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Role of Lifestyle on Cholecystokinin Levels in Patients After Gastric Sleeve Surgery

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Abstract

The study focused on impact of lifestyle and its relationship with cholecystokinin hormone (CCK) and its role in obesity for both sexes. Samples were collected from 45 obese patients who later served as controls and were followed up in three groups after gastric sleeve surgery (3 months, 6 months, and 9 months post-surgery). Results showed that hormone levels decreased with age, while body mass index (BMI) increased with age in obese group compared to control group. Incidence of CCK was higher in females than in males, and age is a major factor affecting hormone levels and reducing its activity. Furthermore, smokers are more likely to develop obesity than non-smokers due to their lower levels of CCK.

Finally, this study discovered a relationship between low CCK levels and an increased risk factor for obesity, along with unhealthy habits and lifestyle. The study recommends that patients who have undergone gastric sleeve surgery improve their lifestyle to achieve good results and maintain a stable, long-lasting ideal weight.

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دور نمط الحياة على مستويات الكوليسيستوكينين لدى المرضى بعد جراحة تكميم المعدة

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المستخلص:

ركزت الدراسة على تأثير نمط الحياة وعلاقته بهرمون الكوليسيستوكينين (CCK) ودوره في السمنة لدى كلا الجنسين. جُمعت عينات من 45 مريضًا يعانون من السمنة، والذين استُخدموا لاحقًا كمجموعة ضابطة، وتمت متابعتهم في ثلاث مجموعات بعد جراحة تكميم المعدة (3 أشهر، 6 أشهر، و9 أشهر بعد الجراحة). أظهرت النتائج انخفاض مستويات الهرمون مع التقدم في السن، بينما ارتفع مؤشر كتلة الجسم (BMI) مع التقدم في السن لدى المجموعة البدينة مقارنةً بالمجموعة الضابطة. كان معدل الإصابة بهرمون الكوليسيستوكينين أعلى لدى الإناث منه لدى الذكور، ويُعد العمر عاملًا رئيسيًا يؤثر على مستويات الهرمون ويقلل من نشاطه. علاوة على ذلك، فإن المدخنين أكثر عرضة للإصابة بالسمنة من غير المدخنين بسبب انخفاض مستويات الكوليسيستوكينين لديهم. وأخيرًا، كشفت هذه الدراسة عن وجود علاقة بين انخفاض مستويات الكوليسيستوكينين وزيادة عامل خطر الإصابة بالسمنة، إلى جانب العادات غير الصحية ونمط الحياة غير الصحي. توصي الدراسة المرضى الذين خضعوا لجراحة تكميم المعدة بتحسين نمط حياتهم لتحقيق نتائج جيدة والحفاظ على وزن مثالي مستقر ودائم.

الكلمات المفتاحية: كوليسيستوكينين (CCK)، العمر، الجنس، جراحة تكميم المعدة، السمنة.

Introduction:

Sleeve gastrectomy, also known as 'gastric sleeve,' involves removing up to 85% of the lateral portion of the stomach, resulting in a small, tube- or banana-shaped stomach (Askari *et al.*,2023). The width of the remaining stomach (sleeve) is determined based on the size of the bougie tube used during the procedure, and the diameter is often less than 2 cm. This surgery is an effective procedure for significant weight loss and contributes to improving obesity-related health conditions such as type 2 diabetes and high blood pressure. However, some patients with gastroesophageal reflux disease may notice an increase in symptoms after surgery, due to increased pressure inside the sleeve stomach compared to its normal state before resection (Kehagias *et al*.,2013).

Fat in general levels were more different in males. some investigations have proven that women are more addicted to sweets than meat products. During reproductive ages, women are naturally susceptible to iron deficiency and anemia. Men, on the other side, tend to be heavier with larger muscle mass that may increase surgical time and general postoperative complications including rhabdomyolysis (Kochkodan *et al*.,2018).

Cholecystokinin (CCK) is a peptide hormone CCK is composed of varying numbers of amino acids depending on post-translational modification of the 150-amino acid precursor, prepro-cholecystokinin (Chaudhri *et al*.,2006). It plays a crucial role in the digestive process. It is the major hormonal regulator of gallbladder contraction and pancreatic enzyme secretion (Sekiguchi ,2021). CCK is released by cells in the upper small intestine in response to the presence of hydrochloric acid, amino acids, or fatty acids, particularly in the duodenum Cawthon & de La Serre ,2021).

Given that CCK is also thought to modulate gut motility and gastric emptying (Li *et al*., 2011). It is clear to see why a therapeutic role for CCK has been considered in obesity-diabetes (Pathak et *al.*,2018). However, in this context it should be recognized that the biological activity of CCK-8, the most druggable form of CCK, since its smaller size facilitates easier and more cost-effective pharmaceutical synthesis and opens up more potential options for drug delivery, is rapidly annulled by circulating aminopeptidase enzymes (Cao *et al*.,2016). At high levels of CCK can increase the effect of how fast gastric emptying occurs, and it does this by increasing the excitatory effect it has on both the small and large intestine, which leads to movement in the bowels or by improving the tension of the pyloric sphincter (Okonkwo *et al*.,2025).

Materials and methods:

The study comprised 45 patients of both sexes with morbid obesity and dyslipidemia who had bariatric surgery at Al-Zahrawi Hospital's Bariatric Surgery Department. For postoperative follow-up, patients were randomly assigned to one of three groups (group 1 after three months, group 2 after six months, and group 3 after nine months). The patients in the study group had an average age ranging from 20 to 55 years. After a fast of 12-13 hours, samples were taken to quantify cholecystokinin (CCK) using ELISA using a specific test, and lipid levels using were measured using a specific kit by UV/VIS Spectrophotometer by UV/VI'S spectrophotometry. BMI was computed by dividing weight (kg) by height (m^2).

Finally, SPSS software was used to analyze the data (Kirkpatrick& Feeney,2012).

Results and Discussion:

Cholecystokinin levels in individuals after gastric sleeve surgery according to body mass index (BMI) for both sexes:

Gastric sleeve surgery causes considerable weight loss and alterations in intestinal hormone output in both sexes. Table (1) indicates that three months after gastric sleeve surgery, cholecystokinin levels gradually increase relative to preoperative levels and continue to climb with a BMI of ≤ 25 kg/m^2. The majority of patients dropped considerable amounts of weight, which coincided with a rise in cholecystokinin secretion in the same group. Comparing the groups (3 months, 6 months, and 9 months) verifies the study's findings, which reveal an inverse association between cholecystokinin and BMI.

Patients with a BMI > 25 kg/m^2 suffered more nutritional and metabolic imbalances and weight stability than those with a BMI < 25 kg/m^2 at three, six, and nine months after surgery, respectively. Weight reduction occurred, but it was sluggish. The study also found that the best results are usually obtained 6 to 9 months after gastric sleeve surgery, with careful adherence to a specific diet and medical follow-up. Cholecystokinin levels rise dramatically following gastric sleeve surgery, and they serve a crucial role in reducing hunger and increasing fullness, resulting in rapid weight loss. This is due to variations in receptor sensitivity, individual genetic and inherited factors, lifestyle, and the nature and kind of food, all of which contribute. Cholecystokinin secretion increases as the body adapts to a new eating pattern and lifestyle, unlike the first few months after gastric sleeve surgery.

Table (1): Cholecystokinin hormone level in patients after gastric sleeve surgery based on body mass index for both sexes

	Patient After Gastric Sleeve Surgery Mean ± SD BMI ≤25 Kg/m^2	Patient After Gastric Sleeve Surgery Mean ± SD BMI >25 Kg/m^2	P-value
CCK (pg/ml)/ After 3 months (No. 8)	29.4 ± 3.2	26.1 ± 1.8	**0.01****
CCK (pg/ml)/ After 6 months (No. 17)	32.3 ± 2.4	27.3 ± 2.3	**0.002****
CCK (pg/ml)/ After 9 months (No. 20)	32.7 ± 2.5	27.8 ± 2.7	**0.002***

*Significant differences at P≤0.05, **Significant differences at P≤0.01

The relationship between CCK and lipid levels in patients after gastric sleeve surgery:

The study found as Table (2) a statistically significant inverse association between CCK and the lipid profile, which includes CHO, TG, LDL-C, and VLDL-C, as well as BMI. Furthermore, a statistically significant direct relationship was observed between CCK and HDL-C through the reduction of factors associated with an increased risk of metabolic and cardiovascular diseases and the increase in HDL-C; this improvement is attributed to CCK's critical role in controlling hunger, reducing caloric intake, and inducing intestinal hormones that improve insulin responsiveness and lower blood cholesterol.

Table (2): Correlation of CCK hormone with other hormonal and biochemical variables in patients After gastric sleeve surgery

Biochemical Variables	Pearson Correlation	P-value
CCK1R Pg/ml	+0.53	0.004***
CHO mg/dl	-0.28	0.1(n.s.)
TG mg/dl	-0.37	0.03*
HDL-C mg/dl	+0.43	0.02*
LDL-C mg/dl	-0.31	0.05*
VLDL-C mg/dl	-0.4	0.03*
BMI	-0.45	0.02*

*Significant differences at P≤0.05, ***Significant differences at P≤0.001,

n.s. = No significant differences

Correlation of CCK Concentration with Age Groups for Both Sexes After Gastric Sleeve Surgery:

Figure (1) reveals that CCK levels in both sexes fall with age following gastric sleeve surgery. This deterioration could have several causes. Food consumption diminishes physically with age, impacting both the central and peripheral systems. The CCK levels in young person's rise due to increased secretion following the treatment. However, this response varied with age, with data indicating a significantly lower response after gastric sleeve surgery when compared to age. This could be because aging weakens the body's response to satiety hormones, such as CCK, due to a loss in metabolism, a change in neural receptor sensitivity to the hormone, and a general decline in digestion hormone secretion. This leads to delayed weight loss in the elderly following gastric sleeve surgery. Reduced testosterone levels in males and estrogen levels in females result in increased leptin levels, which could explain the considerable drop in food intake, it has also been observed that many elderly people suffer from mild inflammatory disorders that lead to loss of appetite.

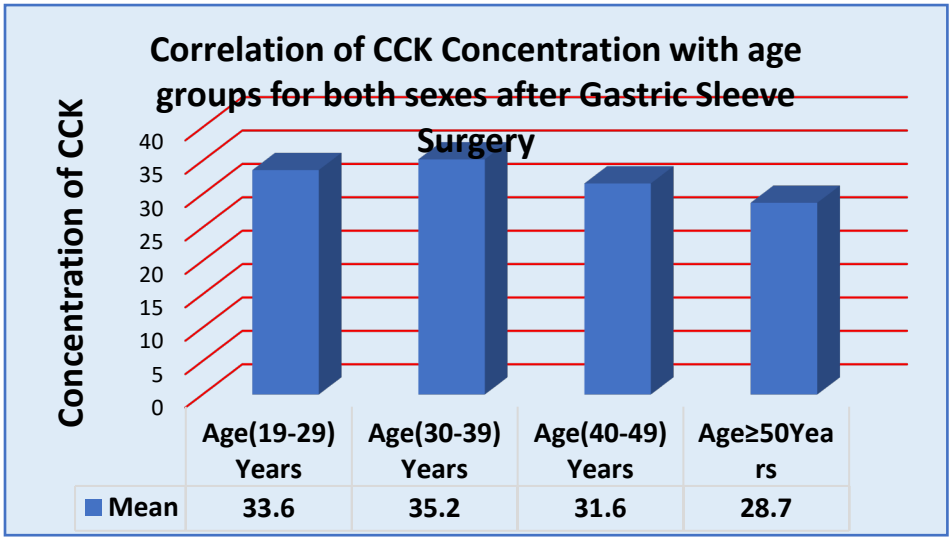

Figure (1): Correlation of CCK concentration with age groups for both sexes after gastric sleeve surgery

Concentration of CCK According to the Smoking Before and After Gastric Sleeve Surgery:

Figure (2) shows an increase in cholecystokinin levels in smokers of both sexes, regardless of age, after gastric sleeve surgery. Smoking may disturb gut flora, affecting hormone production. Nicotine may also interfere with nerve signal transmission in the vagus nerve, which regulates satiety hormone release. As a result, the body may increase the release of cholecystokinin in order to better

"activate" these signals. Furthermore, new coping strategies lead to an increase in intestinal hormone secretion (such as cholecystokinin) after gastric sleeve surgery. Nicotine may cause smokers to have partial cholecystokinin receptor (CCK1R) resistance. As a result, the body may produce more cholecystokinin in an attempt to compensate for the resistance; this is similar to "overproduction" seen in situations of hormone resistance.

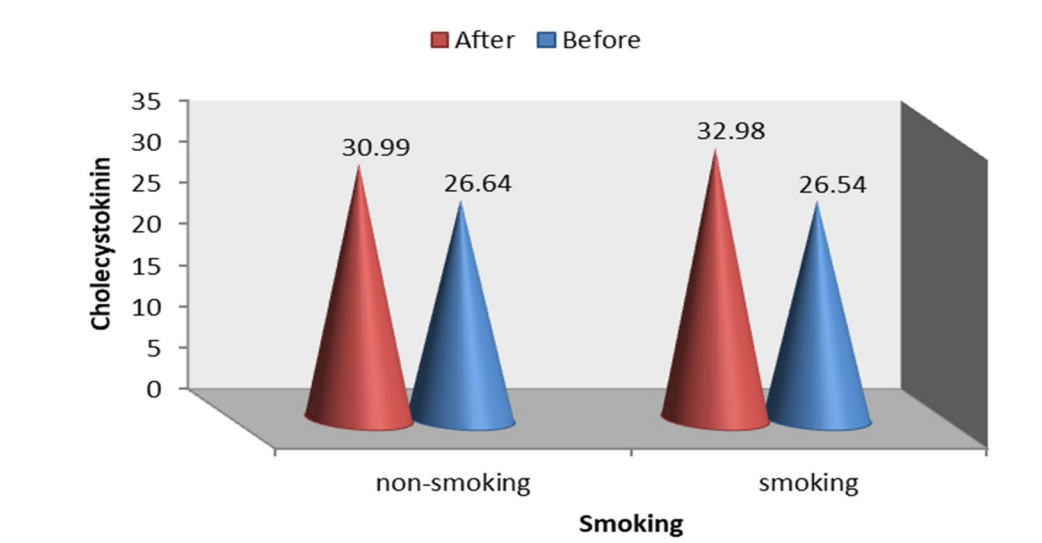

Figure (2): Concentration of CCK according to the smoking before and after gastric sleeve surgery

Conclusion:

This study revealed a link between low cholecystokinin levels and an increased risk factor for obesity, a highly influential factor, and CCK secretion increases significantly nine months after gastric sleeve surgery as the body adapts to a new diet and lifestyle, unlike the first few months after gastric sleeve surgery.

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