Possibilities of Portal Vein Reconstruction during Surgical Treatment of Pancreatic Cancer – Experiment on a Large Animal

Introduction: Pancreatic cancer is a fatal malignancy that is known as one of the leading causes of cancer mortality worldwide. The only potentially curative treatment is radical surgical resection. Because of the lack of early symptoms, the diagnosis is usually made in advanced stages of the disease. In the majority of patients, the tumor is already locally advanced or it has distant metastases at the time of diagnosis. Pancreatic cancer tends to infiltrate the portal vein (PV) or the superior mesenteric vein (SMV). Nowadays, resection of infiltrated parts of PV/SMV is recommended in specialized centers. There are several established techniques of PV/SMV reconstruction. The use of allogeneic venous grafts seems to be a method with minimal risk of adverse effects but there is only limited experience with these grafts. The optimal anatomical origin of allogeneic venous grafts for PV/SMV reconstruction remains unknown.

Aims: The aim of this experiment was to compare two types of allogeneic venous grafts used for PV reconstruction in a large animal model of pancreatico-duodenectomy. These grafts were harvested from the systemic venous system (inferior caval vein grafts – IVC grafts) and the portal venous system (PV grafts). The purpose was also to compare the microstructure of these grafts and to evaluate their possible remodelation after implantation. The experiment was also planned with the intent to enable monitoring of proportions of these grafts in the postoperative period and to identify technical factors that influence the risk of PV thrombosis.

Methods: Pancreaticoduodenectomy with PV reconstruction was successfully performed in 26 piglets. The animals were divided into two experimental groups according to the type of implanted graft (PV group, n = 13; IVC group, n = 13). The postoperative monitoring period was 4 weeks. Regular Doppler ultrasonography controls were performed before the operation and throughout the postoperative period. Specimens of venous grafts taken right after their retrieval and also 4 weeks after implant were examined by qualitative and quantitative histology. Computer simulations of blood flow in the reconstructed portal system were performed to identify risk factors of PV thrombosis.

Results: Nineteen animals survived throughout the whole monitoring period. Five animals in the PV group and two in the IVC group died prematurely due to postoperative complications. Higher amounts of smooth muscle cells and lesser amounts of collagen I and III were observed in the wall of PV grafts compared to IVC grafts right after their retrieval. However, both types of grafts had similar morphology 4 weeks after implantation. Larger graft diameters right after implantation were documented in cases of PV grafts. Computer simulations helped to identify areas susceptible to thrombosis. The propensity for blood stagnation as a risk factor for thrombosis was more noticeable in cases of grafts of larger diameters (especially when the diameter exceeded PV diameter). Thrombosis of extrahepatic PV occurred in 4 animals from the PV group and 1 animal from the IVC group.

Conclusion: Results of this experiment support the use of allografts from the systemic venous system for PV reconstruction in patients with pancreatic cancer when needed.