



## Case Report

## Angioplasty and Stenting of Intracranial Stenosis

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## ABSTRACT

Stroke is a major medical health problem. The goal of stroke prevention can be achieved by modification of vascular risk factors and by use of antiplatelet and anticoagulant drugs. Unfortunately many patients with intracranial disease are refractory to medical management. In recent past there has been significant advancement in intracranial angioplasty and stenting due to better understanding of the disease and availability of better tools and technology. We are reporting 2 cases with 3 lesions dealt with intracranial angioplasty with or without stenting with excellent clinical results, of which we have follow up of more than 1 year. In our cases there was no periprocedural morbidity and mortality with no restenosis till 2 years of follow-up. In addition it also adds to quality of life as evident in our patients. Cerebral angioplasty and stenting may be beneficial to manage an intracranial atherosclerotic stenosis and to improve quality of life of patients. This initial result for cerebral angioplasty and stenting is promising and requires further studies.

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## 1. Introduction

Stroke is a major medical health problem. It is the third leading cause of death and one of the leading causes of disability in adults. Majority (85%) are ischemic in origin. Stroke management targets prevention which is better than treating it. Lifetime costs per patient were in the range USD 11 787 for 'unclassified' stroke in Australia to USD 3035671 in stroke patients with untreated non-rheumatic atrial fibrillation in a UK setting (costs inflated to 2003 values). For the lifetime costs of ischemic stroke only, the range narrowed to USD 41257 in Australia and USD 104629 in the UK. These data confirm that stroke management is associated with a vast economic burden.<sup>1</sup> No correlation of lifetime cost of stroke with specific cost components or time horizon was identified. The cost of stroke is influenced by severity (more severe strokes cost more due to extended hospitalization), age (costs were

greater in younger stroke patients) and gender (direct costs were greater for women, but indirect costs were greater in men). With the recent encouraging evidence of interventions that reduce the incidence of stroke and reduced economic burden.<sup>1</sup> The goal of stroke prevention can be achieved by modification of vascular risk factors and by use of antiplatelet and anticoagulant drugs. However in patients with large vessel disease like carotid stenosis and vertebral artery stenosis, stroke prevention can be more effectively achieved by intervention like carotid endarterectomy or carotid angioplasty and stenting.<sup>2</sup> Intracranial stenosis accounts for additional 10-29% of stroke patients who can be benefited by revascularisation of stenotic vessels. Extracranial stenotic disease has better defined guidelines for the disease modification and has established practice guidelines.<sup>2,3</sup> In contrast to this intracranial atherosclerotic disease have no defined guidelines for medical or interventional treatment. Advancement of interventional neuroradiological technique has led to performance of transluminal angioplasty and stenting with reasonable

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safety. Of the all ischemic cerebrovascular disease 30-40% are extracranial, and 10-29% are intracranial stenotic disease.<sup>4</sup> There are racial difference in the incidence, western literature report it 8-10% while Chinese and korean literature shows 50-60% incidence.<sup>5</sup> Reliable data are lacking from Indian subcontinent. Unfortunately many patient with intracranial disease are refractory to medical management. Medical management are either antiplatelet or anticoagulation. WASID study reported slightly reduced rate of stroke with anticoagulation compared with antiplatelet but increased hemorrhagic complication.<sup>6</sup> Similar results were subsequently shown in WARSS study comparing antiplatelet and anticoagulant.<sup>7</sup> Despite adequate medical management, many patients suffer from recurrent TIA and stroke.<sup>8</sup> Intracranial vasculature differs from extra cranial vasculature in the form that it has thinner adventitia, inconsistent muscular layer and bathed in cerebrospinal fluid. Clinically intracranial stenotic disease like middle cerebral artery (MCA) present with fewer warning signs like TIA in 20 % only, compared to extracranial internal carotid artery disease (ICA) where TIA may occur in as high as 60% cases. Secondly MCA occlusion lead to stroke in 100% cases as comparison to stroke in approximately 60% cases in ICA occlusion<sup>9</sup> Thirdly annual risk of stroke in Intracranial stenosis is 5-15% in a prospective study,<sup>10</sup> while in a retrospective study it is as high as 10-24% in vertebrobasilar junction stenosis. Despite significant mortality and morbidity there is no established surgical or interventional treatment as randomised control trials are lacking. SAMPRIS TRIAL in Department of Neurosurgery, Vanderbilt University Medical Center, Nashville, TN, USA. failed to show benefit but Chinese,<sup>11</sup> and Indian trial Balloon angioplasty is a safe option and can be effectively used in patients of ICAD with acceptable risks and promising outcomes.<sup>12</sup> In recent past there has been significant advancement in intracranial angioplasty and stenting due to better understanding of the disease and availability of better tools and technology, it is now being preferred for high degree symptomatic stenosis failing maximal medical management. Present guidelines for intervention in intracranial stenosis are<sup>1</sup> patient with critical stenosis<sup>2</sup> failed medical management. In the past there has been suggestion that angioplasty is feasible but gives suboptimal results but stent plus angioplasty gives better results.<sup>13</sup>

We are reporting 2 cases with 3 lesions dealt with intracranial angioplasty with or without stenting with excellent clinical results, of which we have follow up of more than 1 year. To best of our knowledge this is the first study of intervention in intracranial stenotic disease from Indian subcontinent.

## 2. Case 1

A 24 years old male was admitted to the hospital because of recurrent neurologic symptoms. He had history of left sided hemi paresis involving face, arm and leg in April 2003. His vitals were normal. Neurological examination revealed normal level of consciousness and Broca's aphasia. He had left sided UMN type facial paresis with motor power in left upper as well as lower limb 2/5 with both planter being flexor. Sensory system was normal with no signs of in coordination. Complete blood count was normal and blood sugar, urea, and s. creatine were normal. Cardiac examination was normal including ECG and ECHO. Serum B12 level and homocysteine level were normal. His lipid profile was normal. His plain CT head showed two area of hypodensity suggestive of infarct in right basal ganglia and cortical area in MCA territory.

His MRI head also revealed same findings and additionally multiple hyperintensities were noted in subcortical region as well. Magnetic resonance angioplasty (MRA) revealed area of high degree stenosis at the origin of MCA on right side. During this time patient improved completely without any neurological deficit in a week time. He was put on oral anticoagulation and INR was kept at 2.5. Despite adequate anticoagulation patient had another episode of transient ischemic attack (TIA) 7 months later. At this time patient was referred to us and we subjected him to cerebral angiogram. Right internal carotid artery (RICA) angiogram revealed high degree stenosis at proximal M1 segment of MCA. Left internal carotid artery angiogram (LICA) revealed completely filling of left MCA and ACA and there is also filling of opposite MCA and ACA partially. In this patient first a wire was navigated then a ballon was gently inflated. Post angioplasty films reveals completely filling of right MCA and ACA territory. Patient is completely asymptomatic without any neurological deficit and enjoying a good quality of life at 2 year follow up.

## 3. Case 2

A 63 years old male had history of giddiness and imbalance in walking gradually evolving over 1-2 hour. His vitals were normal. Neurological examination revealed cerebellar sign on left side with power of 4/5 on left side. This persisted for 1-2 hour and he recovered completely on the same day. He was started with aspirin but he had reoccurrences of symptoms one month later and clopidigrel was added. But his problem persisted in the form that he used to feel giddy and developed a tendency to fall whenever he used to get up from supine or sitting position due to orthostatic giddiness. This led to apprehension so much that he curtailed his ambulation drastically. This disability made him bed bound for the majority of time. His MRI revealed an old PCA infarct. His MRA revealed

high degree stenosis at vertebra basilar junction on the right side while there was total occlusion on the left side. Cerebral DSA on right vertebral artery (RVA) angiogram showed high degree stenosis at VBJ with no filling of right posterior cerebral artery (PCA). On the left VA angiogram. There is complete occlusion of left vertebral artery (LVA). An angioplasty was done followed by stent placement across VBJ. Subsequent angiogram showed complete filling at VBJ and appearance of PCA after angioplasty and stenting. Patient had complete resolution of symptoms and ambulatory without any neurological deficit.

#### 4. Discussion

Intracranial balloon angioplasty has inherent complications such as intimal dissection, thrombus formation, re-coiling, and vessel rupture. To overcome these pitfalls, undersized balloon and slow inflation were used, but residual stenosis more than 50% and dissection were still reported in 16% and 14% of all cases respectively.<sup>14</sup> Since the time of first angioplasty in 1980s,<sup>15</sup> there has been rapid evolution in disease understanding and better tools leading to better outcome of intracranial angioplasty and stenting. Lee et al reported good results in 10 patients with symptomatic MCA stenosis but restenosis was 50%.<sup>16</sup> Therefore Terada et al compared results results of PTA alone and PTA with stenting and found later to be more effective in term of gains in the diameter achieved with the two.<sup>13</sup> A report by Jiang et al reported morbidity and mortality rate of 10% and 2.5% respectively with a technical success of 97.6%.<sup>11</sup> In SSYLVA study specifically designed for intracranial atherosclerosis, the stroke rate at 30days and one year were 6.6 and 13.1% only without any mortality. The restenosis was similar to coronary and peripheral vascular territory, of which majority (61%) were asymptomatic. This restenosis following neointimal proliferation carries lower thromboembolic rate than atherosclerosis.<sup>17</sup> This restenosis has been dealt with drug eluting stent with limited success<sup>18,19</sup> in their 6 year experience of intracranial stenting reported major neurological and periprocedural complication in 28% patients, 11% had disabling ischemic stroke, and 17% had intracranial haemorrhage. Despite of recent literature favouring use of stenting it remain investigational and controversial for intracranial stenosis.

Another potential risk following intracranial stenting is 'snow plowing' or stent jailing and compromise of perforator branch arteries. In study on 10 patients after stent placement no branch occlusion occurred and all major branch arteries were patent and no infarct occurred.<sup>20</sup>

Various study depicted in table shows varying incidences of morbidity and mortality. But these all study used limited flexibility balloon mounted stent delivery system deploying cardiological stainless steel stent in fragile intracranial vessels which has potential risk of shearing the stent off the balloon while navigating to target lesion and also

there is difficulty in accurately sizing the stent for vessel with different diameters. Recently there has been limited experience with the use of self expanding nitinol stent which are primarily used for aneurysm. This has advantage over balloon stent delivery system with stainless steel stent in as they can be navigated with better ease in tortuous, fragile intracranial vessels. This results in less intimal injury, less restenosis with good radial force.<sup>21</sup> In our cases there was no periprocedural morbidity and mortality with no restenosis till 2 years of follow-up. These two cases also depicts the difference in presentation of anterior circulation and vertebrobasilar circulation stroke as vertebrobasilar ischemia presents more often hemodynamic impairment during change of posture while anterior circulation more often occurs due to static obstruction to blood supply irrespective of posture, therefore vertebrobasilar slowly evolve with change of posture leading to repeated TIAs, impairing ambulation and at times require maintenance of relatively higher blood pressure. Early intervention avoids huge economic burden as depicted in life time cost incurred in UK of more than 1lac USD, at present no study are available from India of life time cost incurred in stroke management. In addition it also adds to quality of life as evident in our patients.

#### 5. Source of Funding

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#### 6. Conflict of Interest

None.

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