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ARAŞTIRMA / RESEARCH

Influence of anaesthesia induction and associated disparities on radial artery cannulation success

Anestezi indüksiyonu ve anestezi ilişkili değişimlerin radiyal arter kanülasyon başarısına etkisi

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Abstract

Purpose: This study aimed to compare the procedure durations, the number of attempts and first attempt success rates in radial artery(RA) cannulations performed before and after anaesthesia induction. Secondarily, anaesthesia-related determinants of success were to be identified.
Materials and Methods: This study included 73 adult patients. All cannulations were with traditional palpation technique. Ultrasonography was used for arterial diameter/depth measurements. Cannulation time(s), number of attempts and first attempt success/failure were recorded.
Results: A total of 91 cannulations was performed. Median cannulation times were 30s (min-max:17-378) and 37s (min-max:10-217); first attempt success rates were %87.5 and %87.8 in preinduction and postinduction groups, respectively.. Local anaesthetic infiltration increased RA depth but did not affect RA height and width. Body mass index(BMI) and presence of atherosclerotic heart disease(ASHD) and/or peripheral vascular disease(PVD) were found as independent predictors of cannulation time.
Conclusion: RA cannulation success was unaffected by anaesthesia induction.

Keywords:. Radial artery, cannulation, anaesthesia induction, general anaesthesia, local infiltration

Öz

Amaç: Bu çalışmada, anestezi indüksiyonu öncesi ve sonrası yapılan radiyal arter kanülasyonları işlem süreleri, girişim sayısı ve ilk girişimde başarılı olma yüzdeleri açısından karşılaştırılmıştır. İkincil olarak, anestezi ile ilişkili değişkenlerin başarıya etkileri ortaya konulmuştur.
Gereç ve Yöntem: Bu çalışmaya toplam 73 hasta dahil edilmiş olup, tüm kanülasyonlar geleneksel palpasyon yöntemi ile gerçekleştirilmiştir. Arter boyut ve derinlik ölçümleri için ultrasonografi kullanılmıştır. Kanülasyon süreleri, girişim sayıları ve ilk girişimde başarılı olma yüzdeleri kaydedilmiştir.
Bulgular: Çalışmada toplam 91 radiyal arter kanülasyonu yapılmıştır. Sırasıyla anestezi indüksiyonu öncesi ve anestezi indüksiyonu sonrası kanülasyonlarda median kanülasyon süreleri 30s (min-max:17-378) ve 37s (min-max:10-217); ilk girişimde başarılı olma yüzdeleri %87,5 ve %87,8 olarak bulunmuştur. Lokal anestezik infiltrasyonunun RA derinliğini anlamlı düzeyde arttırdığı; fakat sırasıyla RA boy ve enini etkilemediği görülmüştür. Beden kitle indeksi(BMI) ve aterosklerotik kalp hastalığı ve/veya periferik damar hastalığı varlığı (ASHD ve/veya PVD) kanülasyon süresinin bağımsız belirleyicileri olarak bulunmuştur.
Sonuç: RA kanülasyonu başarısı anestezi indüksiyonundan etkilenmemektedir.

Anahtar kelimeler: Radiyal arter, kanülasyon, anestezi indüksiyonu, genel anestezi, lokal infiltrasyon

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INTRODUCTION

Invasive blood pressure(BP) monitoring is a frequently performed procedure in routine anaesthesia practice. It ensures instant, precise BP values during surgery; allows cardiac output measurements via arterial pressure tracings; and provides perioperative access to arterial blood[1,2].

Radial artery(RA) is the preferred artery for this procedure due to its convenience, rich collaterals in supply areas and low risk of complications, of which are mainly hematoma formation, arterial dissection, vasospasm, thrombosis and consequential distal ischemia, infection and pseudoaneurysm formation[1-3]. Although ultrasound(US) guided arterial cannulation techniques has been shown in plenty of studies to improve success rates and reduce complications[4-6]; still, cannulation with traditional direct palpation technique is the most common method due to limited access to US in most centers and less familiarity of especially young clinicians with US use[3,7]. It is necessary to know the factors and circumstances that increase the chance to localize the artery and successfully cannulate at first attempt in conditions where US is unavailable. In literature; the patient's age, gender, body mass index(BMI), anatomical variations, presence of age- and concomitant disease-related vascular changes, hemodynamic status and clinician's experience in related technique are the factors that were investigated as potential predictors of successful artery localization and cannulation[8,9].

As a widely accepted practice, if anticipated wide BP fluctuations during anaesthesia induction or potential end-organ disease that mandates beat-to-beat BP regulation be present, cannulation before anaesthesia induction is indicated[10]. The technical impossibility of obtaining reliable BP values in obese and severely edematous patients may also oblige anaesthetist to put an arterial line before induction[11]. Apart from that; cannulations indicated for planned intraoperative controlled hypotension or anticipated major surgical bleeding are performed after anaesthesia induction while the patient is under general anaesthesia. Circumstances under which cannulations carried out differ such that patients' BP is presumably lower than baseline following anaesthesia induction in postinduction cannulations while preinduction cannulations are performed in a baseline hemodynamic state. In preinduction cannulations, subcutaneous local anaesthesia(LA) infiltration performed for pain prophylaxis may alter RA anatomy and have an impact on the outcome. Additionally, preinduction cannulations differ from others in terms of patients' characteristics in whom they are indicated, that these patients presumably have advanced age, higher incidence of chronic hypertension and cardiovascular diseases, higher BMIs and higher ASA physical status scores.

This study aims to reveal the influence of anaesthesia induction and associated potential determinants on RA cannulation success. We hypothesized that during preinduction cannulations BP would be higher, LA infiltration may change the regional anatomy, patients are older and have a higher incidence of concomitant diseases and these differences may influence the cannulation success rates and cannulation durations. Secondarily, the individual effects of patient characteristics, RA width, height, depth and mean arterial pressures(MAP) on success rates and the cannulation times are to be shown.

MATERİAL AND METHODS

This is a prospective, observational study that has been conducted between November 2016-January 2017 in General Surgery operation rooms of a University Hospital. The study was conducted in accordance with the most recent version of the Declaration of Helsinki following approval of institutional Clinical Research Ethics Committee on 14th November 2016 (Decision no. 17-874-16). Informed patient consent that was approved by the institutional Clinical Research Ethics Committee was obtained from all patients.

Sample

A total of 73 patients was observed and analyzed during the study. Patients were eligible if they were ≥18 years, were undergoing elective surgery, were indicated with perioperative radial artery cannulation and have given informed consent. Exclusion criteria included patients who were younger than 18 years; pregnant; in hemorrhagic, septic or cardiogenic shock state needing immediate surgery; those who have a history of allergy to any general or local anaesthetic, and those who had previous surgery on the radial artery.

Procedure

Following transfer to the operation room for surgery, patients were monitored with standard anaesthesia monitors (electrocardiography, pulse oximetry and non-invasive blood pressure monitoring). Intravenous access was gained and 0,01-0,05 mg/kg midazolam with 0,5-2 mcg/kg fentanyl were given to all patients for sedation. After confirmation of eligibility, as a part of routine departmental practice, it was decided by the senior anaesthetist in the operation room whether respective patient would have arterial cannulation before or after general anaesthesia induction. Demographic data, including age, gender, ASA (American Society of Anaesthetists) physical status, weight and height; presence of chronic hypertension (HT), presence of at least one of atherosclerotic heart disease and/or peripheral vascular disease diagnosis and baseline MAP were recorded. Additionally, RA diameters and depth were measured with short axis out-of-plane technique using 10-5 MHz linear probe of Sonosite M-Turbo ultrasound machine (Sonosite, Inc., Bothell, WA, 98021, USA) and recorded as baseline RA height, width and depth.

Preinduction cannulations were performed following local infiltration of 1 ml prilocaine; whereas postinduction cannulations were done after general anaesthesia induction with appropriate doses of propofol or thiopenthal and endotracheal intubation without any local anaesthetic infiltration. Ultrasonography was used for measurement of arterial diameters after local anaesthetic infiltration (if performed) and before each cannulation. Arterial height and width measurements were taken by measuring the distance between lumen-intima interfaces. Arterial depth was measured as the distance between skin and upper lumen-intima interface. Arterial images where measurements performed on, were taken after optimization of probe pressure and probe location to prevent arterial compression. Procedural MAP were also taken immediately before every attempt in addition to baseline MAP. Baseline and procedural MAP were taken with non-invasive BP measurement technique.

Each cannulation was put into practice in supine position, under sterile skin preparation with 90°arm abduction and 45° wrist extension using standard 20G iv. cannula (Bıcakcılar Medical inc., Istanbul/Turkey). All cannulations were direct palpation guided and performed on the distal one-third of the wrist region, which was named as "cun position" by BJ. Lee et al.[12]. Cannulations were performed starting from non-dominant arm. In case of unsuccessful attempt repeated more than once in one arm, subsequent two attempts were continued in the opposite side until successful cannulation. After 4 unsuccessful attempts in total, procedure was to be carried out by senior anaesthetist.

During cannulations, duration between initial arterial palpation to placement of cannula into radial artery was recorded as cannulation time in units of seconds(s). If the attempt was failed, timer was stopped, sufficient compression on artery were provided, new arterial diameters were measured and timer resumed at the time of palpation for another attempt. If failure repeated, anaesthetist had gone over the same sequence until successful placement of arterial line. Successful cannulation was defined as placing the full length of cannula into the artery and confirming the arterial pressure tracing on monitor screen as soon as pressure transducer is connected. The duration between the placement of the full length of cannula into the artery and inspection of arterial pressure tracing on the monitor screen was not counted in cannulation time. At the end of procedure, cannulation time obtained by adding durations of each attempt in a patient, the total number of attempts, and first attempt success status was recorded in each patient. All cannulations analyzed were performed by fourth year anaesthesia resident Ayşegül Turgay with more than 300 direct palpation guided RA cannulations experience.

Statistical analysis

A priori, power analysis was conducted to determine an appropriate sample size to achieve adequate power. Results of a pilot study with 7 patients in preinduction group and 11 patients in postinduction group with primary outcome parameter as total cannulation time showed that groups with a minimum of 24 patients had 80% power when alpha was 0.05. Thus, the study was continued to be conducted until each group included at least 24 patients. A post-hoc power analysis using G power version 3.1.9.4 power analysis programme revealed power of 95% when alpha was 0.05 for 24 patients in preinduction group and 49 patients in postinduction group [13]. Statistical analysis was performed using SPSS for Windows, version 22 (SPSS®, IBM corp. Chicago, Illinois, USA). The distribution of variables was analyzed with Shapiro-Wilk test and variables except age, BMI, baseline MAP were abnormally distributed. Demographic data were analyzed for gender, ASA physical status, chronic HT prevalance, and cardiovascular disease prevalance using Pearson Chi-square test; and for age, BMI, baseline MAP, baseline RA diameters/depth, procedural MAP and procedural RA diameters/depth using Mann Whitney U test. Differences between preinduction and postinduction cannulation groups were analyzed in terms of total cannulation times and total number of attempts with Mann Whitney U test and in terms of first attempt success rates with Fisher's exact test. Analysis of changes in RA width, height and depth resulting from local anaesthesia infiltration were performed with Wilcoxon's signed ranks test. Procedural MAP, RA diameters/depth are compared among successful and unsuccessful attempts using Mann Whitney U test. The Spearman rank correlation analysis was performed to identify the relationship of total cannulation times with baseline characteristics, procedural MAP, procedural arterial diameters/depth.

The variables that are found to correlate with cannulation time are further analyzed with multivariable linear regression analysis whether they are independent predictors of cannulation time. Multicolinearity among independent variables was assessed with tolerance and variance inflation factors(VIF). Two-sided $p<0.05$ was interpreted as statistically significant. Gender, ASA scores, chronic HT prevalance, ASHD and/or PVD prevalance and total number of attempts were expressed as count, first attempt success rates were expressed as a percentage and continous variables were expressed as median (interquartile range) or if necessary, median (minimum-maximum).

RESULTS

According to power analysis, study was conducted until each group reaches at least 24 patients. During follow-up, 2 patients from postinduction group due to interruption of measurements and 1 patient from preinduction group due to patient discomfort/restlessness were excluded (Figure 1). When a number of 24 patients were reached in preinduction group, there were 49 patients observed in postinduction group and thus, a total of 73 patients was included and analyzed in the study. The demographic data and baseline patient characteristics including age, gender, BMI, ASA physical status, presence of chronic HT, presence of ASHD and/or PVD, baseline MAP and baseline RA measurements were presented in Table 1. To detail further for obesity, 5 patients were obese (BMI:30-39.99 kg/m²), 1 patient was morbid obese (BMI≥40 kg/m²) in preinduction group and 15 patients were obese, 2 patients were morbid obese in postinduction group (Obesity ratios were 6/24 versus 17/49 in preinduction and postinduction groups, respectively). Median age, ASA physical status score, prevalance of chronic HT and the prevalance of ASHD and/or PVD were significantly higher in the preinduction group (p=0.043, p=0.010, p=0.021 and p=0.008 respectively).

Additionally, procedural conditions were compared among groups. MAP measured immediately before initial attempts were significantly higher in preinduction group [preinduction group MAP= 103.33 (87.75-116); postinduction group MAP=90 (76.5-103); data shown as median (interquartile range); p=0.012] whereas RA anatomy did not differ among groups (p=0.710, p=0.547 and p=0.197 for width, height and depth, respectively).

Total cannulation times(s), number of attempts(n) and first attempt success rates (%) were expressed in Table 2. First attempt success rates did not differ among groups (%87.5 and %87.8 in preinduction and postinduction groups respectively; p=1.000). There were not any statistically significant difference between median cannulation times (median 30s, min. 17s, max. 378s in preinduction group; median 37s, min. 10s, max. 217s in postinduction group; p= 0.773). Median values of the number of attempts per patient were 1 and did not differ among groups (p=0.861). Maximum number of attempts recorded in one patient were 5 attempts (n=2) and 4 attempts (n=1) in preinduction and postinduction groups, respectively. The fifth attempts that were performed in those 2 patients in preinduction group were not carried out by resident anaesthetist but her senior anaesthetist. These 2 attempts' durations were added to total cannulation times and counted in number of attempts during analysis of these 2 patients but not taken into assessment with other 91 attempts during analysis of individual attempts.

Figure 2 shows influence of 1 ml subcutanous local anaesthetic infiltration on the radial artery. Local infiltration increased radial arterial depth significantly ($p<0.001$).

Table 1. Demographic data and baseline patient characteristics

	Preinduction group	Postinduction group	p
Age	64.5 (49.25-71)	56 (46-65.5)	0.043
Gender (M/F)	10/14	29/20	0.159
BMI (kg/m^2)	27.8 (23.51-31.4)	27.6 (23.92-31.08)	0.787
ASA status (≤2/≥3)	8/16	32/17	0.010
Chronic HT (+/-)	13/11	13/36	0.021
ASHD and/or PVD (+/-)	11/13	7/42	0.008
Baseline MAP	105.8 (93.17-114)	93.6 (86-11.83)	0.103
Baseline RA width	0.21 (0.20-0.24)	0.22 (0.18-0.25)	0.864
Baseline RA height	0.21 (0.20-0.26)	0.21 (0.20-0.27)	0.727
Baseline RA depth	0.22 (0.20-0.25)	0.23 (0.19-0.29)	0.759

Data are expressed as median (interquartile range) except where shown. p<0.05 is statistically significant.
BMI, body mass index; ASA, American Society of Anaesthesiologists; HT, hypertension; ASHD, atherosclerotic heart disease; PVD, peripheral vascular disease; MAP, mean arterial pressure; RA, radial artery. Blood pressures are shown in mm Hg. Width, height and depth are in cm.

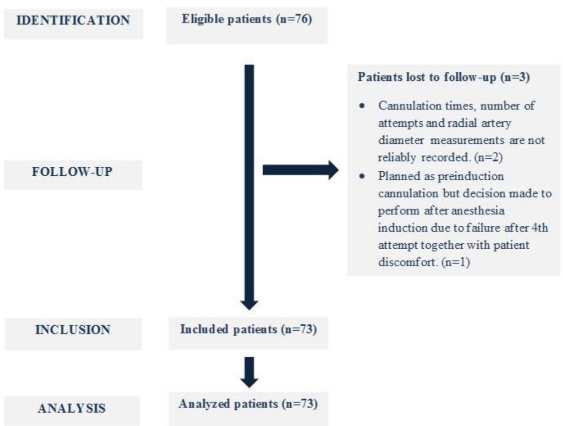

Figure 1. STROBE(Strengthening The Reporting of Observational Studies in Epidemiology) Study Flow Diagram

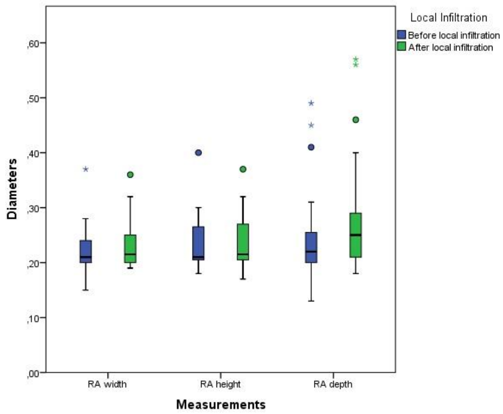

Figure 2. Effect of local infiltration on radial artery width, height and depth.

1 ml of local anaesthesia infiltration to radial groove produced no change in radial artery width or height (p=0.498, p=0.552 respectively) but increased radial artery depth significantly (p<0.001). p<0.05 is statistically significant. LA, local anaesthetic; RA, radial artery; diameters are shown in cm.

As each single attempt was assessed individually and attempts (n=91) were grouped as successful(n=71) and unsuccessful attempts(n=20); baseline characteristics were significantly different in terms of BMI [median (interquartile range) in successful attempts= 27.74 (23.76-31.02); in unsuccessful attempts= 33.97 (27.68-37.47); p=0.004], chronic HT prevalance (hypertensive to non-hypertensive ratio 24/47 in successful attempts; 13/7 in unsuccessful attempts; p=0.012), ASHD and/or PVD (diseased to non-diseased ratio 16/55 in successful attempts; 10/10 in unsuccessful attempts;p=0.016) and baseline MAP [median (interquartile range) in successful attempts= 100 (87.33-112); in unsuccessful attempts= 114 (106.33-114.33); p=0.021]. Other variables such as age, gender, ASA physical status and RA diameters/depth were similar in preinduction and postinduction cannulations.

Correlation of cannulation time with each baseline variable were assessed with Spearman rank correlation analysis and BMI, baseline MAP, chronic HT presence and ASHD and/or PVD presence variables were found to correlate with cannulation time (Table 3). Correlation coefficients(ϱ) and their significance were ϱ= 0.238, p=0.023 for BMI; ϱ=0.279, p=0.007 for baseline MAP; ϱ=0.268, p=0.01 for chronic HT presence and ϱ= 0.316, p=0.002 for ASHD and/or PVD presence. A multiple linear regression analysis was performed for the relationship between BMI, baseline MAP, chronic HT presence and ASHD and/or PVD presence as independent variables and cannulation time as the dependent variable (Table 3).

Table 2. Total cannulation times, number of attempts and first attempt success rates

	Preinduction group	Postinduction group	p
Total cannulation time	30 (17-378)	37 (10-217)	0.773
Total number of attempts	1 (1-5)	1 (1-4)	0.861
First attempt success rate	%87.5 (21/24)	%87.8 (43/49)	1.000

Data are expressed as median (minimum-maximum) except where shown.
p<0.05 is statistically significant. Total cannulation times are in seconds. Total number of attempts are counts. Success rates are in percent (ratio).

Table 3. Independent indicators of cannulation time among all cannulations

	Correlation coefficients	β	SE(β)	Std(β)	p
BMI	0.238*	0.880	0.426	0.219	0.040
Baseline MAP	0.279*	0.009	0.194	0.006	0.961
Chronic HT (+/-)	0.268*	4.052	5.769	0.083	0.484
ASHD and/or PVD (+/-)	0.316*	15.989	6.225	0.302	0.012

*p<0.05 for Spearman Rank correlation coefficient. ; Multiple correlation coefficient (R)= 0.428, p=0.001.; p<0.05 is statistically significant.
β, Beta regression coefficient; SE, Standart error; Std(β), standardized partial regression coefficient.
BMI, body mass index; MAP, mean arterial pressure; HT, hypertension; ASHD and/or PVD, atherosclerotic heart disease and/or peripheral vascular disease.

Multicolinearity assessment showed no significant association within independent variables (Tolerance>0.10 and VIF<10.0 for all independent variables). According to the regression line modelled (Table 3), the regression equation was as follows:

Cannulation time = 10.561 + 0.888xBMI
+ 0.009xBaseline MAP
+ 4.052xChronic HT existance
+ 15.989xASHD and/or PVD existance.

Multiple linear regression analysis has indicated that BMI and ASHD and/or PVD presence were independent predictors of cannulation time showing each 1 kg/m² increase in BMI results in prolongation of total cannulation time by 0.88s (p=0.040) (Figure 3) and ASHD and/or PVD presence prolongs the total cannulation time by 15.9s (p=0.012).

Procedural MAP and RA width, height, depth were found no different among successful and unsuccessful attempts [procedural MAP(mm hg) in successful attempts=96.67 (80.67-105.67), in unsuccessful attempts= 101.83 (76.17-110.25), p=0.518; Procedural RA width(mm) in successful attempts=0.21 (0.19-0.25), in unsuccessful attempts=0.26 (0.21-0.31), p=0.407; Procedural RA height(mm) in successful attempts=0.21 (0.20-0.27), in unsuccessful attempts=0.24 (0.20-0.26), p=0.066; Procedural RA depth(mm) in successful attempts=0.25 (0.20-0.29), in unsuccessful attempts=0.24 (0.23-0.32), p=0.304; data shown as median(interquartile range)] and additionally cannulation times were not correlated with neither of these variables.

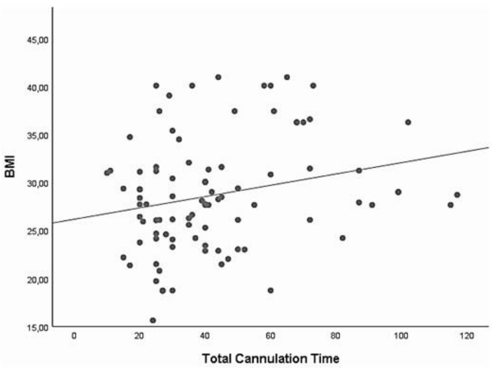

Figure 3. Relationship between body mass index(kg/m²) and cannulation time in units of seconds (p=0.040).

Unstandardized β coefficient for BMI=0.88. R=0.428 and p=0.001 for multivariable regression model. p<0.05 is statistically significant. BMI, body mass index.

During the conduct of the study, no vasospasm was inspected. Hematoma formations due to posterior wall puncture were inspected after 10 of 20 unsuccessful cannulations as a short term complication.

DISCUSSION

The primary finding of our study was that there were no difference between radial artery cannulations performed before anaesthesia induction versus after anaesthesia induction in terms of cannulation times, number of attempts and first attempt success rates. Secondarily, we have revealed BMI, baseline MAP, chronic HT presence, ASHD and/or PVD presence were significantly higher in failed attempts; and BMI and ASHD and/or PVD were independent predictors of cannulation time. To the best of our knowledge, no previous study has investigated or identified the effects of anaesthesia induction and associated condition disparities on radial artery cannulation success. Nevertheless, many studies previously searched for the effect of variables that are associated with preinduction cannulations such as local anaesthetic induced arterial anatomic changes, hemodynamic status, BMI, advanced age and concomitant diseases on procedure success.

Arterial depth, pulse pressure, chronic hypertension presence and the experience of proceduralist are reported as independent predictors of accurate arterial central axis palpation in the first step of 3 step study including 33 anaesthetists and interns by Nakayama et al.[8]. They further developed a training programme focusing on arterial depths and pressures, trained first year interns for detection of arterial central axis with direct palpation and showed training novices about high arterial depths and low arterial pressures during radial artery palpation significantly reduces disparity between palpated and actual central axes[8]. Accurate arterial location detection is an important component of success which is confirmed by several studies reporting improvement in success rates and cannulation times with simultaneous ultrasonographic visualization of artery[5,6]. In our study, we have found that subcutanous local infiltration in preinduction cannulations significantly increases radial arterial depth (Figure 2) but the depth has no effect on success rates and cannulation times. However, increased preinduction radial artery depths in our study are not exceeding a median value of 0.25 cm (IQR:0.20-0.29) and not creating a significant difference with postinduction cannulations' arterial depths. Nakayama et al. reported that arterial depth of 0.5 cm is a threshold and any disparity in palpated axis was observed above that point[8]. Furthermore, they mitigate success outcomes by training their interns with arterial depths between 0.25-0.45 cm which are deeper than the arteries in our study[8]. Arterial locations deeper than our subjects' radial arteries still might be associated with lower success rates and longer cannulation times but we can conclude that 1 ml local anaesthesia-induced increase in arterial depth is not influential on success. Our conclusion is also supported by the results of study by Kucuk et al. showing arterial height is not effective on the cannulation times and total number of attempts[9].

Procedural mean arterial pressures were significantly higher in preinduction group but were not effective neither on success rates nor cannulation times. No difference between baseline mean arterial pressures of patient groups in spite of higher chronic hypertension prevalance in preinduction cannulations might be the result of perioperative ongoing antihypertensive therapy in these patients. Eventhough preinduction procedural arterial pressures are higher than postinduction cannulations, preclusion of further increase by the influence of antihypertensives might be explaining disparities with the results of the abovementioned study[8]. On the other hand, in a review by Miller et al., it was indicated that only severe hypotension was associated with failure and systolic blood pressure was not a predictor of success in their ultrasound-guided radial artery cannulation experience which is compatible with our results[3]. Inherently, severely hypotensive patients needing immediate surgery were excluded from our study.

Baseline mean arterial pressure, presence of chronic hypertension and the presence of at least one of atherosclerotic heart disease and/or peripheral vascular disease were higher in failed attempts and presence of atherosclerotic/peripheral vascular diseases was an independent predictor of cannulation time as the results of our study. These results were, somewhat, compatible with the study suggesting sclerosis of the arterial wall with chronic high arterial pressures or thickening associated with vascular diseases may cause inaccurate palpation of arterial central axis[8]. These independent variables were also significantly higher in ratio in patients receiving preinduction cannulations but possible inadequate power of study for these variables might have prevented seeing their effects on preinduction cannulation success outcomes.

Body mass index was found as an independent predictor of cannulation time and was significantly higher in failed attempts in our study. In literature, BJ Lee et al. suggested that indices which are known to be associated with sensation of radial arterial pulse frequency and maximum pulse amplitude were not associated with obesity. The only index associated with obesity was pulse depth index which was an indicator of depth sensation[12]. Nakayama et al. reported similar results and stated that BMI was not a predictor of arterial central axis disparity during arterial palpation[8]. Assuming accurate palpation is the key for successful cannulation; the reason of somewhat conflicting results with our study may be lack of adjustment for variables other than obesity in our study. Apart from that, in the study of BJ Lee et al., the definition of obesity as BMI≥23 kg/m² together with use of BMI as a categorical variable (obese vs. non-obese) instead of continuous variable might be responsible for incompatible results[12]. In a systematic review by JYA Ne et al. it was stated that obesity is associated with brachial artery stiffness. The results of our study about BMI might be related to difficulty in the sensation of a stiff radial artery in patients with high BMI[14].

This study has several limitations. Foremost, the groups that were compared have different baseline characteristics and were not randomized. Future studies that are designed with randomization will make a bigger contribution to our knowledge in this field. During the conduct of study, all cannulations performed by only one proceduralist who has experience of 4 years in the anaesthesiology department of a large tertiary care hospital. This limits the generalizability of the results to proceduralists with different expertise levels. An experience threshold was defined by Nakayama et al. as having 3 or more years experience in anaesthesia is an independent predictor of accurate palpation[8]. Along with the experience, exclusion of severe hypotensive patients from cohort might be one of the underlying factors for high first attempt success rates in this study that was also pointed in the review by Miller et al.[3]. In addition, inconclusive or conflicting results of the study can be attributed to the fact that it was only powered for cannulation times between preinduction and postinduction groups, not for the individual effects of associated variables. A larger number of patients may provide more definitive evidence on the influence of arterial anatomy, hemodynamics, underlying diseases and obesity on success rates. Lastly, this study was not designed for follow-up and analysis of long-term complications of radial artery cannulations. Future studies about the effect of local anaesthesia infiltration, especially on colonization and infection rates as an additional invasive procedure, as well as on other complications such as thrombosis, distal ischemia, pseudoaneurysm formation will contribute to our knowledge.

Based on the findings of this study, first attempt success rates, cannulation times and number of attempts were not different in radial arterial cannulations performed before or after general anaesthesia induction with direct palpation technique. Body mass index and presence atherosclerotic/peripheral vascular diseases were independent predictors of cannulation times. Our study will contribute to our knowledge about the determinants of success in radial arterial cannulations with direct palpation technique and help us to develop coping skills with the factors associated with lower success rates in radial arterial cannulations.

Yazar Katkıları: Çalışma konsepti/Tasarımı: AT, OAB, VB, HAU; Veri toplama: AT, OAB, VB, HAU; Veri analizi ve yorumlama: AT, OAB, VB, HAU; Yazı taslağı: AT, OAB, VB, HAU; İçeriğin eleştirel incelenmesi: AT, OAB, VB, HAU; Son onay ve sorumluluk: AT, OAB, VB, HAU; Teknik ve malzeme desteği: AT, OAB, VB, HAU; Süpervizyon: AT, OAB, VB, HAU; Fon sağlama (mevcut ise): yok.
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