High Prevalence of Cytomegalovirus IgG Positivity Among Children with Congenital Sensorineural Hearing Loss: A Retrospective Observational Study of 273 Cases

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***Abstract*—Cytomegalovirus (CMV) is a major non-genetic cause of congenital sensorineural hearing loss (SNHL), yet routine screening remains limited in many regions, including India. This retrospective observational study analyzed 273 children with congenital SNHL evaluated at a tertiary ENT center in Gujarat as a part of pre-operative evaluation for cochlear implant surgery. Demographic data, audiological profiles, and CMV IgG/IgM serology results were reviewed. CMV IgG positivity was observed in 237 children (86.8%), suggesting significant early-life CMV exposure in this population. Most CMV-seropositive children presented with severe-to-profound hearing loss, while no significant association was noted with laterality. The high seroprevalence highlights the likelihood of unrecognized congenital CMV infections, limited awareness, and absence of standardized newborn CMV screening protocols in India. These findings underscore the importance of integrating CMV-related diagnostic pathways into pediatric hearing-loss evaluations to enable timely identification and early intervention.**

I. INTRODUCTION

Congenital sensorineural hearing loss (SNHL) is one of the most significant developmental disabilities worldwide, and congenital cytomegalovirus (CMV) infection represents the leading non-genetic cause of this impairment. [1,3] CMV is a ubiquitous betaherpesvirus with a complex life cycle and the ability to establish lifelong latency in humans, often producing silent or asymptomatic infection in immunocompetent individuals.[1] Maternal infection—whether primary or recurrent—can result in transplacental fetal transmission [4], leading to neurodevelopmental sequelae including microcephaly, visual impairment, developmental delay, and SNHL. Despite its substantial burden, congenital CMV continues to be under-recognized globally due to limited awareness, diagnostic challenges, and absence of universal screening protocols.

The pathophysiology of CMV-associated hearing loss is multifactorial discussed in detail under discussion section. India has one of the highest CMV seroprevalence rates globally [5,6], with studies showing 80–90% maternal IgG positivity in antenatal women [5,6], reflecting widespread early-life exposure and a high risk of congenital infection. Despite this, systematic CMV screening is not routinely incorporated into neonatal hearing-loss evaluation pathways. This gap is significant because relying solely on clinical signs misses a majority of infected infants, given that most congenital CMV cases are asymptomatic at birth[1,2]. In regions like Gujarat, where both maternal seroprevalence and pediatric hearing-loss burden are high, CMV-related etiologies may be overlooked, leading to delayed diagnosis and missed opportunities for early intervention.

Recognizing this gap, the present retrospective observational study analyzes 273 children with congenital SNHL in Gujarat to determine the prevalence of CMV IgG positivity and explore its clinical significance. By evaluating serological patterns within this large pediatric cohort, the study aims to highlight the magnitude of CMV exposure in children with congenital hearing loss and underscore the importance of strengthening awareness, diagnostic pathways, and early screening measures.

II. MATERIALS AND METHODS

This retrospective observational study was conducted at the Department of ENT, Sola Civil Hospital, Ahmedabad, Gujarat, over a two-year period from January 2023 to January 2025. The study population included 273 children under six years of age who presented with congenital sensorineural hearing loss and were evaluated for cochlear implant candidacy. Only pre-lingual congenital hearing loss cases were included, while children with post-lingual, acquired, syndromic, traumatic, meningitis-related, or ototoxicity-related hearing loss were excluded, along with those having incomplete medical or serological records. All participants underwent a standardized institutional TORCH screening protocol. CMV serology revealed CMV IgG positivity in 237 children, while one child demonstrated CMV IgM positivity, which was subsequently confirmed by urine RT-PCR; this child was started on antiviral therapy as recommended by the paediatric specialist. Two children tested positive for HSV IgG and one for rubella IgG, all of whom were clinically asymptomatic. Maternal histories across all cases indicated absence of symptoms, uneventful pregnancies, and normal deliveries. The cohort comprised 113 male and 160 female children. Audiological evaluation included otoacoustic emissions, auditory brainstem response, tympanometry, and age-appropriate behavioural audiometry, supplemented by radiological assessment using high-resolution CT of the temporal bone and MRI of the brain and internal auditory canal. Data regarding demographics, clinical profiles, serology, and audiological findings were extracted from hospital records. Statistical analysis included descriptive metrics to determine prevalence patterns, with group comparisons performed using the Chi-square or Fisher's exact test, and significance set at $p < 0.05$. Ethical approval was obtained through institutional guidelines, and all data were anonymized to ensure patient confidentiality.

III. RESULT

A total of 273 children under six years of age with congenital sensorineural hearing loss were included in the study. The cohort consisted of 113 males (41.4%) and 160 females (58.6%). CMV IgG antibodies were detected in 237 children, yielding a seroprevalence of 86.8%, while CMV IgM positivity was identified in a single child who was subsequently confirmed positive on urine RT-PCR and initiated on antiviral therapy. Apart from CMV, TORCH screening revealed HSV IgG positivity in two children and rubella IgG positivity in one child, all asymptomatic with uneventful maternal and perinatal histories.

Variable	Count
Total children evaluated	273
Male	113 (41.4%)
Female	160 (58.6%)

Table 1. Demographic Distribution of the Study Population.

Serology Result	Count	Percentage
CMV IgG Positive	237	86.8%
CMV IgM Positive	1	0.36%
HSV IgG Positive	2	0.73%
Rubella IgG Positive	1	0.36%

Table 2. TORCH Serology Results

he statistical evaluation of 273 children with congenital sensorineural hearing loss demonstrated an exceptionally high CMV IgG seroprevalence of 86.8%, with a tightly bounded 95% confidence interval (82.5%–90.1%). This strongly suggests widespread early-life exposure to CMV in this pediatric population. A single confirmed case of acute CMV infection (IgM+ with urine PCR+) highlights that most children likely experienced past CMV exposure, consistent with known Indian maternal seroprevalence trends. Non-CMV TORCH infections were rare (1.1%), reinforcing that CMV was the predominant infectious correlate in this cohort.

IV. DISCUSSION

Congenital cytomegalovirus (cCMV) is well established as the most common non-genetic infectious cause of childhood sensorineural hearing loss (SNHL), and its clinical course is notable for frequent asymptomatic presentation at birth with

subsequent delayed, progressive, or fluctuating hearing impairment. Global birth prevalence estimates for cCMV range from approximately 0.2% to 2% with an overall pooled birth prevalence near 0.5% in contemporary screening studies; among all infants with cCMV, roughly 8–13% will develop SNHL at some point in early childhood. Importantly, a substantial fraction of children with cCMV who later develop SNHL were asymptomatic as neonates and may pass newborn hearing screening (UNHS) only to acquire hearing loss months to years later, which makes early virologic identification and longitudinal audiologic surveillance essential. These epidemiologic observations and long-term outcome data are well summarized in recent multicenter and review studies.

Pathophysiology of CMV-related auditory injury involves direct viral invasion and replication within inner-ear structures, secondary inflammatory responses, and progressive neuronal degeneration. Animal and human studies suggest CMV can infect the cochlear epithelium and spiral ganglion neurons, producing cytopathic changes and inflammatory mediators that disrupt cochlear homeostasis and synaptic integrity; this combination plausibly explains why hearing loss can be unilateral or bilateral, immediate or delayed, and often progressive or fluctuating. The heterogeneity of pathophysiologic mechanisms explains why early identification is valuable even in apparently asymptomatic infants: identifying the viral etiology permits focused audiologic follow-up and consideration of therapeutic options where evidence supports benefit.

Detection and diagnostic timing are critical. Definitive diagnosis of congenital infection requires virologic confirmation (PCR or viral culture) on saliva or urine obtained within the first 21 days of life; testing after that window risks identifying postnatal acquisition (most commonly via breast milk or close contact) that is not generally associated with cCMV-related SNHL. Dried blood spot (DBS) PCR can be useful for retrospective diagnosis when neonatal samples are unavailable, but sensitivity is lower than saliva/urine PCR and negative DBS does not exclude cCMV. Thus, a practical operational principle is that any infant who fails UNHS (or who has risk factors or clinical features suggestive of cCMV) should undergo early targeted virologic testing (saliva/urine PCR within 21 days). Several expert consensus statements and large cohort analyses emphasize this point and have informed the rising interest in hearing-targeted CMV screening programs.

Screening strategies have been debated widely: universal newborn CMV screening would detect all cCMV cases but carries higher cost and logistical complexity; hearing-targeted screening (testing only newborns who fail UNHS) is more economical and identifies many infants at immediate risk of SNHL, but misses asymptomatic neonates who pass UNHS and later develop delayed SNHL. The CHIMES and other investigations documented that a non-negligible proportion of cCMV-associated late-onset hearing loss occurs in infants who initially passed UNHS, reinforcing the limitations of hearing-targeted approaches alone and the need for longitudinal audiologic follow-up in newborns with known cCMV exposure. Cost-effectiveness analyses show tradeoffs between upfront screening costs and downstream savings from earlier intervention and potential reduction in cochlear implantation and special-education needs; local resource considerations determine optimal policy choice.

Management of cCMV-associated SNHL includes careful surveillance and, in selected patients, antiviral therapy. Randomized controlled data support ganciclovir/valganciclovir for neonates with symptomatic cCMV involving the central nervous system, demonstrating improved hearing and neurodevelopmental outcomes in this subgroup. The evidence for treating asymptomatic infants with isolated SNHL is limited and heterogeneous: older observational series, smaller cohorts, and nonrandomized reports suggest possible benefit in preserving or stabilizing hearing thresholds in some cases, but uncertainty remains about durability of effect, optimal timing, and risk–benefit balance given the potential hematologic and hepatic toxicity of antivirals. Recent large tertiary-clinic cohort analyses indicate treated children may show less progression of hearing deterioration than untreated counterparts, but these studies are retrospective and confounded by selection bias (sicker children or those with identified cCMV may be preferentially treated). Consequently, most current guidelines recommend antiviral therapy for neonates with moderate-to-severe symptomatic disease (especially CNS involvement), while the use

of antivirals for asymptomatic infants with isolated SNHL is considered on a case-by-case basis after multidisciplinary discussion (pediatric infectious disease, neurology, audiology, and family), ideally within research protocols when possible. Vigilant laboratory monitoring (CBC, liver/renal parameters) is required during antiviral administration.

India presents particular considerations. Maternal CMV IgG seroprevalence in many Indian cohorts is high (commonly ~80–90%) [5,6], meaning most women have prior exposure; however, primary infections and reinfections/re-exposures can still lead to fetal transmission. High maternal seroprevalence paradoxically may be associated with a substantial absolute number of congenital infections at the population level because reactivation or reinfection events occur across a large seropositive pool. Regional studies from India confirm high antenatal IgG seropositivity (e.g., 83% IgG in a tertiary-center antenatal cohort), and detectable IgM in a minority, highlighting both widespread exposure and an identifiable susceptible minority. These data imply that both universal prevention messages (hygiene counselling for seronegative pregnant women) [4] and targeted newborn evaluation in infants at risk are relevant in the Indian context.

Prevention in the absence of a licensed CMV vaccine currently relies on pragmatic, evidence-based behavioral measures: strict hand hygiene after diaper changes or contact with saliva/respiratory secretions, avoiding sharing of food/utensils or direct mouth contact with young children, and education of seronegative pregnant women (and childcare workers) regarding exposure risks. These simple measures have been shown to reduce maternal seroconversion risk and are recommended by multiple review bodies as the cornerstone of primary prevention, particularly in high-seroprevalence settings where vaccine access is not yet realized. Vaccine research is active but not yet practice-changing.

For detection and assessment of hearing in infants with suspected or confirmed cCMV, an evidence-based pathway includes: confirmatory virology with saliva or urine PCR within 21 days of life (or DBS PCR if retrospective diagnosis is necessary, acknowledging reduced sensitivity), baseline diagnostic audiology (ABR/OAE and tympanometry) prior to discharge or at first presentation, and a structured long-term audiologic surveillance schedule (for example, diagnostic audiology at 3, 6, 9, 12, 18, and 24 months and then every 6–12 months through early school age, with earlier or more frequent testing if thresholds change). Imaging (high-resolution CT and MRI) and genetic testing should be incorporated when clinically indicated or when alternative causes need exclusion. Identification of cCMV before 21 days can streamline etiologic work-up and spare families prolonged, costly investigation for rarer causes of congenital SNHL.

Regarding therapeutic approaches for hearing specifically, the literature supports antiviral therapy for symptomatic neonates with CNS involvement; for asymptomatic infants with isolated SNHL, the data are inconclusive but suggest that some treated infants may experience less progression or later decline in thresholds. Because of toxicity concerns [10] and incomplete evidence for long-term benefit in asymptomatic infants, antiviral therapy should be considered selectively; if initiated, valganciclovir dosing regimens are typically guided by neonatal trials and expert reviews, with careful hematologic and hepatic monitoring during treatment and afterward. Multidisciplinary decision-making and consideration of enrollment into clinical trials or registries are advisable. Cochlear implantation remains a successful rehabilitative option for children with severe-to-profound SNHL of CMV etiology, with outcomes influenced by age at implantation and presence of additional neurodevelopmental disabilities. Longitudinal data suggest that early identification of cCMV and timely pathway entry improves access to amplification and implantation when required.

Practical implication: First, integrating hearing-targeted cCMV testing (saliva/urine PCR for infants who fail UNHS) is an achievable, high-yield step that many centers worldwide are adopting and that aligns with resource-aware practice; this approach captures many infants at immediate risk and facilitates prompt audiologic surveillance. Second, because a proportion of cCMV infants pass UNHS but later develop SNHL, clinicians must institute extended audiologic follow-up for at-risk infants and for infants born to mothers with documented seroconversion during pregnancy. Third, antenatal programs should emphasise primary prevention education (hand hygiene, reduced exposure to saliva/diapers, avoidance of sharing utensils) for seronegative women and high-risk groups. Fourth, in

cochlear implant evaluation pathways (as in your cohort), routine inclusion of TORCH screening, with reflex confirmatory PCR for early postnatal testing where possible, yields valuable etiologic information and guides counselling and follow-up. Finally, antiviral therapy decisions for asymptomatic infants with isolated SNHL should be individualized, made by a multidisciplinary team, and, when chosen, performed with rigorous monitoring and parental informed consent; where possible, centers should participate in registries or trials to build the evidence base.

In summary, the global and Indian literature converge on several points: (1) asymptomatic cCMV is common and significantly contributes to the burden of childhood SNHL; (2) timing matters — virologic diagnosis within 21 days is essential to attribute infection to the congenital period; (3) hearing-targeted CMV screening and extended audiologic surveillance offer practical, resource-sensitive strategies to detect many cases at risk of SNHL; (4) antiviral therapy is proven for symptomatic neonates with CNS disease but remains investigational for asymptomatic infants with isolated SNHL; and (5) prevention via maternal education and improved awareness is an immediately implementable public-health priority in India. These points should inform policy and clinical pathways in Gujarat and similar settings to improve early detection, intervention, and outcomes for children with cCMV-associated hearing loss.

V. CONCLUSION

This study demonstrates an exceptionally high prevalence of CMV IgG seropositivity among children with congenital sensorineural hearing loss in Gujarat, suggesting significant early-life CMV exposure in this population. Although seropositivity did not show a statistically significant association with laterality or severity of hearing loss, the high IgG burden aligns with global and Indian evidence that asymptomatic congenital CMV infection remains frequently unrecognized yet clinically important. Early virologic testing within the neonatal period, structured long-term audiologic surveillance, and improved maternal awareness represent critical strategies to enhance early detection and reduce missed diagnoses. Given the established role of CMV in pediatric hearing impairment, integrating CMV-focused diagnostic pathways into newborn hearing and cochlear implant programs is essential for timely intervention and improved auditory outcomes.REFERENCES

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