Indian Journal of Anatomy

Indexing Information: Index Copernicus, Poland; Google Scholar; ProQuest, USA; Genamics JournalSeek; Scopus (Under Process).

Printed at Saujanya Printing Press, D-47, Okhla Industrial Area Phase-1, New Delhi - 20

Red Flower Publication Pvt. Ltd.
48/41-42 DSIDC, Pocket-II, Mayur Vihar Phase-I
Delhi - 110 091(India)
Phone: 91-11-22754205, 45796900, Fax: 91-11-22754205
E-mail: redflowerppl@vsnl.net
Web:www.rfppl.co.in

The Indian Journal of Anatomy is a quarterly print and online journal of the **Red Flower Publication Pvt. Ltd.** publishes original and peer-reviewed articles, for the dissemination of anatomical knowledge with clinical, surgical and imaging guidance. Includes articles of history, reviews and biographies, locomotors, splachnology, neuroanatomy, imaging anatomy, anatomical variations, anatomical techniques, education and pedagogy in anatomy, Human Anatomy, Veterinary Anatomy, Embryology, Gross Anatomy (Macroscopic), Microscopic Anatomy (Histology, Cytology), Plant Anatomy (Phytotomy), Comparative Anatomy, editorials, letters to the editor, and case reports. Articles of veterinary anatomy, comparative and other morphological sciences are accepted.

Subscription Information

India

Individual	
1 Year	Rs. 5400
Life Subscription (Valid for 10 Years)	Rs. 54000
Institutional (1 Year)	Rs. 6000

Rest of the World

Individual (1 Year)	USD100
Institutional (1 Year)	USD260

PAYMENT METHOD

By Cheque/Demand Draft:

Cheque should be in the name of **Red Flower Publication Pvt. Ltd.** payable at Delhi.

By Bank Transfer/TT:

Bank name: Bank of India

Swift Code: BKIDINBBDOS

Account Name: Red Flower Publication Pvt. Ltd.

Account Number: 604320110000467

Branch: Mayur Vihar Phase-I

Delhi - 110 091 (India)

Send All Orders to: **Red Flower Publication Pvt. Ltd.,** 48/41-42, DSIDC, Pocket-II, Mayur Vihar Phase-I, Delhi - 110 091, India, Phone: 91-11-22754205, 45796900, Fax: 91-11-22754205, E-mail: redflowerppl@vsnl.net, Website: www.rfppl.co.in

Indian Journal of Anatomy

September - December 2015

Volume 4 Number 3

Contents

Original Articles

Case Report

Indian Journal of Anatomy

Library Recommendation Form

If you would like to recommend this journal to your library, simply complete the form below and return it to us. Please type or print the information clearly. We will forward a sample copy to your library, along with this recommendation card.

Please send a sample copy to:

Name of Librarian

Name of Library

Address of Library

Recommended by:

Your Name/ Title

Department

Address

Dear Librarian,

I would like to recommend that your library subscribe to the **Indian Journal of Anatomy**. I believe the major future uses of the journal for your library would provide:

1. useful information for members of my specialty.
2. an excellent research aid.
3. an invaluable student resource.

I have a personal subscription and understand and appreciate the value an institutional subscription would mean to our staff.

Should the journal you're reading right now be a part of your University or institution's library? To have a free sample sent to your librarian, simply fill out and mail this today!

Stock Manager

Red Flower Publication Pvt. Ltd.

48/41-42, DSIDC, Pocket-II, Mayur Vihar, Phase-I

Delhi - 110 091 (India)

Tel: 91-11-22754205, 45796900, Fax: 91-11-22754205

E-mail: redflowerppl@gmail.com, redflowerppl@vsnl.net

Website: www.rfppl.co.in

Original Article

Indian Journal of Anatomy
Volume 4 Number 3, September - December 2015

A Morphometric Study of the Right Atrioventricular Valve in Cadavers

Lata Munde*, P.S. Bhuiyan**

Abstract

The right atrio-ventricular (tricuspid) valve is having three leaflets in majority of cases. However, in some cases it has shown only two leaflets or in few four leaflets. Accurate knowledge of morphometry and morphology is important in differentiating and treating various pathologies of the right atrio-ventricular (tricuspid) valve. Hence, the aim of the present study is to measure various dimensions of the right atrio-ventricular (tricuspid) valve and note any variations found. The dimensions were measured with the help of standard instruments. The data obtained was statistically analysed and compared with the available literature. The Mean results obtained were (in mm), circumference of right atrioventricular valve annulus: - 10.2, width of anterior leaflet: - 4.9, width of posterior leaflet: - 3.8, width of septal leaflet: - 4.4, height of anterior leaflet: - 3.3, height of posterior leaflet: - 3.4, height of septal leaflet: - 4.8

Keywords: Atrioventricular; Morphometric; Tricuspid; Valve.

Introduction

The right atrioventricular valve is also called as tricuspid valve since it has 3 leaflets as the most common occurrence (62%), two leaflets in 30% and four leaflets in 8% cases [1].

The anatomy of right atrioventricular valve complex is highly sophisticated but understanding of it may be helpful in the practice of cardiac surgery, especially in the partial transfer of leaflets of tricuspid valve for mitral valve repair. The right atrioventricular valve may be involved in severe cardiac malformations. Surgical techniques of tricuspid valve repair has been developed for correction of organic tricuspid regurgitation which is resistant to medical therapy.

The normal values of different dimensions are based on echocardiography or angiography. The appropriate knowledge of morphometry of tricuspid valve is essential for the success of prosthetic implants.

Aim

The present study was performed to estimate the various dimensions of the right atrioventricular valve in Indian population which may be helpful for cardiothoracic surgeons and invasive cardiologists.

Objectives

1. To measure the circumference of tricuspid valve annulus
2. To measure the width and height of anterior leaflet
3. To measure the width and height of posterior leaflet
4. To measure the width and height of septal leaflet
5. To note the presence or absence of cleft in posterior leaflet, to count its number if present

Materials and Methods

Fifty four specimens of hearts from cadavers embalmed using 10% formalin were used in this study. The study consisted of meticulous dissection using standard dissection kit and measurement of

Author's Affiliation: *Assistant professor, Department of Anatomy, Dr.S.C.G.M.C., Vishnupuri, Nanded, India. ** Professor and Head, Dept of Anatomy, Seth G.S. Medical College and K.E.M. Hospital, Mumbai.

Corresponding Author: Lata Munde, Assistant professor, Department of Anatomy, Dr.S.C.G.M.C., Vishnupuri, Nanded, India.

E-mail: latamunde@gmail.com

various parameters.

The cadavers used in this study were the ones used by the medical students for dissection in a medical teaching institute and tertiary care hospital. Pericardial cavity was explored and the heart was removed from the cavity.

An incision was made along the right border of right atrium across the opening of superior and inferior venae cavae and the cavity of right atrium was opened and cleared off clots that exposed the right atrioventricular orifice and atrial surface of tricuspid leaflets.

Second incision was made parallel to and just to the right of anterior interventricular groove extending from the root of pulmonary trunk to the inferior border of the heart. Same incision was extended along the inferior border until it reached the junction between right and inferior borders of the heart.

The wall of right ventricle was reflected and cavity of right ventricle cleared off clots with particular care not to damage the chordae tendineae. That exposed the ventricular aspect of tricuspid valve, chordae tendineae and papillary muscles. The measurements were taken in situ with the help of a divider, non elastic thread and measuring scale.

The circumference of tricuspid valve annulus was measured with the help of non elastic thread and a measuring scale (Figure 1). The width of anterior leaflet was measured as distance between two points i.e. Point a and b. Point a was marked at the junction of anterior leaflet with anteroposterior commissure and point b was marked at the junction of anterior leaflet with anteroseptal commissure (Figure 2).

The width of the posterior leaflet was measured as distance between two points' c and d. Point c was marked at the junction of posterior leaflet with anteroposterior commissure and point d was marked at the junction of posterior leaflet with posteroseptal commissure.

The width of septal leaflet was measured as distance between two points e and f. The point e was marked at the junction of septal leaflet with anteroseptal commissure and point f was marked at the junction of septal leaflet with posteroseptal commissure.

The height of anterior, posterior and septal leaflet was measured from base to apex in the middle of leaflet (Figure 3).

Presence or absence of cleft in posterior leaflet was noted, when present its number noted (Figure 4).

All the data was recorded and was statistically analysed for the purpose of calculating the

- Range
- Mean
- Standard deviation

Mean was calculated by the following formula

$$\bar{x} = \frac{1}{n} \cdot \sum_{i=1}^{n} x_i$$

Fig. 1: Illustration showing measurement of the circumference of right atrioventricular valve annulus.
AL = Anterior Leaflet, PL = Posterior Leaflet, SL = Septal Leaflet, S = Superior, I = Inferior, A = Anterior, P = Posterior

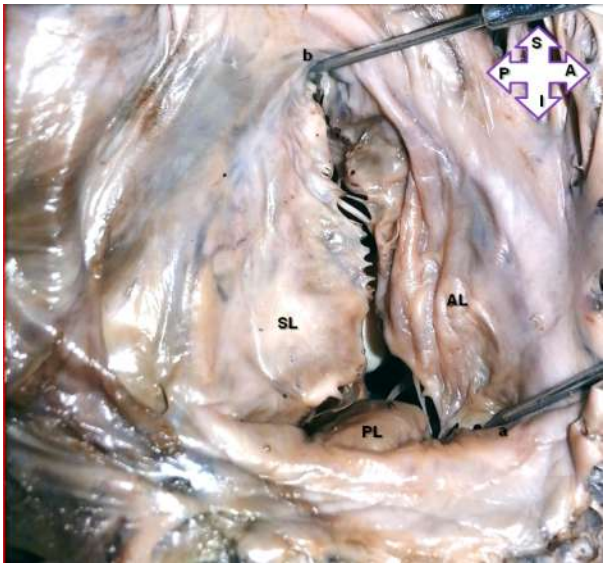


Fig. 2: Illustration showing measurement of the width of anterior leaflet of right atrioventricular valve. a = Junction of AL with anteroposterior commissure, b = Junction of AL with anteroseptal commissure
AL = Anterior Leaflet, PL = Posterior Leaflet, SL = Septal Leaflet, S = Superior, I = Inferior, A = Anterior, P = Posterior,

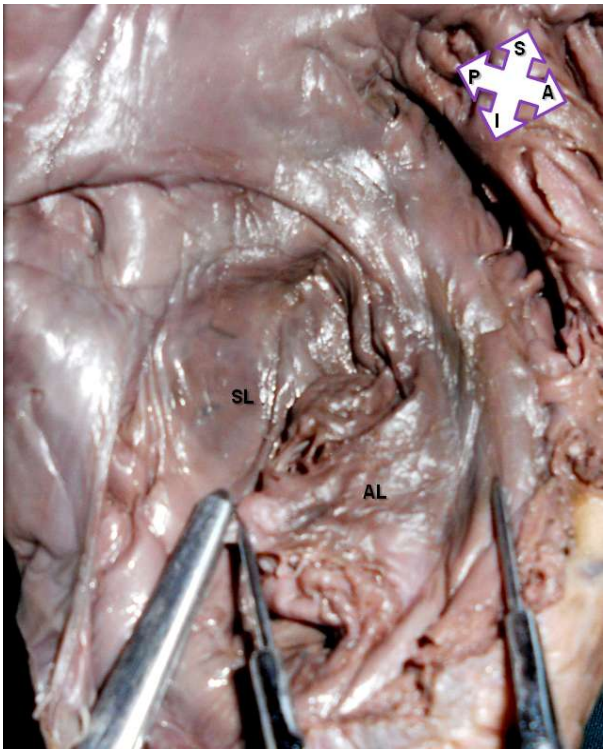


Fig. 3: Illustration showing measurement of the height of anterior leaflet of right atrioventricular valve.
AL = Anterior Leaflet, PL = Posterior Leaflet, SL = Septal Leaflet, S = Superior, I = Inferior, A = Anterior, P = Posterior,

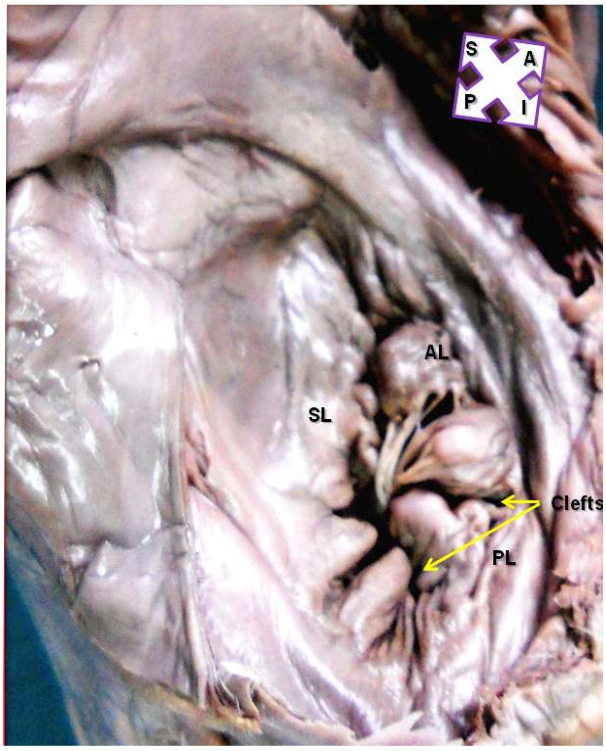


Fig. 4: Illustration showing clefts in the posterior leaflet of the right atrioventricular valve.
AL = Anterior Leaflet, PL = Posterior Leaflet, SL = Septal Leaflet, S = Superior, I = Inferior, A = Anterior, P = Posterior,

Table 1: Showing measurements of various parameters of tricuspid valve

Sr. No.	Parameter	Range (mm)	Mean (mm)	Standard Deviation
1	Circumference of right atrioventricular valve annulus	92 -140	117.1	10.2
2	Width of anterior leaflet	21-45	31.8	4.9
3	Width of posterior leaflet	20-35	27	3.8
4	Width of septal leaflet	16-38	25.2	4.4
5	Height of anterior leaflet	14-29	21.1	3.3
6	Height of posterior leaflet	11-24	16.6	3.4
7	Height of septal leaflet	8-29	16.7	4.8

Table 2: Showing comparison of various parameters of present study with previous studies.

Sr. No	Parameter	Mohammed AB Motabagani [1]	MD Silver et al [2]	Skwarek et al [3]	Skwarek et al [5]	R. Kalyani et al [8]	Fernando Antoniali et al [6]	Natalia Andrade et al [7]	Present study
1	Circumference of right atrioventricular valve annulus	M -129.6 F- 118.2	M -114 F –108	-	M-107.28 F-104.04	M-107.5 F -104	117.5	96.1	117.1
2	Width of anterior leaflet	M - 43.6 F- 30.8	M – 39 F – 35	-	M - 33.56 F - 31.17	M - 36.40 F - 36.4	46.3	44.2	31.8
3	Width of posterior leaflet	M – 29.2 F- 23.4	M – 19.2 F – 18.2	-	M -28.56 F – 27.61	M -25.81 F – 24.2	39.1	22.8	27
4	Width of septal leaflet	M – 33.2 F- 29	M -37 F -35	-	M -29.14 F – 29.5	M -30.12 F – 28	32	30	25.2

5	Height of anterior leaflet	M – 24.6 F- 20.2	M -24 F -21	23.88	-	-	-	-	21.1
6	Height of posterior leaflet	M – 25.2 F- 19.2	M – 17.8 F – 16.5	21.35	-	-	-	-	16.6
7	Height of septal leaflet	M – 15.8 F- 15.2	M -17 F -15	18.33	-	-	-	-	16.7

Table 3: Comparison of average number of clefts in posterior leaflet of the right atrioventricular valve with previous studies

Authors/study	Single cleft	Two cleft	Three cleft	Four cleft	Absent cleft
Mohammed AB Motabagani	80%	-	-	-	20%
Present study	43%	32.75%	8.62%	3.44%	12.06%

Results

Dimensions of various components of the right atrioventricular valve were studied in 54 heart specimens obtained from embalmed cadavers. The following observations were noted:

Table 1 showing results obtained

Discussion

The right atrioventricular (tricuspid) valve is a multi-component complex structure. Right atrioventricular valve although described as having three leaflets, review of literature suggests that the number of leaflets may vary or accessory leaflets may be found between the main leaflets [2]. Magdalena Skwarek et al performed a study on 75/ formalin-fixed adult human hearts, between 27 – 79 years of age and of both sex without any macroscopic pathological changes. They classified the right atrioventricular valve in five types depending upon the number of cusps(3 cusps-Type1, 4 cusps-Type2, 5 cusps-Type3, 6 cusps-Type4, 7 cusps-Type5) [3]. M. Skwarek et al studied the distribution of tendinous chords with respect to their position in the main and accessory leaflets, whether in the margin, ventricular surface or commissural area [4]. M. Skwarek et al performed a study on 96 formalin-fixed hearts and made the following measurements [5]:

1. The attachment length of anterior, posterior and septal leaflets
2. The frontal and sagittal dimensions of the tricuspid valve attachment
3. The right atrioventricular orifice area
4. The circumference of the tricuspid valve attachment orifice
5. The evolution of dimensions of the right atrioventricular orifice with ageing

Mohamed A.B. Motabagani performed comparative anatomical, morphometric and histological studies of the tricuspid valve complex in human and some mammalian hearts (ten hearts of each species). The author made the following measurements [1]:

1. The total annular length of the valve
2. The annular length of each leaflet
3. The height of each leaflet, being measured from the middle of its base at the annulus fibrosus to the middle of its free edge. When scallops were identified in a leaflet, the sum and mean of their heights were considered.
4. The annular length and height of each commissure
5. The length and number of different types of the chordae tendineae

The author observed that the anterior leaflet was the largest, triangular and devoid of clefts.

Fernando Antoniali et al performed a descriptive autopsy study on thirty human hearts without fixation Digital images of the tricuspid ring in its anatomical position and after flattening were analysed by specific software. The mean measurements and ratios were compared in the two different situations [6]. Natalia et al performed a study on digital photographs of 41 hearts obtained from autopsies performed in coroner's office. The photographs were processed using MATLAB software specially developed for the study which provided following measurements [7]:

1. Total perimeter of the annuli of the tricuspid and mitral valves
2. Area of each valvula and the total area that it occupied

3. Intercommissural distance of the heart valves
4. Circular area of the left ventricle at its midpoint
5. Size of the greatest axis of the left ventricle
6. Perimeter and area of the valvar lascinias
7. Volume of the left ventricle

R. Kalyani et al studied 100 formalin-fixed hearts obtained from patients who had died of non-vascular causes and whose age ranged from 8 to 85 years. The authors measured following dimensions [8]:

1. The attachment lengths of anterior, posterior and septal leaflets
2. The circumference of valve along with frontal and sagittal dimensions
3. Area of valve expressed as a triangle and as an eclipse

M. Skwarek et al performed a study on four cuspidal model of right atrioventricular valve on 107 formalin-fixed heart samples which were taken from adult humans. The authors used the four-cuspidal form of the tricuspid valve as the simplest model to show the appearance of accessory leaflets for anatomical and statistical examination. A group of 45 tricuspid valves, classified according to an earlier scheme as Type 2 was identified.

The authors identified subtypes of Type 2 on the basis of the location of the accessory leaflets as follow:

1. Subtype 2A: an accessory leaflet (Cac) between the posterior cusp (CP) and the septal cusp (CS) was found in a group of 24 hearts;
2. Subtype 2B: Cac between the anterior cusp (CA) and the CS, was found in a group of 10 hearts;
3. Subtype 2C: Cac the CA and the CP, a group of 11 hearts.

Afterwards, using a flexible millimetre ruler, the authors made following measurements:

1. The attachment length of the main leaflets: anterior, posterior and septal
2. The attachment length of the accessory leaflets in particular subtypes: 2A, 2B, and 2C
3. The length of the tricuspid attachment in particular walls of the right ventricle: anterior, posterior and septal.

The results obtained were statistically analysed by Pearson's analysis and one way analysis of variance (ANOVA; $p < 0.05$).

On the basis of the results of their study the authors concluded that the separation of accessory leaflets is a complex process [9].

Ashraf M. Anwar et al performed a study on assessment of normal tricuspid valve anatomy in 100 normal adults by real-time three-dimensional echocardiography. The following points were checked for visualization:

1. Tricuspid annulus diameter and area
2. Tricuspid valve leaflets (number, mobility, thickness and relation to each other)
3. Tricuspid valve area
4. Tricuspid valve commissures (anteroseptal, anteroposterior and posteroseptal) including the position of their closure line

All these structures were classified according to a subjective 4- point scale for image quality (1 = not visualised, 2 = inadequate, 3 = sufficient and 4 = good). The tricuspid annulus diameter and area could be measured in 63 patients (70%); normal values were 4.0 ± 0.7 cm and 10.0 ± 2.9 cm^2. Tricuspid valve area could be measured in 77 patients (86%) and mean was 4.8 ± 1.6cm^2.

Tricuspid valve commissural width could be obtained in 63 patients (70%) mean commissural width in these patients was 5.4 ± 1.5 mm for the anteroseptal commissure, 5.2 ± 1.5 mm for posteroseptal commissure and 5.1 ± 1.1 mm for anteroposterior commissure respectively [10].

C. Tei et al performed a two dimensional echocardiographic study on five normal hearts. The authors recorded valve leaflets and their annular attachments from a view of the right ventricular inflow tract obtained by placing the transducer at an intermediate position between the left ventricular apex and the left lower sternal border. The transducer was rotated, and recordings were made at 30 degrees rotational intervals around the circumference of the tricuspid valve annulus. The authors studied cyclical pattern of variations in tricuspid annular size using 12 measurements made during the cardiac cycle. The authors measured annular areas and circumferences, the maximum and minimum tricuspid annular sizes and their percent reduction in 16 normal subjects and 18 patients with tricuspid regurgitation. The authors observed that the mean maximum annular circumference and area were 11.9 ± 0.9 cm and 11.3 ± 1.8 cm^2 in normal subjects. They were significantly greater in tricuspid regurgitation (14.0 ± 0.7 cm and 15.8 ± 1.8 cm^2, respectively). The mean minimum annular sizes were much larger in tricuspid regurgitation (12.5 ± 0.6 cm and 13.0 ± 1.4 cm^2) than in normal subjects (9.6 ± 0.9 cm, 7.6 ± 1.4 cm^2). Thus, the percent reduction of annular circumference and area were significantly decreased in tricuspid regurgitation. For anatomic correlations, authors

measured the tricuspid annular circumference in 18 hearts without underlying valvular disease obtained from autopsy cases. The annular circumference was measured in the fresh and fixed states, which was 13.5 ± 0.8 cm in fresh state and 12.0 ± 0.8 cm fixed state. They observed that the values measured in the fixed hearts were more similar to measurements obtained by echocardiography in a group of normal subjects. They concluded that tricuspid annular reconstruction by the new two-dimensional echocardiographic method provides additional information about normal and abnormal size and function of the tricuspid valve annulus[11].

Gerola LR et al performed an anatomic study of the right atrioventricular valve in children under one year of age using a conservative method of dissection of the heart valve. The main aspects studied were the number of cusps and their morphometric characteristics, such as the width of the base and the depth of the cusps, the number of papillary muscles, number of tendinous cords, and diameter of the fibrous ring and the last one were divided in three regions, anterior, posterior and septal for localization of cusps. They observed that the number of cusps varied from two to four with three cusps as the commonest finding. The fourth cusp, if present, was classified as anterolateral in location. The anterior and septal cusps had bases bigger than those of the posterior and anterolateral cusps; the septal cusp was deeper than the others; and the number of tendinous cords was greater for the anterior and septal cusps than for the posterior and anterolateral cusps [12]. Inflammation induces angiogenesis in the valve and vascularisation in the normally avascular layers of valve [13].

Inflammation of a valve can cause the valve cusps to stick together. Later, fibrous thickening occurs followed by loss of flexibility and shrinkage producing either stenosis or insufficiency [14].

Ebstein anomaly is a congenital malformation of the heart that is characterized by apical displacement of the septal and posterior tricuspid valve leaflets, leading to atrialization of the right ventricle with a variable degree of malformation and displacement of the anterior leaflet [15].

Tricuspid valve annuloplasty performed with either mitral and/or aortic valve operations is accomplished either through a full or partial lower sternotomy approach or less invasive right mini thoracotomy exposure [16].

The treatment of functional insufficiency of the tricuspid valve by valvuloplasty is currently the most accepted technique. It is known that dilatation of the anterior and posterior segments correspond to 5/6 of the total dilatation of tricuspid annulus. Thus, treatment of the dilatation of these segments by annuloplasty restores most of the normal anatomy of the tricuspid valve ring because the septal segment is affected very little [6].

Accurate anatomical knowledge is of great clinical importance for diagnosing valvular lesions, surgical intervention and for development of novel operating techniques. Apart from this, it has potential application for studying functioning of tricuspid valve by echocardiography.

In clinical practice, the size of prosthesis to be inserted is usually determined by the size of native valve annulus. It demands accurate knowledge of annular dimensions.

Partial transfer of tricuspid valve to the mitral valve is an effective procedure for the treatment of mitral valve insufficiency secondary to ruptured chordae tendineae of the anterior leaflet.

The treatment of functional insufficiency of the tricuspid valve by the valvuloplasty is currently the most accepted technique. Tricuspid valve disease is frequently associated with diseases of mitral valve, therefore these two valves are repaired simultaneously using de vega technique or in the case of stenosis, balloon valvuloplasty.

Conclusion

This study will help cardiac surgeons to use the morphometric data while doing surgeries on the right atrioventricular valve.

References

1. Mohamed A. B. Motabagani. Comparative anatomical morphometric and histological studies of the tricuspid valve-complex in human and some mammalian hearts. J. Anat.Soc.India 2006; 55(1): 1-23.
2. M. D. Silver, J.H.C. Lam, Rangnathan and E.D. Wigle. Morphology of the human tricuspid valve. Circulation. 1971; 43: 333-348.
3. Magdalena Skwarek, Marek Grezybiak, Adam kosin'ski, Jolanta Hreczecha. Notes on the morphology of the tricuspid valve in the adult human heart. Folia Morphol. 2004; 63 (3): 319-324.
4. M.Skwarek,J.Hreczecha, M.Dudziak, J.Jerzemowski, M.Grzybiak. The morphology and distribution of the tendinous chords and their relation to the papillary muscles in the tricuspid valve of the human heart. Folia Morphol. 2007; 66(4): 314-322.

5. M.Skwarek,J.Hreczecha, M.Dudziak, J.Jerzemowski, M.Szpinda, M.Grzybiak. Morphometric features of the right atrioventricular orifice in adult human hearts. Folia Morphol . 2008; 67(1): 53-57.

6. Fernando Antoniali, Domingo Marcolino Braile, Glo'ria Maria Braga Poterio, Cledicyon Eloy da Costa, Mauricio Marson Lopes, Gustavo Calado de Aguir Ribeiro, et al. Proportion among the segments of the normal tricuspid valve annulus: parameter for valve annuloplasty. Braz J Cardiovasc Surg 2006; 21(3): 262-271.

7. Natalia Martins Magacho de Andrade, Eduardo Tinois, Reinaldo Wilson Vieira, Domingo Marcolino Braile, Orlando Petrucci Junior, Pedro Paulo Martins de Oliveira et al. Coefficients of proportions of the atrioventricular valves: an anatomical study of valvar segments of normal individuals. Braz J Cardiovasc Surg 2005; 20(3): 255-260.

8. R. Kalyani, M. J. Thej, K. Prabhakar, T. K. Venkatesh, A. K. Thomas, and J. Kiran. Morphometric analysis of tricuspid valve: An Indian Perspective. J Nat Sci Biol Med. 2012; 3(2): 147 – 151.

9. M. Skwarek, J. Hreczecha, M. Dudziak, J. Jerzemowski, B. Wilk, M. Grzybiak . The morphometry of the accessory leaflets of the tricuspid valve in a four cuspidal model .Folia Morphol. 2007; 66(4): 323–327.

10. Ashraf M.Anwar,Marcel L.Geleijnse, Osama L.I.Soliman, Jackies McGhie, Ren'e Frowijn, Attila Nemes, et al.Assessment of normal tricuspid valve anatomy in adults by real-time three dimensional echocardiography.

11. C Tei, J P Pilgrim, P M Shah, J A Ormiston, M Wong. The tricuspid valve annulus: study of size and motion in normal subjects and in patients with tricuspid regurgitation. *Circulation*.1982; 66: 665-671.

12. Gerola LR, Wafae N, Vieira MC, Juliano Y, Smith R, Prates JC. Anatomic study of the tricuspid valve in children .Surg Radiol Anat. 2001; 23(3): 149-53.

13. Michael H. Ross, Wojciech Pawlina. Microanatomy of cardiovascular system. Histology text and atlas. 6th edition. Wolter Kluwer, Lippincott Williams and Wilkins. Philadelphia: page no.402 – 408.

14. Richard S. Snell. Clinical anatomy by regions: 9th edition Lippincott Williams & Wilkins/ Wolters kluwer Health. 2012; page no 91.

15. Ebstein's anomaly Emedicine.medscape.com/ article15447-overview.Accessed on 13/7/2012.

16. Suri R. Mi. Tricuspid valve disease. Cohn Lh. Cardiac surgery in the adult. NewYork: McGraw- hill, 2008; 1111–1123.

Subscription Form

I want to renew/subscribe international class journal **"Indian Journal of Anatomy"** of Red Flower Publication Pvt. Ltd.

Subscription Rates:

- India: Institutional: Rs.6000, Individual: Rs.5400, Life membership (10 years only for individulas) Rs.54000.
- All other countries: $260

Name and complete address (in capitals):

Payment detail:
Demand Draft No.
Date of DD
Amount paid Rs./USD

1. Advance payment required by Demand Draft payable to Red Flower Publicaion Pvt. Ltd. payable at Delhi.
2. Cancellation not allowed except for duplicate payment.
3. Agents allowed 10% discount.
4. Claim must be made within six months from issue date.

Mail all orders to
Red Flower Publication Pvt. Ltd.
48/41-42, DSIDC, Pocket-II, Mayur Vihar Phase-I, Delhi - 110 091 (India)
Tel: 91-11-22754205, 45796900, Fax: 91-11-22754205
E-mail: redflowerppl@vsnl.net, redflowerppl@gmail.com
Website: www.rfppl.co.in

Original Article

Indian Journal of Anatomy
Volume 4 Number 3, September - December 2015

Palmar Main Line Terminations and Position of 't' Triradius in Primary Epilepsy

Col Mohanlal K.*, Vatsala Swamy P., Bhanu B. V.*****

Abstract

Epilepsy is a common worldwide health problem with several personal, familial and social impacts. It has a worldwide incidence of 0.3 to 0.5%.The cause of epilepsy is not known and 70% belonged to Idiopathic variety. *Objective:* This study examines the Palmar Main line terminations and position of 't' triradius among individuals with Primary epilepsy in comparison to the controls. *Methods:* The study included Sixty established cases of primary epilepsy in the age group 05-12yrs who were compared with 60 healthy children of the same age group. The palmar prints were taken using Ink-pad method described by Commins and Midlo. Inverted T pad, ink slab made of plain glass, white paper and cyclostyling ink were used for obtaining prints. Various parameters for palm including termination of main lines (D,C,B and A) and position of T were studied. The results were compared with those of controls. *Results and conclusion:* The analysis of data showed a statistically significant difference in termination of A- line between patients controls ($X^2 = 6.66$; d.f.2). The differences observed in D,C and B line terminations were statistically nonsignificant. No significant difference was observed in number and position of 't' ($X^2 = 1.83$; d.f.2) . Very few studies using similar parameters are available now hence there is a need for a study with larger sample size for confirming the results.

Keywords: Epilepsy; Cryptogenic; Idiopathic Epilepsy; Palmar Main Line.

Introduction

Epilepsy is a common worldwide health problem and has severe personal, familial and social impact. It has a worldwide incidence of approximately 0.3 to 0.5% in different populations and its prevalence has been estimated at 5-10/1000 [1].

Epilepsy is defined as a group of disorders with recurrent episodes of altered cerebral functions and paroxysmal excessive hyper-synchronous discharge of cerebral neurons. The clinical accompaniments of these episodes vary in manifestations, from brief lapses of awareness to prolonged bouts of unconsciousness, limb jerking and incontinence [2].

The cause of epilepsy is not exactly known. Majority of the authors say that 70% belonged to idiopathic epilepsy (cryptogenic) and about 30% are secondary to various causes such as brain trauma, CNS infections, cerebro vascular diseases and brain tumors. Both genetic and environmental factors contribute to the etiology of epilepsy. The primary cause could be genetic and a number of genes have been mapped, Baulac et al (2001) [3] and Brismar (2000) [4]. Studies of twins also confirmed the hereditary influence of the disease(Lennox and Lennox,1960) [5] Over 140 Mendelian disorders have been found to cause seizures and collectively account for about 1% of all epilepsies [6].

The word "dermatoglyphics" coined by Cummins and Midlo (1926) originates from the Greek words "Derma" (skin) and "Glyphae" (carve) [7].

The dermal ridges are formed during third and fourth months of fetal life. Changes may be seen in the palm and ridges in association with epilepsy, since both skin and CNS develop from the same germinal layer(ectoderm) [8]. The dermatoglyphic configurations once formed remain unchanged throughout life and they are highly heritable [9,10].

In this study we aim to probe into the palmar mainline terminations and position of 't' which are

Author's Affiliation: *Reader, ***Former Professor and Head, Dept of Anatomy, AFMC, Pune, Maharashtra 411040. ***Former Professor, Dept of Anthropology, University of Pune, Pune, Maharashtra 411007.

Corresponding Author: Col K. Mohanlal, Reader, Dept of Anatomy, Armed Forces Medical College, Pune, Maharashtra 411040.

E-mail: mohanlalk@rediffmail.com

specific among epileptics, when compared with the controls.

Material and Methods

Source

This case-control study was conducted on 60 known cases of Primary (Idiopathic) epilepsy in the age group of 5-12 years, attending Neurology OPDs of two multi specialty hospitals in South Maharashtra. Children of both sexes were included in the study and those with epilepsy due to other causes were excluded from the study. The controls were 60 normal children in the same age gp of 5-12 yrs. The cases included 42 males and 18 females whereas the controls included 32 males and 28 females. Both the cases and controls represent any religion or caste group from all over India, but residing in this region of Maharashtra state.

Methods

A detailed history of the patient, including history of illness, past medical history, antenatal and natal history, immunization, developmental and family history was recorded in a proforma and a thorough physical examination was carried out.

Dermatoglyphic Printing

Palmar prints of both hands were taken using Ink and pad method as described by Cummins and Midlo (Schauman and Alter,1976) [7].

Equipment

a. Ink slab (25cm X 15 cm X 5 cm) made of plain glass with smooth surface.
b. White paper slightly glazed
c. Inverted T shaped pad of 7cm diameter
d. Black cyclostyling ink

Name of the individual, sex, age and other details were recorded. The prints of both palms were taken after explaining the aim of the study and the procedure for taking prints to the cases/controls. The prints were examined and repeat prints were taken for those found unclear. Examination of prints was done with the help of a 3¼ inch diameter-magnifying lens of 5x power for studying the dermatoglyphic patterns. The markings in the pattern areas are made using a sharp HB Pencil.

System of Analysis

Main Line Termination and Inter-Digital Patterns

The six areas in the palm viz. hypothenar (Hy), thenar (Th) and the four interdigitals (I_1, I_2, I_3, I_4), each constitute a topographic unit, its individuality being expressed both by the existence in some palms of a discrete pattern and by the characteristic presence of partial boundaries formed by palmar triradii (a,b,c,d and t) and their radiants (Fig 1). Based on the four digital triradii, located in proximal relation to the bases of digits II, III, IV, V and tracing their proximal radiant directed toward the interior of the palm; the main-line termination is composed. Having traced the four main lines, the symbols for their terminations are ascribed as main-line termination. While the palmar triradii are recognized in the order a, b, c, d and t, the traced main line of each triradius is recorded as Palmer Main Line Formula D,C,B,A and T (Fig 2). Anatomical position of C-line termination is also observed as Ulnar, Radial, Proximal or Absent subject to its direction of ending.

Among all the main lines, the termination of T is more or less constant i.e., position 13. Rarely, it may terminate at position 11. However, there is considerable variations observed in the positional migration as well as the number of t triradii on palm. The distal migration of axial triradius t has been associated with Mongolism, where it produces a wide atd angle (Fig 3). A wide angle has been observed among the normal population too, though such occurrence is very minimal (Bhanu 1999) [11]. In this study, Bhanu's method of ascertaining t position has been followed [11,12]. The method is described below:

Total number of t-triradii and its anatomical position is described as 1) t-Ulnar/Radial/Axial 2) t'-Ulnar/Radial/Axial 3) t"-Ulnar/Radial/Axial 4) t'"-Ulnar/Radial/Axial. To decide the position of t, the most medial point of distal transverse crease is joined to the distal end of metacarpal digital crease of thumb at Ist inter-digital area. This is called the Palmar Transverse Axis (PTA). Then a perpendicular line is drawn proximally from the middle of the third digit up to the wrist crease. This axis is known as Palmar Longitudinal Axis (PLA). This divides palmar area into Ulnar, Radial and Axial. The area proximal to PTA is then divided into four equal parts by three equidistant and parallel lines between PTA and wrist crease, which denotes the positions as t, t', t'', t'" from proximal to distal, where the PTA intersects the PLA (Fig 12) [11,12].

Analysis of Prints and Statistical Consideration

All prints for the above parameters have been

analyzed first manually and data entry was done in computer for further statistical analysis. After manual analysis and verification of prints, general frequency of all dermatoglyphic parameters for the patients and the controls were calculated. Employing Chi-square test of significance, the observed and the expected values of all the parameters in the patients and controls were compared as :

$$x^2 = \frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}}$$

Observations and Results

Main-Line Termination Of D,C,B, A and T

D-Line Termination

As seen from table-1, the position of D line termination varies bilaterally among the patients and the controls. The position of D line termination on left hand of the patients is in the decreasing order of 7>9=11>8>10 where as on right hand it is 11>7>9>10>8. The D line termination on left hand of the controls is 7>9>11>10, whereas on right hand it is 11>7>9>10>8. Thus the D line termination shows slight variation in position on the left hand between patients and the controls. When both hands are merged together course of D line termination is highest at Position -11, followed by Position-7 among the patients whereas among the controls it is highest at position - 7 and then at position-11. The position of D line termination on both hands is 11>7>9>10>8 among the patients and 7>11>9>10 among the controls. This difference among the patients and controls is *statistically non- significant (X^2 = 1.86; d.f.2).*

Table 1: Frequency of distribution of D line termination among patients & controls

Position	7	8	9	10	11	Tot.
Patient Lh	31.7	1.7	28.3	10.0	28.3	60
Rh	26.7	1.7	20.0	1.7	50.0	60
Lh+Rh	29.2	1.7	24.2	5.9	39.2	120
Control Lh	41.7	0.0	36.7	1.7	20.0	60
Rh	26.7	0.0	23.3	5.0	45.0	60
Lh+Rh	34.2	0.0	30.0	3.3	32.5	120

C-Line Termination

As seen from table 2, the position of C line termination varies bilaterally among the patients and controls. The position of C line termination on left hand of the patients is 9>7>5">8>0>6 where as on right hand it is 9>7>5">8>0>6=10>11. The position of C termination on left hand of the controls is 9>5">7>0>8>5' where as on the right hand, it is 9>5'>7=0=8>11. Thus the C line termination shows slight variation in the position in left hand as well as the right hand between the patients and controls. Also when both hands merged together, the frequency of position of C line termination differed among the patients and the controls. The course of c line termination on both hands is 9>7>5">8>0>6>10>11 among the patients and 9>5">7>0>5'=8>11 among the controls. This difference among the patients and the controls is statistically non-significant (X^2 = 7.30; d.f.4).

Table 2: Frequency of distribution of C line termination among patients & controls

Position	0	5′	5″	6	7	8	9	10	11	Tot.
Lh	10.0	0.0	16.7	1.7	28.3	11.7	31.7	0.0	0.0	60
Patient Rh	6.7	0.0	8.3	3.3	20.0	6.7	50.0	3.3	1.7	60
Lh+Rh	8.3	0.0	12.5	2.5	24.2	9.2	40.8	1.7	0.8	120
Lh	10.0	3.3	18.3	0.0	16.7	6.7	45.0	0.0	0.0	60
Control Rh	8.3	11.7	0.0	0.0	8.3	8.3	61.7	0.0	1.7	60
Lh+Rh	9.2	7.5	9.2	0.0	12.5	7.5	53.6	0.0	0.8	120

C-Line Position

From table 3, it is observed that the frequency of C line termination at the radial position among the patients (43.4%) and the controls (54.2%) when both hands were merged together was statistically non-significant (X^2 = 3.20; d.f.1). The right hand showed more number of radial C terminations and the left hand showed more ulnar terminations among the patient as well as the controls. This difference between left and right hand is statistically significant among the patients (X^2 = 5.25; d.f.1) as well as among the controls (X^2 = 5.32; d.f.1). The difference between all possible C-line endings i.e., ulnar, radial, proximal and absent is statistically non-significant (X^2 = 3.83; d.f.3) between the patients and controls.

Table 3: Anatomical position of C line termination among patients & controls

Position	Radial(%)	Ulnar(%)	Proximal(%)	Absent(%)	Total No.
Lh	31.7	46.7	11.7	10.0	60
Patient Rh	55.0	31.7	8.3	5.0	60
Lh+Rh	43.4	39.2	10.0	7.5	120
Lh	45.0	38.3	6.7	10.0	60
Control Rh	63.3	20.0	8.3	8.3	60
Lh+Rh	54.2	29.2	7.5	9.2	120

B-Line Termination

As seen from table 4, the position of B line termination slightly varies bilaterally among the patients and the controls. The B line termination on left hand of the patients, in descending order of frquency is 7>5"">5'>6 where as on right hand it is 7>5"">5'>8>9. The frequency of B termination on left hand of the controls is 7=5"">5'>4 where as on right hand it is 7>5''>5'>9. Thus the B line termination shows slight variation in position in left hand as well as right hand of the patients and controls. Also when the datas are merged together the positions of B termination differ slightly between the patients (7>5''>5'>6>8>9) and controls (7>5''>5'>9>4) but it is statistically non- significant ($X^2 = 0.01$; d.f.1).

Table 4: Frequency of distribution of B line termination among the patients & controls

Position	4	5'	5''	6	7	8	9	Tot.
Lh	0.0	23.3	33.3	6.7	36. 7	0.0	0.0	60
Patient Rh	0.0	16.7	28.4	0.0	46.7	5.0	3.3	60
Lh+Rh	0.0	20.0	30.8	3.3	41.7	2.5	1.7	120
Lh	1.7	28.3	35.0	0.0	35.0	0.0	0.0	60
Control Rh	0.0	20.0	21.7	0.0	53.3	0.0	5.0	60
Lh+Rh	0.8	24.2	28.3	0.0	44.2	0.0	2.5	120

A-Line Termination

As seen from table 5, the position of A line termination slightly varies bilaterally among the controls and patients. The frequency of A line termination on left hand of the patients is 3>4>5'>5''>1 where as on right hand it is 3>4>5'>5''>11. Among Controls, on left hand it is 3>4>5'>11>1 where as on right hand it is 3>5'>4>11>1>5''. Also when dtas of both hands were merged together the position of A line termination differed among the patients and the controls and this difference is statistically significant ($X^2 = 6.66$; d.f.2). The frequency of A line termination, with both hands taken together is 3>4>5'>1>5''>11 among the patients and 3>4>5'>11>1>5'' among the controls.

Table 5: Frequency of hand wise distribution of A line termination among the patients & controls

Position	1	3	4	5'	5''	11	Tot.
Lh	5.0	56.7	20.0	15.0	3.3	0.0	60
Patient Rh	0.0	38.3	30.0	25.0	1.7	5.0	60
Lh+Rh	2.6	47.5	25.0	20.0	2.0	2.5	120
Lh	1.7	68.3	11.7	11.7	0.0	6.7	60
Control Rh	1.7	53.3	18.3	16.7	1.7	8.3	60
Lh+Rh	1.7	60.8	15.0	14.2	0.8	7.5	120

T Line Termination

Majority of the T termination was at position 13, both among the patients (97.6%) as well as the controls (98.4%). Remaining 3.4% of T among the patients terminated at position 11 on the left hand where as among the controls only one individual had T termination at position 4 on right hand and another had T termination at position 5' on left hand.

Total Number of 'T' Triradii and Their Position

No specific trend has been observed for the number of t among the patients and the controls. Majority of the patients (87%) as well as controls (82%) had only one t and the remaining 13% of patients and 18% of controls had two t triradii in each palm.

As seen from table 6, most of the t triradii lie at the position of t-ulnar (P-72%, C-63.6%). The remaining were at t'– ulnar (P-16.9% , C-23%) , t''- ulnar (P-8.8%, C-10%) and t'''- ulnar (P-2.2%, C-3.3%). Only one palm among controls was found to be with a t-axial. Existing slight difference in the t position among the patients and control is statistically non-significant ($X^2 = 1.83$; d.f.2).

Table 6: Frequency of position of t on both hands (Lh+Rh) : Patients vs Controls

Position	t-ul	t′-ul	t″-ul	t‴-ul	t-ax	Tot.
No	98	23	12	3	0	136
Patient %	72.0	16.9	8.8	2.2	0.0	
No	91	32	14	5	1	143
Control %	63.6	23.0	10.0	3.3	0.8	

Table 7: Main Line terminations showing various position among the patients and controls

Main Line	Patient	Control
D.	11>7>9	7>11>9
C.	9>7>5	9>5>7
B.	7>5>6	7>5>9
A.	3>4>5	3>4>5

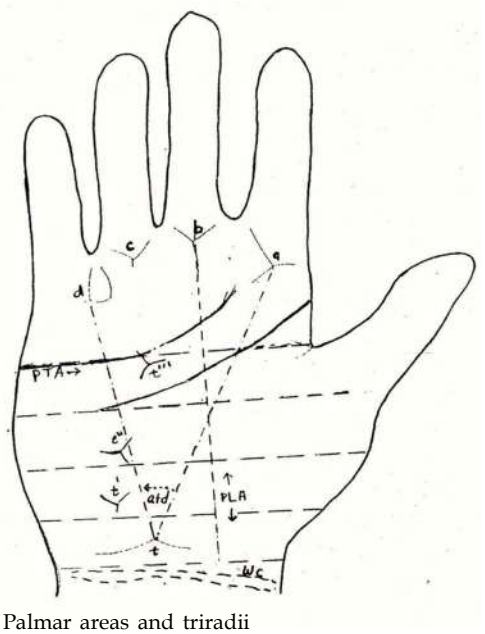
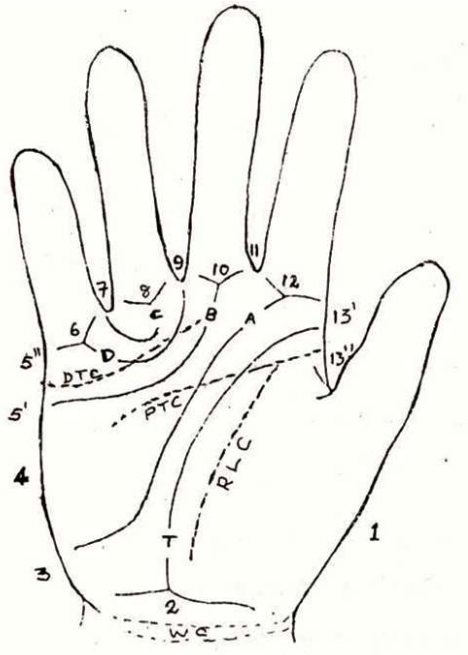


Fig. 1: Palmar areas and triradii



A.B.C.D: Palmar main lines.
T: Main line T.
I-13: Area or paint of main line terminus

Fig. 2: Palm showing Main Line Formula

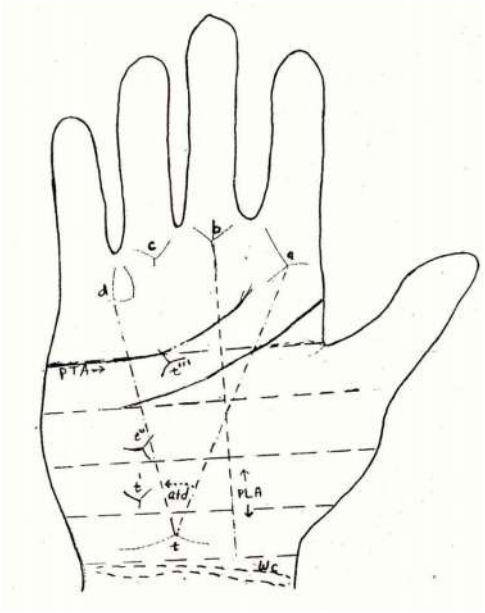


Fig. 3: Palm showing Position of T Triradius

Discussion

The Main Line terminations showed varying position among the patients and controls. The following are the predominant three termination positions in the decreasing order for the D, C, B, A main lines:

There exists a significant bilateral difference among the patients for the radial / ulnar C-line terminations, where as the controls showed predominantly radial termination on both the hands.

A-line termination (Table 5) also shows statistically significant difference between patients and controls

though the order of positions remained the same for the most frequent three positions. A reduction in frequency was found at position 3 and an increased frequency at positions 4,5'and 5" among patients.

More number of controls recorded a distal position of t triradius there by showing a slightly increased atd angle among the controls than among the patients. Ranganath P et al (2004) [13] in their study titled 'Triradii of the Palm in Idiopathic Epilepsy', found a significant increase in Main line index in both hands of female epileptics and no significant difference in 'atd' angle between the patients and controls in both hands of males and females.

In this study, Ridge dissociation too presented a lower frequency among the patients as compared to the control. This is contradictory to the observations made by Brawn and Paskind (1940) [14].

The foregoing salient features and trends of dermatoglyphic parameters analyzed and compared between the patients and the controls indicate that there are differences of varying degrees as observed above, though they are not very significant statistically.

Summary and Conclusion

Palmar Main Lines

i. There is a statistically significant bilateral difference in C line termination among controls as well as patients.

ii. A-line termination shows statistically significant difference between patients and controls. A reduction in frequency was found at position 3 and an increase at positions 4, 5'and 5" among patients.

Triradius T (Number, Position and Atd Angle)

There was no significant difference between patients and controls in the paramaters studied.

Since there were only very few studies carried out earlier showing the association between dermatoglyphics and idiopathic epilepsy, the data available for comparison was insufficient. More studies of this kind with adequate sample size are necessary to reach definite conclusions.

References

1. Mark A Dichter.The epilepsies and convulsive disorders. Harrison's Principles of Internal Medicine. Edited by Kurt J. Isselbacher,Joseph B. Martin. 14 th edn, Mc Graw Hill 1997; 2: 2223–2232.
2. Cull R E, Will R G. Diseases of the nervous system. Davidson's Principles and Practice of Medicine Edited by Christopher RW Edwards, Ian AD Bouchier 17th Ed. Churchill Livingstone 1995; 1064-67.
3. Baulac S, Huberfeld G, Gourfinkel-an I et al. First genetic evidence of GABA (A) receptor dysfunction in epilepsy. Nature Genetics. 2001; 28(1): 46-48.
4. Brismar T. Molecular defects may cause epilepsy. New discoveries can provide better possibilities for directional diagnostics and treatment. Lakartidningen 2000; 97(45): 5102-5106.
5. Lennox W G, Lennox M A. In: Epilepsy and related disorders.Vol 1 and 2, Little Brown and Co, Boston, 1960.
6. Gardiner R M. Genes and Epilepsy. J. Med. Genet 1990; 27: 537-544.
7. Schaumann B, Alter M. Dermatoglyphics in medical disorders. Springer-Verlag 1976; 6: 15-16.
8. Sivanandan G and Sambasivan M. Dermatoglyphics in Epilepsy. Separata No. 19, Mayo1975.
9. Galton F. Fingerprints, London, Mac millan 1892.
10. Sunita U. Sawant,Sunil M. Kolekar, P. Jyothi. Dermatoglyphics in male patients with Schizophrenia. International Journal of Recent Trends in Science And Technology, 2013; 6(2): 109-114.
11. Madhuri D, Meshram MM. Study of Ridges Pattern in Patients with Congenital Anomalies of Hypoplasia of Fingers. Int J Biol Med Res. 2013; 4(3) :3320- 3324.
12. Bhanu B V . Locating the position of axial triradius t on palm: A new method in Dermatoglyphics. The Quiet science.1999.
13. Ranganath P, Rajangam S and Kulkarni R.N. 'Triradii of the Palm in Idiopathic Epilepsy'. J.Anat. Soc. India 2004; 53 (2) : 22-24 Brown M, Paskind, H.A. J.Nerv. & Ment. Dis.1940; 92: 579.

Original Article

Indian Journal of Anatomy
Volume 4 Number 3, September - December 2015

Estimation of Gestational Age by Real Time Ultrasonography (Biparietal Diameter and Head Circumference) to Estimate the Fetal Morphometry in IInd and IIIrd Trimester

Sangeeta Khare*, Manik Chatterjee, Bichitrananda Roul***, Hulesh Mandle******

Abstract

The growth of the human fetus is a complex process resulting in an increase in size over time, has been the subject of extensive study. Before the advent of ultrasound evaluation. Physician interested in the growth process of the fetus could only look at the infant at delivery and infer what had happened in utero. Based on these observations clinicians were able to categorize fetuses in very general terms on the basis of their age and size. In the second and third trimester of pregnancy the fetus has grown sufficiently in size so that extreme anatomic details is visualized. There are number of structures that can be identified and measured during this time, but the basic fetal measurement used to estimate age and weight with ultrasound are-Biparietal Diameter (BPD), Head circumference (HC). This study was performed in Department of Anatomy in close association with the Department of Radiodiagnosis, Pt. J. N. M. Medical College, Raipur, Dr. B. R. Ambedkar Memorial Hospital, Raipur (C.G.). The ultrasonographic examination comprised of recording of, Biparietal Diaeter (BPD), Head Circumference (HC). The fetal growth parameters i.e. BPD, HC, of every patient were measured serially using real time ultrasonographic examination. The mean of all measurement were tabulated, and were compared individually with western nomograms. The accuracy of the individual parameter for different weeks of gestation was noted. This accuracy indicated that, the correctly diagnosed gestational age by sonographic parameters are not equally homologous with known menstrual age. The comparisons concludes that, out of the mean value of all parameters, the minimum discrepancy was found in biparietal diameter, for the prediction of gestational age.

Keywords: Biparietal Diaeter (BPD); Head Circumference (HC); Ultrasonography.

Introduction

The growth of the human fetus is a complex process resulting in an increase in size over time, has been the subject of extensive study. Before the advent of ultrasound evaluation. Physician interested in the growth process of the fetus could only look at the infant at delivery and infer what had happened in utero. Based on these observations clinicians were able to categorize fetuses in very general terms on the basis of their age and size.

Gestation is the period between conception and birth of a baby, during which the fetus grows and develops inside the mother's uterus. Gestational age is the time measured from the first day of the woman's last menstrual cycle to the current date and is measured in weeks. A pregnancy of normal gestation is approximately 40 weeks, with a normal range of 38 to 42 weeks.

Strictly speaking, gestational age of the fetus or infant is a measurement of time *in utero* (inside of the uterus). Gestational age can be determined prior to birth or at birth. Determination of gestational age and effective fetal weight are an important factor in planning appropriate care for the fetus or infant. It provides important information regarding expected or potential problems and directly affects the medical treatment plan for the baby Prior to birth, intrauterine fetal growth can be determined using ultrasound.

Our understanding of normal fetal anatomy as seen on sonograms continue to be an area of considerable growth. The ability of sonography to detect intrafetal structurs depends on a balance between spatial

Author's Affiliation: *Demonstrator **Professor & Head ***Assistant Professor, Dept of Anatomy, Pt. Jawahar Lal Nehru Memorial Medical College, Raipur, C.G. ****Senior resident, Dept of Radiology, Ramkrishna Care Hospital, Raipur, C.G.

Corresponding Author: Bichitrananda Roul, Assistant Professor, Dept of Anatomy, Pt. Jawahar Lal Nehru Memorial Medical College, Jail Road, Raipur, Chhattisgarh 492001.
E-mail: bichi4u2000@yahoo.co.in

resolution and contrast. High resolution, real time scanners with flexible approach to imaging are mandatory for.

Modern Fetal Sonography, Fetal Parts of Interest Fall into Three Major Categories:

1. Structure that generate high-amplitude reflections eg: ossified bones.
2. Structure that generate no internal echoes eg: fluid containing viscera.
3. Those that generate mid – range gray echoes eg. Parenchymal organs lungs, brain, spleen, liver, kidney and muscles.

Real time ultrasonography provides the most appropriate format for imaging fetal bones the resolution and flexibility offered by such systems enables one to rapidly survey the fetal skeleton structures within the fetus, the ossified portion of the skeleton possess the highest level of subject contrast and thus are seen earlier and more consistently than any other organ system.

In the second and third trimester of pregnancy the fetus has grown sufficiently in size so that extreme anatomic details is visualized. There are number of structures that can be identified and measured during this time, but the basic fetal measurement used to estimate age and weight with ultrasound are-

- Biparietal Diameter (BPD)
- Head circumference (HC)

Material and Method

This study was performed in Department of Anatomy in close association with the Department of Radiodiagnosis, Pt. J.N.M. Medical College, Raipur, Dr. B.R. Ambedkar Memorial Hospital, Raipur (C.G.) from Jan2013- october 2015.

Material Required for The Study

Material Required are:

1. Ultrasonographyc (USG) machine (PHILIPS USG MACHINE) (Figure-1 A+B).
2. Transducers (3.5 MHz convex transducer).
3. Ultra sonic jelly.
4. A comfortable bed for the patient.
5. Bedsheets to maintain dignity of the patient.
6. Well trained staff- nurse for USG Procedures.

This study consists of 200 pregnant females, between 20 weeks to 36 weeks gestation with their age ranging from 17-35 years.

Criteria for Selection of Cases

Inclusion Criteria

1. The patients attending the A.N.C. in the department of Radiology Pt. J.N.M. Medical College and Dr. BRAM Hospital Raipur C.G. should be taken as subject.
2. A history of regular menses.
3. The last menstrual period (LMP) of the patient should be well known or with previous sonography report (prior to 20 weeks).
4. Pregnancy was single and viable.

Exclusion Criteria

1. Pregnancy complicated by medical disorder such as anaemia, diabetes melitus, etc… in mother and congenital disorders of fetus will be excluded from the study.
2. Twins pregnancy excluded.

Method

The record and detailed history of the patient was obtained from the department of Obstetrics and Gynecology, Pt. J.N.M. Medical College and Dr. B.R. Ambedkar Memorial Hospital, Raipur (C.G.). Maternal investigations like Hb, TLC, Sickling, VDRL, Blood sugar, Blood grouping, Rh Typing, and urine for routine and microscopic examination.

The ultrasonographic examination comprised of recording of, Biparietal Diaeter (BPD), Head Circumference (HC) .

Technique of Scanning

All examinations were performed by using a Gray scale real time machine (PHILIPS USG MACHINE) employing a 3.5 MHz convex transducer.

Each examination was performed after the routine antenatal check-up by the obstetrician prior to the scan. The patients were explained the procedure and its purposes, prior to scanning. Patient is placed supine and the area between the pubic symphysis and umbilicus is exposed, the ultrasonic jelly is applied to the skin and transducer's head. The jelly serves to make better contact between the skin surface and the transducer, making the passage of ultrasonic wave easier.

The anatomical plane chosen for measurement of various fetal parameters was obtained by placing the transducer over abdomen in the middle sagital section. The fetal head was then looked for the lie of the fetus then placing the transducer over parasaggital plane to define other fetal parts.

After asserting the position of the fetal head, serial scan were made in the plane transducer to the fetal head. The BPD was measured in the scan which shows the widest diameter at the level showing a midline falx echo, two lateral ventricles and the thalami. The reference point for fetal BPD was the outer margin of the proximal skull interface to the inner margin of the distal skull interface (Fig. 2). The Head circumference can be calculated by using the shortest and longest axis of the fetal head measured outer to outer table (Fig. 2).

Observations

Table 1: Distribution of cases according to age groups

S. No.	Age group in yr	No of cases	Percentage
1	18-20	33	16.5
2	21-23	81	40.5
3	24-26	61	30.5
4	27-29	13	6.5
5	30-32	9	4.5
6	33-35	1	0.5
7	>35	2	1
	Total	200	100
	Mean ±SD	23.53±3.20	

Table 1: Showed the maximum no. of cases found between the age group of 21-23 years i.e. 81 cases. Minimum no. of cases found in the age group of 33-35 years is only 1 case.

Table 2: Distribution of cases according to age parity

S. No.	Pregnancy No.	No. of Cases	Percentage
1	1	97	48.5
2	2	87	43.5
3	3	16	8
4	4	0	0
	Total	200	100

Table 2: Showed maximum no. of cases i.e. 97 cases in primipara and minimum no. of case i.e.0 case was found in 4th parity. By this we can say that the awareness of Ultrasonography examination is more in primipara.

Table 3: Mean of various parameters observed in present study

S. No.	Weeks of Gestation	BPD in mm	HC in Mm
1	20	46.54	173.23
2	21	51.36	187.48
3	22	54.53	202.98
4	23	56.23	210.18
5	24	60.85	224.97
6	25	65.43	232.18
7	26	64.81	240.94
8	27	68.25	248.25
9	28	72.41	257.02
10	29	73.39	272.01
11	30	73.64	275.06
12	31	80.12	281.37
13	32	79.55	288.47
14	33	81.55	296.63
15	34	82.00	305.18
16	35	87.70	316.12
17	36	89.82	319.33
	Mean	69.93	255.04
	SD	12.75	43.56

The study includes the sonographic recording of BPD, HC, The mean of present study is tabulated in Table No.3.

Table 4: Comparison of bpd measurement with western nomogram

S. No.	Gestational Age in Weeks	Standard BPD chart by (Wexler S et al,1986)	Mean BPD in Present study	R	p
1	20	46	46.54	0.9763	0.0094
2	21	49	51.36		
3	22	53	54.53		
4	23	55	56.23		
5	24	59	60.85		
6	25	63	65.43	0.9674	0.012
7	26	64	64.81		
8	27	66	68.25		
9	28	72	72.41		
10	29	73	73.39	0.9653	0.0077
11	30	74	73.64		
12	31	78	80.12		
13	32	81	79.55		
14	33	82	81.55	0.9866	0.114
15	34	84	82.00		
16	35	86	87.70		
17	36	88	89.82		
	Mean	69	69.93		
	SD	13.39	12.75		

Table 4 showed the comparison of present study values of BPD measurement with Western Nomogram (chart formulated by Wexler S. et al 1986), it was found that in values of present study there is maximum difference of ± 2.4mm in 2[nd] and ±2mm in 3[rd] trimester.

Table 5: Comparison of hc measurement with western nomogram

S. No.	Gestational Age in Weeks	Western Nomogram (Hadlock F.P.1984)	Mean HC in Present study	r	p
1	20	175	173.23		
2	21	187	187.48	0.9837	0.006
3	22	199	202.98		
4	23	210	210.18		
5	24	221	224.97		
6	25	232	232.18		
7	26	242	240.94	0.9735	0.04
8	27	252	248.25		
9	28	262	257.02		
10	29	271	272.01		
11	30	280	275.06	0.9650	0.011
12	31	289	281.37		
13	32	297	288.47		
14	33	304	296.63		
15	34	312	305.18	0.9758	0.17
16	35	318	316.12		
17	36	325	319.33		
	Mean	257.41	255.04		
	SD	47.64	43.56		

Table 5 showed the comparison of present study values of HC measurement with Western Nomogram (chart formulated by Hadlock F.P.1984),we noted the maximum difference of ±3.7 mm in 2[nd] and ± 9mm in 3[rd] trimester.(The maximum difference of ± 9 mm was found in 32 week.)

Discussion

In present study we have recorded the Amniotic Fluid Index and other conventional ultrasonic parameters of the fetus for assessment and correlation of gestational age. In previous studies the accuracy of prediction of gestational age in the 2[nd] and 3[rd] trimesters have, in general, relied on gold standard, and based on last normal menstrual period in women with regular cycle lengths. To assess the accuracy of method for determination of gestational age, we examined total of 200 pregnant females between 18 - 40 years of age, with the gestational age of 20 weeks to 36 weeks. The parity included in the study is from 1[st] - 4[th] number of pregnancies.

The maximum number of cases out of total 200 normal pregnant female were found in the maternal ages between 21 – 23 years i.e. 81 cases, and minimum in case of age group of 33 – 35 years i.e. 1 cases.

In our study 97 cases belongs to primipara i.e. maximum number of cases out of 200 cases, and minimum number of cases i.e. 16 cases found in 3rd parity and no case found in 4th parity. This study shows the maximum number of cases in primipara because of the fact that, the awareness for the sonographic examination is more in primipara to confirm the intrauterine pregnancy, secondly to avoid birth complications and to detect fetal malformations.

various conventional parameters of the fetuses i.e. Biparietal diameter, Head circumference, was studied sonographically to assess the gestational age by real time sonography. Mean of every parameter was recorded weekly, i.e. from 20th weeks of gestation to 36th weeks of gestation. Equal numbers of cases were not available for every week.

BPD (Biparietal Diameter)

In present study the mean BPD in each week of gestation from 20 – 36 weeks shown in Table no. 3. The BPD is measured from the outer surface of skull table of one side, to the inner margin of the skull table on opposite side (outer to inner).

In the present study the accuracy of the mean BPD in 20-36 weeks of known menstrual age is 69.93% with the variability of ± 12 days. Mongelli M et al (2003) they compared the accuracy of ultrasound dating formulae in late second trimester of pregnancy results were marginally less accurate than the early second trimester. Similar results have been reported by Persson P et al in a large series of patients whose dates were confirmed by CRL in the first trimester of pregnancy.

The mean BPD value of present study between 20 to 36 weeks of pregnancy was compared with the chart formulated by Wexler S et al (1986) the discrepancy of 3 mm was found, which may be due to the variability of the lifestyle and the environment.

The accuracy of the BPD value from known menstrual age ranging between 20 – 23 weeks was 62% and the accuracy of BPD value in 24 – 27 weeks of pregnancy was found 44 % the variability estimate is ±7 days.

In 28 – 31 weeks of pregnancy the accuracy of BPD values was found 28%. The variability estimate is ± 14 days.

In 32-36 weeks of pregnancy the accuracy of BPD value is found to be 26% with variability estimate of ± 3 weeks.

In the present study it was found that in early second trimester the accuracy of BPD value is most reliable with variability of ± 7days. In later half of the second trimester the variability is found to be ± 14 days. It is seen that as the pregnancy advance the variability also increases. In last trimester it reaches up to ± 3 weeks.

The mean BPD of the present study was compared by the standard BPD chart formulated by Wexlers S. et al (1986) in table No.6. The coefficient correlation (r) of BPD with gestational age in present study in 20 – 23 weeks was found to be (r =0.9763) and P value was (p = 0.0094), in 32 – 36 weeks (r= 0.9866) and (p= 0.114).That means with advancing gestational age significance of assessment of gestational age decreases. In early second trimester it is highly significant and in 3rd trimester it is highly insignificant. (If p value is less than < 0.05 that means it is significant).

The BPD, HC and FL shows a linear relationship with gestational age in sensitivity parameters, indicated that these parameters are reliable predictor of gestational age.

HC (Head Circumference)

Head circumference is an important measurement of neonatal head growth and maturity, but the value of this parameter over BPD and FL for prediction of gestational age is not very reliable, however it is a sensitive index of fetal head and maturity which can be affected by variation in fetal head shape. The reliable estimates of head circumference can be calculated by using the shortest and longest axis of the fetal head measured outer to outer.

In present study the accuracy of Head Circumference value from known menstrual age ranging 20 – 23 weeks is 53% and the accuracy of Head Circumference value in 24 – 27 weeks of pregnancy was found 26%. and in 28 – 31 weeks of pregnancy was found 28% and accuracy of Head Circumference in case of more than 32-36 weeks found 30%.

This data shows that the percentage of correctly diagnosed cases decreases as the pregnancy advance. Callen P et al have demonstrated that the head circumference can predict menstrual age within ± 1 week, at 20 weeks of gestation, while Bensen C.B et al have demonstrated that the variability in prediction of age from head circumference reaches to a peak approximately at ± 3.8 weeks in the late 3rd trimester of pregnancy.

Mean Head Circumference value of the present study was compared with the standard chart of Hadlock F.P (1984) In table No.7. In 32th weeks of pregnancy there is maximum discrepancy i.e. ± 1mm. The graph of AC is nonlinear in sensitivity parameter indicate that these.

In second trimester HC value with the standard has got the discrepancy of about ± 5 mm. In the third

trimester the mean variability is of about ± 10 mm comparing with the standard chart. The coefficient correlation (r) of HC with gestational age in present study in 20 – 23 weeks was found to be (r = 0.9837) and P value was (p = 0.006), and in 32 – 36 weeks (r= 0.9758) and (p= 0.17). That means HC is significant for assessment of gestational age in second trimester.

Summary and Conclusion

The present study comprised of sonographic examination of 200 uncomplicated pregnancies between 20 – 36 weeks of gestation. The age of the gravidas ranged from 18 years to 40 years. These patients came for sonographic examination in Department of Radiodiagnosis after attending the antenatal clinic of Department of obstetrics and Gynecology, Dr. B.R. Ambedkar Memorial Hospital, Raipur (C.G.).

The fetal growth parameters i.e. BPD, HC, of every patient were measured serially using real time ultrasonographic examination. The mean of all measurement were tabulated, and were compared individually with western nomograms.

We found that the coefficient of correlation (r) of BPD, varying between (r = 0.96 to 0.98), HC, varying between (r = 0.96 to 0.98), showed a high degree of linear relationship with gestational age.

The mean BPD value for each gestational age was compared with the western standard (Wexler S et al 1986), showed the difference of ± 2.4 mm in 2[nd] trimester and ± 2 mm in 3[rd] trimester.

The mean head circumference on comparing with the western standard (Hadlock F.P 1984) we noted the difference of ± 3.7 mm in 2[nd] trimester and ± 9 mm in 3[rd] trimester. (In 16[th] week there is maximum difference, i.e. of 14 mm.). The accuracy of the individual parameter for different weeks of gestation was noted. This accuracy indicated that, the correctly diagnosed gestational age by sonographic parameters are not equally homologous with known menstrual age. The comparisons concludes that, out of the mean value of all parameters, the minimum discrepancy was found in biparietal diameter, for the prediction of gestational age.

References

1. Benson CB, Doubilet PM: Sonographic prediction of gestational age. Accuracy of 2[nd] and 3[rd] trimester fetal measurement . AJR.Dec. 1991; 157: 1275-1277.
2. Butt K et al. Determination of Gestational age by ultrasonography Journal of obstetrics and Gynaecology 2014 Feb: 36(2): 171-83.
3. Callan P: Ultrasonography in Obstetrics and Gynecology. (1991).
4. Callen P, Rossavic I, Fishburne J: Conceptional age, menstrual age and ultrasound age . A second trimester comparison of pregnancy of known conception date with pregnancies dated from LMP. Obstet. Gynecol. 1989; 73: 234.
5. H.D.Hinh[a], J.L.Landinsky Amniotic fluid index measurements in normal pregnancy after 28 gestational weeks, International Journal of Gynecology and Obstetrics. 2005; 91: 132-136.
6. Hadlock FP et al: Estimating fetal age. Computer-assisted analysis of multiple fetal growth parameters. Radiology.1984; 152: 497.
7. Hadlock FP et al: Ultrasonically measured fetal femur length as a predictor of menstrual age. Am. J. Roentgenal.1982; 138: 875.
8. Hadlock FP, Harrist RB, Sharman RS, Deter RL, Park SK. Estimation of fetal weight with the use of head, body, and femur measurements—a prospective study. Am J Obstet.
9. Jeanty P et al: Estimation of gestational age from measurement of fetal long bones. Journal of ultrasound in medicine. 1984; 3: 75-79.
10. Jhon T, Queenan, O'Brien GD, Campbell S: Ultrasound fetal femur length in relation to intrauterine growth retardation. Am.J.Obstet.Gynaecol. 1982; 35: 144.
11. Moore TR, Cayle JE. The amniotic index in normal human pregnancy. Am J Obstet Gynecol 1990;162: 1168–1173.
12. O'Brien GD et al: Growth of the ultrasound fetal femur length during normal pregnancy. Am.J.Obstet. Gynaecol. 1981; 141: 833.
13. Mongelli M, Yuxin NG et al: Accuracy of ultrasound dating formul.In the late 2[nd] trimester in pregnancies conceived with in vitro fertilization. Acta Radiological July 2003; 44(4): 452- 455.
14. P.Owen,I Osman and T.Farrell. Is there is relationship between fetal weight and Amniotic fluid index: Ultrasound Obstet Gynecol 2002; 20; 61-63.
15. Persson P, Weldner B : Reliability of ultrasound fetometry in estimating gestational age in the 2[nd] trimester. Acta Obstet. Gynecol.1986; 65: 481.
16. Tamura RK, Sabbagha RF: Percentile ranks of sonar fetal abdominal circumference measurements. Am.J.Obstet.Gynaecol. 1980; 138: 475.
17. Warsof SL, Campbell S, Little D, Cooper DJ: A critical assessment of ultrasound fetal cephalometry. 1983; 8: 189-193.
18. Wexler S, Fucchs C et al: Tolerance interval for standards in ultrasound measurement. Determination of BPD standards. J.Clin.Ultrasound. May 1986; 14(4): 243-250.
19. Yeh Ming Neng et al : Ultrasonic measurement of femur length as an index of fetal gestational age.AM. J. Obstet.Gynaecol.1982; 144: 519.

Original Article

Indian Journal of Anatomy
Volume 4 Number 3, September - December 2015

Incidence of Skeletal Deformities in the Male Population of Some North Indian Districts

Col B. K. Mishra*, Col Sushil Kumar**

Abstract

A study was undertaken in the male population of some north Indian districts to know the incidence of skeletal deformities. All the candidates presenting over a period of one and a half years for enrollment in the defence forces at a defence enrollment centre were subjected to medical examination. Persons who had or were suspected of having disabilities were referred to the concerned specialist for confirmation of the disability. All those persons whose disability was adjudged by the concerned specialist as being within permissible limits were taken as fit and the others whose disabilities were beyond permissible limits were taken as unfit. The results were compared with similar studies and discussed.

Keywords: Skeletal Deformity; Knock Knee; Flat Foot; Hammer Toes; Genu Valgus; Cubitus Varus.

Introduction

Various skeletal abnormalities, e.g. genu valgus, genu varus, flat foot etc are normally present in infants and toddlers and are considered physiological. They tend to correct themselves over time with growth. However, sometimes they do not correct with growth due to various factors and are present in adults.

AIM

The aim of this study was to find the incidence of various disabilities in a male north Indian population so as to create a sample database. The scope of this study was limited to skeletal deformities.

Material and Methods

All the candidates presenting over a period of one and a half years for enrollment in the defense forces were included for this study. The age group of this population was between 18 years to 22 years as this is the age limit for enrollment in the defense forces. This sample age group was considered ideal for this study as skeletal growth would have ceased by this age and any growth related correction of the deformities would not be taking place.

A doctor subjected all the candidates to medical examination, and any disability noted. All candidates having any disability were referred to the concerned specialist for confirmation of the disability. Any candidate who did not report for review to the concerned specialist for confirmation of his disability was taken as absent and removed from the study. All those persons who disability was adjudged by the concerned specialist as being within permissible limits were taken as fit and the others whose disabilities were beyond permissible limits were taken as unfit.

The skeletal disabilities were grouped as under:

1. Upper limb deformities
   a. Cubitus valgus > 15^0
   b. Digital deformities – Hyperextension, restriction of movement
   c. Lower limb deformities
   d. Hallux valgus
   e. Hallux varus
   f. Other toe deformities- Hammer toes, over-riding toes

Author's Affiliation: Professor & Head, Department of Anatomy, Army College of Medical Sciences, Delhi Cantt. **Professor & Head, Department of Anatomy, Armed Forces Medical College Pune-411040.

Corresponding Author: Col Sushil Kumar, Professor & Head Department of Anatomy, Armed Forces Medical College Pune-411040, Maharashtra.
E-mail: drsushilkumar@rediffmail.com

g. Flat foot

a. Genu valgus- Inter-malleolar distance (IMD) >5 cm with knees touching

b. Genu varus- Inter-condylar distance (ICD) >7 cm with malleoli touching

2. Vertebral column deformities

a. Kyphosis

b. Scoliosis

c. Listhesis

d. Spondylosis

3. Anterior chest deformities

a. Pigeon chest

b. Barrel chest

The results are tabulated.

Observations

A Total of 4223 candidates reported for medical examination in the above period. Out of this a total of 334 candidates who had disabilities did not report to the specialists concerned and were removed from the study, leaving a total of 3889 candidates. After specialist review, 1471 candidates were found unfit for various causes, out of which 701 were for skeletal abnormalities. Many candidates were found to be suffering from multiples disabilities.

Total candidates - 3889

Unfit candidates - 1471

Unfit candidates with skeletal abnormalities - 701

Percent of unfit candidates - 37.82

Percent of unfit candidates with skeletal abnormalities - 18.02

Skeletal abnormalities as percent of Total unfit - 47.65

The Summary of Skeletal Abnormalities is as Under:

No of Disabilities Present	1	2	3	4
Total No	525	144	31	1

The Details of the Parts Affected are as Under:

S No	Part Affected	Incidence	% of Affected
1.	Foot	371	40.77
2.	Knee	77	8.46
3.	Hand	34	3.74
4.	Elbow	241	26.48
5.	Chest	34	3.74
6.	Spine	153	16.81
	Total	**910**	**100**

Note: The total number of disabilities is more than the number of persons unfit because of persons with multiple disabilities

Discussion

Army personnel have to undergo a lot of physical and mental stress and strain during the course of their routine duties, much more than are the case in civil life. Army, therefore, conducts a very stringent medical examination for candidates who desire to join the armed forces firstly because they have to be physically fit in order to bear the stress and secondly because even comparatively minor deformities may also cause injury or other problems under the stress of army training. This has been amply brought out in the study by Cowan DN et al [1] of Walter Reed Army Institute of Research,

Washington, DC, USA on 'Lower limb morphology and risk of overuse injury among male infantry trainees.' They have found that

"The cumulative incidence of lower limb overuse injury was 30%. Relative risk of (RR) of overuse injury was significantly higher among participants with the most valgus knees (RR = 1.9). Those with Q-angle of more than 15 degrees had significantly increased risk specifically for stress fractures (RR = 5.4). Anatomic characteristics were associated with several other types of injuries, including pain and nonacute muscle strain due to overuse."

Reports of various authors, both from the developed countries as well as in less developed countries, who have studied this aspect of the problem is presented below.

Do TT [2] in a study at Children's Hospital Medical Center, Cincinnati found after the age of 2 years, any significant amount of residual bowing is abnormal and may be due to infections, traumatic physeal injuries, genetic predisposition, metabolic factors, or a combination of these.

Kling TF Jr. [3] in another study at James Whitcomb Riley Hospital for Children, Indiana University Medical Center, Indianapolis reported bowlegs and knock-knees are common concerns in the early years of life. For the majority of children, these problems represent normal physiologic development and they correct spontaneously. Other than physiologic varus and valgus, the common causes of pathologic malalignment include Blount's disease, rickets, hereditary conditions, infection, and trauma.

Bleck EE [4] has said Genu valgus and varus correct without treatment in the majority of patients. However, a small percentage of the disorders will

persist if untreated and some cases of genu varus appear to develop into the progressive form of the disorder, Blount's disease."

As is seen from the above reports, valgus and varus deformities are normally presenting children and vary in degree with age [2, 3,4]. Normally they resolve with age but may persist due to Blount's disease, rickets, hereditary conditions, infection, or trauma [2].

In our study we have measured the Inter Malleolar Distances (IMD) and Inter Condylar Distances (ICD). However, in most of the studies the Metaphyseal-Diaphyseal Angles of the tibia (MDA) or the Tibio Femoral Angle has been used.

Comparison of various studies becomes very difficult since various parameters are being used for measurement and the limits for normality are not very clear in all cases. However in this study on 'Normal limits of knee angle in white children—genu varum and genu valgum' at the University of Washington School of Medicine, Seattle by Heath CH, Staheli LT [5] provides a way out by giving one relationship between tibio-femoral angle or Knee angle and Inter-Malleolar Distance (IMD) wherein they mention a maximum Knee angle of 12^0 and maximum IMD of 8cm.

Arazi M, Ogun TC, Memik R [6] of Department of Orthopaedic Surgery and Traumatology, Selcuk University, Konya, Turkey in a study on 'Normal development of the tibio-femoral angle in children: a clinical study of 590 normal subjects from 3 to 17 years of age' found a significantly higher degree of valgus angle than that in previous reports. The maximal mean valgus angle was 9.6 degrees at seven years for boys and 9.8 degrees at 6 years for girls. These differences were considered racial differences between Turkish children and those of other races. Turkish children, aged between 3 and 17 years, exhibited < or =11 degrees physiologic valgus. A measurable varus angle or a valgus higher than 11 degrees during this period should be considered abnormal.

However Bowen RE, Dorey FJ, Moseley CF [7] in a study carried at Shriners Hospital for Children have, in addition, also used tibial deformity as a percentage of the total (%DT) to test the hypothesis that patients with progression have more tibial than femoral varus and they found that tibial varus was found to exceed femoral varus in all patients with progression and also in several patients whose deformity resolved spontaneously. Although more specific and more sensitive than the MDA, the %DT is a good but not perfect predictor of progression. However, all patients in this series with both a %DT >50% and an MDA of 16 degrees or greater went on to progress."

In another study in Department of Surgery, College of Medicine, University of Ibadan Omololu B. et al (8), on 'Normal values of knee angle, intercondylar and intermalleolar distances in Nigerian children' found that knees were maximally bowed at ages 1-3 years and reduced to neutral of 0 degrees at age five (5 years) in girls and age seven [7] in boys. The greatest intermalleolar distances of 2.5 cm and 2.2 cm were noted between the ages of 2 and 4 years.

Enwemeka CS [9] in their study of a total of 3,144 Nigerian school children, adolescents and adults found nine hundred and seventy-two (30.9%) of the subjects were identified with various physical deformities including Non-rachitic Primary Knee Deformities; Pes Planus; Talipes Equinus Varus; Scoliosis; Limb Length Discrepancy; Cubitus Valgus and Hallux Valgus.

In our study of 3889 young adults we have found a total of 701 (18.02%) persons with skeletal deformities Bhat BV, Babu L [10] in a Department of Pediatrics, Jawaharlal Institute of Post-Graduate Medical Education and Research, Pondicherry project studied congenital malformations prospectively from September 1989 to December 1992 covering 12,797 consecutive deliveries. The overall incidence of malformations was 3.7% and it was 3.2% among live births and 15.7% among still births.

Our report falls between these two values. Further work needs to be done in other regions of India to correlate whether incidence is region specific or otherwise and also a survey to see if there is any correlation between the incidence of skeletal anomalies and average socio-economic development of the region.

References

1. Cowan DN, Jones BH, Frykman PN, Polly DW Jr, Harman EA, Rosenstein RM, Rosenstein MT: Lower limb morphology and risk of overuse injury among male infantry trainees. Med Sci Sports Exerc. 1996 Aug; 28(8): 945-52.
2. Do TT: Clinical and radiographic evaluation of bowlegs: Curr Opin Pediatr. 2001 Feb; 13(1): 42-6.
3. Kling TF Jr: Angular deformities of the lower limbs in children: Orthop Clin North Am. 1987 Oct; 18(4): 513-27.
4. Bleck EE: Developmental orthopaedics. III: Toddlers. : Dev Med Child Neurol. 1982 Aug; 24(4): 533-55. Related Articles, Books, LinkOut.
5. Heath CH, Staheli LT: Normal limits of knee angle in white children—genu varum and genu valgum. J Pediatr Orthop. 1993 Mar-Apr; 13(2): 259-62.

6. Arazi M, Ogun TC, Memik R: Normal development of the tibiofemoral angle in children: a clinical study of 590 normal subjects from 3 to 17 years of age. J Pediatr Orthop. 2001 Mar-Apr; 21(2): 264-7.
7. Bowen RE, Dorey FJ, Moseley CF: Relative tibial and femoral varus as a predictor of progression of varus deformities of the lower limbs in young children: J Pediatr Orthop. 2002 Jan-Feb; 22(1): 105-11.
8. Omololu B, Tella A, Ogunlade SO, Adeyemo AA, Adebisi A, Alonge TO, Salawu SA, Akinpelu AO: Normal values of knee angle, intercondylar and intermalleolar distances in Nigerian children. West Afr J Med. 2003 Dec; 22(4): 301-4.
9. Enwemeka CS: Physical deformities in Nigerian schools: The Port Harcourt Cohort study. Int J Rehabil Res. 1984; 7(2): 163-72.
10. Bhat BV, Babu L: Congenital malformations at birth—a prospective study from south India. Indian J Pediatr. 1998 Nov-Dec; 65(6): 873-81.

Original Article

Indian Journal of Anatomy
Volume 4 Number 3, September - December 2015

Pineal Gland' Still a Bit of Mystery: An Escort Study

D.K. Sharma*, Vandana Sharma, Bikash C. Satapathy***, Manisha B. Sinha****, A.U. Siddiqui****, Soumitra Trivedi****, Mrithunjay Rathore******

Abstract

Some groups or communities believe that 'We literally have a third eye, which connects us to spiritual dimensions and supernatural forces' and it is claimed that the Pineal Gland (PG) is that third eye. Majority believes that PG is one of the endocrine glands in vertebrates and secretes mainly a hormone melatonin which regulates circadian rhythm or sleep cycle. In some lower vertebrates, PG has a well-developed eye like structure and in others if not organized as an eye, it functions like a light receptor. Neurobiological effects of meditation and mindfulness have been detected in the form of increased molecular levels of melatonin and dopamine. It is said that PG is relevant in medicine and healthcare for behavior change, stress regulation and treatment of addictions. Its deep location in brain suggested the philosophers throughout history that it possesses a particular importance. On the top of all, PG is also thought to secrete dimethyl tryptamine (DMT), a naturally occurring psychedelic compound called 'The Spirit Molecule' during dreaming, spiritual and mystical experiences and at the time of death. The role of PG as an endocrine gland and its secretory activity is poorly understood. Pineal gland's full purpose is still a bit of mystery and yet to be known but researchers suggest that we are getting closer to understanding PG and more about the entire endocrine system.

Keywords: Neurobiological Effects; Melatonin; Circadian Rhythm; Pineal; Psychedelic.

Introduction

Apart from 3rd eye PG has also been described as 'the seat of the soul', 'the part of the body in which the soul directly exercises its functions', 'the intuition organ', 'the connection point between body and spirit', 'the centre at which the soul and body interact and we receive messages from the divine' and so on. The synonyms of PG are pineal body, conarium and epiphysis cerebri. The PG is a small endocrine gland in the vertebrate brain which produces melatonin, a serotonin derived hormone, and affects the modulation of sleep patterns in both seasonal and circadian rhythms [1,2]. In shape it resembles a pine cone, hence its name and is located in the epithalamus near the center of the brain, between the two cerebral hemispheres, in a groove where the two halves of the thalamus join.

Nearly all vertebrates possess PG with the exception of Hagfish (the most primitive type of vertebrate)[3]. In Hagfish, there is a "pineal equivalent" structure in its dorsal diencephalon [4]. The Lancelet Branchiostoma Lanceolatum (the nearest existing relative to vertebrates) also lacks a recognizable PG. Few more vertebrates including the Alligator lack PG, as they have been lost in the course of evolution [5]. However the Lamprey, almost as primitive as Hagfish possesses PG [3]. In many reptiles, PG is represented by a combined structure with its anterior part pineal or parietal eye and posterior part glandular in nature. It is said that the human PG represents the persistent posterior glandular part only with the disappearance of anterior parietal eye.

So PG has a colorful and misunderstood history

Author's Affiliation: *Additional Professor,***Senior Resident, ****Assistant Professors, Department of Anatomy, All India Institute of Medical Sciences (AIIMS) Raipur Chhattisgarh India. **Associate Professor, Department of Anatomy, Gandhi Medical College, Bhopal Madhya Pradesh, India.

Corresponding Author: D.K. Sharma, Additional Professor, Department of Anatomy, All India Institute of Medical Sciences (AIIMS), Raipur-492 099, Chhattisgarh India.

E-mail: dhyanesh.sharma@gmail.com

and is considered a somewhat mysterious organ, as its function was discovered last of the endocrine glands. PG is compared to the photoreceptive 'third parietal eye' present in the epithalamus of some animal species, which is also called the pineal eye [6]. PG was once named 'the third eye' due to many reasons, ranging from its location deep central part of the brain to its connection with the light sensation. PG has been studied for thousands of years; during third century a famous Roman physician Galen described it as 'the seat of the soul'. This reference was given again by a prominent philosopher and mathematician Rene Descartes (1596-1650), who wrote about PG in depth. By supporting Galen's thoughts, Descartes commented that the PG is principal seat of the soul, where all our thoughts are formed however his observations have been widely rejected.

Anatomy: In adult human, PG is reddish-gray in color, about a grain of rice in size (5-8 mm), approximately 0.1 gram in weight. It is located just rostro-dorsal to superior colliculi, projecting posteroinferiorly between them, behind and beneath the stria medullaris between thalamic bodies. The gland is relatively larger in children but begins to shrink with the onset of puberty. It is a part of the epithalamus below the splenium of corpus callosum but separated from it by the tela choroidea of the third ventricle with location in the quadrigeminal or superior cistern or *cistern of the great cerebral vein and* so remains bathed in cerebrospinal fluid. A small pineal recess of the third ventricle projects into the stalk or peduncle of the gland to divide it anteriorly into two laminae, superior and inferior, containing the habenular and posterior commissure respectively. PG is a midline structure shaped like a pine cone [7,8].

Blood supply: PG has profuse blood supply, second to the kidney but distinct from most of the mammalian brain, because it is not separated from the body by the blood brain barrier system [9].

Innervations: PG has a rich supply of adrenergic nerves that greatly influence its function. Sympathetic innervation is from the superior cervical ganglion whereas parasympathetic from the pterygopalatine and otic ganglia. Further, some nerve fibers penetrate into the pineal gland via the pineal stalk as central innervation. The neurons in the trigeminal ganglion also innervate the gland with their nerve fibers containing the neuropeptide PACAP (pituitary adenylate cyclase-activating polypeptide).

Histology

Microscopically PG is composed of two types of cells, pinealocytes and neuroglial cells, with a rich network of blood vessels and sympathetic fibres derived from the superior cervical ganglion. No neural tissue is present and spaces or cysts may be present. Vessels and nerves enter the gland through the connective tissue septa which partly separate the lobules. Sympathetic ganglion cells may be present. PG presents a lobular parenchyma of pinealocytes surrounded by connective tissue spaces. The gland's surface is covered by a pial capsule. As it is quite cellular (in relation to cortex and white matter) it may be mistaken for a neoplasm [10]. PG consists mainly of pinealocytes but four other cell types have been identified (i) Pinealocytes are arranged in the form of cords and clusters among capillaries. Each cell consists of a cell body with 4-6 lengthy long tortuous cytoplasmic processes and stained lightly basophilic by special silver impregnation methods. Cytoplasmic processes end in relation to blood vessels as swellings having granules containing melatonin and its precursor serotonin. Pinealocytes are the main cell type forming 95% of the cell population. They are modified neurons characterized by large irregular nuclei and prominent nucleoli (ii) Interstitial cells are neuroglial cells mainly astroglial cells characterized by dark elongated nuclei with cytoplasm stained darker than that of the pinealocytes. They also have long cytoplasmic processes which support pinealocytes and blood vessels (iii) Perivascular phagocytes are antigen presenting cells, located close to capillaries in the gland (iv) Pineal neurons or sympathetic ganglion cells and (v) Peptidergic neuron-like cells possessing a paracrine regulatory function.

Calcareous concretions due to fluoride, calcium and phosphorus deposits are constantly present in the pineal after the 17th year of life in the form of aggregations called 'brain sand' or 'corpora arenacea or acervuli', which are basophilic bodies showing concentric layers and present extracellularly in the matrix and visible in x-rays of skull. Their number increases with the age and they serve as landmark to radiologists in. Chemical analysis shows that they are composed of calcium phosphate, calcium carbonate, magnesium phosphate, and ammonium phosphate [11]. Deposits of the calcite form of calcium carbonate were described in 2002 [12]. Calcium and phosphorus deposits in the PG have been linked with aging.

Development

PG grows in size until about 1–2 years of age and then remains stable [13,14] but its weight increases continuously from the puberty onwards [15,16]. It is believed that the rich levels of melatonin in children

inhibit sexual development. The PG tumors have been linked with precocious puberty. The melatonin production is gradually reduced after puberty.

Function

Melatonin production: PG has long been regarded as a vestigial organ of no importance but recent investigations have shown it as an endocrine gland of great importance producing hormone melanin mainly. The synthesis and discharge of melatonin is remarkably influenced by the exposure of animal to light and is more during dark period. Melatonin is N-acetyl-5-methoxy-tryptamine, a derivative of the amino acid tryptophan and it regulates the circadian rhythm or sleep cycle by contributing a person feeling awake or sleepy. The production of melatonin is stimulated by darkness and inhibited by light [17,18]. Photosensitive cells in the retina detect light and signal the suprachiasmatic nucleus (SCN), entraining its rhythm to 24-hour cycle in nature. Fibers project from the SCN to the paraventricular nuclei (PVN), relay the circadian signals to spinal cord and out via sympathetic system to superior cervical ganglia (SCG); and from there into PG. The compound pinoline is also produced in the pineal gland which is one of the beta-carbolines [19]. Apart from regulating circadian rhythm the melatonin has some other functions in central nervous system (CNS).

Regulation of other endocrine glands: Some scientists claim that melatonin blocks the secretion of gonadotrophins (LH and FSH) from the anterior pituitary gland. These hormones aid in the proper development and functioning of ovaries and testes. Studies on rodents suggest that PG influences the pituitary gland secretion of sex hormones, follicle stimulating hormone (FSH) and luteinizing hormone (LH). A pinealectomy was performed on rodents and no change in pituitary weight was observed however there was an increase in the concentration of FSH and LH within the gland. In this same study, administration of melatonin did not return the concentrations of FSH to normal levels, suggesting that pineal gland influences the pituitary glands secretion of FSH and LH through some other transmitting molecule. PG presents important regulatory influence on many other endocrine organs including the hypophysis cerebri, thyroid, parathyroid, adrenal and gonads [20].

Drug metabolism: Studies suggest that PG may influence the actions of recreational drugs like cocaine and antidepressants like fluoxetine (Prozac); and may protect against neurodegeneration.

Clinical Significance

Calcification: PG is typically seen in adults as becomes calcified and often seen in skull X-rays but has been observed in children as young as of 2 years. Calcification rates vary widely by country and correlate with an increase in age [21]. Internal secretions of PG inhibit the development of the reproductive glands, because in cases where it is severely damaged in children, the result is accelerated development of the sexual organs and the skeleton.[22] In animals, PG plays a major role in sexual development, hibernation, metabolism, and seasonal breeding. Some recent studies show that PG calcification is significantly higher in patients with Alzheimer's disease than other types of dementia. Calcification may contribute the pathogenesis of Alzheimer's disease and reflect an absence of crystallization inhibitors [23]. Calcium, phosphorus and fluoride deposits in PG have been correlated with aging, as the brain ages, more deposits collect [24].

Cancer: All tumors involving PG are occasionally seen and mostly arise from sequestered embryonic germ cells. They most commonly take the form of germinomas, similar to testicular seminoma or ovarian dysegerminoma. Most pinealophiles restrict the terms pinealoma to neoplasms arising from the pineocytes. Pineal tumor may compress the superior colliculi and pretectal area of the dorsal midbrain and results the Parinaud's syndrome. Pineal tumor also may compress the cerebral aqueduct and results the non-communicating hydrocephalus. These neoplasms are divided into two categories, pineoblastomas and pineocytomas on the basis of neoplastic aggressiveness. The manifestations of pressure effect consist of visual disturbances, headache, mental deterioration, and sometimes dementia-like behavior.

Other Animals

Pinealocytes in many non-mammalian vertebrates have a strong resemblance to the photoreceptor cells of eye. Some evolutionary biologists believe that the vertebrate pineal cells possess a common evolutionary ancestor with retinal cells. Pineal cytostructure seems to have evolutionary similarities to the retinal cells of chordates [25]. Modern birds and reptiles have been found to express the phototransducing pigment melanopsin in PG. Avian PG is believed to act like the SCN in mammals [26]. In some vertebrates, exposure to light can set off a chain reaction of enzymatic events within PG that regulate circadian rhythms [27]. Some early vertebrate fossil skulls have a pineal opening which correlates the physiology of the modern "living fossils", the lampreys and the

tuatara; and some other vertebrates having parietal eye, which is photosensitive. The parietal eye represents evolution's earlier approach to photoreception. The structures of pineal eye in tuatara are analogous to the cornea, lens, and retina, though the latter resembles that of an octopus rather than a vertebrate retina. The asymmetrical whole consists of the 'eye' to the left and the 'pineal sac' to the right. In animals that have lost the parietal eye, including mammals, the pineal sac is retained and condensed into the form of the pineal gland [28]. The brain of the Russian Melovatka bird, about 90 million years old, is an exception which shows a larger parietal eye and PG. In human and other mammals, the light signals necessary to set circadian rhythms are sent from the eye through the retinohypothalamic system to the SCN and PG.

Society and Culture

Seventeenth century philosopher and scientist Rene Descartes, dedicating much time to study PG, called it the 'principal seat of the soul'. Descartes attached significance to the gland because he believed it to be the only section of the brain to exist as a single part rather than one-half of a pair. He argued that, because a person can never have 'more than one thought at a time', external stimuli must be united within the brain before being considered by the soul, and he considered PG to be situated in the most suitable possible place for this purpose, located centrally in the brain and surrounded by branches of the carotid arteries [29]. Dutch philosopher Baruch Spinoza criticized Descartes viewpoint for neither following from self-evident premises nor being clearly and distinctly perceived as Descartes previously asserted that he could not draw conclusions of this sort. Baruch questioned what Descartes meant by talking of the union of the mind and the body.

The notion of a 'pineal-eye' is central to the philosophy of the French writer Georges Bataille, which is analyzed at length by literary scholar Denis Hollier in his study Against Architecture. In this work Hollier discusses how Bataille uses the concept of a 'pineal-eye' as a reference to a blind-spot in Western rationality and an organ of excess and delirium [30]. This conceptual device is explicit in his surrealist texts 'The Jesuve and The Pineal Eye' [31]. Many spiritual philosophies contain the notion of an inner third eye which is related to the Ajna chakra and PG; and is attributed significance in mystical awakening or enlightenment, clairvoyant perception and higher states of consciousness. This idea occurs historically in ancient central and eastern Asia, as well as in contemporary theories relating to yoga, theosophy, hinduism, pagan religion and New Age Spiritual Philosophies. In hinduism Lord Shiva with third eye shown on the median line superior to both the eyes; and a crescent moon placement with the Bindi, an ornament worn over the forehead are the outward marks indicating PG or Sixth or Ajana chakra.

History

PG was originally believed to be a 'vestigial remnant' of a larger organ. In 1917, it was known that extract of cow pineal lightened frog skin. Dermatology professor Aaron B. Lerner and colleagues at Yele Universily, hoping that a substance from the pineal might be useful in treating skin diseases, isolated and named the hormone melatonin in 1958 [32]. The substance did not prove to be helpful as intended but its discovery helped solve several mysteries such as why removing the rat's pineal accelerated ovary growth, why keeping rats in constant light decreased the weight of their pineals and why pinealectomy and constant light affect ovary growth to an equal extent; this knowledge gave a boost to the then new field of chronobiology.

Interpretation

The secretory activity of PG is only partially understood. Some believe that the pineal gland secretes a single hormone melatonin and its secretion is dictated by light. Researchers have determined that melatonin has two primary functions in humans i.e. controls circadian or biological rhythm and regulates certain reproductive hormones. Circadian rhythm is a 24-hour biological cycle characterized by sleep-wake patterns. Light exposure stops the release of melatonin and in turn helps control circadian rhythms. Melatonin secretion is low during the daylight hours and high during dark periods, which has some influence over our reaction to photoperiod i.e. the length of day versus night. Naturally, photoperiod affects sleep patterns but melatonin's degree of impact over sleep patterns is disputed.

What is fascinating is that PG actually has retinal tissue composed of photoreceptors rods & cones inside, just like the eye, and is wired to the visual cortex in the brain. The photoreceptors of the retina not only strongly resemble the cells of PG which even has vitreous fluid in it like the human eye. An article in Science News stated 'The retina and PG are the organs primarily responsible for the body's recognition and sophisticated processing of external light'. These two organs in mammals seemed to have little else in common and were consequently studied by separate groups of scientists but a new alliance of

researchers is now exploring striking similarities. Their findings suggest that PG was the evolutionary precursor to the modern eye. Furthermore, a study published in Experimental Eye Research revealed that 'Although the mammalian PG is considered to be only indirectly photosensitive, the presence of proteins in PG involved in photo transduction or light sensing in the retina, raises the possibility that direct photic events may occur in the mammalian PG'.

A circadian rhythm is a roughly 24 hours cycle in the physiological processes of living beings including plants, animals, fungi and cyanobacteria. In strict sense the circadian rhythms are endogenously generated and can be modulated by external cues such as sunlight and temperature. Circadian rhythms are physical, mental and behavioral changes which follow a roughly 24-hour cycle. The study of circadian rhythms is called chronobiology. The 'master clock' which controls the circadian rhythms, consists of a group of nerve cells in the brain called SCN which contains about 20,000 nerve cells and is located in the hypothalamus, an area just above optic chiasms. Circadian rhythms can influence sleep-wake cycles, hormone release, body temperature and other important bodily functions. They have been linked to various sleep disorders like insomnia, obesity, diabetes, depression, bipolar disorder and seasonal affective disorders. The body's master clock or SCN controls the production of melatonin hormone which makes us sleepy by relaying information from the eyes to the brain. When there is less light, like at night, the SCN tells the brain to make more melatonin so we get drowsy.

Jet lag occurs when travelers suffer from disrupted circadian rhythms. When we pass through different time zones, our body's clock will be different from our wristwatch. For example if we fly in an airplane from Mumbai to Imphal, we lose 3 hours of time and when we wake up at 7am, our body still thinks it is 4 am, making us feel groggy and disoriented. Our body's clock will eventually reset itself but this often takes a few days. Scientists learn about circadian rhythms by studying humans or by using model organisms that have similar clock genes. Researchers control the subject's environment by altering light and dark periods and then look for changes in gene activity or other molecular signals. Understanding what makes biological clocks tick may lead researchers to managements for sleep disorders, jet lag and other health problems.

In a research study, Shantha Rajaratnam Professor of Psychology at Monash University found that the performance of athletes, depending on circadian rhythms vary during the day up to 26 percent. One's circadian rhythm or circadian phenotype is the internal cycle regulating the behavioral and physiological systems in the body, and is important for determining time of performance best for the athlete. If the players are having issues with sleep, then the adjustments can be made for enhancing both the quality as well as quantity of sleep.

In 1990s, a British scientist Jennifer Luke discovered that fluoride accumulates to strikingly high levels in the pineal gland but it is not yet known if fluoride accumulation affects PG function. Preliminary animal experiments found that fluoride reduced melatonin levels and shortened the time to puberty. Based on this and other evidence, the US National Research Council has stated that 'fluoride is likely to cause decreased melatonin production and to have other effects on normal pineal function, in turn may contribute to a variety of effects in humans'. *PG has highest levels of fluoride in body* as a calcifying tissue that is exposed to a high volume of blood flow and a major target for fluoride accumulation. In fact, the calcified parts of PG have the highest fluoride concentrations, higher than either bone or teeth. While the impacts of these fluoride concentrations in PG are not yet fully understood, studies have found that calcified deposits are associated with decreased numbers of functioning pinealocytes and reduced melatonin production as well as impairments in the sleep-wake cycle. It has been claimed that a child drinking fluoridated tap water looses 20 I.Q. points by the age of 6, as compared to a child that doesn't consume any. United States study claims that due to raised consumption of fluoride the children get puberty at the earlier ages and carry health consequences including a high risk of breast cancer. In animal studies, fluoride exposure causes a decrease in the amount of circulating melatonin and lead to an accelerated sexual maturation in females. Similar findings are reported in few more epidemiological studies on populations drinking fluoridated water, like the girls of fluoridated community reached puberty five months earlier.

Calcite micro-crystals in PG are similar to otolith/ otoconia in human internal ear bone minerals[33]. EM fields: 60 Hz suppresses the activity of PG in our home, work place and outside and reduces melatonin production. These crystals expand and contract due to the presence of EM field of about 60 Hz normally present around us[34]. Pineal calcification is piezoelectric [35]. Piezoelectricity means electricity resulting from pressure or in response to the applied mechanical stress. This is in the frequency range of cell phone communication. Calcium crystals are capable of tuning into radio-stations without the use of electricity [36].

PG is said to secrete a chemical, dimethyl tryptamine (DMT) a naturally occurring psychedelic compound (a component of Ayahuasca-a plant medicine) which has the nickname of 'The Spirit Molecule'. DMT is believed to be released from the PG during dreaming, during spiritual and mystical experiences and during time of death. PG naturally makes its own DMT when fully operational and then creates a visionary state. Spiritual philosophies claim about supernatural forces and events which are hidden, neither apparent to the senses nor obvious to the intelligence. These supernatural forces and events can be seen, felt and heard by activating PG by Meditation. Neurobiological effects of Meditation and Mindfulness have been claimed in the form of increased molecular levels of melatonin and dopamine. Meditation may be relevant in medicine and healthcare to manage behavior change, stress regulation and addictions; and in its extended form the state of Buddhism or Enlightenment can be achieved.

Pineal detoxification or cleaning has also been claimed by avoiding (i) Fluoride (tooth paste, tap water) (ii) Organic foods (meat, pesticides etc) (iii) Alcohol and smoking (iv) Mercury (tooth fillings, vaccines, eating fish, eco light bulbs etc) (v) Heart Healing (overall vibration of the being and seeing other dimensions) (vi) Other toxins (artificial sweeteners, refined sugar, phylenanine in squashes, deodorants, cleaning chemicals, dental mouthwashes, air fresheners) which are really bad for the pineal gland. Raw chocolate/cacao is a pineal gland stimulant/detoxifier in high doses because of the high antioxidant content. Being disciplined with steps (i) to (vi) for a year or so will certainly bring about pineal cleaning and step (vii) is optional but very useful.

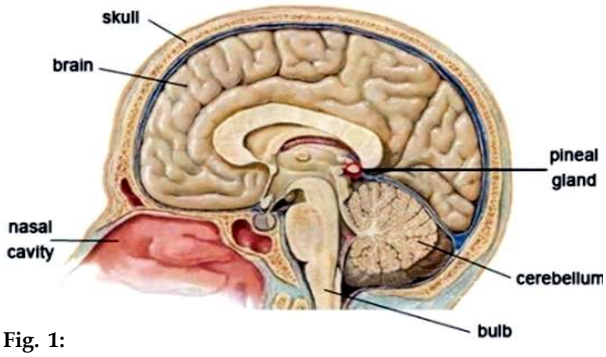


Fig. 1:

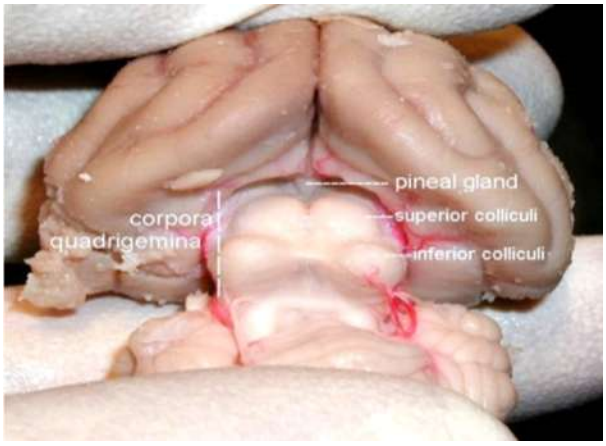


Fig. 2:

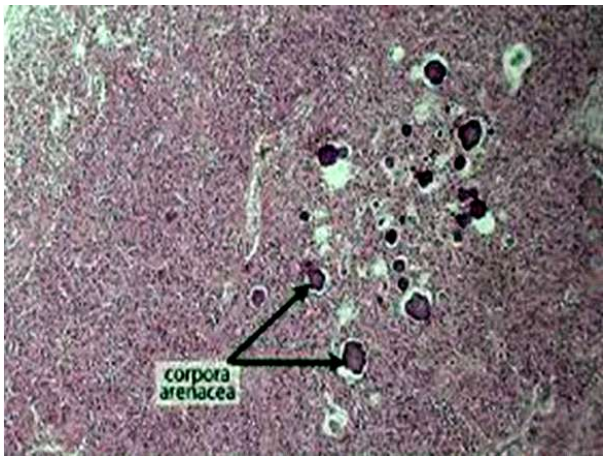


Fig. 3:

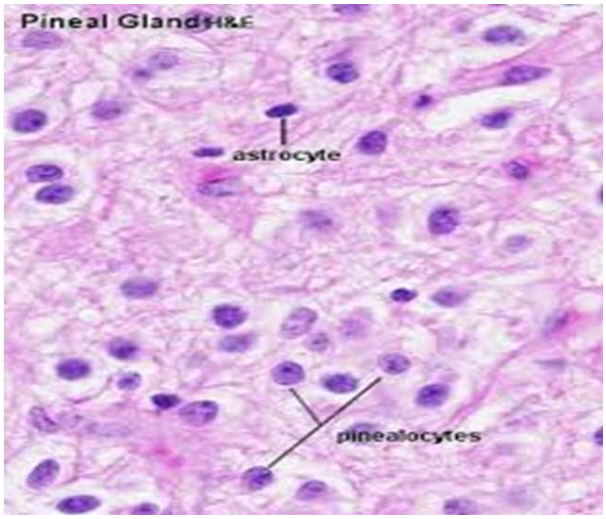


Fig. 4:

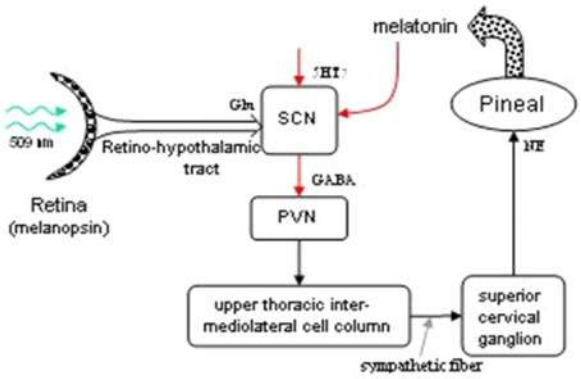


Fig. 5:

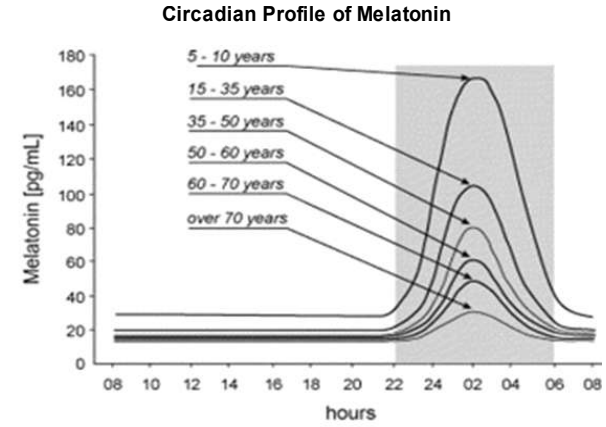


Fig. 6:

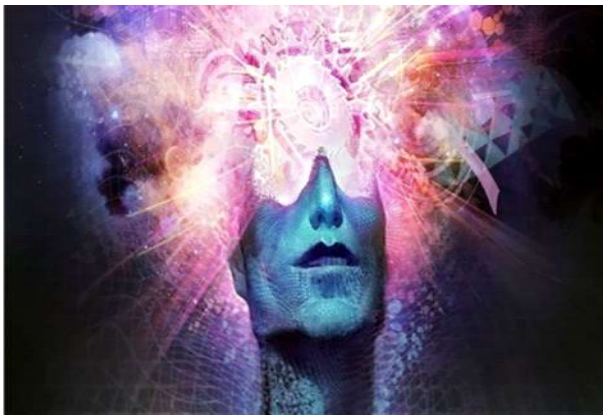


Fig. 7:

Fig. 8:

Fig. 9:

Long term effects of Melatonin is not known and it is not yet approved by Food and Drug Administration (FDA), even then it is being used in some country as anti aging or rejuvenating agent to boost vitality.

Conclusion

The pineal gland's full purpose is still a bit of a mystery. The role of pineal as an endocrine gland and its secretory activity is poorly understood. In humans, the function of melatonin is less well understood. Researchers are still learning about the full purpose of PG and suggest that we are getting closer to the complete understanding the pineal gland; and more about the endocrine system as a whole. Animal studies reveal that it secretes many neurotransmitters eg. melatonin, serotonin and norepinephrine; of these only melatonin is shown to be released into blood and can be considered as a true hormone. Attempt to demonstrate a functional link between PG and normal human processes have yielded equivocal and often confusing results. Its location deep in the brain suggested to philosophers throughout history that it possesses a particular importance. This combination leads it to be regarded as a gland with mystical, metaphysical and occult theories surrounding its perceived functions and so PG is still a bit of mystery.

References

1. Macchi M, Bruce J. "Human pineal physiology and functional significance of melatonin" Front Neuroendocrinol 2004; 25(3-4): 177–95.
2. Arendt J, Skene DJ. "Melatonin as a chronobiotic" Sleep Med Rev. 2005; 9(1): 25-39.
3. Vernadakis AJ, Bemis WE, Bittman EL. "Localization and partial characterization of melatonin receptors in amphioxus, hagfish, lamprey, and skate" Gen. Comp. Endocrinol. April 1998; 110(1): 67-78.
4. Ooka-Souda S, Kadota T, Kabasawa H. "The preoptic nucleus: the probable location of the circadian pacemaker of the hagfish, Eptatretus burgeri". Neurosci Lett. December 1993; 164(1-2): 33-6.
5. Erlich SS, Apuzzo ML. "The pineal gland: anatomy, physiology, and clinical significance". J. Neurosurg. September 1985; 63(3): 321-41.
6. Eakin, RM. The Third Eye Berkeley: University of California Press. 1973.
7. Dorland's Illustrated Medical Dictionary Elsevier Saunders p.1607 ISBN 978-1-4160-6257-8 .
8. Bowen, R "The Pineal Gland and Melatonin" Retrieved

14 October 2011 .

9. Pritchard, Thomas C, Alloway, Kevin Douglas. Medical Neuroscience (Google books preview) Hayes Barton Press. 1999; pp. 76-77. Retrieved 2009-02-08.
10. Kleinschmidt-DeMasters BK, Prayson RA. "An algorithmic approach to the brain biopsy-part I". Arch. Pathol. Lab. Med. November 2006; 130(11): 1630-8.
11. Bocchi G, Valdre G. "Physical, chemical, and mineralogical characterization of carbonate-hydroxyapatite concretions of the human pineal gland" J Inorg Biochem. 1993; 49(3): 209-20.
12. Baconnier S, Lang S, Polomska M, Hilczer B, Berkovic G, Meshulam G. "Calcite microcrystals in the pineal gland of the human brain: first physical and chemical studies" Bioelectromagnetics 2002; 23(7): 488-95.
13. Schmidt F, Penka B, Trauner M, Reinsperger L, Ranner G, Ebner F, Waldhauser F. Lack of pineal growth during childhood. J Clin Endocrinol Metab, 1995 Apr; 80(4): 1221–5.
14. Sumida M, Barkovich AJ, Newton TH. Development of the pineal gland: measurement with MR. AJNR Am J Neuroradiol. 1996 Feb; 17(2): 233-6.
15. Tapp E, Huxley M 'The weight and degree of calcification of the pineal gland' J Pathol. 1971; 105: 31–39.
16. Tapp E, Huxley M 'The histological appearance of the human pineal gland from puberty to old age' J Pathol. 1972; 108: 137–144.
17. Axelrod J. "The pineal gland". Endeavour 1970; 29(108): 144–8.
18. Lowrey, Phillip L and Joseph S. Takahashi "Genetics of the mammalian circadian system: photic entrainment, circadian pacemaker mechanisms, and posttranslational regulation." Annual review of genetics. 2000; 34(1): 533-562.
19. Callaway James C, Gyntber Jukka, Poso Antti, Airaksinen Mauno M, Vepsäläinen Jouko. "The pictet-spengler reaction and biogenic tryptamines: Formation of tetrahydro-â-carbolines at physiologicalpH". Journal of Heterocyclic Chemistry. 1994; 31(2): 431.
20. Motta Marina, Fraschini F, Martini L. "Endocrine Effects of Pineal Gland and of Melatonin.". Exp Biol Med (Maywood) 1967; 126(2): 431-435.
21. Zimmerman Robert A "Age-Related Incidence of Pineal Calcification Detected by Computed Tomography". Radiological Society of North America Retrieved 21 June 2012.
22. "The Pineal Body" Human Anatomy (Gray's Anatomy) Retrieved 2011-09-07.
23. Mahlberg R, Walther S, Kalus P, Bohner G, Haedel S, Reischies FM, Kühl KP, Hellweg R, Kunz D. "Pineal calcification in Alzheimer's disease: An in vivo study using computed tomography". Neurobiology of Aging. 2008; 29(2): 203–209.
24. Luke Jennifer. "Fluoride Deposition in the Aged Human Pineal Gland" Caries Res. March–April 2001; (35): 125–128. |accessdate= requires |url= (help).
25. Klein D. "The 2004 Aschoff/Pittendrigh lecture: Theory of the origin of the pineal gland—a tale of conflict and resolution". J Biol Rhythms. 2004; 19(4): 264–79.
26. Natesan A, Geetha L, Zatz M. "Rhythm and soul in the avian pineal" Cell Tissue Res. 2002; 309(1): 35–45.
27. Moore RY, Heller A, Wurtman RJ, Axelrod J. "Visual pathway mediating pineal response to environmental light" Science. January1967; 155(759): 220–3.
28. Schwab IR, O'Connor GR. "The lonely eye" British Journal of Ophthalmology. March 2005; 89(3): 256.
29. Descartes R. "The Passions of the Soul" excerpted from "Philosophy of the Mind," Chalmers, D. New York: Oxford University Press, Inc.; 2002.
30. Hollier D, Against Architecture: The Writings of Georges Bataille, trans. Betsy Wing, MIT, 1989.
31. Bataille G, Visions of Excess: Selected Writings, 1927–1939 (Theory and History of Literature, Vol. 14), trans. Allan Stoekl et al., Manchester University Press, 1985.
32. Lerner AB, Case JD, Takahashi Y. "Isolation of melatonin and 5-methoxyindole-3-acetic acid from bovine pineal glands" J Biol Chem. 1960; 235: 1992–7.
33. Mabie CP, Wallace BM. Optical, physical and chemical properties of pineal gland calcifications. Calcif Tissue Res. 1974; 16: 59–71.
34. See comment in PubMed Commons belowBaconnier S et al 'Calcite microcrystals in the pineal gland of the human brain: first physical and chemical studies' Bioelectromagnetics. 2002 Oct; 23(7): 488-95.
35. WG Cady, Piezoelectricity, Dover, New York, 1964.
36. R.J. Reiter, Static and extremely low frequency electromagnetic field exposure: Reported effects on the circadian production of melatonin, J. Cell. Biochem. 1993; 51: 394—403.

Original Article

Indian Journal of Anatomy
Volume 4 Number 3, September - December 2015

Cadaveric Study of the Adult Human Brachial Artery

Dipti A. Nimje*, Harish A. Wankhede, P.B. Hosmani***, M.M. Baig******

Abstract

Background: The brachial artery lies immediately deep to the deep fascia. Various variations of the brachial artery and its branches are quoted in literature. Prior anatomical knowledge of such anomalies may be of great clinical significance. The present study concentrates on the morphological features of the brachial artery. *Methodology:* The study was done by the dissection method on 70 human brachial arteries from 35 embalmed human cadavers from various medical colleges in Maharashtra. *Results:* The brachial artery was found to be originating as the continuation of the axillary artery below the lower border of teres major. The mean length of the brachial artery on right side was 24.91±4.13 cm and on left side was 25.27±3.79 cm. On right side mean diameter of the brachial artery at origin was 0.54±0.06 cm and above termination was 0.50±0.06 cm and on left side mean diameter at origin was 0.52±0.05 cm and above termination was 0.49±0.06 cm. The level of termination of the brachial artery above the inter-condylar line was seen in 2 specimens (5.71%) on right side and in 1 specimen (2.85%) on left side and below the inter-condylar line in 33 specimens (94.28%) on right side and in 34 specimens (97.14%) on left side. The presence of the superficial brachial artery was most common variation found in the brachial artery (7.14%), next common variation was higher termination (4.28%). The accessory brachial artery seen in only 1 specimen (1.42%). *Conclusion:* Anatomical knowledge of brachial artery is important because it is commonly used for various surgical and interventional procedures.

Keywords: Axillary Artery; Accessory Brachial Artery; Brachial Artery; Higher Termination; Superficial Brachial Artery.

Introduction

The brachial artery is the continuation of the axillary artery, the change in name occurring at the lower border of the teres major muscle. The artery is superficial in its course in the arm, lying immediately deep to the deep fascia of the anteromedial aspect of the arm. It passes deeply into the cubital fossa before dividing into the radial and ulnar arteries, usually at the level of the neck of the radius[1]. As quoted in the literature the length of the brachial artery varies with the site of division, ranging from 15 to 30 cm, its diameter is around 0.5 to 0.6 cm[2]. Major variations of the principal arteries of the upper limb have long received the attention of anatomists. Various variations of the brachial artery and its branches are quoted in literature like superficial brachial artery, accessory brachial artery, double brachial artery, higher division of the brachial artery, superficial radial artery, aberrant radial artery, superficial ulnar artery and rarely superficial median artery[3]. Brachial artery in its upper part may also give rise to subscapular and posterior circumflex humeral artery, normally branches of the axillary artery; in its lower part to the radial recurrent artery and at its bifurcation to the interosseous artery or to median artery which is usually a branch of interosseous artery[4].

The arteries of the upper limbs are situated in a deep plane and are the favorable sites for intra-arterial cannulation[5]. Dimensions of the brachial artery and flow mediated dilatation are associated with severity

Author's Affiliation: *Assistant Professor, Department of Anatomy, Dr. Bhausaheb Hire Memorial Government Medical College, Dhule. **Assistant Professor, Department of Anatomy, Government Medical College, Miraj. ***Associate Professor, ****Professor & Head, Department of Anatomy, Vaishampayan Memorial Government Medical College, Solapur.

Corresponding Author: Dipti A. Nimje, Assistant Professor in Department of Anatomy, Dr. Bhausaheb Hire Memorial Government Medical College, Dhule, Maharashtra 424001.

E-mail: dr.dipti342@gmail.com

of cardiovascular diseases. Non invasive brachial artery analysis has useful approach for detailed study of cardiovascular system and impact of cardiovascular diseases[6].

Considering the higher incidence of anatomical variations of arteries of the upper limb, prior anatomical knowledge of such anomalies may be of great clinical significance to vascular and plastic surgeons, orthopaedicians and interventional radiologists. The presence of variations in the arterial pattern of the arm and forearm has to keep in mind during surgical procedures, at times of accidents and crush injuries and also in diagnostic procedures like cardiac catheterization, arterial grafting and other angiographic procedures. So the present morphological study intends to establish the frequency and patterns of variation for the human adult brachial arteries of the upper limb.

Material and Methods

The study was done in 70 human brachial arteries from 35 embalmed human cadavers from various medical colleges in Maharashtra by method given in Cunningham's manual of practical anatomy of upper limb [7] .

The length of the brachial artery was measured using measuring tape between following points:

a) At point of inferior border of the teres major muscle

b) At the point of termination of brachial artery

The external diameters of the brachial artery were measured by Vernier caliper at

a) Its origin

b) Its termination

The variations in the brachial artery were also noted and photographed and result were analysed statistically.

Results

Following observations and results we obtained in the present study. Among all 70 specimen studied, the brachial artery was found to be originating as the continuation of the axillary artery below the lower border of teres major (Table 1). Statistically variations in length of the brachial artery are not uniform (Chi-square value on right side=51.71, 'p'<0.01; highly significant and on left side=52.28, 'p'<0.01; highly significant).The mean length of the brachial artery on right side was 24.91cm with standard deviation of 4.13 and on left side was 25.27cm with standard deviation of 3.79. The maximum length of the brachial artery was found to be 29.2cm on right side and 30cm on left side. The minimum length was found to be 8cm on right side and 6cm on left side. The unpaired t-test was applied comparing the mean length of right and left sides and was found to be non significant (t-test value=0.37, df=68, 'p' >0.05) (Table 2).

Unpaired t-test was applied for comparing mean diameter at origin of right and left sides and was found to be non significant (t value =1.49, df=68, 'p' >0.05). The unpaired t-test was applied for comparing mean diameter above termination of right and left sides and was found to be non significant (t-test value=0.68, df=68, 'p' >0.05) (Table 3).

Z-test was applied for difference between two proportions i.e. level of termination above the inter-condylar line on right and left sides and was found to be non significant (Z test=0.59, 'p' >0.05). Similarly, Z-test was applied for difference between two proportions i.e. level of termination below the inter-condylar line on right and left sides and was found to be non significant (Z test=0.59, 'p' >0.05) (Table 4).

Statistically, variations in the brachial artery were found to be non uniform (Chi-square value on right side=87.14, 'p' <0.01; highly significant and for left side Chi-square value =112, 'p' <0.01; highly significant. The Z-test was applied for difference between two proportions i.e. normal brachial artery on right and left sides and was found to be non significant (Z test=1.07, 'p' >0.05). Similarly for superficial brachial artery on right and left sides the test was found to be non significant (Z test=0.16, 'p' >0.05), for higher termination of brachial artery on right and left sides was found to be non significant (Z test=0.59, 'p' >0.05), for accessory brachial artery on right and left sides the test was found to be non significant (Z test=1.007, 'p' >0.05) (Table 5).

Table 1: Origin of the brachial artery

Origin of brachial artery	Right		Left	
	Specimens	Percentage	Specimens	Percentage
Continuation of axillary artery	35	100%	35	100%
Other type of origin	0	0%	0	0%

Table 2: Length of the brachial artery

Length of the Brachial artery in cm	Right		Left	
	Specimens	Percentage	Specimens	Percentage
5.1-10	1	2.85%	1	2.85%
10.1-15	1	2.85%	0	0%
15.1-20	0	0%	0	0%
20.1-25	11	31.42%	13	37.14%
25.1-30	22	62.85%	21	60%
Total	35	100%	35	100%
Mean±SD length	24.91±4.13		25.27±3.79	

*Chi-square test value on right side=51.71, df=4, p<0.01 (highly significant); Chi-square test value on left side=52.28, df=4, p<0.01 (highly significant)
† t-test=0.37, df=68, p>0.05 (not significant)

Table 3: Diameter of the brachial artery

Diameter of the brachial artery in cm		Mean ± S.D.	Maximum	Minimum
At origin	Right	0.54±0.06	0.8	0.38
	Left	0.52±0.05	0.62	0.42
Above termination	Right	0.50±0.06	0.67	0.35
	Left	0.49±0.06	0.66	0.41

*t-test value for diameter at origin=1.49, df=68, p>0.05 (not significant); t-test value for diameter above termination=0.68, df=68, p>0.05 (not significant)

Table 4: Variation in the level of termination of the brachial artery

Level of termination	Right		Left	
	Specimens	Percentage	Specimens	Percentage
Above inter-condylar line	2	5.71%	1	2.85%
At inter-condylar line	0	0%	0	0%
Below inter-condylar line	33	94.28%	34	97.14%

*Z-test value for termination above inter-condylar line=0.59, p>0.05 (not significant); Z-test value for termination below inter-condylar line=0.59, p>0.05 (not significant).

Table 5: Variations in the brachial artery

Variations in brachial artery	Right		Left	
	Specimen	Percentage	Specimen	Percentage
Normal pattern	29	82.85%	32	91.42%
Superficial brachial artery	3	8.57%	2	5.71%
Higher termination	2	5.71%	1	2.85%
Accessory brachial artery	1	2.85%	0	0%
Total	35	100%	35	100%

*Chi-square test value on right side=87.14, df=4, p<0.01 (highly significant); Chi-square test value on left side=112, df=4, p<0.01 (highly significant)
†Z-test value for normal brachial artery=1.07, p>0.05 (not significant)
‡Z-test value for superficial brachial artery=0.16, p>0.05 (not significant)
§Z-test value for higher termination of brachial artery=0.59, p>0.05 (not significant)
||Z-test value for accessory brachial artery=1.007, p>0.05 (not significant)

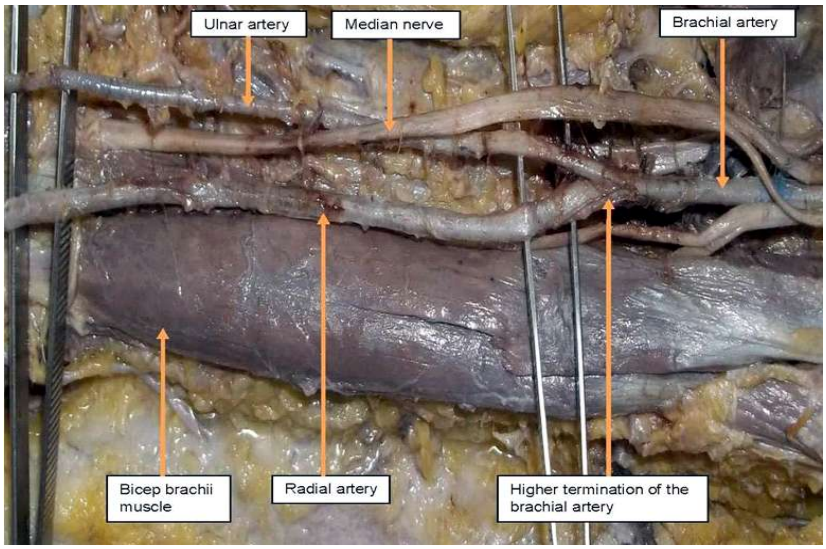


Fig. 1: Photograph showing the higher termination of the brachial artery into ulnar and radial artery which has higher origin in left arm

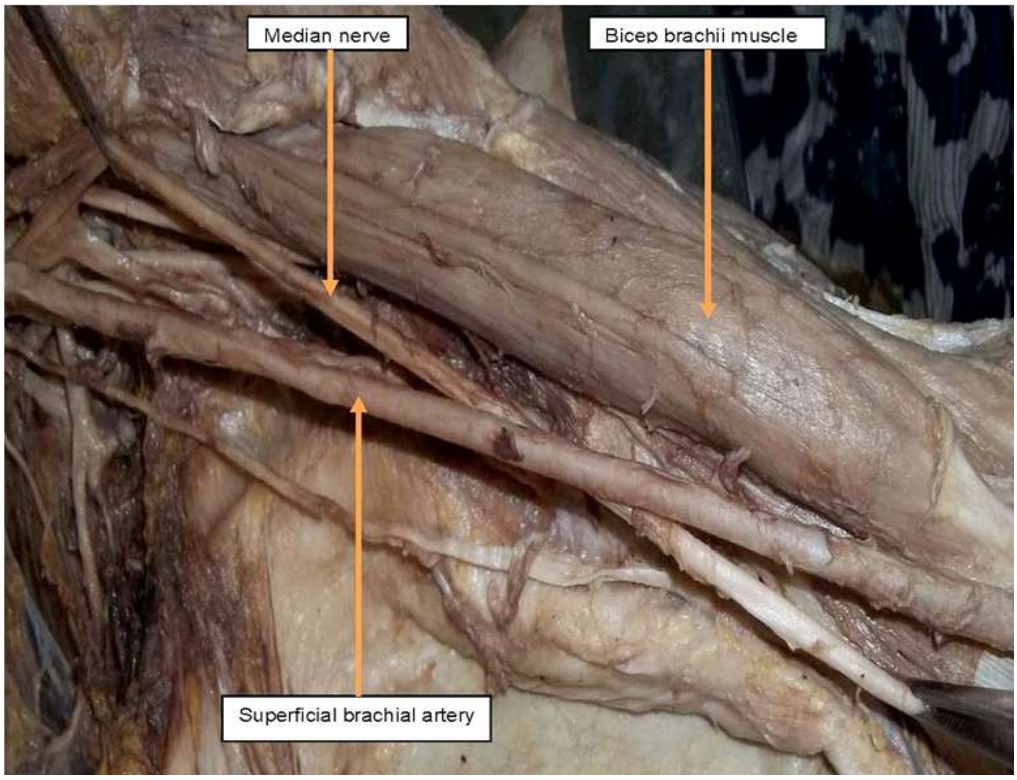


Fig. 2: Photograph showing the superficial brachial artery passing superficial to the median nerve in left arm

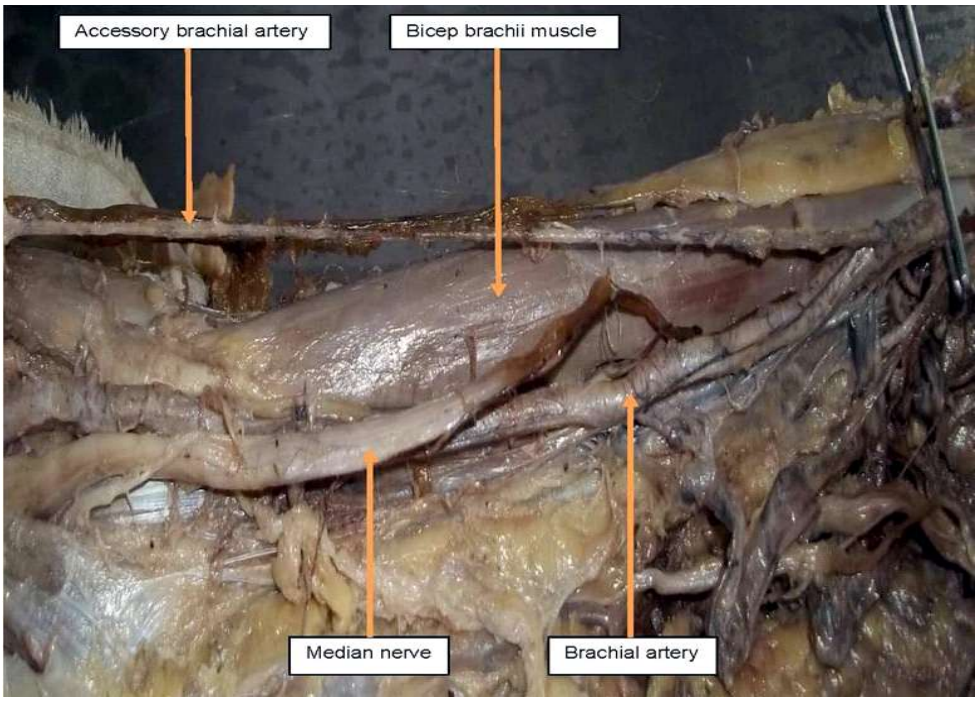


Fig. 3: Photograph showing the accessory brachial artery arising from the brachial artery in right arm. Main brachial artery divides into the ulnar and radial artery while the accessory brachial artery lies superficial to median nerve and gets terminated just below the elbow by giving small branches to forearm muscles

Discussion

For a number of reasons, anomalies of the forelimb arterial tree are fairly common. These arteries have multiple and plexiform sources; display a temporal succession of the emergence of principal arteries, anastomoses and periarticular networks; and some paths that are initially functionally dominant,

subsequently regress. In general, anomalous patterns may present as differences in the mode and proximodistal level of branching; the presence of unusual compound arterial segments; aberrant vessels that connect with other principal vessels, arcades or plexuses; vessels that occupy exceptional tissue planes or which have unexpected neural, mycological or osteoligamentous relationships[8,9].

Patnaik, Kalsey, Singla[4] (2002) conducted the study on 50 upper limbs of 25 cadavers. The brachial artery was a continuation of axillary artery at lower border of teres major in most cases (98%). But in one case (2%) axillary artery in its third part lies 3 cm proximal to lower border of teres major bifurcated into superficial and deep branches which in the forearm continued as radial and ulnar arteries respectively. Bidarkotimath, Avadhani, Kumar[10] (2011) observed in all 50 cadavers, the brachial artery as a continuation of axillary artery at the lower border of teres major muscle. In present study, all 35 cadavers have the brachial artery as a continuation of the axillary artery.

Luzsa[2] (1974) quoted that the length of the brachial artery vary with the site of division and measures 15 to 30 cm. Patnaik, Kalsey, Singla[4] (2002) in their observation found that total length of the brachial artery being on an average 26.29 cm (ranging from 20.5 to 29.0 cm). Bidarkotimath, Avadhani, Kumar[10] (2011) measured the length of the brachial artery in male right and left upper limb was 23 ± 8.64 cm and in female right and left upper limb was 22.65 ± 0.77 cm. In present study, the length of brachial artery is found to be 24.91±4.13cm on right side and 25.27±3.79cm on left side and smaller length of the artery is also found in the cases of higher termination of the brachial artery.

Luzsa[2] (1974) quoted that the diameter of the brachial artery lies between 0.5-0.6cm. In present study, diameter is taken at origin and above termination. At origin diameter is 0.54±0.06cm on right side and 0.52±0.05cm on left side. Above termination diameter is 0.50±0.06cm on right side and 0.49±0.06cm on left side.

Patnaik, Kalsey, Singla[4] (2002) observed that mean distance of termination of the brachial artery below intercondylar line is 2.99 cm (ranging from 1.0 to 4.5 cm) in most cases (98%). In one case they found abnormal origin of the brachial artery. In that case axillary artery in its third part lies 3 cm proximal to lower border of teres major bifurcated into superficial and deep branches which in the forearm continued as radial and ulnar arteries respectively. Pulei A, Obimbo M, Ongeti K et al[11] (2012) performed cadaveric dissection in 162 upper limbs. They found that the brachial artery terminated at the radial neck in 79%, radial tuberosity in 8.6%, proximal arm in 11.1% and mid arm in 1.2% cases. Pattern of termination was either a bifurcation into the radial and ulnar arteries in 90.1% or trifurcation into radial, ulnar and common interosseous arteries in 9.3% cases. They also reported a case of trifurcation of the brachial artery into the profunda brachii, radial and ulnar arteries in 0.6% cases. In present study, termination of the brachial artery below the inter-condylar line is seen in 94.28% cases on right side and 97.14% cases on left side with mean distance of 1.18cm (Range 1-1.4cms) on right side and 1.17cm (Range 1-1.4cms) on left side. Brachial artery termination above the inter-condylar line is seen in 5.71% cases on right side and in 2.85% cases on left side and these cases were that of the higher termination of the brachial artery.

Rodriguez-Baeza A, Nebot J, Ferreria B et al[12] (1995) performed total 150 routine dissections of the upper limb from adult cadavers and 10 from full-term fetuses. In 4 cases (2.5%), two brachial arteries were present, one superficial and another deep to the median nerve. In 2 of those cases the superficial brachial artery ended in an anastomosis at the cubital fossa, whereas in the other 2 cases it continued to the antebrachial region. Rodriguez-Niedenfuhr M, Vazquez T, Nearn L et al[13] (2001) examined total of 192 embalmed cadavers (384 upper limbs) 91 males and 101 females. Superficial brachial artery was seen in 4.9% cases (11% male, 7.9% female). Accessory brachial artery was noted in 0.26% cases (1.1% male). Patnaik, Kalsey, Singla[4] (2002) noted double brachial artery i.e. superficial and deep in 2% cases. Superficial brachial artery was seen in 2% cases. Trifurcation of the brachial artery was also seen in 2% cases. Pulei A, Obimbo M, Ongeti K et al[11] (2012) performed cadaveric dissection in 162 upper limbs in the Department of Anatomy, University of Nairobi, Kenya. They noted superficial brachial artery in 6.1% cases. Higher division was seen in 1.2% cases (in it bifurcation of the brachial artery into radial and ulnar artery was seen in 90.1%, trifurcation into radial, ulnar, common interosseous artery in 9.3% and trifurcation into radial, ulnar, profunda brachii artery in 0.6% cases). Gujar SM, Oza SG, Shekhawat JP et al[14] (2014) has done the study on 30 cadavers in department of anatomy to find out any variations in division pattern of the brachial artery. Variations were found in two cadavers. An unusual short segment of the brachial artery which divide at middle of arm was found in right upper limb of one cadaver. There was a high origin of the radial artery from axillary artery found in right upper limb of one cadaver. Study was done by Ashwini C, Kuberappa V[15] (2014) on

50 cadaveric specimens out of which 49 showed the normal bracial artery configuration. In one cadaver the course of the brachial artery was anomalous. It showed an unusual tortuous course with loops and bends. Tortuous peripheral arteries are usually asymptomatic. An abnormal superficial tortuous brachial artery and its branches may be mistaken for basilic vein during cannulation. Brachial artery aneurysms are rare but potentially limb threatening conditions are also noted by some authors.[16]

In present study, we noted the superficial brachial artery in 8.57% cases on right side and 5.71% cases on left side. Higher termination by bifurcating into radial and ulnar artery is seen in 5.7% cases on right side and 2.85% cases on left side. Accessory brachial artery is seen in 2.85% cases only on right side.

Conclusion

Anatomical knowledge of the brachial artery and variations in them is important because these arteries are most commonly used for procedures like microsurgeries, coronary artery grafting and performing the transarterial coronary procedures. Lack of awareness about variations in the arteries can mislead the surgeon, radiologist, physician while performing various surgeries, radiological procedures and making diagnosis which can affect the proper treatment or can produce the spot emergencies.

References

1. Sinnatamby CS. Vessels and nerves of the arm. In: Last's Anatomy, Regional and Applied. 11th edition. Churchill Livingstone; 2006: 61.
2. Luzsa G. X-ray Anatomy of the vascular system. Butterworths & Co. (Publishers) Ltd.; Blood vessels of the upper extremities. 1974; 200-207.
3. Hollinshead WH. Anatomy for Surgeons: Volume 3. The Back and Limbs. 3rd edition. Philadelphia: Harper and Row Publishers; Chapter 5, Arm, Elbow and Forearm. 1982; 359-364.
4. Patnaik VVG, Kalsey G, Singla RK. Branching pattern of Brachial artery- A Morphological study. Journal of Anatomical Socity of India. 2002; 51(2): 176-86.
5. Ramanathan L, Nayak SR, Vinay KV, Krishnamurthy A, Prabhu LV. Co-existence of superficial brachio-ulno-radial arterial pattern and persistent median artery. Indian Journal of Plastic Surgery. 2009; 42(1): 112-14.
6. Bianchini E, Faita F, Gemignani V, Giannoni M, Demi M. The assessment of Flow–Mediated Dilation (FMD) of the brachial artery. Computers in Cardiology. 2006; 33: 509-12.
7. Romanes GJ. The arm. In: Cunningham's manual of practical anatomy; Volume 1, Upper and Lower limbs. 15th edition. Oxford University Press; 2003: 67-68, 74-77.
8. Standring S (editor-in-chief) et al. Vascular supply and lymphatic drainage. In: Gray's Anatomy. The Anatomical Basis of Clinical Practice. 40th edition. Churchill Livingstone Elsevier; 2008: 827-828, 852-853.
9. Moore KL, Persaud TVN. Blood supply of limbs. The Developing Human, Clinically oriented Embryology. 7th edition. Elsevier; Chapter 17, The Limbs. 2005; 412-414.
10. Bidarkotimath S, Avadhani R, Kumar A. Primary pattern of arteries of upper limb with relevance of their variations. International Journal of Morphology. 2011; 29(4): 1422-28.
11. Pulei A, Obimbo M, Ongeti K, Kitunguu P, Inyimili M, Ogengo J. Surgical significance of brachial arteriel variants in a Kenyan population. Annals of African Surgery. 2012; 9.
12. Rodriguez-Baeza A, Nebot J, Ferreria B, Reina F, Perez J, Sanudo JR, Roig M. An anatomical study and ontogenetic explanation of 23 cases with variations in the main pattern of the human brachio-antebrachial arteries. Journal of Anatomy. 1995; 187: 473-79.
13. Rodriguez-Niedenfuhr M, Vazquez T, Nearn L, Ferreira B, Parkin I, Sanudo JR. Variations of the arterial pattern in the upper limb revisited: A morphplogical and statistical study, with a review of the literature. Journal of Anatomy. 2001; 199: 547-66.
14. Gujar SM, Oza SG, Shekhawat JP, Vikani SK, Prajapati SB. A study on division of brachial Artery and its clinical correlations. Int J Anat Res 2014; 2(1): 208-12.
15. Ashwini C, Kuberappa V. An unusual tortuous brachial artery and its branches: histological basis and its clinical perspective. Int. J. LifeSc. Bt & Pharm. Res. 2014; 3(2): 121-4.
16. Heydari F, Taheri M, Esmailian M. Brachial artery aneurysm as a limb threatening condition; a case report. Emergency. 2015; 3(2): 75-7.

Original Article

Indian Journal of Anatomy
Volume 4 Number 3, September - December 2015

Relationship between Real Time Ultrasonographic Measurement of Placental Thickness and Biparietal Diameter for Estimation of Gestational Age of Fetus

Natwar Lal Agrawal

Abstract

Aim: This study aimed to establish a relationship between placental thickness and biparietal diameter by real time ultrasound for estimation of gestational age of fetus. *Materials and Methods:* This study consists of 100 pregnant females, between 13th to 39th weeks gestation with their age ranging from 18 -35 years, attending antenatal clinic at the department of Obstetrics and gynecology, Pt..J.N.M. Medical College and Dr. B.R. Ambedkar Memorial Hospital Raipur (C.G.) from October 2008 to august 2009. Who were sure for the last menstrual period and fulfilling all criteria for selection of cases.USG was done for estimating fetal age by biparietal diameter (BPD), and placental thickness (PT). BPD was measured from the outer surface of skull table of one side to the inner margin of skull table on opposite side. PT was measured perpendicular to the basal and chorionic plates, in the mid portion of the placenta at the level of insertion of umbilical cord. *Results:* It was observed that the coefficient of correlation (r) between PT and BPD being at 26-30 weeks r = .988 (p = .002), and at 31-35 weeks r = .963 (p = .009) which is statistically significant but at more than >35 weeks it become non significant. *Conclusion:* The study concluded a fairly linear relationship between PT and BPD and it provide accurate parameter for estimating fetal gestational age especially in the late mid trimester and early third trimester, where the exact duration of pregnancy is not known.

Keywords: Biparietal Diameter; Placental Thickness; Fetal Growth; Gestational Age.

Introduction

The Assessment of fetal growth, well being and gestational age in different trimesters can be assessed most reliably by ultrasonographic measurement of various fetal biometric parameters, assessment are typically more accurate when multiple parameters are used[1]. The obstetric ultrasound provides us a single most useful tool of information is the accurate determination of gestational age[2]. Gestational age of the fetus is a measurement of time in utero (Inside of the uterus) is approximately 280 days. Which is the time measured from the first day of the women's last menstrual cycle to the current date and is measured in weeks. So the dating of pregnancy starts before the fertilization. For estimation of gestational age and to evaluate the fetal development the placental thickness (PT) and biparietal diameter (BPD) are used as an important fetal biometric parameter in 2nd and 3rd trimester. According to Ohagwu C.C.et al (2008) [3] – "placental thickness should have a certain relationship with fetal growth parameters especially BPD and AC"

Placenta is primarily a fetal organ and its size is a reflexion of the health and size of the fetus. Placental thickness becomes a important parameter for estimation of gestational age of fetus and it can be measured at the level of the insertion of umbilical card[4]. Theera Tongsong et al [5]established normal values of placental thickness during the first half of pregnancy and they found a linear relationship between placental thickness and gestational age. The another fetal biometric parameter which is most frequently and accurately used for assessment of gestational age of fetus during 2nd trimester from 13weeks onward is biparietal diameter (BPD)[6]. The BPD is a more reliable method of predicting date of spontaneous delivery with greater certainty then even certain last menstrual period[7] . The BPD is measured

Author's Affiliation: Assistant Professor, Department of Anatomy, N.S.C.B. Medical College Jabalpur (M.P.) 482003.

Corresponding Author: Natwar Lal Agrawal, Assistant Professor, Department of Anatomy, N.S.C.B. Medical College Jabalpur (M.P.) 482003.
E-mail: drnatwaragrawal@gmail.com

from outer surface of skull table of one side to the inner margin of skull table on opposite side (outré to inner)[8] . Several other studies have reported the use of placental thickness and biparietal diameter as a promising parameter for estimation of gestational age of fetus in normal singleton pregnancy using real time ultrasonographic assessment [9,10,11].

Materials and Method

This study was performed in Department of Anatomy in close association with the Department of Radiodiagnosis, tertiary care hospital of state medical college. This study consists of 100 pregnant females, between 15 weeks to 39 weeks gestation with their age ranging from 18 -35 years.

Criteria for Selection of Cases

1. A history of regular menses. The last menstrual period of the patient should be well known.
2. Pregnancy complicated by medical disorders such as anemia, diabetes mellitus in mother and any congenital disorders in fetus were excluded from the study.
3. Pregnancy was single and viable. Absence of multiple gestations (e.g. twins) in the current pregnancy.

Ultrasonographic assessment was performed using a gray scale real time machine (LOGIQ 400) employing a 3.5 MHz convex transducer for real time ultrasonographic scanning of fetal biparietal diameter and placental thickness.

The area between the pubic symphysis and umbilicus was exposed. The ultrasonic jelly was applied uniformly to the skin and transducer's head. The anatomical plane chosen for measurement of various fetal parameters was obtained by placing the transducer over abdomen in the middle sagital section. The fetal head was then looked for the lie of the fetus then placing the transducer over parasaggital plane to define other fetal parts. The placenta was located and placental thickness was measured perpendicular to the basal and chorionic plates, in the mid portion of the placenta at the level of insertion of umbilical cord. The biparietal diameter was measured in the scan which shows the widest diameter at the level showing a midline falx echo, two lateral ventricles, and the thalami. The reference point for fetal biparietal diameter was the outer margin of the proximal skull interface to the inner margin of the distal skull interface. To interpret the data was analyzed statistically.

Results

A prospective study of 100 antenatal singleton pregnancies of >15 weeks of gestation was conducted. The patients were observed for the correlation between placental thickness and biparietal diameter with gestational age.

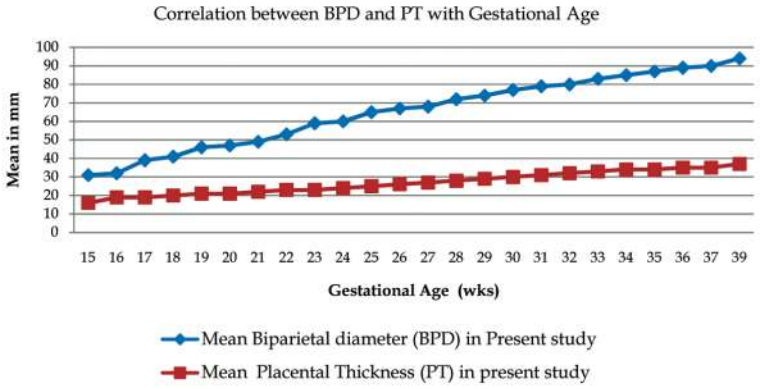
It was observed that the coefficient of correlation (r) between placental thickness and biparietal diameter being r = .878 (p =.022) at 15 – 20 weeks, r = .932(p = .021) at 21 – 25 weeks, r = .988 (p = .002) at 26 – 30 weeks, r = .963 (p = .009) at 31 – 35 weeks and r = .982 (p = .121) at 36 weeks and onwards [Table -1].

In our study shows linear growth pattern between placental thickness and biparietal diameter in late 2nd and early 3rd trimester.[Graph -1].

Table 1: Correlation between BPD and PT with Gestational age (in weeks)

S.No.	Gestational Age in Weeks	MeanBiparietal diameter (BPD)	Mean Placental Thick ness(PT)	r value	P value
1	15	31	16	.878	.022
2	16	32	19		
3	17	39	19		
4	18	41	20		
5	19	46	21		
6	20	47	21		
7	21	49	22	.932	.021
8	22	53	23		
9	23	59	23		
10	24	60	24		
11	25	65	25		
12	26	67	26	.988	.002
13	27	68	27		
14	28	72	28		
15	29	74	29		
16	30	77	30		
17	31	79	31	.963	.009

18	32	80	32		
19	33	83	33		
20	34	85	34		
21	35	87	34		
22	36	89	35	.982	.121
23	37	90	35		
24	39	94	37		
	Mean	65.29	25.96	r=0.986;P<0.0001	
	SD	19.34	6.62	(n = 24)	



Graph 1: Lines diagram shows correlation between BPD and PT with Gestational age (in weeks)

Discussion

In our study we adopted a cross sectional design and did not follow the patients longitudinally. The placental thickness [PT] and biparietal diameter [BPD] was measured ultrasonographically and it was seen that PT and BPD increases linearly with advancing gestational age. Early reports of BPD by USG examination were published by Callen p (1991) demonstrated that BPD value to be an accurate predictor of menstrual age before 20th week of gestation. The placenta is a materno - fetal organ and is responsible for protection and nourishment of fetus[12].

This study was in accordance with several other studies in this regards. The study carried out by Ohagwu C.C. et al [3] found that there was critical positive correlation between fetal growth parameters especially BPD, AC, and PT with gestational age. Baghel P et al [11] observed that there is increase in PT and other fetal parameters almost linearly with gestational age.

The relationship between Placental thickness and biparietal diameter is very much significant for assessment of gestational age in mid 2nd and early 3rd trimester and can be used as a reliable parameter for the assessment of gestational age where the exact duration of pregnancy is not known.

Conclusion

The study concluded a fairly linear relationship between placental thickness and biparietal diameter with gestational age. It provide us accurate parameter for estimating fetal gestational age especially in late mid trimester (21st to 25th week) and early 3rd trimester (26th to 30th week)of gestation where the exact duration of pregnancy is not known.

References

1. Babuta S, Chauhan S. et al: Assessment of fetal gestational age in different trimesters from ultrasonographic measurements of various fetal biometric parameters. J. Anat. Society of india.2013 ; (62): 40-46.
2. Hadlock FP, Deter RL, Harrist RB, and Park SK: "Estimating fetal age: computer assisted analysis of multiple fetal growth parameters". Radiology.1984; 152: 497-501.
3. Ohagwu C.C., Abu P.O.,Ezeokeke U.O.and Ugwu A.C: " Relationship between placental thickness and growth parameters in normal Nigerian foetuses . World Applied Sciences Journal. 2008; 4(6): 864-868.
4. Kliman HJ: The placenta revealed. Am.J. Pathol. 1993; 143(2): 332-336.
5. Tongsong T, Boonyanurak P: Placental thickness in the first half of pregnancy. *J Clin Ultrasound*. 2004; 32(5): 231- 234.
6. Warsof SL, Campbell S, Little D, Cooper DJ: A critical assessment of ultrasound fetal cephalometry. 1983; 8: 189-193.
7. Kurtz Alfred B, Wapner RJ, Kartz RJ et al: Analysis

of biparietal diameter as an accurate indicator of gestational age. Journal of clinical ultrasound.1980; 8: 319-326.

8. Mukerjee B, and Mitra S.C: J. Anat. Society of India. 1985; 34(1).
9. Mital P, Hooja N, Mehndiratta K: Placental thickness: a sonographic parameter for estimating gestational age of the foetus. Indian J Radiol Imaging. 2002; 12: 553-4.
10. Jain A, Kumar G, Agarwal U, et al: Placental thickness – a sonographic indicator of gestational age. *J of Obst and Gyne of India*. 2001; 51(3): 48-9.
11. Baghel P, Bahel V,Paramhans R et al: Correlation of placental thickness estimated by ultrasonography with gestational age and fetal outcome. Indian Journal of Neonatal Medicine and Reaserch. 2015; 3(3): 19-24.
12. T Karthikeyan, Ramesh Kumar Subramaniam, WMS Johnson et al. Placental thickness and its correlation to gestational age and foetal growth parameters – a cross sectional ultrasonographic study; J clin Diagn Res. 2012; 6(10): 1732-1735.

Original Article

Indian Journal of Anatomy
Volume 4 Number 3, September - December 2015

A Cadaveric Study of Anatomical Variations in the Thyroid Gland

Deepa G.*, Shrikrishna B.H.**

Abstract

The thyroid gland is the first endocrine gland to develop in the embryo. Developmental anomalies of thyroid gland are quiet commonly seen. Most of the variations are due to the partial persistence of the median or thyroglossal duct. Persistence of pyramidal lobe, thyroglossal cysts, agenesis of the thyroid gland and aberrant thyroid are the major developmental anomalies of the thyroid gland. We conducted a study in about 40 formalin fixed cadavers to look for any morphological variations of thyroid gland including pyramidal lobe and levator glandular thyroidae. All the anomalies detected were documented and compared with previous studies. The complete knowledge about thyroid anatomy, its variation and its associated anomalies is very important for surgeons for surgical interventions. It is also important for physicians and radiologists so that these variations are not overlooked in the differential diagnosis.

Keywords: Thyroid Gland; Anatomy; Anomalies; Agenesis; Thyroid Cartilage; Surgeons.

Introduction

The thyroid gland, brownish-red and highly vascular, thoracic vertebral is placed anteriorly in the lower neck, level with the fifth cervical to first, thoracic vertebrae. Ensheathed by the pretracheal layer of deep cervical fascia, it has right and left lobes connected by a narrow, median isthmus [1].

The thyroid gland is the first endocrine gland to develop in the embryo. It begins to form approximately 24 days after fertilization [2] and appears as an epithelial proliferation in the flour of the pharynx between the tuberculum impar and the copula at appoint later indicated by the foramen cecum. Subsequently, the thyroid descends in front of pharyngeal gut as a bilobed diverticulum. During this migration, the thyroid remains connected to the tongue by a narrow canal, the thyroglossal duct which later disappears [3].

A conical pyramidal lobe often ascends towards the hyoid bone from the isthmus or the adjacent part of either lobe (more often the left). It is occasionally detached or in two or more parts. A fibrous or fibromuscular band, the levator of thyroid gland (musculus levator glandulae thyroideae) sometimes descends from the hyoid body to the isthmus or pyramidal lobe [1]. It is seen in approximately 50% of people [2]. The pyramidal lobe may be the source of recurrent disease when it is not removed during indicated total thyroidectomy. The identification and removal of the pyramidal lobe are also of great importance for successful postoperative radioactive iodine treatment in patients with differentiated thyroid carcinoma [4].

Small detached masses of thyroid tissue may occur above the lobes or isthmus as accessory thyroid glands [1]. The anomalies of thyroid gland distort the morphology of the gland and may cause functional disorders and various thyroid illnesses.

Materials and Methods

A detailed cadaveric dissection of anterior midline neck region was carried out in about 40 formalin fixed cadavers which were provided for medical students in Department of Anatomy, Navodaya Medical College, Raichur over the period of 4 years. The thyroid gland was looked for any morphological variation including pyramidal lobe and levator glandular thyroidae.

Author's Affiliation: *Assistant Professor, Department of Anatomy, Navodaya Medical College, Raichur Karnataka-584103. ** Professor, Department of ENT, Navodaya Medical College, Raichur Karnataka- 584103.

Corresponding Author: Deepa G., Assistant Professor, Department of Anatomy, Navodaya Medical College, Raichur Karnataka-584103.

E-mail: drdeepagadwal@gmail.com

Results and Observations

The following anatomical variations were observed (Table I):

1. Agenesis of isthmus was observed in one specimen which also showed pyramidal lobe arising from right lobe (Fig. 1).
2. 6 specimens showed partial agenesis of thyroid isthmus (Fig. 2 and Fig. 3).
3. Pyramidal lobe was observed in 7 specimens out of which 4 were seen to be arising from left lobe. One specimen showed pyramidal lobe on right side associated with agenesis of isthmus (Fig.1). Pyramidal lobe was attached to isthmus in two of the specimens (Fig. 4).
4. Levator glandular thyroidae was present in 3 cases out of which two extended from left lobe to cricoid cartilage (Fig. 5) and third from right pyramidal lobe to thyroid cartilage.

Table 1: Showing incidence of thyroid gland variations in the present study

Sl. No	Anomaly	Incidence (Total= 40 Cadavers)	Percentage
1	Agenesis of Isthmus	1	2.5%
2	Partial Agenesis of Isthmus	6	15%
3	Pyramidal Lobe	7	17.5%
4	Levator Glandular Thyroidae	3	7.5%

Fig. 1: Agenesis of isthmus in a specimen which also showed pyramidal lobe arising from right lobe of thyroid gland

Fig. 2: Partial agenesis of thyroid isthmus in a specimen

Fig. 3: Another specimen with Partial agenesis of thyroid isthmus

Fig. 4: Specimen showing pyramidal lobe attachment to isthmus

Fig. 5: Specimen showing levator glandular thyroidae extending from left lobe of thyroid to cricoid cartilage

Discussion

Developmental anomalies of thyroid gland are quiet commonly seen. Most of the variations are due to the partial persistence of the median or thyroglossal duct [5]. Persistence of pyramidal lobe, thyroglossal cysts, agenesis of the thyroid gland and aberrant thyroid are the major developmental anomalies of the thyroid gland [6,7].

Bland Sutton describes the prossesus pyramidalis as part of the original thyroglossal duct, or median thyroid rudiment of His [8]. Pyramidal lobe was seen in 25% cases in the present study. Marshall reported the presence of pyramidal lobe in 43% of the cases [9]. Blumberg stated that 60.65% cases had the pyramidal lobe and in most cases it location was at left side of the gland (left: right = 3:1) [10]. Enayetullah found pyramidal lobe and levator glandulae thyroidae in 50% and 32% of cases respectively [11]. Begum (2004) found pyramidal lobe in 26.7% and most was from the left side [12]. Harjeet et al. observed it in 28.9% of specimens [13]. Study by S.D Joshi et al. described the pyramidal lobe in 37.7% cases and it was also observed the maximum number of pyramidal lobes was attached to left lobe(47.05%) [14]. Levy et al. found that pyramidal lobe was arising from the left lobe in 63% of cases. They described the presence of pyramidal lobe by radioiodine thyroid scan in 17% of normal cases and 43% of pyramidal lobe in patients with diffuse toxic goitre [15]. Using thyroid scintigraphy, Siraj et al. visualized pyramidal lobe in 41% of patients, and they found a greater incidence among females [16]. A much better method for detecting the pyramidal lobe in the living subjects is computed tomography (CT) of the neck. According to Geraci G et al. the pyramidal lobe was identified in only 50% of cases during preoperative diagnostic treatments using either ultrasonography or Tc-99m pertechnetate scintigraphy [17].

Eisler made an extensive study on the levator glandulae thyroidae and its innervations. He states that the levator of the thyroid gland may be innervated either by ansa cervicalis or through vagus [18]. Renade et al. reported levator glandulae thyroidae in 49.5% [19] and study conducted by Veena Kulkarni et al., found levator glandulae thyroidae in 30% cases [20]. In the present study, it was seen in 7.5% cases which was similar to study done by Marshall who reported levator glandulae thyroidae in 10% cases [9]. According to Gregory and Guse, Soemmerring's levator glandulae thyroidae is an accessory muscle which runs from the hyoid bone to insert partly on the thyroid cartilage and partly on the isthmus of the thyroid gland[21]. Bourgery described and illustrated a muscle which he called as "hypothyroidien", which occupied the place of the pyramidal lobe [22]. Finally, Godart reported a case in which the structure was indeed muscular, on the basis of nitric acid test for the muscle [23]. Soemmering's muscle is same as the hyo-thyro-glandulaire of Pointe, the levator glandulae thyroidae superficialis medius et longus of Krause and the musculus thyroideus of Merkel, its usual full name in the literature being 'levator glandulae thyroidae of soemmerring' [24].

Failure in the development of thyroid gland lead to various anomalies. Absence of the thyroid gland, or one of its lobes, is a rare anomaly. In thyroid hemi agenesis, the left lobe is more commonly absent. Mutations in the receptor for thyroid-stimulating hormone is probably involved in some cases[2]. In the present study, agenesis of isthmus was observed in one case which was associated with pyramidal lobe on right lobe and its incidence was 2.5%. Marshall described absent isthmus in 10% cases [9]. Oya observed its absence in 4% of cases[25]. Gruber reported an absence of the isthmus in 5% of the cases [14]. Anson reported absence of isthmus in 6-8% of cases [26]. Deflice M et al. and Dumont JE et al. have reported that genetically developmental agenesis results from mutations in one of these developmental genes (TITF1, PAX8, FOXEI/TITF2), especially TITF2 because, these genes are more essential for normal development of palate and thyroid gland [27,28]. High separation of thyroglossal duct can provoke two independent lateral lobes with or without pyramidal lobes with absence of isthmus. Kumar et al. has reported that due to its rare nature isthmus agenesis should be kept in mind for safe surgery to avoid complications during neck operations [29]. Clinically,

the diagnosis of agenesis of isthmus can be done with scintigraphy. It can also be diagnosed with the aid of USG, CT, MRI or during a surgical procedure. When the image of absent isthmus is observed, a differential diagnosis against autonomous thyroid nodule, thyroiditis, primary carcinoma, neoplastic metastasis and infiltrative diseases like Amyloidosis should be considered [30].

Conclusion

The complete knowledge about thyroid anatomy and its variation is very important for surgeons for surgical interventions. Understanding of anatomical variations and its associated anomalies is also important for physicians and radiologists so that these variations are not overlooked in the differential diagnosis.

References

1. Mary Dyson. Endocrine System. *In* Gray's Anatomy, 38th ed. Churchill Livingstone, London, 2000: 1891-92.
2. Keith L Moore. The developing Human. Clinically oriented embryology. 8th ed. Saunders, New Delhi, 2008: 173.
3. Sadler TW. Head and Neck. *In* Langman's Medical Embryology, 11th ed. Wolters Kluwer, New Delhi, 2010: 278.
4. Kafeel Hussain et al. Morphological Variations of the Thyroid Gland. Journal of Dental and Medical Sciences. Mar. 2015; 14(3): 18-24.
5. Melnick JC, Stemkowski PE. Thyroid hemi-agenesis (hockey stick sign): a review of the world literature and a report of four cases. J Clin Endocrinol Metab 1981; 52: 247-51.
6. Moore KL, Dalley AF. Clinically Oriented Anatomy. 5th ed. Philadelphia: Lippincott Williams and Wilkins, 2006: 1083-5.
7. RomanesGJ. Cunningham's Textbook of Anatomy. 12th ed. Oxford: Oxford University Press, 1981: 57-9, 286, 596-7.
8. Bland Sutton. Dermoids, pp. 79-83.
9. Marshall CF. Variations in the form of the thyroid gland in man. J Anat. 1895; 29: 234–339.
10. Blumberg NA. Observations on the pyramidal lobe of the thyroid gland. S Afr Med J. 1981 June; 59(26): 949-50.
11. Enayetullah M. Gross and histomorphological study of the thyroid and parathyroid glands in Bangladeshi people (M.Phil.Thesis). Dhaka:University of Dhaka; 1996.
12. Begum M. Gross and histomorphological study of human post-mortem thyroid gland in Bangladeshi people (M.Phil.Thesis). Dhaka:University of Dhaka; 2004.
13. Harjeet A, Sahni D, Indar J, Aggarwal AK . Shape, measurement and weight of the thyroid gland in northwest Indians. Surg Radiol Anat. 2004; 26: 91–95.
14. S.D. Joshi et al., The thyroid gland and its variations. Folia Morphol. 2010; 69(1): 47–50.
15. Levy HA, Sziklas JJ, Rosenberg RJ, Spencer RP. Incidence of a pyramidal lobe on thyroid scans. Clin Nucl Med. 1982; 7: 506–501.
16. Siraj QH, Aleem N, Inam Ur-rahman A, Qaisar S, Ahmed M. The pyramidal lobe: a scintigraphic assessment. Nucl Med Commun. 1989; 10: 685–693.
17. Geraci G, Pisello F, Li Volsi F, Modica G, Sciumè C, The importance of pyramidal lobe in thyroid surgery, G Chir, 2008; 29(11–12): 479–482.
18. Eisler P, Der M. Levator glandulae thyreoidea und verwandte praelaryngeale Muskelbildungen. *Aant Anz.* 1922; 17: 183-96.
19. Ranade A V et al. Anatomical variations of the thyroid gland: possible surgical implications. Singapore Med J. 2008; 49(10): 831.
20. Veena Kulkarni et al. Morphological variations of the thyroid gland. Medica Innovatica. Dec 2012; 1(2): 35-38.
21. Gregory JK, Guse DM. Unique variant of levator glandulae thyroideae muscle. Clin Anat 2007; 20: 966-7.
22. Bourgery JM. Traite complet d'anatomie de l'homme, comprenant la medicine operatoire, avec planches lithographiees d'apres nature par NH Jacob. Atlas. Paris. C. [-A.] Delaunay 1831; Tome II: 90, 1836; Tome IV: 91. French.
23. Godart J. Muscle de la glande thyroide, muscle de Duvernoi, musculus levator glandulae thyreoideae. (Exemple du Soemmerring.) [Abstr.] Bull Soc Anat Paris 1847; 22: 202-5. French.
24. Krause W. Handbuch der menschlichen Anatomie. Durchaus nach eigenen Untersuchungen, und mit besonderer Rücksicht auf das Bedürfnis der Studirenden, der praktischen Ärzte und Wundärzte und der Gerichtsärzte. 3. ed. Bd 2. Hannover: Hahn'sche Buchhandlung, 1879: 427. German.
25. Oya SA. Gross anatomical study on anomalies of the thyroid gland. Gazi Medical J. 1997; 8: 33–38.
26. Anson BJ. Morris Human Anatomy 12th edition. The Blackinston division Mc Graw Hill Boock Co - Newyork.1996: 168-169.
27. De Felice M, Di Lauro R .Thyroid development and its disorders: genetics and molecular mechanisms. Endocr Rev. 2004; 25: 722–746.
28. Dumont J E, Vassart G. Thyroid Dysgenesis: Multigenic or Epigeneti. Or Both? Endocrinol.2005; 146(12): 5035–5037.

29. Kumar G P, Satyanarayana N, Viswakarma N, Guha R, Dutta AK and Sunitha P. Agenesis of isthmus of thyroid gland, its embryological basis and clinical significance. A case report. Nepal Med coll J.2010; 12(4): 272-274.

30. Jamuna et.al. Agenesis of Isthmus of Thyroid Gland. Innovative Journal of Medical and Health Science. Nov–Dec 2013; 3(6): 266 - 267.

Revised Rates for 2016 (Institutional)

Title	Frequency	Rate (Rs): India	Rate ($):ROW
Dermatology International	2	5000	500
Gastroenterology International	2	5500	550
Indian Journal of Agriculture Business	2	5000	500
Indian Journal of Anatomy	3	8000	800
Indian Journal of Ancient Medicine and Yoga	4	7500	750
Indian Journal of Anesthesia and Analgesia	2	7000	700
Indian Journal of Anthropology	2	12000	1200
Indian Journal of Biology	2	4000	400
Indian Journal of Cancer Education and Research	2	8500	850
Indian Journal of Communicable Diseases	2	8000	800
Indian Journal of Dental Education	4	4500	450
Indian Journal of Forensic Medicine and Pathology	4	15500	1550
Indian Journal of Forensic Odontology	2	4500	450
Indian Journal of Genetics and Molecular Research	2	6500	650
Indian Journal of Law and Human Behavior	2	5500	550
Indian Journal of Library and Information Science	3	9000	900
Indian Journal of Maternal-Fetal & Neonatal Medicine	2	9000	900
Indian Journal of Medical & Health Sciences	2	6500	650
Indian Journal of Obstetrics and Gynecology	2	7000	700
Indian Journal of Pathology: Research and Practice	2	11500	1150
Indian Journal of Plant and Soil	2	5500	550
Indian Journal of Preventive Medicine	2	6500	650
International Journal of Food, Nutrition & Dietetics	2	5000	500
International Journal of History	2	6500	650
International Journal of Neurology and Neurosurgery	2	10000	1000
International Journal of Political Science	2	5500	550
International Journal of Practical Nursing	3	5000	500
International Physiology	2	7000	700
Journal of Animal Feed Science and Technology	2	4100	410
Journal of Cardiovascular Medicine and Surgery	2	9100	910
Journal of Forensic Chemistry and Toxicology	2	9000	900
Journal of Microbiology and Related Research	2	8000	800
Journal of Orthopaedic Education	2	5000	500
Journal of Pharmaceutical and Medicinal Chemistry	2	16000	1600
Journal of Practical Biochemistry and Biophysics	2	5500	550
Journal of Social Welfare and Management	4	7500	750
New Indian Journal of Surgery	2	7100	710
Ophthalmology and Allied Sciences	2	5500	550
Otolaryngology International	2	5000	500
Pediatric Education and Research	4	7000	700
Physiotherapy and Occupational Therapy Journal	4	8500	850
Urology, Nephrology and Andrology International	2	7000	700
SUPER SPECIALITY JOURNALS			
Indian Journal of Emergency Medicine	2	12000	1200
Indian Journal of Surgical Nursing	3	5000	500
Indian Journal of Trauma & Emergency Pediatrics	2	9000	900
International Journal of Pediatric Nursing	2	5000	500
Journal of Community and Public Health Nurisng	2	5000	500
Journal of Geriatric Nursing	2	5000	500
Journal of Medical Images and Case Reports	2	5000	500
Journal of Nurse Midwifery and Maternal Health	2	5000	500
Journal of Organ Transplantation	2	25900	2590
Journal of Psychiatric Nursing	3	5000	500
Psychiatry and Mental Health	2	7500	750
OPEN ACCESS JOURNALS			
Global Research in Engineering		5000	500
Global Research in Food and Nutrition		5000	500
Global Research in Library and Information Science		5000	500
Global Research in Medical Sciences		5000	500
Global Research in Space Science		5000	500

Terms of Supply:

1. Advance payment required by Demand Draft payable to Red Flower Publicaion Pvt. Ltd. payable at Delhi.
2. Cancellation not allowed except for duplicate payment.
3. Agents allowed 10% discount.
4. Claim must be made within six months from issue date.

Order from

Red Flower Publication Pvt. Ltd., 48/41-42, DSIDC, Pocket-II, Mayur Vihar Phase-I, Delhi - 110 091 (India), Tel: 91-11-22754205, 45796900, Fax: 91-11-22754205. E-mail: redflowerppl@vsnl.net, redflowerppl@gmail.com, Website: www.rfppl.co.in

Original Article

Indian Journal of Anatomy
Volume 4 Number 3, September - December 2015

Newer Technologies to Teach Basic Sciences

Sharadkumar Pralhad Sawant*, Anupama M. Chauhan, Shaheen Rizvi*****

Abstract

Anatomy is the base of medical science in India and is taught practically to all disciplines of undergraduate health sciences in the first year. It is an acknowledged fact that a basic knowledge of Anatomy is a prerequisite to learn any other branch of medicine. All medical professionals must have a basic knowledge of Anatomy so as to ensure safe medical practice. Traditionally, Anatomy teaching consists of didactic lectures as well as dissections or prosections as per the requirement of the course. Lecture is defined as an oral discourse on a given subject before an audience for purpose of instruction and leaning. In the traditional method lectures were taken via chalk and board, but nowadays power point presentations are increasingly being used. To make Anatomy learning both pleasant and motivating, new methods of teaching gross anatomy are being assessed as medical colleges endeavour to find time in their curricula for new content without fore-going fundamental anatomical knowledge. This paper examines the other teaching methodologies for teaching gross anatomy.

Keywords: Anatomy; Medical Science; Undergraduate Students; Medical Professionals; Medical Practice; Traditional Methods & New Methods of Teaching.

Introduction

It is an innate challenge teaching Anatomy. Firstly, Anatomy is a subject in which students have to learn many new concepts and complex terminologies making it difficult. As a result, they find it monotonous and painstaking and concentrate their efforts on "memorizing" the lists of new terminologies. Secondly, the recent changing face of medical education has lead to a reduction in the hours of teaching Anatomy. Thirdly, students are extremely diverse with respect to their grades, their scientific literacy levels, their abilities, their cultural backgrounds and professional fields. Hence it remains a challenge to find and assess methods to teach *all* students anatomy more effectively, in less time, and often with limited resources [1].

Author's Affiliation: *Professor and Head, ***Assistant Lecturer, Department of Anatomy, K. J. Somaiya Medical College, Somaiya Ayurvihar, Eastern Express Highway, Sion, Mumbai-400 022. **Assistant Professor, Dr. Panjabrao Deshmukh Memorial Medical College, Amravati, Maharashtra.

Corresponding Author: Sharadkumar Pralhad Sawant, 25/2, Samrat Ashok Nagar Society, Shell Colony Road, Chembur, Mumbai – 400 071, Maharashtra, India.
E-mail: drspsawant@gmail.com

The fundamental approach to teaching Anatomy is the use of human cadavers. Cadavers are indispensible to the study of human Anatomy. With increasing awareness of voluntary body donations, there is no dearth of cadavers and students in India get ample opportunities for dissection.

Anatomy as a subject not only requires surface learning or memorisation but also requires deep learning through understanding and the ability to apply the information to solve clinical problems.

For effective learning of Anatomy, students need to be engaged and sustained in significant learning activities through interaction with other students. Having interested and zealous teachers is also crucial to sustaining a students' interest [2].

Discussion

Didactic Lectures have been a universal form of teaching and learning since ancient times, especially for large group teaching, when the number of students attending is much larger than the number of teachers available. Lecture is defined as an oral discourse on a given subject before an audience for purpose of instruction and leaning. During a lecture, both the

visual and auditory senses are used to absorb information. In the usual course of teaching, the most frequently used method of taking didactic lectures is the chalk and board method, while the use of transparencies with an overhead projector (TOHP) is also popular. Nowadays, the use of PowerPoint (PPT) presentations is the most popular electronic presentation used. Some students prefer PPT presentations, mainly because they evade the issue of poor handwriting and dirty blackboards, but students develop into passive observers rather than active participants. Although use of PPT has some constructive effects, it reduces the interactive dialogue between teacher and students. On the other hand majority of students favour chalkboard teaching not only because of the improved student-teacher interaction but also lectures using chalkboard, contained natural breathers or breaks (eg, during writing or rubbing out the blackboard) allow students to follow the material and take down their notes. Hence, a chalkboard is said to be more student-centered while PPT is more teacher-centered [3]. This is also followed in all colleges as one of the traditional teaching method for anatomy. Anatomy teaching in medical schools has been traditionally based around the use of human cadaveric specimens, either taking the whole body specimens for complete dissection or as prosected specimens. Cadaveric dissection is central and indispensable to the study of human anatomy. The concrete foundation of medicine comes from a sufficient and very accurate knowledge of human anatomy and this can be achieved only from learning human dissection. Thus dissection training has remained an significant part of medical curriculum. In addition, cadaveric dissection allows students to not only grasp the three -dimensional anatomy and but also the concepts of biological variability. Through dissection, students are able to envision firsthand, the actual structures of the human body. The manual dexterity learnt in the dissection room are vital in almost every branch of medicine and thus dissection has remained a globally identifiable step in becoming a doctor [4]. Cadavers are embalmed with formaldehyde, a hazardous chemical, and carry the risk of accidental overexposure. Hence some medical schools in the West, began to explore alternative methods for teaching Anatomy. In some schools, dissection has been substituted by plastinated specimens. Plastination, a method invented by Gunther von Hagens, makes it possible for prosections or slices of cadavers to be conserved in a safe, strong, dry polymer medium that is odourless and inert. Plastinated specimens appear like a perfect choice, as the specimens allow students to see a high degree of anatomical specificity, even though they are dry, odourless, and non-toxic. Although the expenditure of acquiring the collection of plastinated specimens is significant, the specimens have a life span of twenty years or longer. There are no recurring costs such as those of cadaver acquisition and embalming associated with a dissection laboratory [5]. But dissection is considered to be a far superior tool to achieve anatomical knowledge. According to Professor Harold Ellis, of London: ''Dissection teaches the basic language of medicine and some manual dexterity. It introduces an understanding of three-dimensional anatomy and the concept of biological variation. It acclimatizes students to the reality of death and teaches respect for the body" [6].

Medical imaging technologies, such as Radiographs, CT, MRI and ultrasound disclose both normal and pathological anatomy. Teaching radiographic anatomy to pre-clinical medical students is essential, as it correlates anatomical studies to clinical medicine and simultaneously prepares them for the radiology they will come upon in their clinical years. The most extensively used medical imaging modality in anatomy teaching is radiographs. It is a vital part of all anatomy teaching programs. Plain radiographs allow students to study primarily skeletal anatomy. The study of soft tissue anatomy using radiographs rely on the use of contrast, in studies such as barium meal, barium enema, intravenous urogram, hysterosalpingogram, etc. Radiographs and Ultrasound are non-invasive methods of morphological study to supplement the teaching of gross human anatomy. They allow students to visualize 'living anatomy' through correlations with cadaveric dissection. Students can use radiographs and ultrasound to learn normal anatomy of the thorax, abdomen, pelvis, and extremities [7]. CT and MRI images initiate the study of sectional anatomy, and transform the three dimensional structures and relationships into two-dimensional representations and help the students to understand the concepts better. Students will have the opportunity to correlate these sectional images side by side with the dissected or prosected specimens. They facilitate a better understanding of the anatomy of the spine as well as the study of neuroanatomy. Integrating these medical imaging modalities in the study of anatomy is fitting, not only because they recommend ways of visualizing the anatomy of living subjects, but also because they are the very same diagnostic resources which the students will use in their clinical years and in their practice [8]. Students get encouraged when they see the application of what they are doing and are likely to retain the information, because they are learning it in context. Problem based

learning was developed on these grounds . A given 'problem' often a clinically related one, is given to the students and from this problem, students are left to explore different topics and learn the different facets of the problem. e.g. – An elderly lady falls and fractures her leg may be the problem. From this, the students will learn the anatomy of the lower limb, pathophysiology of bone healing, pharmacology of pain relief, the risks of immobilisataion in the elderly and the consequences of disability. This type of approach is being progressively adopted by many medical colleges. It also helps the pre-clinical students to improve their clinico- pathological skills early in the profession. At the end of the day, it is the problem-solving skills rather than memory based learning which are crucial for treating patients [9]. Evidence is available to show that knowledge retrieval is facilitated when knowledge is acquired in a situation resembling those in which it will be applied. By heading in the direction of integrated learning, anatomical details may be reduced but the ability to apply knowledge increases [10]. Students secure what they learn by looking at the surface anatomy relevant to the area on themselves, or on each other. Surface anatomy is the study done on the surface of the subject by inspection, palpation and manipulation, in relation to the anatomy under the skin. It brings forth students' interest in gross anatomy, showing them what they learned from books, lectures, and dissection are actually present in living persons. Although the facts are apparent and should need no convincing, the students still show astonishment and elation, when they first 'discover' what lies under the skin. This informs us that surface anatomy is an invaluable method of instruction. Living Anatomy forms the obvious connection between basic gross anatomy and clinical practice, because it is the basis of physical examination [11].

Inspite of all the above methods, a number of students still find Anatomy difficult to comprehend. For such students various methods can be employed to facilitate their learning:

1. For students who are mainly visual learners or artists – Such students are encouraged to draw anatomical drawings or what they visualise during dissection, on a board or on paper. This is a valuable learning tool for them and allows them to recapitulate and combine concepts and facts to make them easier to learn. These visual cues also assist with long-term retention of information [12].
2. For students who are mainly tactile learners – Such students are given models to study or they themselves are encouraged to prepare models using moulding clay. This approach is enjoyable and reinforces learning, while developing a real 3-D image of structures and their relationships.
3. For students who prefer learning by 'doing' – Such students can be taught Anatomy by performing body movements with weights or by performing movements of the various joints of the body. This 'doing' assists in long term retention of information for many students [13].

Recommendations

Anatomists should include recommended teaching strategies in their teaching methodologies. They should apply evidence based practice, in their choice of teaching strategies, for subject content. The use of peer and student evaluation of teaching strategies should be increased, as a means to improving the use of learner centered teaching strategies as well as to identify best practices. Educators should assess and understand their own teaching styles, so that they can adapt them to meet the learning styles of the students. A user friendly tool to assess the learning styles of students, should be designed, piloted and implemented. This is important in anatomy education; so as to assist lecturers in choosing teaching methods to match the learning styles of students. Benchmarking can be carried out with the department of Anatomy of other colleges to identify best practices and implement them.

Conclusion

Proper utilization of newer technologies along with the traditional teaching methods will certainly lead to enhanced understanding of gross anatomy and will ultimately improve students' performance. The advanced teaching methodologies will help in learning anatomy in a better and an easier way. If these new- view points on teaching methodologies are employed, the environment for learning Anatomy will not only be appealing and interesting but also exciting and enjoyable, leading to deeper learning Students will accomplish the desired learning outcomes, and will gradually become positive and self-directed learners.

Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

SPS drafted the manuscript, performed the literature review and SR assisted with writing the paper.

Acknowledgement

Authors are thankful to Dean Dr. Geeta Niyogi Madam for her support and encouragement. Authors are also thankful to Mr. M. Murugan for his help. Authors also acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript. The authors are also grateful to authors/editors/publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

References

1. Ramsden P. Learning to Teach in Higher Education. 2nd edn. London: Routledge Falmer; 2003. Approaches to learning (Chapter 4) pp. 39–61. ISBN 0-415-30345-1.
2. Professor Claudia Diaz, James Cook University, For stimulating multidisciplinary first year students to learn Anatomy for life via innovative, pro-active approaches to improve engagement and learning outcomes, 2011 Citations for Outstanding Contributions to Student Learning.
3. Vikas Seth, Prerna Upadhyaya, Mushtaq Ahmad, and Vijay Moghe, PowerPoint or chalk and talk: Perceptions of medical students versus dental students in a medical college in India- Adv Med Educ Pract. 2010; 1: 11–16.
4. Horst-Werner Korf, Helmut Wicht, Robert L. Snipes, Jean-Pierre Timmermans, Friedrich Paulsen, Gabriele Rune, Eveline Baumgart-Vogt,-The dissection course – necessary and indispensable for teaching anatomy to medical students, Ann Anat. 2008; 190: 16-22.
5. Fruhstorfer BH, Palmer J, Brydges S, Abrahams PH. The use of plastinated prosections for teaching anatomy: the view of medical students on the value of this learning resource. Clin Anat 2011; 24: 246.
6. Harold Ellis: a surgeon's contribution to anatomy education. Anat Cell Biol. 2012 Mar; 45(1): 70–71. Published online 2012 Mar 31.
7. McNulty JA, Sonntag B, Sinacore JM. Evaluation of computer-aided instruction in a gross anatomy course: a six-year study. Anat Sci Educ 2009; 2: 2-8.
8. De Barros N, Rodrigues CJ, Rodrigues AJ Jr, De Negri Germano MA, Cerri GG. The value of teaching sectional anatomy to improve CT scan interpretation. Clin Anat. 2001; 14: 36-41.
9. Katinka J A H Prince[1], Henk Van Mameren[2], Nelien Hylkema[1] Jan Drukker[2], Albert J J A herpbier[3] and Cees P M Van Der Vleuten[4] Does problem-based learning lead to deficiencies in basic science knowledge? An empirical case on anatomy, Medical Education. January 2003; 37(1): 15-21.
10. Karpicke JD, Roediger HL. The critical importance of retrieval for learning. Science 2008; 319: 966-8.
11. Pallab K Ganguly1, Lap Ki Chan2, Living anatomy in the 21st century: how far can we go? South East Asian Journal of Medical Education. 2008; 2(2).
12. Edgell: Multiple Approaches to Teaching Anatomy, Teaching Innovation Projects. 2011; 1(1): 1, Art. 3.
13. P. Benly, Teaching Methodologies on Anatomy- A Review, J. Pharm. Sci. & Res. 2014; 6(6): 242-243.

Indian Journal of Anatomy
Volume 4 Number 3, September - December 2015

Transposition of External and Internal Carotid Arteries: Clinical Significance

S. D. Jadhav*, B. R. Zambare**

Abstract

The arteries of the human body show a large number of variations. In literature, many reports are available regarding variations of carotid arteries and their branches. Present paper describes a case of transposition of external and internal carotid arteries. Initially, the internal carotid artery was medial to external carotid artery at the bifurcation of the common carotid artery, while ascending upward the internal carotid artery passes behind the external carotid arteryand ultimately entered the carotid canal. Such variations are important for surgeons and radiologist.

Keywords: External Carotid Artery; Internalcarotid Artery; Transposition; Variation.

Introduction

Anatomy texts describe that the internal carotid artery (ICA) lying behind or postero-lateral to the external carotid artery (ECA) in 88% of cases [1]. Many variations including high origin of ECA and ICA, aberrant branching patterns of ECA, absences of ECA or lateral position of ECA have been described in literature [2]. Few cases have been reported the transposition of external and internal carotid arteries in the medical literature. Angiographic and ultrasound examinations of these arteries revealed the incidence of transposition between 4% and 12% [3, 4, 5]. This is due to an absence of stringent criteria for defining the degree of rotation of the carotid bifurcation required to consider the ECA as lying lateral to the ICA. Definition of a laterally positioned ECA is that when the superior thyroid, lingual and facial branches of ECA should cross and cover the ICA, with the ECA lying posterior or postero-laterally to the ICA[6].

Vascular variations are common. Aging of arteries and earlier appearance of cerebrovascular diseases are more common when arteries show anomalies and variations[7]. Morphological variations of the external and internal carotid arteries are responsible for insufficiencies of cerebral vascularization in 10-15% of cases[8, 9]. Knowledge on the anatomical variations of the ECA and ICA is necessary for the correct interpretation of different radiological procedures, clinical examination and surgical procedures. Transposition of ICA and ECA may have important surgical and clinical implications, especially in terms of the incidence of cranial nerve damage.

Materials and Methods

In the Department of Anatomy, PDVVPF'S Medical College, We observed a transposition of internal carotid and external carotid arteries during dissection of neck of a 46 year old male cadaver. The right anterior triangle of neck was dissected carefully bilaterally and different structures were identified. Photographs were taken.

Cases Report

We observed a variation in the position and course of the external and internal carotid arteries on the right side of the neck. The internal carotid artery was medial and posterior to the external carotid artery

Author's Affiliation: *Associate Professor, **Professor and HOD, Department of Anatomy, Padamashree Dr. VithalraoVikhePatil Foundations Medical College, Ahmednagar, Maharashtra, India.

Corresponding Author: Surekha Dilip Jadhav, Associate Professor, Department– Anatomy, PDVVPF Medical Collage, Vadgaon –Gupta (Viladghat) Post: M.I.D.C., Ahmednagar, Maharashtra, India, Pin: 414111.

E-mail: drsurekhadjadhav@gmail.com

(Fig. 1). Initially, the ICA was medial to ECA, while ascending upward the internal carotid artery passes behind the ECA and ultimately entered the carotid canal. The superior thyroid artery, lingual artery and facial arteries were found to branch out from the anterior aspect of the ECA and to cross the internal carotid artery superficially. The internal jugular vein was removed for better exposure which was present lateral to ECA. The hypoglossal nerve was crossing the loop of lingual artery and origin of facial artery (Fig. 1). On the left side, the internal and external carotid arteries and internal jugular vein followed their usual relation and course.

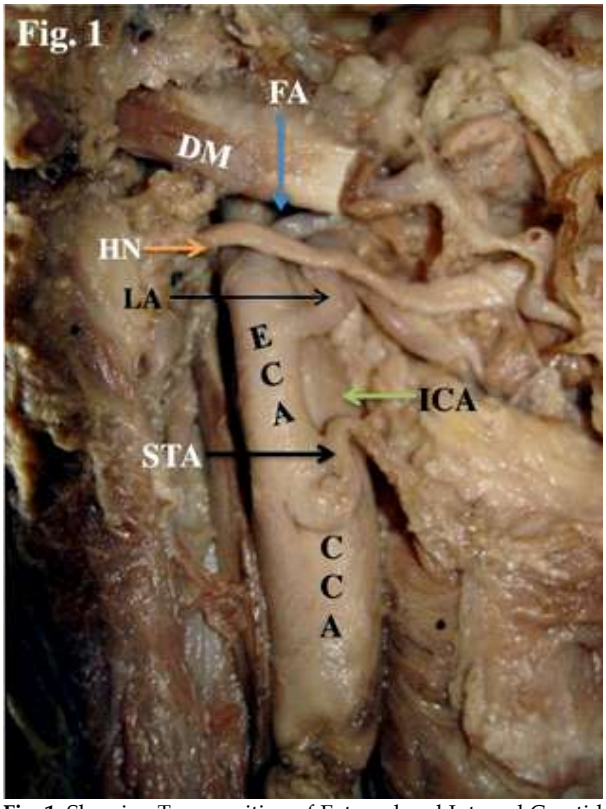


Fig. 1: Showing Transposition of External and Internal Carotid Arteries
FA- Facial artery; DM- Digastric muscle; HN- Hypoglossal nerve; LA- Lingual artery, ECA- External carotid artery; STA- Superior thyroid artery; CCA- Common carotid artery; ICA- Internal carotid artery.

Discussion

Handa et al mentioned that the first description of the lateral position of the ECA was reported by an anatomist Hyrtl in 1841 [10]. According to Zumre et al. that excessive mediolateral migration of the ECA during embryogenesis is the cause of the lateral ECA. Also, he stated that a secondary cause may be age-related elongation and tortuosity of the carotid arteries due to atherosclerosis [11]. Jasmindeliæ et al. studied the positional variations of the external and the internal carotid artery by using MRI angiography and found 4 different types[12]:

Type-1 ECA in its initial part is placed medially and goes to the front side of the ICA in 90% of cases.

Type-2 In 7% of cases, the right ECA is placed laterally from the ICA. Symmetric (bilateral) lateral position of the ECA in relation to the ICA was found in 2% of cases.

Type- 3, The ICA (medially) and ECA (laterally) go away from each other, without crossing, (Divergent position)was found in 1% of cases.

Type-4, In 1% of cases the right ECA and the right ICA cross two times.

Incidence of lateral position of ECA was studied by few researchers and they reported its incidence in 4.9% cases and its occurrenceis more on right side[4]. Agarwal and Agarwal reported a rare case of retropharyngeal tortuous right ICA [13]. In literature, there are few reports about peripheral hypoglossal nerve palsy which were due to laterally placed ECA[4]

In the present case, the ECA was placed lateral to the ICA at origin and in their subsequent course the ICA pass behind the ECA which is dangerous situation. Transposition of ECA and ICA is a dangerous variation.Such variations are recognized accidently or during cadaveric dissection because most affected people are asymptomatic and no treatment is necessary [14]. During bleeding from terminal branches of ECA occasionally it is necessary to consider ligation of the artery. It is very important to ensure that the artery being ligated must be the ECA rather than internal carotid as ligation of latter causes a high risk of hemi paresis.

Precise knowledge of the position of the ECA and ICA is essential for surgeons and radiologists to undertake a various surgical and radiological procedure in the neck region. Correct diagnosis of these cases can be made byintravenous digital subtraction angiography (IVDSA) and Doppler scanning, ultrasound scanningor magnetic resonance imaging scan[15].

Conclusion

The ECA and ICA are the main arteries of the head, neckand brain region. Therefore, it is essential to understand the precise knowledge of surgical anatomy and variations of these arteries to carry out various surgical and interventional radiological procedures and to minimize intra and post-operative

complication. This case report describes the transposition of ECA and ICA which will provide knowledge to surgeons for clinical examination and surgical proceduresand radiologist for the correct interpretation of different radiological procedures.

References

1. Ozgur Z, Govsa F, Ozgur T. Anatomic evaluation of the carotid artery bifurcation in cadavers: implications for open and endovascular ther- apy. SurgRadiolAnat 2008; 30: 475–80.
2. Bergman RA, Thompson SA, Afifi AK, Saadeh FA. Compendium of human anatomic variations. Urban &Schwarzenberg. Baltimore- Munich 65, 1988.
3. Prendes JL, McKinney WM, Buonanno FS, Jones A M. Anatomic variations of the carotid bifurcation affecting doppler scan interpretation. J Clin Ultrasound 1980; 8(2): 147-50.
4. Ueda S, Konyama Y, Takase K. Peripheral hypoglossal nerve palsy caused by lateral position of the external carotid artery and an abnormally high position of bifurcation of the external and internal carotid arteries – case report. Stroke 1984; 15(4): 736-9.
5. Bussaka H, Sato N, Oguni T et al. Lateral position of the ex- ternal carotid artery. RinshoHoshasen 1990; 35(9): 1061-3.
6. GiustinoMarcucci, Federico Accrocca, Roberto Gabrielli, Roberto Antonelli, Alessandro G. Giordano, Gennaro De Vivo, Andrea Siani. Complete transposition of carotid bifurcation: can it be an additional risk factor of injury to the cranial nerves during carotid endarterectomy? Interactive CardioVascular and Thoracic Surgery. 2011; 13: 471-74.
7. Benson M, Hamer JT. Anomalous origin of the occipital artery from internal carotid artery. VascSurg 1998; 8(5): 653-8.
8. Haccein-Bey L, Daniels DL, Ulmer JL et al. The ascendingpharyngeal artery: branches, anastomoses, and clinical sig- nificance. AJNR. 2002; 23(7): 1246-56.
9. Shang JB, Li YH, Chen Y et al. Clinical application of transarterial embolization for massive hemorrhage in the nasopharyngeal and maxillofacial regions. Di Yi Jun Yi Da XueXueBao.2004; 24(2): 210-2.
10. Handa J, Matsuda M, Handa H. Lateral position of the external carotid artery. Report of a case. Radiology. 1972; 102: 361-62.
11. Zumre O, Salbacak A, Cicekcibasi AE, Tuncer I, Seker M. Investigation of the bifurcation level of the common carotid artery and variations of the branches of the external carotid artery in human fetuses. Ann Anat. 2005; 187: 361–69.
12. Jasmindeliæ, Alma bajtareviæ, EldarIsakoviæ. Positional variations of the external and the internal carotid artery.Acta Med Sal. 2010; 39(2): 86-89.
13. Agrawal R, Agrawal S. Dangerous anatomic variation of internal carotid artery – a rare case report. Int. J. Anat. Variat. 2011; 4: 174-76.
14. Galletti B., Bucolo S., Abbate G., Calabrese G., Romano G., Quattrocchi C., Freni F. Internal carotid artery transposition as risk factor in pharyngeal surgery. Laryngoscope. 2002; 112: 1845-48.
15. Trigaux JP, Delchambre F, Van Beers B. Anatomical variations of the carotid bifurcation: implications for digital subtraction angiography and ultrasonography. Br J Radiol 1990; 63: 181–85.

Indexing information page of Index Copernicus

Guidelines for Authors

Manuscripts must be prepared in accordance with "Uniform requirements for Manuscripts submitted to Biomedical Journal" developed by international committee of medical Journal Editors.

Types of Manuscripts and Limits

Original articles: Up to 3000 words excluding references and abstract and up to 10 references.

Review articles: Up to 2500 words excluding references and abstract and up to 10 references.

Case reports: Up to 1000 words excluding references and abstract and up to 10 references.

Online Submission of the Manuscripts

Articles can also be submitted online from http://rfppl.co.in/customer_index.php.

I) First Page File: Prepare the title page, covering letter, acknowledgement, etc. using a word processor program. All information which can reveal your identity should be here. use text/rtf/doc/PDF files. Do not zip the files.

2) Article file: The main text of the article, beginning from Abstract till References (including tables) should be in this file. Do not include any information (such as acknowledgement, your name in page headers, etc.) in this file. Use text/rtf/doc/PDF files. Do not zip the files. Limit the file size to 400 Kb. Do not incorporate images in the file. If file size is large, graphs can be submitted as images separately without incorporating them in the article file to reduce the size of the file.

3) Images: Submit good quality color images. Each image should be less than 100 Kb in size. Size of the image can be reduced by decreasing the actual height and width of the images (keep up to 400 pixels or 3 inches). All image formats (jpeg, tiff, gif, bmp, png, eps etc.) are acceptable; jpeg is most suitable.

Legends: Legends for the figures/images should be included at the end of the article file.

If the manuscript is submitted online, the contributors' form and copyright transfer form has to be submitted in original with the signatures of all the contributors within two weeks from submission. Hard copies of the images (3 sets), for articles submitted online, should be sent to the journal office at the time of submission of a revised manuscript. Editorial office: **Red Flower Publication Pvt. Ltd., 48/41-42, DSIDC, Pocket-II, Mayur Vihar Phase-I, Delhi – 110 091, India, Phone: 91-11-22754205, 45796900, Fax: 91-11-22754205, E-mail: redflowerppl@vsnl.net. Website: www.rfppl.co.in**

Preparation of the Manuscript

The text of observational and experimental articles should be divided into sections with the headings: Introduction, Methods, Results, Discussion, References, Tables, Figures, Figure legends, and Acknowledgment. Do not make subheadings in these sections.

Title Page

The title page should carry

1) Type of manuscript (e.g. Original article, Review article, Case Report)
2) The title of the article, should be concise and informative;
3) Running title or short title not more than 50 characters;
4) The name by which each contributor is known (Last name, First name and initials of middle name), with his or her highest academic degree(s) and institutional affiliation;
5) The name of the department(s) and institution(s) to which the work should be attributed;
6) The name, address, phone numbers, facsimile numbers and e-mail address of the contributor responsible for correspondence about the manuscript; should be mentoined.
7) The total number of pages, total number of photographs and word counts separately for abstract and for the text (excluding the references and abstract);
8) Source(s) of support in the form of grants, equipment, drugs, or all of these;
9) Acknowledgement, if any; and
l0) If the manuscript was presented as part at a meeting, the organization, place, and exact date on which it was read.

Abstract Page

The second page should carry the full title of the manuscript and an abstract (of no more than 150 words for case reports, brief reports and 250 words for original articles). The abstract should be structured and state the Context (Background), Aims, Settings and Design, Methods and Materials, Statistical analysis used, Results and Conclusions. Below the abstract should provide 3 to 10 keywords.

Introduction

State the background of the study and purpose of the study and summarize the rationale for the study or observation.

Methods

The methods section should include only information that was available at the time the plan or protocol for the study was written such as study approach, design, type of sample, sample size, sampling technique, setting of the study, description of data collection tools and methods; all information obtained during the conduct of the study belongs in the Results section.

Reports of randomized clinical trials should be based on the CONSORT Statement (http://www.consort-statement. org). When reporting experiments on human subjects, indicate whether the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975, as revised in 2000 (available at http://www.wma.net/e/policy/l 7-c_e.html).

Results

Present your results in logical sequence in the text, tables, and illustrations, giving the main or most important findings first. Do not repeat in the text all the data in the tables or illustrations; emphasize or summarize only important observations. Extra or supplementary materials and technical details can be placed in an appendix where it will be accessible but will not interrupt the flow of the text; alternatively, it can be published only in the electronic version of the journal.

Discussion

Include summary of key findings (primary outcome measures, secondary outcome measures, results as they relate to a prior hypothesis); Strengths and limitations of the study (study question, study design, data collection, analysis and interpretation); Interpretation and implications in the context of the totality of evidence (is there a systematic review to refer to, if not, could one be reasonably done here and now?, What this study adds to the available evidence, effects on patient care and health policy, possible mechanisms)? Controversies raised by this study; and Future research directions (for this particular research collaboration, underlying mechanisms, clinical research). Do not repeat in detail data or other material given in the Introduction or the Results section.

References

List references in alphabetical order. Each listed reference should be cited in text (not in alphabetic order), and each text citation should be listed in the References section. Identify references in text, tables, and legends by Arabic numerals in square bracket (e.g. [10]). Please refer to ICMJE Guidelines (http://www.nlm.nih.gov/bsd/uniform_requirements.html) for more examples.

Standard journal article

[1] Flink H, Tegelberg Å, Thörn M, Lagerlöf F. Effect of oral iron supplementation on unstimulated salivary flow rate: A randomized, double-blind, placebo-controlled trial. J Oral Pathol Med 2006; 35: 540-7.

[2] Twetman S, Axelsson S, Dahlgren H, Holm AK, Källestål C, Lagerlöf F, et al. Caries-preventive effect of fluoride toothpaste: A systematic review. Acta Odontol Scand 2003; 61: 347-55.

Article in supplement or special issue

[3] Fleischer W, Reimer K. Povidone iodine antisepsis. State of the art. Dermatology 1997; 195 Suppl 2: 3-9.

Corporate (collective) author

[4] American Academy of Periodontology. Sonic and ultrasonic scalers in periodontics. J Periodontol 2000; 71: 1792-801.

Unpublished article

[5] Garoushi S, Lassila LV, Tezvergil A, Vallittu PK. Static and fatigue compression test for particulate filler composite resin with fiber-reinforced composite substructure. Dent Mater 2006.

Personal author(s)

[6] Hosmer D, Lemeshow S. Applied logistic regression, 2nd edn. New York: Wiley-Interscience; 2000.

Chapter in book

[7] Nauntofte B, Tenovuo J, Lagerlöf F. Secretion and composition of saliva. In: Fejerskov O, Kidd EAM,

editors. Dental caries: The disease and its clinical management. Oxford: Blackwell Munksgaard; 2003. p. 7-27.

No author given

[8] World Health Organization. Oral health surveys - basic methods, 4th edn. Geneva: World Health Organization; 1997.

Reference from electronic media

[9] National Statistics Online—Trends in suicide by method in England and Wales, 1979-2001. www.statistics.gov.uk/downloads/theme_health/HSQ 20.pdf (accessed Jan 24, 2005): 7-18. Only verified references against the original documents should be cited. Authors are responsible for the accuracy and completeness of their references and for correct text citation. The number of reference should be kept limited to 20 in case of major communications and 10 for short communications.

More information about other reference types is available at www.nlm.nih.gov/bsd/uniform_requirements.html, but observes some minor deviations (no full stop after journal title, no issue or date after volume, etc).

Tables

Tables should be self-explanatory and should not duplicate textual material.

Tables with more than 10 columns and 25 rows are not acceptable.

Table numbers should be in Arabic numerals, consecutively in the order of their first citation in the text and supply a brief title for each.

Explain in footnotes all non-standard abbreviations that are used in each table.

For footnotes use the following symbols, in this sequence: *, ¶, †, ‡‡,

Illustrations (Figures)

Graphics files are welcome if supplied as Tiff, EPS, or PowerPoint files of minimum 1200x1600 pixel size. The minimum line weight for line art is 0.5 point for optimal printing.

When possible, please place symbol legends below the figure instead of to the side.

Original color figures can be printed in color at the editor's and publisher's discretion provided the author agrees to pay.

Type or print out legends (maximum 40 words, excluding the credit line) for illustrations using double spacing, with Arabic numerals corresponding to the illustrations.

Sending a revised manuscript

While submitting a revised manuscript, contributors are requested to include, along with single copy of the final revised manuscript, a photocopy of the revised manuscript with the changes underlined in red and copy of the comments with the point to point clarification to each comment. The manuscript number should be written on each of these documents. If the manuscript is submitted online, the contributors' form and copyright transfer form has to be submitted in original with the signatures of all the contributors within two weeks of submission. Hard copies of images should be sent to the office of the journal. There is no need to send printed manuscript for articles submitted online.

Reprints

Journal provides no free printed reprints, however a author copy is sent to the main author and additional copies are available on payment (ask to the journal office).

Copyrights

The whole of the literary matter in the journal is copyright and cannot be reproduced without the written permission.

Declaration

A declaration should be submitted stating that the manuscript represents valid work and that neither this manuscript nor one with substantially similar content under the present authorship has been published or is being considered for publication elsewhere and the authorship of this article will not be contested by any one whose name (s) is/are not listed here, and that the order of authorship as placed in the manuscript is final and accepted by the co-authors. Declarations should be signed by all the authors in the order in which they are mentioned in the original manuscript. Matters appearing in the Journal are covered by copyright but no objection will be made to their reproduction provided permission is obtained from the Editor prior to publication and due acknowledgment of the source is made.

Abbreviations

Standard abbreviations should be used and be spelt out when first used in the text. Abbreviations should not be used in the title or abstract.

Checklist

- Manuscript Title
- Covering letter: Signed by all contributors
- Previous publication/ presentations mentioned, Source of funding mentioned
- Conflicts of interest disclosed

Authors

- Middle name initials provided.
- Author for correspondence, with e-mail address provided.
- Number of contributors restricted as per the instructions.
- Identity not revealed in paper except title page (e.g.name of the institute in Methods, citing previous study as 'our study')

Presentation and Format

- Double spacing
- Margins 2.5 cm from all four sides
- Title page contains all the desired information. Running title provided (not more than 50 characters)
- Abstract page contains the full title of the manuscript
- Abstract provided: Structured abstract provided for an original article.
- Key words provided (three or more)
- Introduction of 75-100 words
- Headings in title case (not ALL CAPITALS). References cited in square brackets
- References according to the journal's instructions

Language and grammar

- Uniformly American English
- Abbreviations spelt out in full for the first time. Numerals from 1 to l0 spelt out
- Numerals at the beginning of the sentence spelt out

Tables and figures

- No repetition of data in tables and graphs and in text.
- Actual numbers from which graphs drawn, provided.
- Figures necessary and of good quality (color)
- Table and figure numbers in Arabic letters (not Roman).
- Labels pasted on back of the photographs (no names written)
- Figure legends provided (not more than 40 words)
- Patients' privacy maintained, (if not permission taken)
- Credit note for borrowed figures/tables provided
- Manuscript provided on a CDROM (with double spacing)

Submitting the Manuscript

- Is the journal editor's contact information current?
- Is the cover letter included with the manuscript? Does the letter:

1. Include the author's postal address, e-mail address, telephone number, and fax number for future correspondence?
2. State that the manuscript is original, not previously published, and not under concurrent consideration elsewhere?
3. Inform the journal editor of the existence of any similar published manuscripts written by the author?
4. Mention any supplemental material you are submitting for the online version of your article. Contributors' Form (to be modified as applicable and one signed copy attached with the manuscript)

Subject Index

Revised Rates for 2016 (Institutional)

Title	Frequency	Rate (Rs): India	Rate ($):ROW
Dermatology International	2	5000	500
Gastroenterology International	2	5500	550
Indian Journal of Agriculture Business	2	5000	500
Indian Journal of Anatomy	3	8000	800
Indian Journal of Ancient Medicine and Yoga	4	7500	750
Indian Journal of Anesthesia and Analgesia	2	7000	700
Indian Journal of Anthropology	2	12000	1200
Indian Journal of Biology	2	4000	400
Indian Journal of Cancer Education and Research	2	8500	850
Indian Journal of Communicable Diseases	2	8000	800
Indian Journal of Dental Education	4	4500	450
Indian Journal of Forensic Medicine and Pathology	4	15500	1550
Indian Journal of Forensic Odontology	2	4500	450
Indian Journal of Genetics and Molecular Research	2	6500	650
Indian Journal of Law and Human Behavior	2	5500	550
Indian Journal of Library and Information Science	3	9000	900
Indian Journal of Maternal-Fetal & Neonatal Medicine	2	9000	900
Indian Journal of Medical & Health Sciences	2	6500	650
Indian Journal of Obstetrics and Gynecology	2	7000	700
Indian Journal of Pathology: Research and Practice	2	11500	1150
Indian Journal of Plant and Soil	2	5500	550
Indian Journal of Preventive Medicine	2	6500	650
International Journal of Food, Nutrition & Dietetics	2	5000	500
International Journal of History	2	6500	650
International Journal of Neurology and Neurosurgery	2	10000	1000
International Journal of Political Science	2	5500	550
International Journal of Practical Nursing	3	5000	500
International Physiology	2	7000	700
Journal of Animal Feed Science and Technology	2	4100	410
Journal of Cardiovascular Medicine and Surgery	2	9100	910
Journal of Forensic Chemistry and Toxicology	2	9000	900
Journal of Microbiology and Related Research	2	8000	800
Journal of Orthopaedic Education	2	5000	500
Journal of Pharmaceutical and Medicinal Chemistry	2	16000	1600
Journal of Practical Biochemistry and Biophysics	2	5500	550
Journal of Social Welfare and Management	4	7500	750
New Indian Journal of Surgery	2	7100	710
Ophthalmology and Allied Sciences	2	5500	550
Otolaryngology International	2	5000	500
Pediatric Education and Research	4	7000	700
Physiotherapy and Occupational Therapy Journal	4	8500	850
Urology, Nephrology and Andrology International	2	7000	700
SUPER SPECIALITY JOURNALS			
Indian Journal of Emergency Medicine	2	12000	1200
Indian Journal of Surgical Nursing	3	5000	500
Indian Journal of Trauma & Emergency Pediatrics	2	9000	900
International Journal of Pediatric Nursing	2	5000	500
Journal of Community and Public Health Nurisng	2	5000	500
Journal of Geriatric Nursing	2	5000	500
Journal of Medical Images and Case Reports	2	5000	500
Journal of Nurse Midwifery and Maternal Health	2	5000	500
Journal of Organ Transplantation	2	25900	2590
Journal of Psychiatric Nursing	3	5000	500
Psychiatry and Mental Health	2	7500	750
OPEN ACCESS JOURNALS			
Global Research in Engineering		5000	500
Global Research in Food and Nutrition		5000	500
Global Research in Library and Information Science		5000	500
Global Research in Medical Sciences		5000	500
Global Research in Space Science		5000	500

Terms of Supply:

1. Advance payment required by Demand Draft payable to Red Flower Publicaion Pvt. Ltd. payable at Delhi.
2. Cancellation not allowed except for duplicate payment.
3. Agents allowed 10% discount.
4. Claim must be made within six months from issue date.

Order from

Red Flower Publication Pvt. Ltd., 48/41-42, DSIDC, Pocket-II, Mayur Vihar Phase-I, Delhi - 110 091 (India), Tel: 91-11-22754205, 45796900, Fax: 91-11-22754205. E-mail: redflowerppl@vsnl.net, redflowerppl@gmail.com, Website: www.rfppl.co.in

Author Index

Introducing a new sister concerned company of ***Red Flower Publication Pvt. Ltd.***

RF Library Services Pvt. Ltd.

RF Library Services Pvt. Ltd. is a global market leader in managing professional information. We develop and deliver innovative services that enable the use of knowledge to its full extent. As the only information Service Company globally we play a key role in today's complex information marketplace. Founded in 1985 as a registered company under sub-section (2) of section 7 of the Companies Act, 2013 and rule 8 of the Companies (Incorporation) Rules, 2014, the business draws on more than a decade of experience within the information industry. With this knowledge, we satisfy the needs of thousands of customers from over 30 countries. We are a division of Red Flower Publication Pvt. Ltd.

Where we are based?
RF Library Services Pvt. Ltd is located in Delhi-91 in India.

RF Library Services Pvt. Ltd.
D-223/216, Laxmi Chambers, Laxmi Nagar,
Near Laxmi Nagar Metro Station,
Delhi-110092(India)
Tel: 011-22756995, Fax: 011-22756995
E-mail: rflibraryservices@vsnl.net, rflibraryservices@gmail.com
Wesite: www.rf-libraryservices.com