JUCVM Journal of Updates in Cardiovascular Medicine

Research Article

155

JUCVM 2024;12(4):155-161

DOI: 10.32596/jucvm.galenos.2024-41-123

Effect of Regional Versus Local Anesthesia on Outcomes of Radiocephalic Arteriovenous Fistula Creation for Hemodialysis Access: A Prospective Randomized Study

Mustafa Selçuk Atasoy[1], Hakan Güven[2], Ahmet Yüksel[1], Ayhan Müdüroğlu[1], Demir Çetintaş[1], Ali Önder Kılıç[1], Serdar Badem[1], Mustafa Aldemir[3], Mustafa Çağdaş Çayır[4], Murad Kaya[5], Mustafa İşleyen[6], Yusuf Velioğlu[1]

[1]University of Health Sciences Turkey, Bursa City Hospital, Clinic of Cardiovascular Surgery, Turkey, Bursa
[2]Mudanya University, Bursa Medical Park Hospital, Clinic of Cardiovascular Surgery, Turkey, Bursa
[3]University of Health Sciences Turkey, Bursa Yüksek İhtisas Training and Research Hospital, Clinic of Cardiovascular Surgery, Turkey, Bursa
[4]Pamukkale University Faculty of Medicine, Department of Cardiovascular Surgery, Turkey, Denizli
[5]University of Health Sciences Turkey, Bursa City Hospital, Clinic of Anesthesiology and Reanimation, Turkey, Bursa
[6]University of Health Sciences Turkey, Bursa City Hospital, Clinic of Radiology, Turkey, Bursa

Abstract

Objectives: To investigate the effect of regional versus local anesthesia on perioperative outcomes in patients with end-stage renal disease undergoing radiocephalic arteriovenous fistula for hemodialysis access.

Materials and Methods: A total of 80 patients who underwent primary radiocephalic arteriovenous fistula were included in this study and randomly and equally divided into two groups; as regional anesthesia group (n=40) and local anesthesia group (n=40). The basic clinical characteristics and perioperative outcomes of the patients were recorded and compared between the groups.

Address for Correspondence: Mustafa Selçuk Atasoy, University of Health Sciences Turkey, Bursa City Hospital, Clinic of Cardiovascular Surgery, Turkey, Bursa
e-mail: drmsatasoy@gmail.com **ORCID:** orcid.org/0009-0009-3321-7170
Received: 12.08.2024 **Accepted:** 12.12.2024

Cite this article as: Atasoy MS, Güven H, Yüksel A, Müdüroğlu A, Çetintaş D. Kılıç AÖ, Badem S, Aldemir M, Çayır MÇ, Kaya M, İşleyen M, Velioğlu Y. Effect of Regional Versus Local Anesthesia on Outcomes of Radiocephalic Arteriovenous Fistula Creation for Hemodialysis Access: A Prospective Randomized Study. JUCVM. 2024;12(4):155-161.
DOI: 10.32596/jucvm.galenos.2024-41-123

JUCVM Journal of Updates in Cardiovascular Medicine

Abstract

Results: The mean ages were 59.7 years in the regional anesthesia group and 60.4 years in the local anesthesia group. Twenty-nine (72.5%) of the patients in the regional anesthesia group and 26 (65%) of the patients in the local anesthesia group were male. The groups were statistically similar in terms of basic clinical characteristics. There were no significant differences in postoperative complications, including bleeding and wound infection, between the groups. There were no significant differences in immediate, primary, and functional patency rates between the groups, and both groups were statistically similar.

Conclusion: Compared with local anesthesia, regional anesthesia has not significant impact on perioperative outcomes in patients with radiocephalic arteriovenous fistula for hemodialysis access.

Keywords: Regional anesthesia, local anesthesia, radiocephalic arteriovenous fistula

Introduction

Hemodialysis is the most commonly used renal replacement therapy for patients with end-stage renal disease (ESRD). An autogenous arteriovenous fistula (AVF) is the most appropriate option for hemodialysis access because of their association with lower thrombosis and infection risks, increased quality of life, and longer life expectancy[1]. On the other hand, in some patients with autogenous AVF, AVFs cannot be used for hemodialysis access for various reasons. In the literature, the rate of patients who cannot access hemodialysis through autogenous AVFs is between 10% and 50%[2]. AVF failure is frequently observed in patients who undergo radiocephalic AVF creation on small diameters and distal vessels at the wrist level. Several factors such as small cephalic vein and radial artery diameters, insufficient blood flow in the radial artery, and obstruction or occlusion in the cephalic vein increase the risk of radiocephalic AVF failure[3].

AVF can be created using various anesthesia techniques, including local anesthesia (LA), regional anesthesia (RA), such as brachial plexus block (BPB), and general anesthesia. In patients with ESRD, local and RA methods are almost always preferred over general anesthesia for creating AVF because of general anesthesia-related adverse events and frequent comorbidities[4]. There is no exact evidence that any one anesthetic approach could have a substantial impact on AVF outcome or failure even if RA procedures could directly influence vessel diameters and perioperative blood flow. In other words, it is still controversial whether RA is exactly superior to LA in terms of postoperative outcomes in patients created AVF. Thus, we designed this study to examine whether BPB and LA, the two most commonly used anesthesia methods for AVF creation, make a significant difference in postoperative outcomes in patients undergoing radiocephalic AVFs[5,6]. Thus, we designed this study to examine whether BPB and LA, the two most commonly used anesthesia methods for AVF creation, significantly affect postoperative outcomes in patients undergoing radiocephalic AVF.

Materials and Methods

Ethics Committee approval was obtained from the Uludağ University Faculty of Medicine Clinical Researches Ethics Committee (approval no.: 2017-10/31 date: 04.07.2017), and the study was conducted based on the ethical rules of the Declaration of Helsinki. The patients included in the study were informed about not only the operation but also the study, and written informed consent was obtained.

Patients and Study Design

This prospective randomized comparative study included patients undergoing autogenous radiocephalic AVF for hemodialysis access. A total of 80 patients were randomly assigned using a computer-generated allocation system to receive either regional or LA and equally divided into two groups. During the operation, patients in group 1 were operated under RA while those in group 2 were operated under LA. The inclusion criteria were first-time primary native radiocephalic AVF operation at the wrist level. The exclusion criteria were age under 18 years, pregnancy, previous AVF operation, operations performed at levels other than the wrist level, and AVF operation using a synthetic graft. A CONSORT flow diagram for patients screened and excluded from the study is shown in Figure 1.

The patients' baseline clinical characteristics and perioperative outcomes were recorded and compared between the groups. All patients underwent routine Doppler ultrasonographic evaluation not only preoperatively but also in all postoperative control examinations. Doppler ultrasonographic evaluations were performed by a single experienced radiologist. In this study, the primary endpoint was primary patency at 3 months, while the secondary endpoints were immediate patency and functional patency at 3 months, as well as postoperative complications, including bleeding and wound infection. Immediate patency was defined as the existence of a thrill or bruit on the created AVF upon hospital discharge. Primary patency at 3 months was defined as the existence of a thrill or bruit on the created AVF in the absence of any additional intervention within the first 3 months after the operation. Functional

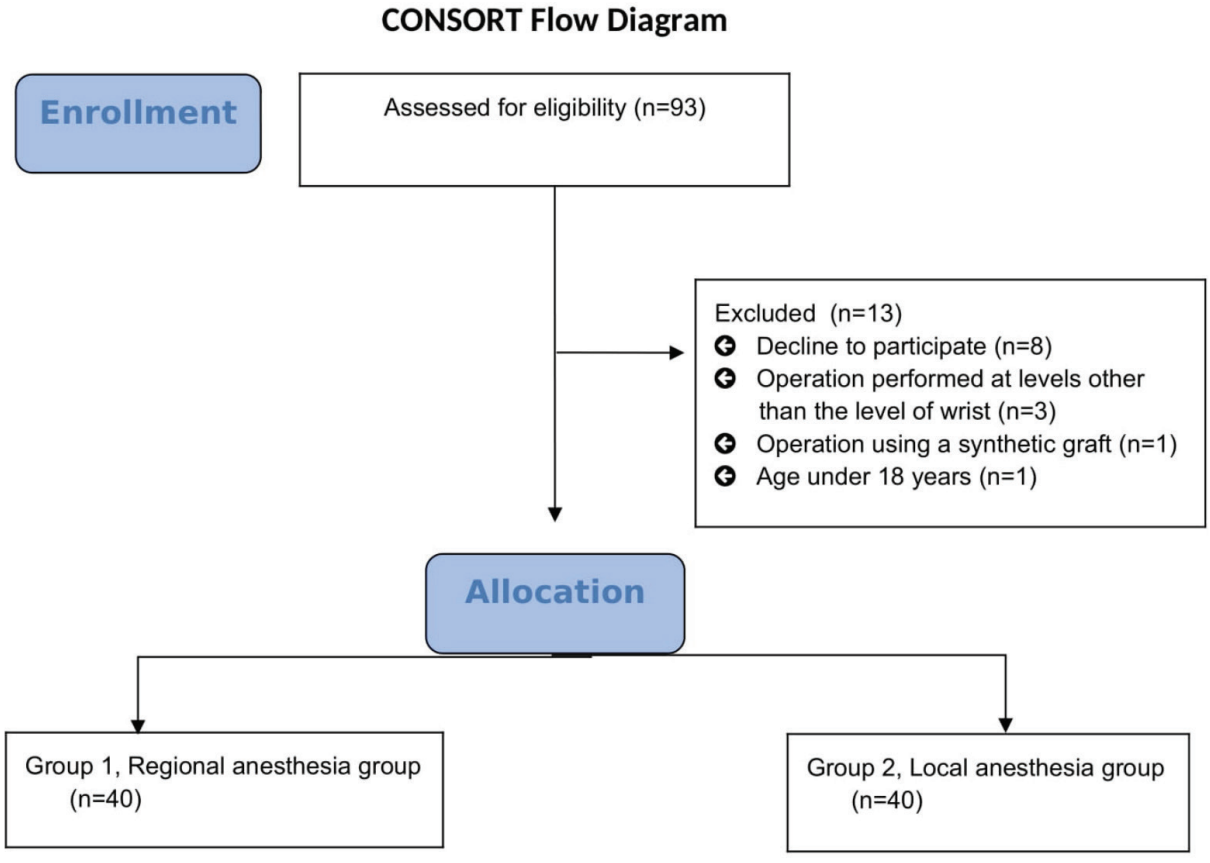

Figure 1. CONSORT Flow Diagram

patency at 3 months was evaluated both clinically (used in hemodialysis patients, or deemed suitable for vascular access by the expert hemodialysis nurse in predialysis patients) and ultrasonographically (> 5 mm diameter and flow rate > 500 mL/min).

Anesthesia and Operative Techniques

BPB was performed by expert anesthesiologists using an axillary approach. The patients were placed in the supine position with their arms abducted, and the axillary region was made aseptic. The nerves were identified using a needle-connected nerve stimulator system. When negative pressure was applied and no blood was seen, 5 mL of bupivacaine was applied at once. LA was provided with 10-15 mL of prilocaine subcutaneously after asepsis of the surgical field was achieved. All patients were operated on by the same surgical team. After preparing the radial artery and cephalic vein, 0.5 mL of heparin was intravenously administered to the patients. The cephalic vein was thoroughly freed to increase fistula flow. Anastomoses were performed using 7/0 polypropylene with the end-to-side anastomosis technique. After the completion of the anastomosis, the existence of a thrill or bruit was considered to indicate that the anastomosis was working. After surgery, low-molecular-weight heparin was administered for one week to prevent AVF thrombosis if not contraindicated.

Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences version 20.0 (SPSS Inc., Chicago, Illinois, USA). The conformity of continuous variables to normal distribution was investigated with Kolmogorov-Smirnov test. When comparing continuous variables with normal distribution, Student's t-test was used. The chi-square test was used to compare categorical variables. Data are presented as mean ± standard deviation for continuous variables and number (percentage) for categorical variables. A p-value of less than 0.05 was considered statistically significant.

Results

The mean ages of the regional and LA groups were 59.7 and 60.4 years, respectively. Twenty-nine (72.5%) patients in the RA group and 26 (65%) patients in the LA group were male. The most common comorbid diseases in our study population were hypertension, coronary artery disease, and diabetes mellitus. The mean preoperative cephalic vein diameters at the level of wrist were 2.31 mm in RA group and 2.35 mm in LA group. There were no significant differences between the groups in terms of the analyzed baseline clinical characteristics, and the groups were statistically similar (Table 1).

Table 1. Baseline clinical characteristics

Variable	Group 1 (Regional anesthesia)	Group 2 (Local anesthesia)	p-value
Age (year)	59.7±11.2	60.4±11.0	0.764
Gender (male)	29 (72.5%)	26 (65%)	0.469
Obesity (BMI >30 kg/m²)	12 (30%)	11 (27.5%)	0.805
HT	28 (70%)	30 (75%)	0.617
DM	12 (30%)	13 (32.5%)	0.809
CAD	15 (37.5%)	16 (40%)	0.818
Cephalic vein (wrist) diameter (mm)	2.31±0.20	2.25±0.18	0.157
Radial artery diameter (mm)	2.13±0.08	2.11±0.09	0.369

BMI: Body mass index, HT: Hypertension, DM: Diabetes mellitus, CAD: Coronary artery diseas

Following the operations, thrill could not be received in two of the RA patients and five of the LA patients, and this difference was not statistically significant. Bleeding (>25 mL) was observed in two patients in the RA group, and these patients were re-explored for bleeding control on the same day after the operation. None of the patients in the LA group underwent re-exploration for bleeding. During the entire follow-up period, superficial wound infection was observed in one RA patient and two LA patients, and the infection regressed with oral antibiotherapy. The primary and functional patency status of the created AVFs were evaluated at 3 months after surgery. The primary patency rate was 87.5% for the RA group and 77.5% for the LA group, whereas the functional patency rate was 82.5% for the RA group and 70% for the LA group, and these differences were not statistically significant (Table 2).

Discussion

In this study, we compared the effects of local and RA on postoperative outcomes in patients undergoing primary radiocephalic AVF creation. The groups were similar in terms of age, sex, comorbidities, and preoperative vascular diameter, ensuring a balanced baseline for analysis. Our findings revealed no statistically significant difference in primary or functional patency rates between the two groups, although RA was associated with slightly higher rates. However, patients in RA groups experienced more bleeding complications, requiring re-exploration in some cases. These results were interpreted in light of the existing literature.

In most patients with ESRD who require hemodialysis, general anesthesia is not often preferred for AVF creation due to the presence of comorbid diseases, such as hypertension, diabetes mellitus, and coronary artery disease, as well as the risks for general anesthesia-related adverse events; rather, LA or RA methods, such as BPB, come to the fore for this purpose[4]. The sympathetic effects of RA, which enhance vascular diameter and improve intraoperative blood flow, have been extensively documented in previous studies[5-7]. For instance, Aitken et al.[5] demonstrated that RA led to better short-term patency rates than LA, although this advantage diminished in the long term. Additionally, RA facilitates distal anastomosis by increasing intraoperative venous diameters, potentially improving surgical outcomes[8]. In our study, the higher primary patency rates observed in the RA group, although not statistically significant, might reflect these effects. However, the lack of significance can be attributed to the limited sample size.

On the other hand, LA is associated with higher rates of vascular spasm, which may increase the risk of early thrombosis and AVF failure[9]. Despite these concerns, our findings suggest comparable blood flow and patency rates between local and RA, which is consistent with prior studies.

From a safety perspective, RA is an operator-dependent technique, and its success and complication rates are significantly influenced by the practitioner's expertise[10,11]. Despite its advantages, RA carries a risk of neurological complications if not administered accurately. Issues such as postoperative paresthesia or paralysis can arise from factors like intraneural injection, direct nerve trauma, ischemia caused by edema or hematoma formation, or neurotoxicity of the anesthetic

Table 2. Postoperative outcomes

Variable	Group 1 (Regional anesthesia)	Group 2 (Local anesthesia)	p-value
Bleeding (> 25 mL)	2 (5%)	0 (0%)	0.152
Wound infection	1 (2.5%)	2 (5%)	0.556
Immediate patency	38 (95%)	35 (87.5%)	0.235
Primary patency at 3 months	35 (87.5%)	31 (77.5%)	0.239
Functional patency at 3 months	33 (82.5%)	28 (70%)	0.189

JUCVM Journal of Updates in Cardiovascular Medicine

agent[12]. The higher re-exploration rates reported in the RA group suggest that the increased blood flow and vascular dilatation effects of RA may increase the risk of bleeding complications, especially in complex patients. Nonetheless, the similar infection rates between the groups in our study reinforce the overall safety of both anesthesia techniques.

Our findings suggest that LA is a feasible and effective option for creating an AVF in patients undergoing primary radiocephalic AVF, offering results comparable to those of RA without increasing the risk of bleeding or neurological complications. Although RA confers potential advantages in vascular hemodynamics, these benefits must be weighed against their complication profile, particularly in centers with limited operator expertise. These results are consistent with the existing literature and highlight the need for individualized anesthetic strategies based on patient characteristics and surgical requirements. Future studies with larger patient cohorts and extended follow-up periods are warranted to further validate these findings and optimize anesthesia practices in AVF surgery.

Study Limitations

This study has several limitations that should be acknowledged. First, the relatively small sample size may have limited the statistical power to detect significant differences in primary and functional patency rates between the groups. Second, our follow-up period was limited to 3 months, which may not capture long-term outcomes such as sustained patency and successful dialysis. Third, as a single-center study, the findings may not be generalizable to other institutions with differing patient populations, surgical techniques, or operator expertise. Lastly, the potential variability in RA administration, influenced by operator skill and technique, might have introduced biases. Future multicenter studies with larger cohorts and extended follow-up periods are needed to address these limitations and provide more robust evidence.

Conclusions

This study highlights that LA a is an effective and reliable option for primary AVF creation, yielding outcomes comparable to those achieved with RA. Although RA demonstrated a slight advantage in primary and functional patency rates, this did not reach statistical significance and was accompanied by higher bleeding-related complications requiring re-exploration. These findings suggest that although RA offers potential hemodynamic benefits, its risks and dependency on operator expertise warrant careful consideration. Tailored anesthetic strategies that prioritize patient safety and surgical efficiency should guide clinical decision-making. Further large-scale, randomized studies with long-term follow-up are necessary to confirm these results and provide more definitive recommendations.

Ethics

Ethics Committee Approval: Ethics Committee approval was obtained from the Uludağ University Faculty of Medicine Clinical Researches Ethics Committee (approval no.: 2017-10/31 date: 04.07.2017), and the study was conducted based on the ethical rules of the Declaration of Helsinki.

Informed Consent: Informed consent was obtained from all patients.

Footnotes

Authorship Contributions

Surgical and Medical Practices: Atasoy MS, Güven H, Yüksel A, Müdüroğlu A, Çetintaş D, Kaya M, İşleyen M., Concept: Atasoy MS, Güven H, Yüksel A, Müdüroğlu A, Çetintaş D, Kılıç AÖ, Badem S, Çayır MÇ, Velioğlu Y, Design: Atasoy MS, Güven H, Yüksel A, Müdüroğlu A, Çetintaş D, Kılıç AÖ, Badem S, Çayır MÇ, Velioğlu Y., Data Collection and/or Processing: Atasoy MS, Güven H, Yüksel A, Kaya M, İşleyen M, Analysis and/or Interpretation: Atasoy MS, Güven H, Yüksel A,

Müdüroğlu A, Aldemir M, Velioğlu Y, Literature Search: Atasoy MS, Güven H, Yüksel A, Müdüroğlu A, Aldemir M, Writing: Atasoy MS, Güven H, Yüksel A.

Conflict of Interest: The authors declare no conflicts of interest concerning the authorship or publication of this article.

Financial Disclosure: This research received no specific grants from any funding agency in the commercial or not-for-profit sectors.

References

1. Lok CE, Huber TS, Lee T, et al.; National Kidney Foundation. KDOQI clinical practice guideline for vascular access: 2019 update. Am J Kidney Dis. 2020;75:1-164.
2. Kumtepe G, Müdüroğlu A, Yüksel A, Gürbüz O. Doppler ultrasonography evaluation in hemodialysis patients prior to arteriovenous fistula surgery: our surgical experience. Damar Cer Derg. 2017;26:50-55.
3. Golledge J, Smith CJ, Emery J, Farrington K, Thompson HH. Outcome of primary radiocephalic fistula for haemodialysis. Br J Surg.1999;86:211-16.
4. Siracuse JJ, Gill HL, Parrack I, et al. Variability in anesthetic considerations for arteriovenous fistula creation. J Vasc Access. 2014;15:364-9.
5. Aitken E, Jackson A, Kearns R, et al. Effect of regional versus local anaesthesia on outcome after arteriovenous fistula creation: a randomised controlled trial. Lancet. 2016;388:1067-1074.
6. Korkmaz UTK. Comparison of local anesthesia and regional block anesthesia techniques in the creation of arteriovenous fistulas for hemodialysis. J Biotechnol and Strategic Health Res. 2021;5:154-160.
7. Wong V, Ward R, Taylor J, Selvakumar S, How TV, Bakran A. Factors associated with early failure of arteriovenous fistulae for haemodialysis access. Eur J Vasc Endovasc Surg. 1996;12:207-13.
8. Shemesh D, Olsha O, Orkin D, et al. Sympathectomy-like effects of brachial plexus block in arteriovenous access surgery. Ultrasound Med Biol. 2006;32:817-22.
9. Mouquet C, Bitker MO, Bailliart O, et al. Anesthesia for creation of a forearm fistula in patients with endstage renal failure. Anesthesiology. 1989;70:909-14.
10. Marhofer P, Schrögendorfer K, Koinig H, Kapral S, Weinstabl C, Mayer N. Ultrasonographic guidance improves sensory block and onset time of three-in-one blocks. Anesth Analg. 1997;85:854-7.
11. Cole NM, Vlassakov K, Brovman EY, Heydarpour M, Urman RD. Regional anesthesia for arteriovenous fistula surgery may reduce hospital length of stay and reoperation rates. Vasc Endovascular Surg. 2018;52:418-426.
12. Brull R, McCartney CJ, Chan VW, El-Beheiry H. Neurological complications after regional anesthesia: contemporary estimates of risk. Anesth Analg. 2007;104:965-74.