Customary paradigm in anesthetic management of carotid endarterectomy patients shifts after pandemic: experiences of an advanced practice centre

E. Kesimci[1], S. Beyazpınar[2], O. Karslıoğlu[2], N. Fatullayeva[1], T. Akay[2]

[1] Department of Anesthesiology, Baskent University, Faculty of Medicine, Ankara, Turkey
[2] Department of Cardiovascular Surgery, Başkent University Faculty of Medicine, Ankara, Turkey

Abstract:

Purpose: During the COVID-19 pandemic, aerosol-generating procedures posed significant infection risks to operating room (OR) staff. This study evaluated the shift from regional anesthesia (RA; cervical plexus block) to general anesthesia (GA) with rapid sequence intubation (RSI) for carotid endarterectomy (CEA) patients to minimize viral transmission while maintaining patient safety.

Materials and Methods: A retrospective analysis of 69 CEA patients (May 2019-May 2021) was conducted: 32 received RA (pre-pandemic) and 37 received GA (during pandemic). Data included demographics, comorbidities, anesthesia type, ICU/hospital stay, and complications. RA involved ultrasound-guided cervical plexus block, while GA employed RSI with videolaryngoscopy and strict aerosol precautions. Statistical analysis compared outcomes between groups.

Results: No significant differences existed in age, gender, or ICU/hospital stay between groups. GA patients had higher ASA scores (*p*<0.001), while RA patients had more cerebrovascular events. RA-associated complications (dysphagia, coughing, respiratory distress) raised aerosolization risks, prompting the GA transition. No COVID-19 transmission occurred among staff during GA procedures.

Conclusion: Despite RA's historical preference for CEA, GA with RSI proved safer for OR staff during the pandemic without compromising patient outcomes. This paradigm shift highlights the importance of adapting anesthetic practices to public health emergencies while balancing procedural risks. Institutional protocols should prioritize staff safety during aerosol-generating procedures without sacrificing patient care.

Keywords: Carotid endarterectomy, COVID-19, general anesthesia, regional anesthesia, aerosol-generating procedures, rapid sequence intubation.

INTRODUCTION

Anesthesiologists, and operating room (OR) staff are exposed to infectious droplets and aerosols during airway management. In ORs, anesthesiologists have to take strict precautions to lessen aerosol-generating procedures for avoidance of infection spread to other patients and healthcare workers[1]. General anesthesia (GA) and rapid sequence induction (RSI) are both recommended to reduce airborne and droplet transmission through the patient's mouth and nose in COVID-19 outbreak[2,3].

Carotid endarterectomy (CEA) has been accepted as a "gold standard" treatment option in symptomatic patients since 1970[4]. However, these patients have so many comorbidities and are commonly prone to intraoperative hemodynamic deterioations[5-9]. Thus, personalized anesthetic management is required[6,10]. The choice of anesthetic technique for these patients has been widely debated over years, mainly owing to the advantages and disadvantages of GA and/or regional anesthesia (RA). Although both techniques have common aims, there is no consensus on anesthetic choice for CEA. It usually depends on decisions and comfort of the instuitution.

Our center is a center where RA has been used to be the first-choice of anesthetic management in CEA patients for years. However, complications related to cervical plexus block such as anxiety, paroxysmal coughing, shortness of breath, airway obstruction, dysphagia and also a possible need for emergent oratracheal intubation in these patients, caused a change in our customized anesthetic approach in COVID-19 outbreak. Although, endotracheal intubation is a high risk procedure even under elective conditions, during COVID-19 outbreak, we still preferred GA rather than RA, in CEA patients at our center during this period.

We aimed to guide cardiovascular teams in managing CEA patients in the favour of both patients and medical staff to preserve public health efforts to mitigate and avoid infection spread in this pandemic.

Author for correspondence:

Prof. Elvin Kesimci, MD, PhD

Baskent University Medical Faculty, Department of Anesthesiology, Fevzi Çakmak Cd 10. Sok. No:45, 06490 Bahçelievler/Ankara, Turkey
Tel: 90 312203 68 68 - 4855
E-mail: dr.ahmed.elshiekh1@gmail.com
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MATERIALS AND METHODS

After the approval of Clinical Research Ethics Committee from the Faculty of Medicine of Başkent University (KA22/396), 69 patients who underwent CEA operation at Başkent University Ankara Hospital between May 2019 and May 2021 were retrospectively evaluated according to the chronological order. As a result of COVID-19 outbreak, 37 patients between February 2020-May 2021 had GA, while 32 patients between May 2019-January 2020 had cervical plexus block. By screening the patient files, demographic data of patients (age, gender, body mass index (BMI)), comorbidities, type of anesthesia and operation, length of intensive care unit (ICU) and hospital stay and complications observed, were recorded. Exclusion criteria included synchronous carotid endarterectomy with coronary artery bypass or valve surgery.

Anesthesia management

No premedication was given to patients. All patients had intravenous (iv) access established. Routine monitorization included electrocardiography, pulse oximetry, invasive blood pressure measured from the contralateral radial artery.

In RA Group, oxygen (2 L/min) was administered nasally. Cervical plexus block was performed by a senior anesthesiologist, with the patient in the supine position and the head turned slightly away. Routinely, sternocleidomastoid muscle (SCM), cricoid cartilage and mastoid process were first identified. Then the puncture side on the disinfected skin of the lateral neck was covered by sterile covers. The common carotid artery, internal jugular vein and vagus nerve at the level of the 6th cervical vertebra (C6) behind SCM were identified by the transducer of the ultrasound. Under ultrasound visualization, the needle was firts advanced into the carotid sheath from the posterior border and then to the anterior border of the SCM transversally. Close to the carotid artery 20 mL local anesthetic (LA) solution (5 mL 0.5% bupivacaine and 5 mL 2% prilocaine) was administered perivascularly, in two equal doses. By sensorial testing in the appropriate nerve distribution we let the surgeons to start the surgery. No any other sedating agent was administered. If inadequate analgesia and discomfort were detected, local anesthetic (lidocaine 1%) administration was tried. For neurologic and motor function assessment, the patients were asked to squeeze the stress ball that was placed into the contralateral hand as well as some questions to answer.

After COVID-19 outbreak, the accustomed cervical plexus block practice was changed to GA practice. The patients were monitored by cerebral oximetry using near infrared spectrophotometry (NIRS) before anesthesia induction to record the baseline values and continuous NIRS monitorization was applied throughout the operations. Anesthesia was administered without premedication to the patients by using different hypnotic agents according to the preferences of the anesthesiologist. Intravenous lidocaine (1 mg kg^{-1}) was used to suppress the hemodynamic responses before anesthesia induction. Then a single dose of fentanyl (2 µg kg^{-1}) was administered. Rocuronium bromide (0.6 mg kg^{-1}) was used as a muscle relaxant. Oratracheal intubation was performed in all patients. Mechanical ventilation with 4-6 mL kg^{-1} tidal volume and a breathing frequency of 12-16 min^{-1} was performed and the end-tidal CO_2 concentration was maintained at 30-35 mmHg. For anesthesia maintenance either sevoflurane (0.8-1.1%) or desflurane (5-6%) was administered through an oxygen/air mixture (FiO_2=50%). At the end, inhalational anesthetic agent was turned off, and sugammadex was applied to every patient for endotracheal extubation and emergence.The neurological examination of the patients were performed in ORs before ICU administration.

During the follow-up in the operation, hypovolemia, arterial hypotension were corrected using iv crystalloids and then, if necessary, by bolus norepinephrine (5 mg) and/or norepinephrine (0.03-0.06 µg kg^{-1} dk^{-1}) infusions. If arterial hypertension occured bolus nitroglycerine was administered.

All the patients were transported to ICU and followed up as required.

Statistical analysis

Data analysis was performed using IBM SPSS Statistics *ver.* 25.0 software (IBM Corporation, Armonk, NY, US). Kolmogorov-Smirnov test was used to investigate whether the normal distribution assumption was met. Categorical data were expressed as numbers (n) and percentage (%) while quantitative data were given as mean ± SD and median (min-max). The mean difference in ages between groups was compared Student's t test. On the other hand, the Mann Whitney U test was applied for the comparisons of quantitative data which the assumption of normality was failed. Categorical data were evaluated Continuity corrected χ^2 or Fisher's exact test, where applicable. A p value less than 0.05 was considered statistically significant.

RESULTS

Between May 2019 and May 2021, 69 patients (25 females, 44 males) who underwent endarterectomy intervention due to carotid artery stenosis were retrospectively analyzed. From January 2020, 37 patients (female/male: 14/23) had general anesthesia (Group GA) with orotracheal intubation. The ones before January 2020 had deep and superficial cervical plexus block (Group RA). There was no difference in mean age and female to male distibution of the patients between the groups (p=0.322 ve p=0.962). ASA physical status scores were significantly higher in Group GA (p<0.001), while there was no difference among the comorbidities between the groups. A history of cerebrovascular event (CVE) and transient ischemic attack (TIA) was more frequently seen in Group RA (Table 1). The length of stay in ICU and hospital was similar between the groups (Table 2).

DISCUSSION

Our study is not the first study to show how COVID-19 outbreak has resulted in significant changes for customized approach to selection, planning, and practice of anesthesia as well as the practices of other fields in medicine. Başkent Uni-

Table 1. Demographic characteristics of patients

	Group GA (n=37)	Group RA (n=32)	p-value
Age (years)	70.8±8.8	72.8±8.2	0.322†
Gender			0.962‡
Female	14 (37.8%)	11 (34.4%)	
Male	23 (62.2%)	21 (65.6%)	
ASA			**<0.001¶**
II	0 (0.0%)	8 (25.0%)	
III	37 (100.0%)	24 (75.0%)	
Comorbidity			
HT	30 (81.1%)	26 (81.3%)	>0.999‡
CAD	23 (62.2%)	22 (68.8%)	0.749‡
AF	5 (13.5%)	3 (9.4%)	0.716¶
DM	16 (43.2%)	11 (34.4%)	0.613‡
COLD	5 (13.5%)	3 (9.4%)	0.716¶
TIA	0 (0.0%)	8 (25.0%)	**<0.001¶**
CVE	2 (5.4%)	12 (37.5%)	**0.003‡**
Smoking	17 (45.9%)	9 (28.1%)	0.203‡

† Student's t testi, ‡ Continuity corrected Chi-square test χ^2 test, ¶ Fisher's exact test

HT: hypertension, CAD: coronary artery disease, AF: atrial fibrillation, DM: Diabetes Mellitus, COLD: chronic obstructive lung disease, TIA: transient ischemic attack, CVE: cerebrovascular event

Table 2. Clinical data of the patients

	Group GA (n=37)	Group RA (n=32)	p-value
Length of stay at ICU (days)	1 (1-12)	1 (1-13)	0.678†
Length of stay at hospital (days)	6 (1-32)	4 (2-44)	0.056†
Bleeding	1 (2.7%)	1 (3.1%)	>0.999‡
Complications			
no complication	31 (83.8%)	26 (81.3%)	>0.999¶
dysphagia	1 (2.7%)	2 (6.3%)	0.593‡
dysphonia	2 (5.4%)	0 (0.0%)	0.495‡
hematoma	2 (5.4%)	2 (6.3%)	>0.999‡
seizure	1 (2.7%)	1 (3.1%)	>0.999‡
cardiac arrest	1 (2.7%)	1 (3.1%)	>0.999‡
Revision required	1 (2.7%)	1 (3.1%)	>0.999‡
MI	0 (0.0%)	1 (3.1%)	0.464‡
Mortality	1 (2.7%)	0 (0.0%)	>0.999‡

† Mann Whitney U testi, ¶ Fisher's exact test, ‡ Continuity corrected Chi-square test χ^2 test,

versity Hospital Cardiovascular Surgery and Anesthesiology Departments had together achieved 483 CEA operations under deep and superficial cervical plexus block from 2003 to January 2020[11]. However; we had to change our accustomed anesthesia practice to GA after COVID-19 outbreak.

Deep cervical plexus block is a good and safe anesthetic technique for assessment of neurological and motor functions in these patients. However possible complications like discomfort at swallowing, paroxysmal coughing, shortness of breath, airway obstruction and need for emergent oratracheal intubation might lead to environmental contamination by generation of aerosols, and droplets. Considering the current evidence on the risks of COVID-19 transmission in the operating rooms, we suggested implementing radical changes and modifications to the anesthetic planning and perioperative management, even our cardiac team is experienced in RA for years.

Previously, there have been multiple reports describing CEA operations being performed under cervical plexus block[12-15]. In late 1900's Stoneham et al, reported that CEA might be performed successfully under either deep or superficial cervical plexus block combined with sedation and local infiltration by the surgeon[13]. However, they declared that the incidence of paralysis of phrenic nerve due to this block was unknown. They didn't report any complications related to RA in that paper, probably as they assumed the incidences very

low[13]. Habitually; most of the reports have been still reviewing the surgical outcome without paying attention to the incidence of intra-operative neurological, hemodynamic and respiratory detoriations. These are the complications faced by the anesthesiologists. Actually, monitorized anesthetic care of CEA patients under RA is a challenge for anesthesiologists. Especially, deep cervical blocks are associated with high rates of serious complications in comparison to superficial/intermediate ones[16]. The peripheral nerve blocks in neck region have a potential risk for puncture-related complications due to many blood vessels and nerves, nearby. Besides, anesthesia of recurrent laryngeal, vagus, hypoglossal, and phrenic nerves are all potential adverse effects. Opperer et al. emphasized the impact of depth of cervical plexus blocks on the blockade of hemi-diaphragmatic motion due to the phrenic nerve's pulsy[17]. The authors couldn't demonstrate clinically significant dysfunctions although there appears to be differences in FEV_1 and FVC before and after the deep cervical blocks. In our patient group, we used to encounter transient respiratory complications, like breathing difficulties, dyspnea, cough, decreases in oxygen saturation and dysphagia. Unfortunately, these procedures became the most aerosol generating procedures in COVID-19 outbreak. This increased the possibility of exposure of the medical staff to these droplets in the operating room. As the anesthesia technique was underestimated as RA, even in COVID-19 outbreak, the OR staff could be in lack of care and thus didn't use personal protective equipments (PPE) properly. Consequently, in contrary of what was expected, we had the patients intubated by the most experienced anesthesiologist in the team with RSI and videolaryngoscopy using an intubation box or transparent shield. To avoid repeated interventions, a guidewire was placed in the intubation tube, the tip was clamped, and we performed intubation following iv administration of a muscle relaxant to prevent any kind of airway irritation reflex. After reaching the appropriate depth, the cuff was inflated and connected to the breathing circuit, and the clamp was removed. The location of the endotracheal tube was confirmed by capnography.

In the literature, most aforementioned RA preferences during COVID-19 outbreak were for emergent orthopedics, urological and/or obstetrics cases[18,19]. These RA managements were all far away from the airway. It was the same in our country. Topcu et al, reported a significantly higher use of RA as the primary anesthetic technique than in the pre-pandemic period[20,21]. However, there are differences among the hospitals, such that our hospital is a private university hospital referred mainly for organ transplantation and extreme aged patients for cardiac surgeries. Thus we didn't have usual traumatic or non-traumatic surgical emergencies like the ones at state hospitals in our region. Most symptomatic carotid disease patients were referrals from the state hospitals. ASA III patients were more in number, probably the patients in better conditions didn't prefer to go to hospitals. However, patients with TIA or stroke were less in number due to possible overall decreases in diagnosis during COVID-19 outbreak.

Indeed, COVID-19 outbreak has affected the practice of medicine in many ways. The shift in the customary paradigm at our center is one of these examples. We believe strict adherence to our department's protective measures led to our optimal results.

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