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CASE REPORT – PATIENT REVIEW – THIRD DEGREE OBESITY, METABOLIC SYNDROME, INCREASED CARDIOVASCULAR RISK AND ELECTROLYTE DISBALANCE WITH THE DURATION OF BODY REDUCTION TREATMENT IN A SPECIAL HOSPITAL CIGOTA

Summary: The Cigota program is a medical program designed to reduce body weight. The concept of the program is based on: well-balanced diet, strictly defined and dosed physical activity and educational lectures. Patient, 27 years of age, hospitalized at the Cigota Special Hospital within the program Cigota. At the age of 19 he began to gain weight, and for about 2 years he had gain about 110kg. He is treated by psychosis (*shizophrenia*). This was his first time to recived hospital treatment for obesity. Anthropometric measures on the day of admission – BMI: 64.58kg/m², body fat: 47.8% (110.8kg), waist circumference: 180cm. At the addmition the patient has been diagnosed third degree obesity, metabolic syndrome and first degree hypertension. The patient was subjected to 24 hours medical supervision under diet, dosed physical activity and daily psychological treatment. During the obesity treatment, its noticed electrolyte disbalance, dilution hyponatremia with hypokalaemia, moderate symptomatology and chronic development. This was corrected over the next seven days by adequate oral supplements of potassium, sodium, magnesium and restriction of fluid intake. At the end of the treatment (160 days), a total weight loss of 105.8kg was achieved, or 45.86% of the original weight. Significant reduction in body fat was achieved by 68.8% of the original values, the reduction of waist circumference by 61cm and 33.8% respectively. Established pharmacological regulation of hypertension, regulation of glycemia and triglycerides, established cholesterol fraction (HDL/LDL) favorable profile, significantly reduced value of uric acid in the serum. And after two years from the onset of obesity treatment in our institution, the patient continued the trend of weight loss in the home environment and achieved a shift from category

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obesity to the category overweight, stable regulation of blood pressure and corrected metabolic parameters of cardiovascular risk (glycemia, cholesterol with fractions , triglycerides, uric acid), and in the heart ultrasound finding there was a reduction in septum thickness and repair of ejection fraction of the heart.

Key words: *obesity, cardiovascular risk, electrolyte disbalance, weight loss*.

Excessive nutrition and obesity are risk factors for the development of cardiovascular diseases, insults, diabetes, cancer, and in particular hypertension associated with cardio-vascular and metabolic disorders and increased mortality. (1)

Obesity mortality increases by 30% for each BMI increase by 5 units. (1) A particular role is due to increased visceral fat (abdominal obesity) that is a source of cytokine and other factors of inflammation and oxidative stress that contribute to the development of endothelial dysfunction, atherosclerosis, and insulin resistance.

Weight loss and everyday moderate physical activity lead to mass decrease and thickness of the left ventricle wall, reduction of arterial stiffness, improvement of endothelial dysfunction leading to a reduction in blood pressure and cardiometabolic risk, and an increase in susceptibility of target tissues to insulin. (3)

The Cigota program is a medical program designed to reduce weight and change the lifestyle. The concept of the program's purity is based on a well-balanced diet, strictly defined and dosed physical activity, educational lectures and motivational-emotional aspect towards the individual (program user). The essence of the program is to establish a disturbed balance between energy and consumption intake, weight reduction and reduction of cardiometabolic risk factors, maintaining weight loss, preventing obesity and improving physical ability regardless of age, sex and gender.

The average weight loss for the two-week stay on the program is 5.8 kg, with an average of 5.4 kg losing women, and 6.2 kg men. Diets are individually prescribed, all of them are hypocalories with preserved nutritional value of foods and a balanced nutrient ratio. The daily energy input is on average between 1000 and 1500kcal. Salt intake is reduced to a maximum of 3g per day. Physical activities are strictly dosed, administered 3-4 hours a day, and include: long, recreational walks, exercise in the gym and pool exercises.

Case Report:

Patient B.I. 27 years old, hospitalized at the Cigota Special Hospital within the Cigota program. On the first medical examination during the hospital admission he was states the difficulties: choking, fatigue, edema on legs and arms, he can not sleep in a lying position (the sleep was interrupted – wakes up every half hour), accelerated pulse, fatigue after walking a couple of meters flat. It is treated for 5 years from psyc-

hosis (shizophrenia), and recive therapy – Leponex tbl. 100mg, 2 tbl. in the evening. Often there is a feeling of nervousness, tension and fears.

History of obesity: at the end of high school, at age 19, he began to gain weight. At that time he had about 100kg. He was intensively trained martial arts. Over the next 2 years, the weight was about 100-110 kg. From the age of 22, he started consuming alcohol and narcotics (cocaine). He stopped practicing sports. During that period he began to gain weight intensely – he gained about 40kg and then he had about 160kg (in 24-th years). Conducted dietary diet according to the doctor's advice and nutritionists and lost about 40kg. From the age of 25, he was again rapidly gaining weight (with short-term diet, which quickly abandoned it) and in the next 2 years, another 110 kg he was gained. In the meantime, he said that he has stopped taking narcotics and alcohol. Regularly takes prescribed medications-antipsychotics. By the date of admission to our institution, there is no hospital obesity treatment.

Anthropometric measures on the day of reception:height: 189cm, weight: 230.7 kg, BMI: 64.58 kg / m2, body fat: 47.8% (110.8kg), waist circumference: 180cm. In the biochemical analysis of blood, inflammatory syndrome is present: elevated sedimentation of erythrocytes (SE-38) and CRP-34. Mildly elevated glycemic values (6.6mmol/L, HbA1c: 5.9%). In lipid status, elevated triglycerides and disorders of HDL/LDL indicate an increased cardiovascular risk: cholesterol-4.51 mmol/l (HDL-0.8 mmol/l, LDL-3.4 mmol/l), triglycerides-4.35 mmol/l. Proteins in serum, BUN and creatinine are in reference values. Highly elevated urate levels have been recorded: uric acid-1137micromol/l (normally less than 430micromol/L). The values of the electrolyte are in reference values (Na-139 mmol/l, K-4.2mmol/l, Cl-110mmol/l, Ca-2.47 mmol/l). The thyroid functionality was intact (FT4-15.3 TSH-3.63).

By objective examination, registered first-degree hypertension (TA: 150 / 85mm Hg left arm, 155/90 mm Hg right arm). In the ECG: sinus rhythm, ST depression of 0.5mm in inferior leads, negative T in D3.Auscultation of the lungs: extension of expirium and wheezing. Auscultation of the heart: rhythmic heart action, tones muted, no murmurs, with tachycardia in quiescent 110 / min. Present tedious legs and arms edema. Heart ultrasound : the left ventricular dimensions (57/39 mm), the thicker septum (IVS: 11 mm) are registered. The good contractility of the left ventricle is registered, with no segmental kinetics with EF: 62%; slightly enlarged left atrium (41mm) and mild degree of tricuspidal regurgitation (TR: 1+, SPRV: 22mm Hg) and stained pericardium behind the back wall. The described findings correspond to the third degree obesity (malignant obesity), metabolic syndrome, and hypertension of the first degree.

In Cigota, the patient was underwent 24-hour medical supervision under a diet, dosed physical activity, daily psychological treatment, with psychiatrist consultation continued to take previously administered therapy of antipsychotics with the addition of anxiolytics (Rivotril, 2mg 3x1/2 tbl). Regular control of electrolytes and blood biochemical analyses carried out every 7 days of treatment.

During the first weeks, he initially started to lose about 4 kg per week, and after 10-th weeks losing weight was slower – about 2-3 kg per week. Blood pressure from the second week of stay was in reference values: values of 128-136 / 82-88mm Hg. The morning glycemic values were from 5.6 to 6.2 mmol / l. The arms and legs edema withdrawal was registered already at the end of the first week, and since the third week only discrete pretibial edema is present. Intensive diuresis up to 4.5l / 24h in the first two weeks, then between 2.5-3l / 24h. From the fourth week of his stay, he could walk to 1.5km without fatigue. After six weeks, he was continuous sleep, he had no longer choking, he started to sleep on the flat head. During the ninth week of the stay, there is a pronounced constipation with flatulence, which after several days is regulated by the application of several different laxatives. Since then, until the end of hospitalization, the stool was regular.

During the 89th day of obesity treatment, fatigue, headache, nausea and cramps in the muscles was developed. In laboratory analyzes, electrolyte decline was registered : hyponatraemia, hypokalaemia and hypochloremia (Na-122mmol / l, K-2.3mmol /l, Cl-77mmol / L). BUN and creatinine was in reference values. Blood pressure was dropped: TA: 105 / 65mm Hg with normal pulse (frequency 84 / min). In the ECG no changes in the ST segment and T waves were reported, which would indicate registered electrolyte disorders (without the dynamics of the ECG image change in relation to the day of reception). Anamnestically, it is learned that it introduces a higher amount of water (6-7 liters / day) due to heat and excessive sweating and daily exercise, and the fact is that excessive fluid intake is often reported in patients with a diagnosis of psychosis.

The indicated drop in electrolyte is interpreted as a dilution hyponatriemia with a low potassium level. Reduction of fluid intake was recommended, 3g KCl intake per os for the first three days, and then 2g KCl per day,salt intake as a diet supplementation, magnesium intake (375mg per os), as well as exercise discontinuation. After the third day of therapy, serum electrolytes were corrected and the following measurements were made: Na-139mmol / l, K-3.2mmol / l, Cl-98 mmol/l. The patient felt better, with no cramps in the muscles with only a mild feeling of fatigue and nausea. After the seventh day of the treatment described, a complete correction of the resulting electrolyte imbalance was made (Na-138 mmol/l, K-3.9 mmol/l, Cl-102 mmol/l) with complete withdrawal of the discomfort. All subsequent electrolyte measurements during the stay were in reference values.

Diet continued and dosed physical activity continued. Blood pressure values were in reference values (115-128 / 75-84mm Hg). Weight loss continued, on average 2-3 kg per week.

Anthropometric measurements on discharge after 160 days of obesity treatment – height: 189cm, weight: 125.9kg, BMI: 35.25kg / m², body fat: 28% (35.30kg), waist circumference: 119cm. In biochemical analyses of blood without inflammatory syndrome (SE-10, CRP-0.5), regular glycemic values (glycemia-4.75 mmol /l, HbA1c:

5.5%), corrected lipid profile with significant reduction in atherosclerosis index : cholesterol-4.82mmol/ l (HDL-1.32mmol/l, LDL-2.9mmol / l), triglycerides-0.99mmol/l. A significant decrease of uric acid in serum was recorded: uric acid – 532micromol / l (430mikromol / L standard), as well as regular electrolyte values (Na-141 mmol/l, K-4.4mmol /l, Cl-109mmol/l, Ca-2.47mmol/l). Other biochemical parameters were in reference values. Blood pressure values and ECG images in reference values (TA: 124 /76mm Hg, Fr: 72 /min, ECG:sin rhythm, without ST-Tchanges). The patient received a recommendation for further weight loss, physical training and diet in home conditions, blood pressure control and blood biochemical parameters.

After two years of starting the treatment, the patient returned to the Cigota program – scheduled control measurements. Anthropometric measurements at the control – height: 189 cm, weight: 107.8 kg, BMI: 29.86 kg / m2, body fat: 12.80% (13.8 kg), waist circumference: 105 cm. Blood biochemical analysis were in reference values: glycemia-5.2 mmol/l, HbA1c:5.3%, cholesterol-4.35mmol/l (HDL-1.4mmol/l, LDL-2.5mmol/l), triglycerides-1.28mmol/l,uric acid-330 micromol/l (normally less than 430 micromol/ L). Serum electrolyte values in the normal range: Na-140 mmol / l, K-4.6 mmol / l, Cl-109 mmol / l, Ca-2.41 mmol / l. BUN and creatinine in blood, transaminases and bilirubin were in reference values. Blood pressure values in the normal range, as well as ECG findings, and on ultrasound of the heart: septum thickness – 9.5mm, regular left ventricular dimensions (55 / 37mm) and EF: 65 %, with unchanged dimensions of the left atrium (41mm) and right ventricles (compared to the first overview), without stratification in the pericardium.

He was suggested recommendations for further control and continuation of maintenance of healthy lifestyle, proper nutrition and regular physical activity.

Discussion:

There is a positive (linear) correlation between excess weight and obesity and blood pressure (4.5)

An estimate based on meta-analysis of prospective studies is that for every 1cm increase in the circumference of the waist, by 2% the risk for cardiovascular events is increased .(2,6)

Metabolic syndrome is the name for a set of cardiometabolic risk factors that arise as a consequence of insulin resistance and abnormal accumulation and function of fat tissue. (7) At least three metabolic risk factors need to be established for the diagnosis of metabolic syndrome of the following:

1.Abdominal type of obesity (waist circumference ≥94 cm men and women ≥80 cm, BMI> 30 kg / m2) – if BMI> 30 kg / m2, no waist circumference is required.

2. glucose peak ≥ 5.6 mmol / L or taking drugs for hyperglycaemia.

3. triglycerides ≥1.7 mmol /L or taking therapy for hypertriglyceridaemia

4. HDL cholesterol <1.03 mmol / L (men) or <1.29 mmol / L (women) or taking therapy for reduced HDL

5. blood pressure values of ≥130 / 85 mm Hg or taking therapy for hypertension. (8)

The primary goal in treating patients with overweight and metabolic syndrome is weight loss. Weight reduction by 5-10% results in significant effects on cardiovascular risk factors (mainly on dyslipidemia and hypertension), glycemic control, insulin resistance, diabetes frequency and life quality. (3,9)

Increasing body weight, increases the extracellular and minute volume, which is associated with increased metabolic activity in tissues and increased oxygen consumption. This leads to the development of inflammation and oxidative stress in tissues, the activation of multiple neurohumoral systems (of which RAAS system plays a key role) which contributes to the development of endothelial dysfunction and damaged vasodilatation (increased arterial stiffening). Obesity generally results in an increase in sympathetic activity that is associated with increased cardiac frequency and consequent RAAS activation. (11)

Increased leptin concentration in obese patients is positively correlated with an increase in sympathetic activity. (12)

The Framingham study showed that about two times higher the prevalence of hypertension in obese patients compared to normally nourished persons belonging to both sexes: the study showed that 78% of men and 65% of overweight women had hypertension. For every 4.5kg increase in body weight, the systolic pressure increased by 4mmHg. Reduction for 5.5mm Hg systolic and 3mm Hg diastolic pressure reduces by 15% the incidence of coronary artery disease and 27% incidence of stroke. (13)

Potentially possible biological mechanisms linking weight loss and body fat and consequently reducing cardiovascular risk are repairing endothelial dysfunction, reducing insulin resistance, changes in sodium metabolism and changes in ion transport, changes in RAAS stimulation and sympathetic nervous system, changes in the vascular structure and functions (reduction of vascular resistance-"arterial stiffening"), changes in concentrations of natriuretic peptides. (3,9)

In Western countries, the average daily salt intake is high (9 to 10g per day), while the recommended maximum is up to 5g per day. Even a small reduction in salt intake (1 g per day) reduces systolic blood pressure by 3.1mm Hg in hypertensive patients, and 1.6mm Hg in normotensive patients. Increased intake of potassium (through fruits and vegetables) has positive effects on blood pressure and reduces the risk of occurrence of the stroke. (14)

Daily moderate physical activity decreases by an average of 11mm Hg systolic and 8mm Hg diastolic blood pressure. Physical activity reduces blood pressure in approximately 75% of people with hypertension. Many studies have shown that regular, individually dosed, physical activity can improve the biological efficacy of insulin. It is important to point out that this activity must be aerobic. (15)

Physical activity emphasizes the effect of insulin on peripheral tissues (skeletal muscles), increases glucose clearance in the liver and reduces its production. The GLUT-4 response and enzymes that regulate the deposit and oxidation of glucose in skeletal muscles are increasing (15,16). Abdominal fat deposits and intramuscular depots of triglycerides are reduced. Increasing muscle mass increases the storage space for glucosis, which contributes to the reduction of insulin resistance. The liver becomes more sensitive to insulin and controls the production of glucosis. Improves the control of metabolism of free fatty acids, increases the peripheral clearance of glucosis, and also reduces the production of glucosis in the liver. (17)

Non-pharmacological measures are preferably administered at the same time, as the diet activates the tyrosine kinase of the insulin receptor and lowers the plasma concentrations of glucosis and insulin, and physical activity not only reduces plasma concentrations of glucosis, insulin and free fatty acids, but also increases the density of capillaries in skeletal muscles. Diet and physical activity make the muscle cells and other target tissues more responsive to insulin, and better use glucosis. (18)

During prolonged obesity treatment, with hypocalories, low daily intake of sodium and regular aerobic and anaerobic exercise, adequate hydration is also required. Electrolyte and metabolic disorders that are more commonly reported in the obesity treatment outside medical supervision are frequently recorded in elderly people and in persons who are already treated with other diseases(comorbidities):diabetes,hypertension, metabolic, gastroenterological disorders, psychosis... (19, 20)

The most common electrolyte disorders are: hyponatraemia, hypokalaemia, hypomagnesaemia, and hypocalcaemia, and of metabolic disorders – hypoglycaemia, followed by a mild or more pronounced symptomatology. The above mentioned disorders should be recognized and corrected in time by appropriate therapy. (21)

In the described presentation of the patient who was on the obesity treatment in our institution within the program Cigota at the end of treatment (160 days), total weight loss of 105.8 kg was achieved, or 45.86% of the original weight. Significant reduction of body fat was achieved by 68.8% of the original values, ie loss of 75.5kg of body fat, reduction of waist circumference by 61cm and 33.8% (from 180cm to 119cm). Established non-pharmacological regulation of hypertension: blood pressure values on average about 120-130/75-82mm Hg. The established regulation of glycosis and triglyceride, a favorable profile of cholesterol fractions (HDL / LDL), a significant reduction in serum uric acid, and a significant reduction in cardiovascular risk, and the patient has "came out" the high cardiometabolic risk zone and from the criterion of the metabolic syndrome.

During hospitalization of the obesity treatment, the development of an electrolyte disbalance was interpreted as a dilution hyponatremia with hypokalaemia.The above mentioned electrolyte disbalance was moderate symptomatology and chronic development and was corrected over the next seven days by adequate oral supplements of potassium, sodium, magnesium and restriction of fluid intake. (20,21)

During the stay, there were no significant hemodynamic, metabolic and electrolyte disorders and no significant clinical symptomatology. There were withdrawal almost all of the symptoms that occurred, except for occasional insomnia and feelings of tension and fears within the basic disease (psychosis).

After discharge from hospital he was given instructions and recommendations for continuing the implementation of dietary regime and physical training in home conditions. The patient continued the trend of weight loss. He had been in contact with our Cigota team (doctor, nutritionist, sport professors, psychologist) and regularly carried out medical controls at the place of residence as advised.

After a year and a half of the discharge from hospital, patient came to the Cigota program at scheduled control measurements and medical examinations. And after two years of starting obesity treatment in our institution, the patient continued the trend of weight loss in the home conditions (reduction of 18.1kg, or 14.3% in the previous period) with further significant reduction in body fat (by 15.2% or 21.5kg respectively) and waist size (by 14cm, or by 11.8%). The patient achieved a shift from the category obesity into the category overweight. Stable blood pressure, corrected metabolic parameters of cardiovascular risk (glycemia, cholesterol with fractions, triglycerides, uric acid) was achieved, and in the findings of ultrasound of the heart there was a reduction in septum thickness and correction of ejection fraction of the heart. This has resulted in a significant reduction in total cardiometabolic risk factors, which is the ultimate goal of obesity treatment within the program's Cigota.

References:

1. Zhang C., Rexrode KM, van Dam R.M., Li T.Y., Hu F.B. Abdominal obesity and risk of all-cause, cardiovascular and cancer mortality: sixteen years of follow-up in US women. Circulation 2008, 117: 1658-1667.
2. Carl J. Lavie, Richard V. Milani, Hector O. Ventura.Obessity and Cardiovascular Disease. JACC, May 2009, 53 (21) 1925-1932;
3. Schneider R, Golzman B, Turkot S et al. Effect of weight loss on blood pressure, arterial compliance, and insulin resistance in normotensive obese subjects. Am J Med Sci 2005,330: 157-160
4. Jiang SZ, Lu W, Zong XF, Ruan HY, Liu Y. Obesity and hypertension. Exp Ther Med. 2016; 12 (4): 2395-2399.
5. Chandra A, Neeland IJ, Berry JD et al. The relationship between body mass and fat distribution with incident hypertension: observations from the Dallas Heart Study. J Am Coll Cardiol 2014; 64: 997-1002
6. See R., Abdullah S.M., McGuire D.K., et al. The association of different measures of overweight and obesity with prevalent atherosclerosis: the Dallas Heart Study. J Am Coll Cardiol 2007; 50: 752-759.

7. Eckel R.H., Grundy S.M., Zimmet P.Z. The metabolic syndrome. Lancet 2005; 365: 1415-1428
8. Mongraw-Chaffin M., Foster C.M., Anderson A.M.C, Burke G et al. Metabolic Healthy Obesity, Transition to Metabolic Syndrome, and Cardiovascular Risk, JACC May 2018; 71 (17): 1857-1865;
9. Straznicky NE, Grima MT, Eikelis N, Nestel PJ et al. Effects of weight loss versus weight loss maintenance on sympathetic nervous system activity and metabolic syndrome components. J Clin Endocrinol Metab. 2011; 96: E503-E508.
10. Straznicky NE, Grima MT, Eikelis N, Nestel PJ et al. The effects of weight loss versus weight loss maintenance on sympathetic nervous system activity and metabolic syndrome components. J Clin Endocrinol Metab. 2011; 96: E503-E508.
11. Lambert EA, Straznicky NE, Dixon JB, Lambert GW. Should the sympathetic nervous system be a target for improving cardiometabolic risk in obesity? Am J Physiol Heart Circ Physiol. 2015; 309: H244-H258.
12. Hall JE to Silva AA, to Carmo JM, Dubinion J et al. Obesity-induced hypertension: role of sympathetic nervous system, leptin, and melanocortins. J. Biol Chem. 2010; 285: 17271-17276
13. Wilson PW, D'Agostino RB, Sullivan L, Parise H et al. Overweight and obesity as determinants of cardiovascular risk: the Framingham experience. Arr Intern Med. 2002; 162: 1867-1872.
14. Blumenthal A.J, Sherwood A, Smith JP, Hinderliter A. The Role of Salt Reduction in the Management of Hypertension. JACC .April 2018; 71 (14): 1597-1598
15. Swift DL, Johannsen NM, Lavie CJ, Earnest CP, Blair SN, Church TS. Effects of clinically significant weight loss with exercise training on insulin resistance and cardiometabolic adaptations. Obesity. 2016; 24 (4): 812-9.
16. Swift DL, Johannsen NM, Lavie CJ, Earnest CP, Church TS. The Role of Exercise and Physical Activity in Weight Loss and Maintenance. Prog Cardiovasc Dis. 2014; 56 (4): 441-7.
17. Kraus WE, Houmard JA, Duscha BD, Knetzger KJ, Wharton MB, McCartney JS, et al. Effects of the Amount and Intensity of Exercise on Plasma Lipoproteins. N Engl J Med. 2002; 347 (19): 1483-92
18. Wu T, Gao X, Chen M, van Dam RM. Long-term effectiveness of diet-plus-exercise interventions vs. diet-only interventions for weight loss: a meta-analysis. Obes Rev 2009; 10: 313-323
19. Sterns RH, Silver SM. Complications and management of hyponatremia. Curr Opin Nephrol Hypertens. 2016; 25: 114-9.
20. Lien Y-HH, Shapiro JI. Hyponatremia: clinical diagnosis and management. Am J Med. 2007; 120: 653-8.
21. Sterns RH. Disorders of plasma sodium-causes, consequences, and correction. N Engl J Med. 2015; 372: 55-65.