Doppler Assisted Ankle Block in the Diabetic Foot with Peripheral Vascular Disease.

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Abstract:

Introduction
For nerve block procedures in a diabetic foot with peripheral vascular disease (PVD), the nerves at the ankle level are located indirectly by locating the diseased artery or vein with hand held Doppler because of the proximity of the vessels to the nerves. Effectiveness of this method is assessed by the rate of success of the block, rate of effective post operative analgesia and its mean duration with bupivacaine 0.5%. Furthermore, the aim was to assess the rate of complications pertaining to the Doppler use and nerve block.

Materials and Methods
All the diabetic patients admitted to the wound clinic with peripheral vascular disease who required surgical procedures during the period from 1st December 2001 to 31st June 2005 were recruited in the study. A 10 MHZ hand held Doppler (Huntleigh, UK) which picks up diseased arteries and veins readily was used to determine the location of diseased artery or vein. Patient satisfaction grading charts for the perioperative analgesia, rate of conversion to other modes of anesthesia and the rate of complications and mean duration of postoperative analgesia with bupivacaine 0.5% were determined.

Results
A total of 75 patients (46 males & 29 females) in the age group of 60 to 75 years were studied. Successful nerve block was obtained with 0.5% bupivacaine in 99% of cases and less than 1% needed conversion. Because of successful blocks, 80% of patients had continuous postoperative analgesia for 2 to 4 hours with a mean of 3.5 hours following surgery. Complication rates were < 2%. Accidental puncture of the vessel & hematoma was noted only one case.

Conclusion
Methods such as palpation of vessels, nerve stimulators, anatomical surface markings and fascial click are not specific for location of nerves in the diabetic foot with peripheral vascular disease. In this cohort of diabetic patients with PVD we found a high rate of success in obtaining perioperative anesthesia. This simple non-invasive method with a short learning curve is useful in the surgical management of diabetic foot disorders.

Key words: Peripheral vascular disease in diabetes, ankle block, Doppler use.

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Introduction

With the increasing prevalence of diabetes, there are more patients presenting with painful neuropathy and diabetic peripheral vascular disease requiring surgical procedures. This study was done with the intention to find out ways and means of establishing successful ankle blocks assisted by a hand held Doppler.
For the successful block at ankle level, the exact location of the nerves has to be discernible.\(^1\) In the peripheries, the nerves course in close proximity to the vessels nearby.\(^2, 3, 4\) (Fig. 1).

The close relationship of nerves to blood vessels at the ankle are shown in Table 1.

![Figure 1: Cadaveric dissection showing deep peroneal nerve related to anterior tibial vessels](image)

### Table 1: Position of peripheral nerves in relation to the dopplered vessels at ankle

<table>
<thead>
<tr>
<th>Nerve at ankle</th>
<th>Vessel related</th>
<th>Position of nerve to the vessel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep Peroneal nerve</td>
<td>Anterior tibial artery and venae comitantes</td>
<td>Lateral</td>
</tr>
<tr>
<td>Superficial Peroneal nerve</td>
<td>SPNA (Superficial peroneal nerve artery)</td>
<td>On it</td>
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<tr>
<td>Tibial nerve</td>
<td>Posterior tibial artery and its venae comitantes</td>
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<tr>
<td>Saphenous nerve</td>
<td>Great Saphenous vein</td>
<td>Posterior</td>
</tr>
<tr>
<td>Sural nerve</td>
<td>Small saphenous vein</td>
<td>Lateral</td>
</tr>
</tbody>
</table>

**Materials and Methods**

Diabetic patients with painful neuropathy and peripheral vascular disease (PVD) with an ankle brachial index of less than 0.8 and a digital pressure ≤ 30mm of Hg were included in the study. Patients with diabetes and PVD with totally insensitive feet or those who required proximal regional blocks were excluded. Presence of satisfactory nerve block was determined and the conversion rates to other types of anesthesia or nerve blocks were computed from operation records. Patients’ satisfactory gradation charts were used for assessing the perioperative analgesia effectiveness. The staff nurse in the post operative ward would indicate in the records when the patient required supplementary analgesia as measured by number of hours following surgery. The complications were assessed from follow-up records.
As soon as the patient entered the holding area, the vessels were located. Using a 10MHZ hand held Doppler and based on the arterial phasic sound or in the case of complete arterial occlusion, venous telegraphic wire sound of veins or venae comitantes were located. The course of the vessel was marked with mercurochrome solution. From the anatomical knowledge about the location of nerve trunk in relation to the detected vessel, the needle entry point was marked in close proximity to it. After preparation of the patient, the local anesthetic agent (0.5% bupivacaine) was deposited in the ellipsoid tract from the bony hitch point to subcutaneous tissues using a 23-guage needle. After 15 minutes the anesthesia status was assessed and the surgical procedure was commenced. Only a single injection for every site was used.
Results

During the period between 1st December 2001 and 31st June 2005, 75 (46 male and 29 female) subjects were selected for the study. These patients had undergone successful Doppler assisted ankle block using 0.5% bupivacaine. Successful intraoperative analgesia was obtained in 99% of cases. Only 1 patient required sedation as a supplement to the ankle block. Among the patients with successful blocks, 80% had continuous post operative analgesia for 2-4 hours (mean 3.5 hours). Among the 20% of remaining patients, post operative analgesia remained for 1-2 hours (mean 1.5 hours). Only one patient had a hematoma formation at the needle prick site, which resolved by conservative measures.

Discussion

Regional anesthetic blocks are safe and effective methods that do not produce any serious hemodynamic disturbances. Such events could be detrimental to diabetic patients and particularly for any flap reconstructive procedures. In chronic ischemic legs, with multiple and diffuse stenoses in the leg segmental vessels, hypotension can precipitate thrombosis easily. Since neuroaxial anesthesia often produces hypotension, effective ankle blocks or high leg blocks are most favored. Palpation alone cannot pick up diseased vessels, and such pulsations can be difficult to ascertain in the presence of edema. Nerve locators are not always useful in the presence of peripheral neuropathy, as there can be severe motor paralysis that can mitigate any response. Therefore this indirect method of accurate location of the nerves facilitates a successful block, even in the presence of edema. When arterial stenosis is present, the 10MHZ Doppler picks up monophasic flow and if the artery is totally occluded, it picks up venous flow of the venae comitantes. In the latter case, the venous Doppler signals indirectly detects the accurate location of the corresponding nerves. Furthermore, the Doppler technique is totally non-invasive and does not elicit pain. A Doppler probe of 3mm in diameter effectively locates vessels of small size at ankle level like the superficial peroneal nerve artery (SPNA) which is useful for locating the superficial peroneal nerve. A single injection was given at each site and multiple injections were not used in this study. Accidental vessel penetration was grossly decreased and the hematoma rate was less than 2% in these patients. In only one instance, conversion was required for a patient with metabolic acidosis with mild hyperkalemia.

Neuroaxial anesthesia and general anesthesia requires careful assessment and preparation of the patient. In diabetes, due to preoperative fasting, there is a need for close observation of glycemic control. Invariably, diabetic patients have intercurrent illnesses that increases the risk of complications related to general and neuroaxial anesthesia. Therefore, in diabetic patients, particularly in those with peripheral neuropathy, nerve blocks not only provide successful surgical anesthesia, but also provide a method to help decrease the incidence of perioperative complications. Since complications of nerve blocks are negligible, such local or regional techniques should be considered as an anesthesia of choice for diabetic patients undergoing peripheral surgical procedures.

In this scenario, Doppler exactly locates the vessels at ankle level and thereby anatomically closely situated nerves are blocked effectively by depositing the local anesthetic in the perivascular space.
In this review of nerve block done in our institution, 99% of patients had successful blocks by using this technique. The only disadvantage was that a patient had to endure multiple needle pricks for successful foot anesthesia. At the ankle level, there was no need for change of posture. Doppler examination was totally painless and complications such as hematoma and ecchymosis formation in a patient who was heparinized, was related only to the needle prick. The local block also provided excellent postoperative analgesia, which obviated the need for other analgesics, and therefore nullified postoperative analgesic-induced complications. All of these nerve blocks produce no disturbance in hemodynamics, and as shown in our study with 0.5% bupivacaine, the mean total duration of anesthesia is 3.5 hours. Therefore most reconstructive surgical procedures can safely be performed within this time period.

**Conclusion**

The described technique was found to be a very effective method to provide anesthesia for diabetic foot operations where peripheral vascular disease and neuropathy coexists. With very few complications and prolonged anesthesia, it can avoid the detrimental effects of general anesthesia and also effectively reduce the need for postoperative analgesics. The author considers this local anesthetic technique to be the method of choice when performing most diabetic foot surgical procedures.

**References**


