Cardiovascular Topics

A comparison of two different management plans for patients requiring both carotid endarterectomy and coronary artery bypass grafting

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Abstract

Background: Carotid endarterectomy (CEA) is a prophylactic operation that is used to mitigate the risk of stroke caused by embolism of atherosclerotic plaques in the carotid bifurcation. Previously, the large, multicentre, randomised, controlled GALA study found no significant differences in clinical outcomes between patients treated using general or local anaesthesia. While this study provided important insights into disease outcomes based on treatment modalities, it did not answer questions regarding the safety of CEA under local anaesthesia in patients at high risk for cardiovascular complications. Here, we examined the use of two different management plans in patients requiring both carotid endarterectomy and coronary artery bypass grafting (CABG), in terms of their effects on hospital mortality.

Methods: Thirty-four patients consecutively operated on in our cardiovascular department were included in this analysis. The patients were divided into two groups based on the anaesthetic management plan. The first group consisted of patients who underwent CEA and CABG under general anaesthesia in the same session (GA group); the second group consisted of patients who initially underwent CEA under cervical block anaesthesia followed by CABG under general anaesthesia in a separate session (CB-GA group). These two groups were compared in terms of postoperative complications and hospital mortality.

Results: The incidence of postoperative myocardial infarction was higher in the CB-GA group, with four patients experiencing postoperative myocardial infarction, compared to no patients in the GA group.

Conclusion: For patients requiring CEA and CABG, performing both operations under general anaesthesia in the same session was safer than initially performing CEA under cervical block anaesthesia followed by CABG under general anaesthesia.

Keywords: carotid endarterectomy, cervical block anaesthesia, general anaesthesia, coronary artery bypass grafting

Submitted 15/6/20, accepted 14/9/20

Cardiovasc J Afr 2021; **32**: online publication www.cvja.co.za

DOI: 10.5830/CVJA-2020-042

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Carotid endarterectomy (CEA) is a prophylactic operation that is used to mitigate the risk of stroke caused by embolism of atherosclerotic plaques in the carotid bifurcation.[1,2] In two large studies, the North American Symptomatic Endarterectomy Trial (NASCET) and the European Carotid Surgery Trial (ECTS), CEA was recommended, particularly in symptomatic patients who have more than 70% stenosis of the carotid artery.[3,4] However, the overall mortality rate for CEA was reported to be 1.3–1.8% in two large systematic reviews in which the highest rate was 15%[5,6]

In the GALA study, the largest multicentre, randomised, controlled trial of its kind to date, CEA under general anaesthesia (GA) and local anaesthesia (LA) were compared, with the authors finding no significant differences between the methods in terms of stroke, myocardial infarction (MI), or death in the first 30 days following surgery.[7] However, despite the scope of the trial, the GALA study was not able to answer the questions regarding the safety of CEA performed under LA in patients at high risk for cardiovascular complications.

The aim of this study was to compare two different management plans in patients requiring both CEA and coronary artery bypass grafting (CABG) in terms of their effects on hospital mortality. For the first management plan, patients were initially treated by CEA under cervical block (CB) anaesthesia, followed by CABG administered under GA in a separate session. For the second management plan, both CEA and CABG were performed in the same session under GA.

Methods

This retrospective study was approved by the Selcuk University ethics committee, Konya, Turkey. Over a period of five years (January 2008 to December 2013), 98 CEA operations were performed in our cardiovascular department, of which 73 (74%) were operated under CB anaesthesia and 25 (26%) under GA.

Among the 98 patients who underwent CEA operations, CABG was performed in 34 patients due to coronary artery disease (CAD). In 18 of these 34 patients, CABG was performed in the same session with CEA (GA group). As the skill and experience of our clinic increased in terms of CEA under CB anaesthesia, physicians began performing these procedures in patients scheduled to undergo concomitant CABG for CAD. For these 16 patients, CEA was first performed under CB anaesthesia, followed by CABG performed, as a separate procedure during the same hospital stay, under GA (CB-GA group). The regional anaesthesia technique consisted of a superficial cervical plexus block using 0.25% plain bupivacaine with additional local infiltration as needed during the course of the operation. Heparin was administered before carotid clamping (100 IE/kg).

Patient data were obtained from in-patient charts, out-patient records, operating room notes, and telephone calls. The range of pre-operative symptoms included asymptomatic, non-disabling ischaemic stroke, transient ischaemic attack (TIA) and stroke. Cerebrovascular accident history was investigated by a neurologist through direct interview and medical charts. Non-disabling stroke was defined by a residual deficit, associated with a score of ≤ 2 according to the modified Rankin scale. TIA was defined as an abrupt onset of symptoms and/or signs related to a focal cerebral or visual deficit (amaurosis fugax) attributed to focal loss lasting less than 24 hours. Stroke was defined as an abrupt onset of symptoms and/or signs related to a focal and/or global deficit of cerebral functions lasting more than 24 hours and not attributable to causes other than cerebrovascular accident.[8] Asymptomatic patients had no history of cerebrovascular symptoms.

The following peri-operative variables were considered: demographics (age, gender), presence of current or previous smoking, diabetes mellitus (DM), hypertension (HT), hypercholesterolaemia, presence of peripheral obstructive disease (POD), history of CAD (previous MI, stable or unstable angina, percutaneous or surgical coronary revascularisation), renal dysfunction and obesity.

Duplex ultrasonography (USG) was performed in all patients and findings were confirmed by magnetic resonance angiography (MRA). Indications for surgery were either a stenotic lesion measuring > 50% of the carotid artery together with a neurological event or, for those who were asymptomatic, a stenotic lesion measuring > 70%.

Carotid artery endarterectomy was performed in all patients. After the procedure, heparin was not routinely reversed. Standard heparinisation was used to control the active clotting time during cardiopulmonary bypass. Internal mammary artery and saphenous vein grafts were prepared, and the coronary bypass process was completed. All patients were followed in the intensive care unit postoperatively for at least 24 hours.

In the GA group, patients were intubated. Somatosensory evoked potential (SSEP) monitoring and stump pressure monitoring were routinely used. If SSEP monitoring showed slowing to ≤ 50% of the pre-clamping response or the stump pressure was below 50 mmHg, carotid shunting was performed in the CB-GA group. At the time of carotid clamping, patients were examined neurologically by testing their ability to squeeze a ball that made a sound; shunting was performed using an Inahara-Pruitt outlying shunt if the response was deemed inadequate. CEA was performed using patch closure [saphenous, Dacron or PTFE (polytetrafluoroethylene)] or primary closure.

Bleeding was defined as a need to change postoperative dressings one or more times, a requirement for neutralisation with protamine, or re-operation of the patient because of haematoma. Wound infection was controlled by specialists in infection. For postoperative assessment of cranial nerve damage, the 10th, 11th and 12th cranial nerves were examined. Patients with suspected nerve damage were consulted by a neurologist. All patients were examined by the same neurologist both pre- and postoperatively.

Obstructions identified by Doppler ultrasonography within the first 30 days were interpreted as early restenosis and obstructions identified in the following 30 days were considered late restenosis. All patients who had complaints consistent with symptoms of MI, together with electrocardiograph and troponin changes in the postoperative period were considered to have clinical features of MI.

The primary endpoint was death in the postoperative 30 days. Secondary endpoints were postoperative complications such as bleeding or haematoma, infection, cranial nerve damage, non-disabling ischaemic stroke, TIA, amaurosis fugax, early restenosis, late restenosis and postoperative MI.

Statistical analysis

This was performed using the PASW v.18 software package. For comparisons between groups, independent samples *t*-tests were used for continuous variables and χ^2 or Fisher's exact test were used for categorical variables. In the analysis, p-values < 0.05 were considered statistically significant.

Results

In total, 34 patients treated for both carotid artery disease and CAD were included in this study. Of these 34 patients, 18 (53%) were operated under GA in the same session (GA group). For the other 16 patients (47%), CEA was first performed under CB anaesthesia, followed by CABG performed under GA (CB-GA group). Pre-operative patient data are shown in Table 1.

Intra-operative data of the patient groups are shown in Table 2. The clamping time was shorter in the GA than in the CB-GA group (Table 2). No significant difference in shunting was seen between groups (two patients in the GA group vs three patients in CB-GA group).

No significant differences were found between the groups

Table 1. Demographic characteristics and clinical variables of the patient population

Variables	*GA group (n = 18)*	*CB-GA group (n = 16)*	*p-value*
Age	66.39 ± 8.64	67.44 ± 6.34	0.692
Male	14 (77.8)	12 (75.0)	0.999
Asymptomatic	15 (83.3)	13 (81.2)	0.999
Amaurosis fugax	–	–	–
TIA	3 (16.7)	2 (12.5)	0.999
Non-disabling stroke	–	–	–
Stroke	0 (0.0)	1 (6.2)	0.471
Smoking	9 (50.0)	7 (43.8)	0.716
HT	2 (11.1)	7 (43.8)	0.052
DM	2 (11.1)	4 (25.0)	0.387
Hypercholesterolaemia	1 (5.6)	2 (12.5)	0.591
CAD	13 (72.2)	11 (68.8)	0.999
PAD	0 (0.0)	2 (12.5)	0.214
Renal dysfunction	4 (22.2)	2 (12.5)	0.660
Obesity	2 (11.1)	2 (12.5)	0.999

GA: general anaesthesia; CB: cervical block; TIA: transient ischaemic attack; HT: hypertension; DM: diabetes mellitus; CAD: coronary artery disease; PAD: peripheral arterial disease.

in terms of postoperative bleeding, infection, cranial nerve damage, early or late restenosis, TIA, stroke or death (Table 3). Postoperative MI occurred in four patients in the CB-GA group, but was not observed in any patient in the GA group ($p = 0.039$) (Table 3). In two of these four patients with postoperative MI, left main coronary artery (LMCA) lesions were observed, while the other two patients exhibited multi-vessel disease. These patients were assessed by a cardiologist and emergency CABG surgery was performed. One of the two patients with LMCA lesions could not be saved and died. The other three patients underwent successful CABG operations and were discharged from the hospital.

Discussion

CEA has been shown to reduce the risk of stroke in both asymptomatic and symptomatic patients in several large trials.[3,4,9,10] Current European Society for Vascular Surgery guidelines identify five different indications in patients with carotid artery disease, including neurological symptomatology, degree of carotid stenosis, medical co-morbidities, vascular and local anatomical features and carotid plaque morphology. The last three of these criteria were proposed as a means of differentiating between CEA and carotid artery stenting (CAS).[11] However, in terms of stroke and death, numerous randomised trials did not find any significant difference between CEA and CAS. Stenting may have some possible advantages, such as avoidance of GA and surgical trauma,[12-14] although it has also been identified as an independent predictor of retinal embolisation.[15]

In the 1960s, with the initiation of operations under LA, many surgeons began to prefer it when performing operations.[16] In our clinic, many of the surgeons also prefer LA, resulting in more CEA operations being performed under LA. Previous studies have suggested that use of LA for CEA surgery may change the attitude of many surgeons to the procedure.[17,18] Since it alerts the surgeon for the necessity of a shunt, awake testing of brain function during carotid clamping under LA is more reliable than various indirect techniques that are used under GA. Such an approach may be safer than operations performed under GA, as evidenced by the lower number of shunts used in these procedures. In our study, shunts were used less frequently in patients who underwent CEA under CB anaesthesia; however, this difference was not statistically significant.

Awake testing and cerebral monitoring are regarded as the gold standard for shunting.[19] Although shunts should protect the brain from strokes caused by low cerebral blood flow during carotid clamping, they can damage the arterial wall, causing embolisms in the brain.

LA may have some advantages in terms of MI and pulmonary complication rates, when compared with GA.[17] Furthermore, LA is associated with a better assessment of neurological outcomes.[20,21] The GALA study included 3 526 patients and compared GA versus LA for carotid artery surgery. It found no significant differences in quality of life, length of hospital stay, or primary outcome (stroke, MI, death between randomisation and 30 days after surgery) in the pre-specified subgroups of age (above or below 75 years) or for those considered at higher risk for surgery. While the study provided important insights into disease outcomes based on treatment modalities, it did not answer questions regarding the safety of CEA under LA in patients at high risk for cardiovascular complications.

Table 2. Intra-operative data of the patient groups

Variables	*GA group (n = 18)*	*CB-GA group (n = 16)*	*p-value*
Clamping time	31.06 ± 3.57	41.25 ± 7.39	< 0.001
Contralateral obstruction	2 (11.1)	3 (18.8)	0.648
Shunt	2 (11.1)	3 (18.8)	0.648
Primer closure	6 (33.3)	4 (25.0)	0.715
Saphenous	0 (0.0)	1 (6.2)	0.471
PTFE	–	–	–
Dacron	12 (66.7)	11 (68.8)	0.897

GA: general anaesthetic; CB: central block; PTFE: polytetrafluoroethylene.

Table 3. Comparison of postoperative complications between patient groups

Complications	*GA group (n = 18)*	*CB-GA group (n = 16)*	*p-value*
Bleeding	4 (22.2)	0 (0.0)	0.105
Infection	–	–	–
Cranial nerve damage	1 (5.6)	0 (0.0)	0.999
Early restenosis	–	–	–
Late restenosis	–	–	–
TIA	–	–	–
Stroke	–	–	–
Postoperative MI	0 (0.0)	4 (25.0)	0.039
Death	0 (0.0)	1 (6.2)	0.471

GA: general anaesthetic; CB: central block; TIA: transient ischaemic attack, MI: myocardial infarction.

Conclusion

In our study, the postoperative MI rate was higher in the CB-GA group, with four cases of postoperative MI in the CB-GA group compared to none in the GA group. Based on these observations, for patients requiring CEA and CABG, performing both operations under GA and in the same session was the safer option compared to initially performing CEA under CB anaesthesia followed by CABG under GA.

References

1. Eastcott HHG, Pickering GW, Robb CG. Reconstruction of internal carotid artery in a patient with intermittent attacks of hemiplegia. *Lancet* 1954; **2**: 994–996.
2. DeBakey ME. Successful carotid endarterectomy for cerebrovascular insufficiency. Nineteen-year follow-up. *J Am Med Assoc* 1975: **233**; 1083–1085.
3. European Carotid Surgery Trialists' Collaborative Group. Randomised trial of endarterectomy for recently symptomatic carotid stenosis: final results of the MRC European Carotid Surgery Trial (ECST). *Lancet* 1998; **35**1: 1379–1387.
4. North American Symptomatic Carotid Endarterectomy Trial Collaborators. Beneficial effect of carotid endarterectomy in symptomatic patients with high-grade carotid stenosis. *N Eng J Med* 1991; **325**: 445–453.
5. Rothwell PM, Slattery J, Warlow CP. A systematic review of the risks of stroke and death due to endarterectomy for symptomatic carotid stenosis. *Stroke* 1996; **27**(2): 260–265.
6. Rothwell PM, Slattery J, Warlow CP. A systematic comparison of the risks of stroke and death due to carotid endarterectomy for symptomatic and asymptomatic stenosis. *Stroke* 1996; **27**(2): 266–269.
7. Lewis SC, Warlow CP, Bodenham AR, Colam B, Rothwell PM, Torgerson D, *et al*. General anaesthesia versus local anaesthesia for carotid surgery (GALA): A multicentre, randomised controlled trial. *Lancet* 2008; **372**: 2132–2142.
8. Warlow C, Sudlow C, Dennis M, *et al*. WHO (World Health Organization). Cerebrovascular disorders: A clinical and research classification; Offset publication 1978; No 43. Geneva: World Health Organization, 1978. Stroke. *Lancet* 2003; **362**: 1211–1224.
9. Executive Committee for the Asymptomatic Carotid Atherosclerosis Study. Endarterectomy for asymptomatic carotid artery stenosis. *J Am Med Assoc* 1995; **273**: 1421–1428.
10. Holiday A, Mansfield A, Marro J, Peto C, Peto R, Potter J, *et al*. MRC Asymptomatic Carotid Surgery Trial (ACST) Collaborative Group. Prevention of disabling and fatal strokes by successful carotid endarterectomy in patients without recent neurological symptoms: randomised controlled trial. *Lancet* 2004; **36**3: 1491–1502.
11. Liapis CD, Bell sir PRF, Sivenius J, Nicolaides A, Fernandes e Fernandes J, Biasi G *et al*. ESVS Guidelines. Invasive treatment for carotid stenosis: indications, techniques. *Eur J Vasc Endovasc Surg* 2009; **37**: 1–19.
12. Yadav JS, Wholey MH, Kuntz RE, Fayad P, Katzen BT, Mishkel GJ, *et al*. Stenting and angioplasty with protection in patients at high risk for endarterectomy investigators. Protected carotid-artery stenting versus endarterectomy in high-risk patients (SAPPHIRE). *N Engl J Med* 2004; **35**: 1493–1501.
13. Hobson RW, Howard VJ, Roubin GS, Brott TG, Ferguson RD, Popma JJ, *et al*. Carotid artery stenting is associated with increased complications in octogenarians: 30-day stroke and death rates in the CREST lead-in phase. *J Vasc Surg* 2004; **40**: 1106–1111.
14. EVA-3S Investigators. Carotid angioplasty and stenting with and without cerebral protection: clinical alert from the endarterectomy versus angioplasty in patients with symptomatic severe carotid stenosis (EVA-3S) trial. *Stroke* 2004; **35**: e18–20.
15. Song G, Sun R, Chen YF, Ma Y, Wang YB, *et al*. Retinal embolization after carotid endarterectomy and stenting for carotid artery stenosis. *J Clin Neurosci* 2015; **22**: 1298–1302.
16. Durand H, Masson V, Matte R, Plante JM, d'Amours M. Regional anaesthesia in carotid thromboendarterectomy. *Laval Med* 1969; **40**: 256–261.
17. Rerkasem K, Bond R, Rothwell PM. Local versus general anaesthesia for carotid endarterectomy. *Cochrane Database of Syst Rev* 2004; **2**: CD000126.
18. Stoneham MD, Knighton JD. Regional anaesthesia for carotid endarterectomy. *Br J Anaesth* 1999; **82**: 910–919.
19. McCleary AJ, Maritati G, Gough MJ. Carotid endarterectomy; local anaesthesia? *Eur J Vasc Endovasc Surg* 2001; **22**: 1–12.
20. Paraskevas KI, Mikhailidis DP, Oikonomou K, Verhoeven EL. Local versus general anaesthesia for carotid endarterectomy: Issues beyond stroke, myocardial infarction, and death rates. *Angiology* 2012; **63**: 405–408.
21. McCarthy RJ, Walker R, McAteer P, Budd JS, Horrocks M. Patient and hospital benefits of local anaesthesia for carotid endarterectomy. *Eur J Vasc Endovasc Surg* 2011; **22**: 13–18.