Sedation or loco regional anesthesia for CEA?

28

G. Marcucci, F. Accrocca, A. Sbroscia, G. Pierettori, R. Antonelli, R. Gabrielli, A. G. Giordano, F. Mounayergi, A. Siani

Abstract

We retrospectively evaluated the safety of carotid endarterectomy (CEA) performed with general anesthesia (GA) using remifentanil conscious sedation (RCS). From January 2005 to September 2011, 720 consecutive CEA were performed on 633 patients. GA was induced with remifentanil and propofol. Before clamping, propofol infusion was stopped and remifentanil was reduced until the patient was awake and able to collaborate. Overall stroke and death rate was 1,1% (8/720), four deaths (0.55%) and four stroke (0.55%). TIA occurred in 0.2% (2/720). Incidence of postoperative hematoma was 1.5%. In 67 patients (9,3%) a shunt was deployed. The incidence of postoperative nausea/vomiting was 4.3% and conversion to GA occurred in the 5.6% of cases. Patients satisfied at the 24-h interview were 94.3% and at third-month were 98%. CEA performed with GA-RCS were satisfactory and highlighted the advantages of both GA (hemodynamic stability and excellent control of ventilation) and local anesthesia (LA) with the direct evaluation of neurological status.

Introduction

The role of carotid endarterectomy in stroke prevention is well established but there are still many controversies concerning the optimal anaesthetic technique since the CEA can be performed either with local (LA) or general anaesthesia (GA) [1,2].

Currently no data registered from randomized trials by the Cochrane reviews or GALA trial seem evidence which is the best procedure, despite the non randomised studies show a potential benefits by the use of LA[3,4].

We describe our experience with a total intravenous (iv) anaesthetic technique, introduced by Muchada *et al*.[5], in which the patients is intubated and ventilated and where the infusion of the remifentanil leads to a consciousness level that permits an awake monitoring (remifentanil conscious sedation - RCS-CEA). This procedure has the advantage of both LA and GA leading to safe neurological monitoring, better airway control and hemodynamic stability.

Aim of this retrospective study was to evaluate the effectiveness and the safety of CEA with conscious sedation under remifentanil with orotracheal intubation. Moreover a comparative analysis with a consecutive cohort of CEA performed under LA before this series was carried out.

Methods

From January 2005 to September 2011, 720 consecutive CEA in 633 patients (M/F 443/277, age 75 SD ± 7.2) were performed. Intervention was bilateral in 87 (12.1%) cases and twenty CEA were re-interventions for restenosis after previous ipsilateral CEA (2.7%). Stenosis degree was based on NASCET method. Indications for CEA were 70% stenosis of internal carotid stenosis (ICA) in asymptomatic individuals and 50% or more for the patients with history of prior six-months neurological events. Diagnosis was carried out by means of color-coded ultrasounds (US) scan examinations, while Computerized Tomography angiography (CTA) scan and Magnetic Resonance Imaging (MRI) were performed respectively in two hundred thirty-eight (33.1%) and one hundred thirty-six (18,9%) when further evaluation were needed. One hundred eighty-five patients (25,6%) submitted to two hundred-one CEA (27,9%) were classified as high-risk patient according with SAPPHIRE criteria. The patient characteristics are reported in [Table 1]. All patients were submitted to a standard preoperative evaluation by a cardiologist, independent neurologist and by ear, nose and throat (ENT) specialist.

Male	443 61.5%
Female 2	277 38.5%
Mean patient age	75 ± 7.2 range 50-92 years
CAD	368 51.1%
Diabetes	237 32.9%
Smoking	382 53.1%
Hypertension	576 80.1%
COPD	43 5.9%
CRF (creatinine >3 mg/dL)	20 2.7%
Symptomatic	400 55.5%
Asymptomatic	320 44.5%
Contralateral CEA	87 12.1%
Contralateral ICA Occlusion	74 10.2%

Table 1 Patients data

Anesthetic protocol

Three peripheral venous cannulae were inserted for propofol, remifentanil and fluids or drugs infusion. Standard monitoring include invasive arterial blood pressure, electrocardiography for ST analysis, O^2 saturation, inspired oxygen fraction, end-tidal carbon dioxide and respiratory parameters. A superficial plexus block with ropivicaine 0.75% 10 ±5 ml along the posterior border of sternocleidomastoid muscle was performed. After infusion of 500 ml of crystalloid fluid, anaesthetic management was carried out by means of iv infusion of remifentanil (Ultiva, Glaxo-Wellcome Inc., Research Triangle Park, NC, USA) at 0,075 µ./kg./min, until grade 2 of Ramsay scale. Induction was performed by infusion of propofol 1% 1/1,5 mg/Kg. After administration of succinylcholine, a trans-mucosal topical application of lidocaine 2% 10 and tracheal intubation was carried out. After intubation, a continuous iv remifentanil infusion of 0,10-0,25 µ./kg./min was started. The patient was mechanically ventilated in intermittent positive pressure ventilation (IPPV) or pressure control ventilation (PCV)

with 5 cm H_20 of positive end-expiratory pressure (PEEP) modality, tidal volume (TV) 8-12 ml/kg, respiratory rate (RR) 11 ±2, O2/air 40/60%. Before clamping, propofol infusion was stopped and remifentanil was slowly reduced until the patient was becoming awake and able to collaborate. The neurological status was tested by a foam-rubber toy squeeze and through the open and close eyes movement. The remifentanil was regulated to obtain a good motor evaluation avoiding pain and discomfort. After the clamping, the squeeze test was repeated every 15-30 second for two minutes. In case of carotid clamping ischemia revealed by slowing or no movements of the contralateral hand, no eyes opening to the request and progressive loss of consciousness, a 9 Fr. Pruitt-Inahara shunt (Le Maitre Vascular, Burlington, MA, 01803, USA) was inserted and the patient checked again to show recovery of the consciousness. In all cases a prophylaxis of postoperative nausea and vomiting with 10 mg of metaclopramide was carried out. At the end of the procedure, remifentanil was stopped and the endotracheal tube removed[Table 2].

Insertion of venous and arterial cannulas and standard monitoring.
Ropivacaine 7.5% 25±5 ml for superficial cervical block.
v remifentanil infusion 0.75 μ/kg/min.
Iv propofol 1% 1.5/2 mg/kg for induction.
Administration of succinylcholine.
Use of transmucosal lidocaine 2% 10 ml before tracheal intubation.
Orotracheal intubation.
Continuous intravenous remifentanil infusion 0.12–0.25 μ/kg/min.
Ventilation using the intermittent positive-pressure modality (tidal volume 8–12 ml/kg, respiratory rate 11±2/min, oxygen/air 40/60% mixture) .
Interruption of propofol administration (20 min before arterial clamping).
Iv remifentanil was reduced until the patient was awake and able to collaborate pre-clamping (0,1-0,2 μ/kg/min).
Neurological status monitoring by squeezing a foam-rubber toy and opening and closing the eyes.
Carotid clamping (internal, then external and common).
Iv remifentanil regulation to obtain a good motor evaluation avoiding pain and discomfort.
Squeeze test repeated every 15–30 s for 2 min (9-Fr Pruitt–Inahara shunt in cases of intolerance).
Carotid reopening.
Iv remifentanil cessation at end of procedure and endotracheal tube removal.
Check for recovery of consciousness.

Table 2 Anesthetic protocol

Surgical Technique

Carotid arteries were exposed trough a longitudinal mini-skin incision along the medial border of the sternocleidomastoid muscle in six hundred-one patients (83,5%) or a transverse mini-skin incision in one hundred-nineteen cases (16,5%) according with our published experience[6]. A ventro-jugular route was performed in all cases. A preventive clamping of the ICA after iv eparinization was performed, followed by a rapid and careful dissection of the common and external carotid arteries. The

bulb was mobilized only in cases of eversion technique. CEA with Dacron patch angioplasty (Maquet Cardiovascular, Datascope, Athélia 1, 13705 La Ciotat Cedex, France) was the preferred technique and performed in 614 cases (85.4%), eversion endarterectomy was carried out in 98 cases (13.6%). Only three primary closure (0.4%) and five ICA-common carotid artery (CCA) polytetrafluoroethylene (PTFE, W.L. Gore & Associates, Newark, Delaware, USA) by-pass were performed (0,5%). A policy of selective shunting was carried out with shunt use in sixty-seven cases (9,3%)[Table 3].

Surgical	Anesthetic	
Patch 614 (85.4%)	Time between intubation and start CEA	50.4±15.3
Eversion 98 (13.6%)	Duration of Anesthesia	120.4±10.33
By-pass 5 (0.5%)	Duration of Surgery	50.5±30.8
Direct suture 3 (0.4%)	Clamping Time	27.4±10.1
Shunt 67 (9.3%)	Awakening time	7.2±2.2

Table 3 Surgical and anesthetic data

Perioperative care and follow-up

All patients were submitted to ECG and enzyme assay in the recovery room for 12 hours. Surgical intensive care unit was not routinely used. Neurologic or cardiologic re-evaluation was performed only in cases of postoperative complications. In all cases salicylates (160 mg) and statins therapy were used in the postoperative and in long-term period. A questionnaire was filled by independent anesthetist the day after surgery regarding the grade of satisfaction about anesthetic procedure (fear, anxiety, pain, weakness and/or panic) and three months later during follow-up the patients were interviewed to show satisfaction of this method of operation and whether to undergo a new intervention. Clinical and US follow-up was carried out at 1, 3, 6,12 months and then yearly. Mean duration was 24 months (1-60 months). Postoperative CTA scan was carried out only in selected cases to confirm a redo stenosis after CEA detected at US.

Outcome measures and Statistical analysis

Primary endpoint included 30-day perioperative incidence of stroke /TIA, myocardial infarction (MI) and death (combined myocardial-death and stroke-death). Secondary endpoint was to evaluate the patients comfort during RCS-GA postoperatively and at 3-month. We compared the results of 720 CEA performed with RCS with 115 CEA performed between January 2003 to December 2004 with LA by the Student's T-test and Chi-square analysis. All analyses have been developed by software SPSS (13.0 version, SPSS Inc, Chicago, USA). A P value < 0.05 was considered significant.

Results

Overall stroke and death rate in our series was 1,1% (8/720). Mortality rate was 0,55% (4/720). In all cases the cause of death was a MI. There were four neurological deficits at wakening (4/720, 0.55%) ipsilateral to the CEA. Two patients had a minor stroke, two a major disabling stroke. In two

patients a TIA with full recovery after 24 hours occurred (2/720, 0,2%). Cumulative stroke rate was 0.83% (6/720). In all cases a prompt US was performed to exclude ICA thrombosis, technical defect or hyperperfusion syndrome. CTA scan were positive in all cases. No major or minor stroke, TIA or cerebral hemorrhagic complications were recorded during the postoperative period. In all patients the neurological event occurred intraoperatively before the carotid artery was clamped due likely to detachment of atheromatous debris. Eleven patients (1.5%) were submitted to a surgical drainage for postoperative hematoma. The time between intubation and start of CEA was 50.4±15,3 minutes, the duration of anesthesia was 120.4±10.3 minutes, the surgical time 50.5±30.8 minutes and the clamping time 27.4±10.1 minutes. The awakening time before carotid clamping was 7.2±2.2 minutes. An extubation under 10 minutes was carried out in all patients[Table 3]. In no cases major hemodinamic instability during induction was noted. Bradycardia, arterial hypertension or hypotension occurred always before the awakening phase and were prompted corrected by vasopressor/vasodilatator drugs. The systolic blood pressure was maintained 20-30% above the baseline value during the clamping period by means of vasopressor drugs (ephedrine). We never observed severe respiratory muscle contraction during remifentanil infusion. Nausea and vomiting were reported in 31 cases (4.3%), meanwhile forty patients (5.6%) reported uncomfortable feeling during operation leading to deep the anaesthetics during the intervention for the state of agitation and restlessness[Table 4]. Postoperative questionnaire the day after surgery about comfort during RCS-GA showed excellent results without pain, fear, panic or anxiety also in cases of shunt deployment in 94.3% (672 CEA) of patients. Surgeons found satisfactory the surgical procedure in all patients. Three months after it was proposed an evaluation about the acceptance of a new intervention, if necessary, to make the same surgery and anesthesia collecting a degree of acceptance more than 98%[Table 5]. No statistical significant differences were observed between the RCS-CEA and LA-CEA cohorts about incidence of major and minor neurological and cardiac complications. Significative differences were detected in shunt deployment and conversion to GA. No difference was reported in hematoma incidence. A less incidence of postoperative nausea was collected in LA cohort[Table 6]. We noted a progressive reduction in the incidence of shunt deployment due to intolerance to vessel clamping only from 3.7% in the first two years to 2.4% in the last 2 years.

	Number	Rate
Major stroke	2	0.27%
Minor stroke	2	0.27%
TIA	2	0.27%
Death	4	0.55%
Hematomas	11	1.5%
Cranial nerve injuries	10	1.3%
Nausea/vomiting	31	4.5%
Conversion to GA for agitation	40	5.6%

Table 4 Results of RCS-CEA

Did you feel anxiety, fear, panic or pain during the operation?
Did the tracheal tube hurt you?
Did you feel nausea or vomiting during or at the end the operation?
Did you tried helplessness during the operation?
Did you feel sore throat after operation?
In cases of other side operation do you accept the same technique?

Table 5 Questionnaire at first postoperative day and at 3-month after operation

	RCS-CEA	LA-CEA	P
Minor Stroke	2/720 (0.2%	-	N/S
Major Stroke	2/720(0,2%)	-	N/S
Mortality	8/720 (1.1%)	-	N/S
Shunt Applied	67/275 (9,3%)	20/115 (17.3%)	0.26
TIA/RIND	2/720 (0.2%)	2/115 (1.7%)0.47	
Hematomas	11/716 (1.5%)	1/115 (0.8%)	0.65
Nausea/vomiting	31/716 (4.3	0/115 (0%)	<0.05
Conversion to GA	40/716 (5,6%)	20/115 (17.3%)	0.26

Table 6 RCS-CEA vs. LA-CEA : surgical data and results

Discussion

The GA and the LA present results and complications well recognized in many series and data recovered from randomized trials by the Cochrane reviews or GALA trials do not indicate which is the best procedure, despite the non randomized studies seem to show a potential benefits by the use of LA. Indeed, the LA has slowly established itself to become the main choice of anesthesia in clinical practice. The widely established benefits of CEA performed under LA include awake monitoring, better cerebral autoregulation, higher cardiovascular stability, shorter postoperative recovery, but the discomfort for both patient and surgeon seems to be a major challenge especially in cases of technically demanding intervention or intraoperative ischemia due to vessels clamping. By contrast, GA has the advantages of more stable hemodynamics, better airway control and cerebral protection to the clamping with no cerebral perfusion modification but do not carry out to safe evaluation of neurological status despite some techniques and devices have been used to detect cerebral ischemia due to carotid clamping[7]. The use of remifentanil in CEA appears to give the possibility to combine the pro and cons of GA and LA. The advantage of this technique is that the duration of anesthesia is not limited and an adequate ventilation and a maintenance of a safe monitoring of the neurological status are assured. Remifentanil is an opiate with short half-life, duration of effect, remarkable ability to produce analgesia easily adaptable to surgical needs and non specific tissue and plasma esterase metabolism[8]. Many reports now confirmed the safe and efficacious employment of this type of anesthesia. Coppi *et al.*[9] reported their experience with 533 consecutive patients submitted to CEA under RCS anesthesia showing that GA using remifentanil was safe, effective and satisfactory. Same results were achieved in the experience of Baldinelli[10] and Bevilacqua[11]. In our previous work we compared RCS-GA with LA showing no statistical difference in term of overall stroke-death rate and incidence of shunt deployment[12]. In our technique the patients were intubated with propofol and remifentanil and then they were awakened and maintained only under remifentanil. During CEA, patients were awake and able to collaborate without pain. In our experience we observed that older age, chronic renal failure or hepatic disease did not influence the target dose to achieve the better analgesia, confirming the validity of these anesthesia even in very high-risk patients[13].

In these retrospective study we applied these anesthetic procedure in seven hundred-twenty consecutive CEA operations with a very safe neurological monitoring of the mental and the motor function during the arterial clamping without the necessity of instrumental neurological monito-

ring. A selective shunt policy was carried out in all cases with a deployment shunt incidence of 9.3%. However eliminating the percentage of patients in whom the shunt was placed because converted into the GA due to intolerance, the real incidence of shunt deployment was 3,7% in our series. We noted a progressive reduction in total shunt deployment from 3,7 % to 2.4% in the last period due to more confidence and trust with this anesthetic technique. The conversion rate from local to GA due to patient intolerance was observed in 5.6%. In literature the conversion rate of LA or RCS-GA to GA is ranging between 1.6-2.21 %[11-14]. In our series this discrepancy may be due to high incidence of high-risk patients, older patients and non compliant. However, in our study we included also the hostile neck due to redo-CEA, high bifurcation, previous neck surgery or irradiation that led to more time consuming difficult intervention that justify this results. The conversion to total GA were carried out only in few cases of very intolerance patients or in presence of neurological complications. In cases of intolerance to the vessel clamping the patients was maintained always awake to evaluate the efficacy of shunt. In this way we carried out a safe control monitoring avoiding all the possible complication due to shunt deployment as kinking or occlusion. We observed a statistical difference with our previous series about the incidence of shunt deployment and conversion to GA between RCS-CEA group and LA-CEA group. In our opinion this is due to the fact that in the cases of agitation during LA the patient was converted directly to GA anesthesia and due to the high incidence of hostile necks treated. With a good level of analgesia the orotracheal tube and the operative position were well tolerated and the airways control was guaranteed avoiding the patients anxiety and the stress due to long time position. A prophylaxis of postoperative nausea and vomiting with 10 mg of metaclopramide was always started with a incidence of these complications in 31 patients (4.3%).

Despite the many advantages, this anesthetic procedure can show important side effects due to hemodynamic instability during the induction, like bradicardia, arterial hypotension or hypertension especially in beta blocked patients or due to respiratory muscle contraction[10,11,12,13,15].

In our experience all the occurred changes were prompt corrected on the basis of hemodynamic parameters and no higher cardiac complications in perioperative and postoperative were detected even in high-risk patients for comorbidities. No respiratory muscles contraction occurred because we routinely used succinylcholine before the intubation and in any way with the patient intubated this complication does really not represent a life risk.

Conclusion

RCS-CEA is safe and effective with a very satisfactory result in term of early cardiovascular and neurological mortality and morbidity and long-term results comparable with those found in literature using LA or GA. Remifentanil conscious sedation can lead to an optimal monitoring of the neurological status, better airways control and cerebral protection during arterial clamping, combining all the advantages of GA with the patient-awake neurological monitoring like LA. A selective shunt policy, good compliance for both patient and surgeon, calm environment during the endarterectomy, patching and hemostasis avoiding neck movements or patients discomfort was achieved in all cases. The possibility of hemodynamic instability during the induction still remains a controversial topic. Randomized studies comparing this procedure with LA or GA are necessary to validate this techniques, but in our opinion RCS could become an interesting anesthetic procedure for CEA.

References

1. Rothwell PM, Eliasziw M, Gutnikov SA, Fox AJ, Taylor DW, Mayberg MR, Warlow CP,Barnett HJ; Carotid Endarterectomy Trialists' Collaboration Analysis of pooled data from the randomised controlled trials of endarterectomy for symptomatic carotid stenosis. Lancet 2003;11:107-16.

2. Halliday A, Harrison M, Hayter E, Kong X, Mansfield A, Marro J, Pan H, Peto R, Potter J, Rahimi K, Rau A, Robertson S, Streifler J, Thomas D; Asymptomatic Carotid Surgery Trial (ACST) Collaborative Group. 10-year stroke prevention after successful carotid endarterectomy for asymptomatic stenosis (ACST-1): a multicentre randomised trial. Lancet. 2010;25:1074-84.

3. Rerkasem K, Rothwell PM. Local versus general anaesthesia for carotid endarterectomy. Cochrane Database Syst Rev. 2008;8:CD000126.

4. GALA Trial Collaborative Group, Lewis SC, Warlow CP, Bodenham AR, Colam B, Rothwell PM, Torgerson D, Dellagrammaticas D, Horrocks M, Liapis C, Banning AP, Gough M, Gough MJ. General anaesthesia versus local anaesthesia for carotid surgery (GALA): a multicentre, randomised controlled trial. Lancet. 2008;20:372(9656):2132-42.

5. Muchada R, Lucchesie G. Carotid endarterectomy under remifentanil. Rev Esp Anestesiol Reanim. 2001;48:508-12.

6. Marcucci G, Antonelli R, Gabrielli R, Accrocca F, Giordano AG, Siani A. Short longitudinal versus transverse skin incision for carotid endarterectomy: impact on cranial and cervical nerve injuries and esthetic outcome. J Cardiovasc Surg (Torino). 2011;52:145-52.

7. Bond R, Rerkarsem K, Counsell C, Salinas R, Naylor R, Warlow C. Routine or selective shunting for carotid endarterectomy/ and different methods of monitoring in selective shunting). Cochrane Database Syst Rev 2002;2:CD000190

8. Beers R, Camporesi E. Remifentanil update: clinical science and utility. CNS Drugs. 2004;18:1085-104

9. Coppi G, Moratto R, Ragazzi G, Nicolosi E, Silingardi R, Benassi Franciosi G, Rambaldi M, Navi A, Ciardullo AV Effectiveness and safety of carotid endarterectomy under remifentanil. J Cardiovasc Surg (Torino). 2005;46:431-6.

10. Baldinelli F, Pedrazzoli R, Ebner H, Auricchio F. Asleep-awake-asleep technique during carotid endarterectomy: a case series. J Cardiothorac Vasc Anesth. 2010;24:550-4.

11. Bevilacqua S, Romagnoli S, Ciappi F, Lazzeri C, Gelsomino S, Pratesi C, Gensini GF. Anesthesia for carotid endarterectomy: the third option. Patient cooperation during general anesthesia. Anesth Analg. 2009;108:1929-36

12. Marcucci G, Siani A, Antonelli R, Mounayergi F, Accrocca F, Giordano GA, Gabrielli R, Pierettori G, Sbroscia A. Carotid endarterectomy: general anaesthesia with remifentanyl conscious sedation vs loco-regional anaesthesia. Int Angiol. 2009;28:496-9.

13. Marcucci G, Siani A, Accrocca F, Gabrielli R, Giordano A, Antonelli R, Sbroscia A, Mounayergi F. Preserved consciousness in general anesthesia during carotid endarterectomy: a six-year experience. Interact Cardiovasc Thorac Surg. 2011 Sep 1. [Epub ahead of print]

14. Melliere D, Desgranges P, Becquemin JP, Selka D, Berrahal D, D'Audiffret A, Allaire E, *et al.* Surgery of the internal carotid: locoregional or general anesthesia? Ann Chir 2000;125:530-8

15. Godet G., Reina M., Raux M., Amour J., De Castro V. Anaesthesia for carotid endarterectomy: comparison of hypnotic-and opioid based techniques. Br J Anaesth. 2004;92:329-34