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Efficacy of ultrasound guided popliteal sciatic-saphenous adductor canal block versus ankle block in diabetic foot surgery

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Abstract

Foot is one of the most parts of the body that faces many problems such as trauma, strain, infection and other pathological conditions. Diabetes Mellitus is a multi-systemic disease that effects most organs. This prospective study aimed to compare the effectiveness of five nerves ankle block versus popliteal sciatic with adductor canal saphenous block in diabetic foot surgery. Hundred patients were included in this study (American Society of Anesthesiologists class III and IV-E). All the participants had full routine preoperative investigations with doppler ultrasound study for peripheral circulation. Two groups, group A involves those who had operation under ankle block regional anesthesia, while group B, anesthesia was done by popliteal sciatic–saphenous adductor canal block. There was a significant difference between the two anesthetic techniques regarding the onset of action and efficiency of 0.75% ropivacaine in popliteal sciatic nerve block in comparison with five nerves ankle block. Almost all the patients and surgeons were satisfied by popliteal sciatic-saphenous adductor canal block in which there was minimal need of sedative and analgesic drugs such as midazolam or ketamine. Popliteal sciatic–adductor canal saphenous block is more convenient and effective to provide the state of surgical anesthesia with minimal need to adjuvant sedative drugs. The best results could be obtained with the popliteal sciatic-saphenous block with only 2 injections instead of 5. This will minimize the risk of infection as it is far from the operative site. Also, it is faster in onset of action and provides good postoperative analgesia than ankle block.

Keywords: Ultrasound guided; Popliteal sciatic-saphenous block; Ropivacaine

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Introduction

Many Diabetic foot problems do not respond to conservative management. There are numerous conditions such as trauma, infection or vascular complications of diabetes that might necessitates surgery of the foot including; toes amputation, skin or soft tissue repair, wound debridement, bone grafting, fixation or osteotomy [1]. The type of anesthesia is essential in foot surgery. Regional anesthesia unlike general anesthesia & other different methods of anesthesia, the postoperative outcome allows patient to be discharged shortly after procedure without risk & The goal is to reduce the cost of the surgical procedure by reducing the length of hospital stay with free of pain [2]. Regional anesthesia is well tolerated, and it is a good option to the patient. Also it has a property of postoperative pain relief with minimal risk of cardiac and pulmonary complications which is important in critically ill patients[3, 4]. Many studies have shown that peripheral nerve blocks are highly effective for patients undergoing outpatient surgery, both in delaying and reducing the onset of pain postoperative pain [3-6]. There are different methods of regional anesthesia that are suitable for foot surgery such as ankle block or popliteal sciatic–saphenous adductor canal block [7, 8]. The most significant advantage of peripheral nerve blocks over other regional anesthesia methods is that anesthesia is limited to the area supplied by the nerve [9]. Peripheral nerve block can potentially be utilized as the sole anesthesia for foot and ankle operations. This can be indicated in critically ill patients who undergo life and/or limb saving surgery. Profound analgesia during post-operative time and the avoidance of PONV are also potential benefits of peripheral nerve block. Other advantages include earlier hospital discharge and encourage oral intake for food and medications at postoperative period [7].

Ankle block, this type of regional anesthesia is performed while the patient in supine position and the foot on padded support. The goal is to block five nerves: Superficial nerves (superficial peroneal, sural, saphenous), deep nerves (posterior tibial, deep peroneal). All these nerves are branches of the sciatic nerve except the saphenous nerve that is a terminal branch of the femoral nerve as shown in figure 1.

Popliteal-Sciatic block, this block is performed by two approaches: The Posterior approach; which is performed with the patient in the prone or oblique position with the

legs slightly abducted. And the lateral approach, which is performed with the patient in supine or oblique (more convenient) position. Enough space must be made to accommodate the transducer beneath the knee and thigh. With posterior and lateral popliteal approaches, the transducer position gives identical sonographic anatomy.

Saphenous nerve block, this type is used to complete the leg block. It is accomplished in supine position with operative side of the leg extended. With the introduction of ultrasound guided block, regional anesthesia became more convenient and safer regarding the localization of nerves and adjacent structures. Ultrasound guide facilitates accurate placement of local anesthesia which in turn will minimize the dose that may be injected outside the nerve resulting in less probability of local anesthetic toxicities. Also, there will be minimal trials of injections with more successful rates.

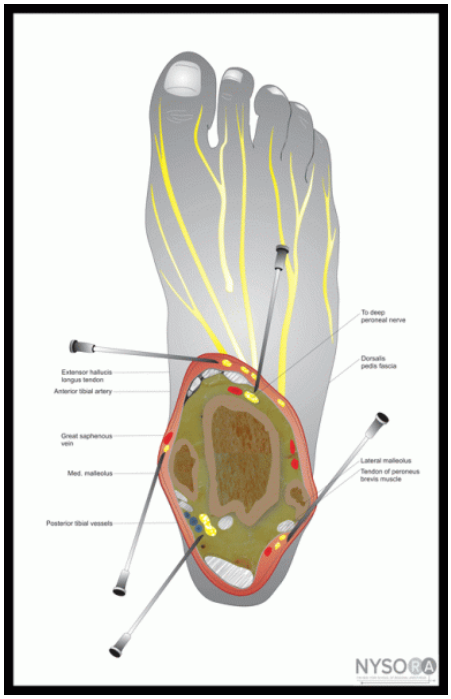

Figure 1.

showing foot innervation (Cited from NYSORA)

Retrospective studies have been shown that long-term analgesia was ensured with adductor canal saphenous - sciatic popliteal blocks, ankle blocks, and similar methods that were applied to provide anesthesia during lower extremity operations [10]. Popliteal lymph nodes Are small in size and its six or seven in number, are implanted in the fat of the popliteal fossa. One lies immediately under the popliteal fascia, near to

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the terminal part of the small saphenous vein and drains the region from which this vein derives its tributaries, such as superficial regions of the posterolateral aspect of the leg and the plantar aspect of the foot therefore any foot infection leads to enlargement of the popliteal lymph nodes that obscure the sono -anatomical image of the popliteal fossa Figure 2 shows the popliteal lymph nodes enlargement, Popliteal artery and vein and tibial, common peroneal, and medial sural cutaneous nerves.

Figure 2.

The lymphatic System. 5. The Lymphatics of the Lower Extremity, Gray, Henry (1918) Anatomy of the Human Body

This study aimed to compare the effectiveness of five nerves ankle block against popliteal sciatic with saphenous block in diabetic foot surgery.

Patients and methods

This study was carried out in Alfaihaa Teaching Hospital, Basrah, Iraq after taking patients' consent and ethical committee approval. One hundred patients with diabetic foot were included in this study in the period from April 2015 to March 2016. Patients were ASA class III & IV E and they were scheduled for foot surgery. In this prospective study, the exclusion criteria were; patients with known allergy to local anesthetic agents, coagulopathies, on anticoagulant therapy and those who had local infection at the site of block. Fifty patients underwent ankle block (group A), and another 50 patients underwent popliteal sciatic saphenous block (group B). Equipment's and drugs; Ultrasound machine with linear transducer (8-12 MHz), sterile sleeve, and gel. Syringes (20 ml,10 ml), 22-gauge echogenic needle with extension tube. Sterile gloves and disinfectant. Local anesthetic solution, Ropivacaine 0.75%. Sedative agents were Midazolam and sub-dissociative dose of ketamine.

Technique

While the patient in supine position, the skin was disinfected with povidone iodine in both blocks. Successful block is predicted by the spread of local anesthetic around the nerve as seen by the ultrasonic image. Ropavicaine 0.75% was used per each nerve in both procedures to ensure an effective block. The operation was started following loss of sensation and temperature differences in each area. Sedation was accomplished by using Midazolam (0.1 mg/kg) and sub-dissociative dose of ketamine (0.1 mg/kg).

In the popliteal-sciatic block, a high frequency ultrasound transducer was placed parallel to the popliteal crease to recognize the popliteal artery and vein which were identified by the aid of Color Doppler Ultrasound when necessary at depth of 3-4 cm. At this level, the popliteal artery was a round pulsatile structure, the ultrasound probe is then slowly moved cephalad, and the tibial nerve was shown as a hyperechoic honeycomb structure that is superficial to the popliteal artery. The ultrasound probe was then slowly moved laterally further cephalad until the common peroneal nerve become visible just medial to the biceps femoris muscle and lateral to the tibial nerve. At this point, the probe was advanced more cephalad until the split point of the sciatic nerve into TN (Tibial Nerve) and the CPN (Common Peroneal Nerve)

Then the needle was inserted in-plane in a horizontal orientation from the lateral aspect of the thigh and adjacent to the nerve. Following frequent aspiration, 1-2 ml of normal saline was injected to confirm the proper position of the needle by hydro-dissection. After recognition of TN and CPN, injection of 15 ml of 0.75% ropavicaine local anesthetic was performed. Surgery was started after the area innervated by these two nerves has been blocked; in other way the patient cannot do planter and dorsi flexion of the foot. The saphenous nerve was seen on ultrasound image as a small rounded hyperechoic structure medial to the femoral artery. The femoral vein accompanied by the artery were typically visualized at 2-3 cm depth, the needle was inserted in-plane in lateral to medial orientation and advanced toward the femoral artery. Additional needle repositioning might be necessary when there was resistance or poor hydro-dissection.

The ankle block was performed while the patient in supine position and the foot on padded support. The procedure was started by; posterior tibial Nerve, this nerve supplies the sole of the foot & the area between the big & second toe, block of this nerve doing by palpate the posterior tibial artery behind the medial malleolus & Inject 3-5-mL of anesthetic one cm in depth & one cm superior to this point.

Sural Nerve

Supply the Posterior and lateral foot Inject 3-5-mL of anesthetic subcutaneously between the Achilles tendon and one cm above lateral malleolus

Superficial Peroneal Nerve Block

Gives innervation to the dorsal aspect of the foot and toes Inject 4-10-mL of anesthetic subcutaneously in a band between the lateral malleolus and the extensor hallucis longus tendon.

Deep Peroneal Nerve Block

Innervate the area between the big toe and the second toe, ask the patient to do dorsiflex of their foot and insert the needle one cm above the medial malleolus aiming underneath the extensor hallucis longus tendon and advance until you hit the tibia. Then inject 3-5-mL of anesthetic

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Saphenous Nerve Block

Gives sensory innervation to the medial aspect of the foot Inject 2-5-mL subcutaneously between the medial malleolus and the anterior tibial tendon.

Patients were asked about the degree of pain and their satisfaction about the procedure. The surgeon is satisfied as the patient is satisfied. The grades of satisfaction are from 1-4: grade 1 is unsatisfied, grade 2 is poor, grade 3 is accepted, and grade 4 is highly satisfied.

Statistical analysis

Data were analyzed statistically using students unpaired t-test for difference of means, Fishers exact test, Pearson chi-square test. SPSS program was used for statistical analysis. A p-value <0.05 was considered as significant.

Results

This prospective study included 100 patients scheduled for foot surgery. Fifty of them received ankle block (AB) and the other 50 received popliteal sciatic block (PB). There was no significant difference between means of both groups regarding the age (AB=45±15, PB=44±16) and weight (AB=65±15, PB= 66±12), also the gender ratio was of no significance as well as the type of operation as shown in table I.

Table I.

Characteristics of patients participating in this study.

Variables	Group A, *N*=50 Mean±SD	Group B, *N*=50 Mean±SD
Age (year)	45±15	44±16
Weight (kg)	65±15	66±12
Gender (male:female)	5:6	6:5
Type of operation		
1-Forefoot amputation	20	20
2-Amputation of toes	10	10
3-Osteotomy	10	10
4-Wound debridement	7	5
5-Others; such as change of dressing and flaps	3	5

Regarding the use of intraoperative booster doses of Midazolam and ketamine, table 2 shows highly significant differences (P<0.01) between the two groups as many patients in ankle block group needed frequent doses. Also, patients with ankle block needed ketamine analgesia.

Table 2.

Differences in boosting doses between the groups

Variable	Group A *N*=50 Mean±SD	Group B *N*=50 Mean±SD	P-value
Midazolam booster dose need	1.5±0.5	1.1±0.3	<0.01
Sub-dissociative dose of Ketamine need	2.2±1.0	0.0±0.0	<0.01

The results of this study showed that group B has much better satisfaction for the patients and surgeons. There was 80% of the patients in group B with high satisfaction as compared with the 50% of group A as demonstrated in table 3.

Table 3.

Grades of satisfaction

	Grades of satisfaction	Group A N=50	Group B N=50	P-value
Patients and Surgeons Satisfaction	4 (high satisfied)	25	40	P<0.05
	3 (acceptable)	10	5	
	2 (poor)	8	3	
	1 (unsatisfied)	7	2	

Discussion

This study showed that there were no significant differences regarding age, gender, weight and type of operation as demonstrated in table 1. Table 2 demonstrated the need of sedative dose of Midazolam with or without the use of ketamine sub-dissociative doses. This because the area in the ankle block was infected due diabetic neurovascular complications so the local anesthetic agent will not work properly in acidic pH. This can cause minimal pain sensation due to partial block that disturb the patient during surgery. The results go in favor of the popliteal sciatic- adductor canal saphenous block. Patients and surgeon's satisfaction were significantly higher in group B ($P<0.05$). This because there was a smaller number of pricks to the patient than the ankle block and the area of local anesthetic injections in group B is clean and away from the site of infection so the anesthetic agent act properly. The visualization of the nerves with the ultrasound image is better in group B, for all these reasons it is better to perform anesthesia for diabetic foot using the popliteal sciatic- adductor canal saphenous block. The approach of popliteal nerve blocks is safe as the reported rate is 0-10% The most common complications include incomplete anesthesia, infection, and neuropraxia [11]. The degree of patients' perceptions, attitudes & beliefs, will help to assess the quality of health care services [12]. The choice of anesthesia used, and patient gender affects anxiety levels, as females are more anxious than males. The result of this study goes with Canales *et al* as they stated that popliteal block gives excellent anesthetic results for ankle and foot surgery especially in diabetic patients who have systemic complications and disturbed body immunity [13]. Hegewald *et al*. has demonstrated that not only popliteal block highly efficacious, but can also be executed by the novice foot and ankle surgeon [14]. While, low surgeon satisfaction in ankle block was noticed because of infection and edema of the foot that increases the possibility of failure. Also, the bacterial invasion and intravascular injection are more common with ankle block. Although the advantage of popliteal approach in this study got more satisfaction than ankle block but the frequency of neuropathic complication following a popliteal nerve block was notably in postoperative period higher than ankle block [15]. Patient satisfaction is good indicator of health care outcome and evaluation of the quality in anesthesiology [16, 17].

Conclusion

According to the result of this study, the popliteal sciatic–saphenous adductor canal block may be considered as anesthesia of choice in diabetic foot surgery.

Competing interests

The author declare that he has no competing interests.

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