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Local or general anesthesia for carotid endarterectomy: Which anesthesia technique should be preferred?

Karotid endarterektomi için lokal veya genel anestezi: Hangi anestezi tekniği tercih edilmelidir?

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Abstract

Aim: Carotid endarterectomy is performed in order to prevent disability or fatal stroke in patients with carotid stenosis. The objective of this study was to analyze and compare patients undergoing carotid endarterectomy under general or local anesthesia, and to determine whether the local anesthesia method is superior to general anesthesia in terms of postoperative morbidity and mortality.

Methods: A total of 80 patients who underwent carotid endarterectomy due to significant carotid arterial stenosis under general or local anesthesia in the cardiovascular surgery clinic of our hospital between November 2016 and January 2019 were included in this prospective cohort study. Forty carotid endarterectomy operations were performed under general anesthesia and 40 under local anesthesia. The study groups were divided as the general anesthesia group and local anesthesia group. Both groups were compared in terms of sociodemographic characteristics, preoperative risk factors, postoperative complications, operation time and length of hospital stay.

Results: No statistically significant difference was found between the two groups in terms of age and gender (P=0.665, P=0.636; respectively). The groups were similar in terms of the rate of asymptomatic patients, stroke or myocardial infarction, postoperative complications including minor stroke, cranial nerve damage, hematoma and internal carotid artery occlusion (P=0.264, P=0.780,P=1.000, P=0.870, P=0.870, P=1.000, P=0.723, respectively). The mean operation time and length of hospital stay were statistically significantly shorter in the local anesthesia group compared to general anesthesia group (P<0.001, P=0.655; respectively).

Conclusion: Local anesthesia provided shorter operation time and length of hospital stay for carotid endarterectomy procedure. Further comprehensive prospective studies are needed to clarify benefits of the use of local anesthesia for carotid endarterectomy.

Keywords: Carotid endarterectomy, Local anesthesia, General anesthesia, Complications, Mortality

Öz

Amaç: Karotid endarterektomi, karotid stenoz bulunan hastalarda sakatlığı veya ölümcül inmeyi engellemek için uygulanan bir prosedürdür. Bu çalışmanın amacı genel veya lokal anestezi teknikleri altında karotid endarterektomi uygulanan hastaları analiz ederek karşılaştırmak ve lokal anestezi yönteminin postoperatif morbidite ve mortalite açısından genel anesteziden daha üstün olup olmadığını belirlemektir.

Yöntemler: Kasım 2016 ve Ocak 2019 tarihleri arasında hastanemizin kardiyovasküler cerrahi kliniğinde ciddi karotid stenoz nedeniyle genel veya lokal anestezi altında karotid endarterektomi prosedürü uygulanan toplam 80 hasta bu prospektif kohort çalışmaya dahil edilmiştir. Prosedür 40 hastada genel ve 40 hastada lokal anestezi altında uygulanmıştır, ve çalışma grupları genel anestezi grubu ve lokal anestezi grubu olarak ikiye ayrıldı. İki grup sosyodemografik özellikler, preoperatif risk faktörleri, postoperatif komplikasyonlar, operasyon süresi ve hastanede kalış süresi açısından değerlendirilmiştir.

Bulgular: İki grup arasında yaş ve cinsiyet açısından anlamlı bir fark saptanmamıştır (sırasıyla P=0,665, P=0,636). Benzer şekilde genel anestezi ve lokal anestezi grupları arasında asemptomatik hastaların oranı, inme veya miyokard enfarktüsü insidansı açısından anlamlı fark saptanmamıştır (sırasıyla P=0,264, P=0,780, P=1,000). Postoperatif komplikasyonlardan minor strok (P=0,870), kraniyal sinir hasarı (P=0,870), hematom (P=1,000) ve internal karotis arter oklüzyonu (P=0,723) açısından iki group arasında anlamlı fark saptanmamıştır. Ortalama operasyon süresi ve hastanede kalış süresinin lokal anestezi grubunda genel anestezi grubuna kıyasla istatistiksel olarak anlamlı şekilde daha kısa olduğu saptanmıştır (sırasıyla P<0,001, P=0,655).

Sonuç: Lokal anestezi ile karotid endarterektomi prosedürü için daha kısa operasyon süresi ve hastanede kalış süresi saptanmıştır. Karotid endarterektomi prosedürü için lokal anestezi kullanımının yararlarını aydınlatmak amacıyla daha fazla kapsamlı prospektif çalışma gereklidir.

Anahtar kelimeler: Karotid endarterektomi, Lokal anestezi, Genel anestezi, Komplikasyonlar, Mortalite

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Introduction

Stroke is the most common cause of neurologic disability in the developed and developing countries. Carotid endarterectomy (CEA) is performed in order to prevent disability or fatal stroke in patients with carotid stenosis. The main goal of CEA is to successfully remove atherosclerotic plaque and to reconstruct the carotid artery without perioperative complications [1-4]. Patients with carotid stenosis may be asymptomatic, have transient ischemic attacks or minor stroke. Safety and effectiveness of CEA have been commonly demonstrated in the literature [5,6]. The primary aims of anesthesia during CEA is to maintain airway control and oxygenation, provide good operative conditions for the surgeon, and enable cerebral monitoring. This method can be performed under both general anesthesia (GA) and local anesthesia (LA). The choice of the anesthetic technique depends on familiarity of the surgeon with the procedure, general status and preference of the patient. On the other hand, performing CEA under LA has increased especially within the last 30 years. Studies are continuing to investigate the use of LA during CEA to reduce the risk of postoperative complications [7,8]. LA can be achieved with local filtration, superficial and/or deep cervical plexus blockage with and without ultrasound guidance [9]. The most important advantage of performing CEA procedure under LA is the ability to evaluate the patient clinically without a need for monitoring devices. LA allows communication with the patient, enabling the surgeon to take necessary actions when needed. In addition, adverse outcomes seen with GA such as sore throat, weakness, nausea, and vomiting can be eliminated with LA. On the other hand, the advantages of GA over LA include more easily provided oxygenation and ability to adjust arterial CO_2 tensions [10]. However, evidence about the benefits of agents used during GA is not enough [8]. Anesthetists and surgeons have been in debate on superiority of both techniques for years [11].

The objective of this study was to analyze and compare patients undergoing CEA under GA and LA, and to determine whether LA technique is superior over GA in terms of postoperative morbidity and mortality.

Materials and methods

This prospective cohort study included a total of 98 patients who underwent CEA due to carotid stenosis under GA or LA in the cardiovascular surgery clinic of our hospital between November 2016 and January 2019. Asymptomatic patients with carotid artery stenoses of >70% and >80% were confirmed with radiologic imaging. Definitive diagnosis was established through Doppler ultrasonography and/or angiographic assessment. Patients aged under 18 or over 80 years old, those in the terminal period with low life expectancy, patients with advanced congestive heart disease or cancer, those who preferred any of the anesthesia methods, those lost to follow-up, patients who underwent additional surgical interventions and those in whom LA was converted to GA due to intolerability or anxiety were excluded from the study (n=18). Remaining 80 patients were included in the analysis. CEA priority was determined according to the degree and/or side of the symptoms in patients with bilateral carotid artery stenosis.

Patients were randomly assigned to GA or LA groups with the closed envelope method. Accordingly, 40 CEA operations were performed under GA and 40 under LA. Patients in LA and GA groups were compared in terms of sociodemographic characteristics, preoperative risk factors, postoperative complications, operation time and length of hospital stay.

LA was performed using 0.75% ropivacaine. Sixteen mililitres was used to infiltrate the skin and underlying tissue. Intravenous sedatives and anxiolytic agents were used as recommended by the anesthesiologist.

In GA group, patients were intubated. Remifentanil infusion was used together with etomidate and propofol for anesthesia. During the procedure, patients were monitored with ECG, blood pressure and oxygen saturation. GA was conventionally performed using patches in all patients. All patients were admitted to the intensive care unit for 24 hours.

Sample size calculation

Sample size estimation was based on the method described by Faul et al. [12]. Using the G*Power 3.1 program, based on the existing findings and by taking alpha = 0.05 and d = 0.8, the effect size of the sample was determined to be large and the power of the study was calculated as 94.2%.

Ethics statements

Approval of Uludag University Clinical Researches Ethics Committee (decision no: 2016-18/10, approval date: 11/01/2016) was obtained prior to the study. All patients were informed about the study objectives in details and gave verbal and written consent. The study was conducted in accordance with the Declaration of Helsinki.

Statistical analysis

Data obtained in the study were statistically analyzed using SPSS v 21.0 (SPSS Inc, Chicago, IL, USA) package software. Continuous variables were expressed as mean (standard deviation), while categorical variables were given as frequency and percentage. Continuous variables were compared between the two groups with Mann-Whitney U and independent t test, and categorical variables with Chi-square test. $P<0.05$ values were considered as statistically significant.

Results

CEA operations were performed under GA in 40 (50%) and under LA in 40 (50%) patients. Among them, 70% (n=28) were male in GA group, while this rate was 62.5% (n=25) in LA group. The mean age was found as 64.83 years in GA group and 66.87 years in LA group. No statistically significant difference was found between GA and LA groups in terms of age and gender ($P=0.665$, $P=0.636$; respectively). Of the patients, 42.5% (n=17) were asymptomatic in GA group, while this rate was 57.5% (n=23) in LA group. There was no statistically significant difference between GA and LA groups in terms of the rate of asymptomatic patients ($P=0.264$). Comorbidities of the patients in both groups are given in Table 1.

Investigation of the smoking statuses of the patients revealed that 60% (n=24) of the patients in GA group and 47.5% (n=19) of the patients in LA group were smokers. No statistically significant difference was observed between both groups in terms of smoking ($P=0.380$). Looking at the preoperative risk

factors, stroke was found in 7 (17.5%) patients in GA group and 9 (22.5%) patients in LA group. A history of myocardial infarction (MI) was found in 6 (15%) patients in GA group and 6 (15%) patients in LA group. No statistically significant difference was found between GA and LA groups in terms of the incidence of stroke and MI (P=0.780, 1.000; respectively). Contralateral occlusion was found in 55% in both groups.

Right-sided CEA was performed in 52.5% (n=21) of the patients in GA group and 55% (n=22) of the patients in LA group. Intraoperative maximum and minimum blood pressure values were 123 (21) and 110 (25) mmHg in GA group, and 165 (21) and 140 (22) mmHg in LA group. Accordingly, intraoperative blood pressure values were significantly higher in LA group. Mortality did not occur in any patient following the procedures. Postoperative complications of the patients in GA and LA groups are presented in Table 2.

Themean operation times in the GA and LA groups were 89.9 (10.1) minutes and 60.2(5.5) minutes, respectively. Accordingly, the mean operation time was statistically significantly shorter in LA group (P<0.001).The mean lengths of intensive care unit and hospital stay were found as 1.4 (0.3) and 5.5 (1.3) days in GA group and 1.1 (0.2) and 3.6 (0.5) days in LA group. The mean length of hospital stay was also statistically significantly shorter in LA group (P=0.655). Perioperative outcomes of the patients in GA and LA groups are shown in Table 3.

Table 1: Comorbidities of the patients in GA and LA groups

	GA Group (n=40)		LA Group (n=40)		*P*-value
	n	%	n	%	
Diabetes mellitus	7	17.5	11	27.5	0.228
Peripheral arterial disease	14	35.0	12	30.0	0.473
Hypertension	32	80.0	28	70.0	0.560
Renal dysfunction	4	10.0	2	5.0	0.177

Table 2: Postoperative complications of the patients in GA and LA groups

	GA Group (n=40)		LA Group (n=40)		*P*-value
	n	%	n	%	
Minor stroke	1	2.5	0	0.0	0.870
Cranial nerve damage	1	2.5	0	0.0	0.870
Hematoma	1	2.5	1	2.5	1.000
Internal carotid artery occlusion	2	5.0	1	2.5	0.723

Table 3: Perioperative outcomes of the patients in GA and LA groups

	GA Group (n=40)	LA Group (n=40)	*P*-value
Mean operation time (min)	89.9 (10.1)	60.2 (5.5)	<0.001
Mean length of intensive care unit stay (day)	1.4 (0.3)	1.1 (0.2)	0.655
Mean length of hospital stay (day)	5.5 (1.3)	3.6 (0.5)	<0.001

Discussion

Numerous prospective and retrospective studies have reported that CEA is the most efficient treatment method in both asymptomatic and symptomatic patients with carotid artery stenosis [13]. European Vascular Surgery guidelines recommend CEA for patients with carotid artery stenosis >70% [14]. Advancements both in surgical experience and anesthesiology have reduced the incidence of surgical complications in CEA procedures performed under both GA and LA [5]. However, there is still debate of which anesthesia technique is superior over the other, and the choice of anesthesia technique largely depends on the preference of the surgeon and tolerability of the patient. While LA provides a better perioperative hemodynamic stability during CEA, this technique also enables direct evaluation of neurologic status of the patient. On the other hand, GA is indicated for non-cooperating patients, it is more comfortable for the surgeon and allows cerebral flow and perfusion. Depending on the developments in modern anesthesia techniques, some surgeons prefer to use GA, because of decreased patient anxiety and lower cerebral oxygen requirement with the GA method [15].

There are many comorbid risk factors increasing surgical morbidity-mortality rates in patients with carotid atherosclerosis. In a comprehensive study conducted in 22 countries worldwide, 90% of all strokes were associated with the most common 10 risk factors: These factors include previous tension, smoking, diabetes mellitus (DM), insufficient physical activity, high waist-to-hip ratio, high diet risk score, alcohol abuse, stress/depression, cardiovascular disease and high apolipoprotein B/apolipoprotein A1 ratio [16]. In our study, the most common comorbidities were found as hypertension in 75%, occlusive arterial disease in 32.5%, diabetes mellitus in 22.5% and renal dysfunction in 7.5% of the patients. However, no statistically significant difference was found between GA and LA groups in terms of accompanying diseases. In our study, 42.5% of the patients in GA group and 57.5% of the patients in LA group were asymptomatic. No statistically significant difference was found between the groups in terms of the rate of asymptomatic patients. Similarly, in a retrospective study by Lobo et al. [17], no significant difference was found between GA and LA groups in terms of the rate of asymptomatic patients. In this, study a history of MI was found in 15% of the patients in both groups. Watts et al. [18] reported the incidence of MI history as 18% in GA and 15% in LA groups, which is consistent with our study. We found a history of previous stroke in 17.5% of the patients in GA group, and 22.5% of the patients in LA group. These rates were reported as 23.7% and 29.7% respectively in a study by Lutz et al [19].

One of the important advantages of LA is reduced variability in intraoperative blood pressure values. In our study, fluctuations in intraoperative blood pressures were significantly lower in LA group. Also, Allen et al. [20] examined 679 CEA procedures performed under GA or LA and found that blood pressure instability was higher in GA group compared to LA group.

It has been reported that performing CEA in awake patients has the advantage of a shorter operation time compared to the operations carried out under GA [21]. In their study, Kalko et al. [22] reported shorter operation times with LA technique. In our study, the mean operation time was measured as 89.9 minutes in GA group and 60.2 minutes in LA group. Similarly operation times for both techniques reported by Watts et al. [18] were very close to our results. The authors reported the mean operation time as 88 minutes in GA group and 63 minutes in LA group. On the other hand, there have been studies reporting longer operation times. In a study by Lutz et al. [19], the mean operation times were reported as 111.38 minutes in GA group and 103.98 minutes in LA group, which were both longer. We attributed this difference between the studies to different operation techniques used during CEA procedures.

Mortality rates used by the American Heart Association (AHA) to formulate recommendations for CEA are based on studies older than 10 years. In a more recent study by Ederle et al. [23] conducted in 2010, 120-day mortality from CEA was

reported as 0.8%. In another study performed by Brott et al. [24] in the same year, 30-day mortality was reported as 0.3%. In our study, no mortality was seen in any patient. In a study by Toktas et al. [25] comparing GA and LA methods, 2 patients died in GA group. Some studies reported no significant difference between the two methods in terms of mortality [26-28].

Postoperative complications related to CEA procedure include MI, perioperative stroke, bleeding, cervical hematoma, nerve injury, infection, and carotid restenosis. In our study, postoperative complications included internal carotid artery occlusion in two, hematoma in one, cranial nerve injury in one, and minor stroke in one patient in the GA group, while internal carotid occlusion was seen in one and hematoma in one patient in the LA group. No statistically significant difference was observed between the two groups in terms of postoperative complications. Similarly, Kalko et al. [22] reported no significant difference between GA and LA techniques in terms of postoperative complications. In the study by Watts et al. [18], hemodynamic instability and cardiopulmonary complications were significantly lower in the LA group, while no statistically significant difference was found between both groups in terms of the other postoperative complications. In another study by Ferrero et al. [29] evaluating 428 patients who underwent CEA procedures under GA or LA, no significant difference was found between both groups, and no mortality was observed in any patient. Additionally, in a recent study by Saraç et al [30], the authors shared an institutional experience on 215 patients undergoing CEA procedures under local anesthesia, and suggested that low rates of complication and great rates of patency might be obtained using local anesthesia at CEA procedures.

In our study, the mean length of hospital stay was found as 5.5 days in GA group and 3.6 days in LA group. Accordingly, the mean length of hospital stay was statistically significantly shorter in LA group. Kalko et al. [22] also reported shorter duration of hospitalization in LA group compared to GA group.

According to our results, no statistically significant difference was found between both methods in terms of postoperative complications, while operation time and length of hospital stay were significantly lower with LA method. The reason for not preferring CEA under LA is that this method decreases the degree meticulousness. However, increasing surgical experience with LA prevents this difficulty.

Limitations

This study was conducted in a single center and included a relatively small number of patients. This limited our statistical analysis especially for the comparison of postoperative complications. However, prospective design of the study and randomization of the patients to the two groups are strengths of our study.

Conclusion

The results of our study demonstrated that LA performed for CEA enabled the surgeons to assess neurologic status of the patient and provided shorter operation times. However, further prospective studies with a larger series of patients and longer follow-up durations are needed to clarify benefits of the use of LA for CEA procedure.

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