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## Evaluation of medical rescue activities performed by Medical Rescue Teams in a patient with acute brain ischemia

### Ocena medycznych czynności ratunkowych wykonanych przez zespoły ratownictwa medycznego u pacjenta w ostrym niedokrwieniu mózgu

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#### Keywords

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#### Słowa kluczowe

udar niedokrwieny mózgu, zespół ratownictwa medycznego, symulacja medyczna, tromboliza

#### Summary

**Introduction.** Each year stroke is recognised in approximately 15 million people worldwide. Proper recognition based on exclusion of other metabolic disorders which may present similar clinical symptoms is primarily the basis for the implementation of treatment of ischemic brain stroke. The first element of the chain of survival, that is, early recognition of a patient with a life-threatening condition and fast call for emergency services with no doubt have influence on minimizing the consequences of brain stroke.

**Aim.** The aim of the study is the assessment of conducted simulated emergency activities of the Medical Rescue Teams in the scope of correctness of performing of medical rescue operations in a patient with suspected brain stroke.

**Material and methods.** 42 Medical Rescue Teams taking part in the XII International Polish Medical Rescue Championships were involved in the study. The assessment of the performed medical rescue activities was made in real-time of duration of the task through the completing of the prepared evaluation card by the championships judges.

**Results.** Considering the cardiovascular system all 42 teams (100%) made a blood pressure measurement. 35 teams (83.3%) have not administered antihypertensive drugs to the patient. 38 teams (90.5%) qualified the patient for urgent transport to a stroke department. 35 teams (83.3%) notified the stroke department team about transporting a patient with suspected ischemic brain stroke via the Medical Dispatcher.

**Conclusions.** The members of the Medical Rescue Team properly implement the algorithm of guidelines of procedure with a patient with suspected brain stroke.

#### Streszczenie

**Wstęp.** Na świecie każdego roku udar mózgu rozpoznawany jest u około 15 mln osób. Podstawą wdrożenia leczenia udaru niedokrwienego mózgu jest przede wszystkim właściwe rozpoznanie,

### Conflict of interest

### Konflikt interesów

None

Brak konfliktu interesów

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oparte na wykluczeniu innych zaburzeń o charakterze metabolicznym, które mogą manifestować podobne objawy kliniczne, oraz wykluczenie udaru krwotocznego. Pierwszy element łańcucha przeżycia, czyli wczesne rozpoznanie pacjenta w stanie zagrożenia życia i szybkie wezwanie służb ratowniczych, bez wątpienia ma wpływ na zminimalizowanie skutków udaru mózgu.

**Cel pracy.** Celem pracy jest ocena przeprowadzonych symulowanych działań Zespołów Ratownictwa Medycznego pod względem poprawności wykonania medycznych czynności ratunkowych u pacjenta z podejrzeniem udaru mózgu.

**Materiał i metoda.** Do badania włączono 42 zespoły ratownictwa medycznego, które brały udział w XII Międzynarodowych Mistrzostwach Polski w Ratownictwie Medycznym. Ocena wykonanych medycznych czynności ratunkowych była dokonywana w czasie rzeczywistym trwania zadania poprzez uzupełnianie przez sędziów mistrzostw przygotowanej karty oceny.

**Wyniki.** Oceniając układ krążenia, wszystkie 42 (100%) zespoły wykonały pomiar ciśnienia tętniczego krwi. 35 (83,3%) zespołów nie podało pacjentowi leków hipotensyjnych. 38 zespołów (90,5%) zakwalifikowało pacjenta do priorytetowego transportu do oddziału udarowego. 35 zespołów (83,3%) powiadomiło za pośrednictwem Dyspozytora Medycznego pracowników oddziału udarowego o transporcie pacjenta z podejrzeniem udaru niedokrwiennego mózgu.

**Wnioski.** Członkowie Zespołów Ratownictwa Medycznego prawidłowo wdrażają algorytm wytycznych postępowania z pacjentem z podejrzeniem udaru mózgu.

## INTRODUCTION

The system of Emergency medical services was created to provide help to everyone who is in sudden threat to human health. The legislator precisely specifies the definition of sudden threat to human health as sudden or foreseeable occurrence of symptoms compromising the health status with possible serious injury of body functions or bodily injury, or, loss of human life as a direct consequence, requiring immediate medical rescue activities. The Act on the State Medical Rescue Services provides minimising the time that has elapsed from the occurrence of the sudden threat to human life to entering medical treatment at a specialist department (1).

Each year stroke is diagnosed at approximately 15 million people worldwide. From 4.6 to 5.7 million people die from brain stroke which constitutes 10% of overall deaths globally (2-4).

In developed countries brain stroke is the third leading cause of death, and the most common cause of the occurrence of disability in people aged over 40 (2, 5). Data collected by the World Health Organization (WHO) suggest that in 2015 brain stroke was the second cause of death of adults globally after the ischemic heart disease (6).

In Europe, Poland is second after the Russian Federation with the highest rate of deaths caused by strokes. The percentage level of deaths caused by strokes in Poland is two times higher than in Germany, France or Great Britain (7, 8).

Long-term consequences of brain stroke, that is, the necessity to provide the patient care of other people and rehabilitation cause generating the highest medical treatment costs of the commonly occurring disease entities. This is the reason why brain stroke causes a serious global economic problem (9).

In 2013 the American Heart Association and American Stroke Association updated the current definition of brain stroke. Brain stroke is defined as sudden occurrence of focal or generalised disorders of the brain function caused only by vascular causes related to the brain blood flow, lasting longer than 24 hours.

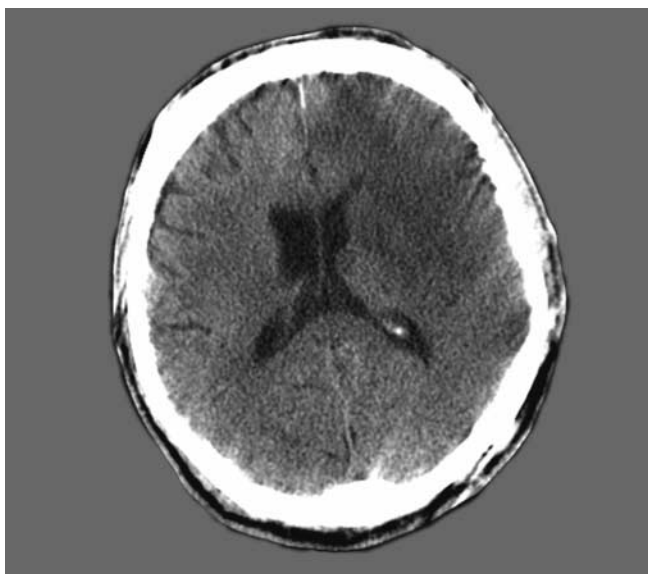
Stroke may also be recognized when:

- focal neurological symptoms last less than 24 hours, however, ischaemic focus was clearly documented using brain imaging techniques,
- the symptoms resolved after thrombolytic treatment, or the patient died within the first day from the onset of occurrence of the symptoms.

If the focal neurological symptoms resolve spontaneously before 24 hours pass and the ischemic focus is not observed any more in the brain imaging examination a transient ischemic brain attack is observed (TIA) (10, 11).

In the process of increasing of the stroke outbreak 2 millions of neurons are destroyed every minute (12). An example of results of computer tomography examination of a patient with ischemic brain stroke in the first and third day of hospitalization has been presented on figures 1 and 2. The pathogenic basis of a brain stroke are brain circulation disorders growing in time (in thromboembolic, embolic or hemodynamic mechanism) which cause gradual decline of perfusion in the brain and starting anaerobic glycolysis. The free radicals formed in this process cause damage of the blood-brain barrier and influx of plasma components to the extracellular compartment, which results in increasing of the volume of the brain, as a result of angiogenic and cytotoxic edema. The clinical symptoms of perfusion and biochemical disturbances and of the increase in brain volume, depending on the vascular eel affected by the attack are neurological losses (most often quantitative and qualitative disturbances of the state of consciousness, speech impairment, mobility deficits in the scope of cranial nerves and limbs). The basis for implementing treatment of ischemic brain stroke is firstly proper recognition based on excluding other metabolic disorders that may demonstrate similar clinical symptoms (e.g. hypoglycaemia, epileptic seizure, migraine) and exclusion of haemorrhagic stroke. A routine medical imaging conducted to this end is a computer tomography examination which ensures visibility of ischemic stroke characteristics: hypodense area covered with the stroke, blurring of the borders of the insula on the side of the stroke, increased electron density in the reach of the artery covered with the

stroke and the head of the caudate nucleus on the side of the stroke, and the examination allows for excluding other pathology manifested by similar neurological symptoms (hematoma, brain tumour) (13).



**Fig. 1.** Computed-tomography of the head within the first 24 hours from the occurrence of the symptoms of the left middle cerebral artery ischemic stroke – hypodense area in the left frontal-temporal region. Patient aged 51 with clinical symptoms of aphasia, pyramidal paresis of right extremities and central paresis of nerve VII on the right



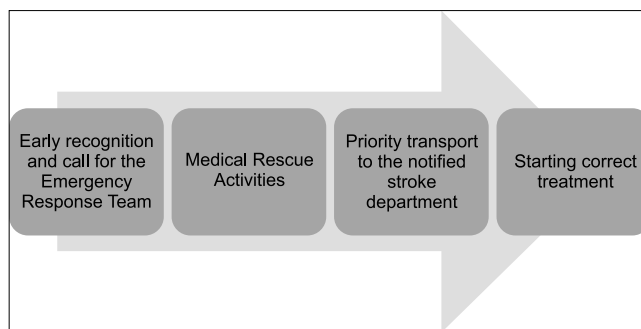
**Fig. 2.** Computed-tomography of the head within 72 hours from the occurrence of the symptoms of the ischemic stroke in the patient from figure 1. Significant enlargement of the hypodense area within the scope of the left brain hemisphere with signs of brain edema (flattening of the gyri (ridges), narrowing of the sulci (grooves) at the convexity). Significant mass effect in the form of compression and displacement of the supratentorial ventricular system to the right

The key role in the treatment of ischemic stroke is played by the proceeding based on the possibility of recanalization of a closed vessel and reperfusion of areas covered with the ischemia as well as by the time that has elapsed from occurrence of the clinical symptoms till the moment of implementing the purposeful form of treatment.

Confirmation of the stroke is a basis for the application of intravenous thrombolysis with the use of the recombinant tissue plasminogen activator (rt-PA), if the time that has elapsed from occurrence of the symptoms of brain stroke shall not be longer than 4.5 hour, and, if the patient fulfils other criteria for application of this form of treatment (age 18-80, exclusion of haemorrhagic stroke, time of occurrence of symptoms at least 30 minutes and no substantial improvement after treatment). The form of the supply of rt-PA has influence on the possibility to prolong the time of recanalization of the closed vessel. In the event of intravascular interventions implemented by centres specialising in interventional neuroradiology the possibility of rt-PA supply directly to the artery affected by the thrombus through arteriography allows to prolong the time to 6 hours from the onset of occurrence of brain stroke symptoms. Results may be even more effective through mechanical thrombectomy (14-18).

In some cases when stroke symptoms are accompanied by large mass effect and the deteriorating neurological status of the patient the remaining solution is performing bone-meningeal decompression (19, 20).

The chain of survival used in emergency medicine (fig. 3) is a contractual definition of a few interdependent links that have influence on patients' survival. The first element of the chain of survival, that is, early recognition of a patient with life threat and fast call for rescue services without any doubt have influence on minimising the effects of brain stroke (21). The subsequent links in the chain of survival in brain stroke are priority transport with previous notifying of the appropriate unit as well as fast making of the proper diagnosis and starting adequate treatment (3).



**Fig. 3.** "Chain of survival" in a patient with stroke (own elaboration)

The considerations for the functioning of the Emergency Medical Services should treat patients with symptoms that may indicate brain stroke with the highest priority.

A large proportion of patients and witnesses cannot recognize the symptoms that may indicate brain stroke which causes delay in entering specialised treatment (3).

#### AIM

The aim of the conducted simulated action of the Medical Rescue Teams was the assessment of the performed medical rescue activities in a patient with suspected brain stroke. The teams' activities related to the classifying of a patient for immediate treatment at

a specialised stroke department were assessed. The operations were assessed according to the Guidelines of the Group of Experts of the Vascular Diseases Section of the Polish Society of Neurology from the year 2012.

## MATERIAL AND METHODS

Forty two basic and specialist Medical Rescue Teams taking part in the XII International Polish Medical Rescue Championships were included in the study. The Championships organised by the Bielsko-Biała Emergency Medical Services took place on 24-27.01.2017 in Bielsko-Biała and the district of Bielsko-Biała. The place where the medical simulation took place was the laboratory room of the Department of Nursing and Emergency Medicine of the University of Bielsko-Biała. The assessment of the performed medical rescue activities was made in real-time of duration of the task through the completing of the evaluation card by the championships judges. The evaluation card was prepared based on the guidelines of the group of Experts of the Vascular Diseases Section of the Polish Society of Neurology from the year 2012 and the guidelines of the European Resuscitation Council from 2015. The performed rescue medical activities were assessed during the 8-minute simulation conducted with the participation of helpers. The last two minutes of the task consisted in completing the card qualifying the patient for treatment at a stroke department.

The Medical Rescue Team was called to a man, aged 50, who fainted. The patient was the lecturer of the Faculty of Health Sciences who conducted first aid classes for first year students of the Emergency Medicine Department. After the man fainted the students put him in a safety position and called the Medical Rescue Team.

During carrying out the examination following the ABCDE scheme (airway, breathing, circulation, disability, exposure) the judges have indicated the following values of the patient's parameters:

- A – patient's airways patent, free from foreign bodies, free from vomit and other contents,
- B – the patient is spontaneously breathing with a frequency of 2 breathes per 10 sec., the chest rises upwards symmetrically, auscultation revealed symmetrical vesicular murmur, percussion revealed the notes heard are symmetrically resonant, jugular veins properly filled, trachea in axis, SpO<sub>2</sub> 90% (after proper oxygen therapy 97%),
- C – BP 185/100, capillary refill < 2 seconds, proper heart sounds, skin – pink, warm, dry, pulse well-taut on the carotid artery and radial artery, parameters monitored – ECG – AF 105/minute,
- D – pupils symmetric, of proper width, responsive to light, glycemia 106 mg% (5.9 mmol/l), muscle tension on the left side abolished, temperature 36.6° Celsius,
- E – soft abdomen, lower limbs without swelling, free from varices, upper limbs – without changes, left hemiplegia, back – without changes.

During the simulation (second minute) the wife of the patient, who earlier received information from the

students, came. The teams had the possibility to take precise SAMPLE history and to have access to the delivered medical records of the patient (the last Hospital Discharge Summary Report).

The teams were assessed in the scope of proper fulfilment of the medical rescue activities in a patient with suspected brain stroke. Directly after taking the basic vital parameters it was appropriate to begin applying passive oxygen therapy to the patient.

Other significant elements that were assessed were blood pressure measurement, inserting an intravenous cannula to the limb that was not under paresis and lack of supplying cures lowering blood pressure.

After securing the patient a decision had to be made about urgent contact with a Medical Dispatcher of the Public-safety answering point in order to agree on the place of transport to the stroke department and it was also important to notify the stroke team.

The assessed elements from the patient's qualification cards to the stroke unit completed by the team were: age of the patient, history taking aimed at revealing epilepsy or convulsions, exact date of onset of the disease, exact time of the onset of the disease, the taken antiplatelet drugs, history of head injuries in the last 3 months and the date of last hospitalization.

## RESULTS

The research involved 42 Medical Rescue Teams (100%). The analysis of the conducted medical rescue activities indicated that 40 teams (95.2%) performed full ABC examination. One team (2.4%) did not examine the pulse of the patient. One team (2.4%) did not perform the elements of the ABC examination at all. 26 teams (61.9%) gathered full SAMPLE history from the students and patient's wife. The remaining 16 teams (38.1%) did not gather full history which made precise completing of the card qualifying for treatment at a stroke unit impossible. Table 1 shows elements of SAMPLE history with division into the number and percentage of the proper and skipped answers.

Verification in the scope of the ability to evaluate the functioning of the respiratory system has shown that 41 teams (97.6%) performed the pulse oximetry examination. One team (2.4%) did not perform this examination. 28 (66.7%) of the teams performed chest auscultation. 14 teams (33.3%) did not perform the patient's chest auscultation. Despite the indications to start passive oxygen therapy in the assessed first 2 minutes of simulation 26 teams (61.9%) started it. 14 teams (33.3%) started it after the elapse of the first 2 minutes of simulation. 2 teams (4.8%) did not start the passive oxygen therapy till the end of the simulation.

Assessing the circulatory system all 42 teams (100%) measured blood pressure. 35 teams (83.3%) did not administer antihypertensive drugs to the patient. 7 teams (16.7%) administered antihypertensive drugs to the patient. Among those teams which administered antihypertensive drugs the most frequently chosen drug was Furosemid, with administration from 10

**Tab. 1.** Correctness of the obtained information from the SAMPLE history

History components	Number of correctly collected information	Percentage of correctly collected information	Number of collected incorrectly or skipped information	Percentage of incorrectly collected or skipped information
S	40	95.2%	2	4.8%
A	36	85.7%	6	14.3%
M	37	88.1%	5	11.9%
P	36	85.7%	6	14.3%
L	23	54.8%	19	45.2%
E	37	88.1%	5	11.9%

to 40 mg – it was administered by 5 teams (71.4%). 2 teams (28.6%) administered Ebrantil to the patient in a dose from 6.25 to 12.5 mg.

The choice of the limb to which an intravenous cannula was inserted was also verified. 31 teams (73.8%) made the right decision to insert an intravenous cannula to the limb that was not under paresis. The remaining 11 teams (26.2%) inserted the intravenous cannula to the limb under paresis. The element assessed in the neurological examination were the examination of the pupils (symmetry and response to light) and the controlling of the glycemic level. 33 teams (78.6%) conducted proper pupil examination. 41 teams (97.6%) checked the patient's glycemic level. Regarding the elements not subject to assessment the teams additionally performed an evaluation of the patient in the Glasgow Coma Scale – 22 teams (66.7%), AVPU – 31 teams (73.8%). The element not subject to assessment was also the examination of the Babinsky's reflex which was conducted by 17 teams (40.5%), and the Brudzinski's sign conducted by 4 teams (9.5%).

The highest ranked elements of the simulation were: the decision about transporting the patient to a stroke department and notifying the stroke team. 38 teams (90.5%) qualified the patient to urgent transport to a stroke department. 35 teams (83.3%) notified the stroke department team (through the Medical Dispatcher) about transporting a patient with suspected ischemic brain stroke. The results of the analysis of a part of the parameters from the card qualifying the patient to treatment at the stroke department have been presented in table 2.

## DISCUSSION

The guidelines of management of a patient with suspected brain stroke emphasize the time interval in which

the patient should be placed at a specialist department – “time is brain” (14, 22). In the performed medical simulation over 90% of teams qualified the patient for urgent transport to a stroke department and 83% of teams asked the Medical Dispatcher to notify the stroke unit about the planned arrival of a patient that might require immediate thrombolytic treatment. Proceeding this way is a proper choice because it gives possibility to start fast and adequate treatment. The inspection findings of the Supreme Chamber of Control (“The Preparation of hospitals for treatment of patients with brain stroke” – 2016) indicate that hospitals which have got stroke departments in their structure conduct 33% more brain neuroimaging examinations within the first hour from the patient's admission than hospitals which treat such patients in neurological departments or internal diseases departments (7). In their research on the delay in beginning thrombolytic treatment in patients with brain stroke calculated the time median from the moment of occurrence of stroke symptoms to the moment of admission of the patient to a hospital as 72.5 minutes. In the implemented scenario the assumed time for the patient's arrival to the stroke department from the place where the stroke happened was 9 minutes. The decision of such transport was made by 90% of medical rescue teams which shows very high consciousness of the participants of the simulation in the scope of the significance of the elapsing time in patients with suspected brain stroke.

The history collected from the patient, family and witnesses of what happened is an extremely important element of the procedure (2, 14, 23). One of the most important elements of this history is the exact time of occurrence of the symptoms. The information about the onset of occurrence of the first symptoms of the disease

**Tab. 2.** The summary of the assessed answers from the card qualifying to treatment at a stroke department (N = 42)

Assessed parameter	Number of correct answers	Level of percentage of correct answers	Number of incorrect answers	Level of percentage of incorrect answers
Age of patient	32	76.2%	11	26.2%
History of epilepsy, convulsions (negative)	38	90.5%	4	9.5%
Exact date of onset of disease	36	85.7%	6	14.3%
Exact hour of onset of disease	32	76.2%	10	23.8%
Taken antiplatelet drugs	22	52.4%	20	47.6%
History of head injuries in the last 3 months (no)	17	40.5%	25	59.5%
Data of last hospitalization	26	61.9%	16	38.1%

has significance for the doctors who decide on the choice of the strategy of the procedure applied to the patient. The exact hour of occurrence of the disease was provided by 32 teams (76.2%). The lack of this information in the documentation of 10 teams may result from the lack of time (2 minute task) for completing the whole card, or from insufficient knowledge on the importance of the hour of occurrence of the symptoms for the strategy of further proceeding with the patient.

In his book "Early evaluation and treatment of patients with acute ischemic stroke" Kaźmierski precisely describes the significant role of the Medical Rescue Team. He draws special attention to the detailed history (allowing to determine the onset of the disease), history of co-existing diseases, obtaining information on the taken medicines as the elements which influence further treatment (2).

A satisfactorily high result (over 90% teams) was observed in the scope of taking the history relating to the occurrence of convulsions before the arrival of the Medical Rescue Team. Such proceedings may suggest the proper conduct of differential diagnostics at the scene of the incident. Another parameter of differential diagnostics was the measurement of the glyce-mic level which was performed by 41 teams (97.6%). The symptoms accompanying hypoglycaemia such as: behavioural disorders, confusion, muscle tremor, convulsions or coma may also appear in a patient in which brain stroke occurred (24).

A distressingly weak result was obtained in the answer on the question regarding taken anticoagulants. 52% teams properly completed this part of the medical records.

The conducted research confirms the knowledge of the value of blood pressure which does not require pre-hospital treatment in patients with suspected brain stroke. The vast majority – 35 teams (83.3%) made a decision about not administering antihypertensive drugs in a patient with blood pressure of 185/100 mmHg. Rapid reduction of the blood pressure value in patients with brain stroke may cause an increase of the ischemic area and worsen the hemodynamic conditions in the area of the stroke and the border area (25).

## CONCLUSIONS

1. The members of the Medical Rescue Teams properly implement the guidelines of procedure with a patient with brain stroke.
2. Social campaigns and social education may have influence on lowering pre-hospital delay.
3. The introduction of a standardized qualification card for treatment at a stroke department for the Medical Rescue Teams would allow for avoiding lacks in key elements of the medical history.
4. The introduction of a communication system e.g. an emergency telephone at the stroke department for Medical Rescue Teams would reduce the time of notifying the stroke team and of the starting of treatment.

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