Epitranscriptomics and liquid biopsy: Advancing early cancer detection and understanding tumor progression.

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Introduction

Cancer remains one of the leading causes of mortality worldwide, with early detection and understanding of tumor biology being crucial for improving patient outcomes. Recent advances in molecular biology have highlighted the role of epitranscriptomics, the study of chemical modifications in RNA, in tumor progression. Simultaneously, liquid biopsy has emerged as a non-invasive technique for detecting cancer at its earliest stages. These two fields intersect to provide novel insights into cancer diagnosis, prognosis, and treatment strategies [1].

Epitranscriptomics focuses on RNA modifications that regulate gene expression without altering the DNA sequence. One of the most studied modifications is N6-methyladenosine (m6A), which influences RNA stability, splicing, and translation. Aberrant m6A modifications have been linked to various cancers, affecting oncogene expression and tumor microenvironment dynamics [2].

Emerging evidence suggests that dysregulation of RNA modifications contributes to uncontrolled cell proliferation, metastasis, and immune evasion. For example, changes in m6A methylation patterns have been observed in hepatocellular carcinoma, glioblastoma, and breast cancer, highlighting its potential as a biomarker for tumor progression [3].

Targeting RNA-modifying enzymes, such as m6A methyltransferases (METTL3, METTL14) or demethylases (ALKBH5, FTO), has shown promise in preclinical studies. Modulating these pathways could offer new therapeutic opportunities for personalized cancer treatment by restoring normal RNA modification patterns [4].

Liquid biopsy, which involves analyzing circulating tumor DNA (ctDNA), RNA, or exosomes in bodily fluids, offers a minimally invasive method for early cancer detection. Unlike traditional tissue biopsies, which require invasive procedures, liquid biopsy enables real-time monitoring of tumor dynamics and genetic alterations [5].

Recent studies have identified epitranscriptomic markers in circulating RNA, such as m6A-modified transcripts, which can serve as early indicators of cancer. These markers can help distinguish between malignant and benign conditions, aiding in early diagnosis and risk stratification [6].

Liquid biopsy is already being utilized in clinical settings for detecting cancers such as lung, colorectal, and prostate cancer. However, challenges remain, including standardizing detection techniques, improving sensitivity, and validating biomarkers for routine clinical use [7].

Combining epitranscriptomic analysis with liquid biopsy has the potential to enhance cancer diagnostics significantly. By profiling RNA modifications in circulating tumor RNA, researchers can gain a deeper understanding of tumor evolution and treatment resistance mechanisms [8].

The integration of artificial intelligence and machine learning in liquid biopsy analysis holds promise for improving cancer detection accuracy. Additionally, further exploration of RNA modifications could lead to the discovery of novel therapeutic targets and enhance precision oncology strategies [9, 10].

Conclusion

Epitranscriptomics and liquid biopsy represent two revolutionary approaches in cancer research. While epitranscriptomics provides crucial insights into tumor progression, liquid biopsy offers a non-invasive method for early detection and disease monitoring. The synergy between these fields has the potential to transform cancer diagnosis and treatment, ultimately improving patient outcomes and paving the way for personalized medicine.

References

1. Ibrahim SA, Ayivi RD, Zimmerman T, et al. Lactic acid bacteria as antimicrobial agents: Food safety and microbial food spoilage prevention. Food. 2021;10(12):3131.
2. Grudlewska-Buda K, Bauza-Kaszewska J, Wiktorczyk-Kapischke N, et al. Antibiotic Resistance in selected emerging bacterial foodborne Pathogens An issue of concern?. Antib. 2023;12(5):880.
3. Mokoena MP, Omatola CA, Olaniran AO. Applications of lactic acid bacteria and their bacteriocins against food spoilage microorganisms and foodborne pathogens. Mole. 2021;26(22):7055.
4. Misiou O, Koutsoumanis K. Climate change and its implications for food safety and spoilage. Trend Food Sci Technolo. 2022;126:142-52.

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5. Mohanty D, Suar M, Panda SK. Nanotechnological interventions in bacteriocin formulations–advances, and scope for challenging food spoilage bacteria and drug-resistant foodborne pathogens. Crit Rev Food Sci Nutr. 2023:1-8.
6. Nisa M, Dar RA, Fomda BA, et al. Combating food spoilage and pathogenic microbes via bacteriocins: A natural and eco-friendly substitute to antibiotics. Food Control. 2023;149:109710.
7. Wu-Wu JW, Guadamuz-Mayorga C, Oviedo-Cerdas D, et al. Antibiotic resistance and food safety: Perspectives on new technologies and molecules for microbial control in the food industry. Antib. 2023;12(3):550.
8. György É, Laslo É, Antal M, et al. Antibiotic resistance pattern of the allochthonous bacteria isolated from commercially available spices. Food Sci Nut. 2021;9(8):4550-60.
9. Sivalingam KM, Sama DS, Vaithilingam S. Prevalence and antibiotic susceptibility pattern of foodborne bacterial pathogens isolated from spoiled vegetables at Wolaita Sodo town, South Ethiopia. Journal of Food Quality. 2024;2024(1):8823056.
10. Stanley D, Batacan Jr R, Bajagai YS. Rapid growth of antimicrobial resistance: the role of agriculture in the problem and the solutions. Appl Microb Biotech. 2022;106(21):6953-62.

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