Thyroid Scintigraphy in Children with Hypothyroidism: A Five-year Experience†

PAWANA PUSUWAN, M.D.*,
SUTTIPONG WACHARASINDHU, M.D.**,
VIYADA ATTANATHO, M.D.*,
SUNANTA CHIEWVIT, M.D.*,
SUPAWADEE LIKITMASKUL, M.D.**,
SOMLAK INTARASUPHT, M.Sc.*,
JIRAPORN MUNGKHARAK, M.D.*,
RUDEE PLEEHACHINDA, M.D.*

Abstract

The presence or absence of thyroid glandular tissue demonstrated by thyroid scintigraphy is important for genetic and prognostic counseling and for acceleration of diagnosis in other affected siblings. Technetium-99m-pertechnetate thyroid scintigraphy was performed on 27 children with cretinism at the Division of Nuclear Medicine, Faculty of Medicine Siriraj Hospital during the 5-year period from June 1991. Based on scintigraphic findings, three main groups of thyroid localization were seen. Thirteen (48.1%) were athyrotic while 3 (11.1%) had an ectopic thyroid and 11 (40.8%) had gland in normal position. Perchlorate discharge test was performed in 8 children of the last group and the results were positive indicating an organification defect. Thyroid scintigraphy and perchlorate discharge test provided the useful information for diagnosis, follow-up, and prognosis in children with cretinism.

Hypothyroidism is not generally suspected at birth and more frequently becomes apparent during childhood(1). Primary congenital hypothyroidism may be due to an absent or hypoplastic gland, an ectopic gland or an inborn error of thyroid hormone metabolism(2). Determination of the cause of hypothyroidism is of genetic, epidemiologic and prognostic importance(3).

Thyroid scintigraphy plays an important role in the evaluation of the thyroid gland due to the functional and anatomical information of the gland. We reported the scintigraphic pattern in 27 children with cretinism in Siriraj Hospital between June 1991 and May 1996.

* Department of Radiology,
** Department of Pediatrics, Faculty of Medicine, Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.
† Presented at the Scientific Meeting of the Nuclear Medicine Society of Thailand, Bangkok, November, 1996.

MATERIAL AND METHOD

Between June 1991 and May 1996, 27 children with biochemical diagnosis of cretinism underwent ^{99m}Tc thyroid scintigraphy in the Division of Nuclear Medicine, Department of Radiology, Siriraj Hospital. ^{99m}Tc pertechnetate thyroid scintigraphys were performed on these children utilizing a gamma camera with a low-energy general-purpose collimator. The radionuclide dose was 500 μCi to 1 mCi. Three scintigraphic patterns of thyroid localization were noted; (a) no detectable thyroid activity, (b) ectopic location and (c) normal location with normal or increased size and uptake.

Eight children with normal location of the thyroid gland underwent perchlorate discharge test using 10 μCi of ^{131}I. With a scintillation probe and scaler, thyroid uptake was performed every 10 minutes for 60 minutes. Then the patients were administered potassium perchlorate. Thyroid uptake was subsequently measured every 10 minutes for 30 minutes. A discharge of greater than 5 per cent indicated an organification defect[4].

Table 1. Clinical and laboratory data in 27 hypothyroid patients.

Patient	Sex	Age (yr)	TSH (mIU/L)	T4 (μg%)
Group 1 No detected thyroid activity				
1	F	6 7/12	78.8	0.5
2	F	6/12	66.3	3.8
3	F	2	73.4	0.3
4	F	1 3/12	100	0.3
5	F	9/12	67.1	0.2
6	F	1 8/12	106	0.2
7	M	1 3/12	100	0
8	F	1 2/12	97	0.1
9	F	2 4/12	200	0.5
10	F	8	100	0.4
11	F	3/12	15	2.9
12	F	9/12	67.2	0.1
13	F	6/12	324.5	0
Median			97 *	0.3 **
Range			15-324.5	0.0-3.8
Group 2 Ectopic thyroid				
14	F	4	103.8	0.1
15	M	2	150	0.4
16	F	5	69.1	3.8
Median			103.8 *	0.4 **
Range			69.1-150	0.1-3.8
Group 3 Normal location				
17	M	5	9	3.4
18	F	6/12	66.3	0.4
19	M	2/12	93.3	3.2
20	F	10 6/12	100	2.4
21	F	6 6/12	150	0.4
22	F	5/12	100	0
23	F	6	100	1
24	F	8	100	0.9
25	F	9	24.5	2.8
26	M	2/12	405.6	0.7
27	M	1/12	159.7	3.7
Median			100 *	1 **
Range			9-405.6	0-3.7

* p value = 0.75 (Kruskal-Wallis One Way Analysis of Variance)
** p value = 0.1 (Kruskal-Wallis One Way Analysis of Variance)

Kruskal-Wallis one way analysis of variance were derived for serum TSH and T_4 levels in three groups of the patients.

RESULTS

The diagnosis of hypothyroidism was diagnosed in all subjects by higher than the upper normal limit of serum TSH levels (normal TSH 0.3-6 mIU/L) and serum T_4 levels of less than 4 μg% (normal T_4 4-11 μg%) (Table 1).

^{99m}Tc pertechnetate thyroid scintigraphy in these 27 children demonstrated no thyroid tissue in 13 patients (48.1%) (Fig. 1). Three children (11.1%) had ectopic thyroid gland. In these patients, there were 2 cases of lingual thyroid and a case of sublingual location (Fig. 2). The remaining 11 children had normally located glands (Fig. 3). Eight children of the last group had positive results of perchlorate discharge test indicating an organification defect (Fig. 4). The two patients with dyshormonogenesis in this report were siblings (case no. 22 and 27).

DISCUSSION

There was no significant difference between the biological findings, TSH and T_4 (p value = 0.75 and 0.1 respectively by Kruskal-Wallis One Way Analysis of Variance) and the scintigraphic findings of the thyroid gland in this study. The results of the thyroid imaging showed the spectrum possible for gland anatomy, ranging from athyrotic, through lingual or sublingual thyroids, to normal or enlarged glands in a normal location. Our results were similar to previous reports that thyroid dysgenesis (aplasia, ectopia) was the most common etiology of congenital hypothyroidism[3,5].

A high percentage (40.8%) of patients had normally located glands with positive results of perchlorate discharge test. These were similar to the results reported by Desonki et al[3]. It is important to distinguish dyshormonogenesis from dysgenesis. Athyrosis and ectopic thyroid recur very rarely in the same family, whereas, hypothyroidism due to defects in thyroid hormone syn-

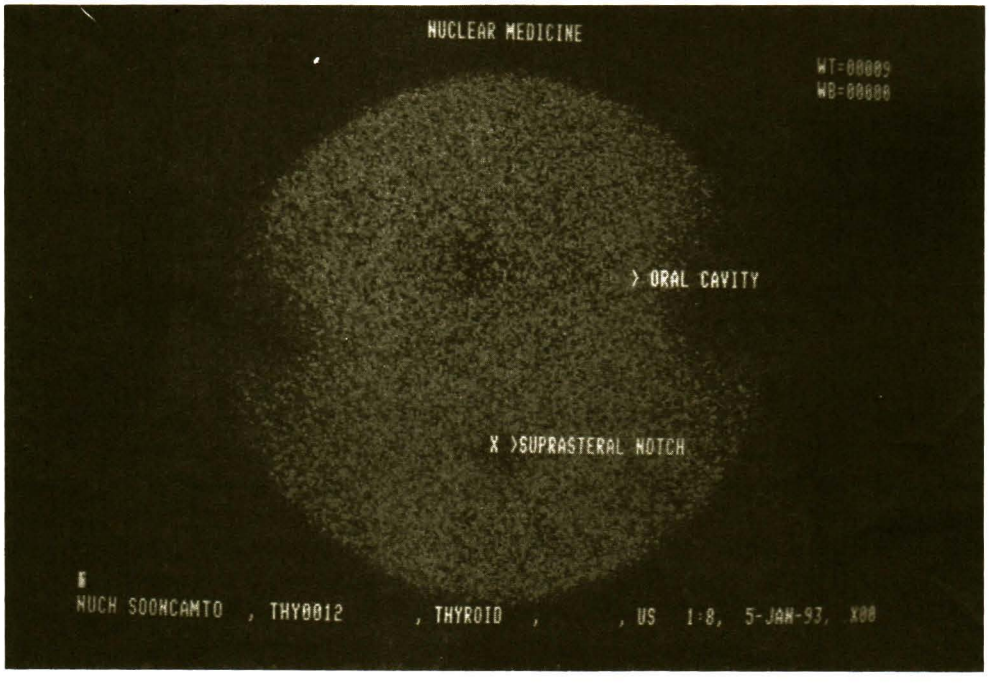

Fig. 1. ^{99m}Tc pertechnetate thyroid imaging of an infant with athyrosis showed absence of detectable thyroid activity.

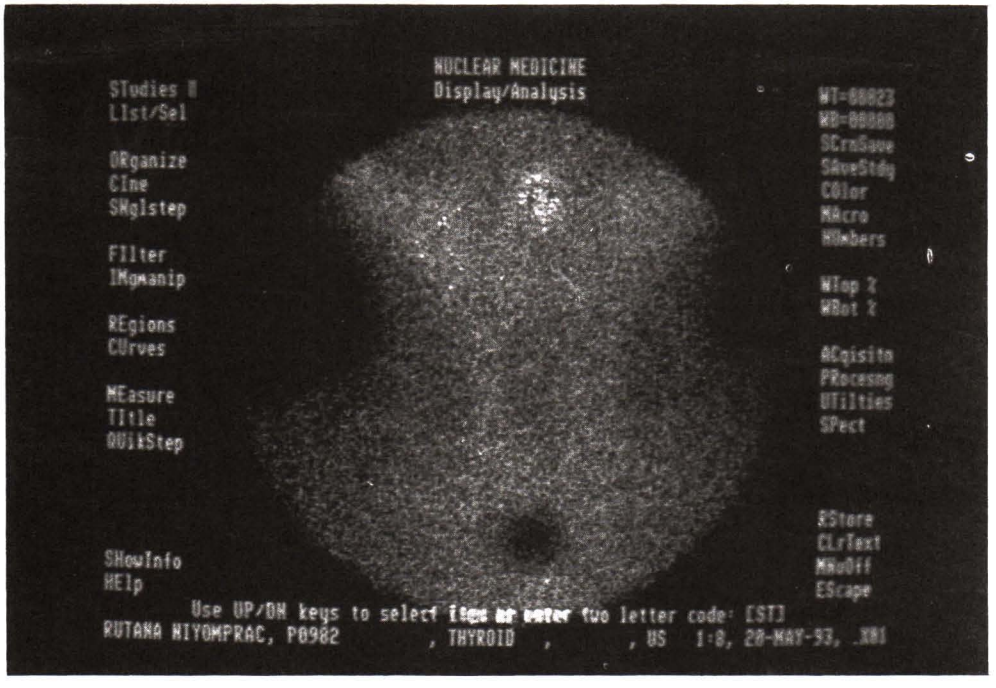

Fig. 2. Thyroid imaging (^{99m}Tc pertechnetate) demonstrated ectopic thyroid tissue in sublingual location.

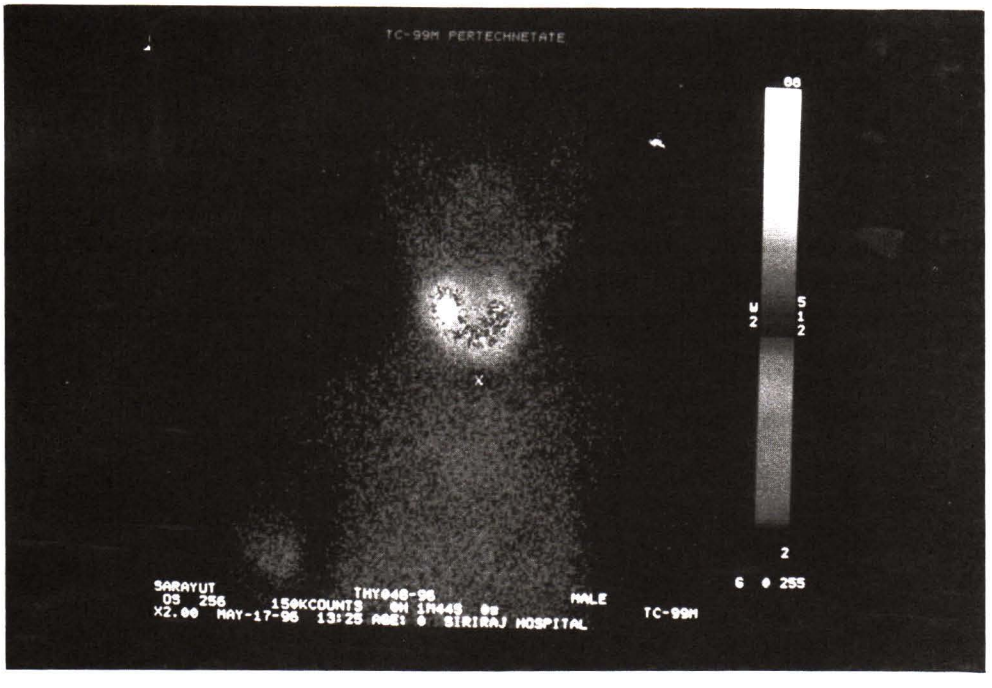

Fig. 3. Thyroid imaging (^{99m}Tc pertechnetate) of an infant with dyshormonogenesis. The thyroid was enlarged and situated in normal position.

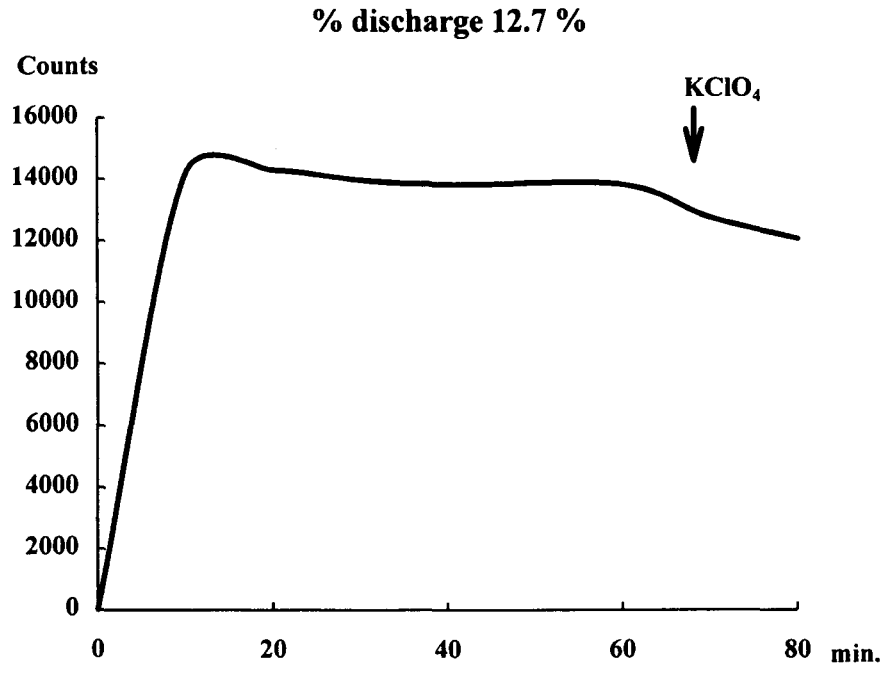

Fig. 4. Perchlorate discharge test of the patient in Fig. 3 was positive (12.7% discharge) indicating an organification defect. The perchlorate discharge test of this patient's older sister was also positive.

thesis and metabolism are inherited as autosomal recessive traits with an estimated frequency of 25 per cent in siblings(6). The presence and location of the thyroid gland in children with cretinism has direct effect on genetic counseling and prognosis. Thyroid imaging is accurate in categorizing these entities. The study can be easily performed giving low radiation exposure to the children.

ACKNOWLEDGEMENT

The authors wish to thank Dr. Yupin Suputhamongkol for statistical assistance and Mrs. Nucharee Putrasreni for preparation of all illustrations.

(Received for publication on January 9, 1997)

REFERENCES

1. Kim EE, Doenstad PA, Choy YC, et al. Avid thyroid uptake of [Tc-99m] sodium pertechnetate in children with goitrous cretinism. Clin Paediatr 1981; 20: 437-9.
2. New England Congenital Hypothyroidism Collaborative. Characteristics of infantile hypothyroidism discovered on neonatal screening. J Paediatr 1984; 104: 539-44.
3. Desonki ME, Al-Juraytan N, Al-Nuaim A, et al. Thyroid scintigraphy and perchlorate discharge test in the diagnosis of congenital hypothyroidism. Eur J Nucl Med 1995; 22: 1005-8.
4. Intarasupht S, Na Songkla S, Chanachai R, et al. Perchlorate discharge test. Siriraj Hosp Gaz 1988; 40: 13-6.
5. Wells RG, Sty JR, Duck SC. Technetium-99m pertechnetate thyroid scintigraphy: congenital hypothyroid screening. Pediatr Radiol 1986; 16: 368-3.
6. Bauman RA, Bode HH, Playek A, et al. Technetium 99m pertechnetate scans in congenital hypothyroidism. J Paediatr 1976; 89: 268-71.

ภาพสแกนต่อมธัยรอยด์ในผู้ป่วยเด็กที่มีภาวะขาดธัยรอยด์ฮอร์โมน: ประสบการณ์ 5 ปี

ภาวนา ภูสุวรรณ, พ.บ., สุภาวดี ลิขิตมาศกุล, พ.บ.**, สุทธิพงศ์ วัชรสินธุ, พ.บ.**, สมลักษณ์ อินทรศัพท์, วท.ม.*, วิยะดา อัตนโถ, พ.บ.*, จิราพร มังครักษ์, พ.บ.*, สุนันทา เชี่ยววิทย์, พ.บ.*, ฤดี ปลีหจินดา, พ.บ.**

การสแกนต่อมธัยรอยด์เป็นการตรวจเพื่อแสดงว่าผู้ป่วยมีหรือไม่มีเนื้อเยื่อต่อมธัยรอยด์ ซึ่งจะมีประโยชน์ในการวินิจฉัยและการพยากรณ์โรคทั้งในด้านของผู้ป่วยและในญาติพี่น้องในกรณีที่เป็นความผิดปกติทางพันธุกรรม ได้ทำการศึกษาภาพสแกนต่อมธัยรอยด์ด้วย Technetium-99m pertechnetate ในผู้ป่วยเด็กที่มีภาวะขาดธัยรอยด์ฮอร์โมน ที่แผนกเวชศาสตร์นิวเคลียร์ โรงพยาบาลศิริราช ในระยะเวลา 5 ปีเริ่มจากมิถุนายน พ.ศ.2534 รวมทั้งหมด 27 ราย จากภาพสแกนพบลักษณะของต่อมธัยรอยด์เป็น 3 กลุ่มคือ กลุ่มที่หนึ่งไม่พบต่อมธัยรอยด์ พบ 13 รายคิดเป็นร้อยละ 48.1 กลุ่มที่สองพบต่อมธัยรอยด์อยู่ผิดที่ (ectopic) 3 รายคิดเป็นร้อยละ 11.1 และกลุ่มสุดท้ายพบมีต่อมธัยรอยด์อยู่ในตำแหน่งปกติ 11 รายคิดเป็นร้อยละ 40.8 ผู้ป่วยในกลุ่มสุดท้าย 8 รายได้รับการตรวจด้วยวิธี Perchlorate discharge ได้ผลเป็นบวก ซึ่งแสดงว่ามีความผิดปกติในขบวนการสร้างธัยรอยด์ฮอร์โมนแบบ organification defect พบว่าการสแกนต่อมธัยรอยด์และการตรวจวิธี Perchlorate discharge เป็นการตรวจที่มีประโยชน์ทั้งในแง่ของการวินิจฉัย การตรวจติดตามผล และการพยากรณ์โรค ในผู้ป่วยเด็กที่มีภาวะการขาดธัยรอยด์ฮอร์โมน

* ภาควิชารังสีวิทยา,

** ภาควิชากุมารเวชศาสตร์, คณะแพทยศาสตร์ ศิริราชพยาบาล, มหาวิทยาลัยมหิดล, กรุงเทพฯ 10700