

# Basilar Artery Tip Aneurysm: A Review

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## ABSTRACT

Patients with arterial aneurysms in the basilar tip location represent a therapeutic challenge. Various studies have shown the cause of Basilar Tip Aneurysm (BTA) as a multifactorial process which involves factors like genetic, anatomic, and environmental risk factors. The present review aims to discuss the risk factors, epidemiology, familial aneurysm, prevalence of basilar tip aneurysm and author's opinion on the importance of the role of radiology in the diagnosis and treatment of BTA.

**Keywords:** Angiogram, Familial aneurysm, Intracranial aneurysm, Subarachnoid haemorrhage

## INTRODUCTION

The formation of the basilar artery is at the confluence of the two vertebral arteries at the base of the medulla oblongata. The bifurcation angle of the basilar artery into two posterior cerebral arteries creates a particular zone of higher wall shear stress which leads to an aneurysm [1].

The formation of an aneurysm is multifactorial, and its precise path physiology is still questionable. Few authors have discussed the luminal forces and their role in the formation of an aneurysm [2]. Diogo MC et al., found that basilar artery aneurysm is less common among the patients with fetal-type Posterior Cerebral Artery (fPCA) with less haemodynamic stress [3]. It is believed that the vascular dilation caused by the focal weakness of the arterial wall results in an intracranial aneurysm [2]. The prevalence of an intracranial aneurysm increases with age from 1% to 10% for the saccular type of aneurysm [3]. Majority of the aneurysms are unruptured and asymptomatic; while few ruptured aneurysms end up with high morbidity and mortality rates [4]. Hence, the diagnosis of basal artery aneurysm in primordial level helps in prevention of its rupture.

## Literature Search

Two electronic databases (PubMed, and Google Scholar) were searched for BTA from their inception till November 2018. Keywords like Basal artery, Basal artery aneurysm, Basal artery tip rupture,

and treatment were used. The preferred citations were analysed, and systematic reviews on the Basal tip aneurysm topics were transferred to Mendeley Desktop app version 1.19.3 © 2008-2018. Citation tracking was completed for all the noted articles.

## Epidemiology

It is observed that Intracranial Aneurysms (IAs) in the adult population varies between 1-5% [2]. As per Vlak MH et al., the unruptured Basilar Tip Aneurysms (BTAs) show a prevalence of nearly 3% of all IAs [5]. As per Ujje H et al., the percentage of variations in unruptured aneurysms in the age group of 0-29 years was 1.1%, 40-49 years was 3.5%, 50-59 years was 5.7%, 60-69 years was 7.4%, 70-79 years was 6.1%, 80-89 years was 9.3% and 37.5% of unruptured aneurysm were observed in the age above 90 years or older [6]. Caranci F et al., in his review observed that the IA was more in women in comparison to men (3:1) [2]. [Table/Fig-1] describes various studies on BTA [1,3,7-14].

## Risk Factors

The BTA formation is a multifactorial process which includes genetic, anatomic, and environmental risk factors [15,16]. Histological decrease in the tunica media, the middle layer of the artery causes structural defects [2]. Cigarette smoking and hypertension as an acquired risk factor influence the pathogenesis of IA. Conditions like autosomal-dominant polycystic kidney disease, neurofibromatosis

	Authors	Year	Country	Radiographical Investigation	Patients	Findings
1	Wang C, et al. [7]	2018	China	Biplane angiographic equipment.	23	The LVIS stent represents a feasible and safe option for BTA
2	Abecassi.IJ, et al., [8]	2018	USA	MRI Angiogram	141 Ruptured=88 Unruptured=53	Clipping=48 Coiling=93
3	Pahl FH, et al. [1]	2017	Brazil	Angiogram Glasgow Coma Score (GCS)	43	Surgical clipping is considered the best treatment option
4	Qin H, et al. [9]	2017	China	3D digital subtraction angiography	67	$D_{max}$ to dome width and Energy Loss (EL) was the reason for the rupture of an aneurysm at the bifurcation.
5	Diogo MC, et al. [3]	2016	Portugal	Cather angiography	59	1. Hemodynamic stress is the cause of an aneurysm 2. fPCA is a protective variant for the formation of BTA.
6	Takano N, et al. [10]	2016	Japan	- MRA -3D TOF-MRA	7	-MRA Showed better result than 3DMRA
7	Akgul E, et al. [11]	2011	Turkey	Digital subtraction angiography	9	Dual Y-stent assisted coil embolization was done successfully
8	Urbach H, et al. [12]	2009	Germany	MR angiogram for unruptured. CT angiograms for ruptured aneurysms.	20	Along with enterprise stent, secondary stenting after coiling is better to reopen the artery.
9	Wakhloo AK, et al. [13]	2007	USA	A biplane neuroangiography system with the 3D capability (Artis; Siemens, Forchheim)	69	Complexed shaped platinum coil shows higher packing density, but it is a challenge for the basilar tip.
10	Lubicz B, et al. [14]	2013	Belgium	Single or biplane digital subtraction angiography	19	EVT of wide-neck bifurcation IAA with the WEB was feasible. (WEB is flow disruptor)

**[Table/Fig-1]:** Various studies conducted worldwide on basilar tip aneurysm [1,3,7-14].

$D_{max}$  is defined as longest dimension from the aneurysm neck to the dome tip

type I, Marfan syndrome, multiple endocrine neoplasia type I, pseudoxanthoma elasticum, hereditary haemorrhagic telangiectasia, and Ehlers-Danlos syndrome type II and IV are associated with the presence of an aneurysm [15]. With an addition to the above-causative genetic and environmental factors, the haemodynamic stress on arterial branch points and the outer wall of curved segments of cerebral arteries is thought to play a significant role in aneurysm formation. Also, haemodynamic stress is maximum at the basilar tip [5,17].

### Familial Aneurysm

An aneurysm is more prevalent among the first degree relatives of patients with Subarachnoid Haemorrhage (SAH) or IAs [5,18-21]. Familial aggregation of IA indicates that the rate of aneurysm formation is higher in some families than others [22]. The reason might be due to both genetic and shared environmental influences [20].

### Prevalence and Location of Aneurysm Rupture

Subarachnoid haemorrhage occurs due to the rupture of aneurysm especially at the bifurcation of the tip of the basal artery. The risk of the rupture is based on the location and morphology than the size of the aneurysm. The aneurysm depends on the morphology and has three determinants: a) Morphology; b) Haemodynamic; and c) Association of parent vessels and its relationship with nearby vasculature, the associated risk factors include the larger basilar vessel angle and parent-daughter vessel angle [4].

However, there has been increasing evidence for the importance of not only size but also of the location and morphology of an aneurysm in predicting rupture risk [23]. Regarding the independent risk factors for rupture, aneurysms of 7 mm or larger are associated with a significantly increased risk of rupture [23].

### Radiographic Investigation

#### Cerebral Angiogram

Cerebral angiography is a procedure for both diagnosis and treatment. In the procedure, the catheter is inserted, and contrast material is injected to examine the blood vessels. It gives a clear picture of the blood vessels of the basal and vertebral artery. It identifies abnormalities such as aneurysms and disease such as atherosclerosis (plaque) [24]. Advancement in the technology has given a vision for better understanding in the diagnosis of the anatomical 3D orientation of a cerebral aneurysm which gives a better view for therapeutics and prognosis. A 3D reconstruction of the volume data from MR and CT angiogram gives a detailed spatial resolution which gives a geometric configuration of the aneurysm [25]. Satoh T et al., found that evaluation of the aneurysmal neck complex with transluminal 3D MR and CT angiograms is a useful adjunct not only in clinical diagnosis but also in the therapeutic management of cerebral aneurysms along with surgical or interventional procedures [25]. Matsumoto M et al., mentioned the importance of CT angiography in detecting the aneurysmal neck, configuration of the sac and the arterial branches near the aneurysm [26] which helps the neurosurgeons in the diagnosis of complex-shaped aneurysms as well as in the planning of treatment (clip and/or coil placement) procedures [26].

The unruptured cerebral aneurysms are monitored using 3D CT angiography, and Magnetic Resonance (MR) is used for follow-up studies, but for better detection of the smaller size of aneurysm 3D CT angiography is better than MR angiography [26]. Satoh T et al., reports few limitations of the MR and CT angiography—firstly, the lumen of the small arteries are undetected; secondly because of change in the position of the brain parenchyma the images of operative view does not match; thirdly, the outer wall configuration of the aneurysm wall cannot be measured [25].

The measurement of the pressure on the aneurysm walls can be done using a two-dimensional finite element computer model. It gives three ideal shapes half spherical, spherical and pear-shaped aneurysm. There is variation in the radius of the parent artery and Reynolds number based on the ostium width of the parent artery. Few secular intracranial aneurysms are detected in their asymptomatic phase by the aid of non-invasive diagnostic imaging techniques, such as computed tomography, magnetic resonance angiography, and magnetic resonance imaging. Majority of unruptured and asymptomatic intracranial aneurysms have the tendency to grow thrombose and rupture [17].

### Intervention

The treatment of intracranial aneurysm is observed controversial to whether to treat surgically or manage endo-vascularly [16]. Interventional radiographic treatment includes the coil treatment in the ruptured aneurysm; it is treated with coils with the “balloon remodelling technique.” This type of treatment is preferred in the acute phase and in those aneurysms which cannot be closed; recanalisation is done in control angiography [27].

Tateshima S et al., conducted an in-vitro study of intra aneurysm flow dynamics using a clear acrylic Basilar Artery (BA) tip aneurysm model. It was prepared from a patient's 3D CT angiogram and was used to analyse flow modifications during one cardiac cycle. Flow velocity profiles were quantitatively evaluated using LDV; results showed that flow velocity and plasticity were higher in the aneurysm neck's inflow zone when compared with those in the outflow zone [28].

### CONCLUSION

Basal tip aneurysm is associated with various risk factors, few acquired risk factors like smoking and alcohol consumption are avoidable. Early detection of BTA and its treatment gives better prognosis. The author gives an insight in to the use of Angiogram, 3D tomography application, MRI angiogram, CT angiography in the treatment of BTA. Some of the modern techniques like Complex-Shaped Platinum Coils, Y stents coils can also be useful in the treatment of the aneurysm.

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