

## Original Research Article

# Role of Tc-99m pertechnetate thyroid scintigraphy in evaluation of lingual and midline neck swellings

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## ABSTRACT

**Background:** The ectopic thyroid tissue in thyroglossal cyst or suprahyoid swelling is one of most important differential to be diagnosed. The purpose of this study was to find out role of Technetium-99m Pertechnetate Thyroid Scintigraphy (TS) to detect functioning thyroid tissue in ectopic locations presenting as midline neck swelling.

**Methods:** A retrospective observational study was done where 26 subjects presenting with midline neck swelling were included. These subjects were injected with 1-5MBq/kg of Technetium-99m Pertechnetate to perform the TS. The uptake of tracer in the midline neck swelling and in other ectopic location was assessed. The comparison with Ultrasound (USG) was also done.

**Results:** 12 (46.15%) subjects presented with infra hyoid swelling and rest 14 (53.85%) presented with supra hyoid and submental swelling. 33.3% subjects presenting with thyroglossal duct cyst showed functioning thyroid tissue. Also 4 subjects showed dual functioning ectopic tissue. USG and TS showed concordant results for detecting thyroid tissue in ectopic location ( $p=0.68$ ). However, TS performed better to detect ectopically located thyroid tissue ( $p=0.0086$ ).

**Conclusions:** USG and TS showed similar results to detect thyroid tissue in normal location. However, TS is better to detect topically located thyroid tissue. TS adds information of functioning thyroid tissue during workup of midline neck swelling.

**Keywords:** Midline neck swelling, Thyroid scan, Ultrasound

## INTRODUCTION

The most common congenital mass in the neck is the thyroglossal duct cyst; 60-80% of thyroglossal duct cysts are associated with the hyoid bone.<sup>1,2</sup> Paramedian thyroglossal duct cysts can mimic a second branchial cleft cyst, cystic hygroma, dermoid cyst, epidermoid cyst, thymic cyst, bronchogenic cyst, lymph node and laryngocele are the other differential diagnosis.<sup>1,3-5</sup> At least 50% of patients with a thyroglossal duct cyst present

before 20 years of age, usually with a gradually enlarging painless mass.<sup>2,4</sup>

When a child or young adult presents with a mass in the anterior portion of the neck, diagnostic considerations include a thyroglossal duct cyst and ectopic thyroid tissue. These entities are often suspected clinically, and imaging provides an opportunity to evaluate the extent, confirm the diagnosis, and evaluate for complications. Although the diagnosis of a thyroglossal duct cyst can

often be made clinically, preoperative imaging may be performed to identify the anatomic extent of the cyst, identify ectopic thyroid tissue, and evaluate for potential malignancy within the cyst.<sup>3,4</sup>

Imaging characteristics of a thyroglossal duct cyst as a simple cyst and of ectopic thyroid tissue as a hyperattenuating soft-tissue mass can help identify these lesions at computed tomography (CT); however, intrinsic magnetic resonance, CT, and ultrasonographic imaging characteristics alone cannot be used to confirm the diagnosis. Rather, knowledge of the typical course of the thyroid primordium during embryologic development is essential to understand the variant locations along this path where thyroid tissue can be found.<sup>3</sup> Portions of the tract and remnants of thyroid tissue associated with it may persist at any point between the tongue and the thyroid. Ectopic thyroid tissue may also be seen in the walls of thyroglossal cysts. Thus, the identification of functioning thyroid tissue is prudent. Also, the knowledge of functioning status of native thyroid gland is important during preoperative evaluation.<sup>6</sup>

Even if the Ultrasound (USG) is the main preferred investigation of choice that does not involve radiation exposure; the assessment of ectopic thyroid in retrosternal, intralaryngeal, or intratracheal locations is largely limited.<sup>7</sup> The purpose of the study was to assess the role of Technetium Pertechnetate-99m Thyroid Scintigraphy (TS) to assess the functioning status of eutopic (normal location) thyroid gland and ectopic thyroid tissue located in midline neck swellings in suprahyoid and infra-hyoid locations.

## METHODS

This was a retrospective observational study where 26 subjects (13 boys and 13 girls) referred to the Nuclear Medicine Departments during period from Jan 2008 to Jan 2018 for Technetium-99m Pertechnetate were included. The inclusion criterion was patients presenting with mid-line or anterior neck swelling. The USG of neck was suspicious for thyroid tissue or was unable to differentiate between thyroid tissue and lymph node. The subjects previously diagnosed with congenital hypothyroidism and on thyroxin replacement therapy were excluded. The intake of drugs and food items causing iodine interference that reduces Technetium-99m uptake by the subject was ruled out.

The subjects were injected with mean dose of 1mCi (37MBq) (dose adjusted to body weight in children, 1-5 MBq/kg) of Technetium-99m Pertechnetate intravenously. The anterior and lateral images of head, neck and mediastinum were acquired under gamma camera for 300k counts each 20minutes after the injection of radiotracer.<sup>8</sup> The Single Photon Emission Computer Tomography/Computer Tomography (SPECT/CT) images were acquired using low dose CT; as required. The scan was visually interpreted by Nuclear Medicine

Physician for presence of uptake of Technetium-99m Pertechnetate at normal thyroid gland location, corresponding to midline or anterior neck swelling and at ectopic location.

The uptake of Technetium-99m Pertechnetate in the tissue in thyroid gland located at anatomical position was considered as functioning eutopic thyroid gland. The uptake of Technetium Pertechnetate in the midline neck swelling was considered as functioning thyroglossal cyst. The concentration of Technetium-99m Pertechnetate in ectopic location (suprahyoid) was considered as functioning sublingual or lingual thyroid tissue.

The presence of functioning thyroid tissue in mid line or anterior neck swelling was compared using TS and USG. The functioning thyroid tissue at normal anatomical position on TS and presence of thyroid gland on USG was also compared. The additional functioning thyroid tissue at ectopic locations was assessed on TS.

Two tailed Chi square test with Yates Correction and Fishers exact test were used to find out the difference in the detection of thyroid tissue at eutopic and ectopic location using TS and USG. The p value of <0.01 was considered as statically significant.

## RESULTS

The mean age of presentation of midline neck swelling was 13.5 yrs with majority of subjects presented after 10 years (65%). There were 12 (46.15%) subjects presented with infra hyoid swelling and the rest 14 (53.85%) presented with supra hyoid or sub-mental swelling (Figure 1).

The mean TSH was 13.3  $\mu$ IU (Table 1). There was significant difference noted in the TSH value and location of functioning thyroid tissue ( $p=0.0163$ ). The subjects with functioning eutopic thyroid showed preferentially low TSH (<20) (Table 2).

USG and TS showed 100% concordant results for the eutopic thyroid tissue (Table 3, Figure 2). However, with respect to the detection of ectopically located thyroid tissue TS ( $p=0.0086$ ) performed better than the USG ( $p=0.6806$ ). The TS was able to detect additional ectopic thyroid tissue especially in lingual region. (Figure 3) There were 4 patients detected with dual ectopic thyroid tissue on TS in lingual regions in addition to sub mental and thyroglossal cyst tissue (Table 1). 13 (50%) subjects showed absence of functioning thyroid tissue on TS in midline swellings. Also, presence of functioning eutopic thyroid gland was demonstrated using TS. There were 18 patients presenting with thyroglossal duct cyst on USG and few of them presented with ruptured cysts with infection. 6 (33.3%) of them showed presence of functioning thyroid tissue on TS and the rest were non-functioning cysts (Figure 4).

**Table 1: Clinical presentation with USG and TS findings of subjects.**

Age	Sex	Presentation	TSH (µIU)	USG		TS	
				Thyroid Gland in normal location	Ectopic	Thyroid tissue in normal location	Ectopic
18 yrs	F	midline neck swelling - below hyoid	2.4	+ only right lobe	-	+ hemiagenesis	-
18 yrs	M	Midline neck swelling - supra hyoid	3.4	-	ectopic Thyroid - submental	-	Dual ectopic - sublingual and supra hyoid location
12 yrs	M	submental swelling	50	-	ectopic thyroid	-	sublingual functioning thyroid tissue
25 yrs	F	difficulty in swallowing and submittal swelling	75	+	-	+	Functioning lingual thyroid
17 yrs	F	submental swelling	70	-	thyroglossal cyst	-	Dual - thyroglossal tract and supra hyoid
16 yrs	F	submental swelling	15	-	submental cystic lesion thyroid or lymph node	-	Dual- lingual and supra hyoid tissue
11 yrs	M	Midline neck swelling	24.3	-	thyroglossal cyst	-	Dual -sublingual and thyroglossal cyst
15yrs	F	midline neck swelling	20	-	thyroglossal cyst	-	Thyroglossal cyst - functioning
8 yrs	M	midline neck swelling	5.4	+	thyroglossal cyst	+	-
1.5 yrs	M	Midline neck swelling	7.1	+	thyroglossal cyst	+	-
25 yrs	F	midline neck swelling	12.51	-	enlarged isthmus and thyroglossal cyst	-	Functioning isthmus and thyroglossal cyst
25yrs	F	submental swelling	3.7	+	thyroid tissue/ lymph node	+	-
1.5 yrs	M	midline neck swelling	2.1	+	thyroid swelling /lymph node	+	-
14 yrs	F	midline neck swelling	4.2	+	thyroglossal cyst	+	-
32 yrs	F	submental swelling and bleeding per oral	8	-	Thyroid swelling	-	Functioning lingual thyroid
23yrs	F	submental swelling	7	-	thyroid swelling	-	Functioning lingual thyroid
14 yrs	M	submental swelling	3.9	+	-	+	-
8 yrs	M	midline neck swelling	4.1	+	thyroglossal cyst	+	-
2 yrs	M	midline neck swelling	1.83	+	thyroglossal cyst	+	-
3 yrs	F	midline neck swelling	2.01	+	thyroglossal cyst	+	-
5 yrs	F	midline neck swelling	2.5	+	thyroglossal cyst	+	-
17 yrs	M	submental swelling	5.03	+	ectopic thyroid/lymph node	+	-
18yrs	F	submental swelling	6.79	+	ectopic thyroid /lymph node	+	-
11 yrs	M	submental fullness and bleeding per oral	2.78	+	ectopic thyroid /lymph node	+	-
2 yrs	M	submental swelling	3	+	ectopic thyroid /lymph node	+	-
9 yrs	M	midline neck swelling	4	-	thyroglossal cyst	-	functioning thyroglossal cyst

**Table 2: Correlation of TSH with location of functioning thyroid tissue on TS.**

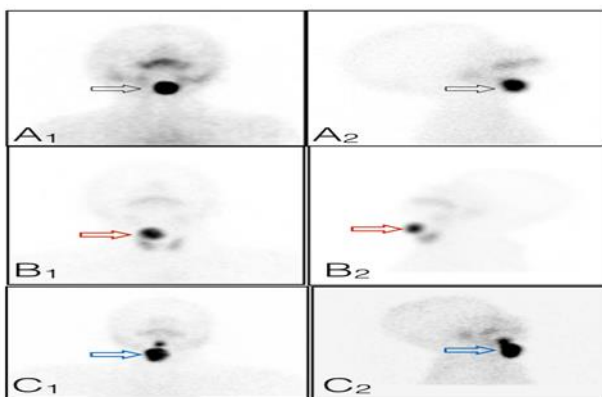
Functioning Thyroid tissue on TS	Sublingual	Thyroglossal cyst	Dual Ectopic tissue	Both ectopic and Eutopic thyroid	Eutopic (normal location) Thyroid only
TSH ( $\mu$ IU)					
< 20	2	2	2	0	15
$\geq$ 20	1	1	2	1	0

TSH: Thyroid Stimulating Hormone. TS: Tc-99m Pertechnetate Thyroid Scintigraphy. P = 0.0163 (between TSH value in ectopic and ectopically located thyroid tissue using Fishers Exact test)

**Table 3: Correlation between USG and TS for detection of functioning thyroid tissue in subjects presenting with midline neck swelling.**

	Eutopic (normal location) thyroid tissue	Ectopic functioning thyroid tissue
Concordant		
Not visualised on both USG and TS	10	2
Visualised on both USG and TS	16	10
Discordant		
Only seen on TS	0	5 (1 sublingual and 4 dual ectopic)
Only seen on USG (Thyroglossal cyst)	0	13

USG: Ultrasound. TS: Tc-99m Pertechnetate Thyroid Scan

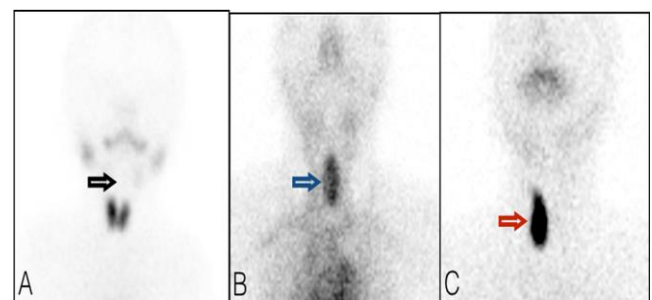


**Figure 1: Various ectopic located thyroid tissue seen on TS as sub-mental (black arrow, A1 anterior image and A2 left lateral image), functioning thyroglossal tissue along with ectopic thyroid tissue (red arrow, B1 anterior image and B2 left lateral image), dual functioning ectopic tissue in thyroglossal duct cyst and sub lingual (blue arrow, C1 anterior image and C2 lateral image).**

**DISCUSSION**

The mean age of presentation of this study group was 13.5 yrs that is incongruent with the existing literature.<sup>2,3</sup> Of all thyroglossal duct cysts, 25-65% are found in the infrahyoid portion of the neck, and they tend to splay the strap muscles or lie slightly off the midline, deep to or embedded within the strap muscles, with a thin connecting stalk to the midline.<sup>3</sup> However in this study group 46.15% subjects presented with infra hyoid swelling.

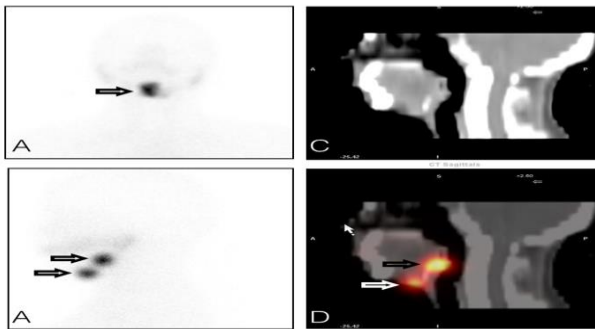
Sonography is useful due to its easy availability and high sensitivity in the detection of thyroid pathologies.



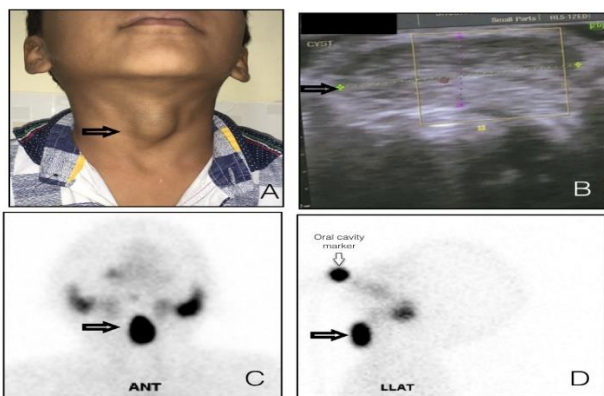
**Figure 2: Functioning status of midline neck swelling on TS A) non-functioning (black arrow), B) functioning thyroglossal duct cyst (blue arrow), C) hemiagenesis with right lobe functioning (red arrow).**

It allows the demonstration of pathological conditions accompanying thyroid developmental anomalies, i.e. concomitant focal lesions as well as autoimmune or neoplastic processes. Despite its unquestionable advantages, this examination also has several limitations. The ultrasound waves do not penetrate through calcified structures.<sup>9</sup> However, one of the significant limitations of ultrasonography is poor sensitivity in visualisation of ectopic thyroid, if compared to radionuclide scanning.<sup>10,11</sup> Our study also supported the same finding especially with respect to the deep seated (lingual and sublingual) thyroid tissue. TS detected additional functioning lingual and sublingual thyroid tissue in subjects better than the USG. The dual ectopic thyroid tissue was also detected by TS in 4 patients. This study added the information regarding

functioning status of thyroglossal duct cyst. 33.3% of them showed presence of thyroid tissue.<sup>12</sup> Thus TS was a better guide to decide about the surgical resection/excision biopsy of these swellings.<sup>13,14</sup>



**Figure 3: Dual functioning thyroid tissue detected on TS A) anterior and left lateral images of TS showing two foci of thyroid tissue C and D) SPECT/CT images of TS clarifying the location at lingual and sub mental region.**



**Figure 4: 9 yrs male presented with midline neck swelling (A) that showed thyroglossal duct cyst on USG (B) and TS showed only functioning thyroid tissue in the thyroglossal duct cyst (C and D).**

Although radionuclide image of the thyroid obtained with Technetium-99m Perchnetate, is useful in identifying thyroid tissue, either in the usual thyroid bed or at ectopic sites; a normal thyroid gland can trap the majority of the radionuclide, making identification of small ectopic rests difficult.<sup>1,4</sup> Our study did not have significant interference from the normal thyroid tissue as TS could detect additional functioning thyroid tissue in 5 patients (one of them showed ectopic thyroid and thyroglossal tract and the other 4 patients showed dual ectopic tissue in lingual and along thyroglossal tract). One of the patients had hemiagenesis; who presented with midline neck swelling.<sup>15-17</sup> Four patients (15.3%) presented with dual ectopically functioning thyroid tissue in the study population.<sup>11,18</sup> A study on comparison of combined Ultrasound and Isotope scanning versus Ultrasound scanning alone concluded that Isotope scanning was

superior to ultrasound in detection of ectopic tissue.<sup>11,19,20</sup> The incidence of dual ectopic thyroid tissue was about 20%; whereas our study with the given subset showed 15.8%.

The subjects included in our study presented late with not significantly raised TSH and the TSH levels were <20 in eutopic thyroid tissue and ectopic thyroid tissue showed further raised TSH levels. Such comparison of ectopic thyroid tissue with TSH level has been done and has found similar results.<sup>21</sup>

As this was a retrospective observational study; the cytology findings of the midline swelling could not be performed; the sensitivity and specificity of TS and USG could not be determined.

### CONCLUSION

This retrospective study emphasizes the indispensable role of TS in midline neck swellings of childhood. TS performed better than USG specially to detect ectopically located thyroid tissue at lingual and dual functioning ectopic thyroid tissue. The functioning status of thyroglossal cysts was determined using TS. This may help the surgical management of midline neck swellings better. Further studies of histopathological co-relation with imaging are required to understand the characterization of midline neck swelling.

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### REFERENCES

1. Som PM, Smoker WR, Curtin HD, Reidenberg JS, Laitman J. Congenital lesions of the neck. In: Som PM, Curtin HD, eds. Head and neck imaging. 5th ed. St Louis, Mo: Mosby;2011:2235-86.
2. Allard RH. The thyroglossal cyst. Head Neck Surg. 1982;5(2):134-46.
3. Zander DA, Smoker WR. Imaging of ectopic thyroid tissue and thyroglossal duct cysts. Radiographics. 2014;34(1):37-50.
4. Ahuja AT, Wong KT, King AD, Yuen EH. Imaging for thyroglossal duct cyst: the bare essentials. Clin Radiol. 2005;60(2):141-8.
5. Koeller KK, Alamo L, Adair CF, Smirniotopoulos JG. Congenital cystic masses of the neck: radiologic-pathologic correlation. Radiographics. 1999;19(1):121-46.
6. Subramanyam P, Palaniswamy SS. Pictorial essay of developmental thyroid anomalies identified by Technetium thyroid scintigraphy. Indian J Nucl Med. 2015;30:323-7.
7. Ruchała M, Szczepanek E, Sowiński J. Diagnostic value of radionuclide scanning and ultrasonography

- in thyroid developmental anomaly imaging. *Nucl Med Rev Cent East Eur.* 2011;14(1):21-8.
8. Ziessman H, O'Malley J. *Nuclear Medicine: The Requisites 4th Edition, Endocrinology.* Boston: Saunders;2014:66-97.
  9. Kreisner E, Camargo-Neto E, Maia CR, Gross JL. Accuracy of ultrasonography to establish the diagnosis and aetiology of permanent primary congenital hypothyroidism. *Clin Endocrinol (Oxf).* 2003;59:361-5.
  10. Perry J, Maroo S, MacLennan AC, Jones JH, Donaldson MDC. Combined ultrasound and isotope scanning is more informative in the diagnosis of congenital hypothyroidism than single scanning. *Arch Dis Child.* 2006;91:972-6.
  11. Jain A, Pathak S. Rare developmental abnormalities of thyroid gland, especially multiple ectopia: A review and our experience. *Indian J Nucl Med.* 2010;25(4):143-6.
  12. Kurt A, Ortug C, Aydar Y, Ortug G. An incidence study on thyroglossal duct cysts in adults. *Saudi Med J.* 2007;28:593-7.
  13. Hirshoren N, Neuman T, Udassin R, Elidan J, Weinberger JM. The imperative of the Sistrunk operation: review of 160 thyroglossal tract remnant operations. *Otolaryngol Head Neck Surg.* 2009;140:338-42.
  14. Katz AD, Hachigian M. Thyroglossal duct cysts. A thirty-year experience with emphasis on occurrence in older patients. *Am J Surg.* 1988;155:741-4.
  15. Ozer C, Demir Apaydin F, Yildiz, Duce MN, Kinaci NC, Azizoglu F, et al. Thyroid hemiagenesis: two case reports. *Eur J Radiol.* 2003;48:23-6.
  16. Gursoy A, Anil C, Unal AD, Demirer AN, Tutuncu NB, Erdogan MF. Clinical and epidemiological characteristics of thyroid hemiagenesis: ultrasound screening in patients with thyroid disease and normal population. *Endocrine.* 2008;33:338-41.
  17. Korpál-Szczyrska M, Kosiak W, Swieton D. Prevalence of thyroid hemiagenesis in an asymptomatic schoolchildren population. *Thyroid.* 2008;18:637-9.
  18. McCoul ED, De Vries EJ. Concurrent lingual thyroid and undescended thyroglossal duct thyroid without orthotopic thyroid gland. *Laryngoscope.* 2009;119:1937-40.
  19. Müller J, Ritzén EM, Ivarsson SA, Rajpert-De Meyts E, Norjavaara E, Skakkebaek NE, et al. Revised guidelines for neonatal screening programmes for primary congenital hypothyroidism. *Hormone Research in Paediatrics.* 1999;52(1):49-52.
  20. American Academy of Pediatrics, Rose SR; Section on Endocrinology and Committee on Genetics, American Thyroid Association, Brown RS; Public Health Committee, Lawson Wilkins Pediatric Endocrine Society, Foley T, Kaplowitz PB, Kaye CI, Sundararajan S, Varma SK. Update of newborn screening and therapy for congenital hypothyroidism. *Pediatrics.* 2006;117(6):2290-303.
  21. Fugazzola L, Persani L, Mannavola D, Reschini E, Vannucchi G, Weber G, et al. Recombinant human TSH testing is a valuable tool for differential diagnosis of congenital hypothyroidism during l-thyroxine replacement. *Clinical endocrinology.* 2003;59(2):230-6.

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