Original Article

Access this article online

Website: www.afrjpaedsurg.org

DOI: 10.4103/0189-6725.187815

Quick Response Code:

The value of using loupe magnification and methylene blue dye in intra-operative identification of thyroglossal duct tract

Abdelrahman E. M. Ezzat, Mustafa I. Eid, Mabrouk M. Akel[1], Marwa M. El-Begermy[2], Ayman Y. Abbas

ABSTRACT

Background: This was a comparative randomised study to find out the value of using loupe magnification and methylene blue dye in identification of the thyroglossal duct and to compare between them. **Patients and Methods:** Twenty-two patients who presented with infrahyoid thyroglossal duct cyst were subjected to excision of the cyst with two methods for identification of thyroglossal duct track during the operation. Data were anlysed for identification of multiple tracts, the tract relation to the hyoid bone, incidence of complications and operative time. **Results:** We found that multiple tracts were present in 9.1% of the patients in Group I and 36.3% in Group II, with no statistically significant difference between the two groups. The incidence of complications was 27.2% in Group I and 9.1% in Group II, with no statistically significant difference between both groups. However, the incidence of identification of the tract, and its relation to the hyoid bone was higher in Group II (90.9%) than in Group I (45.5%) , with a statistically significant difference between both groups. Also the incidence of identification of the extension level of the tract above the hyoid bone and up to the tongue base was significantly higher in Group II (72.8%) as compared to Group I (9.1%). The operative time was significantly shorter in Group II (54.35 min) and was 76.55 min in Group I, ($P = 0.0001$). **Conclusion:** Intra-operative identification of the thyroglossal tract is an essential step in the removal of the thyroglossal duct cyst. Both loupe magnification and methylene blue dye help in the tract identification, however, the usage of surgical loupes enhances better and safe results.

Key words: Identification of duct, loupe magnification, methylene blue dye, thyroglossal duct

INTRODUCTION

The ductus glandula thyroid or thyroglossal duct (TGD) is an embryologic structure that guides the descent of the thyroid gland from the foramen caecum to its final position in the anterior neck.[1,2] The development of the thyroglossal duct cyst (TGDC) occurs if the duct remains persistently patent. Later on, the cyst may form anywhere from the level of the foramen caecum to the thyroid gland.[3]

It is one of the most common congenital neck lesions were it represents 70% of midline neck masses in children.[4] However, this condition could also present in the adult population. The reported incidence of TGDC is 7% in most of publications,[5] and a higher rate of 15-17% has been reported in published autopsy studies.[6] Several studies have shown that the TGDC may appear in the midline either at, above (suprahyoid) or below (infrahyoid) the hyoid bone and also reported their deviation from the midline (mainly to the left side).[7,8]

In 1920, Sistrunk described his procedure that consists of the resection of the central portion of the hyoid bone along with a wide core of tissue between the hyoid bone and foramen caecum with the deliberate aim of removal of all possible thyroglossal tract remnants, hence, preventing recurrence.[9]

Departments of ENT and [1]Pediatric Surgery, Faculty of Medicine, Al-Azhar University, [2]Department of ENT, Faculty of Medicine, Ain Shams University, Cairo, Egypt

Address for correspondence:
Dr. Abdelrahman E. M. Ezzat,
Department of ENT, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.
E-mail: aemei_ibrahim@yahoo.co.uk

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

Cite this article as: Ezzat AE, Eid MI, Akel MM, El-Begermy MM, Abbas AY. The value of using loupe magnification and methylene blue dye in intra-operative identification of thyroglossal duct tract. Afr J Paediatr Surg 2016;13:140-4.

Our research aimed to find out the value of using loupe magnification and methylene blue dye in identification of the TGD and to compare between both methods, trying to find out the best method for thyroglossal tract identification in order to reduce the incidence of complications and recurrence after removal.

PATIENTS AND METHODS

Patients

The study was conducted between September 2011 and May 2015. Comparative randomised blind clinical study was conducted on 22 patients with infrahyoid TGDC over 4 years. The mean follow-up time was 2.2 years. The study was conducted in academic tertiary care medical centres (Al Azhar University Hospitals and, Ain shams University hospitals in Cairo, Egypt).

They were divided into two groups according to the identification method; Group I where methylene blue dye was used, included 11 patients with a mean age of 6.356 years ± 2.742 standard deviation (SD), while in Group II, loupe magnification was used, and it included 11 patients with a mean age of 7.04 ± 4.501 SD. The patients were randomly selected in both groups. There was no statistically significant difference between both groups as regards age, gender or geographic distribution ($p = 0.898$, 0.078 and 0.391 respectively) [Table 1]. Our patients' inclusion criteria were:

Our inclusion criteria included paediatric patients (below the age of 18), presenting with infrahyoid TGDC. Exclusion criteria included adult patients, the presence of TG fistula, presence of currant infection and/ or suspected hyoid or suprahyoid TGDC.

All patients or their guardians signed a pre-operative consent for the operation and the conduct of research, to know their rights and duties. The work was approved by our universities Ethical Committee.

Pre-operative assessment

All patients were subjected to full history taking and clinical examination including movement of the neck swelling with tongue protrusion. We used neck ultrasound in all patients to confirm our diagnosis and to differentiate TGDC from other midline cystic lesions; it was also used to assure the presence of normal thyroid gland. Routine preoperative laboratory investigations were done. On the operative table and before starting the operation in Group I; 1% methylene blue solution diluted in saline with a dilution of 1:10 was injected into the cyst using a tuberculin syringe and a 1½-inch 23 or 25-gauge needle. 0.2 mL to 0.5 mL of the diluted solution was injected into the cyst itself [Figure 1]. Injection was done either ultrasound guided if the cyst was small or deep, or without ultrasound if the cyst could be easily detected.

Operative details

The patient was placed in a supine position with the neck in full extension and a horizontal skin incision was made between the thyroid notch and the hyoid bone. Approximately 3-6 cm in length, in a skin crease inferior to the lesion, and the skin and platysma muscle were reflected. The myocutaneous flap was elevated adequately to expose the hyoid bone. Then, the cyst and the duct were identified, either by the colour of the methylene blue solution in Group I or by 2.5 X loupes (EyeMag®, Carl Ziss®, - Germany) in Group II.

Table 1: The descriptive statistics of residency, age and gender distribution of patients

Items	Group I		Group II		*P*
	n	Percentage	*n*	Percentage	
Area					
Rural	5	45.5	7	63.5	0.669[+]
Urban	6	54.5	4	36.5	
Sex					
Male	7	63.5	8	73.00	0.078[+]
Female	4	36.5	3	27.00	
Age					
Range	4.2-13.3		3.5-16.7		0.898[+]
Mean±SD	7.04±4.501		6.356±2.742		

[+]Not significant at $P \geq 0.05$. SD: Standard deviation

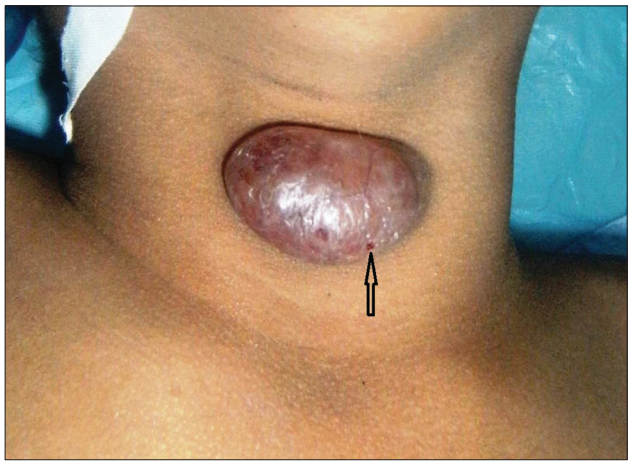


Figure 1: Infrahyoid thyroglossal duct cysts, the arrow (→) is the injection site

The strap muscles were divided at the midline and the cyst was dissected from surrounding tissues up to the hyoid bone. Then, after traction of the central hyoid with Allis grasping forceps, the muscles attached to the hyoid were dissected from the centre. After cutting the central part of hyoid, the body of hyoid with the tract and the cystic portion of the TGDC were freely released from surrounding muscular structures [Figure 2A]. Dissection continued deeply to include the tract of the TGDC, and a core of tongue musculature to the level of lingual mucosa where the tract was transected [Figure 2B]. The tongue defect was tightly closed and the remnant strap muscles were approximated. A drain was inserted when indicated, and the wound was closed in layers by layer. All the operative details were recorded for further analysis of data.

Postoperatively the specimens were sent for histopathology to confirmat the clinical diagnosis. None of the specimens were found to have a malignant criterion within it. Post-operative complications were reported; and patients were followed up to 2 years.

Statistical analysis

The results were summarised and the two groups were compared. Quantitative data were presented as median and range. Qualitative data were presented as frequencies and percentages. Chi-square (χ^2), Fisher's exact tests and unpaired *t*-test were used to compare the groups. Statistical analysis was done through the professional statistics package SPSS® for Windows (SPSS Inc., Chicago, IL, USA). $P \leq 0.05$ was considered statistically significant.

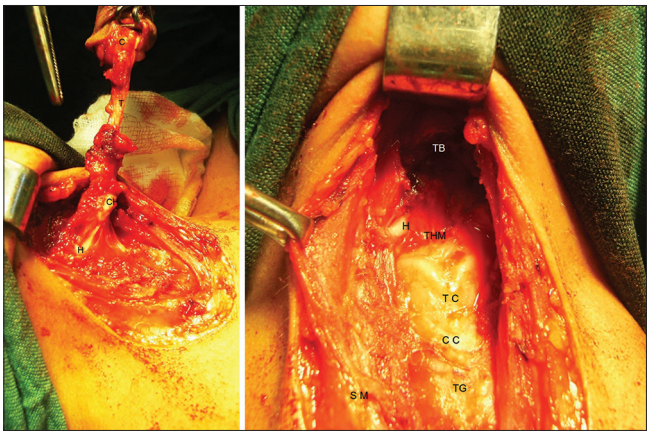


Figure 2: Intra-operative thryoglossal track excision. (a) During removal of the track; shows the thryoglossal track (T), thryoglossal cyst (C), hyoid bone (H), and removed part of hyoid bone (CH). (b) After removal of the track; shows the tongue base (TB), hyoid bone (H), thyrohyoid membrane (THM), thyroid cartilage (TC), cricoid cartilage (CC), thyroid gland (TG), strap muscles (SM)

RESULTS

Comparison between the two groups was done in all parameters summarised in Tables 2-4. We found that multiple tracts were present in 22.7% of the total number of cases (9.1% of cases in Group I and 36.3% in Group II), there was no statistically significant difference between both groups ($P = 0.065$) [Table 2]. There was also no statistically significant difference between both groups regarding the incidence of complications ($P = 0.157$), complications occurred in 27.2% of cases in Group I and 9.1% in Group II, with an overall incidence of 18.1% in the total number of patients [Table 3].

The TGD tract was identified successfully in 78.1% of the whole number of patients; however, by using loupe

Table 2: The descriptive statistics of the presence of multiple tracts, direction of tract, level of identification and operative complications

Items	Group I		Group II		Total		*P*
	n	%	*n*	%	*n*	%	
Multiple tracts	1	9.1	4	36.3	5	22.5	0.065+
Direction of tract							
Superficial to hyoid	3	27.2	7	63.6	10	45.5	0.0046*
Deep to hyoid	1	9.1	2	18.1	3	13.5	
Penetrate hyoid	1	9.1	1	9.1	2	9.1	
Couldn't be detected	6	54.5	1	9.1	7	31.9	
Level of identification							
Below the hyoid	2	18.1	0	0	2	9.1	0.0034*
Up to the hyoid	8	72.7	3	27.2	11	50	
Above the hyoid	1	9.1	5	45.6	6	27.4	
The tongue base	0	0	3	27.2	3	13.5	

+Not significant at $P \geq 0.05$, *Significant at $P \leq 0.05$

Table 3: The descriptive statistics of the incidence of post-operative complications

Complications	Group I		Group II		Total		*P*
	n	%	*n*	%	*n*	%	
Injury of air way	0	0	0	0	0	0	0.157+
Recurrence up to 2 years follows up	1	9.1	0	0	1	4.5	
Seroma or wound dehiscence	1	9.1	0	0	1	4.5	
Toxicity of dye	0	0	0	0	0	0	
Local wound infection	1	9.1.1	1	9.1	2	9	
Total	3	27.2	1	9.1	4	18.1	

+Not significant at $P \geq 0.05$

Table 4: The descriptive statistics of the operative time

Items	Range	Mean ± SD	*t*-test	
			t	*P*
Time of operation without anaesthesia time (min)				
Group I	60-95	76.55±10.85	5.5548	0.0001*
Group II	40-70	54.35±14.20		

*Significant at $P \leq 0.05$

magnification, the incidence of tract identification was higher in Group II (90.9 %) than in Group I (45.5 %) (difference was statistically significant, $P = 0.0046$) [Table 2]. The incidence of identification of the tract extension level above the hyoid and up to the tongue base was 40.9 % of the total number of patients; it was significantly higher in Group II (72.8%) than in group I (9.1%) (difference was statistically significant, $P = 0.0034$) [Table 2]. Regarding the operative time; it was 76.55 ± 10.85 min in Group I and 54.35 ± 14.20 min in Group II with statistically significant difference between both groups ($P = 0.0001$) [Table 4].

DISCUSSION

Sistrunk technique has remained the gold standard for the management of TGDC because it has greatly reduced the recurrence rate, and is associated with a very low morbidity. Hence, several authors have proposed variants of the Sistrunk procedure. They consist of different types of wider dissections that include more tongue base tissue, an extension to the infrahyoid space including strap muscles or an *en bloc* central neck dissection. None of them has been proven to significantly improve the outcome and recurrences remain a matter of concern.[8,4,10-14]

The tract may be found posterior to the hyoid in approximately 15 up to 30% of cases, which has important implications for treatment.[15,16] In our research, the tract was found deep to the hyoid in 13% if the cases and penetrated the hyoid in 9%. By combining the available literature the rate of recurrence obtained was about 10.7% (9.1-12.6%). A recurrence rate of 20% (12.2-30.8%) was observed for interventions for recurrent cases but contributions are less robust for this secondary aim.[17] However, in our study the recurrence rate was 9.1% in Group I and no recurrence was found in Group II, with an overall rate of recurrence of 4.5% after 2 years of follow-up.

According to the principle TGDC excision operations, the central portion of the hyoid bone should be resected with the cystic portion to insure removal of the tract and prevent recurrence of TGDC.[18] As reported by Galluzzi *et al.*, the multiple tracts, pre-operative rupture of (pluricystic or monocystic) TGDC, post-operative infection and inflammation at surgery, are the causes of recurrences; however, he stated that the data are incomplete and inconclusive.[17]

In addition to TGDC recurrence, other complications of the Sistrunk operation have been reviewed in literature, including seroma, local wound infection, stitch abscess and wound dehiscence and laryngotracheal injury.[19] A recent review noted such minor complications to occur in 29% of patients undergoing a Sistrunk operation.[20] Hence, the identification of the tract will decrease the amount and extension of dissection preventing any future complications. In our study minor complications in the form of seroma, wound infection and dehiscence occurred in 13.5% of the total number of cases, with an overall recurrence rate of 4.5%.

As many surgical fields have adopted the use of surgical loupes. Commercially available surgical loupes allow magnification from 2 to 8 times that of the unaided eye.[21] Loupes have many benefits: Cost, flexibility, portability and time savings. Loupes allow closer access to the surgical field, wider orientation and rapid changes in viewing angle, depth of field and adjustment of gaze location within the surgical field through changes of the head and neck.[22] Hence, we started to use the loupe magnification to know the impact of its use on the TGDC excision. Ultrasound guided local injection of methylene blue dye is a safe, efficient and highly effective technique for localising recurrent tumours in scarred pre-operative neck operations.[23,24] Our experience is the same as those who have used the methylene blue dye in local injection with no complications related to the injection.

The operative time is a part of the safety for the patient as the longer the operation, the more the liability for complications. The mean operative time in Pastore and Bartoli research after 10 years of experience was 58 ± 27 min.[25] In our study, we found that the operative time in Group II using loupe magnification was (54.35 ± 14.20 minutes), which was shorter than that in Group I using methylene blue (76.55 ± 10.85 minutes). Although both methods used in our study for TGDC excision, i.e. the use of loupe magnification or methylene blue injection, were safe, efficient and effective, and both reduced the incidence of recurrence without significant difference between them, however, the use of loupe magnification significantly increased the incidence of identification of the track and identification of its extension level, and decreased the operative time as compared to using methylene blue.

CONCLUSION

Intra-operative identification of TGD tract is an essential step in the removal of the TGDC. Both loupe magnification and methylene blue dye help

in identification of the TGDC, however, the usage of surgical loupes enhances better and safe results.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Mondin V, Ferlito A, Muzzi E, Silver CE, Fagan JJ, Devaney KO, *et al*. Thyroglossal duct cyst: Personal experience and literature review. Auris Nasus Larynx 2008;35:11-25.
2. 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.
3. Guarisco JL. Congenital head and neck masses in infants and children. Part I. Ear Nose Throat J 1991;70:40-7.
4. Shah R, Gow K, Sobol SE. Outcome of thyroglossal duct cyst excision is independent of presenting age or symptomatology. Int J Pediatr Otorhinolaryngol 2007;71:1731-5.
5. Kurt A, Ortug C, Aydar Y, Ortug G. An incidence study on thyroglossal duct cysts in adults. Saudi Med J 2007;28:593-7.
6. Sprinzl GM, Koebke J, Wimmers-Klick J, Eckel HE, Thumfart WF. Morphology of the human thyroglossal tract: A histologic and macroscopic study in infants and children. Ann Otol Rhinol Laryngol 2000;109(12 Pt 1):1135-9.
7. Kim MK, Pawel BR, Isaacson G. Central neck dissection for the treatment of recurrent thyroglossal duct cysts in childhood. Otolaryngol Head Neck Surg 1999;121:543-7.
8. Patel NN, Hartley BE, Howard DJ. Management of thyroglossal tract disease after failed Sistrunk's procedure. J Laryngol Otol 2003;117:710-2.
9. Sistrunk WE. The surgical treatment of cysts of the thyroglossal tract. Ann Surg 1920;71:121-122
10. Kim MK, Pawel BR, Isaacson G. Central neck dissection for the treatment of recurrent thyroglossal duct cysts in childhood. Otolaryngol Head Neck Surg 1999;121:543-754.
11. Hewitt K, Pysher T, Park A. Management of thyroglossal duct cysts after failed Sistrunk procedure. Laryngoscope 2007;117:756-8.
12. Perkins JA, Inglis AF, Sie KC, Manning SC. Recurrent thyroglossal duct cysts: A 23-year experience and a new method for management. Ann Otol Rhinol Laryngol 2006;115:850-6.
13. Ostlie DJ, Burjonrappa SC, Snyder CL, Watts J, Murphy JP, Gittes GK, *et al*. Thyroglossal duct infections and surgical outcomes. J Pediatr Surg 2004;39:396-9.
14. Ryu YJ, Kim DW, Jeon HW, Chang H, Sung MW, Hah JH. Modified Sistrunk operation: New concept for management of thyroglossal duct cyst. Int J Pediatr Otorhinolaryngol 2015;79:812-6.
15. Chandra RK, Maddalozzo J, Kovarik P. Histological characterization of the thyroglossal tract: Implications for surgical management. Laryngoscope 2001;111:1002-5.
16. El-Anwar MW, Nofal AA. Thyroglossal duct cyst excision with hyoid bone preservation. Eur Arch Otorhinolaryngol 2015. [Epub ahead of print].
17. Galluzzi F, Pignataro L, Gaini RM, Hartley B, Garavello W. Risk of recurrence in children operated for thyroglossal duct cysts: A systematic review. J Pediatr Surg 2013;48:222-7.
18. Chou J, Walters A, Hage R, Zurada A, Michalak M, Tubbs RS, *et al*. Thyroglossal duct cysts: Anatomy, embryology and treatment. Surg Radiol Anat 2013;35:875-81.
19. Wootten CT, Goudy SL, Rutter MJ, Willging JP, Cotton RT. Airway injury complicating excision of thyroglossal duct cysts. Int J Pediatr Otorhinolaryngol 2009;73:797-801.
20. Maddalozzo J, Venkatesan TK, Gupta P. Complications associated with the Sistrunk procedure. Laryngoscope 2001;111:119-23.
21. Baker JM, Meals RA. A practical guide to surgical loupes. J Hand Surg Am 1997;22:967-74.
22. Graham KE. Keeping spectacle-mounted loupes on comfortably. Plast Reconstr Surg 1997;99:591-2.
23. Harari A, Sippel RS, Goldstein R, Aziz S, Shen W, Gosnell J, *et al*. Successful localization of recurrent thyroid cancer in reoperative neck surgery using ultrasound-guided methylene blue dye injection. J Am Coll Surg 2012;215:555-61.
24. Pollack G, Pollack A, Delfiner J, Fernandez J. Parathyroid surgery and methylene blue: A review with guidelines for safe intraoperative use. Laryngoscope 2009;119:1941-6.
25. Pastore V, Bartoli F. "Extended" Sistrunk procedure in the treatment of recurrent thyroglossal duct cysts: A 10-year experience. Int J Pediatr Otorhinolaryngol 2014;78:1534-6.