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Is ultrasound guided syringe-free method more efficient for saphenous vein catheterization? A prospective randomized controlled study

Safen ven kateterizasyonu için ultrason eşliğinde şırınga içermeyen yöntem daha verimli midir? Prospektif randomize kontrollü bir çalışma

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Abstract

Aim: Syringe-free is a novel technique without making blood aspiration with a syringe and by pushing forward the guide wire after verifying that the needle is inside the vein. In this study, we aimed to compare the vein intervention time between the ultrasound-guided syringe-free technique and the ultrasound-guided technique requiring syringe and aspiration procedures (classic technique), and also the success and complication rates of the first application.

Methods: A prospective randomized controlled study was designed to compare ultrasound-guided syringe-free and ultrasound-guided classic technique in patients performed saphenous vein catheterization between June 2018 and September 2018. Demographic data, the period passed until a successful catheterization, the time for the needle to enter to the vein and the needle intervention number and complications are recorded.

Results: 75 patient were enrolled in the study. There were no differences between demographical data in the patients ($p>0.05$). Vein puncture time were similar in each group ($p=0.750$). In the ultrasound-guided syringe-free group the catheterization time is determined to be significantly shorter ($p=0.003$). In the syringe-free method, it is determined that the successful catheterization number is higher at first try, but the difference is not determined to be significant ($p=0.370$). In both groups, central venous catheter-related complications were not observed during or after the procedure.

Conclusion: In conclusion, an ultrasound-guided syringe-free approach can a decrease the duration of saphenous vein catheterization and allows the operator to perform the whole procedure with ultrasound guidance without interruptions. This method can be used as an advantageous and practical method for experienced operators.

Keywords: Syringe-free, Ultrasound guided, Catheterization

Öz

Amaç: Şırınga ve aspirasyon içermeyen teknik yeni bir tekniktir. Kılavuz tel, kateter iğnesine yerleştirilir ve ultrason probu uzunlamasına veya oblik eksende yerleştirilmiş olarak şırınga ile kan aspirasyonu yapılmadan ve iğnenin damar içinde olduğu görüldükten sonra kılavuz tel ilerletilmesi yapılarak gerçekleştirilir. Bu çalışmada, uzun eksende ultrason eşliğinde uygulanan şırıngasız teknik ile ultrason eşliğinde şırınga ve aspirasyon yapılan tekniği damar girişim süresini, kateterizasyon süresini ve birinci uygulamada başarı ve komplikasyon oranlarını karşılaştırmayı amaçladık.

Yöntemler: Bu randomize kontrollü prospektif çalışma Haziran 2018 ve Eylül 2018 tarihleri arasında safen ven kateterizasyonu uygulanan hastalarda ultrason eşliğinde şırınga içermeyen teknik ile ultrason eşliğinde klasik tekniği karşılaştırmak için tasarlanmıştır. Her iki grupta hastaların demografik bilgileri, başarılı kateterizasyona kadar geçen süre, iğnenin damar içine girme süresi ve iğne girişimi sayısı ve komplikasyonlar kayıt edildi.

Bulgular: 75 hasta çalışmaya alındı. Hastaların demografik özellikleri arasında fark bulunmadı ($p>0,05$). Her iki grupta damar içine girişim zamanı benzer bulundu ($p=0,750$). Şırıngasız yöntemde kateterizasyon süresi anlamlı olarak kısa bulundu ($p=0,003$). Şırıngasız yöntemde ilk denemede başarılı kateterizasyonun daha çok olduğu ama farkın anlamlı olmadığı görüldü ($p=0,370$). Her iki grupta, işlem süresi boyunca veya işlem sonrası dönemde santral venöz kateterle ilişkili komplikasyon görülmedi.

Sonuç: Sonuç olarak ultrason eşliğinde şırıngasız yöntem safen ven kateterizasyonu işleminin süresini kısaltabilir ve uygulayıcının bütün işlemi ultrason eşliğinde kesintisiz yapmasını sağlar. Tecrübeli uygulayıcılar için bu yöntem avantajlı ve pratik bir yöntem olarak kullanılabilir.

Anahtar kelimeler: Şırınga içermeyen, Ultrason eşliğinde, Kateterizasyon

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Introduction

Vein catheterization under the guidance of ultrasound is a significant part of the varicose vein treatment methods for VNUS closure, endovenous laser, foam sclerotherapy, and glue ablation [1,2]. The catheterization by ultrasound allows rapid improvement, better cosmetic results, and higher success rates [3]. Ultrasound-guided vein catheterization is an essential skill for modern phlebologists, anesthetists, and surgeons. Veins can be catheterized by using ultrasound on transverse (short) section, longitudinal (long) section and oblique section [4,5]. It is still argued on which axis the ultrasound-guided venous catheterization method and intervention is realized best [6,7]. In all these approaches, the blood aspiration with syringe is realized in order to verify the position of the vein. Recently a technique that doesn't include syringe and aspiration (syringe-free) is defined. The guide wire is placed on the catheter needle and the ultrasound probe is placed on longitudinal or oblique axis without making blood aspiration with a syringe and by pushing forward the guide wire after verifying that the needle is inside the vein [8,9].

In this study, we aimed to compare the vein intervention time between the ultrasound-guided syringe-free (USGSF) technique and the ultrasound-guided classic (USGC) technique requiring syringe and aspiration procedures and also the success and complication rates of the first application.

Materials and methods

This prospective and randomized study is started following the receipt of approval ethical committee (2018/08-23) and the patients' informed consents. 75 patients (ASA I-III, between 18-75 ages) who received catheterization because of endovenous laser, foam sclerotherapy and glue ablation are included in the study. The patients with a presence of skin infection, anatomical abnormalities, patients who are older than seventy-five and younger than eighteen and patients who refused to participate in the study are excluded. The patients are separated randomly into two groups following the sealed tender technique. The group who got a catheter placed on saphenous vein by using a syringe on the long axis following an ultrasound guidance, is named Group USGC (n=38) and the group who got a catheter placed on the saphenous vein following an ultrasound guidance but without using a syringe on the long axis, is named Group USGSF (n=37). The flowchart of the study is shown in figure 1.

All saphenous catheter placement procedures are realized by the same cardiovascular surgeon experienced in ultrasound-guided procedures, and all the procedures are realized by a single person. In each of the two groups, high-frequency linear US probe (LOGIQ e; GE Healtycare, Solingen, Germany) is used. The patients whose consents are received are monitored through ECG, noninvasive blood pressure and pulse oximeter as a standard. Following the sterilization of the catheter placement area with povidone-iodine, the ultrasound probe is covered with a sterilized casing. In all of the cases, the venous catheter (Certofix® Duo / Trio, Braun, Germany) is placed by using the seldinger technique. In the group including the use of the syringe, the ultrasound probe is placed on the medial knee region and long axis and the saphenous vein is displayed. Together with the ultrasound image, the procedure is continued by using the needle and negative aspiration. After the needle is displayed in the form of a dot in saphenous vein and the blood flow is observed following aspiration, the ultrasound probe is released in the sterile area while the needle is stabilized with one hand and the guide wire is placed with the other. The presence of the wire within the vein is confirmed via the ultrasound probe. In Group USGS, before the procedure, the guide wire is placed inside the needle. The ultrasound probe is placed on the medial knee region, and the saphenous vein is displayed on the long axis. (Figure 2).

When the tip of the needle (on which guide wire is adapted), is displayed in the form of a dot, the saphenous vein is continued to be scanned by the ultrasound, and the guide wire is moved forward. The presence of the wire within the vein is confirmed via the ultrasound probe. The success of the catheterization is determined as the confirmation of the guide wire by the ultrasound. If the guide wire could not be placed within 3 minutes for the defined approach, this intervention is determined as an unsuccessful catheterization. In each of the two groups, demographic data, the period passed until a successful catheterization, the time for the needle to enter to the vein (its determination as a dot during the ultrasound) and the needle intervention (needle passage) number and complications are recorded. Possible complications such as arterial puncture, hematoma and nerve injury are recorded. Also, patient specifications such as age (year), sex, height (cm), weight (kg) and hemodynamic data (systolic and diastolic blood pressure, primary central venous pressure measurement following the placement of the catheter) are recorded.

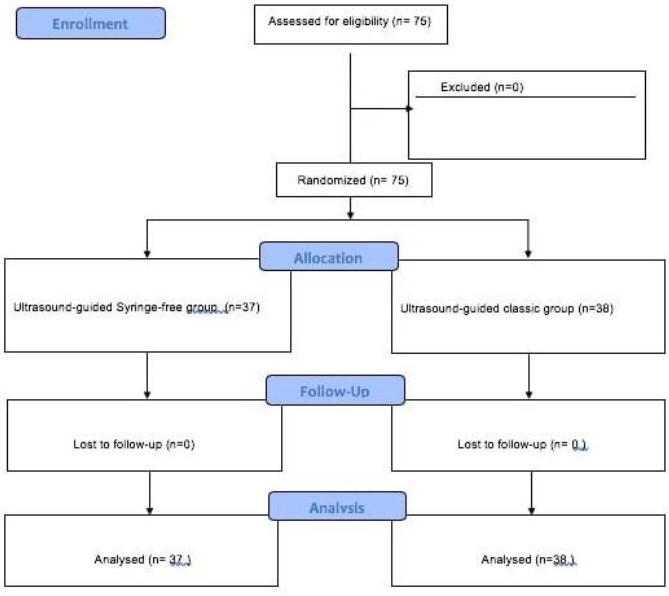

Figure 1: Flow chart

Figure 2: Ultrasound-guided syringe-free method

Results

75 patients who received an ultrasound-guided saphenous vein catheterization and who did not meet the exclusion criteria are included in the study. The patients separated randomly into 2 groups, being syringe-free and classic methods groups (Figure 1). When the demographical qualities of the patients are compared, the results are found to be similar in each group (Table 1). Vein puncture time were similar in each group. In the syringe-free method, the catheterization time is determined to be significantly shorter. In the syringe-free method, it is determined that the successful catheterization number is higher at first try, but the difference is not determined to be significant (Table 2). In each group, no complication is determined during the procedure (for example arterial puncture, hematoma) or after the procedure in relation to the central venous catheter (for example faulty catheter placement, catheter breaking).

Table 1: Demographic and clinical data

	USGSF (n=37)	USGC (n=38)	p
Age years	47.43 (12.67)	50.94 (11.11)	0.730
Weight kilo	78.59 (10.84)	77.44(13.55)	0.125
Height cm	168.75(7.5)	169.86 (9.38)	0.052
Sex Male/Female	18/19	20/18	0.836
Leg Side Right/Left	20/17	18/20(33.2)	0.812

USGSF: Ultrasound guided syringe free group, USGC: Ultrasound guided classic group *The Mann-Whitney U test was used for non-parametric variables. T-tests were used for normal continuous variables. Data are presented as mean and standard deviation (SD)

Table 2. Success rate and time

	USGSF (n=37)	USGC (n=38)	p
VPT	14(12-18)	14(12-21.5)	0.750
CT	56(50-60)	60(55-70)	0.003*
Attempt	26/9/2	23/8/6	0.370

USGSF: Ultrasound guided syhenge free group, USGC: Ultrasound guided classic group *The Mann-Whitney U test was used for non-parametric variables. CT: Catheterization Time VPT: Vascular Puncture Time Data are presented as median and IQR values (25%-75%) *Indicate p<0.05 when comparing groups IQR: Inter Quartile Range

Discussion

According to the conclusion of this study, the successful catheterization time is determined to be shorter when the syringe-free method is applied through an ultrasound-guided long axis approach. This study is the first study in the literature to realize an ultrasound-guided syringe-free method saphenous vein catheterization. Ultrasound-guided vein intervention methods have been compared and studied multiple times in the past [9,10]. There are studies that determined that long axis, short axis, and oblique axis approaches while applying an ultrasound-guided internal jugular venous catheterization don't provide different results within the context of success [11]. Even though it is reported that the primary intervention process takes a shorter period in short axis out of plane approach when compared to the long axis, this difference is not determined as significant [12]. The syringe-free method is firstly reported to be applied in internal jugular venous interventions by Matias et al. [8]. Whereas İnce et al. [13] compared the syringe-free approached applied on the oblique axis through ultrasound guidance and determined that this approach allows a shorter period for entering the vein and for catheterization. In the study that compares the classical and ultrasound-guided methods, the ultrasound-guided method is found much more successful as expected [14]. In this study, we aimed to research if the syringe-free method affects entering a vein and cannulation period and if a catheterization can be made successfully and in short time in saphenous vein catheterization through the syringe-free method, by realizing the catheterization through ultrasound guidance in each of the groups.

During the ultrasound-guided catheterization, sometimes it is difficult to aspirate while entering the needle. When the syringe-free approach is used, there is no need for blood aspiration. All of the needle and the needle tip can always be observed. The syringe-free technique allows us to display all of the procedures (needle, needle tip position, advancement of the guide wire) through the guidance of ultrasound and without any interruptions. In the method requiring aspiration with a needle, even though the needle tip is observed within the vein at the start, as we interrupt displaying in order to aspirate, the needle can move, and the tip of the needle can advance towards the other anatomical structures outside of the vein, or the repeat of the procedure can increase the complication ratio. In the catheterization result of Karakitsos et al. [15] that compared ultrasound and classical method, it is reported that the catheterization realized through ultrasound guidance caused fewer complications and is more secure. The long axis approach provides an advantage in following the guide wire [16]. In a study where the long and short axes are used together during an ultrasound-guided internal jugular vein catheterization and where this is compared with long and short axis approach, it is determined that the combined approach has a smaller vein wall puncture rate and that this provides an advantage in decreasing the complications [17]. In a study where the long axis and short axis approaches are compared, it is determined that the long axis approach caused fewer complications [18]. When the complications are compared in this study, it is determined that all two groups are similar and complications such as arterial puncture, hematoma, are not observed. It can be discussed that the complication risk can be decreased due to the fact that each of these two groups received a catheterization through ultrasound guidance and that the experience of the operator can be effective so as in all other medical processes. We consider that the fact that the surgeon who realized all catheterizations is experienced in procedures guided by the ultrasound increased the success rate and decreased the complication rate in each of the two groups.

Even though this new method provides the operator advantages such as continuing to use the ultrasound during the intervention, it is acceptable that realizing catheterization without aspiration can be a harder and newer process for operators that are not experienced. The limitations of our study are the nonrealization of the procedure by operators with different experience levels and the non-application of the intervention on different veins. There is a need for expanded studies that include more patients in order to observe and compare complications.

In conclusion, an ultrasound-guided syringe-free approach can also decrease the duration of saphenous vein catheterization and allows the operator to perform the whole procedure with ultrasound guidance without interruptions. This method can be used as an advantageous and practical method for experienced operators.

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