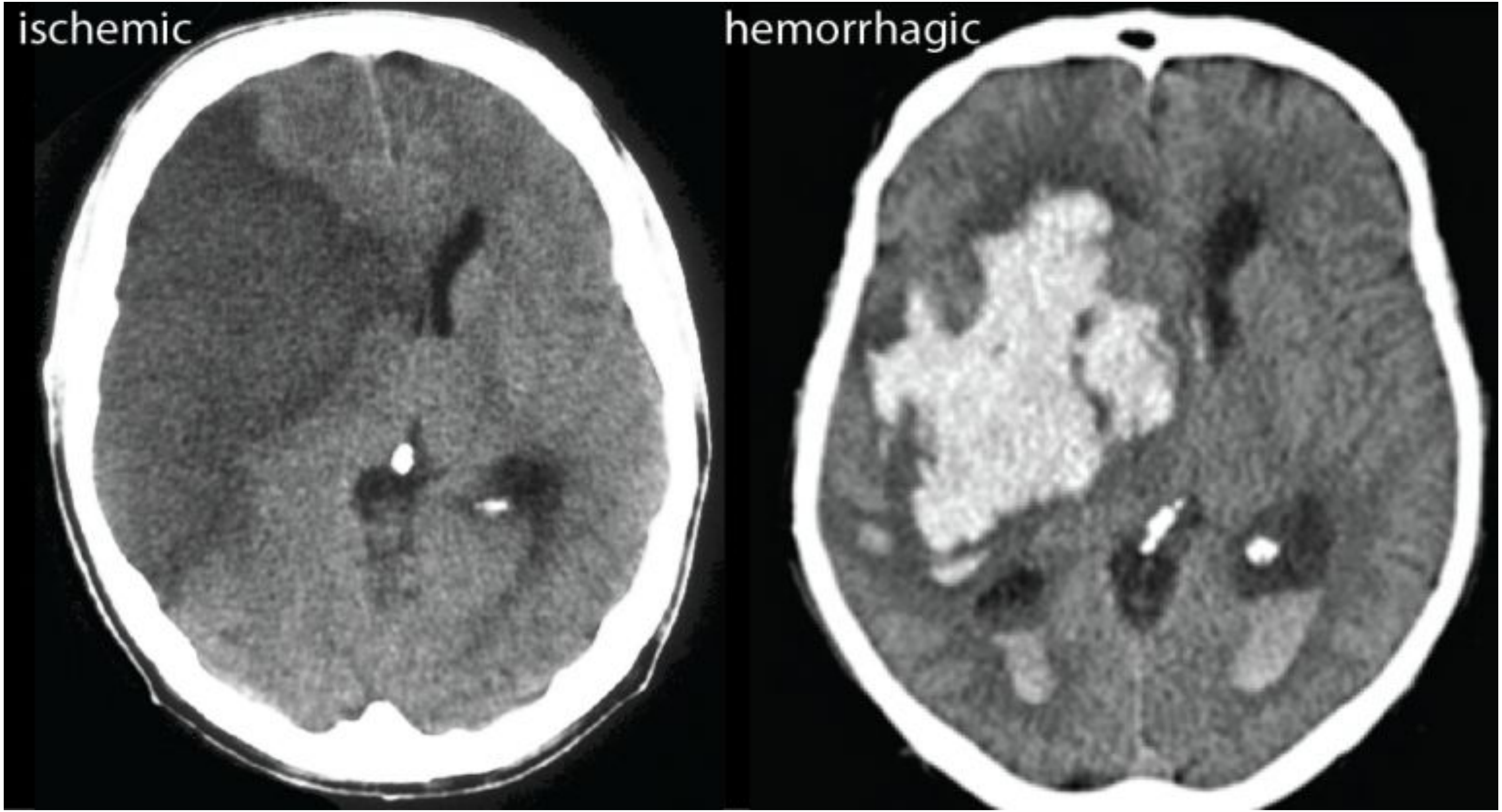
How AI can classify Hemorrhagic and Ischemic Stroke

- ## Ischemic strokes
    - It happens when an artery in the brain gets blocked, usually by a blood clot preventing blood from reaching a part of the brain.
    - blood carries oxygen and nutrients to the cells, without these the brain cells die.
    - It's the most common type of stroke, occurring in 87% of cases.

How AI can classify Hemorrhagic and Ischemic Stroke

❖ Hemorrhagic strokes

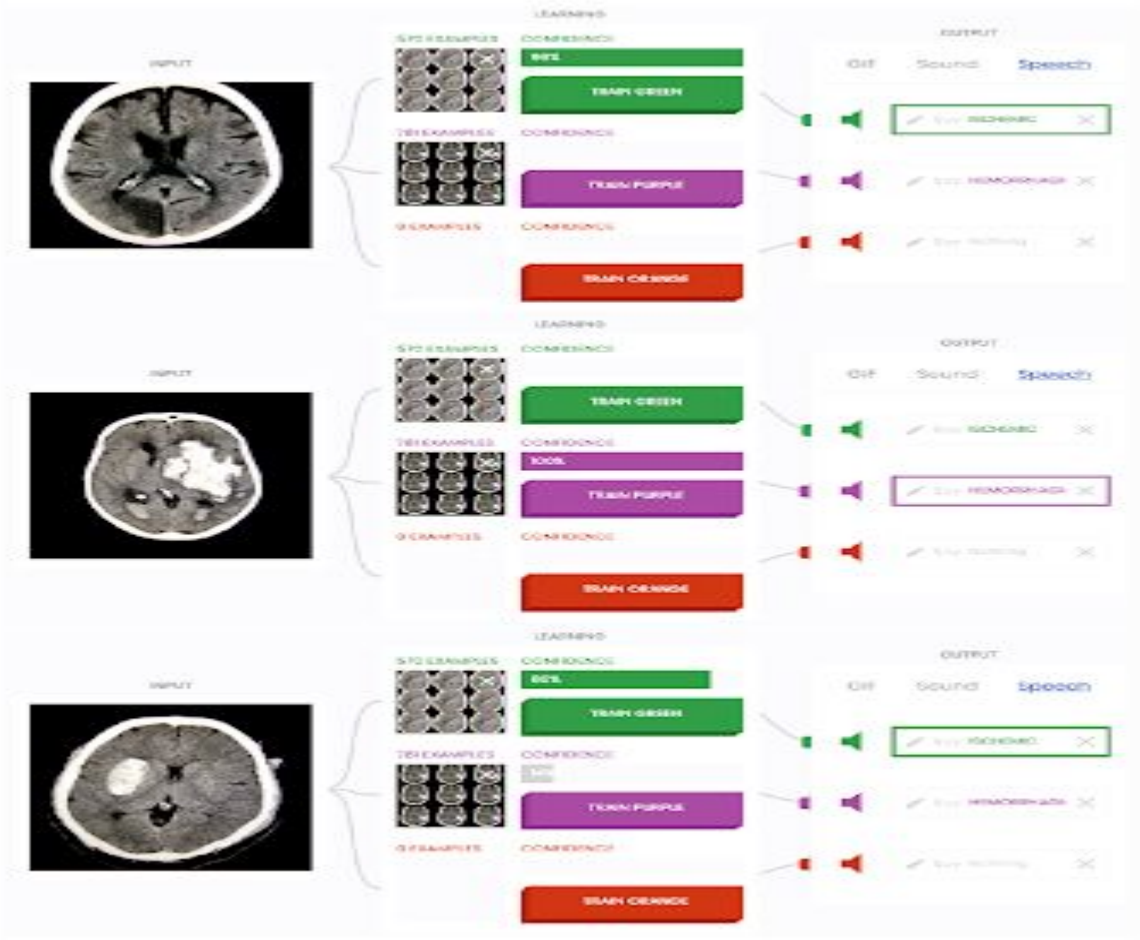
- It happens when a blood artery in the brain bursts, causing blood to spill out into the brain.
- This can be caused by high blood pressure and/or weak arteries.


ischemic
hemorrhagic

In this field, a study is performed to

- The images used in the study were organised into **ischemic and hemorrhagic** stroke by splitting them into separate folders.
- These folders were then each split into big and small based on the size of the stroke.
- The small strokes were less than approximately **20%** of a brain.
- The big strokes were larger than this approximate cut off.
- These four sets were then divided into **training and validation** sets.
- The training set was **90%** of the images.
- The validation set was **10%** of the images.

- The training and validation sets of each stroke were visually compared to make sure that they looked similar.
- In the final training set, there were:-
    - **127 images**:-
        - 56 images of ischemic stroke (45 large and 11 small)
        - 71 images of hemorrhagic stroke (39 large and 32 small)
- In the final validation set there were:-
    - **41 images**:-
        - 20 images of ischemic stroke (18 large and 2 small)
        - 21 images of hemorrhagic stroke (10 large and 11 small)
- This study is performed by Google Teachable Machine


LEARNING
INPUT
OUTPUT
Gif
Sound
Speech
TRAIN GREEN
TRAIN PURPLE
TRAIN ORANGE

The error rate and correct rate of the trained AI program. On average, AI was correct **77.4%** of the time.

Error rate (%)*

	Ischemic	Hemorrhagic	Combined
Big	25.0	20.0	22.2
Small	0.00	27.3	23.1
Combined	20.0	25.0	22.6

*Image 5 not included because not clearly correct or incorrect

Correct rate (%)*

	Ischemic	Hemorrhagic	Combined
Big	75.0	80.0	77.8
Small	100	72.7	76.9
Combined	80.0	75.0	77.4

*Image 5 not included because not clearly correct or incorrect

Detect the Time of onset of stroke using AI

Detect the Time of onset of stroke using AI

The prescribed moment to perform thrombolysis is within **3 to 4.5** hours after the onset of stroke

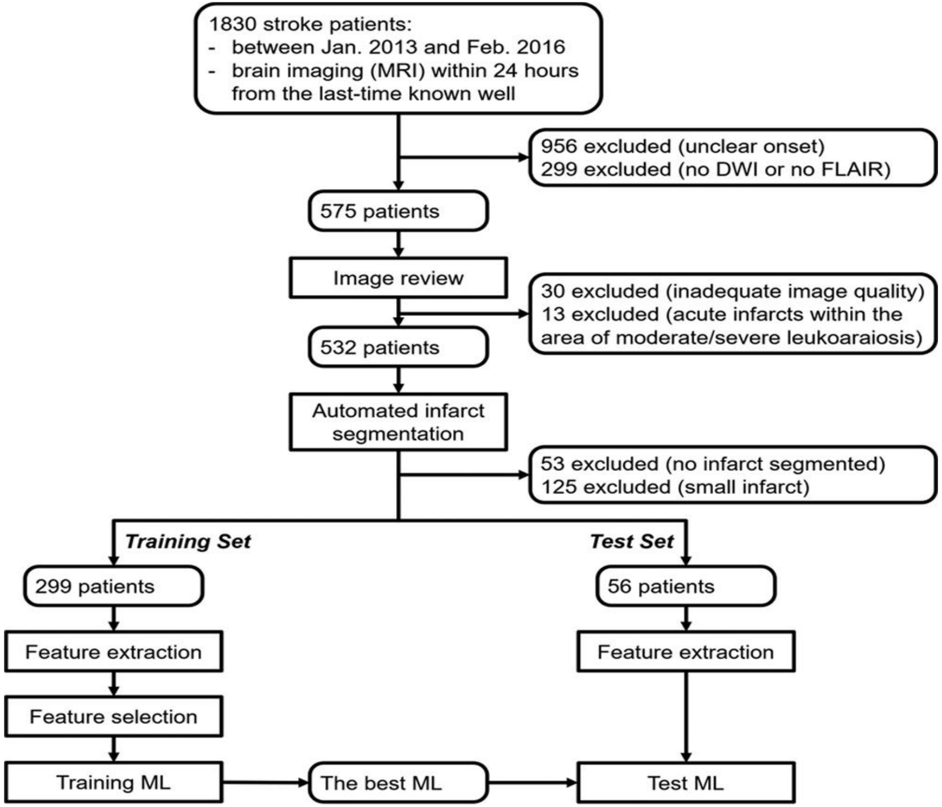
Stroke symptoms are not noticed by the patient.

- However, up to **25%** of stroke patients are reported to have been sleeping during the onset of a stroke.
- reportes said that most events of stroke occur between **6 AM** and noon, suggesting that people waking up in the morning with stroke symptoms are likely to have a **TSS of less than a few hours**.

Detect the Time of onset of stroke using AI

An application of artificial intelligence to detect TSS was developed

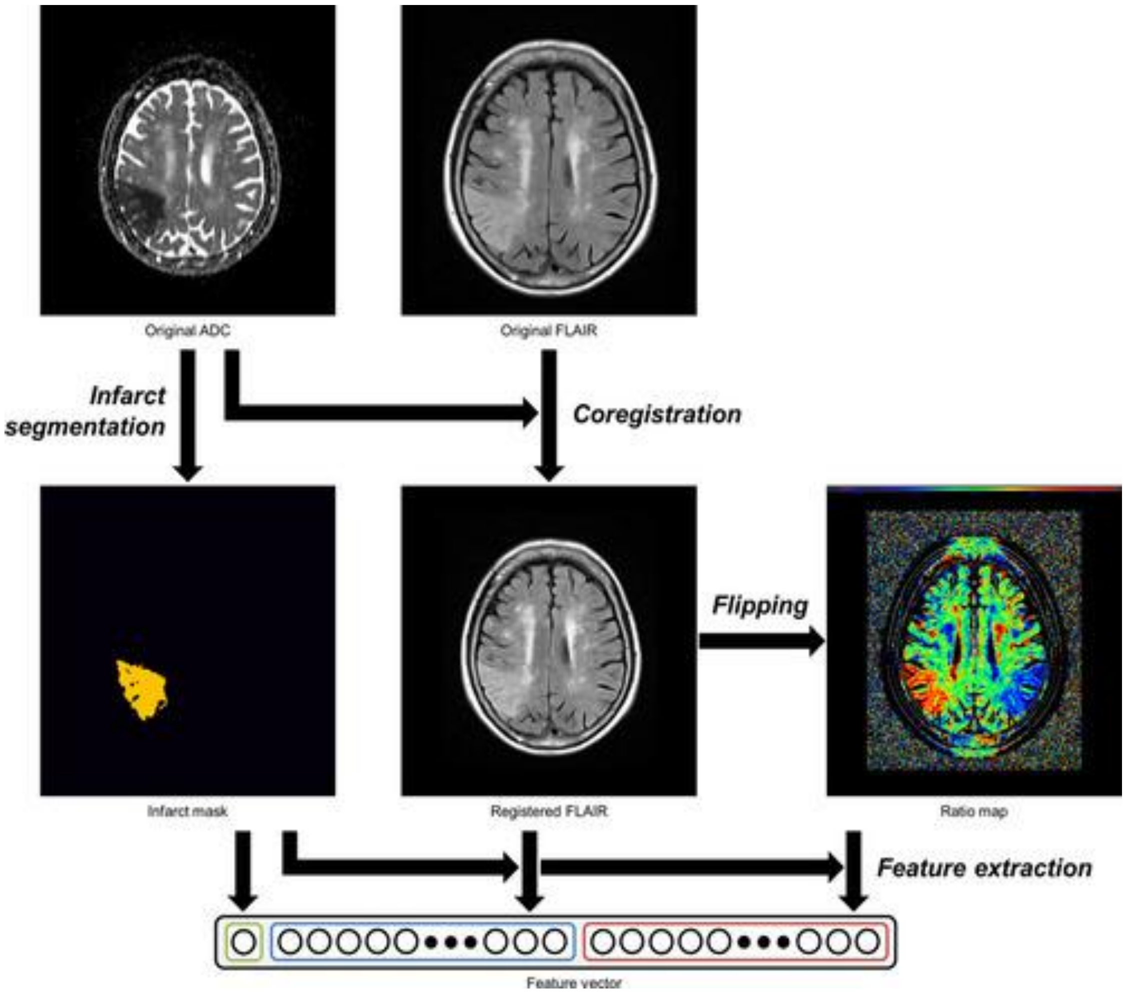
- Use multiple imaging features including those even invisible to humans with a consistent accuracy
- ML methods may be helpful in determining the timing of acute stroke



Using Image Processing

image features were extracted from 2 modified FLAIR images:

- ❖ FLAIR registered on the ADC map.
- ❖ FLAIR ratio map reflected around the midsagittal plane.



Detect the Time of onset of stroke using AI

- **Three ML algorithms were used:**
  - Logistic regression (LR)
  - Support vector machine (SVM)
  - Random forest (RF)
- **Feature Selection using Univariate Analysis:-**
  - Total of 34 vector features from images were significantly different between the groups who underwent MRI **within and after 4.5 hours** of symptom onset and were selected for the generation of ML models.

Table 3. Predictive Values of Machine Algorithms and Human-Determined DWI-FLAIR Mismatches for the Identification of Patients Within 4.5 Hours of Symptom Onset

	Sensitivity	*P* Value	Specificity	*P* Value	PPV	*P* Value	NPV	*P* Value	AUC
Identification of patients within 4.5 h of symptom onset									
Human reading	0.485		0.913		0.889		0.553		
Logistic regression	0.758	0.020	0.826	0.157	0.862	0.622	0.704	0.041	0.831
Support vector machine	0.727	0.033	0.826	0.157	0.857	0.563	0.679	0.071	0.820
Random forest	0.758	0.013	0.826	0.157	0.862	0.619	0.704	0.028	0.851

P value denotes the *P* values derived from comparisons with human results. AUC indicates area under the curve; DWI, diffusion-weighted imaging; FLAIR, fluid attenuated inversion recovery; NPV, negative predictive value; and PPV, positive predictive value.

Identification of Patients With Stroke Within 4.5 Hours of Symptom Onset

Detect the Time of onset of stroke using AI

- **RF model** showed the highest area under the curve for identifying the time window.
- patients within **4.5 hours** of symptom onset were identified with a **sensitivity of 0.48 and a specificity of 0.91.**
- All ML algorithms showed significantly higher sensitivities than human visual assessment in detecting onset times.
- This study showed that an automated system developed using ML methods can be useful in identifying the tissue age of patients with acute stroke assessed within **4.5 hours of symptom onset.**

Detect brain tissue affected using AI

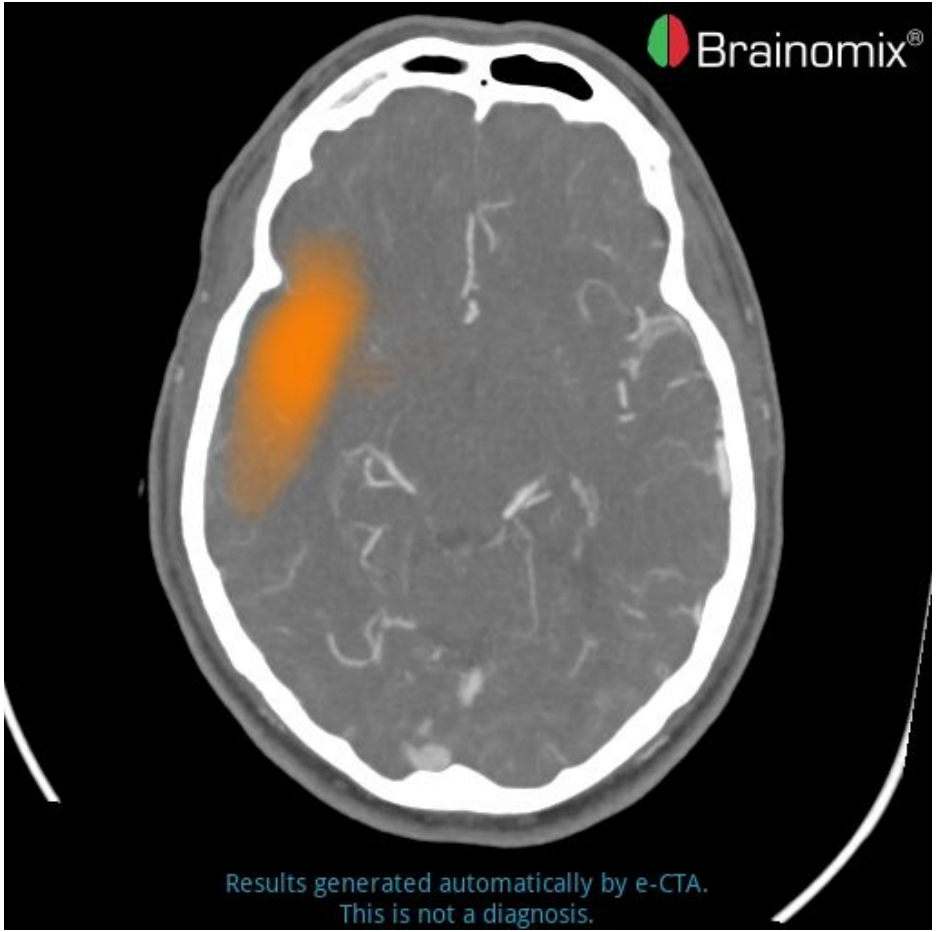
Detect brain tissue affected using AI

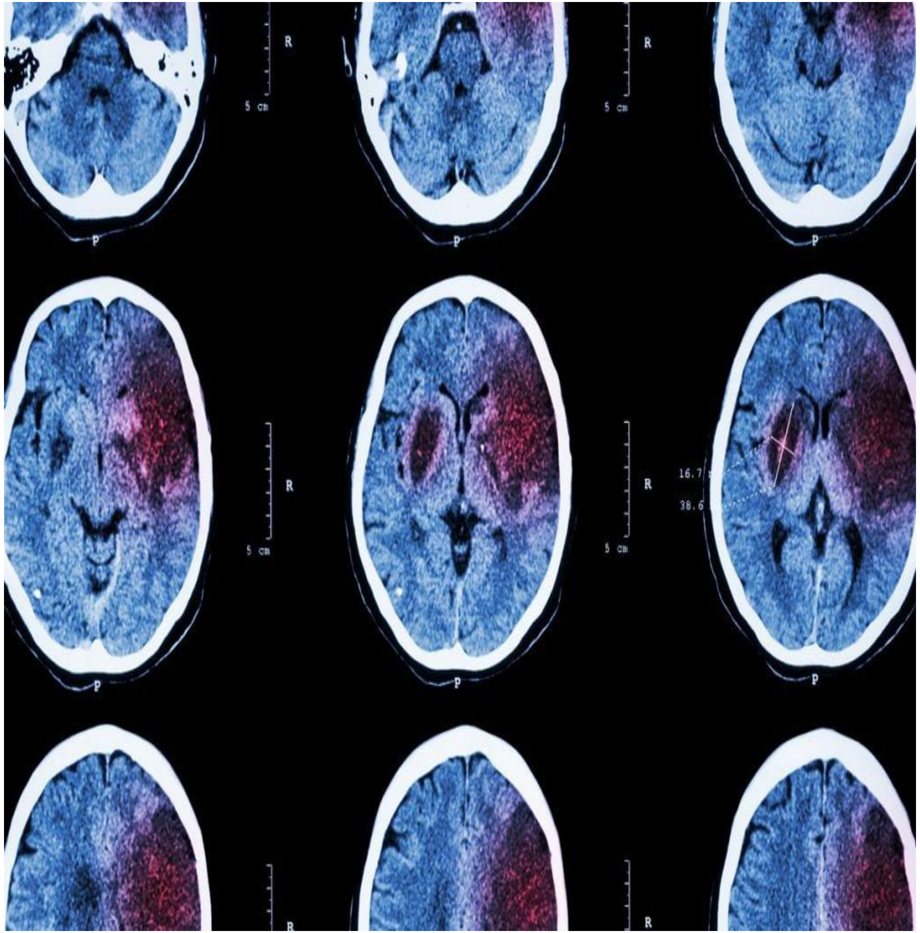
- ❖ When it comes to dealing with a patient that has suffered a stroke, speed is often more important than healthcare.
- ❖ The idea of being able to detect a blocked artery, clot, or rupture that bars blood flow to the brain in minutes, rather than hours, could mean the difference between patient disability and walking out of the hospital.
- ❖ Here, the big role of AI comes

Detect brain tissue affected using AI

RAPID software

- This software takes the image results from the perfusion imaging scans.
- Within a couple of minutes, produces a map that indicates what is dead in pink and what is salvageable in green.
- a small dead area and a large salvageable area – could be successfully treated up to 24 hours





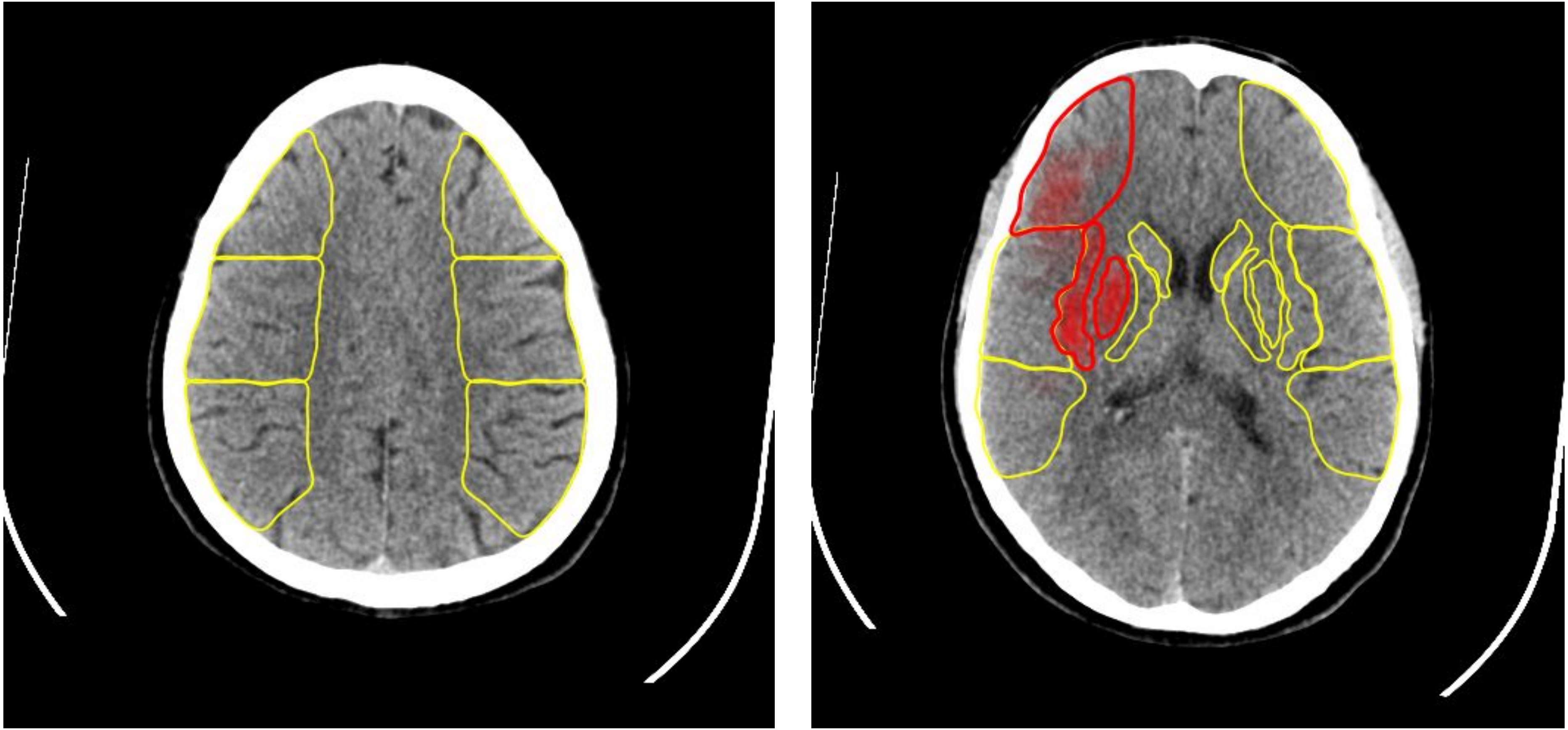
Indicates what is dead and what is salvageable

Detect brain tissue affected using AI

Brainomix greatest validation of AI for ASPECTS, uses CNNs to automatically detect LVOs

e-ASPECTS

- ❖ AI-enabled support for fast and consistent interpretation of non-contrast CTs.
- ❖ It helps to solve this issue by using artificial intelligence (AI) to enable quick and accurate assessment of ischemic stroke damage, both by quantifying the volume of ischemia.



quick and accurate assessment of ischemic stroke damage, both by quantifying the volume of ischemia.

Detect vessels affected using AI

Detect vessel affected using AI

A systematic review of AI in acute LVO stroke identification and triage

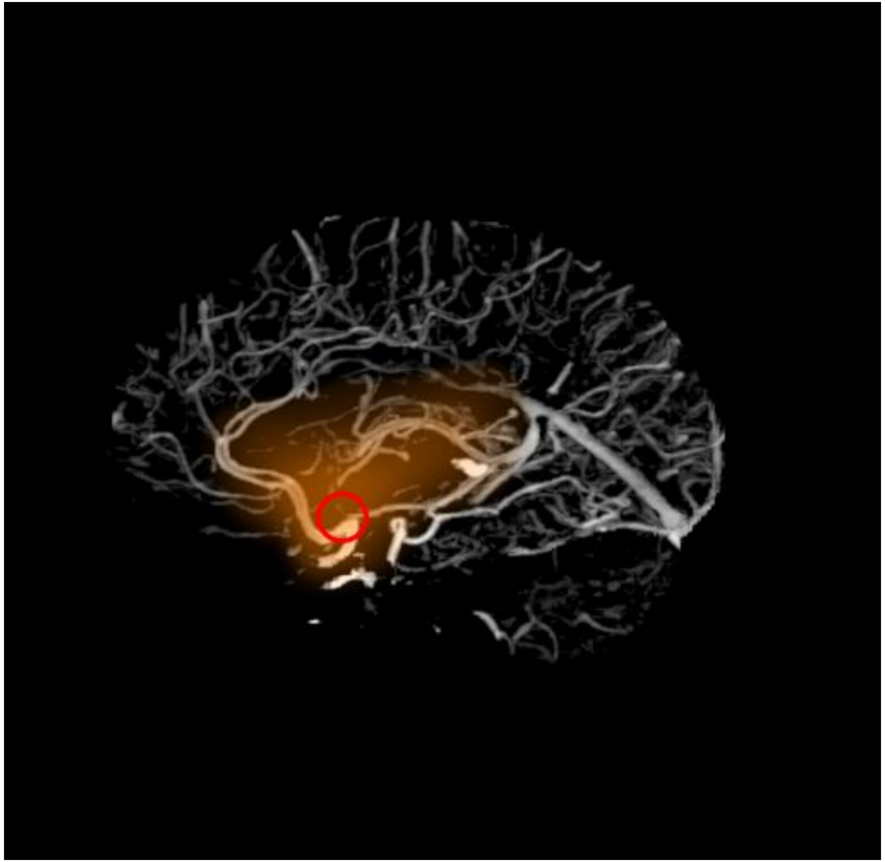
- Large vessel occlusions (LVOs) requires detection and treatment
- Using ML methods of random forest learning (RFL) and convolutional neural networks (CNNs) to detect LVO strokes.
- LVO detection typically used CNNs.
  - Image feature detection had greater sensitivity with CNN than with RFL, **85%** versus **68%**.

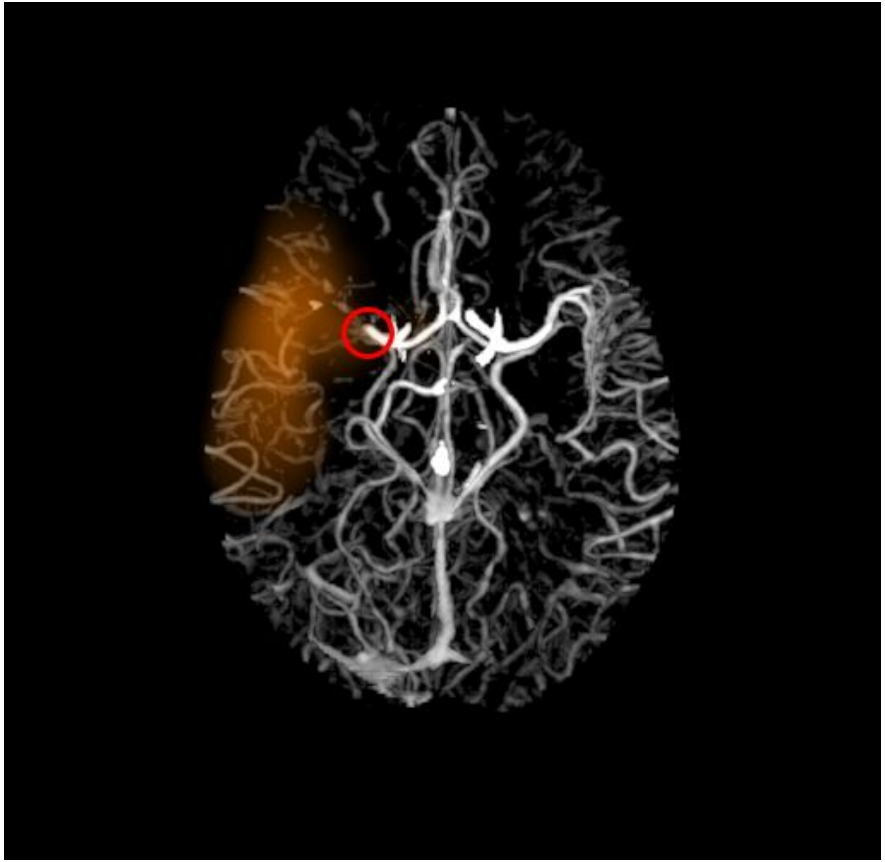
Detect vessel affected using AI

Brainomix greatest validation of AI for ASPECTS, uses CNNs to automatically detect LVOs

e-CTA

- Fast, consistent identification of large vessel occlusion (LVO) and collateral assessments powered by AI and big data, based on CTA analysis.
- e-CTA is ground-breaking CTA image processing software that uses advanced algorithms, artificial intelligence (AI) and large data analytics to automate the detection of LVO locations and standardize the collateral assessment process.





Detection of LVO locations and standardize the collateral assessment process.

Resources

- https://www.quantib.com/blog/how-can-ai-help-determine-time-of-ischemic-stroke-onset
- https://www.ahajournals.org/doi/10.1161/STROKEAHA.119.027611
- https://en.wikipedia.org/wiki/Diffusion_MRI#:~:text=Diffusion%2Dweighted%20magnetic%20resonance%20imaging,generate%20contrast%20in%20MR%20images.
- https://github.com/HyunnaLee/StrokeOnset
- https://labs.dgsom.ucla.edu/arnold/files/papers/HoTMI2019.pdf
- https://www.frontiersin.org/articles/10.3389/fneur.2018.00945/full
- https://github.com/deepmedic/deepmedic
- https://www.sciencedirect.com/science/article/pii/S221315821730147X?via%3Dihub
- https://www.sciencedaily.com/releases/2020/03/200330152137.htm
- https://www.ahajournals.org/doi/10.1161/STROKEAHA.119.027611
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5977679/

Resources

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6236025/
- https://personalpages.manchester.ac.uk/staff/fumie.costen/pastwork/DATA/readingmaterial/strokeAI2.pdf
- https://ysjournal.com/can-artificial-intelligence-tell-the-difference-between-ischemic-and-hemorrhagic-stroke/
- https://ieeexplore.ieee.org/document/8473057
- https://onlinelibrary.wiley.com/doi/full/10.1046/j.1365-2796.2002.01013.x
- https://nocamels.com/2020/08/israel-viz-ai-stroke-detection/
- https://www.youtube.com/watch?time_continue=45&v=XOTe2FlwZ8M&feature=emb_logo
- https://www.viz.ai/
- https://www.medtechdive.com/news/medtronic-to-distribute-ai-stroke-detection-and-triage-software/559206/
- https://brainomix.com/e-stroke-suite

Thank You :)