

## Waardenburg Syndrome: A Rare Cause of Sensorineural Hearing Loss in Infancy

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### Abstract

**Introduction:** Waardenburg syndrome is a rare disease characterized by deafness in association with pigmentary anomalies and defects of neural crest-derived tissues; It is responsible for about 2% of profound congenital hearing loss.

**Case Report:** We report the case of a 4 years old male child with chief complaint of decreased hearing in both ears since childhood, and delayed speech development. The child had features characteristic of Waardenburg syndrome type I. The cochlear implant was performed in the following month with a favorable evolution reported on the APCEI, COR and SIR scales.

**Conclusion:** Waardenburg syndrome is a rare cause of sensorineural hearing loss in children. In this case, it was a type I of Waardenburg syndrome. Because of the profound hearing loss, cochlear implantation was indicated and was performed with a favorable evolution.

**Keywords:** Case Report; Waardenburg Syndrome; Hearing Loss; Cochlear Implant

### Introduction

Waardenburg syndrome is a rare autosomal genetic disorder, with an incidence of 1 in 40.000. It manifest by sensorineural deafness, pigmentations defects of the skin, hair, iris, and various defect of neural crest derived tissues [1].

Described by Petrus Johannes Waardenburg in 1951 [2], It is Caused by physical absence of melanocyte from the skin, hair, eyes and the striavascularis of the cochlea. Melanocytes make a pigment: the melanin which plays an essential role in the normal function of the inner ear, and contributes to skin, hair and eyes color. It is due to mutations of genes: PAX3, EDN3, EDNRB, MITF, SNAI2, SOX10 [3].

Out of five major and five minor criteria of waardenburg syndrome, either two major or one major plus two minor criteria must be present for diagnosis Waardenburg syndrome [4] and it is classified into four clinical types: I - IV

- **+ Type I and III:** Are caused by mutations in the PAX3 gene.
- **+ Type II:** Mutation in the MITF and SNAI2.
- **+ Type IV:** Mutation in the SOX10, EDN3 and EDNRB [5].

Variable penetrance and gene expression of different clinical features of the four subtypes have been described [6]. Type III is similar to type I with additional musculo skeletal abnormalities, type IV is associated with Hirschprung disease [6].

Waardenburg syndrome is responsible for about 2% of profound congenital hearing loss. Congenitally deaf children with WS, severely or profoundly impaired with limited hearing aids benefit, have been integrating cochlear implant programs with encouraging results comparable to those reported for the general population of implanted children [7].

We report a case of a 4 year old male with Clinical features of Waardenburg syndrome with chief complaint of bilateral decreased hearing.

### Case Report

A 4-year-old male child presented to the ENT-HNS department at the hospital 20 August 1953 Casablanca Hospital with chief complaint of decreased hearing in both ears since childhood, and delayed speech development. The child comes from a non-consanguineous marriage, the only one of his parents.

The clinical examination finds sapphire blue eyes, a whitish frontal wick, depigmented skin patches on both hands and a canthal dystopia. The otoscopic examination of the two ears finds a normal eardrum (no signs of otitis); the rest of the clinical examination finds no other abnormalities in particular musculoskeletal or antecedent of Hirschsprung's disease. Visual acuity was 10/10 in both eyes and the psychomotor development was good (Figure 1 and 2).



**Figure 1:** Sapphire blue eyes.



**Figure 2:** Skin depigmentation in both hands.

In view of these clinical signs, the diagnosis of Waardenburg syndrome type I was retained.

Viewing the deep deafness, an auditory potential evoked was demanded and found a deep bilateral sensorineural hearing loss with absence of wave V at 100 dB.

The scan of the temporal bone finds the cavities of the middle ear well ventilated, no abnormalities of the ossicular chain, nor cochlear or the internal auditory canal was detected. This latter appears with a normal size and not enlarged.

The MRI of the cerebellopontine angle and internal auditory meatus finds a normal; non-hypoplastic; acoustic-facial bundle, permeable cochlea, and no signal abnormalities at the cochlear level or at the cerebellopontine angle.

Given these criteria; profound bilateral sensorineural hearing loss and absence of abnormalities at the radiological examination, the child was classified as a candidate for cochlear implantation. The cochlear implant was performed in the following month with a favorable evolution reported on the APCEI, COR and SIR scales (Figure 3).



**Figure 3:** Cochlear implant device.

### Discussion

Waardenburg syndrome is a rare disease characterized by deafness in association with pigmentary anomalies and defects of neural crest-derived tissues. It is characterized by clinical manifestations of oculocutaneous anomalous pigmentation, deafness of varying degree, dystopia canthorum and broad nasal root. This disorder was named after a Dutch ophthalmologist, Petrus Waardenburg, who first described it in 1947 [2]. His investigation of deaf patients with depigmentation and dysmorphology features led to the description of Waardenburg syndrome, now known as type I WS. There are four clinical subtypes of Waardenburg depending on the presence of various clinical features [8].

The estimated prevalence of WS is approximately 1 case per 42,000 individuals [8]. WS I is 1.5 - 2 times more common than WS II; type III and IV are far rarer forms of WS. It is an autosomal disorder with genetic heterogeneity and not all of its forms are dominantly inherited, as previously assumed [9]. Sensorineural hearing loss is quite a frequent feature in Waardenburg syndrome, reported in 60% and 90% of patients with type I and type II, respectively. Bilateral forms of hearing loss are more frequent than unilateral, but not necessarily symmetrical [10]. The extent of hearing impairment is a quite variable feature within and between families, ranging from no measurable clinical loss to profound deafness [10].

These auditory-pigmentary syndromes are caused by physical absence of melanocytes from the skin, hair, eyes, or the stria vascularis of the cochlea. Absence of melanocytes could be because of a failure of differentiation in the neural crest, a failure of melanoblasts to migrate, or a failure to terminally differentiate and survive in their final location [3]. WS2 may be melanocyte specific, whereas WS 1 and the rare variants WS3 and WS4 are neurocristopathies, involving the frontal bone, limb muscles, and enteric ganglia, respectively. All these extra tissues are neural crest derivatives [8]. Multiple genes have been implicated in the syndrome. Abnormalities in the PAX3 gene accounts for most of WS1 and WS3 patients. MITF (microphthalmia associated transcription factor) gene abnormality is responsible for WS2. WS4 is heterogeneous, with reported mutations in EDN3 (endothelin 3), in its receptor EDNRB (endothelin receptor type B), or in SOX10 (SRY-sex determining region Y) [11].

Penetrance study of sensorineural deafness showed 69% penetrance in WS1 and 87% in WS2. WS I and II are autosomal dominant in most of cases. WS III is usually sporadic but when it occurs in families, inheritance is autosomal dominant. Type IV is probably autosomal recessive [6,12].

As per the diagnostic criteria proposed by Waardenburg consortium for diagnosing WS I, two major or one major plus two minor criteria should be present. WS III is similar to type I with additional musculoskeletal abnormalities. People who present with type 3 (Klein-Waardenburg syndrome) present with hypoplastic muscles and contractures of the upper limbs in addition to WS type 1 features. WS IV is associated with Hirschsprung disease.

WS II is characterized by more frequent occurrence of sensorineural hearing loss and heterochromia iridis but absence of dystopia canthorum [13].

The patient under study had the following features characteristic of Waardenburg syndrome type I:

- Bilateral sensorineural hearing loss.
- Prominent white forelock of hair.
- Bilateral blue iris.
- White depigmented lesion on the both hands.

Waardenburg syndrome is responsible for about 2% of profound congenital hearing loss. Congenitally deaf children with WS, severely or profoundly impaired with limited hearing aids benefit, have been integrating cochlear implant programs with encouraging results comparable to those reported for the general population of implanted children [7].

One of the reasons to be aware of the clinical features of WS is differentiation from other pigment disorders like oculocutaneous albinism, nevus amenicus, hypomelanosis of Ito, piebaldism and vitiligo.

### Conclusion

Waardenburg syndrome is a rare cause of sensorineural hearing loss in children. In this case, it was a type I of WS. Because of the profound hearing loss, cochlear implantation was indicated and was performed with a favorable evolution.

### Informed Consent

The patient gave us informed consent for publication.

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