ARTIFICIAL INTELLIGENCE IN THE ROLE OF STROKE DETECTION IN HERZEGOVINA-NERETVA CANTON

Marin Brajković, Gojko Bogdan, Marko Krpan, Bruno Rajič
University Clinical Hospital Mostar, 88 000 Mostar, Bosnia and Herzegovina
Received on 16.5.2025. Reviewed on 29.10.2025. Accepted on 12.11.2025.

ABSTRACT

Stroke is the leading cause of disability in both Bosnia and Herzegovina and Western countries and ranks as the second most common cause of death globally. Strokes are classified into two major categories: ischemic and hemorrhagic. Ischemic strokes account for approximately 85% of all cases, resulting from vascular occlusion, while 10% are due to primary intracerebral hemorrhage and 5% due to subarachnoid hemorrhage. Early intervention in acute stroke cases can lead to full recovery or significantly reduce long-term consequences. Therefore, early symptom recognition, rapid diagnostics, and timely access to treatment options are essential. In addition to thrombolysis, which has been performed for many years, mechanical thrombectomy has been available at the University Clinical Hospital Mostar since late 2022. To ensure patients receive appropriate therapy, thrombolysis and/or mechanical thrombectomy as quickly as possible, stroke symptoms must be promptly identified and diagnostic procedures initiated. Since 2023 Herzegovina-Neretva Canton has implemented an automated platform for rapid stroke detection called Canon AUTOStroke. This AI-based system automatically detects strokes and immediately alerts the designated stroke intervention team via established communication channels. Canon AUTOStroke utilizes deep learning, a form of artificial intelligence that enables computers to process data in a manner inspired by the human brain. By using this AI application, the time required to make therapeutic decisions is significantly reduced, which can be critical to the outcome of acute stroke treatment.

Keywords: artificial intelligence, stroke, early detection, diagnostics, intervention

Corresponding author: Marin Brajković, mag. rad. tehn.; marin.brajkovic@fzs3.sum.ba

INTRODUCTION

Stroke is the leading cause of disability in Bosnia and Herzegovina and Western countries, and the second leading cause of death worldwide. Strokes are divided into two major types: ischemic and hemorrhagic. Ischemic strokes are far more prevalent, accounting for 85% of all cases, caused by vascular occlusion, while 10% are due to primary intracerebral hemorrhage and 5% are due to subarachnoid hemorrhage (1). Stroke results in reduced or absent oxygen supply to the brain, leading to neuronal death. The phrase “time is brain,” commonly used in stroke care, underscores the critical importance of early detection and urgent intervention (2). Timely treatment of acute stroke can result in full recovery or significantly lessen long-term effects (3). In recent years, research has been increasingly focused on the application of artificial intelligence (AI) in stroke detection. A 2020 review by Vivek S. Yedavalli, published in Neuroimaging Clinics of North America, highlights AI’s role in image analysis, diagnostic optimization and outcome prediction (4). Similar studies confirm that AI algorithms, particularly deep learning, can automatically detect signs of hemorrhagic and ischemic stroke on CT scans, often with accuracy comparable to radiology specialists (5,6). The aim of this review is to present the potential of AI in stroke detection and to analyze the impact of automated diagnostic platforms on timely therapeutic decision-making.

Diagnostics and Intervention in the Herzegovina-Neretva Canton

In addition to pharmacological clot dissolution via thrombolysis, which has been performed for many years, mechanical thrombectomy (MT) has been available at the University Clinical Hospital Mostar since late 2022. For patients to receive timely therapy - thrombolysis and/or MT - stroke symptoms must be promptly recognized and appropriate diagnostics performed. The Radiology Department in Mostar successfully diagnoses all types of strokes. Emergency patients undergo brain MSCT scans and, when necessary, MSCT angiography of vertebral and cerebral arteries, as well as MSCT brain perfusion (7). Since 2023, the Canon AUTOStroke platform has been available in HNC for rapid and simplified stroke detection. It is currently used by three institutions: University Clinical Hospital Mostar, Safet Mujić Hospital and Konjic General Hospital. However, University Clinical Hospital Mostar serves as the only comprehensive center in the canton, since it provides both diagnostics and emergency stroke interventions.

Canon AUTOStroke

Canon AUTOStroke is an automated diagnostic platform for stroke patients (8). Based on artificial intelligence, it autonomously detects strokes and immediately alerts the designated intervention team via established communication channels. The existing PACS (Picture Archiving and Communication System) network in HNC is fully compatible with Canon AUTOStroke, facilitating the implementation of its advanced capabilities. The platform consists of four distinct applications, each responsible for detecting specific acute stroke conditions based on stroke type or cause. Canon

AUTOStroke employs deep learning, a form of AI that enables computers to learn and process data in a brain-inspired manner (9). The system includes several modules: ICH AUTOStroke detects signs of intracranial hemorrhage on non-contrast CT scans, studied on over 10,000 cases (10); ASPECTS algorithms assist in identifying ischemic regions and thereby enable assessing stroke severity, which is crucial for therapy selection (11); Large Vessel Occlusion module accurately detects major vessel blockages via CT angiography; and CT Brain Perfusion provides functional brain tissue assessment with perfusion maps and visualizations of potential infarct core and penumbra regions (12,13). All applications share a common goal: to rapidly process patient data and promptly alert medical teams for emergency stroke intervention.

THE ROLE OF A MEDICAL RADIOLOGY ENGINEER

At the Clinical Department of Radiology at the University Clinical Hospital Mostar, the GE Revolution MSCT scanner is used as one of the most advanced devices for high quality imaging in radiological diagnostics. This system supports sophisticated protocols for neurological examinations, including angiographic procedures and brain MSCT perfusion, which are essential for early stroke detection (14). A pivotal and irreplaceable role in this diagnostic chain is held by the medical radiology engineer, who is responsible for conducting complex scans using the MSCT device. To fully utilize the capabilities of the Canon AUTOStroke platform, high-quality imaging data must be acquired, which the application then processes. In addition to performing the scan correctly, the engineer must complete it in the shortest possible time.

DIAGNOSTIC WORKFLOW AND PATIENT MANAGEMENT

Upon receiving notification that a patient with suspected stroke is arriving, the medical radiology engineer ensures the scanner is warmed up and prepares the automatic injector for contrast administration. After positioning the patient, the next step is defining the field of view (FOV) on the CT device. Standard protocols for suspected ischemic stroke include a non-contrast brain CT and CT angiography of the brain, which enables visualization of intracranial arteries and assessment of occlusions. Frequently, CT angiography of the aortic arch and supra-aortic vessels is also performed to evaluate stenosis and occlusions in major arteries (15). If needed, brain CT perfusion is conducted to analyze cerebral blood flow and identify ischemic core and penumbra regions (16). These methods allow for rapid and accurate vascular assessment and perfusion parameter evaluation in patients with suspected acute stroke.

During the scan, the engineer monitors patient's condition, checking for adverse reactions to contrast, as well as the volume, flow rate and pressure of the contrast agent. In cases of extravasation due to vein rupture, the engineer must immediately halt the scan. Therefore, verifying the intravenous access prior to imaging is critical. All procedures must comply with imaging protocols and the patient's clinical status (17). After the scan, the engineer assists medical staff in transferring the patient to a mobile stretcher and verifies that raw data have been successfully transmitted to the hospital information

system and image archiving platform. The data are then processed by Canon AUTOStroke application, which uses AI to automatically interpret the images and generate a report highlighting stroke-related abnormalities. Through mobile technologies, the system alerts the radiology and neurology teams in real time (18).

The resulting data assist interventional radiologists and neurologists in making therapeutic decisions, including timely interventions such as mechanical thrombectomy (19). By using AI applications, the time required for therapeutic decision-making is significantly reduced, which can be critical to patient outcomes in acute stroke cases (20). Information such as stroke onset time and recovery potential are essential for selecting appropriate treatment strategies (21). At University Clinical Hospital Mostar, notable improvements have been observed following the implementation of advanced AI tools, which include reduced "door-to-diagnosis" time, increased eligibility for mechanical thrombectomy and automatic generation of reports with marked pathologies for the neurointervention team. However, it is important to emphasize that these tools do not replace expert radiological assessment, but rather serve as a supportive system that enhances clinical workflow and treatment efficacy within the critical therapeutic window. (22).

CONCLUSION

The application of artificial intelligence in stroke diagnostics and management represents a major advancement in modern medicine, particularly in emergency settings where time is a decisive factor. The introduction of the Canon AUTOStroke platform in healthcare institutions across Herzegovina-Neretva Canton has enabled faster stroke recognition, automated image analysis and timely alerting of specialized teams. The integration of advanced tools with existing diagnostic procedures - alongside the essential role of the medical radiology engineer - has resulted in reduced time from patient arrival to therapeutic decision. Although the platform does not replace the radiologist's expert interpretation, it is a valuable asset that optimizes clinical workflow and contributes to improved healthcare quality and patient outcomes.

LITERATURE

1. Dunbabin DW, Sandercock PA. Investigation of acute stroke: what is the most effective strategy? Postgrad Med J. 1991;67(785):259–70.
2. Gomez CR. Time is brain: the stroke theory of relativity. J Stroke Cerebrovasc Dis. 2018;27(8):2214–27.
3. Colton K, et al. Early stroke recognition and time-based emergency care performance metrics for intracerebral hemorrhage. J Stroke Cerebrovasc Dis. 2020;29(2):104552.
4. Yedavalli VS. Artificial intelligence in stroke imaging: Current and future perspectives. Neuroimaging Clin N Am. 2020;30(4):539–49.
5. Zaharchuk G, Gong E, Wintermark M, Rubin D, Langlotz C. Artificial Intelligence in Stroke Imaging: Current Status and Future Perspectives. J Neuroradiol. 2020;47(1):25–32.
6. Chilamkurthy S, Ghosh R, Tanamala S, Biviji M, Campeau NG, Venugopal VK, et al. Deep Learning Algorithms for Detection of Critical

Findings in Head CT Scans: A Retrospective Study. Lancet. 2018;392(10162):2388–96.
7. Van den Wijngaard IR, et al. Value of whole brain computed tomography perfusion for predicting outcome after TIA or minor ischemic stroke. J Stroke Cerebrovasc Dis. 2015;24(9):2081–7.
8. Rava RA, et al. Assessment of an artificial intelligence algorithm for detection of intracranial hemorrhage. World Neurosurg. 2021;150:e209–17.
9. Matuliauskas D, Stražnickaitė I, Samuilis A, Jatužis D. Machine learning in acute stroke neuroimaging. A systematic literature review. Neurol Semin. 2023;26(2):41–9.
10. Schmitt N, Mokli Y, Weyland CS, et al. Automated detection and segmentation of intracranial hemorrhage suspect hyperdensities in non-contrast-enhanced CT scans of acute stroke patients. Eur Radiol. 2022;32(4):2246–54.
11. Fan Y, Song Z, Zhang M. Emerging frontiers of artificial intelligence and machine learning in ischemic stroke: a comprehensive investigation of state-of-the-art methodologies, clinical applications, and unraveling challenges. EPMA J. 2023;14(4):645–61.
12. Rava RA, Peterson BA, Seymour SE, et al. Validation of an artificial intelligence-driven large vessel occlusion detection algorithm for acute ischemic stroke patients. Neuroradiol J. 2021;34(5):408–17.
13. Václavík D, Volný O, Cimflová P, Švub K, Dvorníková K, Bar M. The importance of CT perfusion for diagnosis and treatment of ischemic stroke in anterior circulation. J Integr Neurosci. 2022;21(3):92.
14. Cheng HW, et al. The application value of gemstone spectral imaging (GSI) combined with an 80 mm wide-body detector in head-neck CTA. Curr Med Imaging. 2024;20(1)
15. Patil S, et al. Detection, diagnosis and treatment of acute ischemic stroke: current and future perspectives. Front Med Technol. 2022;4:748949. doi:10.3389/fmedt.2022.748949
16. de Vries L, et al. PerfU-Net: Baseline infarct estimation from CT perfusion source data for acute ischemic stroke. Med Image Anal. 2023;85:102749.
17. Abu Awwad D, et al. Radiography students' knowledge, attitude and practice relating to infection prevention and control in the use of contrast media injectors in computed tomography. J Med Radiat Sci. 2024
18. Bat-Erdene B-O, Saver JL. Automatic acute stroke symptom detection and emergency medical systems alerting by mobile health technologies: A review. J Stroke Cerebrovasc Dis. 2021;30(7):105826.
19. Almallouhi E, et al. Outcomes of mechanical thrombectomy for patients with stroke presenting with low Alberta stroke program early computed tomography score in the early and extended window. JAMA Netw Open. 2021;4(12):e2137708.
20. Soun JE, et al. Artificial intelligence and acute stroke imaging. AJNR Am J Neuroradiol. 2021;42(1):2–11.
21. Marcus A, et al. Deep learning biomarker of chronometric and biological ischemic stroke lesion age from unenhanced CT. NPJ Digit Med. 2024;7(1):1–10.

22. Waymel Q, et al. Impact of the rise of artificial intelligence in radiology: what do radiologists think? Diagn Interv Imaging. 2019;100(6):327–36.

Brajković M, Bogdan G, Krpan M, Rajič B. ARTIFICIAL INTELLIGENCE IN THE ROLE OF STROKE DETECTION IN HERZEGOVINA-NERETVA CANTON. Zdravstveni glasnik. 2025;11(2):102-108.

UMJETNA INTELIGENCIJA U ULOZI DETEKCIJE MOŽDANIH UDARA U HERCEGOVAČKO-NERETVANSKOJ ŽUPANIJI

Marin Brajković, Gojko Bogdan, Marko Krpan, Bruno Rajič
Sveučilišna klinička bolnica Mostar, 88 000 Mostar, Bosna i Hercegovina

SAŽETAK

Moždani udar je vodeći uzrok invaliditeta kako u BiH tako i u zapadnim zemljama, također nalazi se na drugom mjestu kao glavni uzrok smrtnosti u svijetu. Dijelimo ih na dvije veće skupine, ishemijski i hemoragijski moždani udar. Ishemijski su znatno zastupljeniji odnosno 85% svih udara, nastaju zbog začepljenja krvnih žila dok preostalih 10 % otpada na primarnu intracerebralnu hemoragiju te 5% na subarahnoidalno krvarenje. Rana intervencija kod akutnog moždanog udara može dovesti do potpunog oporavka pacijenta ili znatnog smanjenja posljedica. Iz tog razloga veoma je bitno rano prepoznavanje simptoma zatim što brža dijagnostika i naposlijetku dostupni načini liječenja. Pored trombolize koja se obavlja već duži niz godina, u Sveučilišnoj kliničkoj bolnici Mostar je od kraja 2022. godine dostupna i metoda Mehaničke trombektomije. Da bi pacijent što prije dobio adekvatnu terapiju odnosno trombolizu i/ili mehaničku trombektomiju potrebno je prepoznati simptome koji upućuju na moždani udar te napraviti potrebnu dijagnostiku. Od 2023. godine na području Hercegovačko - Neretvanske županije je dostupna automatizirana platforma za brzo i lakše prepoznavanje moždanih udara pod nazivom Canon AUTOStroke. Ova platforma je zasnovana na umjetnoj inteligenciji i potpuno automatski detektira moždane udare. Putem već uspostavljene komunikacije u trenutku alarmira kontakt osobe uključene u tim za intervencije kod hitnih moždanih udara. Canon AUTOStroke koristi metodu „deep learning“, što je metoda dubokog učenja umjetne inteligencije koja računala uči da obrađuju podatke na način inspiriran ljudskim mozgom. Korištenjem UI aplikacije, vrijeme do donošenja terapijskih odluka značajno se skraćuje, što može imati presudnu ulogu u ishodu liječenja pacijenata s akutnim moždanim udarom.

Ključne riječi: umjetna inteligencija, moždani udar, rana detekcija, dijagnostika, intervencija

Autor za korespondenciju: Marin Brajković, mag. rad. tehn.; marin.brajkovic@fzs3.sum.ba