EDITORIAL

AL-ANBAR MEDICAL JOURNAL
Anb. Med. J. 21(2): 74–76, 2025

Gene Therapy for Congenital Sensorineural Hearing Loss: A Future Perspective in Iraq

Raid M. Al-Ani[1,*] and Asfar Alshibibb[2]

[1] *Department of Surgery/Otolaryngology, College of Medicine, University of Anbar, Anbar, Iraq.*
[2] *Medical Microbiology, Cmlto Canadian College of Medical Technologists, Toronto, Canada.*
(Received : 5 January 2025; Accepted : 20 February 2025; First published online: 17 March 2025)

DOI: 10.33091/amj.2025.156580.2079

Disabled congenital sensorineural hearing loss (SNHL) has major drawbacks to the affected individuals such as delay in speech, cognition, language development, and learning. As a consequence, the affected persons have difficulty in finding appropriate jobs and performing and maintaining their jobs. Additionally, hearing impairment is considered a stigma. Furthermore, they live in isolation, depression, and poor quality of life.

Hearing loss is a common sensory deficit with an approximate incidence of 1 to 3 of every 1000 newborns across the globe with up to 60% of cases being due to genetic factors [1]. A previous systematic review (2020) of the genetic epidemiology of hearing impairment in 22 Arab countries found that the incidence of hereditary hearing loss ranged from 1.2–18 per 1000 birth per year and Iraq carries the highest prevalence (76.3%) [2].

Early detection is an essential aspect in the management of hearing loss in general and congenital one in particular. This step depends on the awareness of the parents about their babies' hearing status. However, it doesn't identify all cases because it depends on the parent's level of education. Therefore, a universal hearing screening program through otoacoustic emissions and auditory brainstem response tests is necessary to diagnose hearing loss in newborns. This program has two major drawbacks; First, it cannot diagnose mild or delayed onset hearing impairment in neonates. Second, it is unable to find the reason for the hearing loss. Nowadays, genetic testing, a universal hearing screening program, and tests for cytomegalovirus are recommended tools for the diagnosis of hearing loss in newborns [3–5].

Current therapeutic options for hearing impairment are hearing aids or cochlear implants. Hearing aids can amplify the sounds for individuals with mild or moderate hearing loss. While the cochlear implant is an option for patients with severe to profound hearing impairment. However, both of them have certain disadvantages, for example, defect in perception the sound waves and frequency sensitivity as well as difficulties with speech perception in noisy environments, because they are rehabilitation options for hearing impairment. Therefore, curative options for hearing loss are urgently needed [3].

In 1990, the Food and Drug Administration gave the first clinical approval for the human gene therapy [6]. Thereafter, a substantial increment in the acceptance of this modality for the treatment of various clinical disorders including hearing impairment. Gene therapy is a promising option to cure many patients with hearing loss because more than 150 independent genes have been recorded as causes of hereditary hearing impairment [7].

Gene therapy can modify the genetic material, thus producing therapeutic effects by repairing or reconstructing genetic material. Therefore, it is a promising treatment option for genetic diseases [8]. There are four ways of gene therapy in human beings; gene suppression, cell replacement, gene replacement, and targeted gene editing [9]. Several researchers advocate the use of gene therapy as a therapeutic option for hearing impairment in animal models. The mouse model is commonly used for inner ear investigations owing to its similarity to the human inner ear, cost-effectiveness, and well-characterized genomes [10]. A recent meta-analysis study on gene therapy for SNHL in 71 mouse-model experimental investigations found that there is a significant improvement of 26.91 dB on hearing tests in the experimental group in comparison with controls [11]. However, the study suggests that future studies are needed to assess the response rate of the

* Corresponding author:E-mail: med.raed.alani2003@uoanbar.edu.iq

http://doi.org/10.33091/amj.2025.156580.2079

treatment, the long-term effects of gene therapy, and relationships among various genetic mutation forms.

Owing to the high expenditure and time-consuming in the diagnosis and treatment of genetic disorders, there is a necessity to use artificial intelligence (AI) in these aspects. Nowadays, AI techniques have the capability to diagnose precisely and offer treatment for genetic disorders [12]. Hence, AI is considered a promising tool in this field.

Genetic disorders are common and involve nearly all systems in the body. In Iraq, many researchers who work hard in this field to diagnose certain genes that they responsible for various diseases such as hematological and neurological problems. Besides, they discover other new genes as the common belief said that the genetic abnormalities didn't stop to specific and well-known genes [13–15]. However, there is a paucity of research in Iraq to diagnose certain genes (Like Connexin 26) related to congenital SNHL [16]. Moreover, there is no attempt to use gene therapy in Iraq even at the level of animal models.

Owing to the importance of the diagnosis of genetic disorders of congenital hearing loss as well as treatment of such cases with gene therapy, it is necessary to follow the following steps:

1. Encourage the researchers in the field to detect the genes which are responsible for congenital hearing impairment.
2. Using animal models (commonly mouse models) or robots as experimental studies to show the efficacy of gene therapy.
3. Application of gene therapy in human beings.

The time needed to accomplish each step depends on the governmental (such as the Ministry of Higher Education and Scientific Research and Ministry of Health) policies which should include 1. Increase the awareness of the responsible researchers about the importance of congenital SNHL and how can they solve it? 2. Create specific well-equipped centers. 3. Supporting researchers financially and morally. 4. Sending postgraduate students and specialized researchers to developed countries in this field to gain experience and learn about the latest scientific developments. 5. Using AI techniques. 6. Encouraging investors to build advanced research centers for the diagnosis and treatment of genetic diseases.

However, the journey is not easy and takes a lot of effort from decision-makers and researchers all over Iraq. Anyhow, the starting point should be shortly to dive into the depths of this sea to come up with powerful research that solves most of the problems of congenital SNHL.

In conclusion, congenital SNHL in children requires decision-makers and specialized researchers to revolutionize the painful reality of Iraq to diagnose and treat this problem.

ETHICAL DECLARATIONS

Acknowledgment

None.

Ethics Approval and Consent to Participate

Not required.

Consent for Publication

Not applicable (no individual personal data included).

Availability of data and material

None.

Competing interests

The authors declare that there is no conflict of interest.

Funding

No funding.

Authors' Contributions

Al-Ani RM designed the study. Al-Ani RM and Alshibib A wrote the manuscript. Al-Ani RM formatted the reference with Endnote software. The authors read and approved the final version of the manuscript.

REFERENCES

[1] C. C. Morton and W. E. Nance. Newborn hearing screening—a silent revolution. *New England Journal of Medicine*, 354(20):2151–2164, 2006.

[2] M. Sidenna, T. Fadl, and H. Zayed. Genetic epidemiology of hearing loss in the 22 arab countries: a systematic review. *Otology & Neurotology*, 41(2):e152–e162, 2020.

[3] R. M. Al-Ani. Various aspects of hearing loss in newborns: A narrative review. *World Journal of Clinical Pediatrics*, 12(3):86, 2023.

[4] C. D'Aguillo *et al.* Genetic screening as an adjunct to universal newborn hearing screening: literature review and implications for non-congenital pre-lingual hearing loss. *International journal of audiology*, 58(12):834–850, 2019.

[5] A. E. Shearer, J. Shen, S. Amr, C. C. Morton, and R. J. Smith. A proposal for comprehensive newborn hearing screening to improve identification of deaf and hard-of-hearing children. *Genetics in Medicine*, 21(11):2614–2630, 2019.

[6] S. A. Rosenberg *et al.* Gene transfer into humans—immunotherapy of patients with advanced melanoma, using tumor-infiltrating lymphocytes modified by retroviral gene transduction. *New England journal of medicine*, 323(9):570–578, 1990.

[7] Z. Fu, L. Zhao, Y. Guo, and J. Yang. Gene therapy for hereditary hearing loss. *Hearing Research*, 455:109151, 2025.

[8] L. Jiang, D. Wang, Y. He, and Y. Shu. Advances in gene therapy hold promise for treating hereditary hearing loss. *Molecular Therapy*, 31(4):934–950, 2023.

[9] R. Omichi, S. B. Shibata, C. C. Morton, and R. J. Smith. Gene therapy for hearing loss. *Human molecular genetics*, 28(R1):R65–R79, 2019.

[10] M. L. Hastings and J. V. Brigande. Fetal gene therapy and pharmacotherapy to treat congenital hearing loss and vestibular dysfunction. *Hearing research*, 394:107931, 2020.

[11] N. K. Yilmaz *et al.* Efficiency of gene therapy for sensorineural hearing loss in mouse model: A meta-analysis. *Laryngoscope Investigative Otolaryngology*, 9(6):e70048, 2024.

[12] R. S. Vilhekar and A. Rawekar. Artificial intelligence in genetics. *Cureus*, 16(1), 2024.

[13] O. A. Ali and B. J. Mohammed. Impact of mir-155 gene polymorphism (rs767649 a> t) and mir-155 gene expression on susceptibility to multiple sclerosis. *Al-Anbar Medical Journal*, 20(1):94–100, 2024.

[14] L. A. Fahad, Z. M. Al-Omar, and K. N. AL-Kheroo. Characterization of the FLT3 mutation in newly diagnosed patients with acute myeloid leukemia. *Al-Anbar Medical Journal*, 20(1):74–79, 2024.

[15] B. K. Karmeet, A. K. A. Al-Kazaz, and Mahdi Saber. Molecular genetics study on autistic patients in iraq. *Iraqi Journal of Science*, 56(1A):119–124, 2015.

[16] A. M. Al-Janabi, H. S. Ahmmed, and S. M. Al-Khafaji. Connexin 26 (GJB2) gene mutations linked with autosomal recessive non-syndromic sensor neural hearing loss in the iraqi population. *Journal of Medicine and Life*, 14(6):841, 2021.

http://doi.org/10.33091/amj.2025.156580.2079