

# The Radio-Anatomical Study of Incidence of Aplasia and Hypoplasia of Anterior Cerebral Artery in the Region of Telangana

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## ABSTRACT

**Introduction:** The knowledge of cerebro-vascular variations is essential to the Radiologists, Neurologists, Neuro surgeons and Anatomists. The Anterior Cerebral Artery (ACA) which is a smaller terminal branch of Internal Carotid Artery (ICA) is known for its Aplastic and Hypoplastic variations which can surprise the surgeon on the operation table.

**Aim:** To evaluate and identify the aplastic and hypoplastic variations of ACA in Telangana population.

**Materials and Methods:** The present retrospective study was conducted by studying meticulously 150 Angiograms collected for a period of Jan 2017 to Jun 2018. In this study 1.5 Tesla MRI Machine (AVANTO of SIEMEN Ltd.) was used. Magnetic Resonance Angiogram (MRA) is used to detect all the possible vascular variations like aplasia, hypoplasia, aneurysms, infarct and thrombosis of cerebral blood vessels. After the collection

of data it was tabulated and statistically analysed. The data was compiled and descriptive analysis was done.

**Results:** The present study was conducted on 150 cerebral angiograms obtained from the people of Telangana. Six angiograms (4%) showed variations of ACA. Aplasia of ACA was seen in three cases. Bilateral aplasia was seen in one case. Unilateral aplasia (Right side) was seen in two cases. Hypoplasia of ACA was seen in three cases which were all unilateral (Left side).

**Conclusion:** In the present study, the incidence of aplasia and hypoplasia of ACA was 4%, aplasia was observed in three angiograms (2%) and hypoplasia was observed unilaterally on the left side in three angiograms (2%). This study also involves examination of MRI and MRA for the incidence of various variations like aplasia, hypoplasia of ACA.

**Keywords:** Angiograms, Cerebral arteries, Variations

## INTRODUCTION

The ACA which is the smaller terminal branch of ICA and is connected to the corresponding artery of the opposite side by an Anterior Communicating Artery (ACoA). Both the ACA and ACoA form anterior part of circle of Willis [1].

ACA supply blood to the midline portion of cerebrum on either side. The ACA lucidly described in three segments A1, A2, A3 [1] for better understanding of its branches and different cerebral areas nourished by it. A1 Segment of ACA is the part from its origin to its junction with the ACoA and A2 Segment of ACA is the part that extends from ACoA to the origin of callosal marginal artery and A3 Segment of ACA is the part distal to the origin of callosal marginal artery [1].

The knowledge of Cerebro-vascular variations is essential for the Radiologists, Neurologists, Neuro surgeons and Anatomists. The ACA is known for its Aplastic and Hypoplastic [2] variations which can surprise the surgeon on the operation table. Besides, enhancing the academic interest a thorough knowledge of all these possible aplastic and hypoplastic variations of ACA will also make the surgeon more confident to handle the unusual situations with confidence rather than surprise. A1 segment hypoplasia is common anatomical variant in such case the contralateral A1 perfuses bilateral ACA territories. This association increases hemodynamic stress over ACoA, which predispose to the aneurysmal formation [3].

Ischemia of the area which is normally supplied by ACA can lead to symptoms like constant weakness and sensory loss in the lower limb and behavioural changes known as ACA syndrome [4], which is commonly diagnosed by MRA and this MRA at present is the safe, dynamic, non-invasive tool for imaging the vascular lesions. It is more sensitive for detecting brain abnormalities during the early stages of

disease like cerebral infarction, tumours, haemorrhages, vascular stenosis, occlusion, aneurysms, and arteriovenous malformations of cerebral blood vessels [5]. The present retrospective study was conducted on the Telangana population to evaluate and identify both unilaterally and bilaterally occurring aplastic and hypoplastic variations of ACA by MRA.

## MATERIALS AND METHODS

The present retrospective study was conducted by observing meticulously 150 MRA obtained from Telangana population for a period of Jan-2017 to Jun-2018 on patients with symptoms of TIA/ Ischemic Cerebral stroke.

In this study we used 1.5 Tesla MRI Machine (AVANTO of SIEMEN Ltd.). The present study focussed on the evaluation of incidence of aplasia and hypoplasia of ACA occurring both unilaterally and bilaterally.

Aplasia means absence of the artery/non-visualisation on MRA. Hypoplasia means thinning and shortening of an artery/reduced calibre of a vessel on MRA [4].

After the collection of data it was tabulated and statistically analysed. The data was compiled and descriptive analysis was done by using Microsoft excel software.

## RESULTS

The present study was conducted on 150 MRI and MRA. Out of which, six angiograms (4%) showed variations of ACA. They are tabulated in [Table/Fig-1,2] along with the percentage.

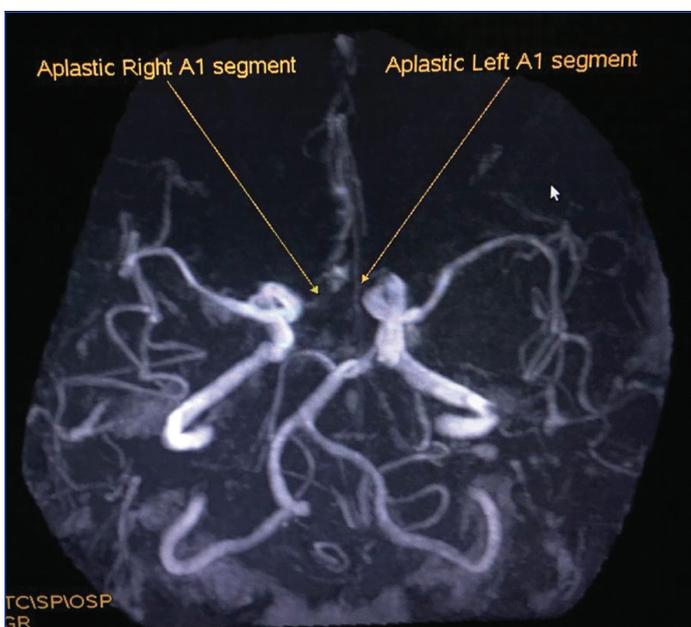
Aplasia of ACA was seen in three cases (2%) [Table/Fig-1]. Bilateral aplasia was seen in one case [Table/Fig-3]. Unilateral aplasia (Right side) was seen in two cases [Table/Fig-4]. Unilateral left sided hypoplasia of ACA was seen in three cases (2%) [Table/Fig-5].

Type of variation	Total Cases	Percentage
Aplasia	3	2%
Hypoplasia	3	2%

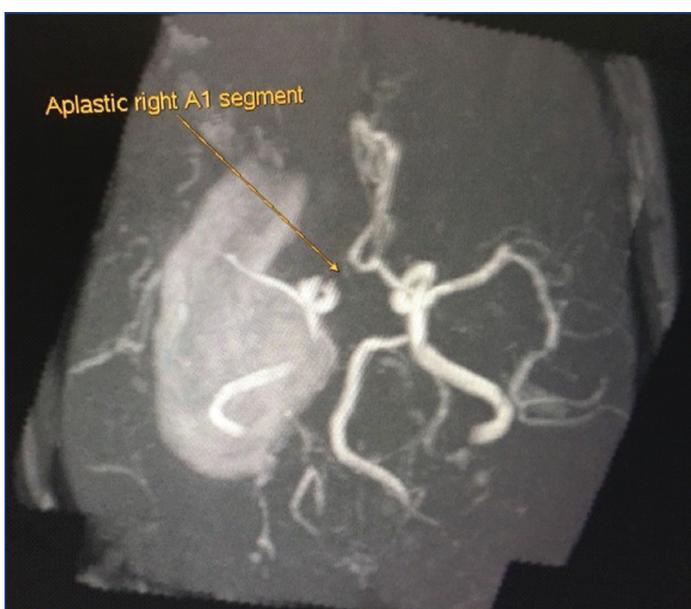
[Table/Fig-1]: Variations of Anterior Cerebral Artery (ACA).

Type of variation	Unilateral	Percentage	Bilateral	Percentage
Aplasia	2 (Right)	1.3%	1	0.6%
Hypoplasia	3 (Left)	2%	-	-

[Table/Fig-2]: Variations of Anterior Cerebral Artery (ACA).



[Table/Fig-3]: Bilateral aplasia of Anterior Cerebral Artery (ACA) (A1 Segment).

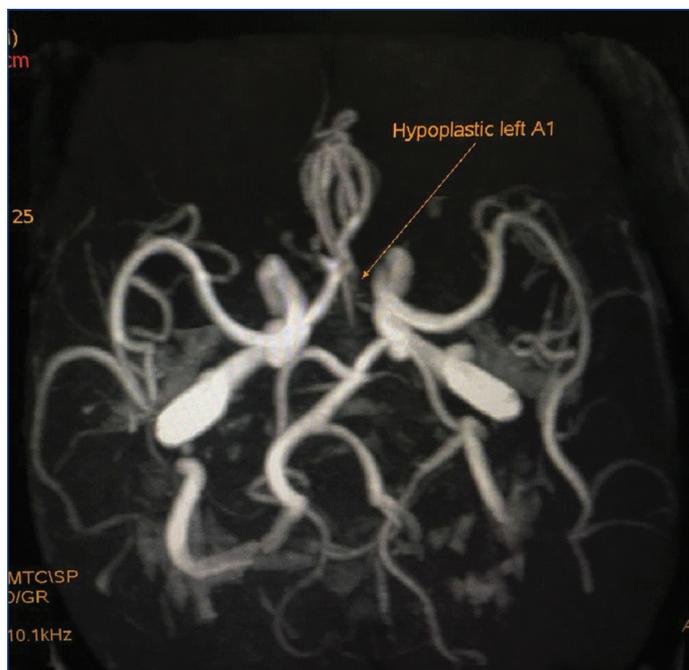


[Table/Fig-4]: Unilateral aplasia of Right Anterior Cerebral Artery (ACA) (A1 Segment).

## DISCUSSION

Variations of the ACA are common incidental findings visualised on MR/CT angiograms and are usually asymptomatic due to the presence of collateral circulation through opposite ACA and ACoA. But their identification is essential for surgical and endovascular treatment planning. Though most of these vascular variations are clinically insignificant, eventually may predispose to the development of aneurysms or ischemic events in these patients.

[Table/Fig-6] shows a wide range of difference in the incidence of aplastic variation of ACA in different ethnic groups [4,6-12]. Job C et al., observed that the aplasia of ACA was 0.9% after their study on ACA and its variations in 104 brain specimens [4]. Similarly Windle



[Table/Fig-5]: Hypoplasia of left Anterior Cerebral Artery (ACA) (A1 Segment).

BC et al., have found aplasia of A1 segment of ACA to be 1% after studying the arteries forming the circle of Willis in 200 dissected brain specimens [7]. However, the authors Uchino A et al., and Chuang YM et al., have observed a higher incidence of aplasia of ACA in cerebral angiograms which were 5% and 6% respectively [8,9]. The highest incidence of aplasia of A1 segment of ACA was 6.8% reported by Singh M et al., after studying 350 angiograms whereas the least incidence of aplasia of ACA was observed by Yasargil MG and Kamran A et al., and the results were 0.5% and 0.93% respectively [10-12]. In the present study aplasia of ACA (A1 segment) is 2% (three cases). Bilaterally in one case [Table/Fig-3] and unilaterally (Right sided) in two cases [Table/Fig-4].

Author/Reference	Place of Study	Ethnic Group	Total Cases	Percentage (%)
Job C et al., [4]	Kottayam and Ottapalam, India	Malayali	104	0.9
Kapoor K et al., [6]	Chandigarh, India	Punjabi	1000	0.4
Windle BC et al., [7]	Birmingham, England	White	200	1
Uchino A et al., [8]	Japan	Japanese	891	5
Chuang YM et al., [9]	Taiwan, China	Taiwanese	280	6
Singh M et al., [10]	Cuttack, India	Bonda	350	6.8
Yasargil MG et al., [11]	Zurich, Switzerland	German	200	0.5
Kamran A et al., [12]	Turkey	Turks	107	0.93
Present study	Telangana, India	Telugu	150	2

[Table/Fig-6]: Incidence of aplasia of ACA in different studies [4,6-12].

Job C et al., observed hypoplasia of ACA in 2.8% after their study on ACA and its variations in 104 brain specimens [4]. Similarly, Kapoor K et al., have found the hypoplasia of ACA was 1.7% after studying variations in the configuration of the circle of Willis in 1000 gross anatomy brain specimens [6]. However, the incidence of hypoplasia of ACA in the dissected brain specimens of Srilankan population was 5% which was reported by De Silva KR et al., after his study on prevalence of typical circle of Willis and the variation in the ACoA [13]. A high incidence of hypoplasia was observed in cerebral angiograms by several authors like Chuang YM et al., Singh M et al., Kamran A et al., and their observations are 6%, 10.5% and 8.4%, respectively [9,10,12]. However, the highest incidence of hypoplasia of ACA was reported by Yasargil MG which was 42% after dissecting 200 brain specimens [Table/Fig-7]. In the present study hypoplasia of ACA was seen in 2% (three cases). All of them were seen in left sided ACA [Table/Fig-5].

Study/Author	Place of Study	Ethnic Group	Total Cases	Percentage (%)
Job C et al., [4]	Kottayam and Ottapalam, India	Malayali	104	2.8
Kapoor K et al., [6]	Chandigarh, India	Punjabi	1000	1.7
Chuang YM et al., [9]	Taiwan, China	Taiwanese	280	6
Singh M et al., [10]	Cuttack, India	Bonda	350	10.5
Yasargil MG et al., [11]	Zurich, Switzerland	German	200	42
Kamran A et al., [12]	Turkey	Turks	107	8.4
De Silva KR et al., [13]	Sri Lanka	Sinhalese	225	5
Present study	Telangana	Telugu	150	2

**[Table/Fig-7]:** Incidence of hypoplasia of ACA in different studies [4,6,9-13].

In the present study no angiogram showed triple ACA. Whereas, Fawcett E et al., observed the presence of third ACA to be 0.3% [14]; similarly Kapoor K et al., reported the incidence of triple ACA to be 2.3% [6]. A high incidence of triple ACA was observed by Stefani MA et al., and Iqbal S et al., and their results are 4% and 6% respectively [15,16].

Hence, it is clear from the above stated results that the present retrospective study done in the Telangana population for the first time is strikingly different from the results stated by existing literature in different populations across the globe.

## LIMITATION

The sample size was limited (150) and collected from radiology department and concentrated only on the aplasia and hypoplasia of ACA.

## CONCLUSION

In the present study, the aplasia and hypoplasia of ACA was 2% each, and there was no triplication of ACA. Vascular variations like hypoplasia, aplasia, paucity, doubling, aneurysm, etc., can be detected by safe non-invasive and reliable techniques like MRI and MRA which were examined in this study.

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