Received: 29 June 2023 | **Accepted:** 20 Sep 2023 **Genel Tıp Derg. Volume** 33/**Issue** 5 (October), 582-587
DOI: 10.54005/geneltip.1320956

ORIGINAL ARTICLE

A Comparative Analysis of Regional and Local Anesthesia in Arteriovenous Fistula Surgery: A Single-Center Study

Arteriovenöz Fistül Cerrahisinde Rejyonal ve Lokal Anestezi Karşılaştırması: Tek Merkezli Bir Araştırma

[1]Mustafa Cüneyt Çiçek

[1]Konya City Hospital, Department of Cardiovascular Surgery, Konya, TÜRKİYE

Correspondence

Mustafa Cüneyt Çiçek, Konya City Hospital, Cardiovascular Surgery Dept. Akabe Mah. Adana Çevreyolu Cad. No: 135 Posta Kodu: 42020 Karatay/KONYA

E-Mail: drmcuneyt@hotmail.com

How to cite ?

Çiçek M. C. A Comparative Analysis of Regional and Local Anesthesia in Arteriovenous Fistula Surgery: A Single-Center Study. Genel Tıp Dergisi. 2023; 33(5): 582-587.

ABSTRACT

Background: This retrospective study aimed to compare the outcomes of regional anesthesia and local anesthesia techniques in arteriovenous fistula operations, focusing on patency rates, operation time, and postoperative pain.
Methods: A total of 77 arteriovenous fistula and arteriovenous graft operations performed between April 2020 and April 2023 on adult patients with chronic renal failure were analyzed. The patients were divided into two groups based on the anesthesia technique: local (n = 49) and regional anesthesia (n = 28) groups.
Results: The majority of operations in the local anesthesia group involved radio-cephalic arteriovenous fistula, while brachio-cephalic, brachio-basilic arteriovenous fistula, and arteriovenous grafts were predominantly performed in the regional anesthesia group. There was no significant difference in operation time between the two groups. However, the regional anesthesia group had a significantly lower need for pain relief within the first 24 hours postoperatively. There were no significant differences in early postoperative fistula failure, bleeding or hematoma between the groups. One case of local wound infection was observed in each group during post-discharge follow-up.
Conclusion: This retrospective analysis suggests that regional anesthesia provides superior pain control in the first 24 hours following arteriovenous fistula surgery compared to local anesthesia. Regional anesthesia is a safe and effective technique and can be preferred for more sophisticated arteriovenous fistula procedures.

Keywords: Arteriovenous fistula, local anesthesia, postoperative analgesic, regional anesthesia.

ÖZ

Amaç: Bu çalışma, rejyonal anestezi ve lokal anestezi tekniklerinin arteriovenöz fistül operasyonlarında açıklık oranları, operasyon süresi ve ameliyat sonrası ağrı açısından karşılaştırılmasını amaçlamaktadır.
Yöntemler: Kliniğimizde Nisan 2020-Nisan 2023 tarihleri arasında kronik böbrek yetmezliği tanılı erişkin hastalara lokal veya rejyonal anestezi uygulanarak gerçekleştirilen hemodiyaliz amaçlı toplam 77 arteriovenöz fistül ve arteriovenöz greft ameliyatı retrospektif olarak değerlendirildi. Hastalar uygulanan anestezi tekniğine göre iki gruba ayrılarak incelendi: lokal (n=49) ve rejyonal anestezi (n=28) grupları.
Bulgular: Lokal anestezi altında yapılan operasyonlarda çoğunlukla radio-sefalik arteriovenöz fistül uygulanırken, rejyonal anestezi altında yapılan operasyonlarda ise brakio-sefalik, brakio-bazilik fistül ve greft ile fistül açılmıştır. Operasyon süresi açısından iki grup arasında anlamlı bir fark bulunmazken, rejyonel anestezi grubunda postoperatif ilk 24 saatte ağrı kesici ihtiyacı lokal anestezi grubuna göre anlamlı olarak daha azdı. Postoperatif erken dönemde her iki grupta da fistül yetmezliği ve kanama/hematom görülme sıklığı arasında anlamlı farklılık bulunmadı. Taburculuktan sonra yapılan kontrollerde ise her iki grupta birer hastada lokal yara yeri enfeksiyonu tespit edildi.
Sonuç: Bu retrospektif çalışma, rejyonel anestezi tekniğinin lokal anesteziye kıyasla arteriovenöz fistül operasyonlarında postoperatif ilk 24 saatte ağrı kontrolünde daha iyi sonuçlar sağladığını göstermiştir. Kolay, güvenli ve etkili bir prosedürdür olan rejyonel anestezi tekniği sofistike bazı arteriovenöz fistül operasyonları için tercih edilebilir.

Anahtar Kelimeler: Arteriovenöz fistül, lokal anestezi, postoperatif analjezik, rejyonal anestezi.

Introduction

Hemodialysis serves as a therapeutic modality employed to enhance both the survival rates and the quality of life for individuals afflicted with chronic renal failure (CRF). Among the various access routes utilized for hemodialysis, commonly employed options include arteriovenous fistula (AVF), arteriovenous graft (AVG), and central venous catheter (CVC). In the present era, fistulae have emerged as one of the most favored access routes, primarily due to their reduced propensity for thrombosis and extended functional lifespan when compared to alternative methods (1-3). The choice of anesthetic technique in fistula surgery plays a crucial role in ensuring patient comfort, safety, and fistula patency. Several options are available for this surgical procedure, including local anesthesia (LA), regional anesthesia (RA), and general anesthesia (GA). However, it is important to note that GA carries potential risks to the respiratory and circulatory systems and may

Peer-Review: Double anonymized - Two External
Plagiarism Checks: Yes - iThenticate
Complaints: geneltip@selcuk.edu.tr

increase the likelihood of complications in certain patients. Therefore, when selecting the anesthesia technique for patients undergoing fistula surgery, particular attention should be given to risk factors such as hypertension (HT), coronary artery disease (CAD), diabetes mellitus (DM) and chronic lung disease. Consequently, less invasive alternatives such as LA and RA emerge as favorable and effective anesthesia options as they contribute to the prevention of cardiovascular and respiratory complications in fistula surgery (4).

The literature provides a limited number of studies comparing the outcomes of RA and LA techniques, both of which are commonly employed in routine clinical practice. The chosen anesthesia technique possesses the capacity to influence several factors that can impact the success of AVF surgery. Hence, the primary objective of this study was to compare the RA and LA techniques routinely employed at our clinic in terms of early AVF patency rates, operation duration and postoperative pain.

Materials and Methods

The study commenced subsequent to obtaining approval from the Non-Drug and Non-Medical Device Research Ethics Committee of KTO Karatay University Faculty of Medicine, dated 25.05.2023, under the decision number 2023/039. All procedures conducted throughout the study adhered to the ethical principles outlined in the Declaration of Helsinki.

A retrospective evaluation was conducted on a total of 77 AVF and AVG operations for hemodialysis, performed using either LA or RA, on adult patients (≥18 years of age) diagnosed with CRF.

Demographic information, preoperative, intraoperative, and postoperative records as well as follow-up results of the patients were retrieved from the hospital's data system. The data included variables such as age, gender, comorbid conditions, fistula type, operation duration, postoperative complications, analgesic requirements, type of anesthesia (local or regional) and AVF and AVG patency during in-hospital and the first post-discharge follow-up (day 10). Based on the anesthesia technique used, the patients were categorized into two groups: Group-1, the local anesthesia group (n = 49), and Group-2, the regional anesthesia group (n = 28). Both groups were comprehensively analyzed and compared basing on the collected data, in conjunction with the existing literature on the subject.

Patients who met any of the following criteria were excluded from the study: presence of coagulopathy, neurological deficits affecting the extremity undergoing the operation, known allergy to local anesthetic agents, active skin infection at the procedural site, advanced age (≥80 years), patients operated on by another surgical team, and patients who required local anesthesia due to inadequate regional anesthesia.

Surgical Procedure

All patients underwent elective procedures and were positioned supine in the operating room. Standard monitoring, including electrocardiography, noninvasive blood pressure measurement and peripheral oxygen saturation monitoring was implemented. In Group 1 patients, a 2% prilocaine solution was administered with a maximum total dose of 5 mg/kg. For patients in Group 2, a 20 ml solution was prepared using a mixture of 7 ml of 1% prilocaine, 8 ml of 0.5% bupivacaine and 5 ml of saline. This solution was administered following the axillary block technique, guided by ultrasonography (USG) and nerve stimulation, with the upper extremity placed in abduction. The success of RA was confirmed by pinprick testing, ensuring complete sensory and motor anesthesia in all patients. Notably, no intraoperative or postoperative complications associated with the RA technique were observed.

The patients underwent various types of AVF and AVG operations, including radio-cephalic AVF, brachio-cephalic AVF, brachio-basilic AVF, and AVG. The AVG procedure involved the placement of a dialysis graft between the brachial artery and the axillary vein. No vasodilator agents were administered intraoperatively or postoperatively. The non-dominant extremity was generally selected for AVF and AVG procedures. The choice of fistula location and type was determined based on the patient's age and vascular structure. Postoperatively, the patency of the newly created AVF and AVG was assessed by the presence of a thrill upon palpation or the detection of a murmur upon auscultation. In cases where no thrill, murmur or presence of hematoma at the fistula site was observed during the postoperative hospital follow-up, revision operations were performed if necessary. Patients were provided with information regarding the care and maintenance of their AVF before discharge, and they were scheduled for an outpatient clinic visit after a 10-day period for further assessment and follow-up.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, N.Y., USA). Descriptive statistics such as mean and standard deviation were used to summarize normally distributed variables while median and interquartile ranges were used for non-normally distributed data. Categorical variables were presented as numbers and percentages. The normality of the data was assessed using the Kolmogorov-Smirnov test. For comparisons between independent groups, the independent sample t-test or Mann-Whitney U test was utilized for continuous variables, depending on the normality of the data. The chi-square test was employed to compare categorical variables. A p-value of less than 0.05 was considered statistically significant.

Results

The study included a total of 77 patients, comprising both males and females. In Group I, 49 patients

underwent surgery under local anesthesia, with a mean age of 61.53±13.45 years. Group II consisted of 28 patients who underwent surgery under regional anesthesia, with a mean age of 57.68±16.02 years. The most prevalent comorbidities observed were HT in 28 patients (36.4%), DM in 16 patients (20.8%), and CAD in 11 patients (14.3%). However, no statistically significant differences were found between the two groups when comparing demographic data and comorbidities. The demographic information of the patients is given in Table-1.

Patients were primarily evaluated for radio-cephalic AVF and brachio-cephalic AVF. However, if the arterial and venous structures in the forearm were deemed unsuitable for AVF, the preference shifted towards brachio-basilic AVF and AVG operations. Among patients in Group 1, radio-cephalic AVF was performed in 42 cases (85.7%), brachio-cephalic AVF in 6 cases (12.2%), and AVG in 1 case (2%). No brachio-basilic AVF procedures were performed in Group 1. In Group 2, radio-cephalic AVF was performed in 3 cases (10.7%), brachio-cephalic AVF in 11 cases (39.3%), brachio-basilic AVF in 9 cases (32.1%), and AVG in 5 cases (17.9%). The number of patients with radio-cephalic AVF was significantly higher in Group 1 compared to Group 2 ($p<0.001$). Conversely, brachio-cephalic AVF, brachio-basilic AVF, and AVG procedures were significantly more common in Group 2 compared to Group 1 ($p=0.014$, $p<0.001$, $p=0.022$, respectively). Considering the entire patient population, radio-cephalic AVF was the most common type of AVF. Table-2 demonstrates the distribution of arteriovenous fistula types among groups.

Table-3 displays the distribution of operation duration, postoperative analgesic requirements in the first 24 hours, and postoperative in-hospital revision based on the type of anesthesia. There was no statistically significant difference observed between the two groups regarding the operation duration ($p = 0.145$). The median operation time was 87 minutes [interquartile range (IQR): 63.5–105] in the LA group and 100.5 minutes (IQR: 76.8–117.8) in the RA group. However, there was a significant difference in the need for painkillers in the first 24 hours postoperatively, with a lower requirement observed in the RA group compared to the LA group ($p = 0.014$).

During the early postoperative in-hospital follow-up, fistula failure was observed in 1 patient (2%) in the LA group, and hemorrhage or hematoma occurred in 4 patients (8.2%). In the RA group, 4 patients (14.3%) experienced fistula failure, and 1 patient (3.6%) developed hemorrhage or hematoma in the surgical field. However, there was no statistically significant difference between the two groups in terms of fistula failure ($p = 0.056$) or hemorrhage or hematoma ($p = 0.648$). In the first post-discharge follow-up, no cases of fistula failure were observed in either group. However, a local wound site infection was detected in one patient in each group.

Table 1. Demographic information of the patients

	Group-1 (n = 49)	Group-2 (n = 28)	p value
Age (years)	61.53±13.45	57.68±16.02	0.263
Sex			
Male	33 (67.3%)	13 (46.4%)	0.119
Female	16 (32.7%)	15 (53.6%)	
Comorbidities			
Hypertension	15 (30.6%)	13 (46.4%)	0.254
Diabetes mellitus	11 (22.4%)	5 (17.9%)	0.853
Coronary artery disease	8 (16.3%)	3 (10.7%)	0.737

Table 2. Distribution of arteriovenous fistula types among groups

	All patients (n = 77)	Group-1 (n = 49)	Group-2 (n = 28)	p value
Radiocephalic AVF	45 (58.4%)	42 (85.7%)	3 (10.7%)	<0.001
Brachiocephalic AVF	17 (22.1%)	6 (12.2%)	11 (39.3%)	0.014
Brachiobasilic AVF	9 (11.7%)	-	9 (32.1%)	<0.001
AVG	6 (7.8%)	1 (2%)	5 (17.9%)	0.022

AVF: Arteriovenous fistula; AVG: Arteriovenous fistula with graft

Table 3. Comparison of operative and postoperative variables

	Group-1 (n = 49)	Group-2 (n = 28)	p value
Operation time (minutes)	87 (63.5-105)	100.5 (76.8-117.8)	0.145
Postoperative revision			
Bleeding/hematoma	4 (8.2%)	1 (3.6%)	0.648
Fistula failure (thrombosis)	1 (2%)	4 (14.3%)	0.056
Need for postoperative analgesic	33 (67.3%)	10 (35.7%)	0.014

Discussion

Patients with end-stage renal failure require hemodialysis, which can be achieved through various methods such as central venous catheter, AVF, or AVG. Among these options, AVGs and AVFs are more commonly preferred due to their ease of maintenance, lower risk of complications, and suitability for long-term use compared to central venous catheters (3). However, early occlusion and inadequate functioning of the fistula are significant challenges encountered in AVFs. These issues can have a negative impact on the treatment process of patients. Although the rate of early and late occlusion in AVFs has decreased with advancements in surgical techniques, it still remains around 10% (5). Therefore, the optimal surgical

creation of fistulas is crucial in ensuring their long-term effectiveness and functionality.

The selection of an appropriate anesthesia technique plays a vital role in achieving successful fistula surgery. LA, RA, and GA are commonly employed methods in AVF surgery. However, LA and RA are often preferred to GA due to their less invasive nature and lower risk of complications (4). Therefore, LA and RA emerge as safe and effective anesthesia options, particularly for patients with comorbid conditions such as DM, HT, and CAD, who are scheduled for AVF creation. These less invasive techniques help prevent potential serious complications, making them favorable choices for anesthesia in AVF surgeries.

Comorbid conditions such as DM, HT, and CAD have a significant impact on the success of fistula surgery as well as the choice of surgical technique and anesthesia method. These conditions have a vasculopathic effect on the circulatory system. DM, in particular, has a pronounced negative influence on the proper maturation and long-term function of the fistula. The altered vasculature in patients with DM can lead to delayed fistula maturation or an increased risk of fistula failure (4). Due to the adverse effects of these systemic diseases on fistula surgery, it is crucial to thoroughly evaluate patients and provide adequate preoperative follow-up. Through a multidisciplinary approach, the success of fistula surgery can be enhanced by effectively managing and controlling diseases such as DM, HT, and CAD. In our study, no statistically significant difference was observed between the two groups regarding the frequency of comorbid diseases.

Determining the appropriate type of fistula is crucial in planning AVF surgery. The selection of fistula type in upper extremity surgeries depends on factors such as the compatibility of arterial and venous vascular structures and individual patient characteristics. Radio-cephalic AVF and brachiocephalic AVF are commonly preferred as the first choice due to their high long-term patency rates (6-7). These types of fistulas are created using an artery and vein that are easily accessible. However, in some cases, the arterial and venous structures in the forearm may not be suitable for AVF creation. In such situations, brachiobasilic AVF or AVG operations are considered. Brachiobasilic AVF involves anastomosing the brachial artery with the basilic vein, while AVG involves using a synthetic graft placed between an artery and vein. These alternative types of fistulas can serve as reliable and sustainable options to meet the hemodialysis needs of patients. In our clinic, radiocephalic and brachiocephalic AVFs are routinely preferred for fistula creation primarily. In fact, in our study, these two types of fistulas were the most commonly used when considering the entire patient group. However, in cases where the forearm region does not have appropriate artery and vein structures, brachiobasilic AVF or AVG operations were performed. In our study, statistically significantly more patients in Group-1 had radiocephalic AVF, while significantly more patients in Group-2 had brachiocephalic AVF, brachiobasilic AVF, and AVG. This may be attributed to the fact that radiocephalic AVFs in the forearm region require smaller incisions compared to more proximal regions where brachiocephalic AVFs, brachiobasilic AVFs, and AVGs are created. Additionally, the vascular anatomical structure in the forearm region is more suitable for local anesthesia.

When the literature is reviewed, it is revealed that both LA and RA techniques, which are commonly preferred in AVF surgery, have their own advantages and disadvantages compared to each other. Some studies have reported potential complications associated with RA such as hematoma, infection, systemic toxicity from intravascular injection and nerve damage (8, 9). On the other hand, other studies have indicated that LA procedures may carry risks of systemic toxicity and infection (10). In our study, no complications related to the anesthesia technique were observed in any patient. This favorable outcome may be attributed to the use of USG guidance, particularly during the RA procedure. The utilization of USG can enhance the accuracy of nerve localization, thereby minimizing the risk of hematoma formation and intravascular injection. By visualizing the targeted structures, USG can aid in the precise administration of anesthetics, reducing the likelihood of complications.

When considering the advantages of both anesthesia techniques, RA demonstrates superiority over LA in terms of providing effective intraoperative and postoperative pain control, reducing operation time, and promoting long-term fistula patency (11, 12). In our study, a statistically significant decrease in the need for postoperative painkillers within the first 24 hours was observed in the RA group compared to the LA group. These findings suggest that RA is more effective in managing intraoperative and postoperative pain and reduces the requirement for analgesic medication, thereby improving the postoperative recovery experience for patients. Moreover, the reduced use of painkillers may potentially contribute to a decrease in the occurrence of side effects and complications.

An additional advantage of regional anesthesia, compared to local anesthesia, is its vasodilatory effect. Regional anesthesia suppresses sympathetic nerve activity, resulting in sympathectomy-like effects and vasodilation (12). This vasodilation contributes to increased arterial blood flow, thereby enhancing the success of arteriovenous fistula procedures. The vasodilatory effect of regional anesthesia may facilitate the maturation process of the AVF, leading to improved long-term patency (13). Consequently, the increased blood flow and accelerated maturation of the AVF assist in meeting the hemodialysis needs more effectively and earlier while reducing the risk of complications such as thrombosis. In contrast, local anesthesia-based fistula operations may induce vascular spasm due to regional infiltration, potentially compromising blood flow and increasing the risk of early fistula thrombosis (4). Fistula thrombosis is a common complication in both the early and late stages

of AVF surgery, with reported frequencies ranging from 9.4% to 38% (14). Early thrombosis is primarily associated with surgical technique-related factors and can be prevented by ensuring high blood flow velocity during the intraoperative and postoperative periods (14). The choice of anesthesia method may significantly influence this phenomenon. Treatment for fistula thrombosis typically requires surgical revision. In our study, one patient (2%) in the local anesthesia group experienced in-hospital fistula thrombosis, while four patients (14.3%) in the regional anesthesia group developed early in-hospital fistula thrombosis. Although not statistically significant, it is worth noting that the higher incidence of fistula thrombosis in the regional anesthesia group compared to the local anesthesia group may be attributed to the fact that the regional anesthesia group included more complex surgical procedures.

Another advantage of regional anesthesia with venodilation is its facilitation of venous access, leading to efficient and expeditious surgical procedures (11). Venodilation results in the dilation of veins and increased venous blood flow, which improves the visibility of the surgical area during the operation. As a result, surgeons can locate the patient's veins more easily and quickly, enabling precise manipulations. In our study, there was no statistically significant difference in operation time between the two groups. The lack of difference in operation time could be attributed to the preference for regional anesthesia in patients undergoing longer and more sophisticated procedures included in the study. Subgroup analysis with a larger sample size could provide further insights into the effect of regional anesthesia on operation duration.

In our study, hematoma and infection were identified as the most common complications following fistula thrombosis. It is important to note that these complications were unrelated to the anesthesia technique but were complications inherent to AVF surgery instead. None of the patients in either group experienced fistula failure as a result of hematoma or infection. There was no statistically significant difference between the two groups regarding the occurrence of these complications. The prevention of complications such as hematoma and infection necessitate the implementation of meticulous surgical techniques. Measures such as maintaining a sterile environment, employing appropriate surgical gloves and instruments, and thorough cleaning and disinfection of surgical equipment are crucial in reducing the risk of infection. Similarly, careful hemostasis techniques to control bleeding and ensuring appropriately sized surgical incisions play an important role in preventing hematoma formation. During the first post-discharge follow-up, which took place on the 10th day after surgery, no cases of fistula failure were observed among our patients. However, it is worth noting that one patient in the LA group and one patient in the RA group presented with a surgical site local infection. These cases were promptly identified and managed with an appropriate antibiotic regimen to effectively treat the infection.

There are a number of noteworthy limitations to our study that merit discussion. Our research design is primarily retrospective in nature. Clearly, the absence of randomization weakens our analysis. In addition, our research was conducted at a single medical center, which may limit the applicability of our findings to a larger population. The size of our patient cohort represents a further limitation. Despite the fact that we analyzed a substantial number of cases, it is crucial to recognize that a larger sample size would have provided greater statistical power and potentially more reliable conclusions. Lastly, it was not possible to conduct a long-term follow-up to determine the patency rates of AVF due to the inaccessibility of the patients. In light of these limitations, caution should be exercised in interpreting our findings, and future research, ideally employing prospective designs and larger, more diverse patient populations is required to further investigate and validate the outcomes observed in our study.

In conclusion, both RA and LA techniques have demonstrated effectiveness and safety in AVF surgery, with minimal complications observed. These techniques offer advantages over GA, particularly in terms of reducing cardiovascular and respiratory risks in patients undergoing AVF surgery. Additionally, the significantly lower requirement for additional analgesics in the early postoperative period in the RA group highlights the potential for improved patient comfort with RA. While our study did not reveal a statistically significant difference in early fistula patency between the RA and LA groups, further studies with longer-term follow-up and larger patient cohorts are needed to provide more conclusive evidence on the effects of both techniques on AVF patency.

Ethical Approval

The study commenced subsequent to obtaining approval from the Non-Drug and Non-Medical Device Research Ethics Committee of KTO Karatay University Faculty of Medicine, dated 25.05.2023, under the decision number 2023/039.Conflict of Interest

Authors declared no conflict of interest.

Funding

The authors received no financial support for the research and/or authorship of this article.

Authors' Contributions

Conception, Materials, Data Collection and/or Processing, Analysis and/or Interpretation, Literature Review, Writer, and Critical Review were made by MCÇ.

References

1.Murea M, Geary RL, Davis RP, Moossavi S. Vascular access for hemodialysis: A perpetual challenge. Semin Dial 2019;32:527-534.

2.Manov JJ, Mohan PP, Vazquez-Padron R. Arteriovenous fistulas for hemodialysis: Brief review and current problems. J Vasc Access 2022;23:839-846.

3.Shechter SM, Chandler T, Skandari MR, Zalunardo N. Cost-effectiveness analysis of vascular access referral policies in CKD. Am J Kidney Dis 2017;70:368-376.

4.Gao C, Weng C, He C, Xu J, Yu L. Comparison of regional and local anesthesia for arteriovenous fistula creation in end-stage renal disease: a systematic review and meta-analysis. BMC Anesthesiol 2020;20:219.

5.Shemesh D, Zigelman C, Olsha O, Alberton J, Shapira J, Abramowitz H. Primary forearm arteriovenous fistula for hemodialysis access--an integrated approach to improve outcomes. Cardiovasc Surg 2003;11:35-41.

6.Jennings WC. Creating arteriovenous fistulas in 132 consecutive patients: exploiting the proximal radial artery arteriovenous fistula: reliable, safe, and simple forearm and upper arm hemodialysis access. Arch Surg 2006;141:27-32.

7.Ahmed I, Pansota MS,Tariq M,Tabassam SA, Saleem MS. Arterio-venous fistula: surgical outcome and primary failure rate. J. Univ. Med. Dent. Coll 2012;3:27-29.

8.Lo Monte AI, Damiano G, Mularo A, Palumbo VD, Alessi R, Gioviale MC, et al. Comparison between local and regional anesthesia in arteriovenous fistula creation. J Vasc Access 2011;12:331-335.

9.Macfarlane AJR, Kearns RJ, Aitken E, Kinsella J, Clancy MJ. Does regional compared to local anaesthesia influence outcome after arteriovenous fistula creation? Trials 2013;14:263.

10.Felice K, Pharm D, Schumann HM. Intravenous lipid emulsion for local anesthetic toxicity: A review of the literature. J Med Toxicol 2008;4:184-192.

11.Shoshiashvili V, Tataradze A, Beglarishvili L, Managadze L, Chkhotua A. Evaluation of efficacy of regional and local anesthesia techniques in arteriovenous fistula criation for dialysis. Georgian Med News 2014;236:7-12.

12.Shemesh D, Olsha O, Orkin D, Raveh D, Goldin I, Reichenstein Y, et al. Sympathectomy-like effects of brachial plexus block in arteriovenous access surgery. Ultrasound Med Biol 2006;32:817–822.

13.Lee C, Snyman A. Different anesthetic techniques for arteriovenous fistula formation: Preliminary data of early and late occlusion rates. Eur J Anaesthesiol 2010; 27:133–134.

14.Çolak MC, Dişli O, Erdil N, Cihan HB, Battaloğlu B. Turgut Özal tıp merkezi kalp ve damar cerrahisi kliniğinde hemodializ için yapılan arteriovenöz fistüllerin erken ve geç dönem komplikasyonları. J Turgut Ozal Med Cent 2011;18: 160-163.