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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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HYDROGEN SULFIDE AND CYSTATHIONINE γ –LYASE LEVELS FOR PATIENTS WITH PARKINSON'S DISEASE

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Abstract.

Parkinson's disease (PD) is a complicated neurodegenerative disease that is the most prevalent severe movement disorder worldwide. The research includes studying the levels of hydrogen sulphide (H_2S) and cystathionine γ–lyase (CSE) with some biochemical parameters in the serum of patients with PD in Mosul City (Iraq), which include Serotonin (SERT), dopamine (DA), sphingomyelin (SM), vitamin B_{12}, Acetylcholine esterase (AChE), monoamine oxidase (MAO), creatine kinase (CK), aspartate aminotransferase (AST), alanine aminotransferase (ALT). Samples reached (100), which included: (40) for the Parkinson's patients group, and (60) for the control group. The results showed there was a significant decrease in the levels of H_2S, CSE, SERT, DA, SM, B_{12} and CK and a significant increase in the activity of MAO, AST, and ALT and no significant difference in AChE activity in serum for Parkinson's patients when compared with the control group. The effect of periods PD revealed, a significant decline of H_2S, CSE, SERT, DA, B_{12}, and AChE, while MAO, CK, AST, and ALT showed a significant rise with increased periods of disease, SM showed a non-significant change with periods of disease. The study concluded that H_2S gas produced within the body and CSE suffer from low levels within the body, and they also decrease with the increase in the duration of the disease as a result of their use as protective functions in the body against Parkinson's disease. And developing it by observing the levels of the variables measured with it, and stimulating the body to increase their levels (H_2S, CSE) in various ways can lead to improving the health condition of patients.

Key words. Parkinson's disease, hydrogen sulfide, cystationine γ –lyase.

Introduction.

Parkinson's disease (PD) is affecting the nervous system. The name goes back to James Parkinson, who was the first to describe this disease in his 1817 paper, "Essay on the Shaking Palsy" [1] whose primary signs and symptoms are motor dysfunctions, including bradykinesia, stiffness and tremor. Patients with PD often suffer from non-motor symptoms, such as autonomic dysfunctions like constipation and psychological symptoms like anxiety and depression. PD is therefore a systemic disease rather than a condition affecting just the central nervous system [2,3]. It can be identified by the accumulation of α-synuclein in intracytoplasmic inclusions called Lewy bodies and the death of dopaminergic neurons in the par's compacta of the substantia nigra [4]. Both genetic and environmental factors can cause its symptoms. Ageing is a risk factor for PD development and concentrating on a shared set of mechanisms that include oxidative stress, neuroinflammation, protein aggregation, defective autophagy, and mitochondrial dysfunction, high levels of toxic metals as a result of exposure to toxic metal pollutants is one of the causes of neurological diseases [5,6].

Hydrogen sulfide (H_2S) is a novel endogenous gaseous signal molecule that is found in living things. It is the 3rd endogenous gasotransmitter, after carbon monoxide (CM) and nitric oxide (NO), and it is involved in many systems and diseases [7]. Three endogenous enzymes have been identified as responsible for the biosynthesis of H_2S from cysteine: 3-mercaptopyruvate sulfurtransferase, CSE, and cystathionine β-synthase. H_2S protects against the majority of neurological diseases. H_2S plays critical roles by eliciting anti-oxidative, anti-apoptotic, neuromodulatory, and anti-inflammatory properties in CNS [8,9]. cystathionine γ–lyase (CSE, EC 4.4.1.1) was first isolated and crystallized from rat liver [10] and is a component of the Cys/Met metabolism that produces H_2S in mammals. CSE plays in preserving the brain's redox balance, especially concerning mitochondrial function. This enzyme is in charge of the last stage of the transsulfuration pathway, which produces cysteine from methionine. The production of glutathione depends on the availability of cysteine, because it maintains protein thiol homeostasis and glutathione levels in the brain, it is essential for neuroprotection [11,12].

A substance known as serotonin (SERT) has effects on both the peripheral and central nervous systems. It functions in our bodies as a neurotransmitter, hormone, and mitogen [13], it affects physiological functions like controlling sleep, behaviour, mood, and appetite, as well as cognitive functions like learning, memory, pleasure, and reward, is the main target of treatment for several neurological and psychiatric conditions, including depressive and anxiety disorder, post-traumatic stress disorder, that are linked to decreased CNS and plasma SERT concentration [14,15]. Dopamine (DA) is a catecholaminergic neurotransmitter that is generated in the substantia nigra cell bodies. It is released into the striatum. The role of dopaminergic system is involved in motor control, reward, happiness, sleep, attention, memory and learning. Dopaminergic signalling pathways play a critical role in maintaining physiological processes, and disruptions in their activity can result in dysfunctions linked to neurodegenerative illnesses [16].

Sphingomyelin (SM) is an essential molecule for the pathophysiology of the brain.it is found in the myelin sheath and plays a role in neurotransmitter receptor localization, and nerve impulse transmission, it has been suggested that it is involved in PD [17] and serves as a source of ceramide for apoptosis and cell signalling [18]. B_{12} is vital to human health and lowers the risk of neurological conditions and birth defects. It is an essential micronutrient for preserving the health of the brain in young people and the elderly. in children, younger, and elders [19]. The function of B_{12} includes cellular energy production, neuroprotective and antioxidant properties, and the synthesis of myelin and neurotransmitters [20].

Acetylcholinesterase (AChE) is a cholinergic enzyme. It catalyzes the hydrolysis of acetylcholine (ACh) into choline and acetic acid [21] affects the inflammatory response, apoptosis, and oxidative stress, all of which are crucial steps in the pathophysiology of neurodegenerative diseases [22]. Monoamine oxidase (MAO) is a major player in the adrenergic system, MAO is known for its role in mood and behaviour regulation. It has also been recognized for its role in neuropsychiatric and neurodegenerative diseases. MAO also influences violent and antisocial, has long been thought to be associated with human emotional and mental states [23]. The enzymes creatine kinase (CK), aspartate aminotransferase (AST) and alanine aminotransferase (ALT) also play crucial roles in the vital function of the organs. A sensitive and crucial screening parameter for the diagnosis and follow-up of several neurological and psychiatric diseases is CK [24] in the energy conversion process in tissues especially skeletal, cardiac muscle and neural tissues like the brain [25]. The AST and ALT enzymes suggest an important for evaluating the functions of the liver in patients with neurological diseases like PD and Alzheimer's disease [26].

This study is the first of its kind that focused on knowing the role of H_2S and CSE in Parkinson's patients, as well as evaluating the health condition by measuring hormones and enzymes, as well as SM and vitamin B_{12}, which are related to neurological diseases, in addition to studying the effect of the duration of illness on Parkinson's patients.

Materials and Methods.

A total of 100 participants enrolled in the present study, including 40 Parkinson's patients and 60 healthy persons as a control group. The samples were gathered from the Ibn Sina and Al-Salam Teaching Hospitals in (Mosul City, Iraq), as well as from outside laboratories in different parts of the city, under the supervision of a neurologist, for the period between February and October 2022.

Serum H_2S was measured by Zhuo et al. method [27]. The assay for CSE involves measuring the rate of formation of α- ketobutyric acid from L-homoserine, it is determined by the method of Friedemann and Haugen [28]. Serum SERT was evaluated using an enzyme–linked immunosorbent assay technique using kits from SunLong Biotechnology (China). While serum DA levels were assessed using an ELISA kit from Bioassay Technology (China), Beside of SM levels were assessed using an ELISA kit from SunLong Biotechnology (China), and vitamin B_{12} automated electrochemiluminescence immunoassay "ECLIA" is intended for use on COBAS analyzers [29].

The activity of AChE was measured according to the method of researcher Ellman [30] while MAO levels were assessed using the method of researcher Buffoni and Blaschko [31]. Serum CK was estimated by researcher Oliver [32], and AST and ALT activities were measured according to the method of Reitman and Frankel [33]. The data were compared between the PD and control to identify the differences. Moreover, the data of PD patients were categorized into those patient which do have PD for less than 2 years (Group 1) which include 19 patients and those for more than 2 years up to 10 years which include 21 patients (Group 2).

Statistical Analysis: The data was statistically examined using the t-test. The data is shown as means with standard error (SE). The t-test was selected to compare two variables and determine the difference between the values that appeared through the (P) value, which occurs at ($P<0.05$) a significant difference, and at ($P>0.05$) a non-significant difference [34].

Results.

In the current research, Comparing the mean values of H_2S and CSE between Parkinson's patients and control groups as seen in Table (1), a significant decline in the levels of H_2S, and CSE was noticed in Parkinson's patients (0.015± 0.002) and (3.20 ± 0.76) compared with the control group (0.027 ± 0.004) and (7.54±1.18), respectively (Table 1).

There was a highly significant decrease was observed in the mean values of SERT, DA, SM and vitamin B_{12} in patients (24.72± 2.99), (106.13±12.38), (7.15±0.331) and (301.75±29.66) compared with control group (110.50±4.65), (234.59±10.35), (31.48±2.20) and (615.00±19.64), respectively (Table 1).

There were significant increase in the mean values of MAO, AST and ALT was noted in Parkinson's patients (109.45±4.96),

Table 1. *Measured parameters in Parkinson's patients as compared with the control group.*

Measured parameters	Control group (n=60)	PD Group (n=40)
H_2S (mol/L)	0.027±0.004*	0.015±0.002
CSE (U/L)	7.54±1.18*	3.2±0.76
SERT (ng/ml)	110.50±4.65***	24.72±2.99
DA (ng/L)	234.59±10.35***	106.13±12.38
SM (ng/ml)	31.48±2.20***	7.15±0.331
Vitamin B_{12} (Pg/ml)	615±19.64***	301.75±29.66
AChE (U/L)	40.59±2.18	46.63±3.73
MAO (U/L)	48.64±1.104	109.45±4.96***
CK (U/L)	116.05±9.85**	89.25±7.41
AST (U/L)	10.10±0.937	13.25±1.49*
ALT (U/L)	5.85±0.76	14.75±1.43***
Data expressed as mean±SE, *Significant at (P≤0.05), **Significant at (P≤0.001), ***Significant at (P≤0.0001).		

Table 2. *Effect of periods of the PD on H2S and CSE levels with some biochemical parameters.*

Measured parameters	Group 1 (n=19) (0-1y)	Group 2 (n=21) (2-10y)
H_2S (mol/L)	0.022±0.003*	0.015±0.002
CSE (U/L)	3.61±0.254***	2.29±0.47
SERT (ng/ml)	24.86±3.11**	19.75±2.44
DA (ng/L)	133.55±11.96***	102.5±16.59
SM (ng/ml)	7.21±0.486	7.22±0.324
B_{12} (pg/ml)	587.6±31.43**	384.22±25.09
AChE (U/L)	49.56±2.25*	43.47±2.64
MAO (U/L)	108.96±3.78	113.52±4.57*
CK (U/L)	68.6±7.18	78.44±6.49**
AST (U/L)	12±2.07	21.22±1.13***
ALT (U/L)	13±4.47	22.55±2.48*
Data expressed as mean±SE, *Significant at (P≤0.05), **Significant at (P≤0.001), ***Significant at (P≤0.0001).		

(13.25±1.49), and (14.75±1.43) as compared with control group (48.64±1.104), (10.10±0.937), and (5.85±0.76) respectively while the results showed a significant decrease in levels of CK inpatient group (89.25±7.41) compared with control group (116.05±9.85), the elevation of AChE in Parkinson's patients statistically not significant (Table 1).

Finally, the effect of periods of the PD on H_2S and CSE levels with some biochemical parameters studied in this research was shown significant decline of H_2S, CSE, SERT, DA, vitamin B_{12} and AChE in Group2 compared with Group1 while MAO, CK, AST, ALT and showed a significant rises in Group2 compared with the Group1 while SM showed a non-significant change between the two groups (Tables 2).

Discussion.

In this study, H_2S shows a high decrease in Parkinson's patients, it serves as an antioxidant to assist in cytoprotection in the brain system against oxidative stress and inflammatory responses by diminishing excessive amounts of oxidative species such as reactive oxygen species (ROS), reactive nitrogen species (RNS), and aggregation of lipid peroxidation products [35], reduced H_2S levels cause neurodegenerative diseases, and H_2S levels function as a marker for neurological diseases such as Parkinson's, Alzheimer's and Huntington's disease, it has a physiological function in maintaining homeostasis and it has cell signalling function to prevent neuroinflammation and product against disorders of the central nervous system [36].

In mammalian cells, L-cysteine serves as the primary substrate for CSE, a major H_2S-producing enzyme that is also an integral component of proteins and a precursor to both H_2S and glutathione. The CSE/ H_2S system is important for both health and disease [37]. Paul et al. showed the neurodegeneration and clinical deficits in Huntington's disease are caused by CSE depletion and its products, such as cysteine [38]. The elevation of H_2S and CSE provide promise for improvement of PD [1].

Furthermore, SERT levels fall in this study, these results are in line with the results of previous studies that pointed out a decrease of SERT in the plasma of Parkinson's patients [39]. Disturbances in SERT levels are associated with neurological diseases, the overactivation of the kynurenine pathway reduces SERT synthesis by pushing tryptophan away from SERT synthesis, suggesting that SERT and its metabolites may be used as a diagnostic and prognostic marker [40].

In this investigation, serum DA was examined, and there is a direct correlation between concentration and PD. PD has been linked to a decrease in DA in the substantia nigra of the brain. Due to its low concentrations, nerve impulses cannot be transmitted, and the brain is unable to carry signals properly. As a result, the brain's communication with other bodily parts is lost [41].

Alterations in sphingolipid metabolism have been described in multiple neurologic diseases such as Parkinson's, multiple sclerosis and Alzheimer's disease as those that have an impact on (CNS) assessing its direct contributions to the growth and health of neurons [42]. The pathophysiology of neurodegeneration is influenced by the metabolism of SM and its metabolite ceramide, which also acts as a mediator of neuroinflammation [43].

Vitamin B_{12} deficiency may be due to their anti-inflammatory, modulatory and antioxidant effects. Treatment with vitamin B_{12} could reduce the symptoms of neurological disease and pathological changes, it is important to the synthesis of myelin in the brain and integrity [44]. Orozco-Barrios et al. showed in PD in which that levodopa treatment increases S-adenosyl methionine consumption to induce a vitamin B_{12} deficiency [45].

The role of AChE in catalytic hydrolysis of cholinergic neurotransmitters [46]. Other reports found a higher activity of the AChE in the saliva of Parkinson's patients [47]. The MAO has a role in regulating many neurological and psychological disorders, since an increase in the enzyme's activity may result in damage to the nervous system and a decline in cognitive awareness [48,49]. MAO inhibitors work as antidepression and anti-anxiety agents and additional nervous system disorders such as panic disorder, and social phobia, as a study indicated that MAO inhibitors are one of the main classes of medications prescribed to treat depression [50].

Vassilopoulos et al. showed that the CK activity was considerably lower in patients with epilepsy and multiple sclerosis than in healthy persons, while no differences were found in patients with PD, it is suggested that the low CK activity observed might be due to the medication taken or to the disease process itself [51]. The elevated (AST, ALT) ratio is associated with cognitive decline, and liver enzymes affecting cognitive function the reason for the increase may be due to the defensive property of these enzymes, protecting the nervous systems, as these enzymes work to relax glutamine, which has a neurotoxic effect [52-54].

Parkinson's Disease is a heterogeneous condition, and factors such as disease stage, medication use, and comorbidities can influence H_2S and CSE levels. Consequently, it becomes essential to control for these confounding variables, which can increase the complexity of the study design and data analysis. Lastly, the study of H_2S and CSE levels in PD is relatively new, and the understanding of their role in the disease pathogenesis is still evolving. This limits the existing literature and scientific evidence available, making it challenging to establish a strong foundation for further research. Despite these limitations, studying the measurement of H_2S and CSE levels in patients with PD holds promise in advancing our understanding of the disease and potentially identifying novel therapeutic targets.

Conclusion.

The study concluded that H_2S gas produced within the body and CSE suffer from low levels within the body, and they also decrease with the increase in the duration of the disease as a result of their use as protective functions in the body against PD. And developing it, by observing the levels of the variables measured with it, and stimulating the body to increase their levels (H_2S, CSE) in various ways can lead to improving the health condition of patients.

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