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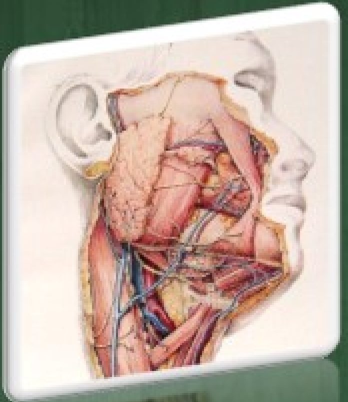

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Original Article

MORPHOMETRY OF RADIAL HEAD: A GUIDE FOR RADIAL HEAD PROSTHESIS

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ABSTRACT

Introduction: Radial head fractures constitute one-third of all elbow fractures and 20% of all trauma cases. The head, being the key element is very important for maintaining stability and biomechanics of the humeroradial joint. Treatment of radial head fractures involves fixation or replacement with radial head prosthesis. However, the designing of prosthesis requires accurate knowledge of morphometry of proximal radius for a specific population to restore normal joint mechanics and joint morphometry. Henceforth, this study was carried out to determine dimensions of radial head in the North Indian subjects.

Materials and methods: The present observational study was conducted on one hundred dry adult human radii with an intact upper end. The parameters included Anteroposterior diameter of radial head (APD), Transverse diameter of radial head (TD), Medial height of radial head (MH], Lateral height of radial head (LH), Anterior height of radial head (AH), Posterior height of radial head (PH), Depth of superior articular facet (D), Surface area of head of radius (SA), Volume of head of radius (VOL), Ventral curve (VC), Dorsal curve (DC), Lateral curve (LC) and Circumference of the head (C). The side dimorphism was noted for any statistically significant side dimorphism.

Results: The morphometry of radial head revealed that the APD, TD were lesser by 2mm to 3mm as compared with western studies. The VC and the PC in the western studies were lesser by 0.4mm and 0.6mm respectively as compared to the current study.

Conclusions: These parameters are of importance for orthopaedic surgeons in the treatment of fractures of the upper radius, where a radial head implant or prosthesis is required. Accurately matched prosthesis in accordance with the size of head will reduce postoperative complications and result in better operative outcome.

Keywords: Looping, Internal carotid artery, Variations

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INTRODUCTION

Radius is the preaxial bone of the forearm, ossified from one primary centre and two secondary centres for upper and lower ends each. Proximal end of radius includes head, neck and radial tuberosity [1]. The radial head is cylindrical having an upper concave hollow surface that fits over the capitulum to form the humeroradial component of elbow joint. The cylindrical circumference is deepest on the medial aspect where it articulates with the radial notch of ulna to form superior radioulnar joint. The radial head is secured anteriorly, laterally and posteriorly within the annular ligament. The head and neck rotate freely within the clasp of the annular ligament during the rotational movements during supination and pronation [2].

Radial head fractures constitute 20% of all elbow trauma cases, 1.7 – 5.4% of all the fractures and one third of elbow fractures [3]. The surgical treatment of displaced radial head fractures where reconstruction is possible involves fixation with the help of plates and screws. However, the cases where the reconstruction is not possible, replacement of the radial head with prosthesis is the treatment of choice [4]. Any mismatch between the size of prosthesis and head of radius might result in subluxation of the head of radius [4]. Dislocation of radial head may further result in osteoarthiritis, posterior interroseus nerve palsy and cubitus valgus deformity [5]. Thus, in depth knowledge of morphometry of proximal radius is very important for orthopaedicians for a better postoperative outcome and for choosing anatomically and biomechanically accurate prosthesis in accordance with the size of radial head for different ethnic groups. The radial head dimensions available to orthopaedic surgeons are frequently based on the studies conducted on western countries. This study is an attempt to construct a baseline of radial head morphometry in Indian subjects which may be utilized for making implants of radial head. The aim of this study is to evaluate the morphometry of radial head in North Indian subjects and compare the results with the previous studies.

MATERIALS AND METHODS

The study on the morphometry of radial head is an observational study and was performed from March to June 2021. It was conducted on One-hundred dry adult human radial bones of unknown age and gender procured from the Bone bank of the department of Anatomy, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi. Inclusion criteria included all the dry adult human radii with intact upper end. The anatomical dimensions were measured from these bones using a vernier calliper of 0.01mm accuracy. All the measurements were taken first by authors and rechecked by other two authors to avoid human error. The observations were tabulated and statistical analysis was done.

The various parameters of radial head taken for the study are as follows:

1. Anteroposterior diameter of radial head (APD): The maximum anteroposterior distance was measured from most anterior point to most posterior point on the superior surface of radial head. [Fig. 1]

2. Transverse diameter of radial head (TD): The maximum transverse distance was measured from most medial point to most lateral point on the superior surface of radial head. [Fig. 2]

3. Medial height of radial head (MH): The maximum vertical distance measured from upper border of head to lower border of head on medial aspect. (Fig. 3)

4. Lateral height of radial head (LH): The maximum vertical distance measured from upper border of head to lower border of head on lateral aspect. (Fig. 4)

5. Anterior height of radial head (AH): The maximum vertical distance measured from upper border of head to lower border of head on anterior aspect. (Fig. 5)

6. Posterior height of radial head (PH): The maximum vertical distance measured from upper border of head to lower border of head on posterior aspect. (Fig. 6)

7. Depth of superior articular facet (D): The depth of superior articular facet was measured by making a plaster of paris cast of the shallow concavity of superior articular facet. The maximum vertical height [h] of the cast formed was taken as depth of the superior articular facet. [6] (Fig. 7)

8. Surface area of head of radius (SA): Surface area of head of radius is calculated by using the formula:

SA= π [r2+h^{2}]]

r = radius of articular surface of head excluding the circumferential rim.

h= Depth or height of superior articular facet [6] (Fig 7a,7b)

9. Volume of head of radius (V): Volume of head of radius is calculated by using the formula:

V= 1/6 πh [3r 2+ h^2]

r =radius of articular surface of head excluding the circumferential rim.

h= Depth or height of superior articular facet. [6] (Fig 7a,7b)

10. Thickness of ventral curve (TVC): It was measured as distance between point A and E on the peripheral rim on the surface of head of radius. [7] (Fig 8).

11. Thickness of dorsal curve (TDC): It was measured as distance between point C and G on the peripheral rim on the surface of head of radius [7] (Fig 8).

12. Thickness of lateral curve (TLC): It was measured as distance between point D and H on the peripheral rim on the superior surface of head of radius. [7] (Fig 8).

13. Circumference of head of radius: It was measured with the help of thread winding around articular peripheral rim of head of radius. The length of the thread was measured along with the help of centimetre scale [7] (Fig. 8).

Data collection: The morphometric parameters of the radial head were taken using a digital vernier calliper of 0.01 mm accuracy. The above-mentioned parameters were taken into account.

Data analysis: The results were tabulated and mean; standard deviation of each parameter was analysed. The observations were compared on both right and left sides for any statistically significant side dimorphism.

Fig 1: Anteroposterior diameter of radial head [APD]

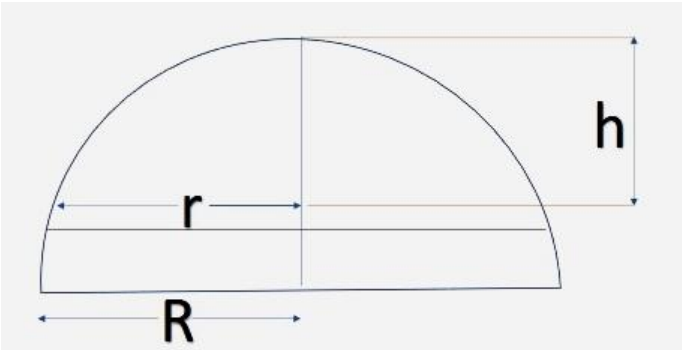
Fig 2: Transverse Diameter of radial head [TD]

Fig 3: Medial Height of radial head [MH]

Fig 4: Lateral Height of radial head [LH]

Fig 5 : Anterior Height of radial head [AH]

Fig 6: Posterior Height of radial head [PH]



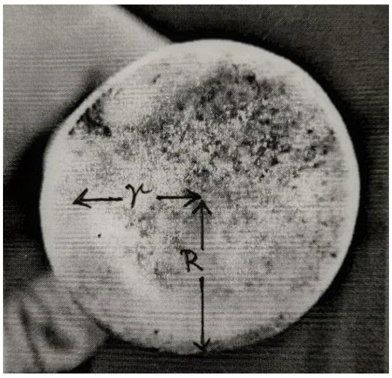


Fig 7 a: **h= height or depth of articular surface, r= radius of articular surface of head and R= radius of hemisphere [6]**

Fig 7b: r = radius of articular surface of head and R= radius of hemisphere

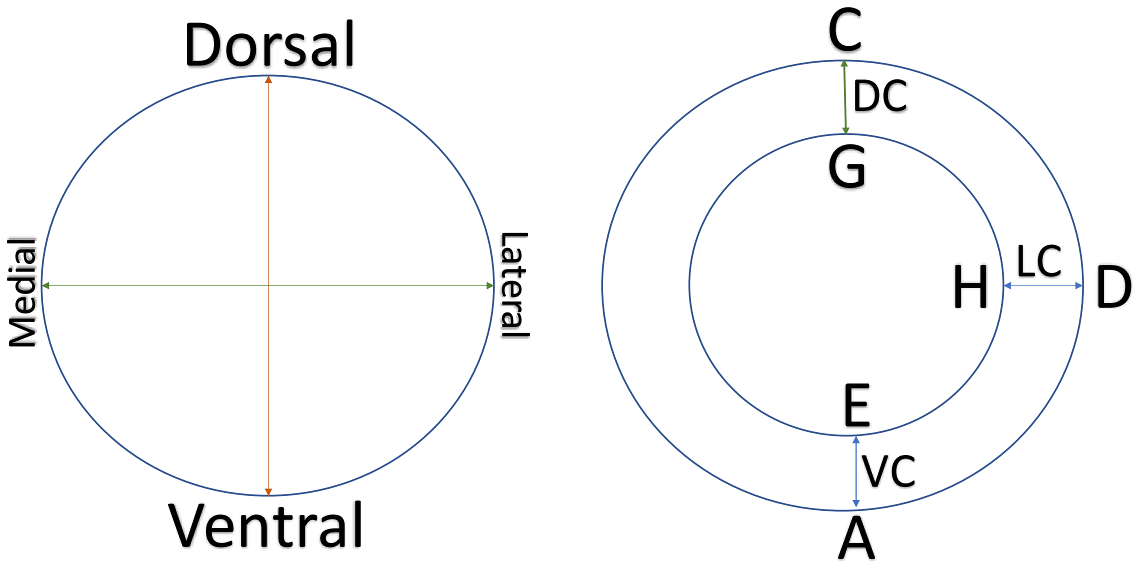


Fig 8: Superior surface of head of radius:
VC: Ventral curve [A-E]
DC: Dorsal curve[C-G]
LC: Lateral curve[D-H]

RESULTS

The mean and standard deviation of the various morphometric parameters Including Anteroposterior diameter [APD], Transverse diameter [TD], Medial height [MH], Lateral height [LH], Anterior height [AH], Posterior height [PH], Depth[D], Surface area [SA], Volume [V], Thickness of ventral curve [TVC], Thickness of Dorsal curve [TDC], Thickness of Lateral curve [TLC] and Circumference of head [C], were recorded on right and left sides and the observations were tabulated.

Anteroposterior diameter of radial head was found to be 19.6±1.89 mm [R] and 18.35±1.94 mm [L]. Transverse diameter being 18.88 ± 2.17mm[R] and 18.38 ±2.019mm [L] Medial height was recorded to be 9.86mm± 1.67mm[R] and 9.55±1.92mm [L]. Lateral height was observed as7.91±1.14mm [R] and 7.89±1.214mm [L]. Anterior height was 8.5±1.67mm[R] and 7.9±1.3mm [L]. Posterior height being 8.38±1.5mm[R] and 7.81±1.2mm [L]. Depth of the superior articular facet was 2.34±0.6mm [R] and 2.57±0.56mm [L].

Surface area was recorded to be 193±57mm [R] and 184.26±41.5mm [L]. Volume was recorded to be 309±30mm[R] and 275.3±117.6mm [L]. Thickness of ventral curve was recorded to be 5.9±1.1mm [R] and 4.92±1.6mm [L]. Thickness of dorsal curve was found to be 4.9±0.93mm [R] and 4.3±0.7mm [L].

Thickness of lateral curve was observed to be 4.5±0.68mm[R] and 4.38±0.76mm [L]. Circumference of the head was calculated as 60.5±11.5mm [R] and 57.6 ±10.7mm [L].

DISCUSSION

The radius is the preaxial bone of the forearm which moves the hand, transmits weight from hand to the arm and participates in the movements of supination and pronation. Its proximal end contains disc shaped head, a constricted neck and an elevation called radial tuberosity. The radial head at the proximal end is an important pivot which causes its axial rotation within the annular ligament.

Further, it is the key element for maintaining physiologic [8] and prosthetic stability of elbow and superior radioulnar joints [9]. Due to the fact that the radial head plays an important part in maintaining the stability of elbow joint, it is crucial to preserve the radial head while performing operative procedures with the help of fixation or prosthetic replacement [10]. The prosthesis should be able to restore the anatomy as well as the physiologic functioning of the radial head as close to the normal as possible [6]. The latter can be obtained by replicating anatomical dimensions as close as possible to the original while designing the prosthesis [11].

Due to ethnic and racial variations of human bones the dimensions of the head of the radius too display wide variations among different populations. Thus, the size of prosthetic implant also varies according to the different populations and these should be designed specifically in accordance with the concerned population. Thus, emphasizing the dire need for morphometry of proximal end of radius.

In the present study, One-hundred radial heads were revisited for various dimensions belonging to North Indian population. Anteroposterior diameter was recorded as 19.6 ±1.89 [R] and 18.35± 1.94 [L]. In the previous studies it was recorded to be 21.3 ±2.39 on right side and 21.2±2.2on left side [16] ,19.27 ± 1.79 on right side and 18.74 ± 2.71 on left side [5], 20.3±2.2 and 19.9±1.7 on right and left sides respectively [12],19.6 ± 1.8 and 18.7± 2.1 on right and left sides respectively [13], 21.6±2.9 [14].

Transverse diameter recorded was 18.88 ±2.17 on right side and 18.38 ±2.019 on left side in the present study. In previous studies it was recorded to be 20.6±1.8 on right side and 20.6±1.9 on left side [7], 19.18 ±2.56 and 18.61 ± 2.19 on right and left sides respectively [5], 9.8±2.49 and 19.8±1.8 on right and left sides respectively [12], 18.9±2.1 on right side and 18.2 ± 2.1 on left side respectively [13] ,21± 2.7 [14].

Medial height was observed to be 9.86±1.67 on right side and 9.55±1.92 on left side in the present study. However, it was found to be 9.00 ±1.59 on right side and 8.77 ±1.439on left side [5], 8.6±1.0 and 9.5±1.2 on right and left sides respectively [12], 9.1±1.0 on right side and 9± 1.3 on left side [13]. Lateral height was found to be 7.19±1.14[R] 7.89±1.214 [L] in the present study. It was observed as 6.53 ±1.65 on right side and 6.58±+1.59 on left side [5], 7.1±7.2 on right and7.3±8.8 on left side [12], 7.3±0.9 on right side and 7.7± 1.4 on left side [13].

Anterior height was found to be 8.5±1.67[R] 7.9±1.3[L] in the present study. It was found to be 7.41 ± 1.46 on right side and 7.61±1.69 on left side [5], 8.5±1.1 and 8.7± 1.99 on right and left side respectively [12]. Posterior height was observed to be 8.38±1.5on right side and 7.81±1.2 on left side in the present study. When compared with the previous studies, posterior height was found to be [7.63 ±1.52 on right side and 7.68±1.74 on left side [5], 7.7± 8.8 and 7.9± 8.69 on right and left sides respectively [12].

The Depth of the superior articular surface was found to be 2.34±0.6 [R] 2.57±0.56 [L]. In the previous studies, it was found to be 2.0 on right and 2.2 on left side [15], 2±0.6 and 1.9 +0.51 on right and left side respectively [13]. Surface area was observed to be 193±57[R] ,184.26±41.5 [L] in the present study. In the previous studies, it was found to be 331.37±73.82- [6].

Volume was observed to be 309±30 [R], 275.3±117.6[L] in the present study. In the previous studies, it was found to be [322.49±122.74 [6]. Thickness of Ventral Curve was found to be 5.9±1.1 R, 4.92± 0.76L in the present study, In the previous studies it was found to be 5.07±0.96 [6], 4.3± 0.5 on right and 4.1±0.8 on left side [13] Thickness of Dorsal curve was observed to be 4.9±0.93 [R], 4.3±0.7 [L]. In the previous studies, It was found to be 4.7. [14], 4.02±0.94 [6], 3.2±0.6 on right side and 3.2 ±0.75 on left side [13]. Thickness of lateral curve was found to be 4.5±0.68 R, 4.38±0.76 L in the present study. In the previous studies it was found to be 4.7 [14], 3.63±0.82, [6] 3.3 ±1on right and 2.8±0.94 on left side [13]. All the measurements are in millimetres [Table 2A, 2B].

Most of the previous studies did not observe the dimensions on the right and left side separately. They have recorded Anteroposterior diameter, Transverse diameter, Medial and Lateral height of the head of the radius, however, Anterior and

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S.No	Name of the parameter	Right [Mean±SD] measured in mm	Left [Mean±SD] measured in mm
1.	Anteroposterior diameter [APD]	19.6 ±1.89	18.35± 1.94
2.	Transverse diameter [TD]	18.88 ±2.17	18.38 ±2.019
3.	Medial height [MH]	9.86±1.67	9.55±1.92
4.	Lateral height [LH]	7.19±1.14	7.89±1.214
5.	Anterior height [AH]	8.5±1.67	7.9±1.3
6.	Posterior height [PH]	8.38±1.5	7.81±1.2
7.	Depth[D]	2.34±0.6	2.57±0.56
8.	Surface area [SA]	193±57	184.26±41.5
9.	Volume [V]	309±30	275.3± 117.6
10.	Thickness of Ventral curve [TVC]	5.9± 1.1	4.92±1.6
11.	Thickness of Dorsal curve [TDC]	4.9±0.93	4.3±0.7
12.	Thickness of Lateral curve [TLC]	4.5±0.68	4.38±0.76
13.	Circumference of the head	60.5±11.5mm[R]	57.6 ±10.7mm[L]

Table-1: Mean and Standard deviation of morphometric parameters of radial head

STUDY	Anteroposterior (APD)	Transverse Diameter (TD)	Medial height (MH)	Lateral Height (LH)	Anterior Height (AH)	Posterior Height (PH)	Depth
G. Captier [14]	21.6± 2.9	21 ± 2.7	-	-	-	-	-
Anjana Mittal [7]	21.3 ±2.3 (R), 21.2±2.2 [L]	20.6+1.8 (R) 20.6+1.9 [L]	-	-	-	-	-
Riya Narwani [15]	-	1.81 – (R) 1.89- (L)	0.96 (R) 0.97 (L)	0.79 - (R) 0.82 - (L)	-	-	0.20- (R) 0.22 – (L)
Soorya Sridhar [5]	19.27 ± 1.79 (R) 18.74 ± 2.71 (L)	19.18 ±2.56 [R] 18.61 ± 2.19[L]	9.00 ±1.59 (R) 8.77 ±1.439 (L)	6.53 ±1.65 (R) 6.58±+1.59 (L)	7.41 ± 1.46 (R) 7.61±1.69 (L)	7.63 ±1.52 (R) 7.68±1.74 (L)	-
Paul Puchwein n et al 2013 [4]	19 ±1.58	-	-	-	-	-	-
Archana Singh and Arun singh [6]	20.50 ±2.33	19.53±2.26	8.65±1.55	6.28 ±1.09	-	-	1.96±0.4 4
Suraj Ethiraj, Jyothi kc, Shalaja Shetty [12]	20.3±2.2(R) 19.9±1.7(L)	19.8±2.49 (R) 19.8±1.8[L]	8.6± 1.0 (R) 9.5±1.2(L)	7.1±7.2[R] 7.3±8.8[L]	8.5±1.1 [R] 8.7± 1.99 (L)	7.7 ±8.8 (R) 7.9±8.69 (L)	-
Chandni Gupta et al [13]	19.6 ± 1.8 (R) 18.7± 2.1 (L)	18.9±2.1 (R) 18.2 ± 2.1[L]	9.1 ± 1.0 (R) 9.0± 1.3 (L)	7.3±0.9 [R] 7.7± 1.4[L]	-	-	2±0.6 [R] 1.9 +0.51(L)
Present study	19.6 ±1.89 (R) 18.35± 1.94 (L)	18.88 ±2.17 (R) 18.38 ±2.019 (L)	9.86±1.67 (R) 9.55±1.92 (L)	7.19±1.14 (R) 7.89±1.214 (L)	8.5±1.67 (R) 7.9±1.3 (L)	8.38±1.5 (R) 7.81±1.2 (L)	2.34±0.6 [R] 2.57±0.5 6 (L)

Table 2A: Comparisons of morphometric dimensions with previous studies.
***All parameters measured in mm**

Study	Surface Area (SA)	Volume (VOL)	Ventral Curve (VC)	Posterior Curve (PC)	Medial Curve (MC)	Lateral Curve (LC)
G. Captier [14]	-	-	5.5	4.3	-	4.7
Anjana Mittal [7]	-	-	5.4	4.1	-	4./3
Archana Singh and Arun Singh[6]	331.37 ± 73.82	322.49±122.74	5.07 ±0.96	4.02 ±0.94	-	3.63±0.82
Chandni Gupta et al[13]	-	-	4.3± 0.5(R) 4.1 ±0.81(L)	3.2±0.6 (R) 3.2± 0.75 (L)	-	3.3±1.0 (R) 2.8±0.94[L]
Present study	193±57[R] 184.26 ±41.5 (L)	309±30[R] 275.3±117.6 (L)	5.9±1.1[R] 4.92± 0.76(L)	4.9±0.93(R) 4.3±0.7(L)	5.1±0.89(R) 4.8±0.9(L)	4.5±0.68(R) 4.38±0.76(L)

Table 2B: Comparisons of morphometric dimensions with previous studies
***All parameters measured in mm**

Posterior height was recorded in fewer studies. The lateral curve, anterior curve, posterior curve was also reported in fewer studies. Surface area was recorded only in fewer studies including that conducted by Archana Singh and Arun Singh. To our knowledge there is no other study which has taken Medial curve morphometry into consideration.

The results for the Anteroposterior diameter, Transverse diameter, Medial height, Lateral height recorded in the present study were similar to the previous studies done by Chandni Gupta et al[13], Suraj Ethiraj [12], and Surya Sridhar[5]. The results for anterior height were similar to Suraj Ethiraj et al [12] The results for Thickness of ventral curve were similar to Archana Singh and Arun Singh [6]. All these studies were conducted on Indian population. The results recorded in the western population showed higher values. The mean diameter of head was reported as 23±1.4 [14]. In another study, the mean values of Ventrodorsal and transverse diameters of the radial head were observed as 21.6±2.9 and 21.0±2.7 respectively [16]. It was observed that the radial head diameter ranged between 22.8±1.9mm maximum and 21.8 ±1.9mm minimum by using computerized tomographic studies.

Broadly speaking our study corroborates to the dimensions of studies conducted on Indian population and differ from western studies thus emphasizing the racial variations in the morphometry of head and designing the prosthesis in accordance with the specific population. Further, the size of the prosthetic implant should accurately match the size of the head of radius as mismatch can result in various complications including valgus deformity and overstuffing of the radiocapitellar joint [4] and may not be able to restore the complex anatomy of proximal radius [16].

Also, these measurements also are of immense clinical significance. It has been observed that the height of the circumference of head is greatest on medial side 9.86±1.67 [R] 9.55±1.92 [L] in the present study as well as the previous studies [Table 2A]. The greater height of the medial sides responsible for the cam effect during rotation at proximal radioulnar joint. If the height on medial side is greater than normal, it will cause a reduction in the degree of supination and pronation. When this height is decreased there is a predisposition for upward displacement of head of radius.

As a result, the radioulnar ligaments and the interosseous membrane becomes lax increasing the instability of the joint [18,19]. The diameter of superior articular surface is very important deciding factor responsible for flexion at elbow joint. If the articular surface is large, flexion may be impaired. Head of radius if does not fit properly in radial fossa, there may be wearing of articular surface during movement and ultimately hampering the movement of elbow joint [20].

CONCLUSION

The present study of morphometry of radial head in North Indian population in hundred dry adult human radii revealed that the APD, TD were lesser by 2mm to 3mm as compared with western studies. The VC and the PC in the western studies were lesser by 0.4mm and 0.6mm respectively as compared to the current study.

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Original Article

CORRELATION OF INFLAMMATORY CYTOKINE INTERLEUKINE (IL-4) AND MATRIX-METALLOPROTEINASE-9 IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

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ABSTRACT

Introduction: Chronic Obstructive Pulmonary Disease (COPD) presents with respiratory symptoms caused by airflow obstruction. Parenchymal abnormalities, constricted airway and inflammation are major causative factors associated with COPD. Proteases such as matrix metalloproteinases (MMP) and a pleiotropic cytokine Interleukin-4 (IL-4) play an important role in lung tissue remodeling. However, there is a dearth in studies correlating the levels of MMP9 and IL-4 in patients of COPD. This study aims to evaluate the serum levels of MMP-9 and IL-4 in COPD and correlate with clinical characteristics of COPD patients.

Materials and methods: This case control study pre-screened 134 participants of which 40 were healthy and 94 were COPD patients from the Department of Pulmonary Medicine at the Prasad Institute of Medical Sciences Lucknow.

Results: Significantly increased level of Serum MMP-9 (212.6 ± 75.5 ng/ml) were detected in COPD group as compared to the control group (97.5± 45.6 ng/ml). Also, the IL-4 levels were significantly different in the control group

Conclusions: Detection of higher levels of MMP9 and IL-4 in patients suffering from COPD in the present study implies that these biomarkers could serve as markers for understanding the depth of COPD development and therapy.

Keywords: Matrix metalloproteinases (MMP), Interleukin-4 (IL-4), COPD

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is characterised by persistent respiratory symptoms and restricted airflow. Shortness of breath and a cough that may or may not produce mucus are the prominent symptoms [1]. As COPD progresses, simple tasks like dressing or walking become more challenging. [2] Although COPD cannot be cured, it can be prevented and treated. Airflow blockage, a characteristic of COPD, a diverse lung disorder, is not entirely reversible. The main causes of airflow restriction in COPD are thought to be structural abnormalities in the lung parenchyma, tiny airways, and inflammation [3]. Smoking, which is a major contributor to COPD, is a risk factor for the disease. In addition to genetics, environmental variables can have an impact on COPD. (4)

In COPD lung tissue remodelling, the extracellular matrix renewal is known to be regulated by a class of proteases called matrix metalloproteinases (MMP) [5] Gelatinase B, commonly known as MMP9, has a molecular weight of 92kD. It is secreted by alveolar macrophages, neutrophils, eosinophils, mast cells, and bronchial epithelial cells during the inflammatory events in COPD. Numerous MMPs have been found to play a role in the lung pathology, MMP-9 is the predominant protease in alveolar tissue and because of its easy detection and quantification, it has attracted the attention in MMPs. Inflammation modulates the protease/antiprotease balance leading to progressive airway destruction as well as remodelling. MMP 9 is not produced in healthy lung tissue, however, during the inflammatory events of COPD, alveolar type II cells, bronchial epithelial cells, clara cells, endothelial cells, fibroblasts and smooth muscle cells produce MMP-9, as well as the leukocytes in the lung. [6] MMP-9 degrades elastin and promotes further lung damage which can promote inflammation in COPD [6]. Overall, these mechanisms support the role of MMP-9 as a key mediator in COPD.

A pleiotropic cytokine is interleukin (IL)-4, commonly referred to as B-cell-stimulating factor. It primarily stimulates the growth of T cells and causes B cells to produce antibodies. It also causes fibroblasts, endothelium, and epithelial cells to proliferate, differentiate, and become activated. It also boosts the recruitment of inflammatory cells (7). However, few studies investigated the inflammatory cytokine levels and MMP 9 level in patients with COPD. In the present study, we aimed to evaluate the serum levels of MMP-9 and IL-4 in COPD and correlate with clinical characteristics of COPD patients.

MATERIALS AND METHODS

We have 134 participants that were pre-screened for this case-control study, wherein 40 healthy controls and 94 COPD patients were drawn from the Department of Pulmonary Medicine at the Prasad Institute of Medical Sciences Lucknow after taking due permissions. Prior to enrolment, all participants were provided written information and their consent was taken. The study's methodology was approved by the University Ethical Committee of Subharti University, Meerut, where the study was registered.

The inclusion criteria for COPD patients and Controls were as follows

COPD - Age 40 – 75 years and Patient who has symptoms of a persistent cough, sputum production, or dyspnea, and/or a history of exposure to risk factors for the disease.

Controls - Healthy volunteers who will be non-COPD based on their medical-history, clinical examination

Non-tobacco users, non-occupational exposure

Severity Grading of COPD

Patients who had a persistent cough, dyspnoea, a history of exposure to COPD risk factors, a forced expiratory volume in one second (FEV1) to forced vital capacity (FVC) ratio of less than 0.7, and reversibility by inhaled bronchodilators in FEV1 of less than 12 percent or 200 mL after two puffs of 200 mg salbutamol administered with a pressure metered-dose inhaler with spacer were considered to have COPD. GOLD guidelines [10] were used to establish the diagnostic criteria for COPD. For GOLD-1, the predicted FEV1 percentage is ≥ 80 %; for GOLD-2, the predicted FEV1 percentage is between 50 – 79 %; for GOLD-3, the predicted FEV1 percentage is 30 – 49 %; and for GOLD-4, the predicted FEV1 percentage is less than 30 %.

RESULTS

Forty healthy control and 94 COPD patients were included in the present study. Mean age of the control group was 52.6 ± 7.46 and the COPD group was 61.3 ± 7.64. In the control group 21 (52.5%) were male and 19 (47.5%) female. In the COPD group 68 (72.3%) males and 26 (27.6%) females were enrolled. In the COPD group 13 patients were current smoker and 32 were non-smoker, while the rest were ex-smokers. COPD patients were divided into GOLD grade 1 (n=18), grade 2(n=68), grade 3(n=6), grade 4 (n=2). (Table 1)

Significantly increased level of Serum MMP-9 (212.6 ± 75.5 ng/ml) were detected in COPD group as compared to the control (97.5± 45.6 ng/ml) and also significantly increased level of IL- 4 (136.3 ± 20.1 ng/l) were present in COPD group (213.79 ± 100.52 ng/ml) as compared to the control group (51.1 ± 7.5 ng/l) (Fig. 1). The levels of MMP 9 and IL-4 increased significantly as the grading increased from 1 to 4. (p=0.001)

The level of IL-4 positively correlated with FEV1/FVC (r=.217 ,p= 0.036) and those of MMP 9 also positively correlated with FEV1/FVC (r=.252 ,p= 0.014). (Fig. 2)

DISCUSSION

In this population-based study, COPD patients had significantly higher serum MMP-9 and IL 4 compared to the healthy control subjects. MMP-9 may play a fundamental role in the aetiology of COPD. According to a prior study, MMP-9 was adversely linked with the degree of airway blockage (11). A population-based COPD cohort study found a correlation between MMP-9 and productive cough and decreased FEV1 (forced expiratory volume in first sec). Furthermore, the burden of tobacco smoking exposure, assessed as number of pack years, was associated with increasing MMP-9/TIMP-1-ratio in both COPD and non-COPD, indicating

Parameter	N= 94
Age mean (minimum – maximum)	61.3(21- 72)
Gender Male Female	 68(72.3%) 26(27.6%)
GOLD grading 1 2 3	18 (13.4%) 68(50.7%) 6(4.5%) 2(1.5%)
Socio economic status Lower middle	 58(61.7%) 36(38.2%)

Table 1 . Demographical and Clinical characteristics of the COPD population.

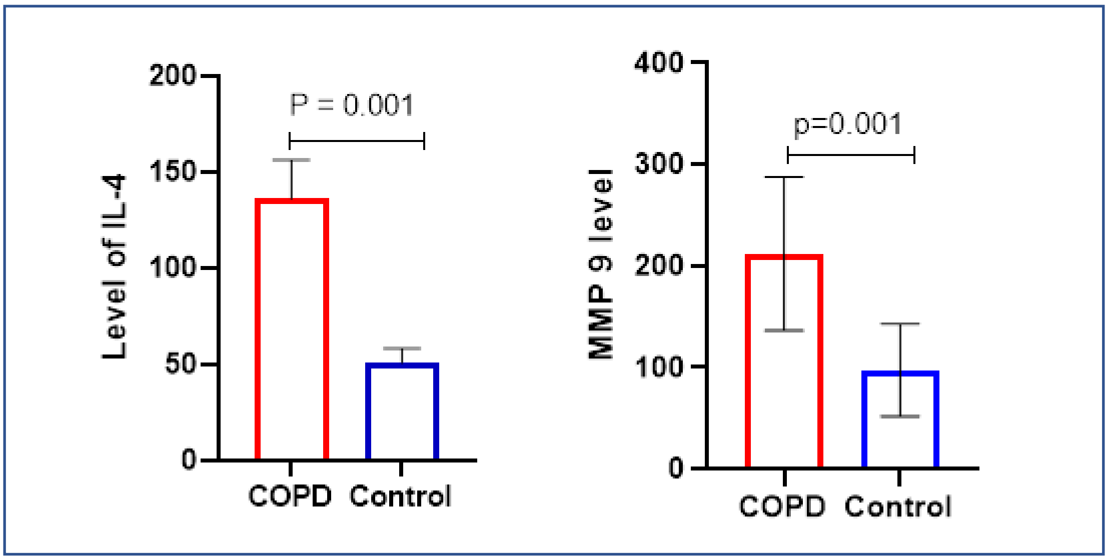

Figure 1. Correlations between plasma inflammatory cytokine levels and MMP-9 and pulmonary function indexes

a tobacco smoke-induced increase in proteolytic activity, independent of sex, age and FEV1. According to a recently published study of 80 women with COPD and 40 controls, not only smoking, but also exposure to biomass combustion, was related to differences in metalloproteinases, including increased MMP-9 and MMP-9/TIMP-1 ratio among those with COPD [12]. Small observational studies have demonstrated increased MMP-9 in COPD patients compared to controls, both in analyses of sputum [13], lung parenchyma [14] and serum [15].

To the best of our knowledge, this is the first study, in which serum MMP-9 has been analysed and also proved to be increased in a

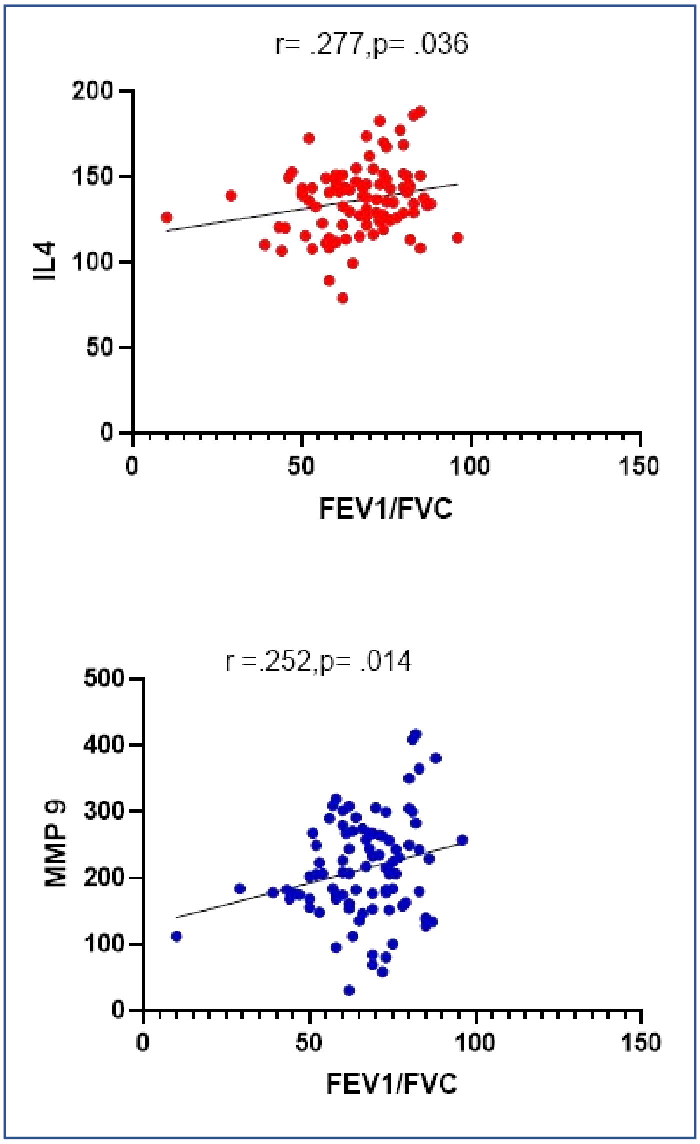

Figure 2. Correlations between plasma inflammatory cytokine levels (IL4) and MMP-9 and pulmonary function indexes

population-based COPD cohort. Furthermore, the association between serum MMP-9 and impaired lung function, assessed as FEV1, in COPD show that MMP-9 is related to disease severity which could indicate that MMP-9 is involved in the disease process in COPD.

Inflammatory cytokines

The result showed that the IL-4 levels were significantly different in the control group. As a pleiotropic cytokine, IL-4 plays a crucial role in type 2 T-helper responses and isotype class switching of B cells to IgE synthesis, and it has thus been suggested that IL-4 may have an important role in COPD pathogenesis [16,17] Serum MMP-9 and IL-4 expression rose in the current experiment, and this trend was similar with GOLD grade. All of these markers have a favourable correlation with COPD patients.

These findings indicate that MMP-9, and IL 4 are closely related to the pathogenesis of inflammation and airflow limitation in the progression of COPD.

CONCLUSION

Patients with COPD had higher serum levels of MMP-9 and IL 4. With the GOLD Grading the elevated levels of MMP-9, IL 4 were discovered, demonstrating the correlation between these biomarkers and the severity of airway limitation in COPD. These findings imply that they could serve as markers for understanding the depth of COPD development and therapy.

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Journal of Anatomical Sciences (U.P. Chapter of Anatomical Society of India)

Original Article

COMPREHENSIVE STUDY OF ANATOMICAL VARIATIONS OF RENAL ARTERY ON HUMAN CADAVERS WITH ITS CLINICAL SIGNIFICANCE

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ABSTRACT

Introduction: Renal artery is a paired branch of abdominal aorta at level of L1-L2. It divides into anterior and posterior branches. In maximum number of people this division into anterior and posterior branches takes place near the hilum but variation can be seen. Variations of renal artery is common and have different names such as supernumerary, accessory or aberrant. It is important for surgeons to have knowledge about such variations.

Materials and methods: In the Department of Anatomy, Subharti Medical College, Meerut, Uttar Pradesh, India 60 human adult cadavers were dissected and 120 kidneys along with their arteries were studied and observed for variations.

Results: Out of 120 specimens, supernumerary renal arteries were seen in 25 right kidney and 24 left kidneys. Out of 25 right supernumerary renal arteries 16 are of aortic origin and 9 are of renal origin. While in 24 left supernumerary renal arteries 14 are of aortic origin and 10 are of renal origin.

Conclusions: Elaborate knowledge of course along with variations in course of renal artery is of prime importance for any general surgeon, urologists, transplant surgeon or radiologist.

Keywords: Renal artery, supernumerary, abdominal aorta

INTRODUCTION

Kidney is one of the vital organs of the body and is supplied by renal arteries. Renal arteries are paired arteries which take about 20% of the cardiac output to supply the organs. They branch from the abdominal aorta laterally at right angle just below the origin of superior mesenteric artery. Near the hilum of the kidney, both left and right renal arteries divide into anterior and posterior branches [1]. The renal artery shows variations in respect to its origin, diameter, obliquity and its relations [2,3].

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According to Merklin and Michele classification, variations of renal artery can be given the following terms like supernumerary, aberrant or accessory [4]. Aberrant and accessory renal arteries are both types of extra renal arteries. Aberrant arteries supply the kidney without passing through the hilum while an accessory artery passes through the hilum and then supplies the kidney [5]. Nomenclature of supernumerary renal arteries is according to the area through which they enter the kidney. If the supernumerary artery enters the kidney through the hilum, it is called hilar supernumerary artery (HSA) and if it enters through superior pole and inferior pole, it is called upper polar supernumerary (UPSA) and lower pole supernumerary artery (LPSA) respectively [6-8]. Elaborate knowledge of such variations is important for urologists and transplant surgeons performing kidney transplants and this knowledge is also important for radiologists.

MATERIALS AND METHODS

In the Department of Anatomy, Subharti Medical College, Meerut, Uttar Pradesh, India, 60 human adult cadavers were dissected for routine dissection conducted for undergraduates and 120 kidneys along with their arteries were studied over a period of 3 years. Variations in renal arteries were studied and noted. As the present study was conducted on cadavers dissected for routine teaching of undergraduate students, no ethical committee clearance was needed. Variations in renal arteries were studied and classified into single renal artery and supernumerary renal artery. Further supernumerary renal artery was observed for its origin from aorta, main renal artery or any other structure.

RESULTS

Table 1 shows the presence of single and supernumerary renal artery in 60 pairs of dissected kidneys or 120 kidneys. Out of 120 kidneys single renal artery was present in 71 specimens (35 right and 36 left) and supernumerary renal artery was seen in 49 specimen (25 right and 24 left).

Out of 49 supernumerary artery 30 (16 right and 14 left) were of aortic origin and 19 (9 right and 10 left) were of renal origin. Out of 30 supernumerary renal arteries with aortic origin, 15 (8 right and 7 left) were hilar supernumerary artery (HSA), 11 (6 right and 5 left) were upper polar supernumerary (UPSA) and 4 (2 right and 2 left) were lower pole supernumerary artery (LPSA). Out of 19 supernumerary renal arteries with renal origin 9 (5 right and 4 left) were hilar supernumerary artery (HSA), 6 (2 right and 4 left) were upper polar supernumerary (UPSA) and 4 (2 right and 2 left) were lower pole supernumerary artery (LPSA).

DISCUSSION

In the present study, out of 120 kidneys supernumerary renal arteries were found in 49 (40.83%) cases which was higher in comparison to the study by Gupta et al (28.33%) [9] and Saldarriage et al (24.90%) [10]. On the other hand, it was found comparable to the study done by Eisendrath et al (45%)[11] and Rupert et al (61%)[12]. In our study incidence of supernumerary renal arteries of aortic origin was 25% which was more than the renal origin (15.83%). This result is similar

No. Of ARTERY	RIGHT KIDNEY	LEFT KIDNEY	TOTAL
SINGLE ARTERY	35 (58.33%)	36 (60%)	71 (59.16%)
SUPERNUMERARY ARTERY	25 (41.66%)	24 (40%)	49 (40.83%)
	60	60	120

Table 1: Number of renal arteries

Supernumerary artery		Right kidney	Left kidney	Total
(A) Aortic origin		16 (26.66%)	14 (23.33%)	30 (25%)
	HSA	08 (13.33%)	07 (11.66%)	15 (12.5%)
	UPSA	06 (10%)	05 (8.33%)	11 (9.16%)
	LPSA	02 (3.33%)	02 (3.33%)	04 (3.33%)
(B) Renal origin		09 (15%)	10 (16.66%)	19 (15.83%)
	HSA	05 (8.33%)	04 (6.66%)	09 (7.5%)
	UPSA	02 (3.33%)	04 (6.66%)	05 (4.16%)
	LPSA	02 (3.33%)	02 (3.33%)	04 (3.33%)

Table 2: Supernumaray renal artery

to the study done by Talvoic et. al. [13], as in their study, supernumerary renal arteries of aortic origin were 30.65% and of renal origin were 12.82%. Our study showed slight right sided dominance in supernumerary renal artery which were seen 41.66% on right and 40% on left, while in the study done by Libertino et. al. [14] left side dominance of supernumerary renal artery was seen.

According to our study upper polar supernumerary artery was seen in 13.33% specimens which was higher than lower polar supernumerary arteries (6.66%). This was similar to the result seen in the study done by Budhiraja V et. al. [6]. In their study, superior polar arteries were seen in 13.1% specimens and inferior polar arteries was seen in 7.1% specimens. While in a study done by Sampaio and passos [15] superior polar arteries were seen in 6.8% specimens and Inferior polar arteries in 5.3% specimens.

CONCLUSION

Renal artery is subjected to show variations. Elaborate knowledge of course along with variations in course of renal artery is of prime importance for any general surgeon, urologist or transplant surgeons. It is also important for radiologist to know about such variations because many times, it is slightly difficult to identify accessory renal artery by angiographic investigation as they can be misdiagnosed as capsular or adrenal arteries. Therefore, it is important to have knowledge about such variations via cadaveric studies.

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Case Report

STERNALIS - VARIATION OF CLINICAL IMPORTANCE

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ABSTRACT

This case report concerns the presence of an accessory anterior thoracic wall muscle during routine dissection in the Department of Anatomy, Vardhman Mahavir Medical College & Safdarjung Hospital, New Delhi. A 59 year old male cadaver was being dissected, when a unilateral accessory muscle was found parallel and lateral to the right margin of sternum. Accidental encounter with Sternalis, one of the many names used to denote this muscle, made it apparent that such anatomical variations is not uncommon. A descriptive knowledge of such common anatomical variations is both essential and crucial in realizing that not any human body is alike. Besides theoretical interest & academic curiosity, the implications of these variations is indispensable in diagnostic and surgical disciplines.

Keywords: Sternalis, Rectus sternalis, Chest wall, Muscle variation, Human anatomy, Mammography, rectus sternalis, anatomical variation, breast augmentation, reconstruction, mammography, medical education, Sternalis, Chest, Breast, Surgery, Radiography, Mammogram.

INTRODUCTION

Sternalis is a well documented anatomical variation, that presents itself as a parasternal mass between the superficial fascia of the anterior thoracic wall and the pectoral fascia. It is prevalent in 7.8% of the general population with most cases occurring unilaterally on the right side. [1] Its prevalence differs among different geographic populations with a maximum of 11.1% prevalence in the Asian population. [2] Having said that it is present in more than one tenth of our population, along with its clinical implications, Sternalis muscle stresses the importance of having a knowledge on anatomic variations.

OBSERVATIONS

This case report concerns the presence of a Sternalis muscle in a cadaver, found during routine dissection, in the Department of Anatomy, Vardhman Mahavir Medical College & Safdarjung Hospital, New Delhi. The muscle presented itself as an accessory anterior

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thoracic wall muscle on the right side. The 59 years old male cadaver that was being dissected, had a unilateral accessory muscle parallel and lateral to the right margin of sternum.

After defining the muscle, it is found to have a single belly, superiorly attached to the anterior surface of manubrium sterni. It ran vertically downwards for 15.5cm, covering the medial end of sternal part pectoralis major extending till the seventh coastal cartilage, inserting into the seventh coastal cartilage and external oblique aponeurosis.

The whole length of the muscle was flat with two surfaces and borders, except for the cranial 2.5cms which was cord-like, till it crossed the level of manubriosternal angle to become flat and fleshy. The maximum width of this sternalis specimen was 3.5cm inferiorly, near its insertion. The posterior surface of the muscle was pierced by an intercoastal nerve from the fifth intercoastal space, midway between both the ends of the muscle.

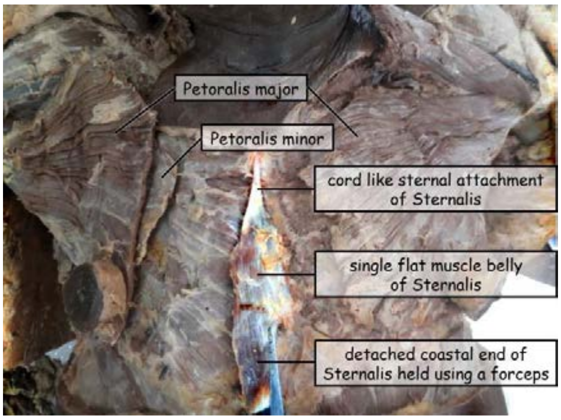

Figure 1: A dissected specimen of anterior thoracic wall with a right sided Sternalis muscle.

DISCUSSION

Dharma et al came across two cases of Sternalis muscle, also addressed as episternalis, presternalis, sternalis brutorum, rectus thoracis, rectus sterni, superficial rectus abdominis and japonicus, in a period of one year. They happened to miss a case of Sternalis in computed tomography, only to find it during mastectomy for breast cancer. But in the second case, they were shrewd to identify the sternalis muscle preoperatively on imaging. [3]

Gross Anatomy

Sternalis can be flat, cord like, flame like or irregularly shaped muscle present in the anterior thoracic wall. It is almost twice as commonly unilateral, and occurs more often on the right side. Its superior attachments can be sternum, inferior border of the cavicle, sternocleidomastoid fascia, pectoralis major and the upper ribs and their costal cartilages. Inferiorly the lower ribs and their costal cartilages, pectoralis major, rectus sheath and

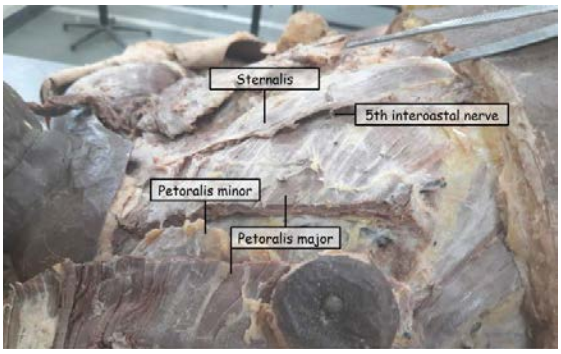

Figure 2: 5th intercoastal nerve piercing the Sternalis muscle, midway between its two attachments.

external abdominal oblique aponeurosis provide attachment.

Its superficial location makes it an ideal candidate for utilization as a muscular flap in plastic reconstruction of the head and neck region. [4]

Nerve supply

Sternalis seems to be innervated by the pectoral (medial or lateral) (51.9%) or intercostal nerves (43.1%). In a few cases (5.0%) both these nerves were found to innervate the muscle. The blood supply is primarily derived from the internal mammary perforators. [1]

Sonne et al, suggested that the medial pectoral nerve must provide the primary nerve supply to Sternalis via small branches that travel in the deep fascia and these branches can be easily mistaken for connective tissue membrane. He also suggested that the intercoastal nerves piercing the Sternalis muscle must be providing cutaneous innervation. It is to be remembered that the intercoastal nerves have more of GSA fibers while the pectoral nerves have more of GSE. [5]

Classification

Since its description by Cabrolius in 1604, several variations in the muscle have been noted and a classification system was put forward by Jelev et al. With the identification of more variants of the muscle, elaborate classification systems were put forward by Raikos et al, Ge et al and Snosek et al. But even in after all these years, a new variant has been identified with three muscle bellies and demands a much detailed classification. [6,7]

Clinical Anatomy

Sternalis muscle may lead to diagnostic dilemma during breast surgery, mammography, computed tomography and magnetic resonance imaging scans where it can mimic tumour. [4]

A cross sectional study by Zina et al, which involved more than 200 doctors majority failed in identifying the Sternalis muscle on a CT and anatomy figure and the most common wrong answer was pectoralis muscle. [8]

During a procedure of mastectomy with free flap reconstruction for breast cancer in a 56 year old female, an aberrant Sternalis muscle was found to be present that was not recognized preoperatively. Though Akyurek et al managed to see through an uneventful procedure, an idea was put forward to use Sternalis as a muscle flap wherever possible. [1]

Naohiro et al goes on to describe a case of breast reconstruction after total mastectomy that presented a challenge with Sternalis muscle. In the case, a loose adipose tissue in connection with Sternalis muscle presented with a caudal lesion of 5cm, making it difficult to use the tissue expander. Eventually Naohiro and team successfully repaired the lesion using an untied suture technique. Besides causing a diagnostic dilemma during examination and investigations, its evident that sternalis has also complicated simple procedures. [9]

Embryology

Snosek et al, in his paper classifying the variants of Sternalis muscle, describes that sternalis is derivation of the pectoralis group of muscles. Interestingly, he affirms this hypothesis by taking into account P.S. Abraham's study of 11 anencephalic fetuses of which six had sternalis muscles. Four among these cases had sternalis muscle closely related to underdeveloped pectoralis major muscle. But it was ambiguous which was the cause and which was the effect, underdeveloped pectoralis muscle or the presence of sternalis muscle. When taking into account the hypothesis that branches of medial pectoral nerve supply the sternalis muscle while the intercoastal nerves simply take a course in close relation to sternalis muscle to end up providing cutaneous innervation, the hypothesis that sternalis muscle develops from the pectoral muscle mass becomes irrefutable. [10]

Phylogeny

When hypothesizing the phylogeny of sternalis muscle, it is important to look at a few similar muscles present in other species. First, there is a rectus abdominis muscle extending from around the cranial end of sternum to pubis, an abdomino-thoracic musculature. Such a rectus abdominis muscle helps in stabilizing the animal when it lands on all four limbs. This can be found in salamanders (urodeles) and langurs (old world monkeys native to the Indian subcontinent). Secondly, there is a rectus thoracis muscle extending from around the sternoclavicular joint to the lower ribs. There it continues with the rectus abdominis muscle which inturn extends from the lower ribs to pubis. Rectus thoracis muscle helps in inspiration and is present in cows (ruminants), horses (equines) and apes (hominids). Eventually Andrew et al affirms that sternalis is an evolutionary modification of these rectus muscles. [11]

CONCLUSION

If it was not for coming across the most common variant of a typical sternalis muscle during routine dissection, it is possible to have remained unaware of the fact that Sternalis is an anatomical variation of clinical importance with its implications affecting both the diagnostic and surgical departments. Though the phylogenetic and embryological details about sternalis are still being debated, besides its nerve supply, it is evident that, to avoid a diagnostic dilemma, intraoperative complications and to make use of an anatomical variation in various procedures, it is imperative to possess the knowledge on Sternalis.

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