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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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EFFECT OF INSULIN HORMONE ON THYROID HORMONE FUNCTION IN PATIENTS WITH DIABETIC TYPE 2 DISEASE

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Abstract.

Background: The thyroid hormones play a crucial role in regulating various physiological processes in the human body. They have a wide range of effects that impact metabolism, growth, development, and overall homeostasis. The current study aimed to investigate the levels of HbA1c and various biomarkers in different patient groups.

Methods: Two groups of patients were included in the study, each consisting of 30 patients, encompassing both genders. One group comprised patients with type 2 diabetes mellitus (T2DM) who were receiving insulin treatment, while the other group comprised patients with T2DM who were not receiving insulin treatment. These patient groups were compared to a control group of participants from both genders. The research employed the colourimetric method to measure HbA1c levels in all groups. Additionally, they utilized the Enzyme-Linked Immunosorbent Assay (ELISA) method to measure the levels of insulin, and T4 in all groups. The study also involved comparing these biomarkers between groups and examining the effect of insulin levels on thyroid hormones. The mean ± SD values were 4.4867±1.02 (µg/dl) and 3.2367± 0.78 (µg/dl)for the T2DM groups with and without insulin treatment, respectively, while it was 7.9033± 0.29 (µg/dl) in the control group. These findings provide valuable insights into the relationship between insulin levels and thyroid hormones, shedding light on the complex interplay between these two physiological systems.

Conclusion: Overall, the impact of insulin on thyroid hormone regulation underscores the intricate interplay between endocrine systems and highlights the need for a comprehensive understanding of these interactions to optimize patient care and improve health outcomes.

Key words. Diabetes mellitus, Hyperglycemia, Insulin, Thyroid hormones.

Introduction.

Diabetes mellitus is a set of metabolic diseases defined by elevated blood sugar levels (hyperglycemia), which can be brought on by a problem with the pancreas' ability to produce insulin or by increased insulin resistance, which reduces the body's ability to respond to insulin. Polyuria, weight loss, polyphagia, polydipsia, and blurred vision are all signs of hyperglycemia [1-4]. Type2 diabetes formerly known as adult-onset diabetes, is a form of diabetes mellitus characterized by high blood sugar, insulin symptoms resistance, and relative lack of insulin common include increased thirst, frequent urination, and unexplained weight loss symptoms may include increased hunger, feeling tired, and sores (wounds) that do not heal often symptoms come on slowly [5-8].

Insulin is a peptide hormone consisting of 51 amino acids and involves two peptide chains A chain and B chain connected by a disulfide bridge respectively, Insulin is secreted and produced by islet β cells of the pancreas [9]. It regulates the metabolism of carbohydrates, fats, and protein by promoting the absorption of glucose from the blood into the liver, fat, and skeletal muscle cells [10-12].

Total thyroxine (Total T4) is generally elevated in hyperthyroidism and decreased in hypothyroidism [13]. Total T4 is measured to see the bound and unbound levels of T4. The total T4 is less useful in cases where there could be protein abnormalities. The total T4 is less accurate due to the large amount of T4 that is bound. The total T3 is measured in clinical practice since the T3 has a decreased amount that is bound as compared to T4 [14].

Materials and Methods.

This case-control study was conducted from October 2022 and January 2023 at the Department of Biochemistry, College of Medicine, Tikrit University on two groups of patients, each group consisted of 30 patients, with both gender (male & female) (with DM type2 group that treated with insulin and Patients with DM type2 group that not treating with insulin), comparing with one group as a control group of participants, from both gender(male & female)

Study settings:

Group I consist of 30 Patients with DM type 2 group that treating with insulin.

Group II consisted of 30 Patients with DM type group that were not treated with insulin.

Group III consist of apparently healthy 30 participants, from both gender (male & female), age range (40-60), without any brain diseases, as a control group.

Exclusion criteria: The study excluded Pre-diabetic Patients or Patients with diabetes mellitus type 1 or Thyroid diseases.

Preparation of blood samples: All blood samples were collected from Baghdad Teaching Hospital / Baghdad. Five millilitres of blood samples were obtained from 60 patients and 30 normal age-matched volunteers which were used as controls. Three millilitres of blood samples were left for 20 minutes in the gel tube at room temperature. After coagulation, sera were separated by centrifugation at 2000 xg for 10 min. Sera were aspirated and divided into small aliquots for the level of T4, and Insulin hormones were measured using enzyme-linked immunosorbent assay (ELISA) kits.

Results.

The level of insulin was measured for each person who participated in this study (whether DM diseases or control individuals). Table 1 shows descriptive statistics of insulin that has a significantly elevated, T2DM with insulin treatment ($p > 0.05$) and T2DM without treatment ($p > 0.05$). Compared with the control group, (Mean ± SD =21.11± 3.77 mIU/L and 27.67± 1.85 mIU/L) in groups (T2DM with insulin treatment and

Table 1. *Level of insulin in the study groups.*

Parameters		T2DM Patients		Control (n=30)
		+insulin (n=30)	no insulin (n=30)	
Insulin (mIU/L)	Mean±SD	21.11± 3.77	27.67± 1.85	12.21±1.5
	P value	<0.05	<0.05	

Table 2. *Level of T4 in the study groups.*

Parameters		T2DM Patients		Control (n=30)
		+insulin (n=30)	no insulin (n=30)	
T4 (µg/dl)	Mean±SD	4.4867±1.02	3.2367± 0.78	7.9033± 0.29
	P value	<0.05	<0.05	

T2DM without treatment) respectively, while it was (12.21±1.5 mIU/L) in the control group.

The level of T4 was measured for each person who participated in this study (whether DM diseases or control individuals). Table 2 shows descriptive statistics of T4 that has a significantly decreased T2DM with insulin treatment ($p > 0.05$), and T2DM without treatment ($p > 0.05$), compared with the control group, (Mean ± SD = 4.4867 ± 1.02 µg/dl and 3.2367 ± 0.78 µg/dl) in groups (T2DM with insulin treatment and T2DM without treatment) respectively, while it was (7.9033 ± 0.29 µg/dl) in the control group.

Discussion.

Insulin that has a significantly elevated, in T2DM with insulin treatment ($p<0.005$), and T2DM without treatment ($p<0.005$) compared with the control group, (Mean ± SD =21.11± 3.77 mIU/L and 27.67± 1.85 mIU/L) in groups (T2DM with insulin treatment and T2DM without treatment) respectively, while it was (12.21±1.5 mIU/L) in the control group. The role of insulin as a diagnostic tool for predicting and detecting type 2 diabetes can be evaluated, where the measurement of insulin levels can be useful in diagnosing and managing T2DM. It can help assess the degree of insulin resistance, determine the appropriate treatment approach (such as lifestyle modifications, oral medications, or insulin therapy), and monitor the response to treatment [15].

The results of this study indicate that insulin levels are elevated in patients with type 2 diabetes compared to the control group in an attempt to overcome this insulin resistance, the pancreas may increase insulin production, leading to higher-than-normal insulin levels. This is known as hyperinsulinemia [14,16].

However, as T2DM progresses, the insulin-producing cells in the pancreas may gradually lose their ability to produce insulin, resulting in reduced insulin secretion. In some cases, individuals with T2DM may eventually develop insulin deficiency, where the pancreas fails to produce adequate insulin [17,18].

The appearance of insulin results for the T2DM with insulin treatment group in a way similar to the control group is due to the effectiveness of insulin treatment injections, Beta-cell preservation: Insulin therapy can help preserve the function of the remaining pancreatic beta cells, which are responsible for insulin production. By providing exogenous insulin, the workload on these cells is reduced, allowing them to rest and potentially slowing down their decline [18,19].

The level of T4 was measured for each person who participated in this study (whether DM diseases or control individuals). T4 has a significantly decreased, in T2DM with insulin treatment ($p<0.005$), and T2DM without treatment ($p<0.005$) compared with the control group, (Mean ± SD = 4.4867 ± 1.02 µg/dl and 3.2367 ± 0.78 µg/dl) in groups (T2DM with insulin treatment and T2DM without treatment) respectively, while it was (7.9033 ± 0.29 µg/dl) in the control group. The current study agrees with a previous study [15,20].

In the context of diabetes and its association with AntiGAD levels, it is important to consider various other parameters that could potentially impact the disease's progression and manifestation. Two such parameters that should be taken into account are the localized proinflammatory milieu and oxygen levels. The localized proinflammatory milieu refers to the presence of inflammation in specific areas or tissues of the body. In the case of diabetes, it has been suggested that inflammation plays a significant role in the development and progression of the disease. Inflammation can lead to insulin resistance, impaired glucose metabolism, and pancreatic beta-cell dysfunction. Additionally, proinflammatory cytokines can directly affect the production and function of the thyroid, which are known to be associated with autoimmune diabetes. Therefore, understanding and addressing the localized proinflammatory milieu is crucial in managing diabetes and its associated thyroid hormone levels [21]. Another important parameter to consider is oxygen levels. Oxygen is a vital component of cellular metabolism and is essential for the proper functioning of various organs and tissues, including the pancreas. Studies have indicated that hypoxia, or low oxygen levels, can lead to pancreatic beta cell dysfunction and impaired insulin secretion. Additionally, hypoxia-inducible factors (HIFs) have been found to modulate the production and release of proinflammatory cytokines, further exacerbating the inflammatory response in diabetes. Therefore, optimizing oxygen levels in individuals with diabetes may have a beneficial impact on the disease and its association with thyroid levels [22,23]. In addition to the aforementioned parameters, it is also important to consider comorbidities or coexisting diseases that patients may have, such as hyperlipidemia. Hyperlipidemia refers to elevated levels of lipids (fats) in the blood, particularly cholesterol and triglycerides. This condition has been associated with an increased risk of cardiovascular complications in diabetes. Furthermore, hyperlipidemia has been shown to modulate the expression of endothelial markers, which play a critical role in the regulation of vascular function [24]. Additionally, hyperlipidemia can influence the levels of adipokines, which are signalling molecules secreted by adipose tissue and have been implicated in insulin resistance and inflammation [25]. Therefore, considering the presence of hyperlipidemia as an additional factor in the context of diabetes and AntiGAD levels is important for a comprehensive understanding of the disease.

Conclusion.

The findings of this research provide valuable insights into the underlying mechanisms that contribute to thyroid dysfunction in patients with this metabolic disorder. The study reveals that insulin plays a crucial role in regulating thyroid hormone levels and function, highlighting the intricate interplay between these two hormone systems. Furthermore, the results suggest that

insulin therapy in individuals with Type 2 Diabetes may have a significant impact on thyroid hormone metabolism, potentially influencing the overall metabolic health of these patients. These findings have important clinical implications, as they emphasize the need for comprehensive management strategies that consider the intricate connections between insulin and thyroid hormones in patients with Type 2 Diabetes. Further research is warranted to explore the underlying molecular mechanisms involved in this interaction and to determine the optimal therapeutic approaches for improving thyroid function and overall metabolic health in individuals with Type 2 Diabetes.

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