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A Study of Variations in the origin and course of Radial Artery

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Abstract: *Anatomical variations of Radial artery are of potential clinical implications during vascular and reconstructive surgeries. The cause of abnormal radial artery origin and superficial course may be developmental and genetic. Intended intravenous injections may lead to unintentional intra-arterial injections if superficial radial artery is mistaken for veins. The aim of the present study is to identify the variations of radial artery in its origin in routine cadaveric dissections in the department of Anatomy , Siddhartha Medical College, Vijayawada, NRI Medical College, Chinnakakani and ACSR Govt. Medical College, Nellore. 96 specimens of upper limb were dissected and observed the following variations. From the third part of Axillary artery, Radial artery was found to be originated bilaterally and its course is superficial.. In the middle of the arm radial artery arised from the medial side of the brachial artery bilaterally where it crosses the median nerve and its course is superficial. In the middle of the arm , Radial artery has taken its origin from the lateral side of the brachial artery unilaterally crossing the median nerve near its origin and its course is superficial. Before cardiac procedures, thorough knowledge about the normal anatomy and expected variations of radial artery should be known to cardiac surgeons as the radial artery is the second most commonly used graft in coronary bypass surgeries in place of great saphenous vein and also for trans-catheter coronary interventions.*
Key words : *Radial Artery, Variations, High Origin*

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I. Introduction :

Variations of radial artery in its origin are commonly encountered in routine dissections. Due to the superficial course of radial artery iatrogenic trauma may occur and can cause potential life threatening haemorrhage. Radial artery is the smaller terminal branch of brachial artery. It begins 1 cm below the elbow joint at the neck of radius, traverses medial to and under cover of brachioradialis It is palpable between the flexor carpiradialis medially and anterior border of radius laterally. It passes between the two heads of 1st dorsal interrosseus muscle and enters the palm, anastomoses with the deep branch of ulnar artery to form the deep palmar arch. The proximal part lies underneath the brachioradialis muscle . Superficial branch of radial nerve lies close to the middle part of radial artery. Distal third of radial artery lies between the tendons of brachioradialis and flexorcarpiradialis[1].

Superficial location of radial artery is one of the causes for its usage in Percutaneous Coronary Angioplasty (PTCA) when compared to brachial or femoral arteries because of its easy access, lower risk and minimal complications. As it is superficially located haemostasis can be secured easily just by local compression [2]. Radial artery has also been used in cosmetic surgeries as forearm flaps [3]. Radial artery grafting during CABG and Radial artery intervention during PTCA does not cause residual ischaemia in the respective hand due to existence of adequate collateral circulation by palmar arch [4].

II. Material and Methods:

After the approval of institutional ethics committee this study was carried out in 96 formalin fixed specimens in routine cadaveric dissection for 1st MBBS students in Siddartha Medical College, Vijayawada, NRI Medical College, Chinnakakani, ACSR Govt. Medical College, and Nellore. Dissection instruments were used for dissection of entire upperlimbs including axillary region according to the steps of Cunningham's manual. The variations of radial artery in the cadavers were tagged and photographs were taken. Specimens were numbered from 01 to 96. Each radial artery was studied with respect to its origin and its variations. All the observations were recorded and tabulated. Data was collected from 96 embalmed adult human cadaveric specimens belonging to both right and left sides and statical analysis was done using software graphpad.com. Data was expressed as percentage.

Observations

In 91 specimens (94.8%) of 96 upper limbs the origin of radial artery was observed to be normal, i.e; in the cubital fossa, below the level of intercondylar line of the humerus.

The following variations in the origin of radial artery were observed.

In 5 (5.2%) upper limb specimens the radial artery was found to be high in origin represented in Fig:1and Table:1 as V1,V2 and V3. In 2 (2.08%) upper limb specimens, radial artery was observed to be arised from 3rd part of axillary artery bilaterally(V1) where it crosses the brachial artery and median nerve in the proximal 1/3 rd of the arm and its course was found to be superficial. Brachial artery was found to be continued as ulnar artery in the cubital fossa and common interosseous artery was found to be originated from the ulnar artery (Fig No. 2 & 3). In the middle of the arm bilateral high origin of radial artery (V2) were noticed in one cadaver (2.08%) where the radial artery has taken its origin from the medial side of the brachial artery crossing the median nerve and brachial artery in the lower 1/3rd of the arm and its course was observed to be superficial. At the level of neck of radius, brachial artery was found to be terminated into ulnar artery and common interosseous artery (Fig No. 4).In the middle of the arm, high origin of radial artery (V3) was observed in one upper limb specimen (1.04%) where Radial artery has taken its origin from the lateral side of the brachial artery crossing the median nerve near its origin and its course was found to be superficial. In the cubital fossa, brachial artery continued as ulnar artery and common interosseous artery has taken its origin from the ulnar artery (Fig No. 5 & 6).

Figure 1

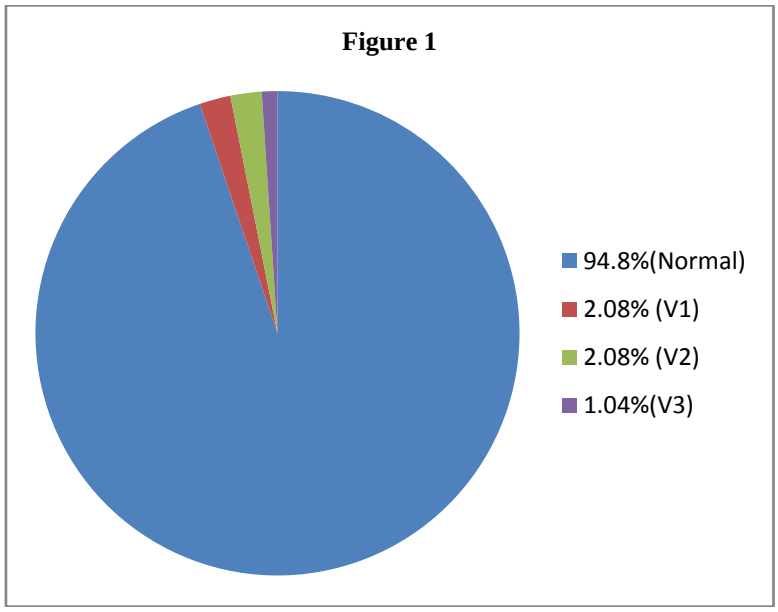
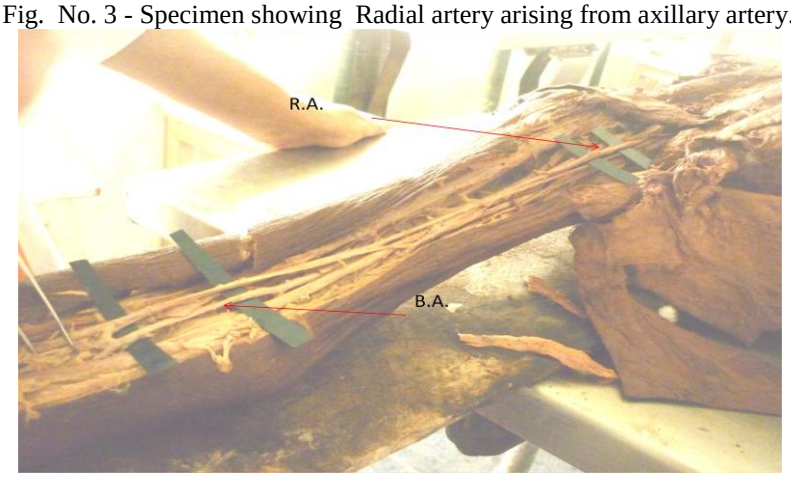


Fig. No. 2 - Specimen showing Radial artery arising from axillary artery

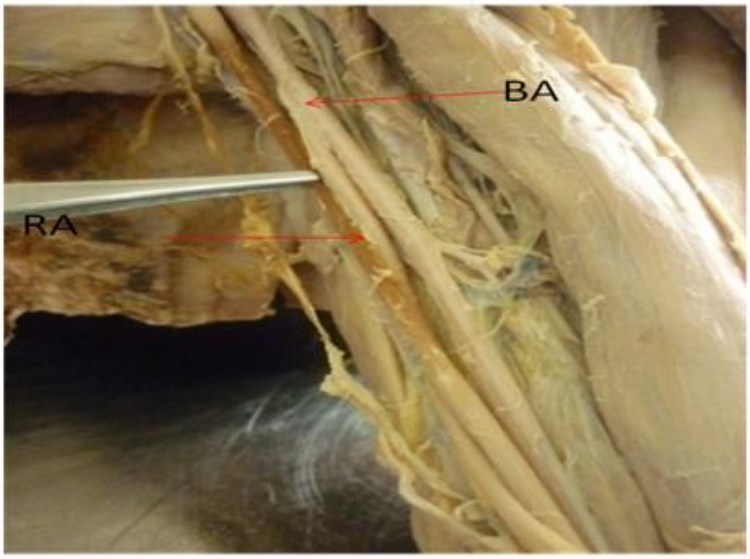
AA – Axillary Artery, RA- Radial Artery

Fig. No. 3 - Specimen showing Radial artery arising from axillary artery.



BA – Brachial Artery, RA- Radial Artery

Fig. No. 4 - Specimen showing Radial Artery arising from the middle of the arm

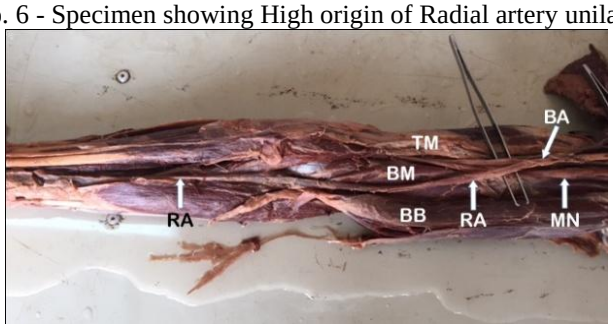


BA – Brachial Artery, RA- Radial Artery

Fig. No. 5 - Specimen showing High origin of Radial artery unilaterally

BA- Brachial Artery, RA- Radial Artery,
TM –Triceps Muscle, BM- Brachialis Muscle, MN –Median Nerve, BB – Biceps Brachii

Fig. No. 6 - Specimen showing High origin of Radial artery unilaterally



BA- Brachial Artery, RA- Radial Artery,
TM –Triceps Muscle, BM- Brachialis Muscle, MN –Median Nerve, BB – Biceps Brachii

Fig. No. 7 showing the Developmental stages of Upper limb arteries

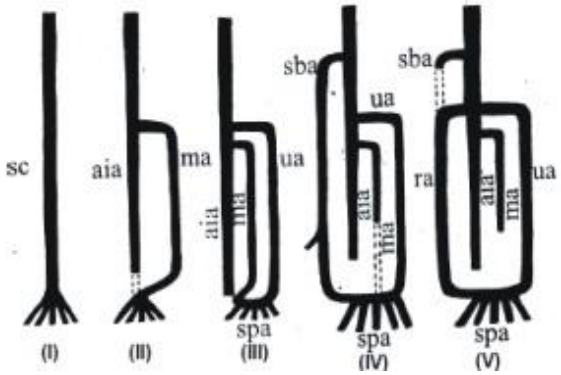


Table :1 showing the variations of Radial artery in its origin

Total Number of Specimens (n=96) **No. of specimens with variations(n=5)**		
	Variation	**Percentage(n)**
V1	Axillary origin of radial artery with its superficial course	2.08% (2)
V2	High origin of radial artery from the middle of the arm bilaterally With superficial course	2.08% (2)
V3	High origin of radial artery from the middle of the arm unilaterally With superficial course	1.04% (1)

III. Discussion

Radial Artery variations in its origin, course and branching pattern are of considerable importance during several clinical procedures and therapeutic practices. Von haller in 1813 noted arterial variations in the upper limb for the first time. The prevalence of frequent anatomical variations of radial artery in its origin was reported to be 14.26% in cadaveric studies and 9.75% in angiographic studies by S Karlsson et .al; [5]. P Jyosthna et al; reported that the variations of radial artery are more common in its origin and proximal course compared to its termination and distal course[6]. The occurances of variations are due to haemodynamics and genetically based. Haemodynamic persistence of superficial system over deep system causes persistence of embryological vessels(Figure:7). Senior and Singer have presented the earliest studies on variations in the arterial system and they concluded that anomalies of the arterial pattern of the upper limb are not uncommon [7, 8]. These anomalies may include aberrant origin or abnormal course or different branching pattern or unexpected relationships with surrounding structures and abnormal termination. Among all anomalies, high origin of radial artery and its branching pattern has gained importance clinically because awareness about high origin and abnormal branching pattern has very important clinical applications in the field of cardio-thoracic surgery, interventional cardiology and plastic surgery.

Radial artery arising from axillary artery bilaterally was reported as 3.25% by Rodriguez et al; and 3% by Konarick M et al; while Mc Cormack has reported as 2.13% [9, 10, 11]. The same variation was observed to be about 2.08% in this study which correlates with the findings of Mc Cormack et al; (table:2). Radial artery arising from the middle of the arm bilaterally was reported to be 5.9% by keen 1961, 2.13% by Keller 1980 and 3% by Miller RA [12, 13,14]. This variation was found to be about 2.08% in this study which correlates with the study of Keller 1980 (table; 3). High Origin of radial artery arising unilaterally with superficial course was reported by Rodriguez Neidenfuhr M as 0.5%, by Yang HJ as 2.3% and Yoo BS also described similar

observation of 2.4% in his study[15,16]. This variation contributes to 1.04% in the present study which correlated with the observations of Rodriguez Neidenfuhr M (table: 4).

High origin of radial artery and its superficial course have several implications during interventional and reconstructive procedures of upper limb. Surgeons should have adequate knowledge about these variations to avoid complications during orthopedic, vascular and reconstructive procedures. Radial artery arising high may cause significant difficulty in transradial approach during percutaneous coronary interventions. Diami et al; reported that high origin of radial artery and its superficial course is vulnerable and prone for injury during venepuncture and surgical procedures while the advantage of superficial location helps the surgeon to do arterial grafting and cardiac catheterization in an easier way [17].The possibility of compression of median nerve by the variant radial artery could be misdiagnosed as radiculopathy and neuropathy[18].

Table-2 Comparision of V1(radial artery arising from axillary artery bilaterally with superficial course) with different studies.

Rodriguez-Niedenfuhr	Konarick.M (2009)	Mc.Cormack (1953)	Present Study
3.25%	3%	*2.13%	*2.08%
Present study correlates with the study of McCormack 1953 (2.13%)			

Table: 3 Comparision of V2 (radial artery arising from middle of the arm bilaterally with superficial course) with different studies

Keen 1961	Kellers 1980	Millers RA	Present study
5.9%	*2.13%	3%	*2.08%
Present study correlates with the study of kellers 1980(2.13%)			

Table: 4 Comparision of V3 (high origin of radial artery unilaterally from the middle of the arm with superficial course) with different Studies.

Rodriguez-Niedenfuhr M	Yang HJ	Yoo BS	Present Study
*0.5%	2.3%	2.4%	*1.04%
Present study correlates with the study of Rodriguez-Niedenfuhr M(0.5%) .			

IV. Conclusion

• The present study demonstrates about 5.2% of variations in the origin and course of Radial artery. Familiarity about these variations is vital to interventional cardiologists, interventional radiologists, vascular surgeons and plastic surgeons in order to avoid dangerous complications during diagnostic or therapeutic procedures and promote good post-procedural outcomes of the patients.

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