“Serum exosomal miRNAs as novel biomarkers in paediatric B-cell precursor acute lymphoblastic leukemia”

B-cell precursor acute lymphoblastic leukaemia (BCP-ALL) is the most common malignant neoplasm in children, accounting for approximately 30% of all paediatric oncology cases. Although current treatment regimens are effective for the majority of patients, approximately 10–15% of children experience disease relapse, which is associated with an unfavourable prognosis. Unfortunately, the available diagnostic tools and risk assessment methods are still insufficient to reliably predict which patients are at higher risk of relapse or poor treatment response. Therefore, there is an urgent need for novel, precise biomarkers to improve diagnosis, guide treatment decisions, and facilitate real-time monitoring of therapy effectiveness.

An emerging area of interest is the study of microRNAs (miRNAs) – short RNA molecules that regulate gene expression and play a critical role in tumour development and progression. In the body, miRNAs circulate not only in free form but also enclosed within exosomes – small vesicles secreted by various cells, including cancer cells. These exosomes carry biological material that reflects the condition of the originating cells. Their analysis offers a non-invasive means of gaining insight into pathological processes, potentially replacing more invasive procedures such as bone marrow biopsies.

This project aims to investigate the expression profile of 752 miRNAs encapsulated in serum exosomes from children with BCP-ALL, both at initial diagnosis and at relapse, and to compare them with age-matched healthy controls. Previously collected diagnostic serum samples stored at one of the largest paediatric oncology centres in Poland will be used. The analyses will be conducted using state-of-the-art exosome isolation techniques and high-sensitivity qPCR panels designed for miRNA quantification. This will be followed by advanced bioinformatic analyses to identify differentially expressed miRNAs between patient subgroups and to explore their association with molecular processes involved in leukaemogenesis.

The project constitutes basic research and is focused on elucidating the molecular biology of BCP-ALL without involving any therapeutic interventions. At the same time, by integrating molecular data with clinical parameters – such as disease subtype, genetic alterations, minimal residual disease levels, and treatment response – it holds significant translational potential. The findings could contribute to the development of novel, non-invasive diagnostic tools in the future. Furthermore, the results may enhance our understanding of the molecular mechanisms underlying BCP-ALL and, in the longer term, support more personalised and effective treatment strategies for paediatric patients. As such, the project aligns with current trends in paediatric oncology aimed at improving therapy outcomes and the quality of life for children with cancer.