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SHORT COMMUNICATION

Diagnostic Potential of microRNAs in Leukemia: a Review of Current Evidence

Abdulmohsen A. Alsanawi [1, 2], Safaa M. Naes [3], Mohammed A. Alhoot [1], Saeed S. Shaikh [4], Muffeed H. M. AlDarwish [2], Taha H. M. Aljassim [2], Mohammed A. H. Altammar [2], Aqeela M. Alkhabbaz [2], Fatimah J. Alzarra [2]

[1] *School of Graduate Studies (SGS), Management & Science University (MSU), Shah Alam, Selangor, Malaysia*
[2] *Department of Laboratory Medicine, King Fahad Hospital of the University, Alkhobar, Saudi Arabia*
[3] *Faculty of Health and Life Sciences (FHLS), Management & Science University (MSU), Shah Alam, Selangor, Malaysia*
[4] *Department of Pathology, Shahida Islam Medical College, Lodhran, Pakistan*

ABSTRACT

Background: **Leukemia is a heterogeneous group of hematological malignancies with diverse clinical outcomes. microRNAs (miRNAs) have emerged as promising non-invasive biomarkers with diagnostic, prognostic, and therapeutic potential. This systematic review aims to summarize the current evidence on the role of microRNAs as diagnostic biomarkers in different subtypes of leukemia.**
Methods: **Following PRISMA guidelines, relevant studies were identified through a systematic search in PubMed, Scopus, and Web of Science up to August 2025. Inclusion criteria covered original research articles assessing miRNA expression in leukemia patients versus healthy controls.**
Results: **A total of 49 studies were included. Several microRNAs (e.g., miR-155, miR-181a, miR-29b) were consistently dysregulated in acute and chronic leukemias. Patterns of expression varied by leukemia subtype and disease stage. Pooled sensitivity and specificity across studies were 0.83 and 0.92, respectively, with AUC = 0.94.**
Conclusions: **microRNAs show high potential as diagnostic biomarkers for leukemia. However, further validation through large-scale, standardized studies is necessary before clinical application.**
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Correspondence:
Associate Prof. Mohammed Abdelfatah Alhoot
School of Graduate Studies (SGS)
Management & Science University (MSU)
Shah Alam, 40100, Selangor
Malaysia
Phone: +60 123418886
Email: malhoot@msu.edu.my
ORCID: 0000-0003-3819-2864

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KEYWORDS

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INTRODUCTION

Leukemia comprises a group of malignant disorders affecting blood and bone marrow, characterized by uncontrolled proliferation of white blood cells [1,2]. Despite advances in diagnosis and treatment, early and accurate detection remains critical for improving patient outcomes [3,4]. microRNAs (miRNAs) are small non-coding RNA molecules involved in post-transcriptional regulation of gene expression [5,6]. Their stability in body fluids and tissue specificity make them attractive candidates for cancer biomarkers, including leukemia

Table 1. Diagnostic performance of key microRNAs in leukemia.

AUC	Specificity	Sensitivity	Leukemia Type	microRNA/Panel
-	83 - 93%	69 - 90%	AML/ALL	miR-155
-	~100%	~90%	pediatric ALL	miR-181a + Smad7
0.91	~90%	~85%	AML	miR-29b
0.97	100%	90%	AML (panel)	miR-29a + miR-142-3p

[7,8]. This review systematically analyzes published studies that investigated miRNA expression patterns in leukemia and their diagnostic implications.

MATERIALS AND METHODS

We conducted a comprehensive literature search in PubMed, Scopus, and Web of Science using the terms: ("microRNA" OR "miRNA") AND ("leukemia") AND ("diagnosis" OR "biomarker"). The search included studies published until August 2025. Included studies were original human research articles evaluating miRNAs as diagnostic biomarkers in leukemia patients, with healthy controls for comparison. Case reports, reviews, animal studies, and studies lacking clear diagnostic data were excluded. Two independent reviewers screened and selected studies based on inclusion criteria. Extracted data included miRNA types, leukemia subtype, sensitivity, specificity, and AUC. Study quality was assessed using the Newcastle-Ottawa Scale.

RESULTS

A total of 49 studies involving 3,489 leukemia patients and 2,756 healthy controls were analyzed. microRNAs such as miR-155, miR-181a, and miR-29b were frequently dysregulated. miR-155 was mostly upregulated in AML and ALL, while miR-29b was downregulated. Combining miRNAs into panels improved diagnostic performance. Pooled sensitivity and specificity across studies were 0.83 and 0.92 respectively (AUC = 0.94).

DISCUSSION

Our findings suggest that specific miRNAs, particularly miR-155, miR-181a, and miR-29b, have strong diagnostic potential for leukemia. Their expression profiles vary across leukemia subtypes and can complement conventional diagnostic techniques. Combining multiple miRNAs into diagnostic panels yielded higher accuracy than single miRNAs.

However, limitations include heterogeneity in sample types (plasma vs. serum), detection methods, and patient populations. Standardization and validation in large, multi-center trials are essential for clinical implementation.

CONCLUSION

microRNAs demonstrate promising diagnostic utility in leukemia. Their ability to distinguish between healthy individuals and leukemia patients makes them attractive candidates for non-invasive diagnostics. Further large-scale studies are required to validate findings and develop clinically applicable diagnostic panels.

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Declaration of Interest:
There are no conflicts of interest for all researchers.

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