Bangladesh Journal of Anatomy January 2009, Vol. 7 No. 1 pp. 26-33

Postmortem Study of Thyroid Arteries in Bangladeshi People

Kanta Roy Rimi[1], Shamim Ara[2], Motahar Hossain[3], KM Shefyetullah[4], Humaira Naushaba[5], BK Bose[6]

Abstract

Context: *Anatomical knowledge of vasculature is essential for successful thyroid surgery. Vascular anatomy of thyroid artery may vary.*

Study design: *Descriptive type of study.*

Place & Period of study: *Department of Anatomy, Dhaka Medical College from July 2003 to December 2004.*

Materials: *Present study was performed on 57 thyroid gland. The samples were collected from unclaimed dead bodies that were under examination in the Department of Forensic Medicine of Dhaka Medical College, Dhaka.*

Methods: *The samples were divided in groups. All samples of thyroid arteries were studied morphologically. Five (5) samples were transferred into aided dissection by common vermilion mixed melted paraffin wax.*

Result: *Superior thyroid artery was most commonly originated from external carotid artery (male- 76.5% both right and left, female-91.3% right, 73.9% left), followed by bifurcation of common carotid artery (male- right 14.7%, left 20.6%, female- left 13%, right 0% and from common carotid artery (male 8.8% right, 2.9% left, female- 8.7% right, 13% left) at the level or above the level of upper border of thyroid cartilage.*

On the right side in 100% and 94.7% cases superior thyroid artery and inferior thyroid artery were originated as a single artery respectively. On the left side in 94.7% and 87.7% cases superior thyroid artery and inferior thyroid artery were originated as a single artery respectively. On the left side, double superior thyroid artery was present in 5.3% cases, double inferior thyroid artery was present in 1.8% cases. Inferior thyroid artery was found to be absent in 4.3% right side, 9.5% left side in female cases and 5.9% both right and left side in male cases.

There was no significant (P>0.05) difference between the length of superior thyroid artery on the right and left side. But the length of inferior thyroid artery showed significant (p<0.001) difference between the right and left side.

Inferior thyroid artery was most commonly originated from thyrocervical trunk (right 47%, left 90.2%), followed by subclavian artery (right 13%, left 9.80%). It most commonly originated at the level of 8^{th}-10^{th} tracheal ring in (right 50%, left 52.95%) cases followed by 6^{th}-8^{th} or 10^{th}-14^{th} tracheal ring (right 27.8%, left 27.45%), 10^{th} – 14^{th} tracheal ring (right 22.2%, left 19.6%).

Thyroidea ima artery was present in 6 out of 57 cadaver (10.52%), most commonly it was originated from brachiocephalic trunk (50%) but it was also originated from arch of aorta (33.3%) and right common carotid artery(16.7%).

Conclusion: *It is important to know the arterial pattern of thyroid gland for successful thyroid surgery in our country. This artery can help to understand the arterial pattern of thyroid gland in our country and there by may help to reduce the complication during thyroid surgery. Due to small size of sample in our study, further study with large samples from different zones, especially in endemic zone of the country using polyester resin cast and more sophisticated micro-anatomical technique with multivariant analysis is recommended.*

Keywords: *Thyroid arteries, Postmortem, Bangladeshi.*

1. Associate Professor (c.c.), Department of Anatomy, Dinajpur Medical College
2. Professor and Head, Department of Anatomy, Dhaka Medical College
3. Professor and Head, Department of Anatomy, Ibrahim Medical College.
4. Director, Medical Education & HMPD, Director General Health Service, Dhaka
5. Professor and Head, Department of Anatomy, Sir Salimullah Medical College, Dhaka
6. Director, Centre for Nuclear Medicine & Ultrasound, Dinajpur

Correspondence: Dr. Kanta Roy Rimi

Introduction:

The thyroid is a highly vascular endocrine gland in human body[1]. The gland is involved in the regulation of metabolism and growth of an individual. It is important clinically as because iodine deficiency disorders are a spectrum of problems which manifests in different stages of life with the varying grades of severity. It is served by two pairs of arteries (Superior and Inferior thyroid artery), and an inconstant artery, thyroidea ima artery[2]. It has been estimated that the normal flow rate is about 5 ml/ gm of thyroid tissue in each minute.

In geographical areas of severe iodide limitation, which are estimated to affect at least 800 million people world-wide; both endemic goitre and mental retardation due to cretinism are encountered[3]. The disease which usually affect the thyroid gland are hypothyroidism, hyperthyroidism, autoimmune thyroiditis, Graves' disease, of which hypothyroidism due to iodine deficiency is the commonest[4]. Medical treatment is not sufficient to manage thyroid disorder specially in case of malignancy and when respiratory distress, dysphagia are present due to thyroid disease[5]. Possible complication during thyroid surgery are hemorrhage, hoarseness of voice, disturbance of phonation, laryngeal spasm, respiratory obstruction, pneumothorax[6]. In an attempt to improve the results of thyroidectomy a careful study of thyroid anatomy is required[5]. With this view, this study was taken to know the exact arterial pattern of thyroid gland in Bangladeshi people.

Materials and Methods:

The present study was performed on thyroid arteries of 57 human thyroid gland from both sexes in different age groups. The study was done from July 2003 to December 2004. The samples of human thyroid and thyroid artery were collected from unclaimed dead bodies, after all legal procedure that was under examination in the Department of Forensic Medicine of Dhaka Medical College, Dhaka. The samples were collected from the dead bodies within 12 – 24 hours of death. The samples were tagged immediately, which was bearing a code number for subsequent identification.

The samples were divided into three different age groups, according to age.

According to sex:

Male (n-34) : Cadavers - 34

Female (n-23): Cadavers - 23

Parameters:

A) Superior Thyroid Artery

1) Site of origin of superior thyroid artery
   a) External carotid artery
   b) Bifurcation of common carotid artery
   c) Common carotid artery
2) Level of origin of superior thyroid artery
   a) At the level of thyroid cartilage
   b) Below the level of thyroid cartilage
   c) Above the level of thyroid cartilage
3) Number of superior thyroid artery
   a) Single
   b) Double
4) Length of main trunk of superior thyroid artery: From origin to its glandular branches. If single branch is present then it was measured from origin to entrance into the gland. Here, single trunk is regarded as a glandular branch also.

B) Inferior Thyroid Artery

1) Site of origin of inferior thyroid artery
   a) Thyrocervical trunk,
   b) Subclavian artery
2) Level of origin of inferior thyroid artery
   a) 6^{th} to 8^{th} tracheal ring
   b) 8^{th} to 10^{th} tracheal ring
   c) 10^{th} to 14^{th} tracheal ring
3) Number of inferior thyroid artery
   a) Single
   b) Double
   c) Absent
4) Length of main trunk of inferior thyroid artery: From origin to its glandular branches. If single branch is present then it was measured from origin to entrance into the gland. Here, single trunk regarded as a glandular branch also.

C) Arteria thyroidea ima

1) Presence or absence of Arteria thyroidea ima
   a) Present
   b) Absent
2) Site of origin of arteria thyroidea ima
   a) Arch of aorta

b) Brachiocephalic trunk

c) Right common carotid artery

Methods of studying the parameters :

Gross morphological study in cadaver by:

(i) Unaided dissection

(ii) Aided dissection

Fifty two (52) study material were subjected to unaided dissection, five (5) to aided dissection.

Measurement Procedure

To note the level of origin of superior thyroid artery, the viscera was held in the anatomical position and the level of origin of the gland was marked by a suture on the thyroid cartilage. At the level of origin of inferior thyroid artery, a permanent marking was given by a suture on the tracheal ring. It was noted by counting the tracheal ring from first to which a suture mark was placed on tracheal ring. Length of the arteries was measured by measuring scale in mm[7] (Fig.-5).

Aided dissection: About 10 gm of common vermillion was mixed with 100 ml of melted paraffin wax (melting point 60^{o}c) and the mixture was kept in the hot air oven for about two hours[7]. A set of narrow plastic tube (infant nasogastric tube no. 6) was firmly fitted to superior thyroid artery through external carotid and upper portion of common carotid artery of a formalin fixed viscera. Then external carotid artery above its origin to superior thyroid artery and common carotid artery below the origin of internal carotid artery was clamped with artery forcep. Then the vermillion mixed melted paraffin was stirred thoroughly with a hot glass stirrer and about 25 ml of the mixture was taken in a 60 ml glass syringe, which was previously warmed in hot water. Then the coloured paraffin was rapidly pushed through the plastic tube into the superior thyroid artery through external carotid artery and upper part of common carotid artery. When no further paraffin could be pushed, the entire viscera was quickly immersed in a bucket of cold water. As a result the vermillion coloured paraffin was hardened within the component artery of the viscera, thereby rendering them visually more prominent. Incase of inferior thyroid artery a set of narrow plastic tube was firmly fitted to inferior thyroid artery through thyrocervical trunk or subclavian artery. Portion of thyrocervical trunk and subclavian artery after origin of inferior thyroid artery was clamped with artery forceps. Then rest of the procedure has done like same of superior thyroid artery, when both side of thyroid arteries hardened by vemillion coloured paraffin wax, the dissection of the viscera was carried out to see arterial pattern of thyroid gland.

Result:

Table II, III, IV, V & Fig. 2A & 2B shows the results of superior thyroid artery. Table -IV, VI, VII, VIII, IX & Fig.-3A, 3B shows the results of infection thyroid artery.

Table X & Fig. 4 shows the origin of thyroids ima artery.

Table I

Showing the different groups of thyroid gland according to age of cadaver

Group	Age (in year)	Number of thyroid gland n=57	%
I	10 - 20	13	22.80
II	21 - 40	32	56.15
III	41 - 60	12	21.05

Table II

Showing the site of origin of superior thyroid artery in cadaveric male and female

Sex	Number of cadaver	Side	Site of origin of superior thyroid artery					
			From External carotid artery		From bifurcation of Common carotid artery		From Common carotid artery	
			No.	%	No.	%	No.	%
Male	34	Right	26	76.5	5	14.7	3	8.8
		Left	26	76.5	7	20.6	1	2.9
Female	23	Right	21	91.3	0	0.0	2	8.7
		Left	17	73.9	3	13.0	3	13.0

Table III

Showing the level of origin of superior thyroid artery

Level of origin in relation to upper border of thyroid cartilage	Right side		Left side	
	Number	%	Number	%
At the level	17	29.8	11	19.3
Above the level	10	17.5	11	19.3
Below the level	30	52.6	35	61.4
Total	57	100.0	57	100.0

Table IV

Showing the number of superior and inferior thyroid arteries in cadaveric male and female

Name of artery	Sex	Number of cadaver	Side	Single		Double		Absent	
				No.	%	No.	%	No.	%
Superior thyroid artery	Male	34	Right	34	100.0	-		-	-
			Left	32	94.1	2	5.9	-	-
	Female	23	Right	23	100.0	-	-	-	-
			Left	22	95.7	1	4.3	-	-
Inferior thyroid artery	Male	34	Right	32	94.1	-		2	5.9
			Left	31	91.2	1	2.9	2	5.9
	Female	23	Right	22	95.7	-	-	1	4.3
			Left	19	90.5	-	-	4	9.5

Table V

Showing the length of main trunk of superior thyroid artery in different age groups

Side	Group	No. of artery	Length (mm)						Mean	*p value
			0 -10		11- 20		21-42			
			No.	%	No.	%	No.	%		
Right (n=57)	Group I(10 - 20) years	13	0	0.0	7	53.8	6	46.2	20.9	p<0.05 (Gr I vs Gr II)
	Group II (21-40) years	32	1	3.1	6	18.8	25	78.1	26.6	p>0.05 (Gr II vs Gr III)
	Group III (41-60) years	12	0	0.0	0	0.0	12	100.0	27.9	p<0.05 (Gr III vs Gr I)
	Mean±SD					25.6±7.1				
Left (n=57)	Group I (10 - 20) years	13	0	0.0	8	61.5	5	38.5	19.8	p<0.001 (Gr I vs Gr II)
	Group II (21-40) years	32	1	3.1	3	9.4	28	87.5	27.2	p>0.05 (Gr II vs Gr III)
	Group III (41-60) years	12	0	0.0	1	8.3	11	91.7	31.1	p<0.01 (Gr III vs Gr I)
	Mean±SD	26.3±7.2**p>0.05								

*p value obtained from unpaired student's t test between groups

**p value obtained from unpaired student's t test between right & left side

Table VI

Showing the site of origin of inferior thyroid artery in cadaveric male and female

	SexSite of origin of inferior thyroid artery							
	Right side (n=54)				Left side (n=51)			
	Thyrocervical trunk		Subclavian artery		Thyrocervical trunk		Subclavian artery	
	Number	%	Number	%	Number	%	Number	%
Male	27	84.4	5	15.6	27	90.0	3	10.0
Female	20	90.9	2	9.1	19	90.5	2	9.5
Total	47	87.0	7	13.0	46	90.2	5	9.8

Table VII

Showing the level of origin of inferior thyroid artery

Level of origin	Right side		Left side	
(at tracheal ring)	Number	%	Number	%
6^{th} - 8^{th}	15	27.8	14	27.45
8^{th} - 10^{th*}	27	50.0	27	52.95
10^{th} -14^{th}	12	22.2	10	19.60
Total	54	100	51	100

Table VIII

Showing the number of terminal (glandular) branches of inferior thyroid arteries in cadaveric male and female

Sex	Number of terminal branches of inferior thyroid artery											
	Right side (n=54)						Left side (n=51)					
	Single		Double		Triple		Single		Double		Triple	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Male	4	12.5	27	84.38	1	3.12	3	9.38	27	84.37	2	6.25
Female	3	13.64	18	81.81	1	4.55	2	10.52	15	78.94	2	10.54
Total	7	12.97	45	83.33	2	3.70	5	9.8	42	82.35	4	7.85

Table IX

Showing the length of main trunk of inferior thyroid arteries in different age group

Side	Group	No. of artery	Length (mm) 20-30 No.	%	31-40 No.	%	41-60 No.	%	Mean	*p value
Right (n=54)	Group I (10 - 20) Years	12	8	66.7	3	25.0	1	8.3	29.5	p<0.01 (Gr I vs Gr II)
	Group II (21-40) Years	31	6	19.4	20	64.5	5	16.1	35.8	p<0.001 (Gr II vs Gr III)
	Group III (41-60) Years	11	0	0.0	5	45.5	6	54.5	43.5	p<0.01 (Gr III vs Gr I)
	Mean±SD		36.0±7.5							
Left (n=51)	Group I (10 - 20) Years	12	4	33.33	5	41.67	3	25.0	34.5	p<0.01 (Gr I vs Gr II)
	Group II (21-40) Years	28	1	3.6	14	50.0	13	46.4	40.9	p<0.001 (Gr II vs Gr III)
	Group III (41-60) Years	11	0	0.0	1	9.1	10	90.9	46.7	p<0.01 (Gr III vs Gr I)
	Mean±SD		40.5±7.1p<0.001**							

*p value obtained from unpaired student's t test between groups

**p value obtained from unpaired student's t test between right and left side

Table X

Showing the distribution of thyroidea ima artery and its origin

Thyroida ima artery	Number	%
Present	6	10.5
Absent	51	89.5
Total	57	100.0
Origin of thyroidea ima Artery		
Arch of aorta	2	33.3
Brachiocephalic trunk	3	50.0
Right common carotid artery	1	16.7
Total	6	100.0

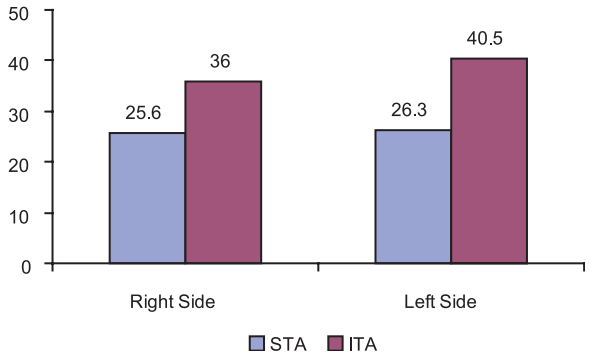

Fig.-1: *Mean length of superior thyroid artery (STA) and inferior thyroid artery (ITA) on both sides*

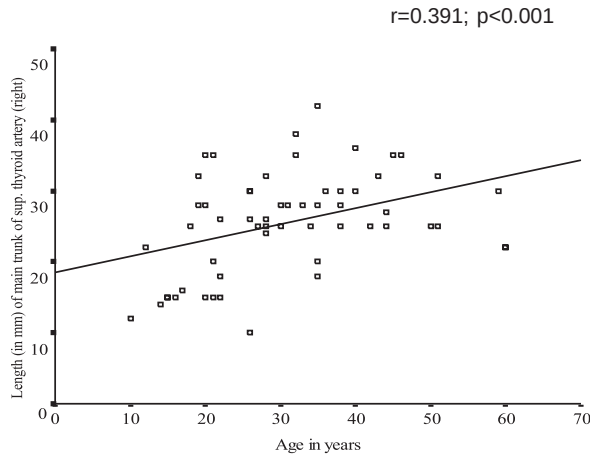

Fig.-2A: *Scatter diagram showing a positive correlation between age of the cadaver and length of main trunk of superior thyroid artery (Right side) r=0.454; p<0.001*

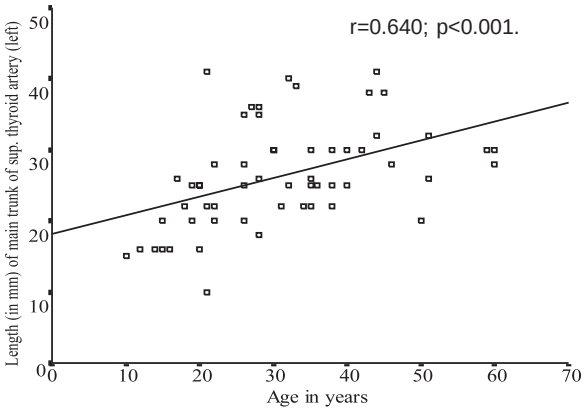

Fig.-2B: *Scatter diagram showing a positive correlation between age of the cadaver and length of main trunk of superior thyroid artery (Left side)*

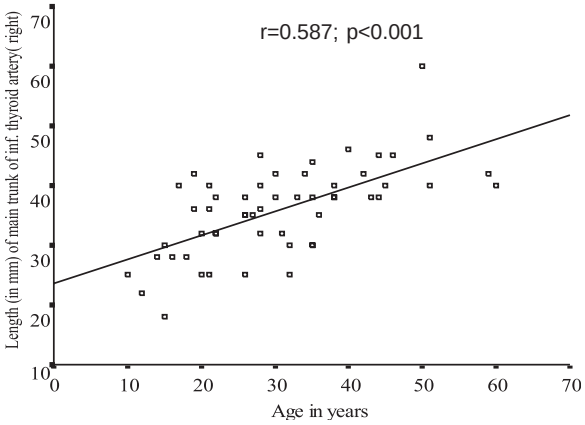

Fig.-3A: *Scatter diagram showing a positive correlation between age of the cadaver and length of main trunk of inferior thyroid artery (right side)*

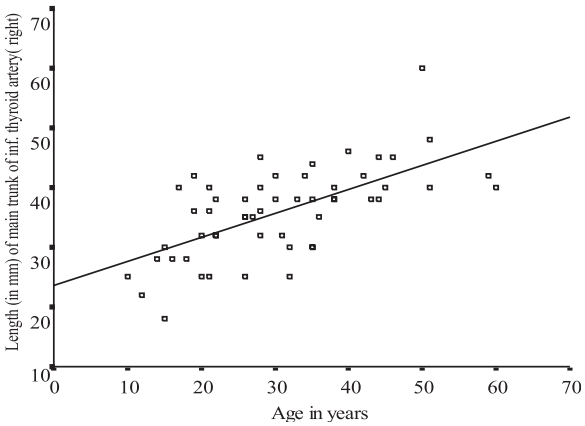

Fig.-3B: *Scatter diagram showing a positive correlation between age of the cadaver and length of main trunk of inferior thyroid artery (left side)*

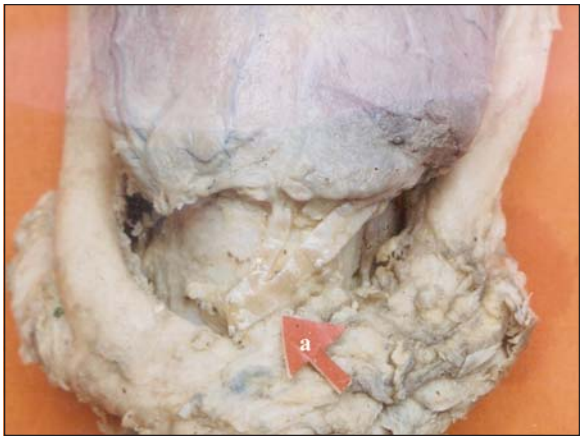

Fig.-4: *Thyroid gland and its artery. 'a' mark indicate arteria thyroidea ima.*

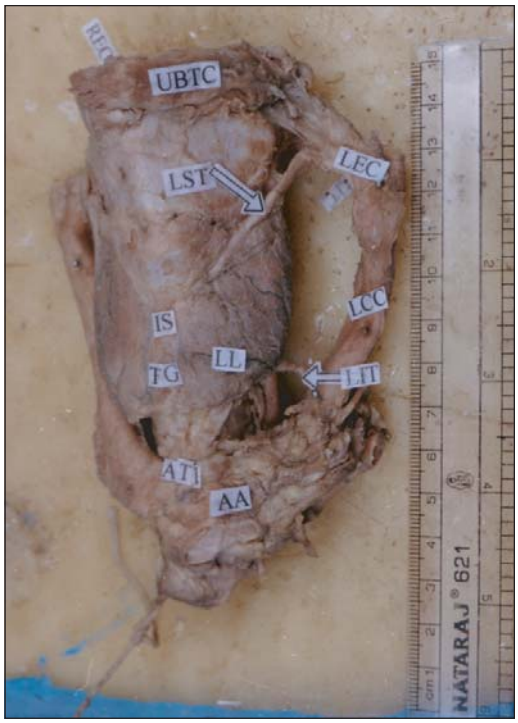

Fig.-5: *Thyroid gland and its related structures. The measuring scale shown on the right hand side.*

UBTC = Upper border of thyroid cartilage
LST = Left Superior thyroid
LEC = Left External carotid
IS = Isthmus
LCC = Left common carotid
LL = Left lobe
TG = Thyroid gland
LIT = Left inferior thyroid
ATI = Arteria thyroidea ima
AA = Arch of aorta

Discussion

Superior thyroid artery arises from the external carotid artery just above the bifurcation, from the bifurcation or from the common carotid artery below the bifurcation[8]. In the present study it was shown that superior thyroid artery arose most commonly from the external carotid artery on both sides. It also arose at the level of bifurcation of common carotid artery in 14.7% cases or less commonly directly from common carotid artery (8.8%). Superior thyroid artery arose from external carotid artery more commonly in female than male (91.3% and 76.5% respectively). The external carotid artery begins opposite the upper border of the thyroid cartilage[9]. In this study, highest percentage of superior thyroid artery originated from below the level of upper border of thyroid cartilage (52.6% right, 61.4% left). It also arose at the level of upper border of thyroid cartilage (29.8% right, 19.3% left) or above the level of upper border of thyroid cartilage (17.5% right, 19.3% left). In this study it was also shown that superior thyroid artery mainly arose as a single branch, in a small number of cases (5.3% left) it arose as a double artery at its origin.

The mean $\pm$SD length of main trunk of superior thyroid artery on right side was 25.6$\pm$7.1 mm and that on left side was 26.3$\pm$7.2 mm. It was revealed that there was no statistically significant variation of mean length of main trunk of superior thyroid artery between right and left side ($p>0.05$). The length of main trunk of superior thyroid artery significantly increased with increasing age of the cadaver ($p<0.05$). From middle age on wards, various structural alterations are found in elastic and medium sized arteries. In normal young adults the intima is about one sixth of the total wall thickness, but after middle age, lipid deposits may grossly expand this layer. The amount of elastin and collagen increases, muscle decreases and there is a lower water content leading to increase in length. This may be the explanation of increase length of main trunk of superior thyroid artery[10].

The inferior thyroid artery usually arises from the thyrocervical trunk. In about 15 percent of individuals it may arise directly from the subclavian artery[8]. In the present study out of 57 cases, inferior thyroid artery were absent in three cases and was found to

originate from thyrocervical trunk in 47 cases, (87.0%), from subclavian artery in seven cases (13.0%) on the right side. On the other hand, out of 57 cases in 6 cases there was no inferior thyroid artery on the left side, in 46 cases (90.2%) cases inferior thyroid arteries arose from thyrocervical trunk and 9.8% cases arose from subclavian artery on the left side. There is no statistically significant variation of origin of inferior thyroid artery between male and female in both side. Inferior thyroid artery may be double[11]. Inferior thyroid artery may be absent[12]. If the artery is absent branches from the ipsilateral superior thyroid artery or the contra lateral inferior thyroid artery take its place. In the present study it was shown that in the majority of cases inferior thyroid artery was single (94.1% - right side, 91.2% - left side) in male, inferior thyroid artery was double (2.9%) and in some cases there was no inferior thyroid artery (4.3% - right side, 9.5% - left side) in female. So, the study was consistent with other studies.

In this study that inferior thyroid artery in majority of cases was originated at the level of 8^{th} to 10^{th} tracheal ring (50.0% -right side, 52.95% - left side). It also arose at the level of 6^{th} – 8^{th} ring in 27.8% cases on the right & in 27.45% cases on the left. At the level of 10^{th} -14^{th} ring 22.2% inferior thyroid artery was originated on the right side and 19.60% on the left side. The mean $\pm$SD length of main trunk of inferior thyroid artery on the right side was 36.0$\pm$7.5 mm and on the left side was 40.5$\pm$7.1 mm. It was revealed that statistically significant variation of mean length of main trunk of inferior thyroid artery was found between right and left side of the cadaver ($p<0.001$) indicating that the mean length was higher on the left side compared to the right side. It was also revealed that on each side, the mean length of main trunk of inferior thyroid artery significantly increased with increasing age of the cadaver ($p<0.001$). Thyroidea ima artery may arise from the brachiocephalic artery, the right common carotid artery, the aortic arch or internal thoracic artery[8]. The frequency of this artery varies from 1.5 to 12.2 percent. The artery may be as large as an inferior thyroid artery or a mere twig. Its frequent location anterior to trachea makes it of major importance in tracheostomy. In the present study, it was shown out of 57 cadavers, 6 (10.5%) had thyroidea ima artery and 51(89.5%) had none. Regarding the origin of the artery 50% originated from brachiocephalic trunk followed by 33.3% from arch of aorta and 16.7% from right common carotid artery (figure: 4).

References

1. Williams, L. Peter and Warwick, Roger (editor), Gray's Anatomy. 36th edn. Churchill Livingstone, Edinburgh 1980; 1049-55.
2. Pemberton, J.J, Beaver, M.G. Anomaly of right recurrent laryngeal nerve. *Surg Gynecol Obstet* 1932; 54: 594-5
3. Charles, G.D. Brook and Nicholas, J, Marshall (editors), Essential Endocrinology. 4th edn., Blackwell Science Limited, Boston. 2001; 78-91.
4. Enayetullah. Gross and histopathological study of the thyroid and parathyroid glands in Bangladeshi people (M. Phil thesis) Dhaka: University of Dhaka. 1996; 17.
5. Hunt, P.S, Poole, M and Reeve, TS: Reappraisal of the surgical anatomy of the thyroid and parathyroid glands. *Br J Surg* 1968; 55: 63-6.
6. Giovanni, S.D Clawdia, A. Agala, T, Etthre, G. Filippo, T. Maria, S. The recurrent laryngeal nerve related to thyroid surgery. *The Am J Surg* 1999; 177: 485-8.
7. Khalil, M. An anatomical study of the circle of willis and other major arteries at the base of the brain in Bangladesh people (M.Phil Thesis), Dhaka: University of Dhaka, 1992; 26.
8. Tzinas, S. Droulias, C, Harlaftis N, Akin, J.T., Gray, S.W., Skandalakias, J.E. Vascular patterns of the thyroid gland. *The American Surgeon* 1980; 1345: 640
9. Allen, W.G. and Sisson, A. G (editor), Surgery of the thyroid and parathyroid glands 3rd edn. Little Brown, New York 1962; 2951-3.
10. Williams, P.L, Warwick, R, Dyson M, Bannister LH (editors) Gray's Anatomy. 37th edn., churchill Livingstone, Edinbrugh. 1989; 624-5.
11. Allan, F.D. An accessory or superficial inferior thyroid artery in a full-term infant. *Anat Rec* 1952; 112: 539.
12. Faller, A. Scharer, O. Variable origin of arteria thyroidea ima. *Acta Anat* 1947; 4(1): 119-22.