Clinical syndromes of thalamic strokes in posterolateral vascular territory: a prospective hospital-based cohort study

Abstract. Background. The article covers pathophysiological features and patterns of the occurrence of neurological, neuropsychological, and clinical vascular syndromes of the thalamic strokes in posterolateral vascular territories. The features of the neurological clinic, topical, and neuroimaging diagnosis of thalamic strokes in posterolateral vascular territories are analyzed and described in a prospective hospital-based cohort study. We aimed to describe and analyze the clinical and neuroimaging features of vascular syndromes of thalamic strokes in posterolateral vascular territory in a prospective hospital-based cohort study. Materials and methods. We have prospectively recruited 319 acute stroke patients, admitted within 24 hours from the onset of the stroke symptoms to the Neurological Center at an academic hospital (Oleksandrivska Clinical Hospital) in Kyiv, Ukraine. Complex neurological, clinical, laboratory, ultrasound, and neuroimaging examinations were performed to all study patients. Results. MRI/CT-proven thalamic stroke was diagnosed in 34 (10.6 %) out of 319 patients, forming a study group. Twenty-two out of 34 patients (average age 61.9 ± 10.2 years) were diagnosed with an acute isolated ischemic thalamic infarction, and 12 patients (average age 59.0 ± 9.6 years) were diagnosed with an acute thalamic hemorrhage. Specific neurological features of clinical vascular syndromes of acute thalamic strokes in posterolateral vascular territories were analyzed, compared, and described. Keywords: thalamus; stroke; thalamic stroke; clinical features; syndrome; vascular territory; posterolateral vascular territory

Introduction
According to the World Health Organization, 15 million people suffer from stroke worldwide each year. Of these, 5 million die and another 5 million are permanently disabled [1–17]. Globally, one in four people over age 25 will have a stroke in their lifetime [18, 19]. There are over 80 million people currently living who have experienced a stroke [19]. Besides, more young people are affected by stroke in low- and middle-income countries. Eastern Europe, East Asia, and parts of Southeast Asia, Central Asia, and sub-Saharan Africa had the highest rates of stroke mortality. Age-standardized prevalence rates of stroke were higher in Eastern Europe and East Asia [8, 20–22].

Thalamic strokes are not rare, accounting for approximately 11 to 23–25 % of cases of all posterior circulation strokes, especially in combination with damage to other structures [23–25]. The thalamus is involved in aspects of learning, memory, speech, language understanding, motivation, attention and wakefulness, manages our sensitivity to temperature, light, and physical touch, and is in charge...
of our sense of balance and awareness of our arms and legs. It controls how we experience pain, and even emotional experiences, expressions, and our personalities. However, currently, there are not enough published prospective hospital-based cohort studies that report and analyze pathophysiological features and patterns of the occurrence of neurological, neuropsychological, and clinical vascular syndromes of the thalamic stroke in posterolateral vascular territories, and their topical diagnosis using clinical, neurological, and neuroimaging methods in a prospective hospital-based cohort study [25–30].

Given all this, we performed a comprehensive clinical and neuroimaging analysis of the treatment results and assessed the outcome of the disease in 34 patients with thalamic stroke, among whom 22 patients were with isolated thalamic infarction and 12 had hemorrhage in the thalamus.

The purpose of this study is to describe and analyze the clinical and neuroimaging features of vascular syndromes of thalamic stroke in posterolateral vascular territories in a prospective hospital-based cohort study, providing a comprehensive clinical and neuroimaging analysis.

Materials and methods

Study setting and patients

We have conducted a prospective hospital-based cohort study of acute thalamic stroke patients. All study participants were admitted to the Neurological Center of Oleksandrivska Clinical Hospital, Kyiv, Ukraine, within the first 24 h since the first stroke symptoms had occurred. The Neurological Center of Oleksandrivska Clinical Hospital consists of an admission department, clinical department of neurology, department of cerebrovascular pathology with intensive care/stroke unit, and a research department of neurology. All stroke patients were examined by at least two board-certified neurologists with training in cerebrovascular diseases. Clinical history, 12-lead electrocardiogram, blood testing, carotid ultrasound, head computed tomography (CT) and/or brain magnetic resonance imaging (MRI) were obtained for all study participants.

Patient inclusion and exclusion

The methods of the study, inclusion and exclusion criteria have been reported in detail previously [29–31, 46, 47]. In brief, only acute thalamic stroke patients aged 18 years or older were included.

Study endpoints and risk factors definitions

Study endpoints of interest were acute ischemic and/or hemorrhagic thalamic stroke. Stroke was defined according to the TOAST criteria [30]. The etiology of stroke was classified to the criteria of the World Health Organization, American Heart Association/American Stroke Association (AHA/ASA) guidelines for adult stroke, and was confirmed by neuroimaging [32, 33]. The etiology of stroke was classified according to the TOAST criteria [34]. The National Institutes of Health Stroke Scale, the Modified Rankin Scale, the Barthel index, and the Charlson Comorbidity Index were determined for all participants. Secondary stroke prevention was prescribed according to the AHA/ASA and the European Stroke Organisation guidelines, immediately after the stroke diagnosis was made [35–41]. Stroke education programs were provided to all study participants [11, 16, 30, 42–45].

Statistical analysis

Parametric and non-parametric statistic methods were applied. The log-rank test was used for univariate comparisons of event-free survival between groups. A two-sided p < 0.05 was considered significant for all analyses. All statistical analyses were performed using IBM SPSS Statistics Version 22.

Results and discussion

Basic characteristics of study population

In total, 319 adult patients with an acute MRI/CT-proven stroke were screened, 34 of whom were diagnosed with a thalamic stroke, forming a study group. Twenty-two (12 men, 10 women aged 50 to 84 years; average age 61.9 ± 10.2 years) out of 34 study group patients were diagnosed with an acute isolated thalamic stroke, and in the rest 12 patients (5 men, 7 women aged 57–75 years; average age 59.0 ± 9.6 years) thalamic hemorrhage was detected.

Vascular symptoms of a stroke in the posterolateral thalamic vascular territory

Stroke of the posterior choroidal artery manifested itself in oculomotor disturbances, visual field deficiency, hyperkinetic syndrome, hand tremor, dystonia, and myoclonus of the fingers. Such abnormalities are referred to by the term “jerky dystonic arm” [30].

A sensitivity impairment with the development of a pure-sensory syndrome that is caused by the damage to the ventrolateral nucleus is a typical manifestation of a stroke in the posterolateral vascular territory of the thalamus. Moreover, hemihypesthesia syndrome can be complete or partial with a disturbance of sensitivity in unusual combinations, such as the isolated oral syndrome. The isolated oral syndrome is also detected in patients with a stroke in the posterior choroidal artery. This can be explained by the peculiar somatotopic organization of the thalamus as sensory projections of the face (especially lips, tongue) are somatotopically represented in the ventral posterior medial nucleus and have a particularly large representation that increases the likelihood of a damage to it with an acute stroke. Sensory projection fields from the trunk and proximal limbs are relatively small compared to the sensory projections of the face, and somatotopically represented by the ventral posterolateral nucleus, located more dorsally and therefore can selectively remain intact during the thalamic stroke [30]. Cognitive impairment manifested itself in an impaired memory and psychosexual impairment — hallucinosis.

In our cohort study, stroke in the posterolateral thalamic vascular territory was detected in 5 (22.7 %) patients. It occurred during the occlusion of thalamogeniculic artery branches that vascularize ventrolateral thalamus, including the posterolateral, ventral, and medial thalamic nuclei. A typical manifestation of a stroke in posterolateral vascular territory of the thalamus was represented by sensitivity and
cognitive impairments. In this case, the hemisensory syndrome was complete in two patients and incomplete in three. The complete hemisensory syndrome manifested itself in a superficial and deep sensitivity decrease, hemiataxia or a feeling of numbness of the skin by a hemitope in the absence of homonymous hemianopsia, aphasia, agnosia, and apraxia. In a case of incomplete hemisensory syndrome, sensory impairments were presented not in the entire half of the body, but only in the face, arm, or leg. In two patients, cheiro-oral syndrome was detected when sensitivity impairment occurred in the region of the angle of the mouth and palm homolaterally; in another patient, cheiro-oral-pedal syndrome was detected that manifested itself in hypoaesthesia of pain and temperature sensitivity in the region of the angle of the mouth, palm and foot on the one side without any motor disorders. Three patients demonstrated moderate cognitive impairment: spatial memory impairment was detected in two patients with a right thalamus infarction, verbal memory impairment was observed in one patient with a stroke in the left posterolateral adjacent thalamus territory.

In one patient, psychosensory disorders that manifested as hallucinosis were noted. The visual hallucinations were true, specific, mainly visual, arose during a normal patient state, consisted of live scenes of colorful and non-hostile people or animals, and stereotypically repeated mainly in the evening or at night and lasted from several seconds to several hours; associated disorders were sleep disorders. It is believed that the occurrence of hallucinosis is due to a damage to the projection centers in the pulvinar of the thalamus, or the medial nuclei of the thalamus or the rostral section of the brainstem (brain peduncles). Therefore, the described disorders are known in the literature as “peduncular hallucinosis” [30].

The main risk factors for the development of thalamic stroke in the posterolateral vascular territory were arterial hypertension (in three patients), as well as diabetes mellitus and hypercholesterolemia (in two patients).

Conclusions

The development of a purely sensory syndrome (complete or in unusual combinations) or a sensorimotor syndrome, mild cognitive impairment, and psychosensory disturbances (hallucinosis) are typical manifestations of a stroke in the posterolateral vascular territory.

Conflicts of interests. Authors declare the absence of any conflicts of interests and their own financial interest that might be construed to influence the results or interpretation of their manuscript.

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References

1. Benjamin E.J., Muntner P., Alonso A. et al. On behalf of the American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics — 2019 update: a report from the American Heart Association. Circulation. 2019. Vol. 139 (10). P. e56-e528.

2. Johnson W., Onuma O., Owlab M., Sachdev S. Stroke: a global response is needed. Bulletin of the World Health Organization. 2016. Vol. 94. P. 634-634A.

3. Vinychuk S.M., Fartushna O.Ye. Cerebrospinal and commissural diaschisis in acute stroke patients: case analysis. Meždunarodnij nevrologičeskij žurnal. 2018. № 5 (99). C. 20-25.

4. Fartushna O.Ye., Vinychuk S.M. Brain injury in patients with acute TIA: clinical features in different TIA subtypes. Meždunarodnij nevrologičeskij žurnal. 2017. № 3 (89). C. 13-18.

5. Feigin V.L., Norving B., Mensah G.A. Global burden of stroke. Circulation research. 2017. Vol. 120 (3). P. 439-448.

6. Global Health Estimates. Geneva: World Health Organization; 2012. Режим доступу: www.who.int/healthinfo/global_burden_disease/en/.

7. Lees R., McGrane F., Fartushna O., Broomfield N.M., Quinn T.J., Dani K., Forbes K., Dawson J. The pattern of cognitive impairment in stroke survivors with carotid stenosis. International Journal of Stroke. 2014. № 9. P. 323-324.

8. Owlab M.O., Acharo-Anthony S., Akinyemi R. et al. The burden of stroke in Africa: a glance at the present and a glimpse into the future. Cardiovasc. J. Afr. 2015. Vol. 26 (2). Suppl. 1. P. S27-38.

9. Wilkins E., Wilson L., Wickramasinghe K. et al. European cardiovascular disease statistics 2017. Brussels: European Heart Network, 2017. 188p.

10. World Stroke Organization. Global Stroke Fact Sheet. 26.02.2019. Режим доступу: https://www.world-stroke.org/images/WSO_Global_Stroke_Fact_Sheet_final.pdf

11. Виничук С.М., Прокопів М.М. Гострий ішемічний інсульт. Києв: Наукова думка, 2006. 286 с.

12. Виничук С.М., Фартушна О.Є. Рання реабілітація після гострих ішемічних порушень мозкового кровообігу. Міжнародний неврологічний журнал. 2016. № 8 (86). С. 34-39.

13. Евтушенко С.К., Філімонов Д.А., Евтушенко І.С. Нові фактори ризику розвитку інсульту у лицьового віку. Журнал неврології та психіатрії ім. С.С. Корсакова. Спецвыпуск. 2015. Т. 115. № 12. С. 3-12.

14. Фартушна О.Є., Прокопів М.М. Актуальності проблеми цереброваскулярних захворювань, транзиторних ішемічних атак та охорони їх діагностики в системі охорони здоров’я в Україні. Проблеми військової хірургії. 2005. № 4 (7). С. 45-48.

15. Фартушна О.Є., Виничук С.М. Виявлення та усунення факторів ризику ішемічного інсульту серед військовослужбовців. Київ: УВМА, 2007. Вип. 19. С. 335-342.
16. Fartushna O.E., Vinychuk S.M. Trazuryтмічні ішемічні атаки. Київ: «Агат-Прінт», 2018. 217 с.
17. Feigin V.L., Nguyen G., Cercy K. et al. GBD 2016 Lifetime Risk of Stroke Collaborators. Global, regional, and country-specific lifetime risks of stroke, 1990 and 2016. N. Engl. J. Med. 2018. Vol. 379 (25). P. 2429-2437.
18. Institute for Health Metrics and Evaluation (IHME). Findings from the Global Burden of Disease Study 2017. Seattle, W.A.: IHME, 2018.
19. World Stroke Organization. Facts and Figures about Stroke. Режим доступу: www.world-stroke.org/component/content/article/16-forpatients/84-facts-and-figures-about-stroke.
20. GBD 2016 Causes of Death Collaborators. Global, regional, and national age–sex-specific mortality for 246 causes of death, 1980–2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet (London, England). 2017. Vol. 390 (10100). P. 1151-1210.
21. Wang H., Naghavi M., Allen C. et al. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016. Vol. 388 (10053). P. 1459-1544.
22. Fartushna O.E., Vinychuk S.M. Епідеміологія транзиторних ішемічних атак в структурі гострих порушень мозкового кровообігу в Україні та інших країнах. Міжнародний неврологічний журнал. 2017. № 5 (91). С. 105–111.
23. Chen X.Y., Wang Q., Wang X. et al. Clinical Features of Thalamic Stroke. Curr. Treat. Options Neurol. 2017. Vol. 19 (2). P. 5.
24. Vinychuk S.M., Янцька Т.А., Віничук С.М. Инфаркт в веретенообразній басейні: клініка і діагностика. Міжнародний неврологічний журнал. 2005. № 3. С. 13–21.
25. Lopez-Serna R., Gonzalez-Cololona P., Lopez-Martinez M.J. Bilateral thalamic stroke due to occlusion of the artery of Percheron in a patient with patent foramen ovale: a case report. Med. Case Reports. 2009. Vol. 3. P. 7392.
26. Bogosslavskaya J., Regli F., Uske A. Thalamic infarcts: clinical syndromes, etiology, and prognosis. Neurology. 1988. Vol. 38 (6). P. 837-48.
27. Cheng H., Tian Y., Hu P., Wang J., Wang K. Time-based prospective memory impairment in patients with thalamic stroke. Behavioral Neuroscience. 2010. Vol. 124 (1). P. 152-158.
28. Steinke W., Sacco R.L., Mohr J.P. et al. Thalamic stroke. Presentation and prognosis of infarcts and hemorrhages. Arch. Neurol. 1992. Vol. 49. P. 703–710.
29. Vinychuk S.M., Прокопів М.М., Трепет Л.Н. Ізольований инфаркт таламуса: клінічні синдроми, діагностика, лікування і ісход. Український медичний часопис. 2012. № 2. С. 87–93.
30. Віничук С.М., Прокопів М.М., Трепет Л.Н. Таламічні інсульти. Київ: Агат-Прінт, 2018. 91 с.
31. Vinychuk S.M., Prakopiev M.M., Trepet L.M., Fartushna O.Y. Thalamic stroke outcomes: a prospective hospital-based cohort study. Mediterranean Neurology and Immunorehabilitation, 16–21.10. 2009: abstract. Tel-Aviv, Israel. 2009. P. 67.
32. Fartushna O.E., Vinychuk S.M. Reducing the risk of recurrent ischemic stroke, after transient ischaemic attack along with neuroprotective and antiaggregant therapy. XIV International Congress of Rehabilitation Medicine and Immunorehabilitation, 12–17.11. 2011. Abstracts of the Conference. Tel-Aviv, Israel. 2011. P. 167.
33. Fartushna O.E., Vinychuk S.M. Thalamic stroke outcomes: a prospective hospital-based cohort study. Mediterranean Neurology and Immunorehabilitation, 16–21.10. 2009: abstract. Tel-Aviv, Israel. 2009. P. 67.
34. Adams H.P., Bendixen B.H., Kappelle L.J. et al. Classification of subtype of acute ischemic stroke. Definitions for use in a multicenter clinical trial. TOAST. Trial of Org. 10172 in Acute Stroke Treatment. Stroke. 1993. Vol 24. P. 35-41.
35. Ringleb P., Schellinger P.D., Hacke W. et al. European Stroke Organisation 2008 guidelines for managing acute cerebral infarction or transient ischemic attack. Part 1. Der Nervenarzt. 2008. Vol. 79. P. 936-957.
36. Adams R., Albers G., Alberts M. et al. Update to the AHA/ASA Recommendations for the Prevention of Stroke in Patients With Stroke and Transient Ischemic Attack. Stroke. 2008. Vol. 39. P. 1647–1652.
37. Fartushna O.E., Vinychuk S.M. Thalamic stroke outcomes: a prospective hospital-based cohort study. Mediterranean Neurology and Immunorehabilitation, 16–21.10. 2009: abstract. Tel-Aviv, Israel. 2009. P. 67.
38. Fartushna O.E., Vinychuk S.M. Thalamic stroke outcomes: a prospective hospital-based cohort study. Mediterranean Neurology and Immunorehabilitation, 16–21.10. 2009: abstract. Tel-Aviv, Israel. 2009. P. 67.
39. Vinychuk S.M., Fartushna O.E. Фактори ризику розвитку повторних транзиторних ішемічних атак — ефективний спосіб профілактики повторних гострих церебральних подій. Міжнародний неврологічний журнал. 2014. № 6. С. 87–92.
40. Віничук С.М., Фартушна О.Є. Апторвастатин та його роль у профілактиці та лікуванні ішемічних порушень мозкового кровообігу. Здоров’я України. 2015. № 9. С. 3.
41. Віничук С.М., Фартушна О.Є. Модифікації програми відновлення функціонування церебральних об’єктів у хворих з таламічним інсультом. Український неврологічний часопис. 2016. № 8(86). С. 34–39.
42. Віничук С.М., Фартушна О.Є. Рання реабілітація після гострих ішемічних порушень мозкового кровообігу. Міжнародний неврологічний журнал. 2016. № 8(86). С. 34–39.
43. Віничук С.М., Фартушна О.Є. Основні програми профілактики транзиторних ішемічних атак та/чи інсульту. Міжнародний неврологічний журнал. 2016. № 8(86). С. 34–39.
Клінічні синдроми таламічних інсультів задньолатеральної судинної території: результати проспективного клінічного когортного дослідження

Резюме. Актуальність. У статті проаналізовані та описані патофізіологічні особливості й закономірності виникнення неврологічних, нейропсихологічних та клінічних судинних синдромів таламічних інсультів задньолатеральної судинної території. Висвітлюються особливості неврологічної кініки, топічної, клінічної та нейровізуалізаційної діагностики таламічних інсультів задньолатеральної судинної території за результатами проспективного клінічного когортного дослідження. Мета дослідження: описати та проаналізувати клінічно-нейровізуалізаційні особливості судинних синдромів таламічних інсультів задньолатеральної судинної території в проспективному клінічному когортному дослідженні. Матеріали та методи. Ми провели проспективне клінічне когортне дослідження 319 пацієнтів з гострим інсультом, які надійшли до неврологічного центру Олександрівської клінічної лікарні м. Києва, Україна, протягом перших 24 годин із моменту виникнення інсульту. Всі пацієнти проходили комплексне обстеження: неврологічне, топічне, лабораторне та нейровізуалізаційне. Результати. Серед 319 обстежених хворих із гострим інсультом нейровізуалізаційно підтверджено 34 (10,6 %) таламічний інсульт. Із них у 22 пацієнтів (середній вік 61,9 ± 10,2 року) — гострий ізольований інфаркт таламуса, а в 12 пацієнтів (середній вік 59,0 ± 9,6 року) — гострий таламічний кровоизлив. Проаналізовано, порівняно та описано специфічні неврологічні особливості клінічних судинних синдромів гострих таламічних інсультів задньолатеральної судинної території.

Ключові слова: таламус; інсульт; таламічний інсульт; клінічні особливості; синдром; судинна територія; задньолатеральна судинна територія

Клинические синдромы инсультов таламуса заднелатеральной сосудистой территории: результаты проспективного клинического когортного исследования

Резюме. Актуальность. В статье проанализированы и описаны патофизиологические особенности и закономерности возникновения неврологических, нейропсихологических и клинических сосудистых синдромов таламических инсультов заднелатеральной сосудистой территории. Освещаются особенности неврологической клиники, топической, клинической и нейровизуализационной диагностики таламических инсультов заднелатеральной сосудистой территории по результатам проспективного клинического когортного исследования. Цель исследования: описать и проанализировать клинико-нейровизуализационные особенности сосудистых синдромов таламических инсультов заднелатеральной сосудистой территории в проспективном клиническом когортном исследовании. Материалы и методы. Мы провели проспективное клиническое когортное исследование 319 пациентов с острым инсультом, поступивших в неврологический центр Александровской клинической больницы г. Киева, Украина, в течение первых 24 часов с момента развития инсульта. Все пациенты прошли комплексное клинико-неврологическое, лабораторное, ультразвуковое и нейровизуализационное обследование. Результаты. Среди 319 обследованных больных с острым инсультом нейровизуализационно подтвержденный таламический инсульт диагностирован у 34 (10,6 %) пациентов. Из них у 22 пациентов (средний возраст 61,9 ± 10,2 года) — острый изолированный инфаркт таламуса, а у 12 пациентов (средний возраст 59,0 ± 9,6 года) — острые таламические кровоизлияния. Проанализированы, сравнены и описаны специфические неврологические особенности клинических сосудистых синдромов острых таламических инсультов заднелатеральной сосудистой территории.

Ключевые слова: таламус; инсульт; таламический инсульт; клинические особенности; синдром; сосудистая территория; заднелатеральная сосудистая территория