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Clinico-Anatomical Study of an Anomalous Axillobrachio-palmar Artery: A Rare Arterial Duplication

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Methods Fifty cadaveric specimens of axilla were studied thoroughly to identify a rare, undocumented anomalous duplication of axillary artery of upper limb.

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Clinico-Anatomical Study of an Anomalous Axillobrachiopalmar Artery: A Rare Arterial Duplication

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Conclusion Precise anatomical description of such variant branches can prove to be a boon for surgeons and radiologists performing different procedures in the axillary region. Procedures like brachial plexus blockade, radical axillary lymph node clearance and arterial stump based flap reconstruction have gained popularity in recent times and can be performed without causing unwanted complications by gaining thorough knowledge of axillary neurovascular anomalies.

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I. INTRODUCTION

Anatomical variations in the upper limb vasculature have been a topic of interest for anatomists, surgeons and radiologists owing to their significant clinical implications. Axillary artery is the continuation of subclavian artery distal to the outer border of the 1st rib to the lower border of teres major. To facilitate its anatomical description, it is divided into three parts by the pectoralis minor muscle. The first part of the artery is closely related to the axillary vein and the trunks of the brachial plexus. The second part lies deep to the pectoralis minor and the third part being distal to the lateral border of the same muscle.(1) The artery is conveniently described to give six branches from its different parts. The origin, number and course of these branches are subject to considerable variations.(2, 3) Precise knowledge of anomalous anatomical disposition

of branches of axillary artery is of utmost importance to the surgeons to avoid unwanted iatrogenic complications during surgical procedures of axilla.

II. MATERIALS AND METHODS

Fifty meticulously dissected, formalin fixed cadaveric axillary specimens of both sexes were studied for course and branching pattern of axillary artery and any undocumented anatomical variation (14 female and 36 males). Classical incisions were given to expose the artery and retain all its branches.

III. RESULTS

In a detailed pilot study of the axillary artery in fifty cases, a unique case of duplication of axillary artery was noted in the third part. The third part of axillary artery gave rise to an anomalous artery (AA) which coursed through the arm and forearm and terminated in the palm to form an incomplete superficial palmar arch. AA was accompanied by a venae comitantes in its entire course.

In the axilla, this anomalous artery took origin 1.8 cms proximal to the origin of posterior circumflex humeral artery and 1.5 cms above the union of the medial and lateral roots of median nerve (fig 1). The AA was the lateral most structure in the axilla, medial only to the musculocutaneous nerve.

In the arm, AA coursed superficial to the coracobrachialis muscle, continued to course on the biceps brachii muscle and gave it a muscular branch to finally reach the cubital fossa. In the upper one third of arm, the median nerve was sandwiched between the AA and the brachial artery. Interestingly, in the lower third of the arm, the AA coursed obliquely to cross the median nerve and brachial artery superficially from lateral to medial side to finally become the medial most structure in the cubital fossa.

In the cubital fossa, the AA was the medial most structure, lateral only to the basilic vein (fig 2) and provided two prominent cutaneous branches to the skin of the cubital fossa. The AA coursed further in the forearm to lay along its medial border, superficial to flexor carpi radialis (FCR) and flexor digitorum superficialis (FDS). Here, the AA gave one muscular branch to the Palmaris longus and two muscular

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branches to the FDS. It coursed between FCR and flexor digitorum profundus and continued along the medial border of FCR to enter the carpal tunnel to reappear in the palm (fig 3). Just above the proximal border of flexor retinaculum, the AA was medial to the median nerve and radial artery.

In the palm, the AA displayed bifurcation, 2.3 cms distal to the radial styloid process, into a medial and a lateral branch. The medial branch joined the superficial branch of ulnar artery which formed an incomplete superficial palmar arch. The lateral branch continued as a proper digital branch to the middle finger (fig 4, fig 5).

IV. DISCUSSION

Course and branching pattern of axillary artery frequently show variations and there are several detailed studies in the literature to highlight this.(4) The present study describes a unique undocumented anomaly of the axillary artery in the arm, forearm and palm with prominent muscular branches from the AA and also its valuable arterial contribution to the hand. Axial artery of the upper limb is derived from the lateral branch of seventh cervical intersegmental artery. This axial artery further divides into axillary, brachial, radial and ulnar arteries.(5) Anatomical variations in the axillary artery branching is a result of developmental disturbance in the formation of the upper limb vascular plexus. Anomalous branches may arise from the artery as a result of excessive branching of the vascular bud.(6) The upper limb arteries develop in five stages. An axial arterial pattern represented in the adult by axillary artery, brachial artery and interosseus artery of the forearm develops first while other branches develop later from the axial system. In the later stages the median artery branches from the anterior interosseous artery and the ulnar artery branches from the brachial artery respectively. In the further course of development a superficial brachial artery arises from the axillary artery and it continues as radial artery. Regression of the median artery and an anastomosis between the brachial artery and superficial brachial artery with regression of the proximal segment of the latter gives rise to the definitive radial artery. The anomalies can be explained by the persistence of embryological vessels.(7, 8) Genetic constitution, fetal positioning in-utero and abnormal musculature can also be the etiological factors for abnormal vascular development.(9) Studies have shown that anomalies of the vascular pattern cause delay in palmar arch differentiation.(10)

A strikingly rare anomaly is for the axillary artery to duplicate in the axilla into brachial artery and a superficial artery which in the past has been referred to as superficial brachial artery.(11) In the present study, a rare anomalous artery (AA) branched off from the third part of the axillary artery and demonstrated significant

differences in its course, relations and branches as compared to the previously described variant branches of the axillary artery. Studies report the duplication of third part of axillary artery into brachial and superficial branches. The reported incidence of such bifurcation is 0.12- 3.2 %. The superficial branch terminated in the cubital fossa.(12) Bifurcation of axillary artery into almost equal size trunks has also been reported. The superficial among the two continued as the brachial artery. The abnormal deep trunk bifurcated into a common circumflex humeral- subscapular trunk and a profunda brachii artery.(13) Studies describe a rare case of axillopalmar artery replacing the superficial palmar arch with regression of the ulnar artery.(14) Literature holds evidence and description of five to eleven branches arising directly from the axillary artery, the most common number being eight.(15) Two to seven branches arising from the axillary artery have also been reported in the literature.(16) A high division of radial artery together with superficial palmar arch formed entirely by the ulnar artery has been reported.(10) Interestingly, in our case the AA itself contributes to the formation of superficial palmar arch by joining it at its termination. The superficial palmar arch was thus formed by the medial branch of the AA and superficial branch of the ulnar artery whereas the lateral branch of the AA continued as proper digital branch to the medial side of the middle finger. Such arterial variations need to be identified as they may pose a surgical challenge to the plastic and orthopedic surgeons operating in the region of forearm and hand. The superficial position of the AA as in the present case may make it extremely vulnerable to trauma and at the same time easily accessible for cannulation procedures. Knowledge of such anomalous Axillobrachiopalmar arteries is significant for the plastic surgeon while raising a radial or ulnar artery flap.(17) In a previous study, the superficial branch of the anomalous axillary artery gave no branches to the neighboring structures in the arm.(18) However, in our case the AA gave numerous muscular and cutaneous branches throughout the arm and forearm and finally terminated in the palm. This study aims at providing an insight into the clinically relevant variations of axillary artery and contributes additional data to existing anatomical literature. Accurate knowledge of axillary arterial variations becomes eminent for performing reparative and angiographic procedures as upper limb arterial flaps and reconstructive surgeries are gaining popularity in the recent times.(19, 20) Presence of such occult branches of axillary artery can become a hindrance, especially in cases of arterio-venous fistulae, lymph node clearance and arterial aneurysms.(21) Orthopedic relocations of dislocated shoulder joint can cause injury of such variant branches of axillary artery, especially if they are adherent to the articular capsule.(22)

V. CONCLUSION

We as anatomists, opine that such anomalous arterial patterns may lead to confusion in interpretation of angiographic patterns which in turn may cause life threatening complications. Abnormal branching pattern of axillary artery may also present an abnormal relationship to brachial plexus and other neurovascular structures. The variations in the origin, course and branching pattern of the Axillobrachiopalmar artery is hence impertinent for accurate diagnostic interpretation.

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Figures:

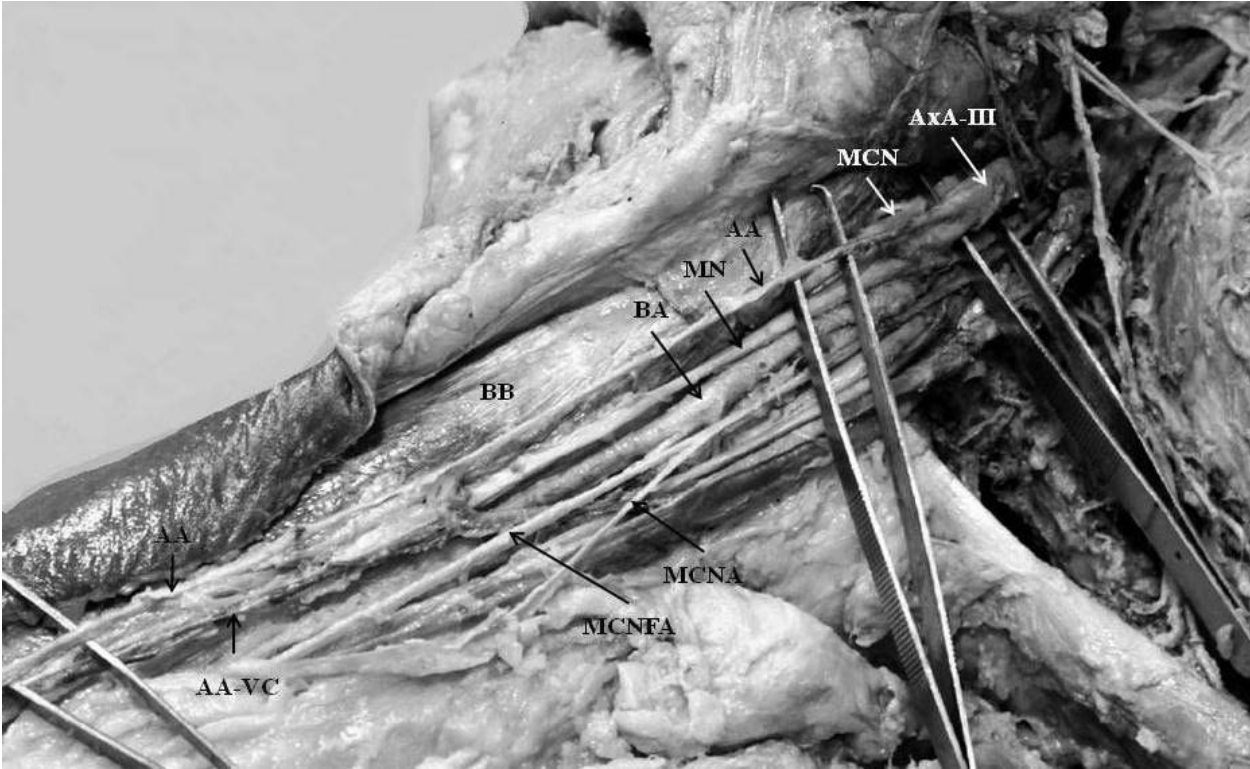


Figure. 1

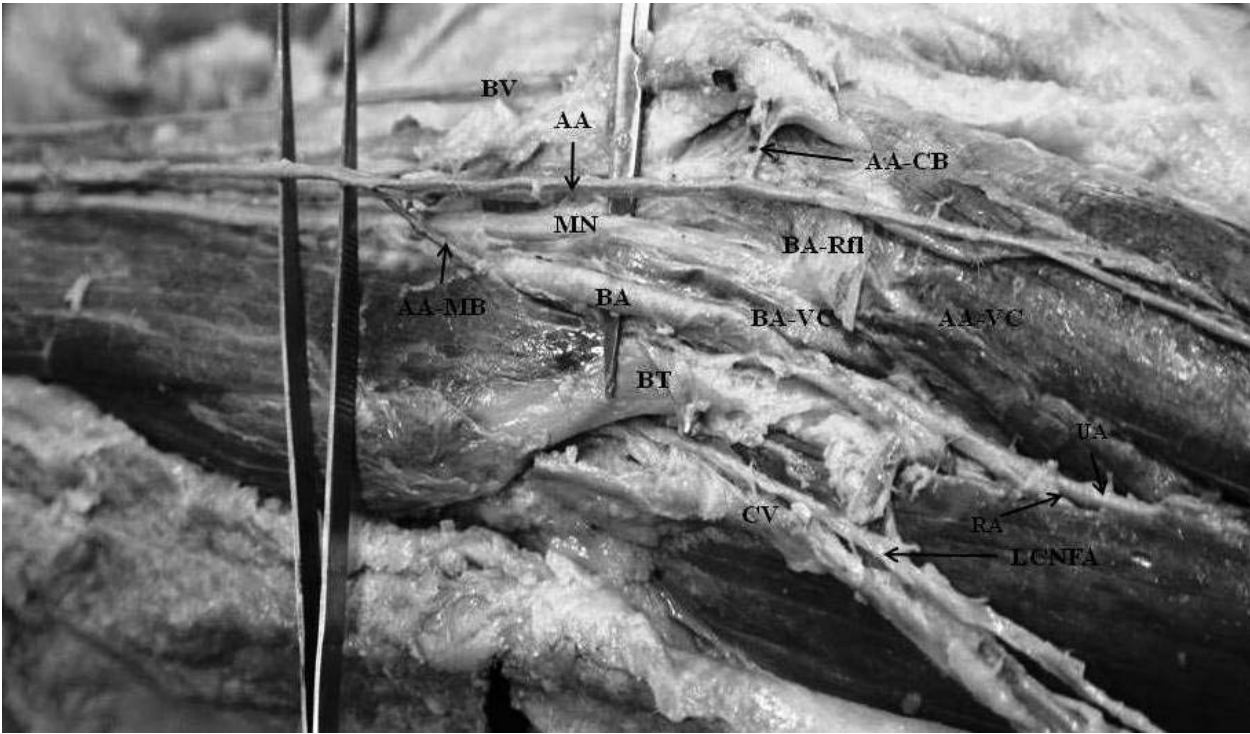


Figure. 2

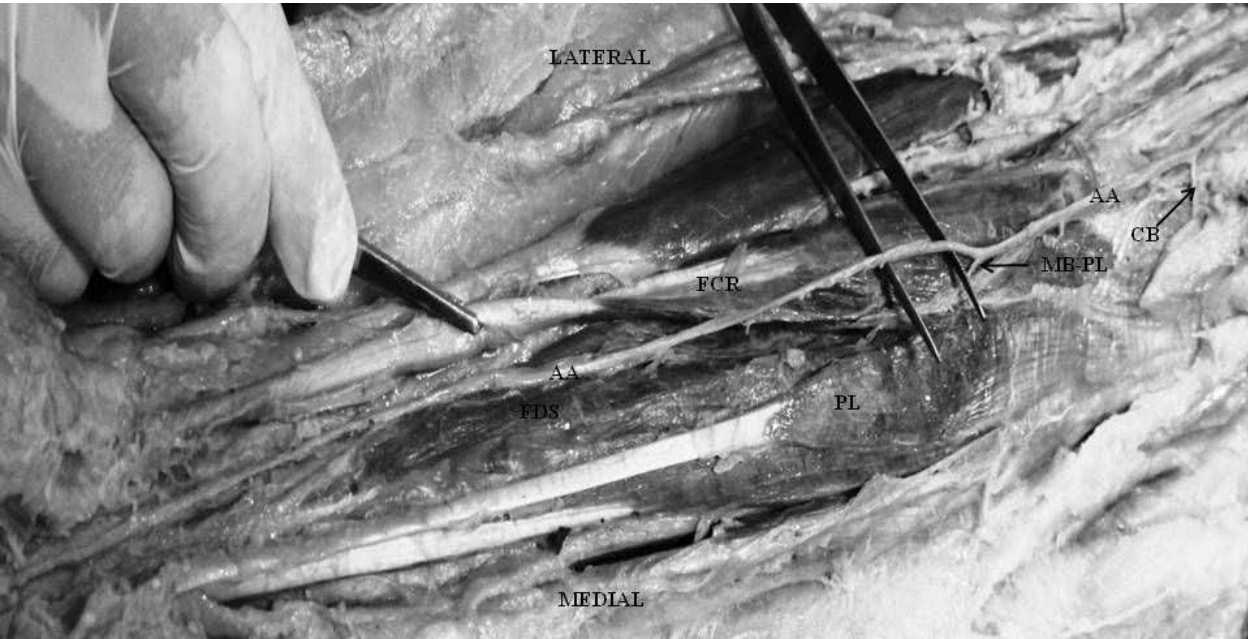


Figure. 3

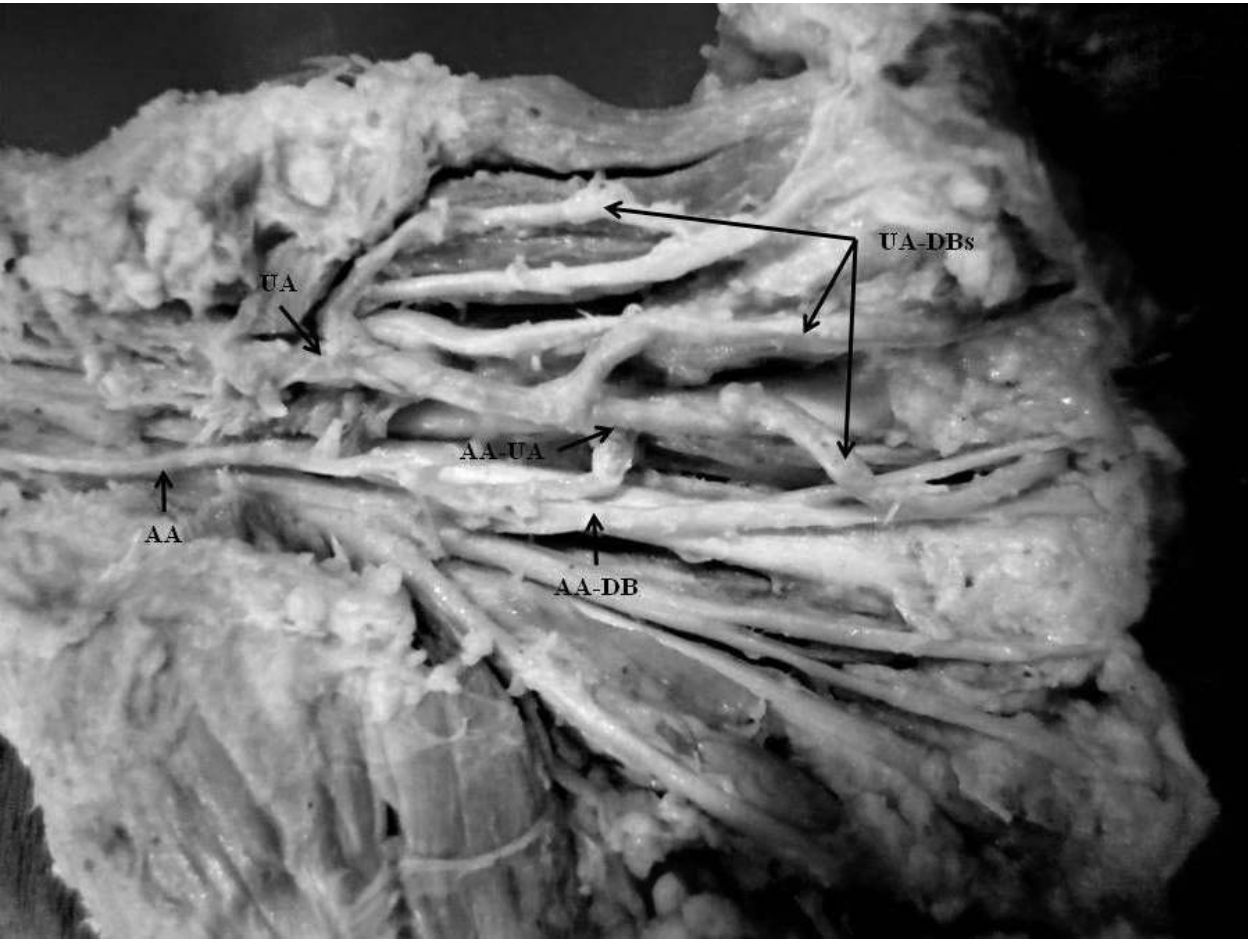


Figure. 4

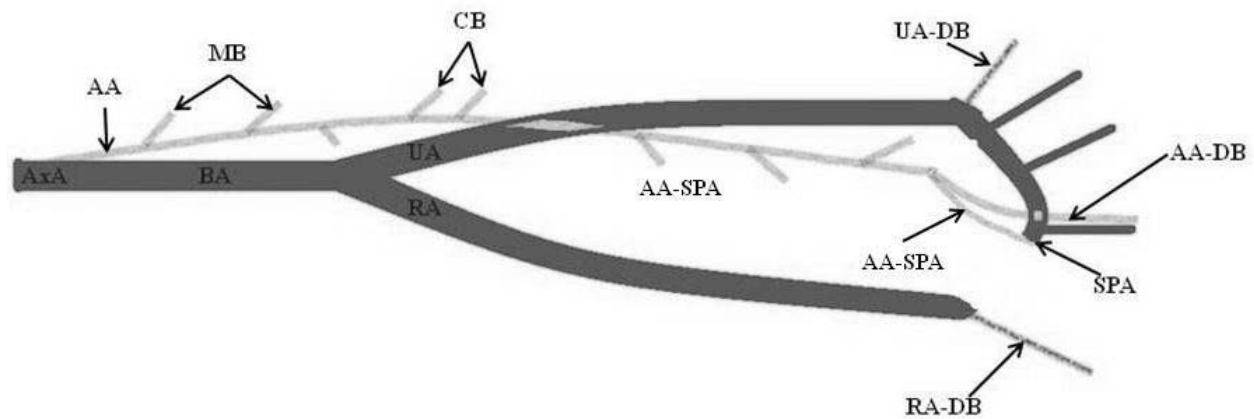


Figure.5

Figure Legends

Fig. 1 shows the origin of the anomalous artery. AxA-III- third part of axillary artery, MCN- musculocutaneous nerve, AA- anomalous artery, MN- median nerve, BA- brachial artery, BB- biceps brachii, MCNA- medial cutaneous nerve of arm, MCNFA- medial cutaneous nerve of forearm, AA-VC- venae comitantes of anomalous artery.

Fig. 2 shows the relations of the AA in the cubital fossa. AA-MB- anomalous artery-muscular branch, BA- brachial artery, BT- biceps tendon, CV- cephalic vein, LCNFA- lateral cutaneous nerve of forearm, BV- basilic vein, AA- anomalous artery, MN- median nerve, AA-CB- anomalous artery-cutaneous branch, BA-Rfl.- bicipital aponeurosis reflected, BA-VC- brachial artery venae comitantes, AA-VC- anomalous artery venae comitantes.

Fig. 3 shows the relation of anomalous artery in the forearm. AA-anomalous artery, PL-palmaris longus, FCR-flexor carpi radialis, FDS-flexor digitorum superficialis, CB-cutaneous branch, MB-PL – muscular branch to Palmaris longus.

Fig. 4 shows the termination of the anomalous artery. AA- anomalous artery, UA- ulnar artery, AA-UA- anomalous artery branch joining the ulnar artery, AA-DB- anomalous artery-digital branch, UA-DBs- ulnar artery-digital branches.

Fig. 5 AA- anomalous artery, AxA- axillary artery, BA- brachial artery, MB- muscular branches, CB- cutaneous branches, UA- ulnar artery, RA- radial artery, SPA- superficial palmar arch, AA-SPA- anomalous artery branch joining the SPA, AA-DB- anomalous artery-digital branch, UA-DB- deep branch of ulnar artery, RA-DB- deep branch of radial artery.