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Carotid Artery Stenting before CABG: A Better Alternative to Treat Concomitant Coronary and Carotid Artery Disease

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ABSTRACT

Background: Atherosclerosis of the coronary and carotid arteries can be fatal. Stroke is a serious complication of coronary artery bypass graft surgery, and carotid artery dysfunction is a major risk factor for stroke (CABG).

Methods: Patients who met the criteria for CABG were included in this prospective cohort study of those with severe carotid artery stenosis (>70%). Complications 30 days after stenting, neurological complications during cardiac surgery, rates of myocardial infarction (MI), and rates of death were among the outcome indicators evaluated.

Results: according to outcome the mean duration of follow-up was 31.23 (±18.27 SD) with range (1-60) months, according to early adverse event there were 1 (0.5%) with cardiac death, 1 (0.5%) with major Ipsilateral Nonfatal Strokes, 2 (1%) with minor strokes, there were 30 cases of cardiac death (15%), 2 cases of neurological death (1%), 4 cases of death for other reasons (2%), 2 cases of major ipsilateral nonfatal stroke (1%), 1 case of major contralateral nonfatal stroke (0.5%), 10 cases of minor ischemic stroke (5%), 12 cases of transient ischemic attack (2%), and 2 cases of nonfatal myocardial infarction (1%).

Conclusion: Patients with concurrent carotid and coronary artery disease may benefit from both hybrid revascularization by CAS-CAB and phased revascularization by CAS-CAB, which are feasible, safe, and provide good short- and long-term results. Our research suggests that CAS should be considered as a feasible alternative to open heart surgery. An adequately powered randomised experiment should compare the two approaches.

Keywords: *coronary artery bypass graft, coronary artery disease, carotid stenosis, outcome*

INTRODUCTION

As a continuing inflammatory process, atherosclerosis affects several vascular regions. According to population-based research, the degree of atherosclerosis in one vascular area is correlated with its involvement in other territories. (1) It has become more apparent over time that this bacteria is the root cause of many cases of coronary artery occlusive disease,

which is often accompanied by carotid artery occlusive disease as a consequence of the spread of systemic atherosclerosis. (2)

Coronary artery disease (CAD) is a disease with many causes that can show up in a number of ways, such as angina, a heart attack, or heart failure. (3)

The main cause of CAD is coronary atherosclerosis, which is linked to a number of risk factors, such as high cholesterol, smoking, diabetes, lack of physical activity, being male, getting older, and being overweight, among others. (4)

Candidates for coronary artery bypass transplant surgery (CABG) or a carotid endarterectomy often have systemic atherosclerosis with occlusive disease in the coronary arteries or carotid arteries (CEA). (5)

One of the worst problems that can happen after CABG is a stroke, which happens between 1 and 5% of the time. One risk factor for a stroke during or soon after CABG is Carotid artery disease is so bad that it's reducing the amount of blood reaching the brain. (6)

The use of less invasive methods for carotid revascularization is on the rise. Patients with carotid stenosis did not fare better with stenting than with endarterectomy after ten years, according to CREST study data. (7) Hence, As an alternative to CEA, CAS may be of interest in high-risk populations such CABG patients. (8)

Results are consistent with a prior meta-analysis showing that patients treated with simultaneous CEA-CABG had a greater peri-operative death rate than those treated with a phased CAS-CABG method. (9)

The goal of this study is to determine whether HP infection is linked to more severe atherosclerosis in the coronary arteries of those who have been diagnosed with coronary artery disease (CAD).

MATERIAL AND METHODS

Those who were candidates for CABG and had stenosis of the carotid artery that was more than 70% were included in this hospital-based prospective cohort study. The study was carried out by a research team. Patients had either symptomatic or asymptomatic carotid artery stenosis, as determined by duplex ultrasonography in a thoroughly authorised vascular laboratory. Patients also had surgical coronary artery disease and a luminal diameter of greater than 60%. Patients were considered to have symptoms if they had experienced a transient ischemic attack, amaurosis fugox, a minor or major disabling stroke involving the study carotid artery within the previous six months prior to the procedure, or if they had ischemic or infarct defects in their cerebral imaging without a clear history of a neurological event.

Patients were not allowed to take part if they had recently had a major stroke, had an intracranial tumour or arteriovenous malformation, were severely disabled because of a stroke or dementia, had intracranial stenosis that was worse than extracranial stenosis, or were unable to give informed consent because of a mental illness.

Each participant provided written informed permission before their participation in the research.

We took careful notes on each patient's age, gender, illnesses (which may have included high blood pressure, , heart failure, DM, stroke, and chronic kidney disease), and smoking habits.

An experienced neurologist examined each patient neurologically at three different points in time: when the trial first began, the day after the stenting procedure, and between two and three days following CABG surgery (depending on the length of time it took the patient to recover after CABG). The assessments were carried out using the stroke scale developed by the National Institutes of Health (NIH). (10) Prior to undergoing CABG surgery, all patients were given CAS with intravenous heparin to maintain an active clotting time of 200 to 250 seconds and a GpIIb/IIIa inhibitor (Eptifibatide) with a bolus of 180 g/kg followed by continuous infusion of 2 g/kg per minute for up to 6 hours. This was done in order to keep an active clotting time of between 200 and 250 seconds. This was done in order to keep an active clotting time of between

200 and 250 seconds. Throughout the same hospitalisation, each patient had CABG within forty-eight hours after undergoing CAS. After the CABG operation, the patient started taking the antiplatelet medicines aspirin and clopidogrel as soon as possible.

At least four hours before to the CABG procedure, loading doses of clopidogrel (600 mg) and aspirin (325 mg) were administered to the patients. At that point, the patients were taken in for the procedure. Alternately, the patients were given a mixture of clopidogrel 75 mg and aspirin 325 mg for 5 days before to CAS. This was done in place of the standard CAS preparation.

Aspirin (325 mg daily) and clopidogrel (75 mg daily) were prescribed to patients for 4 weeks following the operation, and patients were released 2 days after the procedure if there were no complications. Five to six weeks following CAS, bypass surgery on the coronary arteries was planned.

Outcome Assessment:

After coronary artery bypass grafting (CABG), patients were monitored for a full month, beginning on the day of operation. Deaths, heart attacks, and strokes were among the unfavourable occurrences that occurred. Myocardial infarction was defined as having a blood creatine kinase-MB level that was more than twice the upper limit of the normal range, and stroke was defined as a new focal neurological impairment that lasted longer than 24 hours. Both of these conditions were considered to be medical emergencies. A transient ischemic attack, often known as a TIA, is a short neurological abnormality that goes away fully within a period of twenty-four hours (TIA). A stroke that was either ischemic or hemorrhagic was deemed a deadly stroke.

Ethical approval was obtained from Damietta Faculty of Medicine- Al Azhar University ethical committe with number IRB 00012367-21-08-011

Statistical analysis

SPSS 20.0, a statistical application developed by IBM, was used in order to do analysis on the data that was input into the computer. Armonk, New York location of IBM Corporation For the purpose of providing qualitative information, quantitative and percentage descriptions were employed. To guarantee a normally distributed sample, we performed the Kolmogorov-Smirnov test. The presentation of quantitative data included the lowest and highest possible values, as well as the average, standard deviation, median, and interquartile range (IQR) (IQR). At the 5% significance level, the obtained findings were declared to be significant.

RESULTS

TABLE 1: Distribution of the studied cases according to baseline data

	Cases (no=200)	
Age		
Range.	53 – 78	
Mean ± SD.	65.97 ± 7.34	
Gender		
Female	64	32.0
Male	136	68.0
Risk factors		
Hypertension	87	43.5
Diabetes mellitus	53	26.5
Hypercholesterolemia	80	40.0
Smoking	32	16.0
History of neurological symptoms	28	14.0
Previous MI	58	29.0
Valvular heart disease	54	27.0

Congestive heart failure	22	11.0
Unstable angina pectoris	89	44.5
Previous CABG	33	16.5
Previous PTCA	33	16.5
Carotid angioplasty done previously	6	3.0
CEA Previous	9	4.5
heart/neck radiotherapy Previous	6	3.0
Pulmonary disease	21	10.5
Renal failure	18	9.0
significant ACI stenosis on the other side	12	6.0
severe left subclavian artery stenosis or obstruction	4	2.0

This table shows that the mean age of studied cases was 65.97 (±7.34 SD) with range (53-78), among the studied cases there were 64 (32%) females and 136 (68%) males, according to risk factors there were 87 (43.5%) with hypertension, 53 (26.5%) with diabetes, 80 (40%) with hypercholesterolemia, 32 (16%) smokers, 28 (14%) with history of neurological symptoms, 58 (29%) with previous MI, 54 (27%) with valvular heart disease, 22 (11%) with congestive heart failure, 89 (44.5%) with unstable angina pectoris, 33 (16.5%) with previous CABG, 33 (16.5%) with previous PTCA, 6 (3%) with previous carotid angioplasty, 9 (4.5%) with previous CEA, 6 (3%) with previous heart/neck radiotherapy, 21 (10.5%) with pulmonary disease, 18 (9%) with renal failure, 12 (6%) with contralateral severe ACI stenosis and 4 (2%) having significant left subclavian artery stenosis or obstruction.

TABLE 2: Distribution of the studied cases according to operation data

	Cases (no=200)	
Success		
Failure	4	2.0
Success	196	98.0
Angiographic degree of stenosis before		
Range.	77 – 93	
Mean ± SD.	84.45 ± 4.84	
Angiographic degree of stenosis after		
Range.	0 – 87	
Mean ± SD.	6.71 ± 10.52	
Duration between CAS and CABG		
within 14 days	71	35.5
14 to 30 days	62	31.0
after 30 days	67	33.5

This table shows that according to operation data among the studied cases there were 4 (2%) failed operation, the average angiographic stenosis degree before was 84.45 (±4.84 SD) with range (77-93), the average angiographic of stenosis degree after was 6.71 (±10.52 SD) with range (0-8), according to duration between CAS and CABG 71 (35.5%) patients had it don within 14 days, 62 (31%) from 14 to 30 days and 67 (33.5%) after 30 days.

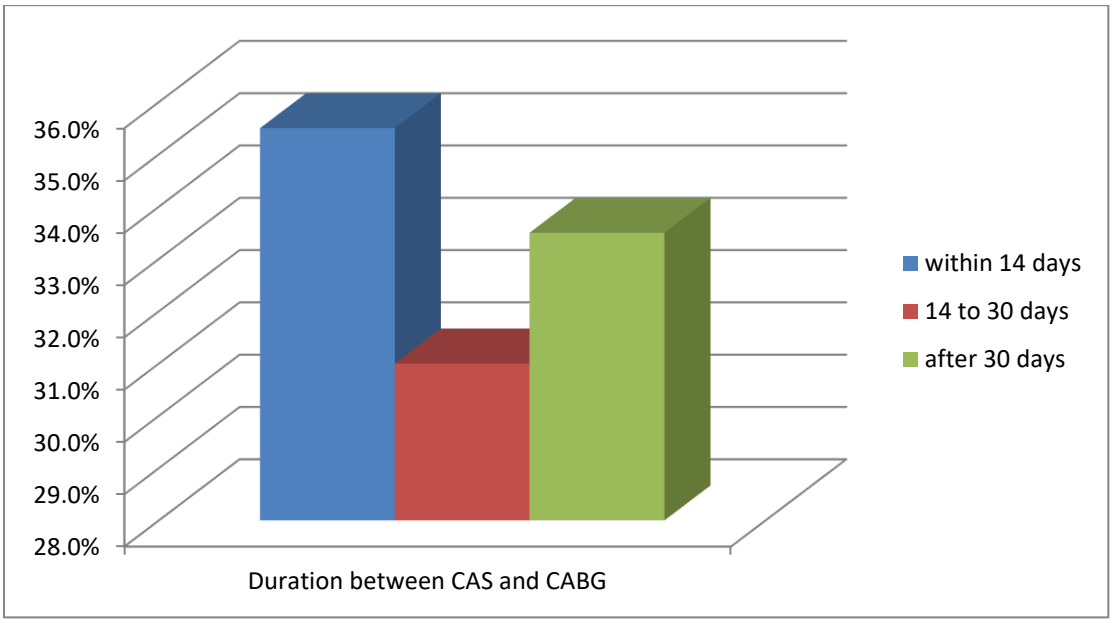

FIG 1: Distribution of the studied cases according to duration between CAS and CABG

TABLE 3: Distribution of the studied cases according to outcome

	Cases (no=200)	
Follow-up (months)		
Range.	1 – 60	
Mean ± SD.	31.23 ± 18.27	
Early Adverse Event	No.	%
Non	190	95.0
Cardiac Deaths	1	0.5
Major Ipsilateral Nonfatal Strokes	1	0.5
Minor Strokes	2	1.0
Transient Ischemic Attacks	4	2.0
Nonfatal MIs	2	1.0
Late Adverse Event		
Non	137	68.5
Cardiac Deaths	30	15.0
Neurological Death	2	1.0
Deaths of other causes	4	2.0
Major Ipsilateral Nonfatal Strokes	2	1.0
Major Contralateral Nonfatal Strokes	1	0.5
Minor Strokes	10	5.0
Transient Ischemic Attacks	12	6.0
Nonfatal MIs	2	1.0

This table shows that according to outcome the mean duration of follow-up was 31.23 (±18.27 SD) with range (1-60) months, according to early adverse event there were 1 (0.5%) with cardiac death, 1 (0.5%) with major Ipsilateral Nonfatal Strokes, 2 (1%) with minor strokes, 4 (2%) with According to late adverse events, there were 12 (6%) transient ischemic attacks and 2 (1%) nonfatal MIs, 30 (15%) cardiac deaths, 2 (1%) neurological deaths, 4 (2%) deaths from other causes, 2 (1%) major ipsilateral nonfatal strokes, 1 (0.5%) major contralateral nonfatal strokes, 10 (5%) minor strokes, and 2 (1%) major ipsilateral nonfatal MIs.

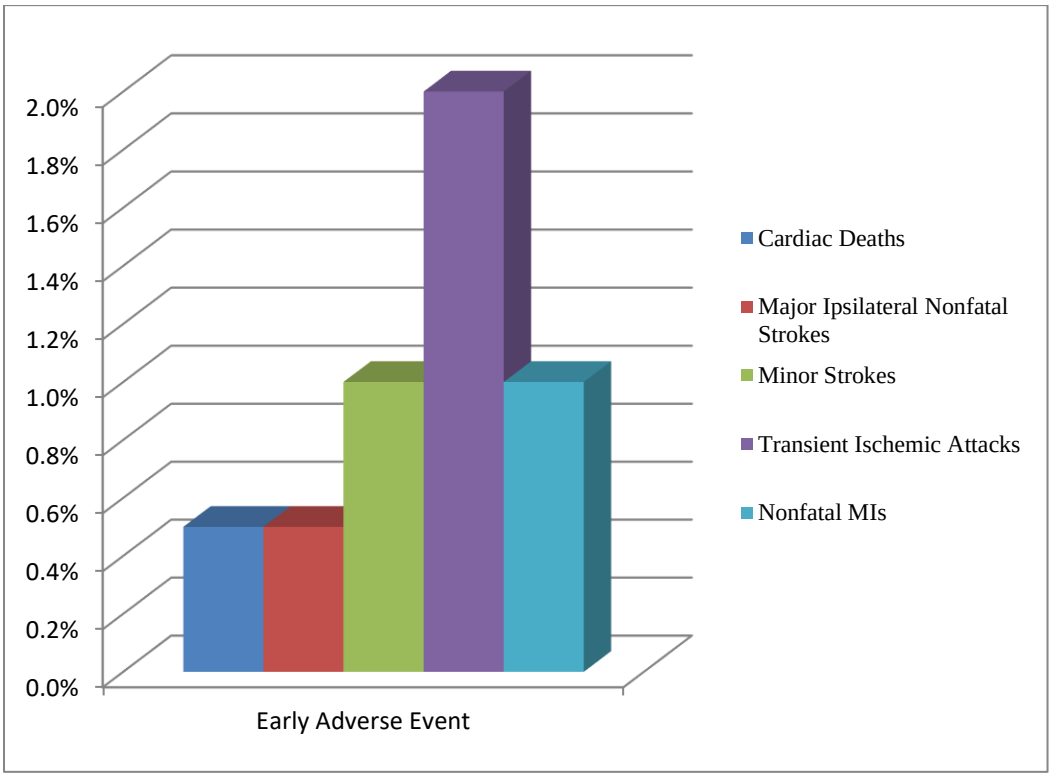

FIG 2: Distribution of the studied cases according to early adverse event

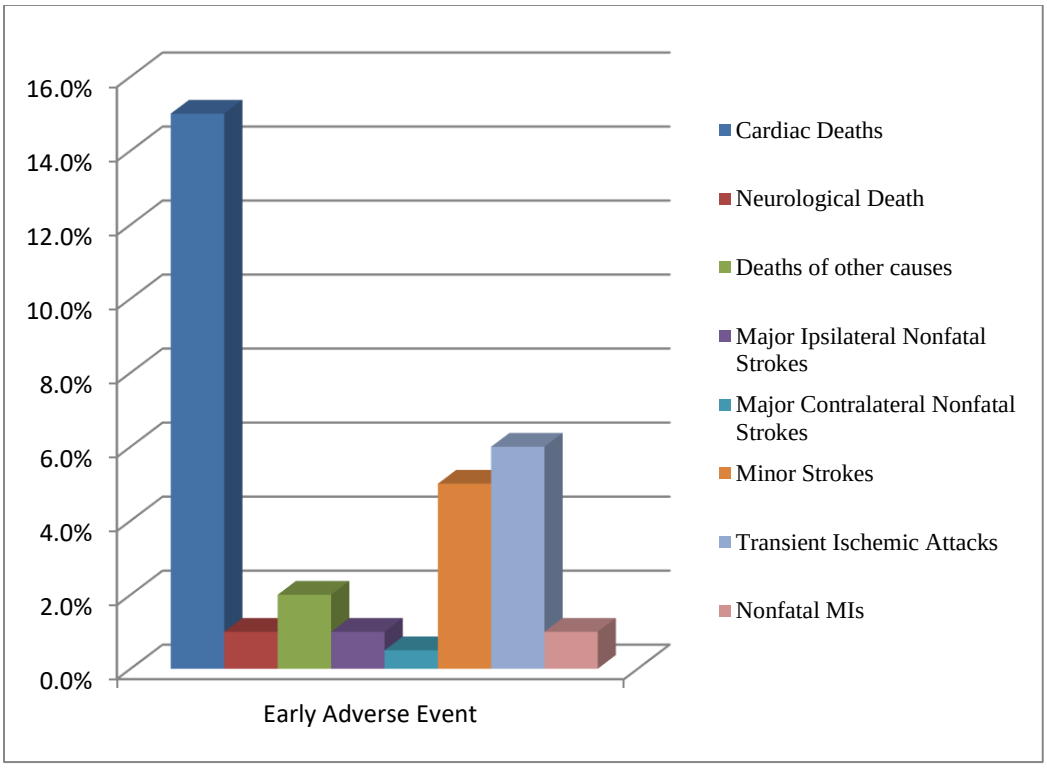

FIG 3: Distribution of the studied cases according to late adverse event

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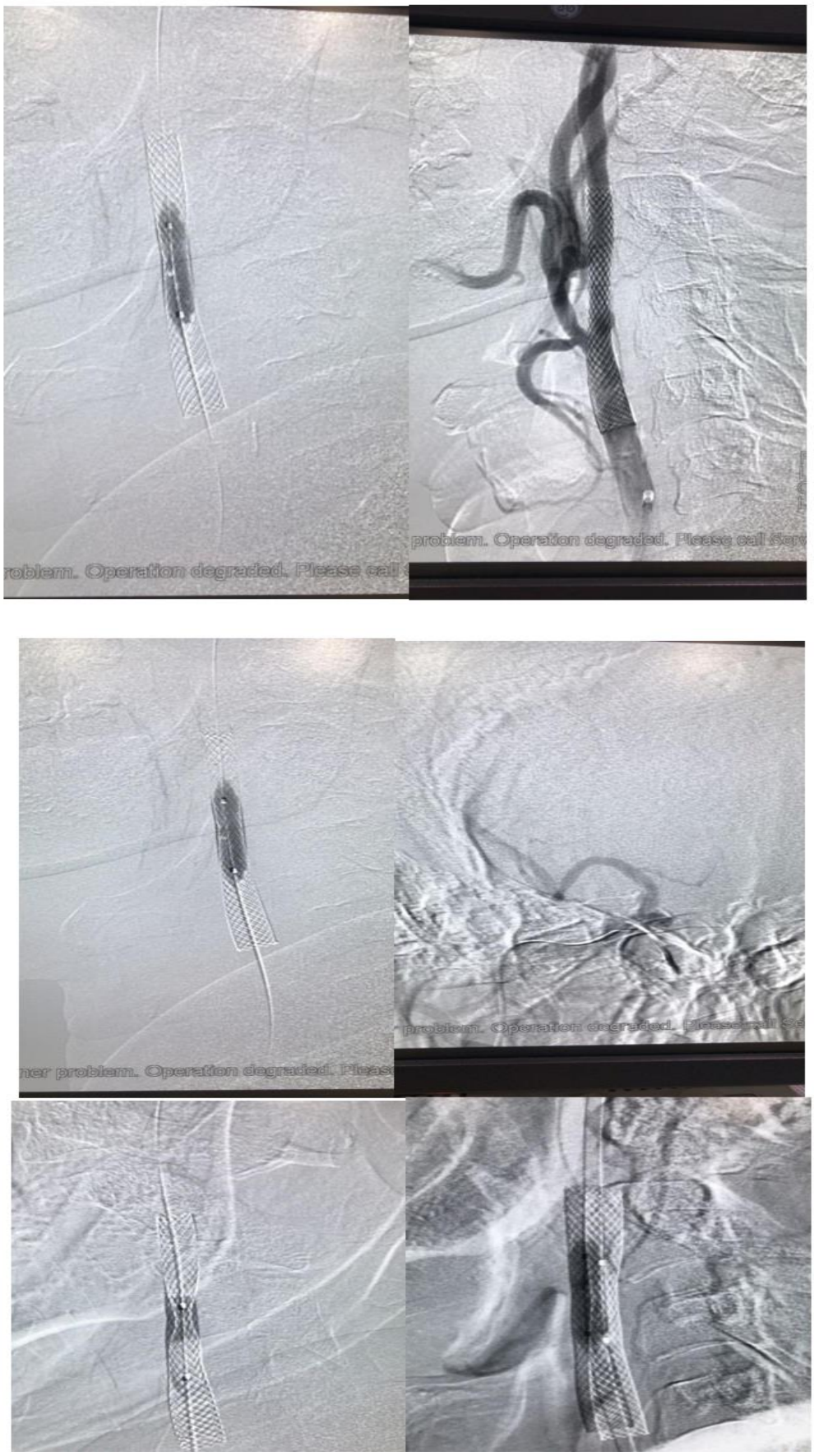

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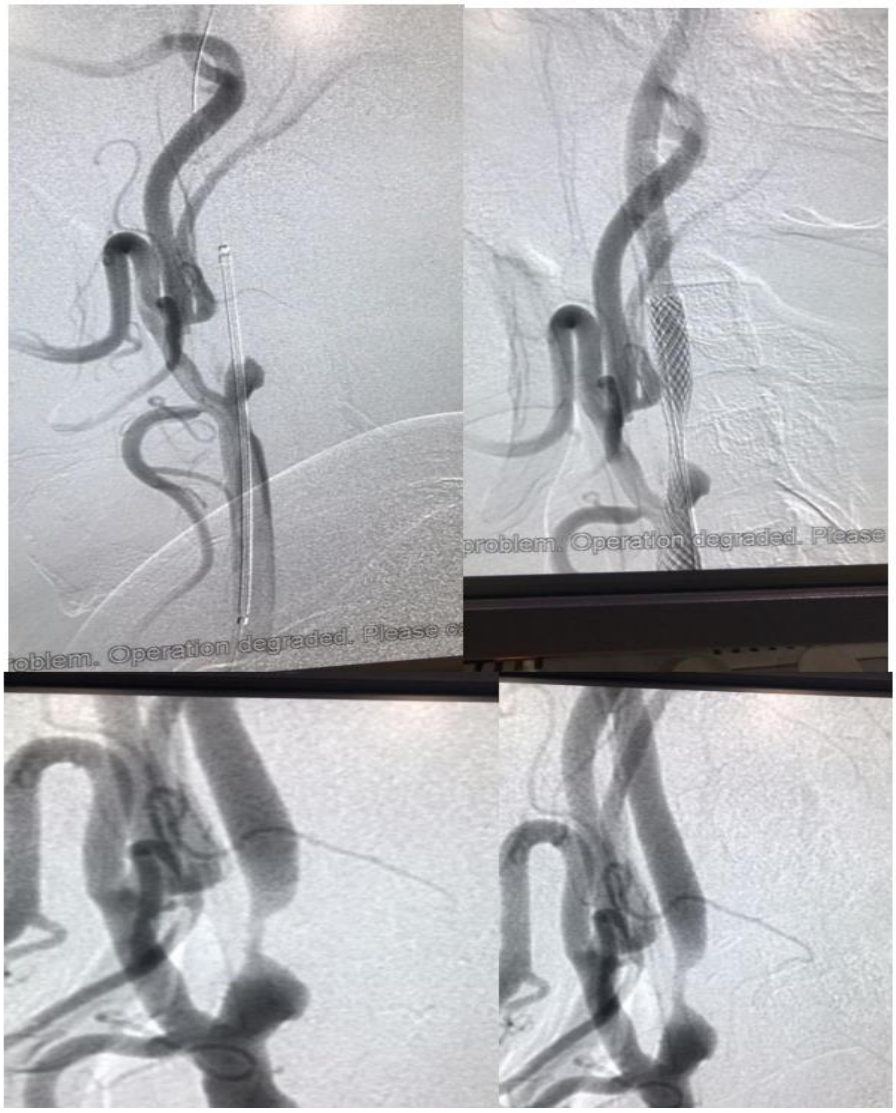

DISCUSSION

Patients having CABG often have concurrent carotid disease, the management of which is still up for debate (11). Staged or synchronous carotid artery stenting (CAS) with CABG, synchronous carotid endarterectomy (CEA) with staged CEA followed by CABG, CABG (either before or during cardiopulmonary bypass), and reverse-staged CABG with CEA are all possible choices (12).

Since CEA/CAS lowers the chance of having a stroke after CABG surgery, it is recommended to be done either before or concurrently with CABG surgery (13). It is unclear what proportion of post-CABG strokes might be attributed to embolism or haemodynamic failure due to underlying carotid disease, especially in neurologically asymptomatic people. The aetiology of post-CABG stroke is complex, but it is unclear what proportion of strokes might be attributed to these factors (14).

The results of CAS and CEA have been comparable for individuals who are considered to have a high surgical risk. Patients with severe CAD who need emergency CABG or valvular surgery may have a few revascularization options available to them; however, there is a paucity of research available that evaluates the efficacy of these various options (15, 16).

The purpose of this investigation was to establish whether or not there is a connection between HP infection and coronary atherosclerosis risk in those who have been diagnosed with CAD.

J Popul Ther Clin Pharmacol Vol 30(7):e199–e210; 05 April 2023.

In the current investigation, among the cases that were examined, there were 64 (32%) females and 136 (68%) men; in accordance with the risk factors, there were 87 (43.5%) individuals with hypertension, 53 (26.5%) with diabetes, 80 (40%) with hypercholesterolemia, 32 (16%) smokers, 28 (14%) with history of neurological symptoms, 58 (29%) with previous MI, 54 (27%) with valvular heart disease, 22 (11%) with congestive heart failure, 89 (44.5%) with unstable angina pectoris, 33 (16.5%) with previous CABG, 33 (16.5%) with previous PTCA, 6 (3%) with previous carotid angioplasty, 9 (4.5%) with previous CEA, 6 (3%) with previous heart/neck radiotherapy, 21 (10.5%) with pulmonary disease, 18 (9%) with renal failure, 12 (6%) with contralateral severe ACI stenosis and 4 (2%) with Stenosis or blockage of the left subclavian artery is severe.

180 individuals who had surgery and CEA at the same time were analysed by Mendiz et al. (17). The overall mortality rate was 10.1%, while it was 14.5% in individuals with a EuroSCORE ≥ 6. It was also discovered by these investigators that the total death rate was 10.1% in this setting. They were an average of 70 years old, plus or minus 80 years, and 43 (or 79.6%) of them were men. Fifty-two (92.6%) of them were hypertensive, fifteen (27.2%) were diabetic, thirty-two (59.3%) had high cholesterol, ten (18.5%) had a prior myocardial infarction, six (11.1%) had undergone coronary artery bypass grafting, two (3.7%) had experienced a prior stroke, six (11.1%) had undergone a prior transient ischemic attack, six (11.1%) had undergone contralateral carotid occlusion 6 (11.1%), and left ventricular

Our findings reveled that among the studied cases there were 4 (2%) failed operation, prior to treatment, The average angiographic degree of stenosis before treatment was 84.45 (±4.84 SD), with a range of 77-93, and the average angiographic degree of stenosis after treatment was 6.71 (±10.52 SD), with a range of 0-93. (0-8), according to duration between CAS and CABG 71 (35.5%) patients had it don within 14 days, 62 (31%) from 14 to 30 days and 67 (33.5%) after 30 days.

In our present study, according to outcome the mean duration of follow-up was 31.23 (±18.27 SD) with range (1-60) months, according to early adverse event there were 1 (0.5%) with cardiac death, 1 (0.5%) with major Ipsilateral Nonfatal Strokes, 2 (1%) with minor strokes, 4 (2%) with Transient Ischemic Attacks and 2 (1%) with nonfatal MIs, according to late adverse event there were 30 (15%) with cardiac death, 2 (1%) with neurological death, 4 (2%) with death of other reasons, 2 (1%) with major Ipsilateral Nonfatal Strokes, 1 (0.5%) with major Contralateral Nonfatal Strokes, 10 (5%) with minor strokes, 12 (6%) with Transient Ischemic Attacks and 2 (1%) with nonfatal Mis.

One patient underwent prior CABG procedures twice, per Mendiz et al. (17). (CABG). results after 30 days. Death from a stroke (major or small), TIA, or carotid artery stenting (5 deaths, 9.2%), death from cardiovascular surgery (1 death, 1.8%), acute myocardial infarction (1%), reoperation for bleeding (7 operations, 13% total), or hemodialysis (5 deaths, 9.2% total) were the most common complications. Parssonet 14.5 ± 5, EuroSCORE 11.8 ± 2.8, STS complications 26.2 ± 9, STS stroke 2.7 ± 1.3, and STS mortality 3.7 ± 0.9 are all risk scores.

In response, Giannopoulos et al. (18) conducted a retrospective investigation on 35 patients with CAS who had had CABG. All 35 patients with symptomatic or asymptomatic carotid artery stenosis and surgical coronary artery disease were angiographically successful with no periprocedural problems. There was no association between CABG, CAS, or duration of hospitalisation with the incidence of TIAs, strokes, MIs, or fatalities. Over the 30-day follow-up period, there were no cases of TIA, stroke, MI, or death. Maybe it's because they only stayed in contact with people for a month. Carotid endarterectomy (CAS) prior to coronary artery bypass grafting has been found to help patients with severe carotid artery disease and concurrent surgical coronary artery disease (CABG).

A prior meta-analysis and comprehensive review A study by Paraskevas et al., (11), and another by Naylor et al., (19) involving a group of 2727 patients who underwent CAS + CABG on the

same day, reported that, in terms of results, 80% of patients with unilateral stenoses were asymptomatic from a neurological standpoint. The combined 30-day death/stroke and death/stroke/heart attack rates were 7.9% (95% CI 6.9:9.2) and 8.8% (95% CI 7.3:10.5), respectively. The 30-day death/stroke rate was 8.5% (95% CI 7.3:9.7) following staged CAS þ CABG but only 5.9% (95% CI 4.0:8.5) after "same-day" operations.

There were three fatalities (3.8%) among the 132 patients (70 8 years, 102 males) who had CAS and CABG on the same day (group 1, n = 97).

Overall, 0.75 percent of patients had stroke (0% in group 1), and 81% of patients survived to a late stage (92 percent in group 1).

The risk of stroke and mortality for patients with severe carotid disease who had a single CABG surgery was 11.5%, but the prevalence of nonfatal MI remained unknown. Ziada et al. observed that patients with a higher baseline risk profile who received CAS and cardiac surgery suffered substantially fewer adverse events than those who underwent combined CEA and CABG (22).

Similarly, Heyden et al. (23) investigated 356 consecutive patients who had CAS before cardiac surgery and observed a success rate of 97.7%. At 30 days, heart surgery patients had a 4.8% mortality and stroke rate (n17). 2% (n=7) of patients developed a myocardial infarction both at the time of cardiac arrest and thirty days after cardiac surgery. 6.7% of all deaths, strokes, and heart attacks were recorded (n24). Forty percent of patients used distal embolic protection devices. Even though 13 patients (3.7%) got CAS and cardiac surgery in conjunction with contralateral CEA, the risk of ipsilateral major stroke was determined to be minimal (1.9%).

Roach et al. (24) noted that 6.1% of patients had neurological impairments shortly after CABG, with a death rate of 21.5%. The increased death rate after OHS is likely attributable to a number of disorders, including stroke. Neurological problems were reduced with consecutive CEA and CABG, although mortality and non-fatal AMI rates were raised (19).

Early findings for this approach were published by Naylor et al. (25), who conducted a meta-analysis of staged CAS-CABG. They found that this procedure had a mortality rate of 5.5% and a stroke rate of 4.2%. Following a period of 30 days, there was a 9.4% increase in the probability of dying, having a stroke, or having a heart attack. Even yet, it's encouraging to learn that nobody passed away as a result of the incident. The therapy that we provided lowered the patient's chance of suffering a stroke, heart attack, or dying within 30 days from occurring to 10.0% (hybrid approach) and 5.1% (staged process). Note, however, that our data was collected from patients with higher than average EuroSCORE levels (9.0 ±2.6 vs 6.4 ±1.8; P 0.001).

In addition, a number of studies have shown that phased CAS and CABG procedures may be effective and risk-free (26, 27). Individuals who have significant atherosclerotic disease and who come in an unstable state and need an urgent OHS may benefit from a less intrusive therapy, such as CAS, to address carotid artery stenosis, which may enhance the risk of stroke for OHS patients (28).

Our research was limited in some ways because it was conducted at a single location and did not include a control group. Additionally, the choice of treatment modalities may have been influenced by the comorbidities of the patients as well as technical factors, and the recruitment period was quite lengthy. On the other hand, it seems that the number of patients who cannot have their disease staged is diminishing as minimally invasive techniques grow more advanced, safer, and more successful.

It is necessary to conduct larger prospective randomised studies, preferably with a big cohort and at many centres.

CONCLUSION

Individuals who suffer from carotid and coronary artery disease may benefit in the short term and long term from hybrid and phased revascularization by CAS-CAB. This kind of revascularization may be done in stages. Findings from our study indicate that CAS may serve as a useful adjunct to standard cardiac procedures.

For a fair comparison of the two approaches, a randomised controlled trial with enough participants is required.

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