

This paper discusses a case of type 2 myocardial infarction (MI) in a patient with concomitant electrolyte disturbances and gastric cancer. A 75-year-old female patient was admitted to the cardiac care unit complaining of a loss-of-consciousness episode preceded by rapid heart palpitations. Based on the presentation of a cardiac rhythm disturbance accompanied by loss of consciousness, ECG changes, and Troponin I test results, a diagnosis of ischemic heart disease (IHD) – specifically, acute left ventricular myocardial infarction (May 28, 2025) – was established, and coronary angiography (CAG) was ordered. Following the CAG results, the diagnosis was refined to: IHD, acute left ventricular myocardial infarction (May 28, 2025), type 2. Coronary angiography performed on May 31, 2025, showed no obstructive changes in the coronary arteries. 24-hour ECG monitoring revealed no complex cardiac rhythm disturbances. Additionally, the patient presented with hypokalemia and hypomagnesemia; consequently, infusion therapy with potassium and magnesium preparations was administered throughout the hospitalization. To determine the cause of the electrolyte imbalances, further diagnostic tests were ordered: 24-hour urine analysis for potassium and magnesium, TSH levels, and ultrasound and contrast-enhanced CT scans of the abdominal cavity and pelvis. Abdominal ultrasound revealed multiple liver metastases. Contrast-enhanced CT of the abdomen and pelvis showed signs of gastric wall thickening and multiple liver lesions (secondary in origin). Thus, the cause of the electrolyte disturbances was likely identified; these disturbances, in turn, could have triggered persistent coronary vasospasm, ultimately leading to the development of myocardial infarction.

The described case of type 2 myocardial infarction may be of interest to cardiologists, given the increasing proportion of myocardial infarction cases involving intact coronary arteries.

Key words: ischemic heart disease, myocardial infarction, coronary vasospasm, hypomagnesemia, hypokalemia.

ORCID кожного автора та його внесок до статті:

Ovcharova O. M.: <http://orcid.org/0009-0004-8403-0692> ^{AFDE}

Antoniuk Y. V.: <http://orcid.org/0009-0005-4535-5627> ^{BCE}

Sablin A. V.: <http://orcid.org/0009-0008-2885-221X> ^{BCF}

Конфлікт інтересів:

Автори заявляють про відсутність конфлікту інтересів.

Адреса для кореспонденції

Овчарова Ольга Михайлівна

Національний медичний університет імені О. О. Богомольця

Україна, 01601, м. Київ, бульвар Тараса Шевченка 13

Тел.: +380637362986

E-mail: ov.mi.an7777@gmail.com

А – концепція роботи та дизайн, В – збір та аналіз даних, С – відповідальність за статичний аналіз, D – написання статті, Е – критичний огляд, F – остаточне затвердження статті.

Ця стаття розповсюджується на умовах ліцензії **Creative Commons Attribution (CC-BY)**, яка дозволяє необмежене використання, поширення та відтворення в будь-якому форматі за умови належного цитування оригінальної роботи © Всі автори, 2026

Стаття надійшла 24.05.2026 року
Стаття прийнята до друку 19.08.2026 року
Опубліковано 29.09.2026 року

DOI 10.29254/2077-4214-2026-3-182-337-342

UDC 616.441-008.61:577.175.4]-092.9:57.02/.03:159.929

Rodynskyi O. H., Tkachenko S. S., Rodynska H. O.

MODIFICATION OF SPONTANEOUS BEHAVIOR OF RATS UNDER CONDITIONS OF HYPERTHYROXINEMIA

Dnipro State Medical University (Dnipro, Ukraine)

dr.tkachenkoss@gmail.com

The study of spontaneous behavior in hyperthyroxinemia is an important aspect of research in the fields of behavioral biology, thyroidology, and neuroscience. The aim of this work was to study the effect of hyperthyroxinemia on the spontaneous behavior of rats. White Wistar rats of two age categories (young – 3–4 months, and middle-aged – 7–8 months), were divided into control and experimental (the state of hyperthyroxinemia was modulated with L- thyroxine oral administration) groups. The level of spontaneous behavior in depression was determined using the Porsolt test. For young rats, the time of the first session of motor activity and the duration of the first freezes in the experimental group was increased compared to intact animals. In middle-aged rats the average value of the first session of motor activity in the experimental group was less than the value of the control group, as well as the time of the first freezes. Changes in the same direction were also observed when analyzing the total duration of freezes. However, the statistical significance of these changes was low. Also, in middle-aged animals of the experimental

group, a significant ($p < 0.05$) decrease in the number of defecation boluses and diving attempts as a way to avoid danger was noted compared to intact rats. Hyperthyroxinemia in a stressful situation causes more inertial behavior in young rats and increases the mobility of nervous processes in the middle-aged range, despite low statistical significance of the changes.

Key words: rats, hyperthyroxinemia, Porsolt's test, behavior.

Connection of the publication with planned research work.

The review article is part of the research project: "Compensatory-adaptive reactions of the central and peripheral nervous system in normal and pathological conditions", state registration number 0123U100034.

Introduction.

The study of animal and human behavior is promising for many reasons. Research on this topic is relevant, since changes in the psycho-emotional sphere, such as depression, anxiety and stress due to the influence of external factors, are factors that modify behavior [1, 2]. In mammals, cognitive exploratory activity is activated spontaneously and controls the natural need to explore a new space, object, phenomenon, etc. [3]. Behavioral tests based on conditioned fear or acute reactions to stress, or on the use of approach and avoidance conflict, are used to study such activity and anxiety [4, 5, 6]. One of the main factors that change behavioral reactions is the level of thyroid hormones, which maintain a sufficient functional level of reactivity of the body's systems. There are many researches devoted to the study of the modulating effect of thyroid hormones on nervous activity and behavior in particular [7–11]. However, the least studied in this aspect is hyperthyroxinemia, which is characterized by an increase in the level of free thyroxine in the blood serum with unchanged content of thyroid-stimulating hormone and free triiodothyronine [12]. Behavioral changes in hyperthyroxinemia are usually impulsive in nature. Spontaneous behavior of rats is a set of different types of activity, in particular locomotion, learning new things, feeding and other forms of behavior that occur without external stimuli. Studying it in hyperthyroxinemia is an important aspect of research in the fields of behavioral biology, thyroidology and neuroscience. Thus, the syndrome of stereotypical behavior in animals is considered as an equivalent model of the paranoid form of schizophrenia in a number of pathogenetic mechanisms [13]. The study of behavioral types helps to understand the basic mechanisms of the brain, thyroid gland, and the influence of genetics and environmental factors on a particular category.

The aim of the study.

To study the features of spontaneous behavior of rats under the influence of experimental hyperthyroxinemia.

Object and research methods.

A randomized controlled study was conducted on 20 white Wistar rats of two age groups: young (3–4 months) weighing from 90 to 270 grams, and middle-aged (7–8 months), weighing from 210 to 340 grams. The animals were divided into control and experimental groups. The state of hyperthyroxinemia was created artificially by adding to the feed a crushed tablet of the drug levothyroxine (L-thyroxine from the company "Berlin Chemie AG") with a dosage of 20 $\mu\text{g}/\text{day}$ during morning feeding at 9 a.m. in rats of the experimental group [14].

The level of spontaneous behavior in depression was determined using the Porsolt test (the "Forced Swim-

ming" method) [7, 15]. According to the test method, the rat was placed for 6 minutes in a pool (a white plastic cylinder 60 cm high and 50 cm in diameter), into which water with a temperature of 27–28°C was poured. The water level in the pool did not allow the animal to rest its hind limbs or the tip of its tail on the bottom of the cylinder [16]. Behavioral indicators were the number and time of periods of complete immobility, which was characterized by the complete absence of swimming movements when the rats were passively held in the water. The number of immobility episodes with a duration in four ranges was counted separately: up to 6 s., 6–18 s., 18–36 s. and over 36 s. In addition, the number of fecal boluses was counted.

The Porsolt test assessed: the appearance of the first session of motor activity, the duration of the first and general freezes, the time of active swimming (the animal makes active swimming movements, tries to find a way out), the time of passive swimming (the animal remains motionless or makes minimal movements). Active swimming is usually associated with the presence of motivation to survive and fight the situation, while passive swimming indicates hopelessness or lack of motivation, which is an indicator of a depressive state.

The experiments were conducted in accordance with the principles of the European Union Directive 2010/10/63 EU, the European Convention for the Protection of Vertebrate Animals during Experiments on Animals.

Statistical data processing was carried out using the AtteStat program (licensed software MS Excel Office Home Business 2KB4Y-6H9DB-BM47K-749PV-PG3KT), using the parametric criterion and confidence intervals (CI). Results were considered statistically significant at $p < 0.05$.

Research results and their discussion.

For young rats, the time to the appearance of the first session of motor activity in the experimental group showed a tendency to almost double the increase compared to intact animals: 26 s (95% CI 10.0–41.5) ($n=10$) and 13.7 s (95% CI 3.65–23.75) ($n=10$), respectively. However, this difference was not statistically significant (Student's t test $t=1.47$, $p=0.158$).

The duration of the first freezes in young animals of the experimental group was 16.6 s (95% CI 4.74–28.46), which also showed a tendency to increase compared to the control group, where the corresponding indicator was 9.3 s (95% CI 0.22–18.82). A statistically significant difference was also not observed in this case (two-sided Student's t -test $t=1.09$, $p=0.292$). At the same time, the total duration of freezes in rats of the control and experimental groups was almost the same and was 32.8 s (95% CI 21.62–43.98) and 36.5 s (95% CI 18.26–54.74), respectively (Student's t -test $t=0.39$, $p=0.700$).

Regarding the calculation of defecation boluses, in the experimental group of rats the value of the indicator was 30.2 (95% CI 17.36–43.04) and was one third higher than the value in the control group – 20.8 (95% CI 8.68–

32.92), however, the reliability of the detected changes was also insufficient (Student's t -test = 1.20, $p=0.244$).

The opposite trend was observed in middle-aged rats. Thus, the mean time to the first motor activity in the experimental group was 30.2 s (95% CI 19.27–41.13) ($n=10$), which was one quarter less than the control group's time of 41.4 s (95% CI 18.05–64.75) ($n=10$). The difference between the values was not statistically significant (Student's t -test $t=0.98$, $p=0.339$).

When studying the time limits of the first extinctions in middle-aged animals, a tendency was found to reduce the indicator in the experimental group animals by almost a third compared to the control value: 19.1 s (95% CI 12.81–25.40) and 28.44 s (95% CI 10.84–46.05), respectively, two-sided Student's t test $t=1.20$, $p=0.247$. Changes in the same direction were observed when analyzing the total duration of extinctions, which was 38.3 s (95% CI 27.69–48.91) in the experimental animals and 51.3 s (95% CI 31.78–70.82) in the control group. No statistically significant difference was observed in this case (two-tailed Student's t -test $t=1.32$, $p=0.202$).

When counting defecation boluses, the indicator value in the experimental animals group was significantly lower than the control value and amounted to an average of 28.2 (95% CI 20.95–35.45) and 49.4 (95% CI 32.77–66.03), respectively, Student's t -test $t=2.64$, $p=0.017$.

Despite the lack of reliability of the detected changes, it can be said that the influence of hyperthyroidism on the higher nervous activity of rats was of a multidirectional nature: inertness prevailed in young animals, while middle-aged rats demonstrated a tendency to increase the mobility of nervous processes.

When in a dangerous situation, rats emit a specific vocal sound (squeak). In the experimental group, the frequency of these vocalization acts was 2 times lower compared to the control for both age groups. This can be explained by the animal's attempt to react to the surrounding situation, realizing the inevitability of the subsequent event.

In a potentially dangerous situation, rats demonstrate a certain cognitive activity, the ability to find an alternative escape route, in particular diving to explore the bottom of the container. The main parameters studied during diving attempts are: the time spent searching for an exit or target underwater; route (analysis of the path chosen by the rat during diving); frequency of search movements (number of episodes of changing direction or stopping).

During the Porsolt test, young rats with experimental hyperthyroxinemia made more diving attempts than intact animals (fig. 1). Such changes in behavior can be explained by the fact that hyperthyroxinemia provokes active actions, often with reckless risks. In addition, it is natural that young

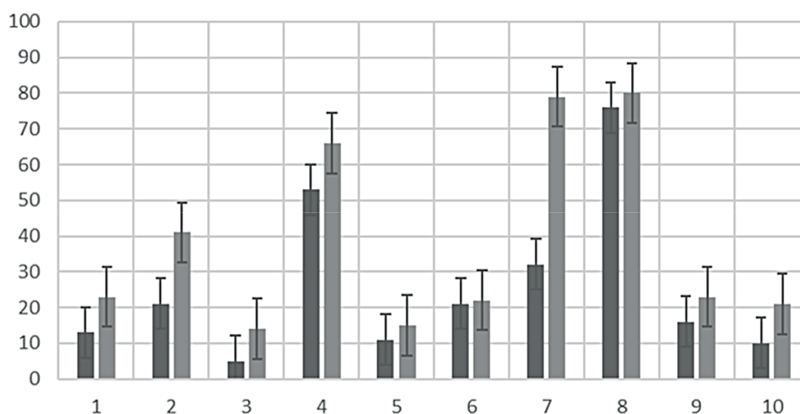


Figure 1 – Diving attempts in young rats during the Porsolt test: Dark-grey – control group, light-grey – experimental group.

animals are more likely to take this step in conditions of threat to their lives, given the phylogenetic and evolutionary stage of development.

Changes in the behavior of middle-aged animals of the experimental group were of the opposite nature - the number of diving attempts was less than in rats of the control group (fig. 2). Perhaps the above is explained by the fact that the effect of an increased level of thyroxine on the fully morpho-functionally formed cerebral cortex, in particular the motor and associative, is less reflected in the behavior of a rat that is in the stage of perception of the inevitable, including with a more mature perception of the surrounding situation [17].

In addition to diving attempts, rats use the tactic of climbing up the pool wall, scratching its wall with their claws (climbing). This form of behavior is called climbing and its duration was almost the same in different age groups of animals. As for the frequency of wall scratches, the value of the indicator was higher in the experimental group of young animals compared to the control in a ratio of 2:1, which can be explained by the anxiogenic effect. In the middle-aged rats, there was no difference in the frequency of scratches between the experimental and control groups. The parity was probably due to age-related anxiolytic predisposition to unpredictable stress, with the absence of pronounced emotional manifestations that worsen the general condition of the body, and exhaustion of neurovegetative processes under the specified simulated conditions.

There are studies according to which the activation of the monoaminergic system affects the emotional behavior of rats in the Porsolt test with unpredictable

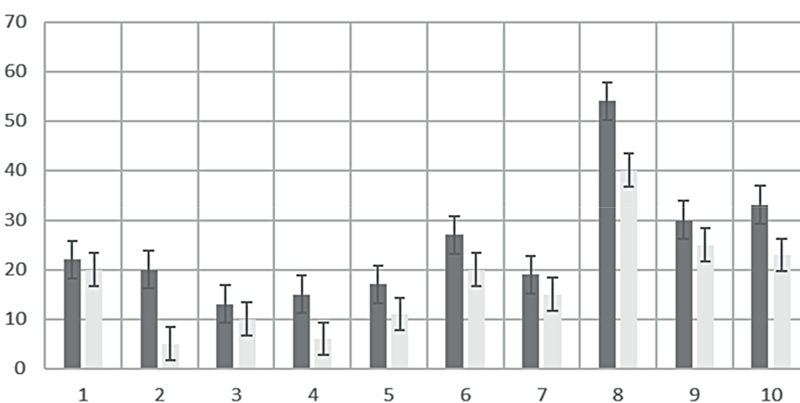


Figure 2 – Diving attempts in middle-aged rats during the Porsolt test: Dark-grey – control group, light-grey – experimental group.

stress and is characterized by a decrease in the number of episodes of passive swimming, its components, the number of attempts to get out of the "pool", and therefore, a corresponding increase in the total time of passive swimming. The time of active swimming increased by 2.6 times (in all cases $p < 0.05$) [16, 18]. Since thyroid hormones exert a modulating effect, increasing the sensitivity of cells to monoaminergic compounds, hyperthyroxinemia can contribute to the emergence of effects in the CNS, similar to the activation of the monoaminergic system, especially in a young organism with a more active metabolism. The latter can explain the behavioral changes we found in the experimental group of rats of the adolescent age range.

According to other studies of spontaneous behavior in rats, against the background of the increase in pathological changes in experimental hypothyroidism, there is a suppression of motor, exploratory and vegetative activity of animals [19]. It is reasonable to assume that experimental hyperthyroxinemia may lead to opposite behavioral changes, especially in young rats, taking into account the high metabolic activity and incomplete functional formation of the cerebral cortex [17].

The applied Porsolt test is precisely the experimental method that is able to detect and assess depressive orientation in the spontaneous activity of rats during forced swimming. It is important to note the interim results regarding the formation of such behavior. It has been proven that rats change their behavior based on visual, olfactory and auditory information, which indicates to us that there is a high probability that the behavior

of experimental animals can change in response to the presence of other individuals when several individuals simultaneously undergo a forced swimming test [20].

Therefore, the main mechanism is probably the activation of an unstable emotional background during exposure to water as a provoking factor for spontaneous behavior. The basis of the pathogenesis of such activity is an imbalance of the serotonergic, adrenergic and dopaminergic neurotransmitter systems of the CNS, therefore anxiety is accompanied by changes in the functional state of monoaminergic mediator systems, which are among the first to react with neurotransmitter imbalance and receptor response disorders [14, 21].

Conclusions.

1. The tendency of hyperthyroidism influence on higher nervous activity of rats depending on age was of a multidirectional nature: inertness prevailed in young animals, while middle-aged rats demonstrated a tendency to increase mobility of nervous processes. Also, a decrease in the number of attempts to avoid danger in animals of the middle-aged range of the experimental group was reliably recorded, as well as the number of defecation boluses.

2. The obtained results expand the boundaries of detailed study of behavior and ways of its correction under changed conditions. This serves as a promising direction in the fields of physiology, psychiatry and cognitive therapy.

Prospects for further research.

Applications of the findings in the fields of physiology, psychiatry, and cognitive therapy.

References

- Ganesh Bala Angu KSV, Dissanayake D, Gunatilake M, Venkatapathy VK, Paranthaman M. A short review on behavioural assessment methods in rodents. *Bioinformation*. 2023;19(8):866-870. DOI: <https://doi.org/10.6026/97320630019866>
- Eraslan E, Castelhanos-Carlos MJ, Amorim L, Soares-Cunha C, Rodrigues AJ, Sousa N. Home-cage behavior is impacted by stress exposure in rats. *Front Behav Neurosci*. 2023;17:1195011. DOI: <https://doi.org/10.3389/fnbeh.2023.1195011>
- Kyrylenko NA, Tyniana Mlu, Hladkii TV. Osoblyvosti povedinkovykh reaktsii shchuriv u labirynti Barnsa na tli intoksykatsii khlorodom aliuminiu. *Visnyk Odeskoho natsionalnoho universytetu*. 2023;28(1(52)):136-146. DOI: [https://doi.org/10.18524/2077-1746.2023.1\(52\).284692](https://doi.org/10.18524/2077-1746.2023.1(52).284692) [in Ukrainian].
- Botsula IV, Kireyev I, Koshovyi OM, Mazur MO, Chebanov VA. Povedinkovi reaktsii hryzuniv pislia vvedennia pokhidnykh 1,2,3-tryazolo-1,4-benzodiazepiniv v testi "vidkrytoho polia". *Farmatsevtichnyi chasopys*. 2023;4:70-77. DOI: <https://doi.org/10.11603/2312-0967.2023.4.1297> [in Ukrainian].
- Harro J. Animals, anxiety, and anxiety disorders: How to measure anxiety in rodents and why. *Behav Brain Res*. 2018;352:81-93. DOI: <https://doi.org/10.1016/j.bbr.2017.10.016>
- Oberrauch S, Sigrist H, Sautter E, Gerster S, Bach DR, Pryce CR. Establishing operant conflict tests for the translational study of anxiety in mice. *Psychopharmacology (Berl)*. 2019;236(8):2527-2541. DOI: <https://doi.org/10.1007/s00213-019-05315-y>
- Demchenko O, Rodynskyi O, Kozlova Yu, Kozlov S, Rodynska H, Titov H. Formation of protective behavior of young rats in conditions of thyroid dysfunction. *Problems of Endocrine Pathology*. 2022;79(1):85-92. DOI: <https://doi.org/10.21856/j-PEP.2022.1.12>
- Tian Z, Wang B, Chen L. Thyroid antibodies and depression: Is the relationship overstated?. *J Psychiatr Res*. 2025;190:216-224. DOI: <https://doi.org/10.1016/j.jpsychires.2025.08.003>
- Russart KLG, Huk D, Nelson RJ, Kirschner LS. Elevated aggressive behavior in male mice with thyroid-specific Prkar1a and global Epac1 gene deletion. *Horm Behav*. 2018;98:121-129. DOI: <https://doi.org/10.1016/j.yhbeh.2017.12.012>
- Fini JB, Demeneix B. Les perturbateurs thyroïdiens et leurs conséquences sur le développement cérébral. *Biol Aujourd'hui*. 2019;213(1-2):17-26. DOI: <https://doi.org/10.1051/jbio/2019009>
- Eslami-Amirabadi M, Sajjadi SA. The relation between thyroid dysregulation and impaired cognition/behaviour: An integrative review. *J Neuroendocrinol*. 2021;33(3):e12948. DOI: <https://doi.org/10.1111/jne.12948>
- Danyliuk O. Yatrohenni zminy shchytopodobnoi zalozy u khvorykh iz fibrylyatsiieiu peredserd pid vplyvom amiodaronu. Aktualni problemy suchasnoi medytsyny: Visnyk Ukrainkoi medychnoi stomatolohichnoi akademii, 2021;21(1):11-16. DOI: <https://doi.org/10.31718/2077-1096.21.1.11> [in Ukrainian].
- Varbanets OI, Hodovan VV, Kashchenko OA, Seifullina II, Martsynko OE. Vplyv novykh ksyaratnykh kompleksiv hermaniiu (IV) na proiavy syndromu stereotypnoi povedinky u shchuriv. *Farmakolohiia i farmatsiia*. 2012;4(132):15-18. [in Ukrainian]
- Voychenko YS, Rodinsky OG. Patterns of anxious activity in young and middle-aged rats under experimental hyperthyroxinemia. *The Odessa Medical Journal*. 2023;4:9-13. DOI: <https://doi.org/10.32782/2226-2008-2023-4-1>
- Porsolt RD, Bertin A, Jalfre M. Behavioral despair in mice: a primary screening test for antidepressants. *Arch Int Pharmacodyn Ther*. 1977;229(2):327-36.
- Vasyanov RS, Stoyanov OM, Dobrovolskyi VV, Plakida OL, Talalayev KO, Babienko VV, et al. Zminy reaktsii tvaryn v testi Porsolta v dynamitsi vidvorennia cherepno-mozkovoï travmy pry modulatsii aktyvnosti monoaminerychnykh neiromediatornykh system. *Visnyk morskoi medytsyny*. 2024;3(104):127-135. DOI: <http://dx.doi.org/10.5281/zenodo.13889264> [in Ukrainian].
- Mizin VV, Lyashenko VP, Lukashov SM. Age changes of bioelectric activity of motor and visual cortex of the rats brain. *Bulletin of problems biology and medicine*. 2018;2(144):197-201 DOI: <https://doi.org/10.29254/2077-4214-2018-2-144-197-201>
- Appelhans O, Mathysen O. Zminy emotsiinykh reaktsii v dynamitsi khronichnoho neperedbachuvanoho stresu v shchuriv za umov modulatsii aktyvnosti monoaminerychnykh neiromediatornykh system. *Visnyk morskoi medytsyny*. 2024;3(104):162-171. DOI: <http://dx.doi.org/10.5281/zenodo.12818397> [in Ukrainian]

19. Nosivets DS. Doslidzhennia vplyvu khondroitynu sulfatu na proiavy osteoartrozu vnaslidok hipotyreozy. Visnyk problem biologii i medyt-syny. 2019;3(152):161-165. DOI: <https://doi.org/10.29254/2077-4214-2019-3-152-161-165> [in Ukrainian].
20. Ueno H, Takahashi Y, Murakami S, Wani K, Matsumoto Y, Okamoto M, et al. Effect of simultaneous testing of two mice in the tail suspension test and forced swim test. Sci Rep. 2022;12(1):9224. DOI: <https://doi.org/10.1038/s41598-022-12986-9>
21. Lutsenko R. Current understanding of the role of the monoaminergic neurotransmitter system in angiogenesis. The Medical and Ecological Problems, 2022;26(5-6):47-51. DOI: <https://doi.org/10.31718/mep.2022.26.5-6.09> [in Ukrainian]

МОДИФІКАЦІЯ СПОНТАННОЇ ПОВЕДІНКИ ЩУРІВ ЗА УМОВ ГІПЕРТИРОКСИНЕМІЇ

Родинський О. Г., Ткаченко С. С., Родинська Г. О.

Резюме. Дослідження поведінки тварин та людей є перспективним з багатьох причин. Вивчення її при гіпертироксинемії є важливим аспектом досліджень у галузях поведінкової біології, тиреоїдології та нейронауки. А оскільки зміни психоемоційної сфери такі як депресивність, тривожність та стреси через вплив зовнішніх чинників є факторами, що модифікують поведінку, дослідження за даною тематикою є актуальними

Метою даної роботи було вивчення впливу гіпертироксинемії на спонтанну поведінку щурів.

Дослідження було проведено на білих щурах лінії Wistar двох вікових категорій (молоді – 3–4 міс., та середнього віку – 7–8 міс.), поділених на контрольну (інтактну) та експериментальну (із попередньо змодельованим фармакологічно станом гіпертироксинемії) групи.

За результатами проведення тесту Порсолта відмічалась тенденція до різноспрямованих змін активності тварин різних експериментальних груп. Для щурів юного віку час появи першого сеансу рухової активності та тривалість перших завмирань в експериментальній групі продемонстрували тенденцію до майже двократного збільшення порівняно з інтактними тваринами. При цьому загальна тривалість завмирань у щурів контрольної та експериментальної груп майже не відрізнялась. Протилежну тенденцію до змін було виявлено у щурів середнього віку. Так, середнє значення появи першого сеансу рухової активності в експериментальній групі було на чверть менше за значення показника контрольної групи. Час перших завмирань у середньовікових тварин також показав тенденцію до зменшення майже на третину в порівнянні з контрольним значенням. Зміни того ж напрямку спостерігались і при аналізі загальної тривалості завмирань. Проте статистична достовірність цих змін була невисока. Також у середньовікових тварин експериментальної групи відмічалось достовірне ($p < 0,05$) зменшення кількості болюсів дефекації та спроб пірнання як шляху оминуту небезпеку в порівнянні з інтактними щурами. Ймовірно, модуляція роботи нейромедіаторних систем ЦНС підвищеним рівнем тироксину була причиною виявлених змін спонтанної поведінки за умов виникнення несприятливої ситуації та розвитку при цьому негативного емоційного фону.

На фоні гіпертироксинемії під час стресової ситуації у щурів юного віку спостерігалась більш інерційна поведінка, тоді як в середньовіковому діапазоні рухливість ВНД процесів зростала, хоча й статистична достовірність змін була невисокою.

Ключові слова: щури, гіпертироксинемія, тест Порсолта, поведінка.

MODIFICATION OF SPONTANEOUS BEHAVIOR OF RATS UNDER CONDITIONS OF HYPERTHYROXINEMIA

Rodynskyi O. H., Tkachenko S. S., Rodynska H. O.

Abstract. The study of animal and human behavior is promising for many reasons. The study of its behavior in hyperthyroxinemia is an important aspect of research in the fields of behavioral biology, thyroidology, and neuroscience. And since changes in the psychoemotional sphere such as depression, anxiety, and stress due to the influence of external factors are factors that modify behavior, research on this topic is relevant

The aim of this work was to study the effect of hyperthyroxinemia on the spontaneous behavior of rats.

The study was conducted on white Wistar rats of two age categories (young – 3–4 months, and middle-aged – 7–8 months), divided into control (intact) and experimental (with a previously pharmacologically simulated state of hyperthyroxinemia) groups.

According to the results of the Porsolt test, a tendency to different-directional changes in the activity of animals of different experimental groups was noted. For young rats, the time of the first session of motor activity and the duration of the first freezes in the experimental group showed a tendency to almost double the increase compared to intact animals. At the same time, the total duration of freezes in rats of the control and experimental groups was almost the same. The opposite tendency to change was found in middle-aged rats. Thus, the average value of the first session of motor activity in the experimental group was a quarter less than the value of the control group. The time of the first freezes in middle-aged animals also showed a tendency to decrease by almost a third compared to the control value. Changes in the same direction were also observed when analyzing the total duration of freezes. However, the statistical significance of these changes was low. Also, in middle-aged animals of the experimental group, a significant ($p < 0.05$) decrease in the number of defecation boluses and diving attempts as a way to avoid danger was noted compared to intact rats. Probably, modulation of the work of neurotransmitter systems of the CNS by an increased level of thyroxine was the cause of the detected changes in spontaneous behavior under the conditions of an unfavorable situation and the development of a negative emotional background.

Hyperthyroxinemia in a stressful situation causes more inertial behavior in young rats and increases the mobility of GNI processes in the middle-aged range, despite low statistical significance of the changes.

Key words: rats, hyperthyroxinemia, Porsolt test, behavior.

ORCID and contributionship:

Rodynskyi O. H.: <https://orcid.org/0000-0002-8011-6104> ABCDEF

Tkachenko S. S.: <https://orcid.org/0000-0002-8828-8349> ABCDE

Rodynska H. O.: <https://orcid.org/0000-0002-1810-2422> ^{BCDE}

Conflict of interest:

The authors declare no conflict of interest

Corresponding author

Tkachenko Serhii Serhiiovych
Dnipro State Medical University
Ukraine, 49044, Dnipro, 9 V. Vernadsky str.
Tel.: +380950642471
E-mail: dr.Tkachenkoss@gmail.com

A – Work concept and design, **B** – Data collection and analysis, **C** – Responsibility for statistical analysis, **D** – Writing the article, **E** – Critical review, **F** – Final approval of the article.

This article is distributed under the terms of the **Creative Commons Attribution (CC-BY) License**, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited © All authors, 2026

Received 27.05.2026

Accepted 02.08.2026

Published 29.09.2026

DOI 10.29254/2077-4214-2026-3-182-342-348

УДК 616.126.42-089:616-089.819

Филипчук В. В., Лазоришинець В. В.

**ПОРІВНЯЛЬНИЙ АНАЛІЗ МІНІМАЛЬНО ІНВАЗИВНОГО ТА КЛАСИЧНОГО ДОСТУПІВ
У ХІРУРГІЧНОМУ ЛІКУВАННІ ІЗОЛЬОВАНОЇ НЕДОСТАТНОСТІ МІТРАЛЬНОГО
КЛАПАНА: БЕЗПОСЕРЕДНІ РЕЗУЛЬТАТИ
ТА ФУНКЦІОНАЛЬНЕ ВІДНОВЛЕННЯ ПАЦІЄНТІВ**

**ДУ «Національний науковий центр серцево-судинної хірургії та спадкової патології
імені М.М. Амосова НАМН України» (м. Київ, Україна)**

vasilvasilivi4@gmail.com

Пластика мітрального клапана залишається пріоритетним методом хірургічної корекції його недостатності, оскільки дає змогу зберегти нативний клапан та підклапанний апарат і забезпечити ефективне усунення патологічної регургітації. Сучасний розвиток малоінвазивної хірургії сприяв впровадженню альтернативних доступів в кардіохірургії, зокрема правобічної мініторакомотомії, що потенційно дозволяє зменшити операційну травму та прискорити післяопераційне відновлення. Водночас остаточно оцінка переваг порівняно з традиційною серединною стернотомією потребує комплексного аналізу безпосередніх клінічних результатів, перебігу раннього післяопераційного періоду та функціонального відновлення пацієнтів. Мета дослідження – порівняти клінічну ефективність і безпеку, особливості раннього післяопераційного періоду та швидкість функціонального відновлення пацієнтів після пластики мітрального клапана через правобічну мініторакомотомію та серединну стернотомію. Ретроспективно проаналізовано результати хірургічного лікування 134 пацієнтів з ізольованою недостатністю мітрального клапана за 2020–2024 роки: 59 хворих після правобічної мініторакомотомії та 75 – після серединної стернотомії. Порівнювали інтраопераційні та ранні післяопераційні показники, тривалість госпіталізації, потребу в анальгезії й темпи функціонального відновлення. Застосування мініторакомотомного доступу супроводжувалося збільшенням тривалості оперативного втручання, штучного кровообігу та перетискання аорти порівняно з традиційною серединною стернотомією, що може бути пов'язано з технічною складністю виконання реконструктивних етапів в умовах обмеженого операційного поля. Водночас малоінвазивний підхід характеризувався достовірно меншою інтраопераційною крововтратою. У ранньому післяопераційному періоді у пацієнтів цієї групи відзначено скорочення тривалості перебування у відділенні інтенсивної терапії та стаціонарі, меншу потребу в післяопераційному знеболенні, ранішу мобілізацію та швидше відновлення фізичної активності. Повернення до повсякденної та професійної діяльності також відбувалося у коротші терміни. При цьому тривалість штучної вентиляції легень і частота післяопераційних ускладнень статистично значущо не відрізнялися між групами, що свідчить про зіставну ранню післяопераційну безпеку досліджуваних хірургічних доступів.

Ключові слова: мінімально інвазивна хірургія, мітральний клапан, серединна поздовжня стернотомія, недостатність мітрального клапана, набуті вади серця, функціональна реабілітація.