Main Article

A Cross Sectional Study of Assessment of Hearing in Infants of Gestational Diabetes Mothers

https://doi.org/10.47210/bjohns.2023.v31i2.939

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ABSTRACT

Introduction

Hearing loss is one of the most prevalent congenital disorders in infants. Neonatal hearing screening is an important tool for early detection of hearing impairment in newborns. Present study is aimed to assess the impact of hearing among babies born to gestational diabetic mothers.

Materials and Methods

This study was conducted among 100 pregnant mothers who gave birth in Obstetrics and Gynaecology Department in a medical college in Pondicherry from December 2020 to July 2022. 50 pregnant women with gestational diabetes mellitus(GDM) were assigned to Group 1 and 50 pregnant women who had no GDM were assigned to Group 2. Hearing screening among the infants were done using Otoacoustic emissions and Brainstem evoked response audiometry (OAE and BERA). The results in Group 1 and Group 2 were collected, analysed and compared.

Results

All patients were between 20 – 45 years of age. The average gestational age was 39.2±5.7 from 36 weeks to 42 weeks. In the present study OAE has shown that 40% babies had bilateral refer and 18% had unilateral refer in GDM mothers which significantly higher than the normal mothers. BERA showed that 14% had hearing loss among those of the GDM mothers which was significantly higher than the normal mothers. Comparison of abnormal hearing screening between the two groups were significant($P < 0.05$).

Conclusion

Gestational diabetes mellitus increases the risk of hearing impairment in newborns. Timely detection and standardised management should be followed and early intervention procedures should be studied and developed.

Keywords

Infant; Hearing loss; Pregnancy; Audiometry, Evoked Response; Diabetes; Gestational

Neonatal hearing screening is an important tool for early detection of hearing impairment in newborns. Gestational diabetes is a metabolic disease that can occur in pregnancy and cause complications similar to other diabetic patients.[1] Gestational diabetes is a metabolic disorder that can emerge during pregnancy and produce consequences similar to those seen in other diabetics.[1] Hearing loss is one of the most prevalent congenital disorders in infants. 1.4 out of every 1000 newborns had a bilateral congenital hearing impairment.[2] The main objective of treatment for gestational diabetes mellitus is to avoid complications. There is only weak evidence that gestational diabetes increases the likelihood of cochlear damage and hearing loss in foetuses, despite the fact that diabetes mellitus usually results in hearing loss.[1,3-5]

The present study was conducted to find the hearing

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status in infants of diabetic mother and non diabetic mother.

Materials and Methods

This Prospective comparative study was conducted from December 2020 to October 2022, after getting ethical clearance from AVMC research committee.

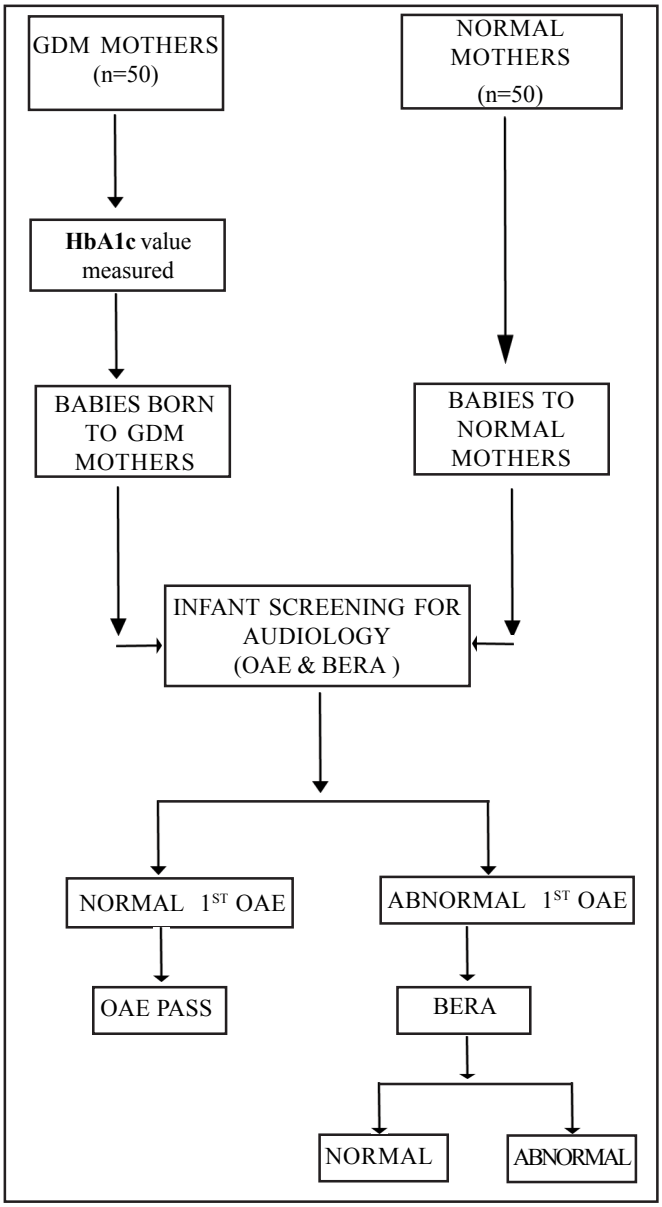

Fig 1. Showing the study methodology

The study included two groups of 50 pregnant women each. One group included normal pregnant women (n=50), and other group included women who are diagnosed with gestational diabetes mellitus. After getting an informed and written consent from the patients, detailed history, clinical assessment and blood investigations were done. Their HbA1c values and OGTT values were recorded. The babies born in both the groups were sent for hearing screening (OAE). Those babies who failed the screening test were subjected for BERA, after 15-20 days.

Mothers with previous history of diabetes, and babies with risk factors like low APGAR, LBW, meningitis, ototoxic drugs, intrauterine infections, and any other congenital deformities were excluded from the study.

According to the OGTT criteria, at least one deranged value of the 0, 1, and 2nd hour (>92, 180 and 153 mg/dl) is diagnosed as GDM[6] and according to the WHO guidelines, HbA1c values more 48 mmol/mol (6.5%) is considered as diagnosis for GDM.[6]

Sample size calculation: Formula $\mathbf{4pq/d^2}$

p = 9.1; q = 1–p; q = 90.9. Error rate (d) = 5

Therefore, the sample size calculated by using the formula is 100

The sample size 100 (50 in each group) was calculated based on the statistical formula for comparison of two proportions with the expected proportion of hearing loss of infants among gestational diabetic and normal mothers were 0.41 and 0.08 respectively. The level of significance and power were taken as 5% and 90% respectively. 10% of non response rate was considered. A similar study by Yildiz E G et al was taken as reference.[7]

HbA1c is done in the department of Biochemistry.

OAE and BERA is available in audiology block which is already routinely carried out in all neonates as a screening procedure.

Results

In this present study a total of 100 pregnant women were selected who fulfilled the inclusion criteria. The mean age was between 20 – 45 years of age, with an average

age of 30.0±5.4 years old. The average gestational age was 39.2±5.7 from 36 weeks to 42 weeks. Both group of newborns delivered by vaginal delivery and caesarean delivery were included. Among the babies of 50 gdm mothers, 8 babies (7.82%) showed BERA variations, and among 50 babies of normal mothers, 3 babies (4.64%). Comparison of abnormal hearing screening between the two groups are significant different (P < 0.05).

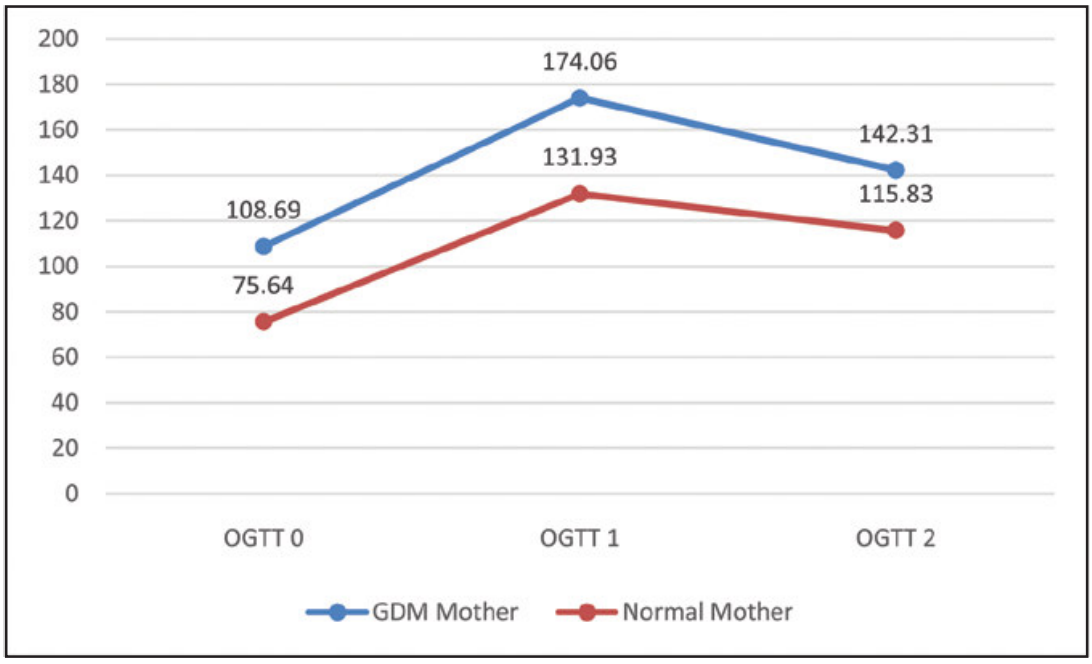

Fig. 2. OGTT among the study participants

Table I : Glucose Challenge test among the study participants

VARIABLE	GDM MOTHER		NORMAL MOTHER		P VALUE
	MEAN	SD	MEAN	SD	
GCT	296	97.44	131.13	9.43	<0.001

Table II: HbA1c among the study participants

VARIABLE	GDM MOTHER		NORMAL MOTHER		P VALUE
	MEAN	SD	MEAN	SD	
HbA1c	6.68	0.59	5.53	0.35	<0.001

Table III: OAE among the study participants

OAE	GDM MOTHER		NORMAL MOTHER		P VALUE
	N	%	N	%	
B/L Pass	21	42	34	68	
B/L Refer	20	40	8	16	
L- Pass R- Refer	3	6	2	4	
R- Pass L- Refer	6	12	6	12	0.038

Table IV: BERA among the study participants

BERA	GDM MOTHER		NORMAL MOTHER		P VALUE
	N	%	N	%	
B/L Minimal HL	1	2	0	0	
B/L Moderate HL	4	8	1	2	
B/L Normal	42	84	49	98	
R Minimal HL	1	2	0	0	
L Moderate HL	1	2	0	0	<0.001

Discussion

According to the World Health Organization, 466 million individuals worldwide suffer from hearing loss that is debilitating. The World Health Organization (WHO), where hearing loss is developing as a serious health problem, predicts that over 1 billion young individuals are at risk of the condition .[8]

According to estimates, 463 million individuals (20-79 years) have diabetes, and the frequency of the disease rises with ageing.[9] Surprisingly, 231 million persons with diabetes do not know they have the disease.[9] Diabetes has been associated with a number of illnesses, including atherosclerosis, which results in kidney disease, retinopathy, neuropathy, and cardiovascular disease. It has been difficult to prove a direct causal relationship between inner ear disease with accompanying hearing loss and the failure of the insulin/glucose signalling that characterises type 2 diabetes.[10]

Some types of hearing loss may be accompanied with diabetic micro-angiopathy in the ear, and both type 1 and type 2 diabetic individuals have been shown to have cochlear alterations. Diabetes resulted in much thicker vascular walls in the stria vascularis and basilar membrane compared to healthy people, as well as a loss of outer hair cells in the basal turns.[11] The beginning of microvascular disease, which comprises thickening of the basement membrane, pericyte degeneration, and endothelial cell hyperplasia, seems to be influenced by endothelial dysfunction.

It has recently been shown in the Nurses' Health Study II Study that maintaining a healthy diet is associated with

a lower incidence of hearing loss.[12] Participants who continued a Mediterranean-style diet or meals low in packaged food and high in dietary fibre showed a decreased incidence of hearing loss when they were examined more than 20 years later. Women who scored in the top 20th percentile for all dietary factors tended to be older, leaner, physically active, and non-smokers.[12] It is well acknowledged that there is a link between hearing loss and the both type 1[13] and type 2[14] diabetes, and that this link is unaffected by the type of diabetes, according to a meta-analysis that included cohorts of patients with both types of diabetes.[15]

In the present study OAE has shown that 40% and 18% had bilateral and unilateral refer in GDM mothers which significantly higher than the normal mothers. In BERA it was shown that 14% had hearing loss among those of the GDM mothers which was significantly higher than the normal mothers. Similarly in a study done Gulen Yidiz,[7] it was shown that initial hearing screening test was unsuccessful in twenty (40.8%) neonates in the GDM group and five (7.7%) neonates in the non GDM group (p =.001). At the first screening, the proportion of neonates in the GDM group with bilaterally unsuccessful hearing screening tests was greater (75% vs. 20%). The second TEOAE hearing screening test was unsuccessful in 15 (75.0%) of 20 neonates in the GDM group and 1 (20.0%) of 5 neonates in the Non GDM group. This is in accordance with the study done by Padmadasan S et al and Zhou JH et al.[16]

Conclusion

This research showed that GDM affects neonates' hearing. Blood glucose levels should be controlled for high-risk populations, combined with quick intervention, standardised therapy, a reasonable diet, and sufficient physical activity. The development of early intervention programmes and the reinforcement of the necessary screening and follow-up procedures are both necessary.

References

1. Hanege FM, Yýlmaz Hanege B, Çelik S, Göçmen A, Kalcýoðlu MT. Is gestational diabetes a risk factor for neonatal hearing loss? Arch Clin Exp Med. 2019;4(1):29-32. doi: 10.25000/acem.491222
2. Karaca CT, Oysu C, Toros SZ, Naiboçlu B, Verim A. Is hearing loss in infants associated with risk factors? Evaluation of the frequency of risk factors. Clin Exp Otorhinolaryngol. 2014;7(4):260-3. doi: 10.3342/ceo.2014.7.4.260, PMID 25436043
3. Stanton SG, Ryerson E, Moore SL, Sullivan-Mahoney M, Couch SC. Hearing screening outcomes in infants of pregestational diabetic mothers. Am J Audiol. 2005;14(1):86-93. doi: 10.1044/1059-0889(2005/008), PMID 16180972
4. Lee JA, Mehta CH, Nguyen SA, Meyer TA. Hearing outcomes in children of diabetic pregnancies. Int J Pediatr Otorhinolaryngol. 2020;132:109925. doi: 10.1016/j.ijporl.2020.109925, PMID 32035347
5. Wang R, Martínez-Frías ML, Graham Jr JM. Infants of diabetic mothers are at increased risk for the oculo-auriculo-vertebral sequence: a case-based and case-control approach. J Pediatr. 2002;141(5):611-7. doi: 10.1067/mpd.2002.128891, PMID 12410187
6. Karagiannis T, Bekiari E, Manolopoulos K, Paletas K, Tsapas A. Gestational diabetes mellitus: why screen and how to diagnose. Hippokratia. 2010;14(3):151-4. PMID 20981162, PMCID PMC2943351
7. Gulen Yýldýz E, Doluoglu S, Karasu Y, Ustun Y. Comparison of hearing screening outcomes in newborns of gestational diabetic and non-diabetic mothers: a prospective, controlled study. J Matern Fetal Neonatal Med. 2022 Sep 9;35(25):10152-7. doi: 10.1080/14767058.2022.2122038, PMID 36093841
8. Deafness and hearing loss [internet]. World Health Organization. World Health Organization; [cited 2022Nov16]. Available from: https://www.who.int/health-topics/hearing-loss.
9. 10th ed [internet]. IDF Diabetes Atlas. [cited 2022Nov16]. Available from: https://diabetesatlas.org/
10. Smith TL, Raynor E, Prazma J, Buenting JE, Pillsbury HC. Insulin dependent diabetic microangiopathy in the inner ear. Laryngoscope. 1995 Mar;105(3 Pt 1):236-40. doi: 10.1288/00005537-199503000-00002, PMID 7877409
11. Agrawal Y, Carey JP, Della Santina CC, Schubert MC, Minor LB. Diabetes, vestibular dysfunction, and falls: analyses from the National Health and Nutrition Examination Survey. Otol Neurotol. 2010 Dec 1;31(9):1445-50. doi: 10.1097/MAO.0b013e3181f2f035, PMID 20856157
12. Curhan SG, Wang M, Eavey RD, Stampfer MJ, Curhan GC. Adherence to healthful dietary patterns is associated with lower risk of hearing loss in women. J Nutr. 2018 Jun 1;148(6):944-51. doi: 10.1093/jn/nxy058, PMID 29757402
13. Teng ZP, Tian R, Xing FL, Tang H, Xu JJ, Zhang BW et al. An

association of type 1 diabetes mellitus with auditory dysfunction: A systematic review and meta-analysis. Laryngoscope. 2017 Jul;127(7):1689-97. doi: 10.1002/lary.26346, PMID 27714821

14. Akinpelu OV, Mujica Mota M, Daniel SJ. Is type 2 diabetes mellitus associated with alterations in hearing? A systematic review and meta-analysis. Laryngoscope. 2014 Mar;124(3):767-76. doi: 10.1002/lary.24354, PMID 23945844

15. Horikawa C, Kodama S, Tanaka S, Fujihara K, Hirasawa R, Yachi Y et al. Diabetes and risk of hearing impairment in adults: a meta-analysis. J Clin Endocrinol Metab. 2013 Jan 1;98(1):51-8. doi: 10.1210/jc.2012-2119, PMID 23150692

16. Zhou JH, Yu K, Ding H, Zhu ZH, Han LH, Zhang T. A clinical study on gestational diabetes mellitus and the hearing of newborns. Diabetes Metab Syndr Obes. 2021;14:2879-82. doi: 10.2147/DMSO.S290647, PMID 34234485.