

SUMMARY

Despite advancements in oncology, pancreatic cancer continues to be associated with a very poor prognosis, with its incidence rising each year. Surgery remains the most effective treatment, but only a small percentage of patients are candidates for tumor resection at the time of diagnosis. Oxidative stress, which results from an imbalance between reactive oxygen species (ROS) production and the body's antioxidant defenses, contributes to cellular damage and cancer progression. Inflammation is the body's defensive response to tissue damage, infection, or other harmful factors. It is a complex process that aims to remove the cause of damage, repair tissues, and restore balance in the body. Acute inflammation in the early stages of cancer can exhibit anti-tumor effects by recognizing and removing cancer cells. Chronic inflammation can lead to carcinogenesis and subsequently stimulates the growth of cancer cells. There are few biomarkers that are being used to better understand how oxidative stress and inflammation are involved in the pathophysiology of malignancies. Surgical procedures of the pancreas are among the most difficult in the abdominal area, fraught with a large number of possible complications. Carrying out such operations requires specialized knowledge and extensive surgical experience, due to the delicate structure of the pancreas and its vital importance for the functioning of the body. Proper preparation of the patient for such surgical intervention is crucial. In recent years, increasing attention has been paid to the role of immunomodulatory nutritional treatment as a potential adjunct to traditional therapies. The provision of components that support the immune system may contribute to the reduction of oxidative stress and inflammation improving the prognosis of pancreatic cancer patients.

This study aimed to evaluate specific parameters of oxidative stress and inflammation in patients with pancreatic cancer. Additionally, it assessed these parameters in patients receiving immunomodulatory nutritional treatment and examined the impact of this nutrition on early postoperative complications, specifying pancreatic fistulas.

The study included 42 patients with pancreatic adenocarcinoma preparing for surgical procedures (pancreatoduodenectomy using the Whipple/Traverso technique and peripancreatic resections) at the Second Department of General, Gastroenterological and Oncological Surgery of the USK in Bialystok between 2020 and 2022. Prior to surgery, patients were randomly assigned to two groups: Group 1 (n=18) received a hospital diet supplemented with Impact Oral

immunostimulant diet (3x 237 ml/day) for 5 days before surgery, followed by continued immunostimulation with early Impact Enteral and parenteral nutrition (Smofkabiven 1206 ml) postoperatively. Group 2 (n=24) did not receive immunostimulatory nutrition.

Selected redox status parameters, including total antioxidant capacity (TAC), total oxidative status (TOS), ferric reducing ability of plasma (FRAP), and oxidative stress index (OSI), were measured. Oxidative damage to proteins was assessed using advanced glycation end products (AGE) and advanced oxidation protein products (AOPP), while lipid damage was measured using malondialdehyde (MDA). The study also evaluated the activity of inflammatory cytokines: IL-1 α , IL-1 β , IL-6, IL-10, and TNF- α . Parameters of oxidative stress and inflammation were assessed at admission, after 5 days of preoperative nutritional treatment, and on the 8th postoperative day (Group 1), as well as at admission and on the 8th postoperative day (Group 2). Results were compared to a control group of 40 healthy subjects. Venous blood samples were collected after an overnight fast. Postoperative complications were assessed using a modified 7-point classification according to Clavien-Dindo, and pancreatic fistulas were evaluated based on the International Study Group of Pancreatic Surgery (ISGPS) criteria. Statistical analysis was performed on the obtained results.

The study revealed a statistically significant increase in oxidative stress and inflammation parameters in both groups of pancreatic cancer patients. In Group 1, after 5 days of immunomodulatory nutrition, there was a significant reduction in TOS (2.05 ± 0.63 vs. 3.28 ± 2.70 $\mu\text{mol H}_2\text{O}_2$ Equiv/l; $p=0.04$) and OSI (1.01 ± 0.38 vs. 1.44 ± 1.40 ; $p=0.03$). However, levels of IL-6 (16.24 ± 6.89 vs. 10.05 ± 7.85 pg/ml; $p=0.05$) and IL-10 (4.66 ± 1.75 vs. 4.50 ± 2.15 pg/ml; $p=0.05$) increased. On postoperative day 8, Group 1 exhibited a significant increase in TAC (2.26 ± 0.10 vs. 2.15 ± 0.22 Trolox mmol/l; $p=0.05$) and FRAP (5.09 ± 1.12 vs. 4.42 ± 0.58 $\mu\text{mol/l}$; $p=0.02$), alongside a decrease in IL-10 (4.66 ± 1.75 vs. 3.39 ± 1.27 pg/ml; $p=0.01$). In contrast, Group 2, which did not receive immunomodulatory nutrition, showed a significantly lower FRAP level (4.15 ± 0.595 vs. 5.09 ± 1.12 $\mu\text{mol/l}$; $p=0.001$) and a higher AGE level (11140.00 ± 1857.62 vs. 10830.00 ± 1484.97 AFU/l; $p=0.236$) on postoperative day 8. There was no significant effect of immunomodulatory nutrition on early postoperative complications.

In summary, pancreatic cancer is associated with notable increases in oxidative stress and inflammation. Perioperative oral immunomodulatory nutrition reduces oxidative stress severity and causes a transient increase in inflammation. After surgery, this diet effectively lowers both oxidative stress and inflammation.

Penney-our Costa

