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Single versus Double Layer Stent Technique in Endovascular Treatment of Significant Carotid Artery Stenosis

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Abstract

Background: The carotid arteries[carotids], which branch off in the neck into the internal and external carotid arteries, are responsible for supplying oxygenated blood to the head and neck. The current work aimed to compare a double carotid stent to a single layer with respect to the safety & prognosis profile of elective carotid stenosis with elevated grade in both symptomatic & asymptomatic cases.

Patients and Methods: This research used an open-label, retrospective design. center research that was conducted on 65 patients over a period of two years at Al-Hussein University Hospital, Cairo, Egypt.

Results: The stenosis was mainly on the left side in both single and double stent groups [59.7% and 57.57%]. The single group used Wall type [For all patients in this group] while double group used Casper type of stents for all patients also in the group. Filer was used in minority of patients in both single and double stent groups [6.06% vs 3.03%]. No significant difference in complications, follow-up modified Rankin scale [mRS], or side of stenosis between single and double stent groups. However, the re-occlusion was significantly higher in the double than single stent groups [21.21% vs 3.13%]. Otherwise, both groups were comparable regarding complications related to the procedure or angioplasty.

Conclusion: Both single layer stent and protected stenting with micromesh Casper stent showed good safety and efficacy in the treatment of carotid stenosis with a low incidence of re-occlusion. These preliminary data require confirmation from larger, randomized and prospective studies.

Keywords: Single; Double Layer Stent Technique; Carotid Artery; Stenosis

INTRODUCTION

The carotid arteries, which branch off in the neck into the internal and external carotid arteries, are responsible for supplying oxygenated blood to the head and neck [1, 2].

Carotid artery disease can present clinical symptoms in the form of a transient ischemic attack or stroke. Because atherosclerotic plaque is a component of generalized atherosclerosis disease, it is responsible for the majority of occurrences of carotid artery stenosis. Carotid artery dissection accompanying fibromuscular dysplasia and arteritis is the primary non-arteriosclerotic etiology of carotid artery stenosis. Decreased in prevalence. Neck radiotherapy, connective tissue disease, and trauma are additional causes [3, 4].

Plaque rupture and subsequent embolism of the brain constitute the principal mechanisms by which carotid disease induces cerebral ischemia. The emergence of the vulnerable or high-risk plaque, which is susceptible to rupture & induces cerebral ischemia, has been facilitated by this [5].

Additionally, the nature of the presenting event is critical. cases who have undergone a hemispheric stroke are at a higher risk for recurrence compared to those who have manifested with a transient ischemic attack [TIA] or an ocular event [such as amaurosis fugax or retinal ischemia] [6].

At the beginning of the twenty-first century, CAS emerged as a less invasive alternative treatment for carotid stenosis. Initially, percutaneous transluminal balloon angioplasty without inserting a stent device was performed. Later, carotid artery-specific stent devices were devised, &primary stenting has since supplanted balloon angioplasty as the preferred endovascular treatment [7].

This study aimed to compare a double carotid stent to a single layer concerning the safety and result profile of elective carotid stenosis procedures in cases with & without symptoms.

PATIENTS And METHODS

This research used an open-label, prospective design. single-center research that was conducted on 65 patients over a period of 2 years at Al-Hussein Hospital, Al-Azhar University, Cairo.

Inclusion criteria:

Patients with or without high-grade carotid stenosis [seventy percent, as measured manually on the basis of digital subtraction angiography [DSA], and according to NASCET Criteria: patient is 18–80 years of age; patient has a Hunt & Hess score of 3 or less; cases who have a premorbid modified Rankin Scale [mRS] score of 3 or lower & are considered bad surgical candidates include the elderly & those with significant medical conditions.

Exclusion criteria:

Cases with major functional impairment [mRS > 3 on the modified Rankin Scale], serious kidney damage, hypertension [BP >180/100], irreversible coagulopathy, or severe hypertension are excluded from the research.

All patients were subjected to the following:

A comprehensive medical & neurological history, like a history of associated comorbidities and risk factors, as well as a thorough neurological examination performed pre- and immediately following the procedure, with mRS used to identify the extent of any neurological conditions [e.g., headache, delirium, altered mental state, TIA, or stroke].

Imaging: We used cerebral angiography to assess the degree of carotid stenosis pre- and post-procedural, and monitored ultrasounds for restenosis and hyper-perfusion syndrome.

Patients were followed up for three months, with carotid stenoses assessed using grading criteria from the World Federation of Neurology. Examinations in laboratories included PT, blood count, PTT, renal function tests, hepatic function tests, and electrocardiography.

Pre-procedural orders: Patients underwent a biplane angiography procedure using a biplane angiography system and received dual antiplatelet therapy [DAPT] with clopidogrel & aspirin. They were guided by a microwire and stents, with Brotege and Wall stents used in the single-layer group and Casper stents in the dual-layer group. After the intervention, the patients were maintained on DAPT for three months & were also prescribed lipid-lowering medication. Under medical supervision, cerebrovascular risk factors such as hypertension were managed as well as treated.

Post-procedure: Perform a comprehensive neurological examination & groin tests prior to admission to the Neurological Intensive Care Unit [NICU]. Most cases with unruptured aneurysms discharge within one day following a procedure. The implementation of routine radiographic follow-up, whenever feasible.

Ethical considerations: All phases of the research were accurately described to the participant and/or caretaker prior to their involvement. We obtained written consent from every participant at this time.

RESULTS

The main comorbid conditions in the current work, the main conditions were hypertension, diabetes mellitus, smoking and hyperlipidemia. Smoking do no differ significantly between single and double stent groups [31.25% vs 27.0% respectively]. However, hypertension, diabetes and hyperlipidemia were significantly higher in the single than double stent groups [75.0%, 37.5% and 71.8% vs 48.5%, 12.0% and 45.5% successively] [Table 1]. The stenosis was mainly on the left side in both single and double stent groups [59.7% and 57.57%]. The single stent group used exclusive the wall type of stent, while the double stent group used Casper stent exclusively. Filer was used in minority of patients in both single and double stent groups [6.06% vs 3.03%]. There was no significant difference between both groups regarding side of stenosis or use of filer [Table 2].

Angiography was present for 31.25% and 18.2% in single and double stent groups respectively. However, the difference was not significant. In addition, the post-stenting angioplasty

was used for 96.8% and 96.9% in single and double stent groups [Table 3]. The post stenting and periprocedural complications were comparable between single and doble stent groups. The main periprocedural complications included acute left watershed infracts, right limb weakness, left upper limb weakness, syncopal attack and transient ischemic attacks. Interestingly, syncopal attack was confined to single stent group, while right limb weakness and left upper limb weakness were confined to doble stent group [Table 4].

The re-occlusion was significantly higher in the double than single stent groups [21.21% vs 3.13%], while the mRS follow up did not differ significantly between both groups [Table 5].

Table [1]: Distribution of comorbidity between the study groups

	Single stent N=32	Double stent N=33	Test	P value
Hypertension	24[75%]	16[48.5%]	4.826	0.02*
Diabetes mellitus	12[37.5%]	4[12%]	5.639	0.01*
Smoking	10[31.25%]	9[27%]	2.402	0.12
Hyperlipidemia	23[71.8%]	15[45.5%]	4.67	0.03*

Table [2]: Distribution of Side of stenosis and stent used between the study groups.

		Single stent N=32	Double stent N=33	Test	P value
Side of stenosis	Right	13 [40.62%]	14 [42.42%]	0.02	0.88
	Left	19 [59.37%]	19 [57.57%]		
Used stent	Wall	32 [100%]	0 [0%]	**36.3**	**≤0.001***
	Casper	0 [0%]	33 [100%]		
Filer	Yes	2 [6.06%]	1 [3.03%]	0.31	0.57
	No	30 [93.75%]	32 [96.9%]		

Table [3]: Comparison of Present angioplasty and post stenting angioplasty between the study groups.

	Single stent N=32	Double stent N=33	Test	P
Present angiography	10[31.25%]	6[18.2%]	1.495	0.22
Post-stenting angioplasty	31[96.8%]	32[96.9%]	0.001	1.0

Table [4]: Distribution of complications between study groups.

		Single stent N=32	Double stent N=33	Test	P
Post-stenting complication		2 [6.25%]	0[0%]	2.12	0.144
Periprocedural complication	No	25 [78.12%]	28 [87.5%]	0.97	0.33
	Acute left watershed infracts	2 [6.25%]	1 [3.03%]	0.38	0.53
	Right limb weakness	0 [0%]	1 [3.03%]	0.98	0.32
	Left upper limb weakness	0 [0%]	1 [3.03%]	1.01	0.32
	Syncopal attack	1 [3.125%]	0 [0%]	1.04	0.31
	TIA	7 [21.87]	2 [6.06]	3.24	0.06

Table [5]: Distribution of follow up between the studied groups.

		Single stent N=32	Double stent N=33	Test	P
Re-occlusion		1 [3.13%]	7 [21.21%]	4.91	0.03
Follow up mRS	0	23 [71.87%]	22 [66.67%]	0.22	0.89
	1	6 [18.75%]	7 [21.21%]		
	2	3 [9.37%]	4 [12.12%]		

mRS: modified Rankin Scale

DISCUSSION

Cerebrovascular disease is a burgeoning global health concern, accounting for ten percent of all fatalities on an international level. Globally, stroke is a significant public health concern and it is prevalent among numerous CVDs [8].

The present study revealed that the mean age of single stent patients was 65.06± 6.52 years, 21 [65.62%] patients were males, and 11 [34.37%] patients were females while the mean age of double stent patients was 64.9± 6.54 years, 63.63% were males, and 36.36% were females, with no significant difference between single and double stent groups. The current study is in agreement with **Kahlberg *et al.*** [9] who sought to evaluate patient

characteristics, procedural details, and outcomes of CAS performed with dual-metal layer nitinol micromesh stents compared with single-layer carotid stents. They reported that the mean age of double stent patients was 73.4 ± 7.4 years, 72 [74%] patients were males, and 25 [26%] patients were females while the mean age of single stent patients was 73.9 ± 8.5 years, and 54 [61%] patients were males. They found that there was no statistically significant difference between the two studied groups regarding age and gender.

As regards comorbidity, our results reported that 24 [75%] patients in single stent group had hypertension, 12 [37.5%] patients had DM, 10 [31.25%] patients were smokers and 23 [71.8%] patients had hyperlipidemia while 16 [48.5%] patients had HTN, 4 [12%] patients had DM, 9 [27%] patients were smokers and 15 [45.5%] patients had hyperlipidemia in double stent group. We found that there was no statistically significant difference between single stent and double stent groups regarding smoking, while there was statistically significant difference between the two studied groups regarding HTN, DM and hyperlipidemia. The current study in consistent with **Kahlberg *et al.*** [9] who revealed that there was no statistically significant difference between single stent and double stent groups regarding smoking, diabetes mellitus, hypertension and dyslipidemia.

In the current work, all patients in single stent used the wall type, and file used for 2 subjects. However, the Casper type used for all patients in the double stent group, and only one patient had filer. These results are consistent with **Reddy and Mulimani** [10] who demonstrated that 9 [47.37%] patients of single stent group had wall stent and 1 [5.26%] patient had no filters while 22 [100%] patients of double stent group had C Guard stent and 15 [68.18%] patients had no filters. They found that there was no statistically significant difference between single stent and double stent groups regarding side of stenosis. The current results in line with **Kahlberg *et al.*** [9] who demonstrated that 9 patients in single stent group had wall stent while 100 patients of double stent had Casper stent. They found that there was statistically significant difference between the two studied groups regarding used stent.

The present study showed that there was no statistically significant difference between single and double stent groups regarding present, post stenting angioplasty or periprocedural and post stenting complications. This agrees with **Reddy and Mulimani** [10] who demonstrated that there was no statistically significant difference between single and double stent groups regarding pre and post stenting angioplasty.

The re-occlusion was significantly higher in the double than single stent groups [21.21% vs 3.13%], while the mRS follow up did not differ significantly between both groups. These results are in line with **Yilmaz *et al.*** [11] who demonstrated that there was no statistically significant difference between single stent and double stent groups regarding Modified Rankin Scale. Similarly, **Sýkora *et al.*** [12] reported that the rate of severe restenosis or re-occlusion was significantly higher in the dual-layer stent group than in the single-layer group [13.3% vs 3.4%, p = 0.01].

Conclusion: Both single layer stent and protected stenting with micromesh Casper stent showed good safety and efficacy in the treatment of carotid stenosis with a low incidence of re-occlusion. These preliminary data require confirmation from larger, randomized and prospective studies.

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