CASE REPORT

Peripheral neural blockade for pain control in patients undergoing percutaneous angioplasty for complex infrapopliteal disease

Kompleks infrapopliteal hastalık için perkütan anjiyoplasti uygulanan hastalarda ağrı kontrolü için periferik nöral blokaj

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Summary– In recent years, percutaneous transluminal angioplasty has become the preferred revascularization option for chronic limb-threatening ischemia (CLTI) and infrapopliteal (IP) arterial disease. CLTI and IP disease require complex and lengthy procedures that necessitate multiple balloon inflations and frequent contrast injections. It will lead to severe discomfort if periprocedural pain control is inadequate. Conventional methods such as local anesthesia and systemic opioids are usually inadequate to provide pain control for complex IP arterial disease interventions. Ultrasound-guided peripheral nerve blockade (PNB) has been recently employed in peripheral procedures, with several small studies reporting favorable results in patients who underwent not complex interventions. In the present series, we report our experience of 4 patients who underwent PNB to relieve pain during endovascular treatment of complex IP disease, and in whom we have observed excellent periprocedural pain control that led to satisfactory postprocedural outcomes.

Özet– Son yıllarda, perkütan translüminal anjiyoplasti, ekstremiteleri tehdit eden kronik iskemi (CLTI) ve infra-popliteal (İP) arter hastalığı için tercih edilen revaskülarizasyon seçeneği haline gelmiştir. CLTİ ve İP arter hastalığı; mükerrer balon dilatasyonu ve sık kontrast enjeksiyonunu gerektiren karmaşık ve uzun prosedürler gerektirir. Periprosedürel ağrı kontrolünün yetersiz kalması ciddi rahatsızlıklara yol açacaktır. Lokal anestezi ve sistemik opioidler gibi geleneksel yöntemler, kompleks İP girişimler sırasında ağrı kontrolünü sağlamak için genellikle yetersizdir. Ultrason rehberliğinde periferik sinir blokajı (PNB), son zamanlarda periferik prosedürlerde kullanılmıştır ve birkaç küçük çalışma, kompleks olmayan girişim yapılan hastalarda olumlu sonuçlar bildirmiştir. Bu seride, kompleks İP hastalığı olan dört hastada endovasküler tedavi sırasında ağrıyı azaltmak için PNB uygulanan, işlem sonrası tatmin edici sonuçlara yol açan ve mükemmel periprosedürel ağrı kontrolünü gözlemlediğimiz deneyimimizi bildirdik.

Revascularization is the mainstay of treatment in patients with chronic limb-threatening ischemia as it is the only method to reduce the frequency and extent of amputations.[1] However, complex infrapopliteal (IP) arterial disease is found in up to 70% of these patients, making these cases challenging for revascularization.[2] Percutaneous peripheral transluminal angioplasty has recently grown in importance with technological advances and increasing procedural experience that has allowed for the treatment of IP disease. An endovascular-first approach with percutaneous transluminal angioplasty (PTA) is gaining traction as surgical revascularization is not always feasible and the long-term graft patency rates are somewhat poor.[3] As PTA for IP disease necessitates rather frequent contrast injections and frequent balloon inflations, severe periprocedural pain is common and conventional pain management with puncture-site anesthesia and systemic opioids are usually inadequate to control pain. Inadequate pain control causes inconvenience to the patient and also to the operators, which could also affect the success of the procedure itself.

Abbreviations:

ATA	*Anterior tibial artery*
BD	*Buerger's disease*
CT	*Computed tomography*
IP	*Infrapopliteal*
PA	*Peroneal artery*
PNB	*Peripheral nerve block*
PTA	*Percutaneous transluminal angioplasty*
PTA	*Posterior tibial artery*
RA	*Room air*
SFA	*Superficial femoral artery*
US	*Under ultrasound*
VAS	*Visual analog scale*

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Table 1. Procedural characteristics of patients with complex infrapopliteal disease undergoing percutaneous revascularization

Case no.	Revascularized arteries	Duration of procedure (min)	Total duration of balloon inflation (min)	Amount of contrast used (mL)	Periprocedural pain
1	SFA, PTA, ATA, PA	137	25	285	None
2	SFA, ATA, Pop	135	20	250	Mild
3	ATA, DPA	144	15	270	None
4	ATA, PA	150	25	240	Mild

SFA: superficial femoral artery; PTA: posterior tibial artery; ATA: anterior tibial artery; PA: peroneal artery; Pop: popliteal artery; DPA: dorsalis pedis artery; min: minimum.

Lower extremity peripheral nerve block (PNB) is an anesthetic method that was initially used to control postoperative pain after orthopedic surgery, but later adopted to control periprocedural pain during percutaneous lower extremity revascularization procedures. However, data on the efficacy of PNB in lower extremity PTA is severely limited, and virtually no data is present for more complex patients with IP disease. In this present series, we report our experience in 4 complex patients with IP disease who underwent PTA, including 2 patients with Buerger's disease (BD), in whom pain control was done using PNB instead of traditional means (Table 1).

CASE REPORT

Case 1

A 39-year-old Caucasian man with a medical history of BD that was diagnosed 3 years before his admission was referred to our institution complaining of right foot and leg pain at rest. On physical examination, his blood pressure was 130/78 mmHg, heart rate was 85 beats/min, and his oxygen saturation was 94% at room air (RA). On inspection, his right foot was cold and clammy, and there was a gangrenous lesion on the fourth toe and several smaller wounds on other digits (Figure 1). The popliteal and distal pulses on the right side could not be felt with palpation and the ankle/brachial index was measured 0.45 in the right leg and 0.55 in the left leg. He had undergone an invasive angiogram a month ago, which showed a distal total occlusion of the right superficial femoral artery (SFA) (Figure 2A) and the distal arterial bed on the right side was not visible. There was also a total occlusion on the left SFA at the osteal level. Based on these findings, an endovascular intervention was planned with the aim to restore flow to the right foot.

Figure 1. Necrosis of the tip of the fourth toe on the right foot and multiple smaller wounds on the dorsal aspect of the right foot.

Before the intervention, a total of 40 mL of 0.5% bupivacaine and 0.25% lidocaine was injected to saphenous, sciatic, common peroneal, and tibial nerves under ultrasound (US) guidance (Figures 3 and 4). A posterior popliteal approach was used to do the sciatic nerve bock. The sciatic nerve crosses between the tendons of biceps femoris and semitendinosus muscles and divides as tibial and common peroneal nerves approximately 6 cm above the midpoint of the posterior skin crease of the popliteal fossa. The patient was placed in a prone position and the sciatic nerve was visualized immediately before dividing into the tibial and common peroneal branches (Figures 3A and 4A). The needle was advanced carefully while applying a continuous pull back, and 20 mL of the anesthetic mixture was injected into the perineural sheath af-

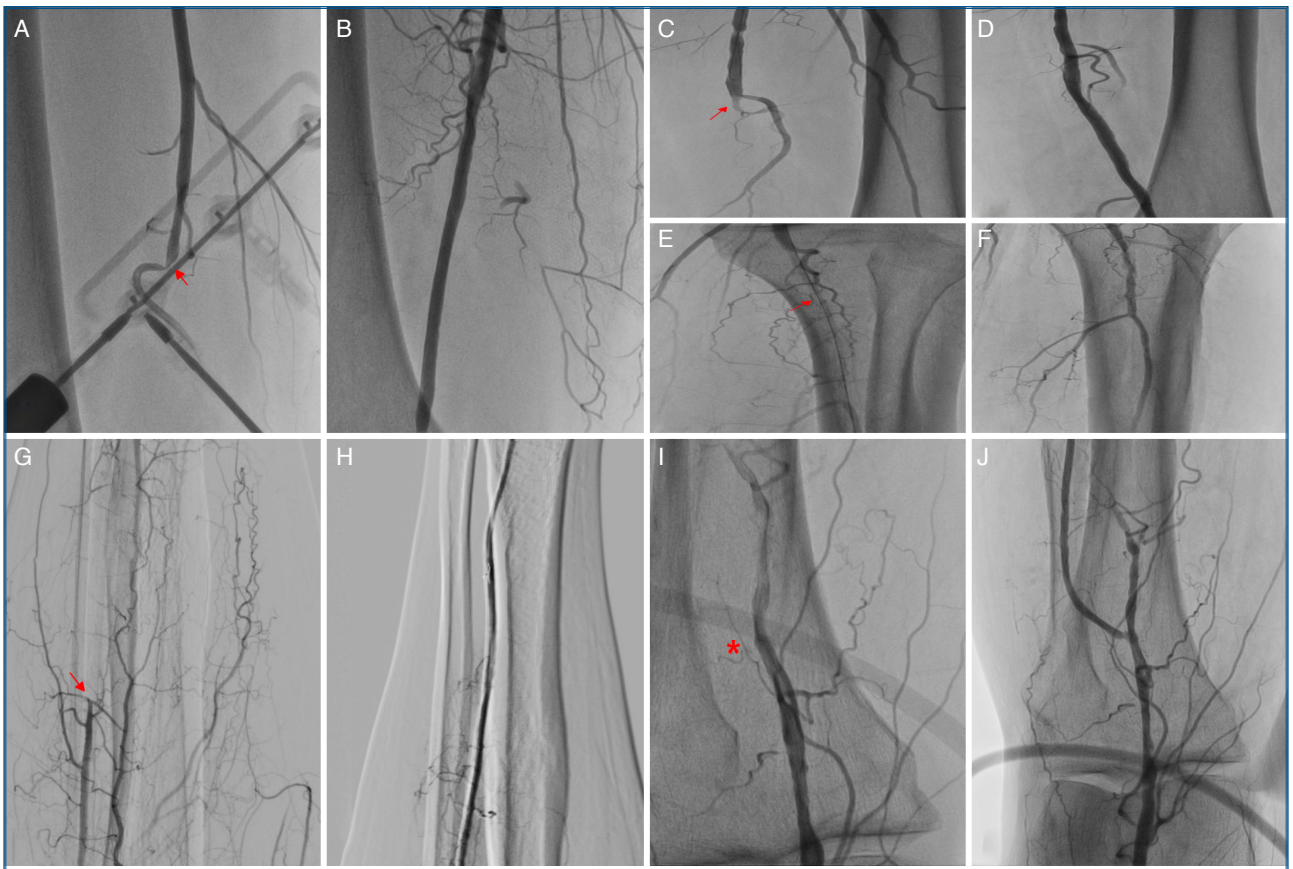

Figure 2. Angiographic images showing peripheral occlusions before and after angioplastic interventions. **(A, B)**: Case-1; **(C-F)**: Case-2; **(G, H)**: Case-3; **(I, J)**: Case 4. **(A)** Total occlusion of the right SFA. **(B)** Complete patency of the SFA after angioplasty. **(C)** Multiple total occlusions within the distal SFA, ATA and TPA. **(D)** Stenting of the SFA lesion. **(E)** Multiple total occlusions within the distal SFA, ATA and TPA. **(F)** Occlusion and angioplasty of the Tibioperoneal trunk. **(G)** Total occlusion of PTA and ATA. **(H)** ATA and DPA balloon angioplasty. **(I)** Failure to view the proximal part of ATA during antegrade injection. **(J)** Restoration of blood flow to the distal segments of ATA.
SFA: superficial femoral artery; ATA: anterior tibial artery; PTA: posterior tibial artery; PA: peroneal artery; DPA: dorsalis pedis artery.

ter confirmation of correct tip placement with US. For saphenous nerve block, the US transducer was placed anteromedially around the mid-thigh level and the nerve was visualized at the distal part of the adductor canal while the patient was in a supine position (Figure 3B). A 25 gauge needle was inserted in a lateral-to-medial orientation and advanced toward the femoral artery with continuous plunger pull back to avoid intravascular injection. Once the needle tip is visualized anterior to the artery and after careful aspiration, 25 mL of mixture is injected into the perineural sheath (Figure 4B).

After anesthesia, the patient expressed that his pain was reduced to 1 on a visual analog scale (VAS), and he did not indicate any additional pain during the procedure. Following anesthesia, the left common femoral artery was punctured, and a long sheath was crossed to the right side and positioned within the right SFA. Subsequently, the occlusion was crossed and dilated. Postprocedural angiograms confirmed complete patency of the SFA (Figure 2B) and anterior tibial artery (ATA) with distal arterial spasm that was successfully treated with intra-arterial nitrate. The patient did not suffer any pain and discomfort during the procedure and the procedure was completed without any clinically relevant complications. Three months after the procedure, the patient was functionally active, and there was a gradual increase in his walking performance and on examination his wounds were partially healed.

Case 2

A 49-year-old man was referred to our department with severe pain in his left leg that was present for several months. At admission, there were multiple

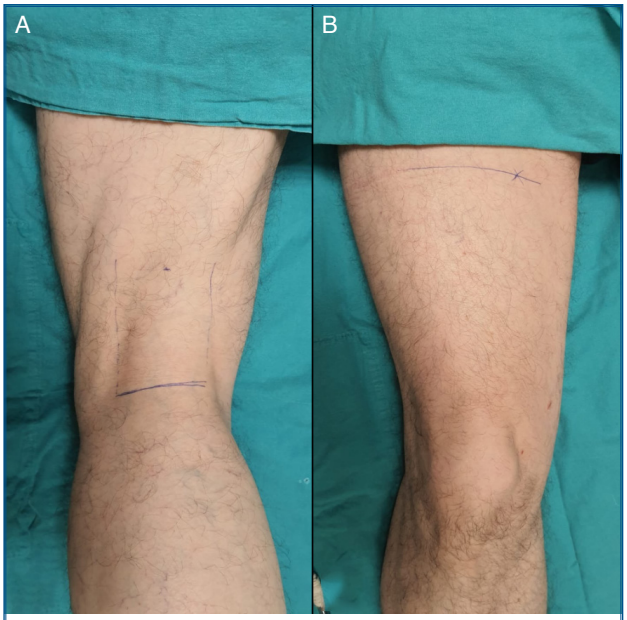

Figure 3. Markers showing access sites for **(A)** sciatic and **(B)** saphenous nerves. The patient is put in prone and supine positions to do sciatic and saphenous nerve blocks, respectively.

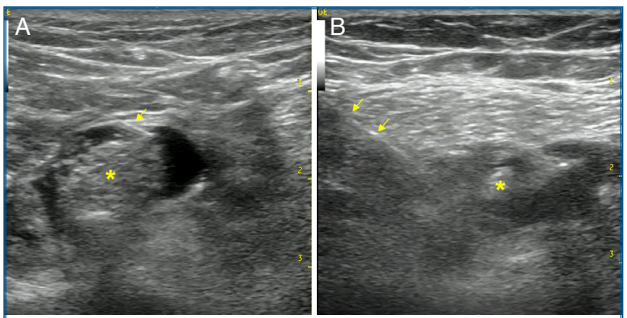

Figure 4. Ultrasound images showing injection of anesthetic mixture to do the nerve block. **(A)** The tip of the needle can be seen (yellow arrow) in close proximity to the sciatic nerve (asterisk). This is done via posterior approach. **(B)** Injection.

wounds on his left foot and he was unable to move his left toe. His past medical history included hypertension, diabetes mellitus, and a mitral valve replacement that was done 5 years ago. He was also an active smoker (2 packs/day). On examination, blood pressure was 140/83 mmHg, heart rate was 91 beats/minute, and oxygen saturation level was 95% at RA. An angiogram that was done 15 days ago at the referring center revealed multiple total occlusions within the distal SFA, ATA, and posterior tibial artery (PTA) (Figures 2C and 2E). An intervention was attempted at the time of angiography but the patient did not tolerate the procedure because of poor pain control. The procedure was re-attempted in our center using nerve blockade by injecting a mixture of bupivacaine and lidocaine to the femoral and sciatic nerves and their main branches as aforementioned. Following injection, the patient indicated that his pain was 2 on the VAS, though the pain had increased temporarily to VAS 4 during the procedure. After administering unfractionated heparin at a dose of 100 U/kg, a 6F sheath was introduced into the right femoral artery and the left femoral artery was accessed with a 6F-JR-4 diagnostic catheter, and a destination sheath was positioned within the left common femoral artery. The SFA lesion was pre-dilated and subsequently stented owing to a flow-limiting lesion (Figure 2D). The total occlusion in the tibioperoneal trunk was crossed with the same wire and microcatheter, followed by balloon inflation (Figure 2F). As the proximal part of the ATA was not seen after balloon inflation, this lesion was crossed retrogradely via a distal puncture and the lesions within the peroneal artery (PA) and ATA were treated with balloon dilation, leading to complete patency of the vessel. The patient had mild pain during balloon inflations but otherwise tolerated the procedure well. One month after the procedure, the patient was seen in the outpatient clinic and at that time he did not have pain at rest or during mild exertion.

Case 3

A 36-year-old man presented to our clinic with unrelenting pain in his left foot that was present for several days. He was an active smoker (1 pack/day) and had been diagnosed with BD 5 years ago based on clinical criteria. A year ago, the patient's great toe was amputated because of an unhealed wound. On admission, his blood pressure was 110/63 mmHg, heart rate was 94 beats/minute, and oxygen saturation was 95% at RA. His left foot was pale, and an open wound was present at the location of the previous amputation. Angiography showed a bilateral total occlusion of PTA and ATA (Figure 2G). As the rest pain and the open wound was on the left side, revascularization was planned for the left side. Before the procedure, femoral and sciatic nerves and their branches were blocked as aforementioned. Following anesthesia, the patient described his pain as 1 on the VAS, and during the procedure, there were no changes in terms of pain.

An antegrade puncture was done and a 6F sheath was placed within the left main femoral artery. The occluded sections were crossed and both ATA and dorsalis pedis artery (DPA) were treated with balloon angioplasty, which led to the restoration of flow to the distal segments (Figure 2H). The patient did not express any pain and discomfort during the procedure and the procedure was completed without any complications.

Case 4

A 74-year-old man presented to our clinic with severe pain in his left foot that was present for several days. On admission, his blood pressure was 145/87 mmHg, heart rate was 89 beats/minute, and oxygen saturation was 94% at RA. An open wound was present at the lateral malleolar level of his left foot. A computed tomography (CT) angiography showed total occlusions of right PTA, ATA, and distal PA. An endovascular revascularization strategy was planned for the left lower extremity. Before the procedure, the left saphenous and common peroneal nerves were blocked as aforementioned, and the patient expressed his pain as 2 on the VAS following anesthesia. An antegrade puncture was done and a 6F sheath was placed within the left main femoral artery. The occlusion was subsequently crossed and PA was dilated using multiple balloon inflations. As the proximal part of the ATA could not be visualized using antegrade injections (Figure 2I), a retrograde puncture was done, the lesion was crossed using a hydrophilic wire, and the occlusion was dilated with multiple balloon inflations, which restored blood flow to the distal segments (Figure 2J). The patient did not report any pain or discomfort during the procedure.

DISCUSSION

Adequate pain control is an essential component of all peripheral interventions yet it is often neglected in everyday practice. Pain is not only caused by periprocedural events such as contrast injection or repeated balloon inflations but also related to senile painful degenerative conditions or lying supine on relatively hard fluoroscopy tables.[4] Local anesthesia does not provide pain control beyond the initial puncture site. Opioids are widely used but are usually inadequate to provide complete pain control; additionally, opioids are associated with severe side effects and they could lead to drug addiction.[5] Adequate pain control is important to not only provide patient comfort but also to improve the success of intervention by improving the tolerability of complex procedures performed during an intervention. This is especially true for interventions involving distal limb arteries where the procedures are usually lengthy and multiple contrast injections and balloon inflations are necessary, thus making these procedures even less comfortable.

PNB has been employed for years to control pain for surgical procedures involving lower extremities.[6] More recently, 2 small studies have reported excellent pain control and good patient and operator satisfaction for percutaneous lower extremity procedures done using PNB.[4,7] In the study reported by Marcus et al.,[4] percutaneous procedures involved either superficial femoral or popliteal arteries, which are usually less technically demanding than the IP revascularization procedures that were described in the present series. Gedikoglu and Eker[7] have reported their results on PNB for patients with critical limb ischemia, but the details on the exact mechanism of limb ischemia, vessels that were revascularized, or the complexity of the procedures were not reported. To the best of our knowledge, the present series is the first description of PNB in patients with BD and complex IP disease, who needed lengthy procedures for revascularization.

While we have not observed any complications that were attributable to anesthesia in these patients, and all patients were mobilized within 12 hours of the procedure, studies have reported several complications related to PNB including long-term nerve damage, hematomas, systemic toxicity of local anesthetics, and myotoxicity.[8,9] Long-lasting complications are rare, and only 0.9% of patients who received a peripheral block had persistent neurological symptoms beyond 6 months.[10] As such, PNB appears as a good option to provide pain control in complex interventions and could be considered as an alternative to systemic opioids, which have serious side effects and are often inadequate to control periprocedural pain.[4] Moreover, adequate pain control can also affect interventional outcomes as

we have observed in our second case, in whom the initial procedure was aborted because of inadequate pain control. While adequate pain control can also be achieved with neuraxial or general anesthesia, both methods are more prone to complications and neuraxial anesthesia would be less desirable for patients on multiple antiplatelet and/or anticoagulant drugs. While our limited experience suggests that PNB could be an ideal anesthetic technique to provide periprocedural pain control in patients needing complex peripheral interventions, more data is needed to ascertain whether PNB is superior to other techniques in terms of pain control or patient outcomes.

For successful PNB procedures, competency in US -guided needle manipulation and a good understanding of the lower extremity nerve anatomy is crucial. While all PNB procedures in the present case series were performed by an anesthesiologist, US-guided needle manipulation for vascular access is done for a variety of cardiovascular procedures and many cardiologists are proficient in this technique.[11,12] Therefore, it is reasonable to consider that PNB could be done by cardiologists after undergoing appropriate training, as this approach could save time and other resources (such as the availability of anesthesiologists) that could be used for other purposes. That said, lack of competence could lead to an increase in complications and do more harm than good, so we would like to emphasize that proper training should be mandatory before embarking on such endeavors.

PNB appears as a promising method to provide pain relief for patients undergoing complex endovascular interventions for IP disease. In our experience, PNB does not only provide much convenience to the patient but also provides comfort to the operator, thus increasing the overall success of the procedure. Nonetheless, formal randomized trials are needed to assess the superiority of PNB over conventional analgesic techniques in this subset of patients needing lengthy and complex procedures.

Informed Consent: Informed consent was obtained from the patients for the publication of the case report and the accompanying images.

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Anahtar Kelimeler: Perkütan transluminal anjiyoplasti; periferik arter hastalığı; infrapopliteal; periferik sinir bloğu