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Nutritional problems of patients after gastrectomy and the risk of developing malnutrition

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The radical treatment for advanced gastric cancer is gastrectomy. This procedure disrupts the anatomy and physiology of the gastrointestinal tract. After surgery, nausea, heartburn, biliary regurgitation, feeling of early satiety, belching, lack of appetite, and swallowing problems are reported to affect food intake. Decreased absorption, loss of nutrients, and increased energy requirements of cancer patients lead to weight loss and the development of malnutrition. After gastrectomy, the composition of the intestinal microbiome changes, the exocrine activity of the pancreas decreases, and deficiency-metabolic disorders (including iron, vitamin B₁₂, zinc, and vitamin D) develop. Approximately 60–70% of gastrectomy patients experience clinically significant deterioration in quality of life. Nutritional management should include dietary modification, appropriate nutritional supplementation and close monitoring of the nutritional status of these patients.

Key words: gastric cancer, gastrectomy, malnutrition, vitamins, trace elements

Introduction

Gastric cancer is one of the most frequently diagnosed cancers in the world. More than 1.1 million new cases and approximately 800,000 deaths are reported annually. Over 85% of gastric cancer cases are registered in countries with high and very high Human Developing Index, mainly in Asia (China) [1].

Primary risk factors for gastric cancer include infection with *Helicobacter pylori* – chronic infection leads to a cascade of changes in the structure of the gastric mucosa – Inadequate diet (rich in salt and canned and smoked foods, poor in fresh fruits and vegetables), smoking, alcohol consumption, obesity, gastroesophageal reflux, age, male gender, and genetic predisposition [1, 2].

Adenocarcinomas account for 90% of all gastric cancers. Other malignancies occurring in the gastric include gastrointestinal stromal tumours (GIST), lymphomas, sarcomas and neuroendocrine tumours (NET).

According to Lauren's classification, there are intestinal, diffuse and mixed- types of gastric cancer, and according to the location, tumours of the distal and proximal parts of the gastric are distinguished [1].

Treatment of gastric cancer

Radical treatment is the surgical removal of the tumour. Depending on the stage and location of the cancer, surgical treatment may consist of subtotal gastrectomy (excision of $\frac{3}{4}$ of the stomach, radical removal without removing the stomach in its entirety) and total gastrectomy (complete removal of the stomach). The standard of treatment for patients with locally advanced gastric cancer is perioperative chemotherapy administered before and after total gastrectomy with D₂ lymphadenectomy (stations 1–12) with Roux-en-Y reconstruction of the gastrointestinal tract. The operation involves suturing the oesophagus with a loop of the small intestine. This loop is connected to a part of the intestine that guides bile and pancreatic juice from the duodenum [3, 4]. This procedure disrupts the anatomy and physiology of the gastrointestinal tract, interferes with the digestion and absorption of nutrients, and leads to problems with the digestive tract [5].

Nutritional problems of patients after gastrectomy

Gastrectomy results in a risk of chronic nausea, heartburn, dumping of food content into the mouth, the feeling of early satiety, belching, lack of appetite, dysphagia, abdominal pain, and diarrhoea. The greatest intensity of symptoms was observed in the first months after surgery before the digestive tract adapted to the new conditions. Their intensity decreases with time. Deficiency-metabolic disorders accompany patients for the rest of their lives. Each of the ailments affects the amount of food intake of the patients, which causes weight loss and deterioration of the patient's quality of life [5, 6].

One of the early consequences of gastrectomy is dumping syndrome. The leading cause of dumping syndrome is the sudden passage of high-osmolarity food into the small intestine, which provokes the accumulation of excessive fluid in the intestines and increased secretion of intestinal hormones. Approximately 15–30 minutes after eating an overly large meal, there is fullness in the epigastrium, bloating, abdominal pain, nausea, sometimes diarrhoea, palpitations, the urge to lie down or sit up, sweating, pale or flushed skin, dizziness, fainting [4, 7, 8]. In Esther Una Cidon's study, dumping syndrome symptoms occurred in 27% of patients after gastrectomy [9]. In preventing dumping syndrome, it is essential to eat small, frequent meals (even 6–8 meals a day), eat slowly, limit fluids during meals and compose meals so that each contains a source of protein and fat [4]. Postprandial hypoglycemia (late postprandial syndrome) is a sharp drop in blood glucose levels combined with feelings of hunger, sweating and even impaired consciousness. It occurs 1–3 h after meal and is caused by a rapid insulin response to hyperglycemia resulting from the rapid absorption of simple sugars in the early small intestine. A low

glycemic index diet containing complex carbohydrates and fibre is recommended to prevent future hypoglycemia. A low glycemic index diet prevents a sudden glycemic peak and insulin release [10].

Loss of appetite is the most common problem after gastrectomy. It may be influenced by the secretion of cholecystokinin after surgery, which precludes satiety and causes a feeling of satiety. Concentrations of the hormones GLP-1 (glucagon-like peptide 1), PYY (intestinal hormone peptide) and ghrelin are altered. Ghrelin is referred to as the hunger hormone, after surgery, its concentration decreases by 65% [11, 12, 13]. Loss of appetite after gastrectomy is reported by about 80% of patients [CITATION Cid10 \l 1045]. One year after surgery, it is still reported by more than 30% of patients [14].

About 80% of patients after gastrectomy present symptoms such as epigastric pain, heartburn, biliary regurgitation, and sometimes vomiting. The described complaints lead to reflux esophagitis - which occurs when the intestinal loop separating the oesophagus from the duodenum or inter-intestinal anastomosis is too short, and no replacement valve mechanism has been created [4]. Preservation of the lower oesophageal sphincter may protect against reflux esophagitis. In the study by Tomit et al., reflux symptoms were present in 30.8% of patients without a lower oesophageal sphincter and only among 8% of patients in whom the sphincter remained. Symptoms of reflux esophagitis are usually more severe in the early postoperative period but can occur chronically, more than a year after surgery. Symptoms of dysphagia and odynophagia accompany post-gastrectomy patients due to altered oesophageal biomechanics (changes in oesophageal muscle tone), alkaline reflux esophagitis, vagus nerve damage and anastomotic stenosis [15]. In the study by Karanicolas et al., dysphagia, loss of appetite and eating restrictions were the most common symptoms. They occurred in 45–55% of patients in the immediate post-gastrectomy period. Among the surveyed people, 40% reported reflux symptoms, and 30% reported nausea/vomiting. Total gastrectomy patients are more likely to report diarrhoea than subtotal gastrectomy patients [16].

Biliary diversion after gastrectomy, changes in the pH of the gastrointestinal tract, and loss of the gastric barrier affect the composition of the gut microbiome. Gastrectomy-induced dysbiosis is characterized by an increased abundance of typical oral cavity bacteria, an increase in aero-tolerant bacteria and an increased abundance of bile acid-transforming bacteria. Increased amounts of *Streptococcus*, *Veillonella*, *Prevotella*, *Oribacterium*, *Mogibacterium* were observed in the gut microbiome of patients after gastrectomy [17, 18]. Liang and colleagues observed a higher abundance of *Veillonella* bacteria, as well as *Escherichia/Shigella* and *Clostridium*, and a lower abundance of *Bacteroides* in the intestinal microflora of gastrectomy patients. The abundance of genera *Akkermansia*, *Lactobacillus* and *Dialister* significantly changed in the perioperative period [19]. Changing the composition of the intestinal microbiome affects the induction of chronic inflammation, resulting in damage to the intestinal mucosa, disruption of intestinal ion transport and increased permeability of the mucosa to pathogens, resulting in diarrhoea. Patients are often accompanied by symptoms such as diarrhoea, bloating, abdominal discomfort, and abdominal pain, referred to as SIBO

(*Small intestinal bacterial overgrowth*) [17]. In the Pérez Aisa et al. study, SIBO was found in 61.6% of patients after gastrectomy [20].

Altered bile acid flow and pancreatic insufficiency due to disturbances in hormonal regulation of gastrointestinal secretory function, lack of synchronization between food intake and pancreatic secretion, and rapid intestinal transit can lead to steatorrhea [4]. Significant reduction in exocrine pancreatic activity and continuous decrease in pancreatic volume over five years post-operation were observed after total gastrectomy [21]. Pancreatic insufficiency is one of the causes of malabsorption. However, routine use of pancreatic enzymes is not justified. Existing studies on pancreatic enzyme supplementation after gastrectomy show inconsistent results. The study by Catarci et al. assessed that pancreatic enzyme supplementation improves nutritional status and quality of life after gastrectomy, particularly within 3 months post-operation [22].

Felice van Erning and colleagues assessed the occurrence of nutritional problems after gastrectomy to one-year post-surgery between 2015 and 2021. Patients after gastric resection most commonly reported loss of appetite (22.2%), taste disturbances (15.8%), and dry mouth (14.4%). The occurrence of symptoms was evaluated before and after the operation. Before the surgery, 26.4% of the participants reported experiencing 2 or more nutritional problems, after the surgery, it was 42.4%. Among the participants, 53.6% reported no discomfort before the operation, whereas after the surgery, it was 43.7% [7]. Surgery and adjuvant chemotherapy exacerbate discomfort and worsen the quality of life. Patients undergoing chemotherapy experience its toxicity. Loss of appetite, dry mouth, weight loss, and nausea were more common in the group of patients after gastrectomy with chemotherapy than after surgery alone [23].

Among approximately 60–70% of patients, there is clinically significant deterioration in quality of life shortly after gastrectomy. In about $\frac{1}{3}$ of patients, symptoms persist for longer than 6 months post-surgery [16]. Total gastric resection results in weight loss, on average 15% of preoperative weight [24]. Over 50% of patients after gastrectomy are malnourished or at risk of malnutrition [5, 25]. In the context of preventing and treating malnutrition, cooperation between a doctor and a dietitian is crucial. Appropriate management aims to limit excessive weight loss and help patients alleviate post-operative discomfort [26].

Gastrectomy leads to the occurrence of nutritional deficiencies. The frequency of diagnosing zinc deficiencies in patients after gastrectomy varies from 10 to 75% [27]. Gastric resection with Roux-en-Y reconstruction may increase the risk of fat-soluble vitamin deficiencies – A, D, E, K [28]. Vitamin D deficiency contributes to decreased bone mineral density and disturbances in their mass and structure (osteoporosis). The level of vitamin D may drop post-surgery by up to 36% [29]. The development of osteomalacia and osteoporosis is also influenced by calcium deficiency, which results from the duodenum being bypassed by the ingested food, changes in pH in the upper gastrointestinal tract, and insufficient dietary intake due to a common problem with lactose tolerance and cow's milk protein [28]. The incidence of osteoporosis after

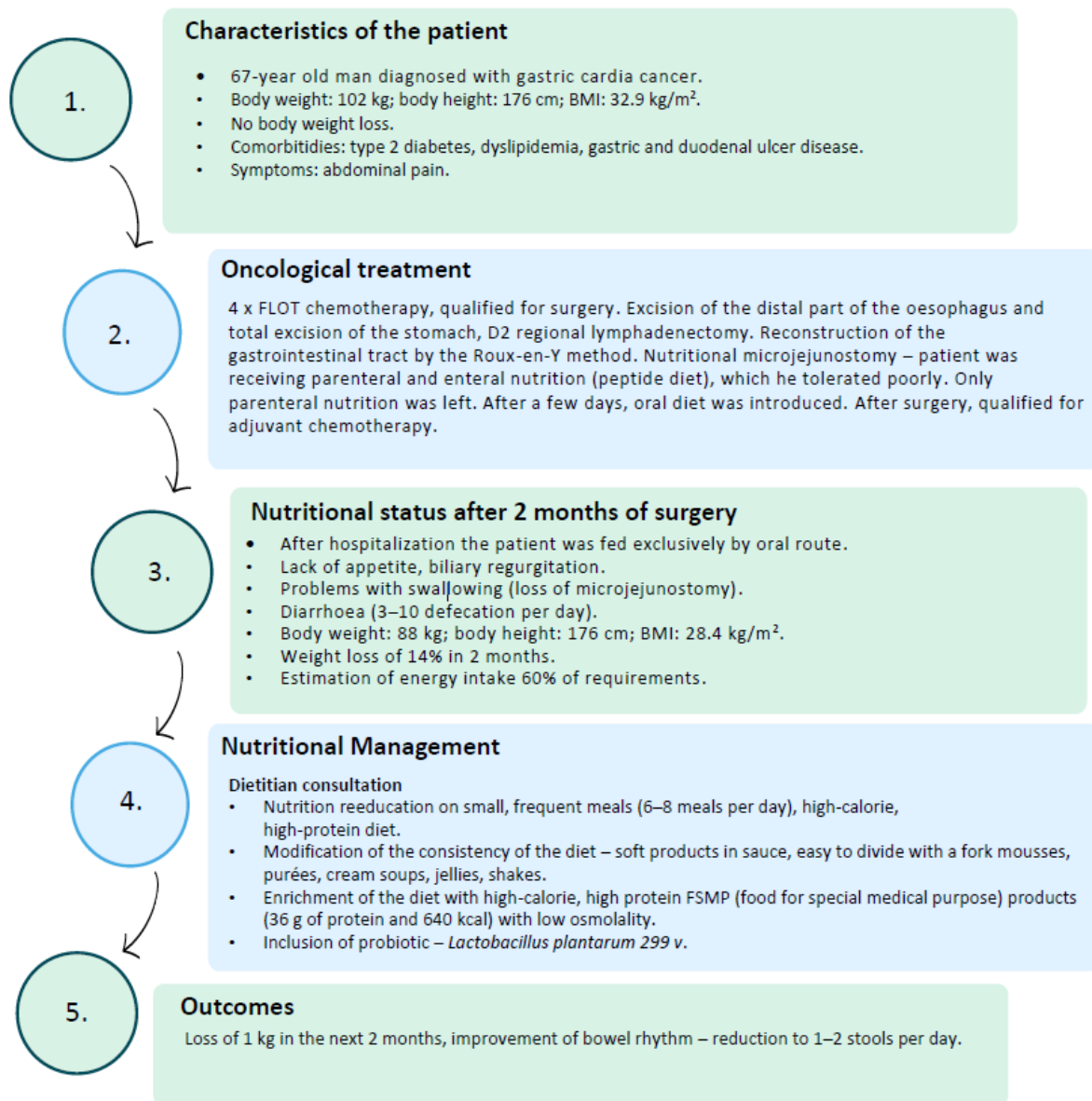
gastrectomy can affect about 40% of patients, and older patients, women and people with diabetes are more at risk [30].

Iron deficiency anaemia is also a common sequela of total gastrectomy. It is diagnosed in 40–70% of patients after gastrectomy [28, 29]. It is caused by perioperative blood loss and a change in the pH of the upper gastrointestinal tract. Increased pH in this region impairs the reduction of trivalent iron to the better-absorbed divalent iron. The way the gastrointestinal tract is reconstructed after gastrectomy causes the digestive contents to bypass the duodenum and upper part of the small intestine. The lower consumption of iron-rich foods is another cause of iron deficiency [4, 28, 29]. Folic acid and vitamin B₁₂ deficiency is a leading cause of megaloblastic anaemia. Vitamin B₁₂ deficiency is significantly more common due to the lack of the Castle's factor, which enables the absorption of this vitamin. The onset time of disease symptoms depends on the condition of the gastric mucosa before treatment and the body's vitamin reserves. Lifelong supplementation of vitamin B₁₂ through intramuscular injections is recommended [28, 29]. During the five years after gastrectomy, the incidence of anaemia increases, and the risk of anaemia is higher in women, patients after total gastrectomy, diabetics and patients with low BMI (body mass index) [31]. Anaemia is also significantly more common in patients with advanced T-stage and lymph node metastasis. Patients with anaemia have lower concentrations of nutritional markers (albumin, prealbumin) and overall survival rates [32].

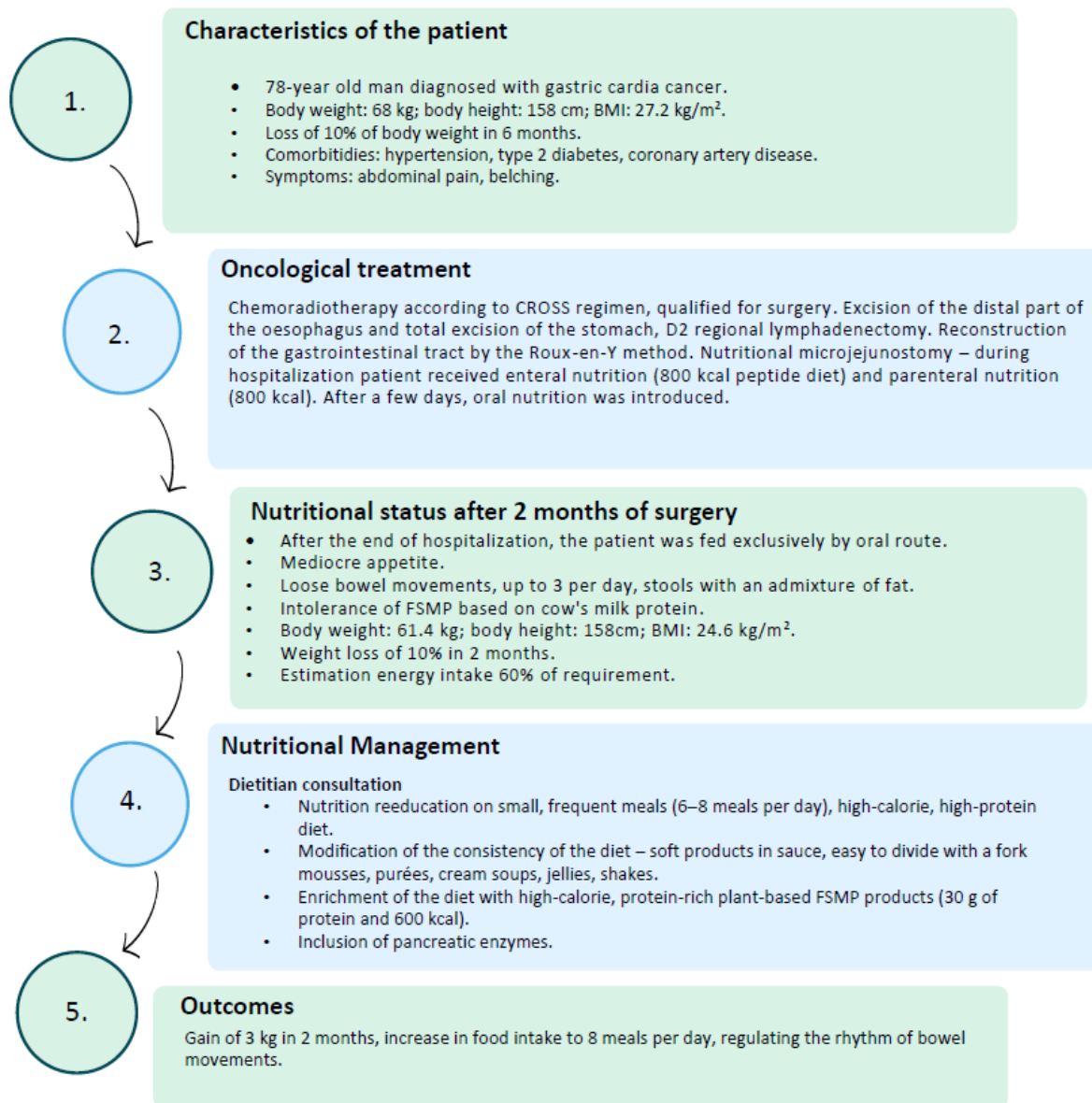
Conclusions

Increased energy demands of oncological patients, inadequate intake, reduced absorption, and loss of nutrients can lead to weight loss and malnutrition. Nutritional management should include dietary modification, appropriate nutritional supplementation, and careful monitoring of these patients' nutritional status.

Case study 1



Case study 2



Article information and declarations

Author contributions

Ewelina Grochowska – conceptualization, project administration, writing – original draft preparation.

Aleksandra Gazi – visualization.

Agnieszka Surwiłło-Snarska – visualization.

Aleksandra Kapała – writing – review and editing.

Conflict of interest

None declared

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