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Challenges and risks of using GLP-1 antagonists in treating type 2 diabetes and obesity

Wyzwania i ryzyko stosowania antagonistów GLP-1 w leczeniu cukrzycy typu 2 i otyłości

Agnieszka Głuszczyk,
4th Military Clinical Hospital, Rudolfa Weigla 5, 50-981 Wrocław, Poland
https://orcid.org/0009-0003-5552-4186
gluszczyk.agnieszka@gmail.com

Jakub Plizga,
4th Military Clinical Hospital, Rudolfa Weigla 5, 50-981 Wrocław, Poland
https://orcid.org/0009-0001-1172-9919
jakubplizga7@gmail.com

Aleksandra Makłowicz, MD
4. Military Clinical Hospital SP ZOZ, Rudolfa Weigla 5, 53-114 Wrocław, Poland,
https://orcid.org/0009-0007-7667-836X;
ola.maklowicz@gmail.com

Ewelina Kopczyńska, MD
Gromkowski Regional Specialist Hospital, ul. Koszarowa 5, 51-149 Wrocław
https://orcid.org/0009-0006-5665-6043
ewekop13@gmail.com

Angelika Szpulak, MD
Brzeg Medical Centrum, ul. Mossora 1, 49-300 Brzeg
https://orcid.org/0009-0000-2660-7538
angelika@brzeg.net

Agata Frańczuk, MD
4. Military Clinical Hospital SP ZOZ, Rudolfa Weigla 5, 53-114 Wrocław, Poland,
https://orcid.org/0009-0008-7840-5282
franczuk.agata@gmail.com

Michalina Grzelka
4. Military Clinical Hospital SP ZOZ, Rudolfa Weigla 5, 53-114 Wrocław, Poland,
https://orcid.org/0009-0000-1515-5564
michalinagrzelka1@gmail.com

Julia Głoskowska
4. Military Clinical Hospital SP ZOZ, Rudolfa Weigla 5, 53-114 Wrocław, Poland,
https://orcid.org/0009-0004-2634-006X
juliagloskowska@icloud.com

Katarzyna Kuleta
10. Military Clinical Hospital Powstańców Warszawy 5, 85-681 Bydgoszcz
https://orcid.org/0009-0007-3491-7721
kuletka8@gmail.com

Patrycja Karkos
Lower Silesian Oncology Center in Wrocław, Plac Ludwika Hirszfelda 12, 53-413 Wrocław, Poland
https://orcid.org/0009-0005-7491-5638
karkos.patrycja@gmail.com

Abstract:

Introduction: Ozempic (semaglutide) is a long-acting GLP-1 receptor agonist widely used to treat type II diabetes and obesity. Its mechanism of action includes stimulation of insulin secretion, inhibition of glucagon secretion, and delaying gastric emptying, which leads to lower blood glucose levels and body weight reduction. Despite its therapeutic benefits, the use of Ozempic may cause side effects that affect patients' quality of life and their ability to continue treatment. This article aims to comprehensively analyze side effects associated with using Ozempic to provide a detailed understanding of their development mechanisms and their impact on patient's daily functioning.
Material and Methods of Research: The literature was collected through searches in the PubMed and Google Scholar databases and references from the initially retrieved articles. Results: The literature review indicates various potential side effects of liraglutide, including gastrointestinal upset, pancreatitis, and the 'Ozempic face' phenomenon. This phenomenon, characterized by a skeletal facial appearance with deepened wrinkles, may result from the drug's impact on body composition and fat distribution, leading to a loss of subcutaneous fat in the face and a more pronounced appearance of underlying facial structures.
Conclusion: Clinical studies highlight the need for continuous patient monitoring by healthcare providers to ensure the safe and effective use of Ozempic. Further education on a healthy lifestyle, diet, and physical activity is necessary to maintain the effects of drug therapy and prevent weight gain after treatment. Additional research on the long-term safety of GLP-1 is also crucial. Physicians should be aware of the potential risks and side effects associated with the use of Ozempic and should educate their patients to enable them to make informed decisions about their treatment. Future research should focus on determining the safe duration of GLP-1 use and developing strategies to prevent adverse side effects, thereby ensuring optimal patient healthcare.

Keywords :ozempic, ozepic face, semaglutide, GLP-1, obesity

Introduction

Ozempic (semaglutide) is a long-acting GLP-1 receptor agonist widely accepted in treating type II diabetes and obesity. (1) The mechanism of action of semaglutide includes stimulation of glucose-dependent insulin secretion, inhibition of glucagon secretion, and delay of gastric emptying, which leads to lower blood glucose levels and weight loss. Despite its numerous therapeutic benefits, the use of Ozempic may be associated with side effects that may affect patients' quality of life and their ability to continue treatment.

Bringing new drugs to market requires a detailed understanding of their safety profile. Therefore, the purpose of this article is to comprehensively analyze the side effects associated with the use of Ozempic. This study aims to identify the most common side effects and understand the mechanisms of their development and the impact on patient's daily functioning. A review of the literature indicates a variety of potential side effects of semaglutide, ranging from gastrointestinal disorders to pancreatitis. In this article, we will present the observations regarding these side effects and discuss the clinical implications of our findings. This allows doctors and patients to make more informed decisions regarding using Ozempic in treating DMII and obesity.

Purpose of the study:

The aim of the study

This study aims to review and synthesize the current literature regarding pharmacological properties, mechanisms of action, and clinical applications. In this way, we strive to provide a detailed and comprehensive understanding of their therapeutic potential, clinical benefits, and associated risks.

Materials and methodology

The literature was collected through searches in the PubMed and Google Scholar databases, supplemented by references from the initially retrieved articles.

History and effects of semaglutide

Ozempic-semaglutide is a glucagon-like peptide 1 (GLP-1) secreted in the human intestine; it consists of 29 ammonium acid residues. After eating food, it is secreted by intestinal cells, especially meals rich in fats and carbohydrates, increasing its secretion (2). It is secreted in two phases; then, it combines with GLP-1 receptors on pancreatic beta cells, stimulating insulin release. Depending on glucose levels. These receptors are also found on heart muscle cells, the brain, veins, arteries, and immune system cells. (3)

Initially, the GLP-1 hormone was intended to be used as a drug for duodenal ulcer disease, and this hormone was isolated in the 1970s by Jens Juul Holst and Joel Habener. In the 1990s, Michael Nauck continued research on this hormone and was the first to administer it to diabetics (4). He noticed a significant increase in insulin in test subjects' blood, with an additional inhibitory effect on glucagon production and glycemia levels. In the same years,

researchers from Novo Nordisk developed the drug Liraglutide. In 2008, they began to research semagultide, which finally received FDA approval in 2017 for the pharmacotherapy of patients with type II diabetes. (5)
Ozempic, as a long-acting drug, can be administered to patients once a week due to the structure of the drug. The active substance is bound to albumin, which reduces renal clearance metabolism and degradation by the enzymes of this substance(3). GLP-1 significantly reduces fasting and post-meal glycemia levels. Additionally, it stimulates insulin synthesis, ensuring the replenishment of insulin reserves in pancreatic β-cells. It has a positive proinsulin-to-insulin ratio, which indicates an improvement in the efficiency of β-cell functioning and an increase in insulin production (4). Semaglutide also inhibits glucose secretion in a glucose-dependent manner. During hypoglycemia, Ozempic does not affect the body's natural response by increasing glucagon levels and does not negatively affect C-peptide levels in patients with type II diabetes. (6)
This drug is used in the long-term treatment of obesity (BMI ≥ 30 kg/m2) or overweight (BMI ≥ 27 kg/m2) with at least one obesity-related disease, such as hypertension, type II diabetes, lipid disorders, or ischemic heart disease (7).

Effects on the body
This medicine slows down the gastric emptying rate after a meal, resulting in glucose appearing in the patient's blood at a later stage. GLP-1 inhibits appetite and has a positive effect on patients' self-control. Ozempic is effective in the treatment of obesity, especially central obesity. Clinical trials have shown an average weight loss of 10-15% in patients after 68 weeks of taking the drug (8).
Clinical studies have also shown that it reduces triglycerides and LDL cholesterol by 12% (9). It also lowers systolic blood pressure and reduces inflammation. As a result, it benefits the vascular endothelium and reduces the afterload of seca. (10) The patients themselves reported an improvement in their well-being and a reduction in the accompanying physical symptoms.

The action of the preparation and side effects
Drugs from this group have the effect of reducing appetite and energy intake, as well as the feeling of greater satiety. However, the effect is caused by delayed gastric emptying, which may ultimately lead to gastroparesis. The mechanism of gastroparesis induction is not fully understood, but we know that GLP-1 receptors play a role in regulating gastric motility. It manifests itself with nausea, vomiting, and stomach discomfort. More severe cases may lead to malnutrition, dehydration, or electrolyte disorders (11). Importantly, in many cases, after stopping the use of this drug, the symptoms disappear (12).
Another desired effect when using these preparations is weight loss. Recently, a new term has appeared to refer to this effect, namely "Ozempic face." (13). It concerns semaglutide, the active substance in this preparation. This phenomenon is described as a bony, dull face with deep wrinkles, occurring after the rapid loss of fat tissue in people using this drug. Ozempic may also cause changes in the final appearance of the cheeks, lips, and chin through this mechanism. A significant difference in these people can be seen in a more recessed tear trough, a sunken jawline, or more visible marionette lines, which significantly change the appearance of the face. This is a new challenge for plastic surgery and aesthetic medicine doctors. This prompts doctors to look for new methods of filling the gaps in the natural fat tissue in the face, constituting its foundation. Without it, the face looks older and loses harmony and even symmetry. This may be particularly visible in older people, where the initial amount of collagen and elastin is reduced. The loss of fat tissue also affects the skin's condition by disturbing its barrier, which may impair skin nutrition (14).

It is also important to check whether there is an excessive loss of vitamins and nutrients because they affect not only the condition of the skin but also the entire body's function(14,15). It is especially worth sensitizing patients to this problem because more and more celebrities on social media promote this drug as a wonderful way to lose excess weight, paying no attention to possible side effects.

A predisposition to pancreatitis after consuming these drugs has also been noticed(16). This is one of the most common reasons for hospital admission, manifesting itself with severe abdominal pain radiating to the back, accompanied by nausea, vomiting, and fever; in addition, diarrhea may occur. The most common causes of acute pancreatitis (AP) are gallstones and alcohol consumption(17). A relationship has also been observed between the use of these drugs and an increased risk of developing this condition. This is due to the stimulation of receptors present in the islets of Langerhans, responsive to GLP-1. (18) This leads to cell hypertrophy, hyperplasia, and inflammation within this organ(11). Importantly, people taking these drugs may initially have an increased risk of pancreatitis due to the primary disease, which can only further burden the already sick patient. People taking GLP-1 are often obese and suffer from type 2 diabetes; these diseases frequently coexist with cholecystitis, hyperlipidemia, or other metabolic diseases that increase the risk of acute pancreatitis(19). Dr. Bogdan Augustin and Dr. Daniela Fodor from the Department of Internal Medicine, Medical University of Romania, presented the case of a 67-year-old woman with symptoms typical of AP who was admitted to the emergency department. Within five days, the patient's health condition significantly deteriorated, and her symptoms intensified. The woman started GLP-1 treatment a few months earlier for the pharmacotherapy of type II diabetes. She had no other disease factors. The patient's condition improved after discontinuing these drugs and appropriate hydration in the hospital (20). A cohort study showed that the risk in people using drugs from this group may be increased by up to 1.5 times compared to patients treated with other antidiabetic drugs. (non-insulin). In new users of these drugs, this risk increases up to 2.1 times compared to people not taking diabetes medications and 2.0 times compared to people taking non-insulin medicines for diabetes. (21)

Studies are refuting this thesis in randomized and non-randomized clinical trials, where GLP-1 agonists or DPP-4 inhibitors were used in patients with type II diabetes. The effects were compared to the placebo group to determine the risk of acute pancreatitis. The results of these studies showed no correlation between GLP-1 agonists and the occurrence of acute pancreatitis. These results were comparable for the group using incretin drugs, 1.05 compared to the control group, and for GLP-1 agonists, 1.06 compared to the control group (22).

It is worth considering the possibility of such a side effect in patients using such therapy, especially when the patient is accompanied by the following conditions: alcohol consumption, hypertriglyceridemia, or gallstones, which significantly increase the risk of this disease. (18,21)

Patients need to be made aware that drug treatment is only an additional aid in losing weight, and the main area they should take care of is a healthy lifestyle, with an appropriate amount of exercise and a healthy and balanced diet. This issue is also important because after stopping taking this drug, it may cause you to return to your previous weight or even increase your weight compared to your starting weight. A clinical trial showed that after discontinuing weekly semagutide administration, patients regained approximately ⅔ of their initial body weight without lifestyle changes. The conclusion is that the basis of obesity treatment is a constant lifestyle change to consolidate pharmacological therapy's effects (23,24).

Another clinical study involved overweight or obese people taking semaglutite once a week. It was shown that in the group where administration of the GLP-1 analog was continued, patients constantly lost weight. However, in the placebo control group, patients began to gain

weight. This is an important signal suggesting that after reaching the target weight, patients should continue pharmacological treatment for some time (25,26). The most important conclusion from this research is to further educate patients about changes in diet, physical activity, and lifestyle to maintain weight and prevent weight regain.

Discussion

These side effects forced us to consider the frequency of use of these drugs in T2DM patients as well as in people whose primary goal is to lose weight quickly and effectively. First of all, the role of doctors is essential in this situation, as they should warn patients about possible side effects and introduce constant monitoring of these patients in areas where these drugs will additionally burden them. The issue of the length of use of these drugs in people who want to reduce their body weight is also essential. There is a risk of weight gain after stopping the use of these drugs if they are not accompanied by health and dietary education of patients, who should make significant changes in their diet. , life to prevent you from returning to your starting weight or even gaining weight compared to your starting weight. We appeal for more research on the risks these preparations may carry and on increased vigilance among doctors towards patients who may signal disturbing symptoms during therapy. It would be essential to determine the safe duration of GLP-1 use and to introduce preventive tests to monitor the health of this group of patients.

Summary

Ozempic (semaglutide) is a long-acting GLP-1 receptor agonist widely used in the treatment of type II diabetes and obesity. It has demonstrated numerous therapeutic benefits, such as improved glycemic control and weight loss. However, the use of Ozempic may be associated with side effects that may affect patients' quality of life and their ability to continue treatment. Therefore, a comprehensive analysis of side effects related to using Ozempic is necessary to understand their mechanisms and their impact on patients' daily functioning.

Studies show a variety of potential side effects of semaglutide, ranging from gastrointestinal upset to pancreatitis. Particular attention is paid to the so-called "Ozempic face," a phenomenon associated with the rapid loss of fat tissue, leading to an emaciated appearance of the face with deepened wrinkles. Additionally, there is a risk of pancreatitis in patients using GLP-1 agonists, especially in those with pre-existing risk factors such as obesity, cholecystitis, or hyperlipidemia.

Clinical studies indicate the need to further educate patients about a healthy lifestyle, diet, and physical activity to maintain the effects of drug therapy and prevent weight gain again after treatment ends. The conclusions from these studies emphasize the need for doctors to constantly monitor patients and conduct further research on the long-term safety of GLP-1.

Doctors must be aware of the potential risks and side effects associated with the use of Ozempic and educate their patients so that they can make informed decisions about their treatment. Future research should focus on determining the safe duration of GLP-1 use and developing strategies to prevent adverse side effects to ensure optimal patient health care.

Disclosure

Conceptualization, Agnieszka Gluszczyk, Jakub Plizga
Methodology, Agata Frańczuk
Software, Aleksandra Makłowicz
Check, Angelika Szpulak, Ewelina Kopczyńska, Julia Głoskowska
Formal analysis Katarzyna Kuleta

Investigation, Patrycja Karkos
Resources, Michalina Grzelka
Data curation, Agnieszka Gluszczyk
Writing - rough preparation, Jakub Plizga
Writing - review and editing, Agata Frańczuk
Visualization, Jakub Plizga;
Supervision, Agnieszka Gluszczyk;
Project administration, Aleksandra Makłowicz
Receiving funding, Michalina Grzelka

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References

1.Smits, M. M., & Van Raalte, D. H. (2021). Safety of Semaglutide. Frontiers in endocrinology, 12, 645563.
https://doi.org/10.3389/fendo.2021.645563
2. Mahapatra, M.K., Karuppasamy, M. & Sahoo, B.M. Semaglutide, a glucagon-like peptide-1 receptor agonist with cardiovascular benefits for management of type 2 diabetes. Rev Endocr Metab Disord 23, 521–539 (2022).
https://doi.org/10.1007/s11154-021-09699-1
3.Semaglutyd- medycyna praktyczna (n.d).
https://www.mp.pl/pacjent/leki/subst.html?id=5893
4. Reynolds, M. (2023, June 12). What the scientist who pioneered Weight-Loss drugs wants you to know. WIRED.
https://www.wired.com/story/obesity-drugs-researcher-interview-ozempic-wegovy/
5. Singh G, Krauthamer M, Bjalme-Evans M. Wegovy (Semaglutide): A New Weight Loss Drug for Chronic Weight Management. Journal of Investigative Medicine. 2022;70(1):5-13
https://doi.org/10.1136/jim-2021-001952
6. Ozempic, European Medicines Agency (n.d).
https://www.ema.europa.eu/en/medicines/human/EPAR/ozempic#assessment-history
7. Tan, Hanna Clementine, et al. " Efficacy and Safety of Semaglutide for Weight Loss in Obesity without Diabetes: A Systematic Review and Meta-Analysis," Journal of the ASEAN Federation of Endocrine Societies, vol 37, no.2,25 Nov. 2022, pp.65-72
https://doi.org/10.15605/jafes.037.02.14
8.Friedrichsen, M., Breitschaft, A., Tadayon, S., Wizert, A., & Skovgaard, D. (2021). The effect of semaglutide 2.4 mg once weekly on energy intake, appetite, control of eating, and gastric emptying in adults with obesity. Diabetes, Obesity and Metabolism, 23(3), 754–762.
https://doi.org/10.1111/dom.14280
9.Hjerpsted, J. B., Flint, A., Brooks, A., Axelsen, M. B., Kvist, T., & Blundell, J. (2017). Semaglutide improves postprandial glucose and lipid metabolism and delays first-hour gastric emptying in subjects with obesity. Diabetes, Obesity and Metabolism, 20(3), 610–619.
https://doi.org/10.1111/dom.13120

10.Vecchié, A., Dallegri, F., Carbone, F., Bonaventura, A., Liberale, L., Portincasa, P., Frühbeck, G., & Montecucco, F. (2018). Obesity phenotypes and their paradoxical association with cardiovascular diseases. European journal of internal medicine, 48, 6–17. https://doi.org/10.1016/j.ejim.2017.10.020
11. Brady SM, Kane MP, Busch RS. GLP-1 agonist use in a patient with an explainable cause of pancreatitis. AACE Clinical Case Reports. 2016; 2(2): e82-e85. https://doi.org/10.4158/EP15658.CR
12. Xie Z, Yang S, Deng W, Li J, Chen J. Efficacy and safety of liraglutide and semaglutide on weight loss in people with obesity or overweight: a systematic review. Clin Epidemiol. 2022; 14: 1463-1476.
https://doi.org/10.2147/CLEP.S391819
13. Shaefer CF Jr, Kushner P, Aguilar R. User's guide to mechanism of action and clinical use of GLP-1 receptor agonists. Postgrad Med. 2015; 127(8): 818-26. https://doi.org/10.1080/00325481.2015.1090295
14. O'Neill ES, Wiegmann AL, Parrella N, Pittman T, Hood K, Kurlander D. Injectable Weight Loss Medications in Plastic Surgery: What We Know, Perioperative Considerations, and Recommendations for the Future. Plast Reconstr Surg Glob Open. 2024;12(1):e5516. Published 2024 Jan 24.
https://doi.org/10.1097/GOX.0000000000005516 indexed in Pubmed: 38268718
15. Humphrey CD, Lawrence AC. Implications of ozempic and other semaglutide medications for facial plastic surgeons. Facial Plast Surg. 2023; 39(6): 719-721. https://doi.org/10.1055/a-2148-6321
16. Wiley KC, Akiyode R, Nunlee-Bland G. Case Study: Use of GLP-1 Receptor Agonist in a Patient on Intensive Insulin Therapy. Diabetes Spectr. 2015;28(2):121-126. doi:10.2337/diaspect.28.2.121, indexed in Pubmed: 25987811
17. Habtezion A. Inflammation in acute and chronic pancreatitis. Curr Opin Gastroenterol. 2015; 31(5): 395-9.
https://doi.org/10.1097/MOG.0000000000000195
18.Zaïmia N, Obeid J, Varrault A, Sabatier J, Broca C, Gilon P, et al. GLP-1 and GIP receptors signal through distinct β-arrestin 2-dependent pathways to regulate pancreatic β cell function. Cell Rep. 2023; 42(11): 113326.
https://doi.org/10.1016/j.celrep.2023.113326
19. Bieganek, P., Sadłowski, B., Łukaszewicz, S., Pawłowski, P., Rybak, J., & Kordialik, J. et al. (2024). NEWLY-EMERGING SIDE EFFECTS OF SEMAGLUTIDE AND LIRAGLUTIDE USAGE ASSOCIATED WITH WEIGHT LOSS TREATMENT. Health Problems of Civilization.
https://doi.org/10.5114/hpc.2024.140505
20. Chis BA, Fodor D. Acute pancreatitis during GLP-1 receptor agonist treatment. a case report. Clujul Med. 2018; 91(1): 117-119.
https://doi.org/10.15386/cjmed-804
21. Knapen LM, de Jong RG, Driessen JH, et al. Use of incretin agents and risk of acute and chronic pancreatitis: A population-based cohort study. Diabetes Obes Metab. 2017;19(3):401-411.
https://doi.org/10.1111/dom.12833, indexed in Pubmed:27883260
22..Li L, Shen J, Bala MM, Busse JW, Ebrahim S, Vandvik PO, et al. Incretin treatment and risk of pancreatitis in patients with type 2 diabetes mellitus: systematic review and meta-analysis of randomised and non-randomised studies. BMJ. 2014; 348: g2366. https://doi.org/10.1136/bmj.g2366

23.Wilding JPH, Batterham RL, Davies M, Van Gaal LF, Kandler K, Konakli K, et al. Weight regain and cardiometabolic effects after withdrawal of semaglutide: the STEP 1 trial extension. Diabetes Obes Metab. 2022; 24(8): 1553-1564.
https://doi.org/10.1111/dom.14725
24. Klausen MK, Thomsen M, Wortwein G, Fink-Jensen A. The role of glucagon-like peptide 1 (GLP-1) in addictive disorders. Br J Pharmacol. 2022; 179(4): 625-641. https://doi.org/10.1111/bph.1567
25. Rubino D, Abrahamsson N, Davies M, Hesse D, Greenway FL, Jensen C, et al. Effect of continued weekly subcutaneous semaglutide vs placebo on weight loss maintenance in adults with overweight or obesity: the STEP 4 randomized clinical trial. JAMA. 2021; 325(14): 1414-1425.
https://doi.org/10.1001/jama.2021.3224
26.Patel F, Gan A, Chang K, Vega KJ. Acute pancreatitis in a patient taking semaglutide. Cureus. 2023; 15(8): e43773.
https://doi.org/10.7759/cureus.43773