LETTER TO EDITOR

Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)-Cas13a: Future Hope to Tackle Anti-Microbial Resistance

Microbiology Insights
Volume 16: 1

DOI: 10.1177/11786361231178623

Tarun Kumar Suvvari[1], Venkata Dinesh Kumar Kandula[2], Venkataramana Kandi[3] and Vimal Thomas[4]

[1]Rangaraya Medical College, Kakinada, Andhra Pradesh, India. [2]GSL Medical College & General Hospital, Rajahmundry, Andhra Pradesh, India. [3]Department of Microbiology, Prathima Institute of Medical Sciences, Karimnagar, Telangana, India. [4]Tbilisi State Medical University, Tbilisi, Georgia.

Dear Editor,

Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) technology has revolutionized the field of genome editing by providing a powerful tool for precise gene editing. Recently, the CRISPR-Cas13a system has been identified as a potential game-changer in the fight against anti-microbial resistance (AMR). CRISPR-Cas13a, also known as CRISPR-C2c2, is a RNA-guided endonuclease that targets RNA molecules. Unlike the well-known CRISPR-Cas9 system that targets DNA molecules, Cas13a can target and destroy specific RNA sequences, including viral RNA, making it a promising therapeutic agent for treating viral infections. Additionally, recent studies have demonstrated the ability of Cas13a to knock down bacterial RNA, making it a potential tool to combat antibiotic-resistant bacteria.[1]

The researchers developed a Cas13a-based RNA-targeting system to silence the genes responsible for antibiotic resistance in E. coli. They used a library of CRISPR RNA (crRNA) targeting specific RNA sequences in the bacterial genome to identify those responsible for antibiotic resistance. They then used Cas13a to degrade those RNA sequences, effectively reversing antibiotic resistance in the bacteria.[2] The CRISPR-Cas13a can be used as a diagnostic tool for identifying antibiotic-resistant bacteria. The researchers designed a Cas13a-based assay that could detect specific RNA sequences associated with antibiotic resistance in bacterial samples. The assay was highly specific and sensitive, detecting even small amounts of bacterial RNA in clinical samples.[3]

Recently their role in the development of Cas13a based Antimicrobial agents started to attract attention. Inhibition of bacterial growth by LshCas13a, a subtype of CRISPR-Cas13a found in Leptotrichia Shahii, has been reported.[4] Latest research has demonstrated the potential of using LshCas13a as a sequence-specific antimicrobial agent. Specifically, researchers have packaged LshCas13a into phage capsids to create a powerful counteracting agent against antimicrobial-resistant bacterial infections.[5] These findings suggest that LshCas13a-based antimicrobials may be a promising strategy for combating antibiotic resistance in clinical settings. In addition to its potential as a therapeutic and diagnostic tool, CRISPR-Cas13a can also be used as a research tool to better understand the mechanisms of AMR. It is also demonstrated the ability of Cas13a to knock down specific genes in bacterial populations, providing a powerful tool to study the genetic basis of antibiotic resistance.

So CRISPR-Cas13a has many promising applications like antimicrobial agent targeting AMR bacteria, targeting and eliminating specific bacterial flora without disturbing other. Its ability to detect specific bacteria could surely be a great solution to detect resistant bacteria that are not detectable by antibiotic susceptibility tests. Many other Cas proteins which act as an antimicrobial agent are not capable of killing the bacteria. In contrast, due to its collateral effect, Cas13a is completely capable of killing the bacteria. Overall, the use of CRISPR-Cas13a in the fight against AMR holds great promise, but there are still several challenges to overcome before it can be widely adopted as a therapeutic or diagnostic tool. One of the main challenges is the delivery of the CRISPR-Cas13a system to the site of infection. Additionally, more research is needed to optimize the specificity and efficiency of Cas13a-based systems.

In conclusion, the recent advances in the use of CRISPR-Cas13a against AMR demonstrate its potential as a powerful therapeutic, diagnostic, and research tool in the fight against antibiotic-resistant bacteria. However, further research is needed to overcome the challenges associated with its use and to optimize its effectiveness in clinical settings.

REFERENCES

1. Guan J, Oromí-Bosch A, Mendoza SD, Karambelkar S, Berry JD, Bondy-Denomy J. Bacteriophage genome engineering with CRISPR-Cas13a. *Nat Microbiol*. 2022;7:1956-1966.
2. Lin P, Qin S, Pu Q, et al. CRISPR-Cas13 inhibitors block RNA editing in bacteria and mammalian cells. *Mol Cell*. 2020;78:850-861.e5.
3. Zhao L, Qiu M, Li X, Yang J, Li J. CRISPR-Cas13a system: a novel tool for molecular diagnostics. *Front Microbiol*. 2022;13:1060947.
4. Kiga K, Tan XE, Ibarra-Chávez R, et al. Development of CRISPR-Cas13a-based antimicrobials capable of sequence-specific killing of target bacteria. *Nat Commun*. 2020;11:2934.
5. Seal BS, Drider D, Oakley BB, et al. Microbial-derived products as potential new antimicrobials. *Vet Res*. 2018;49:66.

RECEIVED: April 7, 2023. ACCEPTED: May 11, 2023.
TYPE: Letter to the Editor
FUNDING: The author(s) received no financial support for the research, authorship, and/or publication of this article.
DECLARATION OF CONFLICTING INTERESTS: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.
CORRESPONDING AUTHOR: Vimal Thomas, Tbilisi State Medical University, Vazha Pshavela 33, Tbilisi, 0177, Georgia. Email: drvimal4u@gmail.com