



Comparison of Local Anesthesia and Regional Block Anesthesia Techniques in The Creation of Arteriovenous Fistulas for Hemodialysis

Hemodiyaliz İçin Arteriyovenöz Fistül Oluşturulmasında Lokal Anestezi ve Bölgesel Blok Anestezi Tekniklerinin Karşılaştırılması

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Özet

Objective	We aimed to compare local anesthesia and regional block anesthesia techniques in the creation of arteriovenous fistula for hemodialysis in patients with chronic kidney disease.
Material ve Metod	A total of 90 patients who underwent arteriovenous fistula creation were divided into regional block and local anesthesia groups. Postoperative complications, maturation time and running status of the fistulas were recorded and compared between the two groups. All patients were followed-up for six months. arteriovenous fistula creation was performed by shunting the cephalic vein to the radial artery of the wrist under either local or regional block anesthesia.
Results	No significant difference was found between the groups in terms of age (p=0.209) and gender (p=0.455). The most commonly encountered postoperative complications included pain (p = 0.090), hematoma (p = 1.000) and infection (p = 0.280). There was no significant difference between the groups in terms of postoperative complications (for all p>0.05). No statistically significant difference was observed between the groups in terms of the running status of the fistulas (for all p>0.05). The median maturation time was statistically significantly shorter in patients undergoing regional block anesthesia (p<0.001).
Conclusion	All patients successfully received hemodialysis through the created fistulas. Fistula maturation times were shorter with regional block anesthesia. The shorter median maturation period makes regional block anesthesia superior over local anesthesia. However, since there is no consensus on this issue yet, it would be beneficial to continue studies on the subject.
Keywords	hemodialysis, arteriovenous fistula, maturation, regional block anesthesia, local anesthesia

Özet

Amaç	Kronik böbrek hastalığı olan hastalarda hemodiyaliz için arteriyovenöz fistül oluşturulmasında lokal anestezi ve bölgesel anestezi tekniklerini karşılaştırmayı amaçladık.
Araçlar ve Yöntem	Arteriyovenöz fistül oluşturulmuş toplam 90 hasta bölgesel ve lokal anestezi gruplarına ayrıldı. Fistüllerin postoperatif komplikasyonları, matürasyon süresi ve çalışma durumu kaydedildi ve iki grup arasında karşılaştırıldı. Tüm hastalar altı ay takip edildi. arteriyovenöz fistül oluşturma işlemi, sefalik venin, lokal veya bölgesel anestezi altında el bileğinin radyal arterine şantlanılmasıyla gerçekleştirildi.
Bulgular	Gruplar arasında yaş (p = 0.209) ve cinsiyet (p = 0.455) açısından anlamlı fark bulunmadı. En sık karşılaşılan postoperatif komplikasyonlar ağrı (p = 0.090), hematoma (p = 1.000) ve enfeksiyondur (p = 0.280). Postoperatif komplikasyonlar açısından gruplar arasında anlamlı fark yoktu (tümü için p> 0.05). Fistüllerin çalışma durumu açısından gruplar arasında istatistiksel olarak anlamlı bir fark gözlenmedi (tümü için p> 0.05). Bölgesel blok anestezi uygulanan hastalarda medyan olgunlaşma süresi istatistiksel olarak anlamlı derecede daha kısaydı (p <0.001).
Sonuç	Tüm hastalar oluşturulan fistüller yoluyla başarılı bir şekilde hemodiyaliz aldı. Bölgesel blok anestezi ile fistül olgunlaşma süreleri kısaldı. Daha kısa medyan olgunlaşma süresi bölgesel anesteziyi lokal anesteziye göre daha üstün kılmaktadır. Ancak bu konuda henüz fikir birliği olmadığı için konuyla ilgili çalışmalara devam etmekte fayda görülmektedir.
Anahtar kelimeler	hemodiyaliz, arteriyovenöz fistül, olgunlaşma, bölgesel anestezi, lokal anestezi

INTRODUCTION

An appropriate and well functioning vascular access that enables the collection of large blood volumes is essential for an efficient hemodialysis in patients with chronic kidney disease (CKD). In such an access, infectious, thrombotic and hemorrhagic complications as well as morbidity and mortality should be minimal¹. Arteriovenous fistula (AVF) creation is a form of treatment applied in patients with CKD. AVF was described for the first time by Cimino and Brescia in 1966 for vascular access in patients receiving hemodialysis^{2,3}. Despite rapid advancements in dialysis technologies, AVF remains the gold standard for providing access to the circulatory system⁴.

A success AVF created for dialysis is not guaranteed. Success use of a newly formed AVF depends on its maturation. Maturation provides strengthening of the vessel for hemodialysis access, vein arterialization and increased blood flow. Maturation of a primary AVF has been reported to take 3 to 6 weeks⁵. Maturation time differs among various age groups such as children, adolescents and elderly. This duration may prolong up to 12-16 weeks in patients with a high risk of vascular complications⁶. Studies have reported that nearly 30% of AVFs do not mature enough for needle insertion^{5,7}.

AV fistulas for hemodialysis have several complications at early and late stages. Early complications include not-running vascular access due to inadequate maturation, complete patency loss within the first 3-6 months of AVF creation, hematoma and infection^{3,8}. Late complications include true or false aneurysms, venous stenosis in the AV puncture site and colorectal circulation⁹.

AVF creation for hemodialysis can be performed under local anesthesia (LA), regional block anesthesia (RA) or general anesthesia (GA). On the other hand, selection of an appropriate anesthesia technique significantly affects early patency and long-term AVF outcomes. GA is associated with an increase in cardiovascular complications in

patients with end-stage renal disease¹⁰. Therefore, LA or RA is preferred to create AVF in these patients. Studies in the literature have reported high failure rates for AVF creation under LA¹¹. Whereas, highly controversial rates of patency and failure have been reported for RA¹². In addition, it is not clear whether short-term benefits of RA affect long-term AVF patency. In the literature, there is still no consensus on the superiority of these two methods over each other and studies on this issue are ongoing. In this study, we aimed to compare LA and RA techniques in the creation of AVFs for hemodialysis in patients with CKD.

MATERIAL and METHODS

A total of 90 patients who underwent AVF creation in the cardiovascular surgery clinic of Mogadishu Somalia- Turkey Recep Tayyip Erdogan Training and Research Hospital between January 2019 and July 2019 were included in the study. The patients were divided into two groups as LA and RA using the closed envelope method by a physician who did not participate in the study.

Patients with vascular diseases in the upper extremities, a history of vascular thrombosis or infection in the injection site were excluded from the study. Patients' demographic data such as age and gender, postoperative complications and fistula maturation times were recorded. In addition, running status of the fistulas was evaluated on the postoperative 10, 30 and 180 days.

All patients included in the study were preoperatively assessed for the quality of the upper venous system. Venous examination was performed with palpation after a tourniquet was applied on the upper arm. In addition, ultrasound scans were performed to detect adequate vessels and to evaluate continuity and quality of the vein for arteriovenous access.

Result data obtained from the operations were collected, analyzed and compared between the two groups.

Surgical Technique

All patients were pre-treated with IV midazolam in the morning of the operation. The patients were routinely monitored with electrocardiogram (ECG), non-invasive blood pressure and pulse-oximeter measurements. After the necessary asepsis and antiseptics applications, 2% lidocaine was administered in the operation site in Group LA. RA was achieved with axillary or infraclavicular approaches. In this group, 15 mL ropivacaine 1% and 10 mL saline (0.9% NaCl) were administered. Following anesthesia, a 5 cm skin incision was made in the wrist and subcutaneous tissues were passed through for exploration. All AVFs were applied to the same area by the same cardiovascular surgeon. The cephalic vein was cut and its distal part was ligated, while arteriotomy was performed in the radial artery with a vertical incision. The cephalic vein was then anastomosed to the radial artery in an end-to-side (E/S) fashion. For the anastomosis, the cephalic vein was stitched to the radial artery using 7/0 running prolene suture and after bleeding control, the skin was closed and AVF creation for dialysis was completed. All patients were taught active arm and hand exercises to help maturation process in the postoperative period. During follow-up, running status of the fistulas was evaluated with palpation, auscultation or Doppler probe.

Ethics Considerations

Before the beginning, all necessary approvals were received from the local ethics committee of Mogadishu Somalia- Turkey Recep Tayyip Erdogan Training and Research Hospital (Date: 07.08.2019 No135). All patients included in the study were informed about the objectives of the study and gave verbal and written consents. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

Statistical Analysis

Data obtained in this study were evaluated and statistically analyzed using SPSS (IBM, SPSS version 25.0, Armonk, NY, USA) package software. General features of the study

population were expressed using descriptive statistics. Before statistical analysis, distributional properties of the continuous variables were evaluated using Anderson-Darling normality test. Groups were compared using independent t-test for normally distributed continuous variables. A multiple explanatory variable analyses was performed for maturation time by fitting groups and gender as factor and age as a covariate. Bivariate comparisons were conducted using Chi-square test for categorical variables. $p < 0.05$ were considered statistically significant.

Results

In this study, 90 patients with CKD who were candidates for AVF were assigned into Groups LA and RA. Group LA consisted of 53 and Group RA 37 patients. Of the 37 patients in Group RA, 19 (21.1%) underwent axillary block anesthesia and 18 (20%) infraclavicular block anesthesia. The median age was found as 54 (min-max: 16-86) years in Group LA and 60 (min-max: 25-84) years in Group RA, and the difference was not statistically significant ($p=0.209$).

Of all patients, 52 (57.8%) were male and 38 (42.2%) were female. When the sex distribution was examined by groups; Group LA consisted of 27 (50.9%) male patients, while Group RA included 24 (64.9%) male patients. No statistically significant difference was found between both groups in terms of gender ($p=0.455$).

The most commonly encountered postoperative complications included pain ($p = 0.090$), hematoma ($p = 1.000$) and infection ($p = 0.280$). There was no significant difference between the groups in terms of postoperative complications (for all $p > 0.05$).

All patients in both groups could receive dialysis through the AVF fistulas created. Running status of the fistulas was evaluated on the 10th, 30th and 180th days of the operation. Accordingly, AVFs were running in all patients in both Group LA and Group RA on the 10th and 30th days of

the AVF operations. However, no statistically significant difference was found between the groups in terms of the running status of the fistulas (for all $p>0.05$).

The median AVF maturation time was found as 39 (min-max: 29-52) days in Group LA and 28 (min-max: 20-50) days in Group RA. Accordingly, the median maturation time was statistically significantly shorter in patients both undergoing axillary block anesthesia and infraclavicular block anesthesia in Group RA than in Group LA (for both, $p<0.001$). In Group RA, no significant difference was found between the patients undergoing axillary block anesthesia and those undergoing infraclavicular block anesthesia in terms of the median maturation time ($p=0.249$). In addition, there was no statistically significant difference between these Group RA subgroups in terms of age ($p=0.618$) and gender (0.053). Table 1 shows the demographic and postoperative variables of the groups.

Table 1: Demographic and postoperative variables

Variables	Local Anesthesia Group (n=53)	Regional Block Anesthesia Group (n=37)	p value
Age(Year)	54(16-86)	60 (25-84)	0.209*
Gender (Male)	27 (50.9%)	24 (64.9%)	0.455**
Postop Hematoma	9 (17%)	7 (18.9%)	1**
Postop Pain	21 (39.6%)	7 (18.9%)	0.090**
Postop Infection	7 (13.2%)	1 (2.7%)	0.280**
Fistula Maturation Time(Day)	39 (29- 52)	28 (20- 50)	<0.000*
Hemodialysis through fistula	53 (100%)	37 (100%)	1**
Postop 10 day fistula running	53 (100%)	37 (100%)	1**
Postop 30 day fistula running	53 (100%)	37 (100%)	1**
Postop 180 day fistula running	52 (98.1%)	36 (97.3%)	1**
Abbreviations: Data expressed as median (minimum-maximum) for continuous variables or number (%) for categorical variables. *Continuous variables compared using independent samples t-test. **Categorical variables reported as frequency (percent) and compared using chi square tests.			

DISCUSSION

Success of the AVF creation for dialysis in CKD patients may be influenced by several factors, including type of anesthesia procedure, fistula patency and maturation time. Although general anesthesia is a suitable method for creating an AVF, it may cause decreased AVF blood flow by reducing blood pressure and cardiac output, and thus failure of the fistula¹³. On the other hand, RA and LA are appropriate alternatives in creating AVFs since they have less effects on the cardiovascular and pulmonary systems. However, there is no consensus of which of these methods is superior over the other and the anesthesia method used in the creation of AVFs varies among health centers¹⁴.

In the present study, outcomes of AVF creation using LA and RA were compared. No significant difference was found between LA and RA anesthesia methods in terms of age and gender. In a study by Malekpour et al.¹⁵ comparing the patency and quality of AVFs between LA and RA techniques, demographic features were found to be similar between both groups.

Both anesthesia techniques may cause certain complications due to vascular proximities. The most common complications include hemorrhage, low venous flow and hematoma immediately after the operation, while late complications include infections, development of aneurysms, fistula vein stenosis, steal syndrome, ischemic neuropathy and thrombosis¹⁶. In a study by Kazemzadeh et al.¹⁷, the most common postoperative complication was reported as vasodilatation in patients undergoing AVF operation with intravenous RA. In the present study, the most common postoperative complication was pain followed by hematoma and infection, while none of the patients developed late complications at the end of the 6-month follow-up. No statistically significant difference was found between the groups in terms of the postoperative complications. There are studies in the literature reporting no significant difference between LA and RA techniques for complications^{12,18,19}.

A functional AVF is defined as an access that provides a flow rate of 350-400 mL/min without recirculation during total hemodialysis duration. Whereas, a non-functioning AVF is an access that can not be used successfully for hemodialysis regardless of its patency²⁰. In our study, running status of the fistulas was evaluated on the postoperative 10, 30 and 180 days. All AVFs were running on the 10th and 30th days, while AVF failure was detected in each one patient in each group. However, no significant difference was found between the two groups in terms of the running status of the fistulas. In a study by Zaliunatiet et al.²¹ comparing the effects of two anesthesia techniques on the outcomes of AVF creation, patients were followed-up for two years. According to the results of that study, the rate of running AVFs was found as 52% with LA and 11% in brachial block²¹. On the other hand, no significant difference was reported between RA and LA groups in terms of the successful AVFs¹⁵. In a meta-analysis and systematic review by Gao et al.¹⁰ including seven studies comparing RA and LA techniques in AVF creation in a total of 852 patients, AVF running rate was reported to be significantly higher in group RA compared to group LA. We attributed the differences between the above mentioned studies to the techniques used in AVF creation and patient groups included. In our study, the patients were followed-up for 6 months and a success rate close to 100% was achieved.

When an AVF is created, the fistula begins to mature after the vein (usually cephalic vein) is shunted by connecting directly to the artery (usually the radial artery). This process is reported to take approximately four weeks. However, this duration may prolong up to 16 weeks in certain patients with vascular complications. Maturation of an AVF is a complex process with several hemodynamic factors playing a key role in biological response²². The reasons for an inadequate maturation may include accessory veins, diabetes mellitus and the use of platelet aggregation inhibitors²³. In addition, maturation failure has been reported between 20-50% due to typical complications such as stenosis, aneurysms and thrombosis, depending on the type

of AVF and the techniques used²⁴. Yildirim et al.²⁵ found that the mean maturation time was significantly shorter in the stellate ganglion block group (41.4 days) than in the LA group (77.1 days) in patients undergoing radiocephalic AVF creation. In our study, AVFs successfully completed the maturation process in all patients. However, there was a statistically significant difference in maturation times between the groups. The median maturation time was significantly shorter in Group RA (28 days) compared to Group LA (39 days). We think that the shorter maturation times in both groups of our study compared to other studies were due to patient selection and the meticulous surgical technique applied. In addition, in LA application, a local anesthetic agent is applied directly to the area and a foreign substance is given to the surgery area. Therefore, tissue integrity may be impaired. In RA application, since anesthesia is applied to the nerve that carries the pain of the region, foreign matter is not given to the operation area and tissue integrity is intact. Therefore, the maturation period of AVF may have been found to be shorter in RA groups.

Study Limitations

The main limitation of our study is the relatively low number of patients and being conducted in a single center. In addition, since the follow-up period was six months, running status of the fistulas could not be examined in a longer period. On the other hand, a high success rate was obtained in this study, as a strong aspect.

CONCLUSION

The results of this study indicate that no significant difference was found between RA and LA techniques in terms of postoperative complications and running status of the fistulas, which was followed-up for six months. All patients successfully received hemodialysis through the created fistulas. Fistula maturation times were shorter with RA. It is seen that the maturation period, which is one of the important factors required for a successfully functioning AVF, makes RA superior. However, since there is no

consensus on this issue yet, it would be beneficial to continue studies on the subject.

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Conflict of Interest

The authors declare no conflict of interest to disclose.

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