UNIVERSITATEA DE MEDICINĂ,
FARMACIE, ŞTIINŢE ŞI TEHNOLOGIE
„GEORGE EMIL PALADE"
DIN TÂRGU MUREŞ

PhD THESIS SUMMARY

"REGENERATION OF DIGESTIVE TUBE AFTER USING AN EXTRACELLULAR MATRIX"

PhD student: Tamás Tóth

Scientific supervisor: Prof. Univ. Dr. Angela Borda

Necrotizing enterocolitis (NEC) is among the most severe surgical emergencies in neonates, with a mortality rate of 20 to 40%. In severe cases, conventional surgical management which is based on the radiological finding of pneumoperitoneum often leads to delayed surgical intervention and extensive bowel resections. These carry the risk of short bowel syndrome and long-term morbidity. New therapeutic approaches are required to preserve functional tissue length and improve prognosis in surgical NEC cases.

The central hypothesis was to form the basis of a translational framework for optimizing surgical treatment in NEC by combining three complementary lines of research—retrospective clinical analysis, experimental validation of porcine small intestinal submucosa (SIS) as a biomaterial, and a systematic review of the literature.

The main objectives were (1) retrospective identification of risk factors and predictive parameters associated with severe NEC; (2) assessment of the capacity of SIS to support tissue regeneration in an animal model; (3) critical review of existing evidence on SIS composition, processing, and clinical applications; and (4) integration of results into a perspective relevant to neonatal surgery.

The retrospective study showed that decision-making algorithms relying exclusively on radiological signs are inadequate. In the analyzed cohort the mortality rate was significantly lower in the surgical subgroup compared with non-surgically managed

patients. The paradox is explained by the fact that the conservative group included fulminant cases, which illustrates both the severity of the disease and the absence of reliable markers to predict rapid deterioration.

In the experimental study SIS was used to repair gastric, intestinal, and colonic defects in rats. Postoperative recovery was uneventful with survival rate of 80% and with no major complications. Histological analysis confirmed, particularly in gastric and colonic regions, scaffold integration, near-complete mucosal regeneration, and restoration of digestive wall architecture. Healing was less uniform in the small intestine. In certain cases partial mucosal regeneration and residual fibrosis were found, which indicates segmental variations in tissue response. The immunological profile was favorable, with limited foreign-body reactions limited to sutures and no destructive inflammation. These findings show the viability of SIS as an alternative to extensive resection.

The systematic review analyzed 205 studies and highlighted the wide interest in SIS usage in different surgical specialties. Considerable heterogeneity was observed in processing techniques and clinical outcomes. Decellularization methods proved critical for biocompatibility and performance. Future directions include combining SIS with stem cells, bioactive agents, and 3D bioprinting technologies. Validation protocols must be standardized in order to support clinical adoption.

The three research components emphasize the translational character of the thesis. The clinical analysis identified an unsolved problem, the experimental study provided a biological alternative, and the literature review placed these findings in the international context.

The conclusions suggest that SIS should be a promising biomaterial with the potential to change current treatment strategies in severe NEC. At the same time, further prospective multicenter trials, animal models that more closely reflect neonatal physiology and long-term follow-up remain essential to confirm the durability of outcomes.