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Hemodynamic Changes Following Regional Anesthesia for Foot Surgeries: A Comparative Study between Ankle Block and Unilateral Subarachnoid Block

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Abstract

Foot surgeries are common surgical procedures performed for various indications ranging from trauma, diabetic foot syndrome, malignancies, abscess drainage, wound debridement, amputation and instrumentation.

The aim of this study is to assess and compare the hemodynamic parameters between ankle block and unilateral subarachnoid block for foot surgeries.

Fifty adult patients scheduled for elective foot surgeries that met the inclusion criteria were enrolled into the study. They were assigned into two groups of 25 each using computer generated numbers into group A and group S. Group A had surgery under the ankle block using 0.5% plain bupivacaine, while group S had surgery done under unilateral subarachoid block using 0.5% heavy bupivacaine. The pulse rate, systolic blood pressure and diastolic blood pressure were observed and recorded.

These variables were analyzed using the Statistical Package for Social Sciences (SPSS) version 25.0 and were presented using relevant tables and figures. Statistical tests of association were performed with a confidence level of 95% and a p-value of less than 0.05 was taken as significant.
The hemodynamic parameters; pulse rate, systolic blood pressure and diastolic blood pressure were significantly lower in group S compared to group A at 5-minute intervals when compared to baseline vital signs, ($P < 0.05$).

Ankle block provided better hemodynamic profiles when compared to unilateral subarachnoid block for foot surgeries.

Keywords: Ankle Block, Unilateral Subarachnoid Block, Hemodynamics, Foot Surgeries

Introduction

Regional anesthesia is an expanding subspecialty that is gaining increasing popularity due to its significant advantages over general anesthesia. These advantages of regional anesthesia over general anesthesia includes minimal systemic impairment, hemodynamic stability, localized postoperative analgesia, Deep Venous Thrombosis (DVT) prophylaxis and reduced hospital stay [1].

Regional techniques have clear clinical and economic advantages over general anesthesia. However, unilateral subarachnoid block and ankle block are adjudged to be the safest techniques [2]. This is because of the minimal hemodynamic variations associated with these techniques as well as lower incidence of complications when compared to general anesthesia [3].

In the recent past, with the improvement in treatment modalities and diagnostic skills, an increasing number of patients with compromised respiratory and poor cardiac reserve are presenting for foot surgeries [2].

A unilateral subarachnoid block offers advantages of the conventional subarachnoid block without typical adverse side effects seen with conventional subarachnoid block [4, 5]. It provides good analgesia intraoperatively for foot surgeries and also provides adequate pain relief postoperatively.
The consequences of inadequate pain control are many and these include tachycardia, hypertension, increased myocardial oxygen consumption, hypoventilation, nausea and vomiting. It also increases the overall hospital stay and cost of medical care [6].

This study compared the pulse rate, systolic blood pressure and diastolic blood pressure between ankle block and unilateral subarachnoid block for foot surgeries.

Methodology

Fifty patients participated in a prospective randomized single-blinded study. These patients were scheduled for elective foot surgery in our Teaching Hospital. The study was carried out for period of six (6) months, from April 2020 to October, 2020 after approval from ethics and research committee of the Hospital UDUTH/ HREC/ 2019/ 803.

The Inclusions criteria were American Society of Anesthesiologists (ASA) physical status I and II, patients between the ages of 18 and 60 years scheduled to undergo elective foot surgeries under regional anesthesia. And patients who refused the procedure, patient with history of drug allergy, infection at the site of the block, coagulopathy, patient on anticoagulants and patients with distorted anotomy of the foot or spine and patient with compromised vascular supply to the foot were excluded from the procedure.

The figures from a similar study by Urafalioglu et al. were used for sample size determination [7]. And after the calculation, the minimum sample size per group equals to 23. However, 25 patients from each group were studied. Fifty ASA physical status I or II patients were randomly assigned into two groups using computer-generated random numbers as group A and S, group A represents ankle block group while group S represents unilateral subarachnoid block group.

A detailed pre-anesthetic evaluation was done a day before the surgery, study protocol explained to the patients, and a written informed consent to participate in the study was obtained from these patients. The fasting guideline (eight hours for solid food and two hours for clear fluids) was explained to the patients and routine laboratory investigations including full blood count, serum electrolytes, and urinalysis were reviewed and when indicated electrocardiograph (ECG) and blood sugar were requested and reviewed.

These patients were consecutively assigned into two groups as group A and S, group A represents ankle block group while group S represents unilateral subarachnoid block group. The pulse rate, systolic blood pressure and diastolic blood pressure were observed and recorded.

The following materials were used for ankle block: sterile gloves, different sizes of syringes with 25G hypodermic needle for skin infiltration, 0.5% plain bupivacaine (DepoFoam), 1% lidocaine and 0.5 % heavy bupivacaine, sterile spinal pack and drapes. All necessary equipment and drugs needed for resuscitation and conversion to general anesthesia were kept ready in case of block failure or toxic reaction to the local anesthetic agent (Bupivacaine) during the procedure.

The following apparatus were used to monitor the patient vital signs: pulse oximeter (CAS M. California, USA) to monitor pulse rate and peripheral oxygen saturation, non-invasive blood pressure cuff to monitor blood pressure using Dash 4000 multiparameter monitor (SAKOMED, Laguna Niguel, USA), a stopwatch to measure onset and duration of sensory block and a Visual Analogue Scale (VAS).

As the patient arrives the operating room, intravenous access on the hand was secured using a wide-bore cannula for fluid administration. Standard monitoring including peripheral oxygen saturation (SpO2), non-invasive blood pressure (NIBP) and ECG were ensured. The baseline readings were obtained and recorded then subsequently at a 5 minutes interval throughout the procedure. The patient was positioned according to the technique of anesthesia either ankle block or unilateral subarachnoid block. All patients were given a single dose of intravenous midazolam 1 mg as an anxiolytic before the procedure.

Unilateral subarachnoid block was administered by placing the patient in a lateral decubitus position depending upon the site of the surgery and under the aseptic technique using 25G, 9cm sprotte spinal needle in L3-L4 intervertebral space and 7.5mg of 0.5% hyperbaric bupivacaine was used. The vital signs: pulse rate, blood pressure and oxygen saturation were observed and recorded at 5 minutes intervals throughout the procedure and thereafter in the recovery room and then in the surgical ward at 1st, 2nd, 4th, 8th, 12th and 24th hours postoperatively.

Ankle block was performed by placing the patient in the supine position and keeping the pillow underneath the lower leg to improve the access to all the five nerves namely; deep peroneal nerve, superficial peroneal nerve, saphenous nerve, posterior tibial nerve and the sural nerve. The aseptic technique ensured and 4mls of 0.5% plain bupivacaine was deposited to block each of the nerve after test aspiration. The vital signs: pulse rate, blood pressure and oxygen saturation were observed and recorded at 5 minutes intervals throughout the procedure and thereafter in the post anesthesia care unit and the surgical ward up to 24 hours postoperatively.

And when the undesirable side effects occur they were managed accordingly as follows; bradycardia with an intravenous dose of Atropine 0.5 mg, hypotension with intravenous fluid and 5 mg intravenous ephedrine. Patients who desaturate to less than 95% were given supplemental oxygen via face mask. Only data obtained from patients well oriented in person, place and time were considered for statistical analysis.

An interviewer-administered structured questionnaire was used in data collection and these data were analysed electronically using statistical package, SPSS version 25. The results obtained were expressed as mean ± SD except where stated otherwise. The variables were analyzed with the unpaired Student's t -test. The P-value ≤0.05 was considered significant.

Results

The difference in the demographic data: age, sex, weight and ASA classification were compared and statistically not insignificant in both the groups as shown in table 1.

Table 1: Demographic and ASA values of group A and group S.

	Group A (n=23) Mean(±SD)	Group S (n=25) Mean(±SD)	P-value
Age (years)	38.52 (±11.66)	35.96 (±10.83)	0.425
Sex (M,F)	14(60.9%), 9(39.1%)	16 (64%), 9(36%)	0.564
Weight (Kg)	65.56 (±8.07)	63.96 (±9.92)	0.535
ASA Status I/II	13(56.5%), 10(43.5%)	17(68%), 8(32%)	0.382

P≤0.05, the difference is statistically significant.

Table 2 compared the mean intraoperative pulse rate (PR) for the two groups at baseline and 5th minute intervals until the end of the surgery. There were significant differences noted at 10th,15th,20th,25th,30th,45th and 60th minutes.

Table 2: Baseline and Intraoperative pulse rate of group A and S

	Group A (n=23) Mean(±SD)	Group S (n=25) Mean(±SD)	P-value
Baseline	93.88 (±4.21)	94.33 (±3.18)	0.679
After 5th min.	87.48 (±3.62)	73.80 (±5.89)	0.679
After 10th min.	86.72 (±3.31)	72.20 (±5.17)	0.000
After 15th min.	85.96 (±3.48)	71.28 (±4.56)	0.000
After 20th min.	86.00 (±3.11)	70.92 (±3.56)	0.000
After 25th min.	85.96 (±2.94)	70.56 (±3.01)	0.000
After 30th min.	87.28 (±2.75)	72.52 (±4.28)	0.000
After 45th min.	85.60 (±4.73)	76.48 (±8.59)	0.000
After 60th min.	87.84 (±4.62)	77.24 (±7.50)	0.000

P≤0.05, the difference is statistically significant.

Similarly, Table 3 compared the mean intraoperative Systolic Blood Pressure (SBP) between the two groups at baseline and 5-minute intervals until the end of the surgery. However, statistically, the significant differences were noted at 10th, 20th, 30th and 60th minutes. This is shown in table 3.

Table 3: Baseline and Intraoperative Systolic Blood Pressure of group A and group S

	Group A (n=23) Mean(±SD)	Group S (n=25) Mean(±SD)	P-value
Baseline	128.72 (±21.46)	130.20 (±5.42)	0.740
After 5th min.	127.48 (±3.16)	114.64 (±3.96)	0.741
After 10th min.	125.20 (±4.56)	112.28 (±3.35)	0.000
After 15th min.	125.52 (±4.50)	111.28 (±2.92)	0.000
After 20th min.	125.40 (±3.39)	111.64 (±2.40)	0.000
After 25th min.	125.36 (±3.46)	111.50 (±2.12)	0.000
After 30th min.	126.80 (±3.12)	113.88 (±2.59)	0.000
After 45th min.	166.32 (±198.72)	117.40 (±5.00)	0.225
After 60th min.	127.44 (±3.12)	118.32 (±3.25)	0.000

P ≤0.05, the difference is statistically significant.

The result of baseline means intraoperative Diastolic Blood Pressure (DBP) when compared to mean Diastolic Blood Pressure (DBP) were statistically significant at 5th,10th,15th,20th,25th,30th and 60th minutes. This is shown in table 4.

Table 4: Baseline and Intraoperative Diastolic Blood Pressure of group A and group S.

	Group A (n=23) Mean(±SD)	Group S (n=25) Mean(±SD)	P-value
Baseline	82.68 (±5.18)	78.84 (±4.14)	0.006
After 5th min.	77.60 (±5.54)	69.76 (±3.49)	0.000

After 10th min.	77.48 (±5.51)	68.16 (±3.52)	0.000
After 15th min.	79.68 (±5.15)	67.84 (±3.36)	0.000
After 20th min.	80.12 (±4.77)	68.72 (±2.23)	0.000
After 25th min.	79.56 (±4.93)	69.16 (±2.08)	0.000
After 30th min.	82.56 (±5.95)	71.40 (±2.83)	0.000
After 45th min.	79.00 (±6.34)	74.68 (±5.79)	0.160
After 60th min.	82.96 (±5.25)	77.48 (±5.65)	0.001

P≤0.05, the difference is statistically significant.

Table 5 compared the mean postoperative pulse rate (PR) for the two groups at 1st, 2nd, 4th, 8th, 12th and 24th hours postoperatively. The result of pulse rate shows no statistically significant difference at 1st and 8th hours postoperatively. However, at 2th, 4th, 12th and 24th hours postoperatively the difference was statistically significant.

Table 5: Postoperative pulse rate of group A and group S

	Group A (n=23) Mean(±SD)	Group S (n=25) Mean(±SD)	P-value
After 1st hour	85.56 (±4.30)	84.96 (±4.95)	0.650
After 2nd hour	80.80 (±3.83)	77.44 (±4.70)	0.008
After 4th hour	80.04 (±3.88)	76.84 (±4.58)	0.010
After 8th hour	81.92 (±5.10)	80.00 (±3.40)	0.124
After 12th hour	84.88 (±5.31)	76.96 (±3.50)	0.000
After 24th hour	90.76 (±5.54)	78.40 (±3.82)	0.000

P≤0.05, the difference is statistically significant.

Similarly, the mean postoperative Systolic Blood Pressure (SBP) were compared with the baseline and the differences were not significant statistically. This is shown in table 6.

Table 6: Postoperative Systolic Blood Pressure of group A and group S

	Group A (n=23) Mean(±SD)	Group S (n=25) Mean(±SD)	P-value
After 1st hour	126.32 (±4.14)	125.92 (±3.40)	0.711
After 2nd hour	125.04 (±4.50)	125.48 (±3.39)	0.698
After 4th hour	127.88 (±3.94)	127.40 (±2.94)	0.628
After 8th hour	128.16 (±2.94)	123.36 (±22.13)	0.288
After 12th hour	129.96 (±4.62)	126.80 (±3.19)	0.012
After 24th hour	130.28 (±2.41)	129.64 (±3.17)	0.426

P≤0.05, the difference is statistically significant.

The results of mean postoperative Diastolic Blood Pressure (DBP) were also compared between the two groups as shown in table 7. At 1st, 2nd and 12th hours, the differences were not statistically significant. However, at the 8th and 24th hours, the differences were statistically significant.

Table 7: Postoperative Diastolic Blood Pressure of group A and group S

	Group A (n=23) Mean(±SD)	Group S (n=25) Mean(±SD)	P-value
After 1st hour	79.16 (±4.97)	80.12 (±3.76)	0.445
After 2nd hour	78.16 (±4.38)	76.44 (±3.57)	0.135
After 4th hour	78.40 (±6.25)	75.52 (±3.81)	0.055
After 8th hour	83.28 (±4.50)	78.56 (±5.30)	0.001
After 12th hour	78.32 (±4.48)	76.72 (±4.79)	0.229
After 24th hour	81.40 (±5.28)	77.28 (±5.09)	0.007

P≤0.05, the difference is statistically significant

Discussion

In this study, the effect of hemodynamic changes of ankle block and unilateral subarachnoid block for foot surgeries were compared.

The cardiovascular profiles of patients in this study were found to be remarkably stable throughout the intraoperative period and 24 hours postoperatively. The patients' vital signs were recorded from baseline and every five (5) minutes up to the end of surgery and thereafter at 1st, 2nd, 4th, 8th, 12th and 24th hours postoperatively. The hemodynamic parameters; pulse rate, systolic blood pressure and diastolic blood pressure were compared between the two groups at baseline and at 5th, 10th, 15th, 20th, 25th, 30th, 45th and at 60th minutes intraoperatively.

There was no statistically significant difference at the baseline and at the 5th minute mean PR between ankle block group and unilateral subarachnoid block group, p=0.679. Thereafter, at 10th, 15th, 20th, 25th, 30th, 45th and 60th minutes. Group A had significantly higher PR than group S, ($p<0.05$). This is in keeping with the findings of Singh et al. they found a significant difference in pulse rate values after 10th, 15th, 30th and 60th minutes when compared to the baseline values [8].

The mean SBP was also compared between the two groups and the difference was not significant at baseline and 5th minute (p=0.740). However, thereafter at 10th, 15th, 20th, 25th, 30th, 45th and 60th minutes group, S had lower SBP compared to the patients in group A and the differences were statistically significant ($p<0.05$). This is similar to findings by Urfalioglu et al. [7]. In their study, they found a statistically significant difference in terms of systolic blood pressure at 30th, 45th and 60th minutes. However, at the 5th, 10th and 15th minutes the difference is not statistically significant in the systolic blood pressure between the ankle blood group and unilateral subarachnoid blood group.

The mean DBP was also compared between the two groups at baseline and subsequently at 5th, 10th, 15th, 20th, 25th, 30th, 45th and 60th minutes. And the difference was statistically significant ($p<0.05$). This is in keeping with the findings of Singh et al [8]. they found that there was a significant difference in the diastolic blood pressure between the ankle block and the unilateral subarachnoid block following elective foot surgeries. The difference was at the 5th, 15th and 30th minute after the block. However, at 60th minutes, the difference was not significant.

The significant decrease in PR, SBP and DBP could be due to the blockade of the sympathetic nervous system by the local anesthetic agent bupivacaine. The findings in this study were similar to the findings in studies by Singh et al. and Urfalioglu et al [8, 7]. When the two groups were compared, there were significant decreases in these vital signs in group S. It was also observed in group S; some patients were given intravenous vasopressors to treat the hypotension which was similar to findings in this study. In this study, postoperative hemodynamic profiles were also studied at 1st, 2nd, 4th, 8th, 12th and 24th hours postoperatively.

The mean postoperative heart rate between the two groups was only significant at the 2nd, 4th, 12th and 24th hour postoperatively ($p<0.05$). The mean SBP between the two groups was only significant at the 12th hour postoperatively (p=0.012). The mean DBP between the two groups were only significant at the 8th and 24th hours postoperatively ($p<0.05$).

The slightly sudden increase in pulse rate, systolic blood pressure and diastolic blood pressure in the first hour after the surgery and thereafter at 2nd, 4th, 8th, 12th and 24th hours could be a result of stimulation during transport from operating room to post anesthesia care unit (PACU) and also due to the wearing off of the effect of local anesthetic agent bupivacaine which causes vasodilatation due to blockade of the sympathetic nervous system.

Singh et al. and Urfalioglu et al. compared hemodynamic data of unilateral spinal anesthesia and peripheral nerve blocks in patients undergoing foot surgery using bupivacaine as a local anesthetic agent [8, 7]. They concluded that peripheral nerve block provided more stable hemodynamic data compared to unilateral subarachnoid block in patients undergoing foot surgery. The similarities in the findings could be due to the study setting being the same, sample sizes were both adequate and only one anesthetist recorded the hemodynamic parameters. This could significantly eliminate the inter-observer variation which could affect the outcome of the results. It was suggested that peripheral nerve block be considered as the anesthetic technique of choice for foot and ankle surgery and postoperative pain relief, especially in patients for whom spinal anesthesia is not feasible. Therefore, this study will help to encourage the use of alternative anesthetic techniques to general anesthesia for foot surgeries. It will also contribute to the limited reference database for peripheral nerve blocks in our subregion.

Conclusion

Ankle block provides better hemodynamic stability compared to unilateral subarachnoid block for foot surgery and therefore, we recommend ankle block for foot surgeries provided there is no contraindications to regional block.

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