

## Outcome of Extracranial Carotid Pseudoaneurysm Surgery: A Retrospective Study

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### ABSTRACT

#### Introduction

Extracranial carotid pseudoaneurysm (ECPA) is commonly associated with blunt or penetrating trauma and can result in thromboembolic event, cranial nerves palsies, rupture and hemorrhage. Due to the limited number of large studies, safety and efficacy of surgical and interventional management of ECPA is not well characterized. Open surgery with resection of pseudoaneurysm with end-to-end anastomosis or interposition graft is currently the preferred method of management. The aim of this study is to study the demographics, etiopathogenesis, presentation and outcome after surgical intervention of ECPA at our center.

#### Methods

All patients who underwent surgery for carotid pseudoaneurysm from June 2012 to December 2019, at Department of Cardiothoracic and Vascular Surgery were included in this retrospective chart review study after evaluation of the hospital record book and electronic medical record. Patients who had stroke or cranial nerve injury before surgery, were excluded from this study.

#### Results

Fifteen patients met the inclusion criteria. Male to female ratio was 11:4. Mean age of presentation was  $38.17 \pm 18.98$  years. All patients presented with tender and pulsatile neck swelling. Common carotid artery involvement was more common. Three patients suffered from stroke postoperatively, and all of these patients died, however, one patient with stroke died due to reasons not related to pseudoaneurysm. Two patients suffered cranial nerve injury and ten patients had no other disabling complications.

#### Conclusion

ECPA is an uncommon but a serious disease and ischemic stroke after surgery is associated with high mortality.

#### Keywords

*Carotid, extracranial, outcome, pseudoaneurysm*

## INTRODUCTION

A pseudoaneurysm is an outpouching in a blood vessels. The arterial wall has three layers namely, the intima, media and adventitia. Extracranial carotid pseudoaneurysm (ECPA) results from the loss of integrity of all three layers of the carotid arterial wall.<sup>1,2</sup> Pseudoaneurysms of the carotid artery are quite rare and the incidence is around 0.07%.<sup>2</sup> The pseudoaneurysm communicates with the lumen of the vessel and is confined outside the arterial lumen, surrounded by fibrous tissue.<sup>3</sup> ECPA is commonly associated with blunt or penetrating trauma. Other causes includes iatrogenic origin, inflammation, infection, vasculitis, tumor, and arteriosclerosis.<sup>4</sup> It is a disease with grave consequences if not recognized and treated early which can result in thromboembolic event to brain,<sup>5</sup> cranial nerves palsies due to compression. Ruptures and hemorrhage are other dangerous complication.<sup>6</sup> Due to the risk of rupture as well as the neurological complications, urgent intervention is recommended for carotid artery pseudoaneurysms.

Due to the limited number of large studies, the safety and efficacy of surgical and interventional management of extracranial carotid pseudoaneurysm is not well characterized,<sup>7</sup> and so the ideal method of open surgery or endovascular stenting for ECPA has not been identified. However, despite the uncertainties, open surgery with resection of pseudoaneurysm with end-to-end anastomosis or interposition of gap by synthetic or saphenous vein grafts is generally accepted to be the preferred method of treatment for an extracranial carotid pseudoaneurysm, in order to prevent thromboembolic events and other complications.<sup>5,7</sup>

The primary aim of this study was to study the demographics, etiology, clinical features and outcome post-surgery of ECPA at our center.

## METHODS

This was a retrospective observational study. Ethical clearance was taken from the Institutional Review Committee before the start of the study. The study was performed at Manmohan Cardiothoracic and Vascular and Transplant Center (MCVTC) after evaluation of the electronic medical record from June 2012 to December 2019. Sixteen patients were found to have undergone surgery for carotid pseudoaneurysm within this time frame. Socio-demographic profile and etiopathogenesis were evaluated. All patients were evaluated with carotid Doppler study and Computed tomography (CT) carotid angiography. CT scan of head of all patients was done to rule stroke before surgery. Patient with history of stroke and/or cranial nerve injury were excluded. One patient with history of stroke

was excluded as it would bias the postoperative assessment.

Fifteen patients were included in the study with no evidence of stroke, cranial nerve involvement before the surgery. All patients underwent urgent open surgery under general anesthesia. Cerebral monitoring during surgery was employed with cerebral oxygen saturation and stump pressure monitoring and clamp pressure of >50 mmHg was considered to have adequate collaterals from contralateral side. Patients underwent either resection of pseudoaneurysm with end to end anastomosis with great saphenous vein (GSV) or extended polytetrafluoroethylene (ePTFE) graft or venous patch-plasty or ligation of carotid artery.

All data were recorded in Microsoft Office Excel sheet and mean, median, standard deviation and percentage were calculated from Microsoft excel.

## RESULTS

In our study male were predominantly affected and the male to female ratio was 11:4 and the mean age of presentation was 38.17±18.98 years.

Size of the pseudoaneurysm was measured on CT carotid angiography. Mean size was found to be 2.37±0.34cm.

Seven patients (46%) had traumatic etiology. Of the seven patients with trauma, three patients (20%) had blunt trauma and four patients (26%) had penetrating trauma to neck. Five patients (33%) had iatrogenic cause of carotid pseudoaneurysm. Among the patients with iatrogenic cause two patients had history of carotid endarterectomy done three years back and three patients had carotid pseudoaneurysm related to complication of central line placement. No cause could be identified in three patients. Interestingly, common cause of penetrating neck trauma in preschoolers was accidental pencil-tip injury. (Table 1)

No symptoms other than tender, pulsatile, neck swelling was recorded in our study. Median duration of symptoms was 3 months (1-5 months) from the onset of neck swelling.

Intraoperatively, 12 patients had involvement of common carotid artery. Two patient had involvement of the internal carotid up to the base of the skull and one patient had involvement of common and external carotids. On two patients with internal carotid artery near the base of skull, distal occlusion balloon, under fluoroscopic guidance was inserted and distal control was taken before the surgical incision. Thirteen patients underwent pseudoaneurysm excision with interposition graft. Two patients under went pseudoaneurysm ligation due to inadequate distal distance for either end-to-end anastomosis or interposition graft. In these patients clamp pressure was measured above 50

Table 1. Characteristics of extracranial carotid pseudoaneurysm patients (n=15)

Characteristics	Number
Gender	
Male	11
Female	4
Age (years)	38.27±18.98
Etiology	
Traumatic	7
Iatrogenic	5
Idiopathic	3
Artery involvement	
Common carotid artery	12
Internal carotid	2
Common carotid and external carotids	1
Surgical procedure	
Pseudoaneurysm excision with end-to-end anastomosis	13
Pseudoaneurysm ligation	2
Postoperative complications	
Ischemic stroke and death	3
Cranial nerve injury	2

mm Hg, hence proceeded with ligation. Average blood loss in our study was 438ml±217ml.

Postoperatively three patients (20%) suffered from ischemic stroke of the affected side, which was revealed clinically and by CT scan of head. All patients with stroke died in early postoperative period. However, one patient with stroke died due to CKD complications (Table 1).

Two (13%) patients suffered from cranial nerve injury of which one patient (6%) patient developed hypoglossal nerve injury and one patient developed glossopharyngeal nerve injury, which were managed conservatively. Ten (66%) patients had no disabling complications. No stroke was documented in patients who underwent carotid artery ligation.

Only seven patients followed up regularly in outpatient department (OPD) for up to six months after which all patients were lost to follow up. All followed up patients were at good state of health till six months.

## DISCUSSION

A pseudoaneurysm is an outpouching in a blood vessels which results from the loss of integrity of all three layers of the arterial wall.<sup>1,2</sup> In our study, traumatic causes of carotid pseudoaneurysm accounted for around forty six percent of cases and twenty percent of cases had previous history of Carotid endarterectomy (CEA). Similar to our study various studies found that trauma remains the most common etiology for carotid pseudoaneurysm

in clinical practice and in a study, the incidence of post-CEA pseudoaneurysm was around 0.025% to 0.625% and the incidence of carotid pseudoaneurysm from any cause accounted for 0.4-4% of all peripheral artery aneurysms.<sup>7,9</sup> Another study also reported that carotid pseudoaneurysm can result in almost one fourth of the patients with carotid injury.<sup>10</sup>

The mean aneurysm size was 2.45 cm (range, 0.8-5 cm).<sup>9</sup> Similar results were observed in our study. Nading. S et al, reported that internal carotid pseudoaneurysm are more common and the occurrence of pseudoaneurysm in external carotid artery is extremely rare.<sup>3</sup> In our study the involvement of common carotid artery was the most common, and isolated external carotid artery was the least involved.

Surgical management is the preferred treatment modality for extracranial carotid pseudoaneurysm. We resected the pseudoaneurysm, ligated and repaired with graft either prosthetic or autogenous.

Our study showed 13% patients with cranial nerve injuries post-surgery whereas, a study conducted by Young M states the risk of cranial nerve injury to be 6- 44%.<sup>11</sup> Due to the distorted local anatomy in patients with ECPA, injury to cranial nerves (CN) IX, X, and XII is a possible complication of open repair.<sup>9</sup> Cranial nerve injury could be as high as 44% and was temporary in most reports.<sup>12</sup>

Schievink et al reported 5 of 22 patient underwent ligation of the carotid pseudoaneurysm and those who underwent ligation did not experience ischemic complications or cranial nerve palsies, however in our study, two patients underwent carotid ligation and one patient had hypoglossal injury and other had no disabling complications.<sup>13</sup>

Mortality rate in post-surgical patients of extracranial carotid pseudoaneurysm in our study was 20%. 10% mortality rate has been documented for pseudoaneurysm undergoing surgical management with 3% of patients experiencing severe stroke in a study presented by Joo Lian.<sup>5</sup> The standard treatment for CCA pseudoaneurysm is surgical repair including ligation of the carotid artery with or without bypass procedure and arterial reconstruction. The rate of stroke or death during surgery was reported to be between 9 and 15%, and the incidence of cranial nerve injuries was reported to be as high as 15% as per case series presented by Ho Kim et al. We have presented all of our surgical cases of which 20% died and 13% of total had cranial nerve injuries.<sup>4</sup>

Due to a high mortality and morbidity associated with open repair of carotid pseudoaneurysm, recent years, have seen emergence of minimally invasive procedure ranging from stenting to coiling.<sup>5</sup> Bush et al reported five symptomatic patients with

pseudoaneurysms with 100% technical success in obliterating the pseudoaneurysms.<sup>14</sup> Twelve patients with fourteen ECPA received stents, with or without coils. No perioperative neurologic or cardiopulmonary complications occurred. Another case series reports 7% stroke or TIA rate and a 1.6% mortality rate<sup>15</sup> in twelve patients with extracranial pseudoaneurysm. This might open new horizon of research for us in future.

## CONCLUSION

ECPA is an uncommon disease. Male are affected more than female. Any groups of patients could present with carotid pseudoaneurysm. Trauma is the leading cause of carotid pseudoaneurysm. Patient experiencing ischemic stroke after open surgical repair of carotid pseudoaneurysm had high mortality.

## CONFLICT OF INTEREST

None declared.

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