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Predyktory przeżycia u pacjentów poddawanych termoablacji mikrofalowej przerzutów raka jelita grubego do wątroby

Rozprawa na stopień doktora nauk medycznych i nauk o zdrowiu

w dyscyplinie nauki medyczne

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Streszczenie w języku angielskim (Abstract)

Predictiors of survival in patients with colorectal liver metastases treated with microwave ablation

Colorectal cancer (CRC) ranks among the most prevalent malignancies globally and poses a significant health burden in Poland. Despite progress in diagnostic tools and treatment strategies, a substantial number of patients develop distant metastases, most commonly in the liver. Patients with colorectal liver metastases (CLM) require a personalized treatment approach. While surgical resection remains the gold standard, minimally invasive techniques such as percutaneous microwave ablation (MWA) have emerged as effective alternatives, particularly for patients with oligometastatic disease.

There is increasing interest in identifying clinical and laboratory markers that predict overall survival (OS) and local tumor control. Frequently studied biomarkers include the tumor specific markers, such as carcinoembryonic antigen (CEA), as well as tumor nonspecific parameters, in example systemic immunological indicators derived from routine blood tests—such as the lymphocyte-to-monocyte ratio (LMR), neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), and albumin-to-globulin ratio (AGR). While their prognostic value has been examined in patients treated with surgery or radiofrequency ablation (RFA), relatively few studies have focused specifically on their role in patients undergoing MWA for CLM.

This dissertation, structured as a series of publications, explores the prognostic potential of simple, blood-derived biomarkers in patients with CLM treated with MWA. It also provides an overview of the current evidence on the efficacy, safety, and prognostic factors influencing overall survival and local tumor progression-free survival.

***Franke J**, Rosiak G, Milczarek K, Konecki D, Wnuk E, Cieszanowski A. Biomarkers of Survival in Patients with Colorectal Liver Metastases Treated with Percutaneous Microwave Ablation. Cancers 2025, 17, 1112.*

This study assessed the prognostic significance of readily available blood-based biomarkers in 57 patients with CLM treated using MWA. The analysis included CEA, CEA density (CEA level relative to lesion volume), and inflammatory markers such as NLR, LMR, PLR, and AGR.

Significant biomarkers cut-off values were determined and incorporated into univariate and multivariate analysis.

Elevated CEA levels, high CEA density, and increased LMR were associated with worse overall survival, whereas higher NLR values and left-sided primary tumor location were linked to improved outcomes. However, in multivariable regression analysis, only CEA, NLR, and tumor sidedness remained statistically significant predictors, while LMR lost its independent prognostic value. The most pronounced negative prognostic factor was a CEA level greater than 29.1 ng/mL, with a hazard ratio (HR) of 4.10. Conversely, an NLR above 2.05 was associated with a protective effect (HR = 0.29), as well as left-sided primary tumors were correlated with improved survival (HR = 0.25). These findings highlight the relevance of systemic inflammation markers and tumor burden indicators in survival prediction.

***Franke J**, Rosiak G, Konecki D, Milczarek K, Cieszanowski A.*
Technical Aspects, Methodological Challenges and Factors Predicting Outcome of Percutaneous Ablation for Colorectal Liver Metastases. Pol J Radiol. 2025;90:279–285.

This article reviews the current literature on the technical, clinical, and biological factors influencing outcomes following percutaneous ablation of CLM. It compares RFA, MWA, and irreversible electroporation (IRE), outlining their respective advantages and limitations, with major focus on thermoablative modalities as the one most commonly used. Although MWA presents several technical advantages over RFA, clinical outcomes in terms of local tumor progression and overall survival are generally comparable. A critical determinant of successful local control is achieving an adequate ablation margin. Studies consistently show that margins of at least 5 mm, and ideally >10 mm, are associated with significantly reduced recurrence rates. The introduction of 3D margin assessment software has improved accuracy over traditional 2D visual „eye-balling" meaning comparison of pre- and postablation images, enhancing detection of insufficient margins. Moreover, advanced imaging techniques such as CT hepatic arteriography have improved intraprocedural visualization and post-procedural margin evaluation, further reducing local tumor progression rates.

Tumor biology also significantly impacts outcomes. Genetic mutations—especially in RAS, BRAF, and microsatellite instability affect both local tumor control and overall survival. For

example, patients with RAS mutations often have worse outcome even when technically successful ablations are performed. Other negative prognostic factors include larger tumor size, perivascular or subcapsular location.

Ongoing clinical trials, including the recently published COLLISION studies, support the use of ablation in selected patients, showing that for small CLMs, ablation can offer non-inferior long-term survival compared to resection, additionaly with lower complication rates.

Conclusions

The publications presented in this dissertation confirm that selected laboratory markers have prognostic value in patients with colorectal liver metastases treated with microwave ablation. A high CEA level is associated with shorter overall survival, while an elevated neutrophil-to-lymphocyte ratio (NLR) correlates with longer survival. Other markers, such as AGR, LMR, and PLR, do not show a significant association with prognosis. The location of the primary tumor also plays a role—patients with left-sided colorectal cancer tend to have better survival outcomes compared to those with right-sided primary tumors.

Treatment effectiveness is strongly influenced by technical factors, particularly the achievement of an adequate ablation margin (A0 ablation), which is essential for both overall survival and local tumor control. In this regard, advanced software for assessing ablation margins starts to be an important part of the procedure as it provides more accurate and effective results than traditional image comparison methods.