Cureus
Part of SPRINGER NATURE

Open Access Case Report

# Thyroglobulin-Related Thyroid Dyshormonogenesis Presenting as Congenital Hypothyroidism With Mild Hearing Loss: A Case Report

Suki Suk-yan Chan [1], Joanna Yuet-ling Tung [1], Sarah Wing-yiu Poon [1], Gloria Shir-wey Pang [1]

1. Department of Paediatrics and Adolescent Medicine, Hong Kong Children's Hospital, Kowloon, HKG

**Corresponding author:** Gloria Shir-wey Pang, gloriapsw@gmail.com

**Review began** 10/10/2026
**Review ended** 11/02/2026
**Published** 11/05/2026

© **Copyright** 2026
Chan et al. This is an open access article distributed under the terms of the Creative Commons Attribution License CC-BY 4.0., which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

**DOI:** 10.7759/cureus.119166

## Abstract

Congenital hypothyroidism (CH) is one of the most common and preventable causes of neurodevelopmental impairment in childhood. Mutations in the thyroglobulin (*TG*) gene are a recognised cause of thyroid dyshormonogenesis, with a variable clinical presentation. However, associated hearing abnormalities have rarely been described. We report a case of a two-year-old Chinese male child diagnosed with congenital primary hypothyroidism through newborn screening, with a cord blood thyroid-stimulating hormone level of 781 mIU/L and free thyroxine of 5.4 pmol/L. Thyroid imaging revealed a normally located thyroid gland without enlargement. In addition, the patient failed bilateral newborn hearing screening, with subsequent auditory testing demonstrating mild hearing loss. Serum thyroglobulin (Tg) was undetectable (<0.1 µg/L), raising suspicion of an underlying Tg synthesis defect. Whole-exome sequencing identified two heterozygous pathogenic *TG* variants (c.274+2T>G and c.1333C>T), supporting a diagnosis of *TG*-related thyroid dyshormonogenesis. Levothyroxine treatment was commenced on Day 2 of life, with subsequent normalisation of thyroid function and age-appropriate growth and development. This case highlights the diagnostic utility of serum Tg measurement in children with congenital hypothyroidism and a eutopic thyroid gland, as well as the role of genetic testing in supporting the diagnosis. The coexistence of hearing impairment in this patient represents a clinical finding with an uncertain relationship to *TG*-related dyshormonogenesis and warrants further evaluation.

**Categories:** Pediatrics
**Keywords:** congenital hypothyroidism, dyshormonogenesis, hearing loss, newborn screening, tg gene, thyroglobulin, thyroglobulin deficiency

## Introduction

Congenital hypothyroidism (CH) is one of the most common and preventable endocrine disorders of infancy. If left untreated, CH can result in irreversible neurocognitive impairment as well as significant disturbances in growth and development [1]. A recent meta-analysis reported a pooled global prevalence of 4.25 cases per 10,000 live births [2]. Owing to the widespread implementation of newborn screening programmes, the majority of affected infants are now identified before the onset of clinical manifestations [1].

The genetic causes of CH can be broadly classified into two major categories according to their underlying pathophysiology: (i) thyroid dysgenesis, resulting from abnormalities in thyroid gland development, and (ii) thyroid dyshormonogenesis, caused by defects in thyroid hormone biosynthesis [3]. Genes associated with thyroid dyshormonogenesis include DUOX1, DUOX2, DUOXA1, DUOXA2, SLC26A4, SLC26A7, SLC5A5, TPO, IYD, and TG [1,3].

Mutations in the thyroglobulin (TG) gene are a well-established cause of thyroid dyshormonogenesis, with an estimated incidence of approximately 1 in 100,000 newborns, and follow an autosomal recessive mode of inheritance [4]. One of the earliest reports linking a TG gene variant to congenital goitre and hypothyroidism was published by Ieiri et al. in 1991. In that study, a splice-site variant caused abnormal mRNA splicing and deletion of exon 4 from the major TG transcript, providing early evidence that defects in the TG gene can result in congenital hypothyroidism [4].

Thyroglobulin (Tg) is a large glycoprotein synthesised by thyroid follicular cells and serves as both the substrate for thyroid hormone synthesis and the major storage protein for iodinated thyroid hormones. Following synthesis, Tg undergoes post-translational processing and is secreted into the follicular lumen, where thyroid hormone production occurs [5].

Thyroid hormone synthesis requires coordinated interactions between Tg, iodide, thyroid peroxidase (TPO), and hydrogen peroxide ($H_2O_2$). TPO catalyses the iodination of tyrosine residues on Tg and subsequent coupling reactions to generate thyroxine (T4) and triiodothyronine (T3). The iodinated Tg is then reabsorbed

by thyroid follicular cells and degraded, releasing T3 and T4 into the circulation [6].

The TG gene is a single-copy gene located on chromosome 8q24.2-q24.3 and comprises 48 exons. To date, more than 229 disease-associated TG variants have been reported, including missense, nonsense, frameshift, splice-site, and large or small deletion variants [7]. These variants may interfere with different stages of Tg biosynthesis, including protein folding, glycosylation, dimerisation, intracellular trafficking, secretion, or the availability of hormonogenic tyrosine residues. Nonsense and frameshift variants may generate prematurely truncated proteins or transcripts that undergo nonsense-mediated decay, whereas missense and splice-site variants may produce full-length or abnormal Tg proteins with impaired folding or secretion [6].

Misfolded Tg proteins are retained within the endoplasmic reticulum, where they are targeted for endoplasmic reticulum-associated degradation rather than transported to the follicular lumen. Consequently, the amount of functional Tg available for iodide storage, tyrosine iodination, and intramolecular T3 and T4 synthesis is markedly reduced [7]. The resulting decrease in thyroid hormone production diminishes negative feedback on the hypothalamic-pituitary-thyroid axis, leading to increased secretion of thyrotropin-releasing hormone (TRH) and thyroid-stimulating hormone (TSH). Chronic TSH stimulation promotes thyroid follicular cell hypertrophy and hyperplasia, explaining the frequent occurrence of congenital or progressively enlarging goitre in individuals with TG-related dyshormonogenesis [6,7].

Therefore, pathogenic TG variants cause congenital primary hypothyroidism through impaired Tg synthesis, maturation, or secretion. The resulting deficiency of functional Tg within the follicular lumen compromises the substrate required for TPO-mediated iodination and coupling reactions, ultimately reducing thyroid hormone synthesis and leading to hypothyroidism [7].

Earlier reports frequently described the coexistence of hypothyroidism and goitre in affected individuals [4,8]. However, with the advent of newborn screening, affected infants are increasingly diagnosed before the development of significant thyroid enlargement, and goitre is now more commonly observed in cases of delayed diagnosis [1]. Individuals with TG mutations typically manifest permanent congenital hypothyroidism [1,9]. Thyroid hormone plays an important role in the development and maturation of the auditory system, and hearing abnormalities have been reported in children with congenital hypothyroidism despite early treatment. However, unlike SLC26A4-associated disease, hearing impairment is not a recognised feature of TG-related thyroid dyshormonogenesis. Consequently, the coexistence of congenital hypothyroidism and hearing loss may present a diagnostic challenge and warrant further genetic evaluation [3].

We report the case of a child with congenital hypothyroidism secondary to TG-related thyroid dyshormonogenesis identified through newborn screening, with concomitant mild hearing impairment.

## Case Presentation

A two-year-old Chinese boy was born following an uneventful pregnancy and delivery, with a birth weight of 2.81 kg.

Newborn screening identified congenital hypothyroidism, with a cord blood thyroid-stimulating hormone (TSH) level of 781 mIU/L (reference range 0.72-11 mIU/L) and a free thyroxine (fT4) level of 5.4 pmol/L (reference range 11.5-28.3 pmol/L). At one year of age, serum thyroglobulin was <0.1 μg/L, and anti-thyroglobulin antibodies were negative. Thyroid ultrasound and radionuclide imaging demonstrated a thyroid gland of normal size and orthotopic location (imaging unavailable). Levothyroxine 50 μg daily (17.8 μg/kg/day) was commenced on Day 2 of life.

There was no maternal history of thyroid disease before or during pregnancy. Maternal thyroid function testing was normal. There was no family history of thyroid disease or hearing impairment.

Newborn automated auditory brainstem response (AABR) screening failed bilaterally. Subsequent auditory brainstem response (ABR) testing at 1 month of age demonstrated mild hearing loss in the left ear (26-40 dBeHL), affecting both low frequencies (35 dBeHL) and high frequencies (40 dBeHL). In the right ear, hearing was normal at low frequencies (25 dBeHL; overall range -10 to 25 dBeHL), but mild high-frequency hearing loss (40 dBeHL) was demonstrated.

On physical examination, weight was at the 75th percentile and height at the 50th percentile. Mid-parental height was calculated at 179.5 cm, corresponding to the 91st percentile. There was no goitre and no clinical features suggestive of hypothyroidism, including facial puffiness, hoarse cry, macroglossia, or umbilical hernia.

Given the coexistence of congenital hypothyroidism and hearing loss, whole-exome sequencing was performed. Genetic analysis identified two heterozygous pathogenic variants in the TG gene: c.274+2T>G

and c.1333C>T. Based on the clinical, biochemical, and genetic findings, TG-related thyroid dyshormonogenesis was considered the most likely diagnosis (Tables *1*, *2*). The parents were referred for genetic testing.

| Parameter | Finding |
|---|---|
| Sex | Male |
| Ethnicity | Chinese |
| Birth weight | 2.81 kg |
| Newborn screening TSH | 781 mIU/L (reference 0.72-11) |
| Free T4 | 5.4 pmol/L (reference 11.5-28.3) |
| Thyroglobulin | <0.1 µg/L |
| Thyroid ultrasound | Eutopic thyroid gland |
| Radionuclide scan | Normal-sized eutopic thyroid gland |
| Age at treatment initiation | Day 2 of life |
| Initial levothyroxine dose | 50 µg/day (18 µg/kg/day) |
| Failed newborn hearing screening | Bilateral AABR failure |
| ABR at 1 month | Mild bilateral hearing impairment, predominantly high-frequency |
| CPA at 2 years | Minimum mild hearing loss in better-hearing ear |
| Tympanometry | Bilateral negative middle-ear pressure |
| Development at 2 years | Age-appropriate motor, social, speech and language development |
| Current levothyroxine dose | 50 µg/day (4 µg/kg/day) |

**TABLE 1: Clinical, Biochemical, and Audiological Summary**

TSH: thyroid-stimulating hormone; T4: thyroxine; AABR: automated auditory brainstem response; ABR: auditory brainstem response; CPA: conditioned play audiometry.

| Gene | Reference Transcript | Variant | Predicted Effect | ACMG Classification |
|---|---|---|---|---|
| TG | NM_003235.5 | c.274+2T>G | Splice-site variant | Pathogenic |
| TG | NM_003235.5 | c.1333C>T | Nonsense variant | Pathogenic |

**TABLE 2: Genetic Findings**

TG: thyroglobulin; ACMG: American College of Medical Genetics and Genomics.

At two years of age, developmental progress was normal, with age-appropriate gross motor, fine motor, social, and speech-language milestones. He used two- to three-word phrases and demonstrated age-appropriate receptive and expressive language skills. No developmental concerns were identified. Conditioned play audiometry (CPA) demonstrated mild hearing loss in the better-hearing ear. Tympanometry showed bilateral negative middle-ear pressure, suggesting possible mild conductive involvement. The exact mechanism of hearing impairment remains uncertain. Initial ABR testing demonstrated mild hearing loss, whereas later tympanometry findings raised the possibility of a conductive component. Continued follow-up with otolaryngology and audiology has been arranged to further characterise the hearing deficit. Levothyroxine replacement therapy was adjusted according to the thyroid function levels, with the latest levothyroxine dose at 4 µg/kg/day. Serial thyroid function test results and levothyroxine dose adjustments are summarised in Table *3*.

| Age | TSH (mIU/L) | Free T4 (pmol/L) | Levothyroxine (µg/day) | Dosage (µg/kg/day) |
|---|---|---|---|---|
| Birth/Newborn screen | 781 (Ref 0.72-11.0) | 5.4 (Ref 11.5-28.3) | 50 | 18 |
| Day 4 | 504 (Ref 0.72-11.0) | 24.5 (Ref 11.5-28.3) | 50 | 18 |
| 1 month | 1.82 (Ref 0.7-5.97) | 40.7 (Ref 12.0-23.0) | 37.5 | 8 |
| 2 months | 1.16 (Ref 0.7-5.97) | 26.5 (Ref 12.0-23.0) | 37.5 | 8 |
| 3 months | 2.12 (Ref 0.7-5.97) | 23.0 (Ref 12.0-23.0) | 37.5 | 5 |
| 5 months | 21.9 (Ref 0.7-5.97) | 17.0 (Ref 12.0-23.0) | 50 | 6 |
| 6 months | 2.12 (Ref 0.7-5.97) | 28.0 (Ref 12.0-23.0) | 50 | 6 |
| 7 months | 1.90 (Ref 0.7-5.97) | 18.0 (Ref 12.0-23.0) | 50 | 6 |
| 10 months | 0.08 (Ref 0.7-5.97) | 20.0 (Ref 12.0-23.0) | 43 | 5 |
| 11 months | 73.7 (Ref 0.7-5.97) | 10.0 (Ref 12.0-23.0) | 50 | 5 |
| 12 months | 4.99 (Ref 0.7-5.97) | 17.0 (Ref 12.0-23.0) | 50 | 5 |
| 15 months | 1.68 (Ref 0.7-5.97) | 21.0 (Ref 12.0-23.0) | 50 | 4 |
| 17 months | 8.80 (Ref 0.7-5.97) | 19.0 (Ref 12.0-23.0) | 62.5 | 5 |
| 21 months | 0.31 (Ref 0.7-5.97) | 29.0 (Ref 12.0-23.0) | 50 | 4 |
| 23 months | 3.39 (Ref 0.7-5.97) | 25.0 (Ref 12.0-23.0) | 50 | 4 |

**TABLE 3: Thyroid Results and Treatment Course**

TSH: thyroid-stimulating hormone; T4: thyroxine.

## Discussion

We report a child identified through newborn screening with congenital hypothyroidism, undetectable serum thyroglobulin concentrations, and two pathogenic TG variants on genetic testing, findings consistent with TG-related thyroid dyshormonogenesis. The child also demonstrated mild hearing impairment. This case highlights the diagnostic value of serum Tg measurement in patients with congenital hypothyroidism and a eutopic thyroid gland, in whom an undetectable Tg concentration may provide an important clue to an underlying Tg synthesis defect.

The introduction of universal newborn screening has significantly improved the early detection and treatment of congenital hypothyroidism, resulting in substantial reductions in the risk of permanent neurodevelopmental impairment [1]. Advances in molecular diagnostics have further enhanced our understanding of the genetic basis of CH and facilitated earlier confirmation of specific aetiologies such as TG-related thyroid dyshormonogenesis. Establishing a molecular diagnosis facilitates individualised counselling, prognostication, and long-term management planning. Identification of the underlying genetic aetiology is particularly important in thyroid dyshormonogenesis, as different gene defects are associated with distinct clinical phenotypes and outcomes. For example, DUOX2-related disease may present with transient congenital hypothyroidism, whereas SLC26A4 mutations are associated with hearing impairment and Pendred syndrome. In contrast, TG-related dyshormonogenesis is typically associated with permanent hypothyroidism requiring lifelong thyroid hormone replacement. Consequently, genetic diagnosis provides valuable information for patient management and genetic counselling [10,11].

The clinical spectrum associated with TG mutations is highly variable, ranging from euthyroidism to hypothyroidism. This variability likely reflects differences in the molecular consequences of individual variants, including residual Tg synthesis, folding, intracellular trafficking, secretion, and hormonogenic capacity. In our case, the c.1333C>T variant is a nonsense variant, and the c.274+2T>G variant is a canonical splice-donor variant predicted to disrupt normal mRNA splicing. Both variants are predicted to result in loss of function. Environmental factors, particularly iodine availability, as well as treatment timing and other genetic modifiers, may also influence the clinical phenotype [5].

Similarly, phenotypic manifestations have been reported to vary considerably. Earlier studies frequently described the presence of goitre, whereas more recent reports have observed thyroid enlargement primarily in patients with delayed diagnosis or suboptimal treatment [1,5]. This trend highlights the effectiveness of

newborn screening programmes in enabling timely diagnosis and prompt initiation of levothyroxine therapy before the development of significant thyroid pathology.

Although our patient did not develop a goitre, the potential for significant thyroid enlargement remains an important consideration in individuals with TG mutations. Large foetal goitres have been reported and may result in complications, including tracheoesophageal compression and polyhydramnios during pregnancy [12]. In families with a known genetic diagnosis, targeted prenatal assessment and close foetal monitoring may be considered. In selected cases, intra-amniotic levothyroxine administration has been reported to reduce foetal goitre size and improve associated polyhydramnios [13].

Genetic evaluation in our patient identified two heterozygous pathogenic variants in the TG gene. The c.1333C>T variant is a pathogenic nonsense variant predicted to result in premature protein truncation. The c.274+2T>G splice-site variant has been reported as one of the most prevalent pathogenic TG variants in Asian populations and appears particularly common among affected Chinese individuals [5,14]. Consistent with observations in other populations, most reported Chinese patients harbouring pathogenic TG variants have permanent congenital hypothyroidism requiring lifelong thyroid hormone replacement [14].

An important diagnostic clue in our patient was the markedly reduced serum Tg concentration (<0.1 μg/L) in the absence of anti-thyroglobulin antibodies. Measurement of serum Tg can be a valuable adjunct in the evaluation of congenital hypothyroidism, particularly in patients with a eutopic thyroid gland. In most forms of thyroid dyshormonogenesis, serum Tg concentrations are typically normal or elevated [15]. In contrast, patients with TG-related dyshormonogenesis characteristically demonstrate markedly reduced or undetectable serum Tg concentrations as a consequence of impaired Tg synthesis, processing, or secretion. Therefore, a profoundly low serum Tg level may serve as an important biochemical clue to the diagnosis and should prompt consideration of targeted molecular analysis of the TG gene [16]. Identification of a causative TG variant provides valuable prognostic information, supports anticipatory guidance regarding the need for lifelong thyroid hormone replacement therapy, and facilitates genetic counselling for affected patients and their families. A limitation of this report is that segregation analysis was unavailable; therefore, the trans configuration of the two TG variants could not be molecularly confirmed.

Although hearing impairment was identified in our patient, this finding should be interpreted cautiously. Hearing loss is not a recognised feature of TG-related thyroid dyshormonogenesis. Furthermore, tympanometry demonstrated bilateral negative middle-ear pressure, raising the possibility of a conductive component. Therefore, the coexistence of hearing impairment and TG-related congenital hypothyroidism does not establish a causal association.

Long-term management considerations in TG-related thyroid dyshormonogenesis include lifelong thyroid hormone replacement and continued surveillance for thyroid enlargement, nodular thyroid disease, and, rarely, thyroid malignancy [9]. Cases of thyroid carcinoma have been reported in adults with longstanding inadequately controlled goitres associated with TG mutations [17].

## Conclusions

We describe a child with congenital hypothyroidism, undetectable serum thyroglobulin concentrations, and two pathogenic TG variants identified on genetic testing, consistent with TG-related thyroid dyshormonogenesis. No clinical evidence of goitre was observed. Mild hearing impairment was also identified; however, its relationship to the underlying TG variants remains uncertain, particularly given evidence suggesting a possible conductive component. Measurement of serum thyroglobulin provides an important diagnostic clue in patients with congenital hypothyroidism and a eutopic thyroid gland, helping to identify individuals who may benefit from targeted molecular analysis of the TG gene. A limitation of this report is the absence of segregation analysis to confirm that the identified TG variants are in trans.

## Additional Information

### Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

**Concept and design:** Suki Suk-yan Chan, Joanna Yuet-ling Tung, Sarah Wing-yiu Poon, Gloria Shir-wey Pang

**Acquisition, analysis, or interpretation of data:** Suki Suk-yan Chan

**Drafting of the manuscript:** Suki Suk-yan Chan, Joanna Yuet-ling Tung, Sarah Wing-yiu Poon, Gloria Shir-wey Pang

**Critical review of the manuscript for important intellectual content:** Joanna Yuet-ling Tung, Sarah Wing-yiu Poon, Gloria Shir-wey Pang

**Supervision:** Joanna Yuet-ling Tung, Sarah Wing-yiu Poon, Gloria Shir-wey Pang

## Disclosures

**Human subjects:** Informed consent for treatment and open access publication was obtained or waived by all participants in this study. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

# References

1. Fernández-Cancio M, Antolín M, Clemente M, et al.: Clinical and molecular study of patients with thyroid dyshormogenesis and variants in the thyroglobulin gene. Front Endocrinol (Lausanne). 2024, 15:1367808. 10.3389/fendo.2024.1367808
2. Liu L, He W, Zhu J, et al.: Global prevalence of congenital hypothyroidism among neonates from 1969 to 2020: a systematic review and meta-analysis. Eur J Pediatr. 2023, 182:2957-65. 10.1007/s00431-023-04932-2
3. Stoupa A, Kariyawasam D, Muzza M, et al.: New genetics in congenital hypothyroidism . Endocrine. 2021, 71:696-705. 10.1007/s12020-021-02646-9
4. Ieiri T, Cochaux P, Targovnik HM, Suzuki M, Shimoda S, Perret J, Vassart G: A 3' splice site mutation in the thyroglobulin gene responsible for congenital goiter with hypothyroidism. J Clin Invest. 1991, 88:1901-5. 10.1172/JCI115513
5. Targovnik HM, Esperante SA, Rivolta CM: Genetics and phenomics of hypothyroidism and goiter due to thyroglobulin mutations. Mol Cell Endocrinol. 2010, 322:44-55. 10.1016/j.mce.2010.01.009
6. Citterio CE, Targovnik HM, Arvan P: The role of thyroglobulin in thyroid hormonogenesis . Nat Rev Endocrinol. 2019, 15:323-38. 10.1038/s41574-019-0184-8
7. Citterio CE, Rivolta CM, Targovnik HM: Structure and genetic variants of thyroglobulin: Pathophysiological implications. Mol Cell Endocrinol. 2021, 528:111227. 10.1016/j.mce.2021.111227
8. Medeiros-Neto G, Targovnik HM, Vassart G: Defective thyroglobulin synthesis and secretion causing goiter and hypothyroidism. Endocr Rev. 1993, 14:165-83. 10.1210/edrv-14-2-165
9. Targovnik HM, Citterio CE, Rivolta CM: Thyroglobulin gene mutations in congenital hypothyroidism . Horm Res Paediatr. 2011, 75:311-21. 10.1159/000324882
10. Maruo Y, Takahashi H, Soeda I, et al.: Transient congenital hypothyroidism caused by biallelic mutations of the dual oxidase 2 gene in Japanese patients detected by a neonatal screening program. J Clin Endocrinol Metab. 2008, 93:4261-7. 10.1210/jc.2008-0856
11. Calcaterra V, Lanna M, Ligato E, et al.: Concomitant Mutations in the Thyroglobulin and SLC26A4 Genes Leading to Fetal Goiter and Congenital Hypothyroidism in a Patient With Pendred Syndrome. Case Rep Endocrinol. 2025, 2025:8797269. 10.1155/crie/8797269
12. Vasudevan P, Powell C, Nicholas AK, Scudamore I, Greening J, Park SM, Schoenmakers N: Intrauterine death following intraamniotic triiodothyronine and thyroxine therapy for fetal goitrous hypothyroidism associated with polyhydramnios and caused by a thyroglobulin mutation. Endocrinol Diabetes Metab Case Rep. 2017, 2017:10.1530/EDM-17-0040
13. Pollé OG, Gheldof A, Lysy PA, Bernard P: Intra-amniotic levothyroxine infusions in a case of fetal goiter due to novel Thyroglobulin gene variants. Clin Case Rep. 2021, 9:e04565. 10.1002/ccr3.4565
14. Hu X, Chen R, Fu C, et al.: Thyroglobulin gene mutations in Chinese patients with congenital hypothyroidism. Mol Cell Endocrinol. 2016, 423:60-6. 10.1016/j.mce.2016.01.007
15. van Trotsenburg P, Stoupa A, Léger J, et al.: Congenital Hypothyroidism: A 2020-2021 Consensus Guidelines Update-An ENDO-European Reference Network Initiative Endorsed by the European Society for Pediatric Endocrinology and the European Society for Endocrinology. Thyroid. 2021, 31:387-419. 10.1089/thy.2020.0333
16. Heo S, Jang JH, Yu J: Congenital hypothyroidism due to thyroglobulin deficiency: a case report with a novel mutation in TG gene. Ann Pediatr Endocrinol Metab. 2019, 24:199-202. 10.6065/apem.2019.24.3.199
17. Hishinuma A, Fukata S, Kakudo K, Murata Y, Ieiri T: High incidence of thyroid cancer in long-standing goiters with thyroglobulin mutations. Thyroid. 2005, 15:1079-84. 10.1089/thy.2005.15.1079