

Regional Anesthesia and Pain

A modification of the inter-cuff technique of IVRA for use in knee arthroscopy

[Une modification de la technique d'ARIV inter-garrot pour l'arthroscopie du genou]

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Purpose: To describe a modified approach to intravenous regional anesthesia (IVRA) for operations on the knee joint.

Clinical features: A 52-yr-old male presenting for knee arthroscopy was anesthetized by IVRA using only 40 mL of lidocaine 0.5%. After performing IVRA in the routine way an additional below knee tourniquet was used and inflated after local anesthetic exsanguination towards the knee. Operation was performed without the need for further analgesic.

Conclusion: The technique allowed the use of a small anesthetic volume for IVRA on the lower limb, thus decreasing the potential risk of local anesthetic toxicity.

Objectif : Décrire une approche modifiée de l'anesthésie régionale intraveineuse (ARIV) pour l'arthroscopie du genou.

Éléments cliniques : Un homme de 52 ans devant subir une arthroscopie du genou a reçu une ARIV avec 40 mL de lidocaïne à 0,5 %. Après avoir réalisé l'ARIV de façon courante, un garrot supplémentaire a été appliqué sous le genou et gonflé après l'exsanguination. On a ensuite injecté l'anesthésique local vers le genou. L'opération n'a pas nécessité d'analgésie supplémentaire.

Conclusion : La technique a permis d'utiliser un petit volume d'anesthésique pour l'ARIV du membre inférieur, ce qui réduit le risque potentiel de toxicité à l'anesthésique local.

INTRAVENOUS regional anesthesia (IVRA) is a reliable and efficient technique with a lower cost than general anesthesia and well adapted for limb surgery in the ambulatory patient.^{1,2} The use of potentially unsafe large doses of local anes-

thetic made the technique unpopular for operations on the lower extremity.³

We describe a case of knee arthroscopy that was performed successfully under IVRA using 40 mL of 0.5% lidocaine isolated between two tourniquets applied above and below the knee.

Case report

A man aged 52 yr weighing 78 kg presented for arthroscopy of the knee joint. He had pain and swelling of the left knee. Preoperative orthopedic examination showed mild genu vara, knee crepitation and synovial thickening. Knee *x-ray* showed advanced osteoarthritic changes more on the patello-femoral articulation and medial compartment of the knee joint.

On the preanesthetic visit the patient requested a regional technique and gave no history of medical problems except previous multiple level lumbar disc surgery. The proposed IVRA technique, which had been approved by the departmental Ethical Committee, was fully explained to him and his consent was taken. The patient was given 10 mg diazepam orally 90 min before surgery.

The patient was placed on the operating table. An *iv* access was secured in the right forearm and routine monitors were applied. A double cuffed tourniquet was arranged over a soft padding above the knee joint and an 18-G plastic cannula was inserted on the dorsum of the foot (Figure 1a). The lower limb was exsanguinated with a rubber bandage (Figure 1b). The tourniquet was then inflated to 270 mmHg which is 100 mmHg above the limb occlusive pressure (LOP) as determined by photoplethysmographic pulse wave

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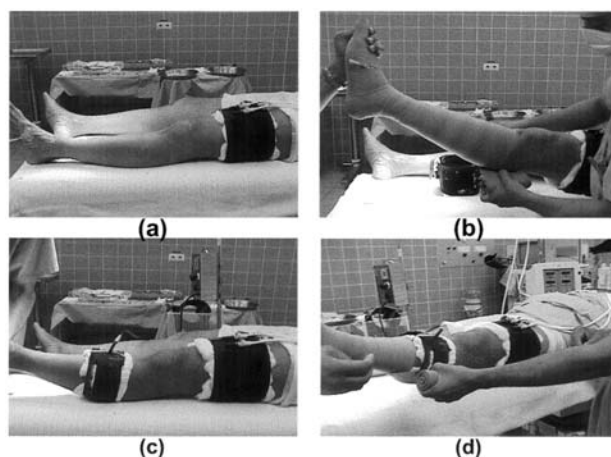


FIGURE Modified intravenous regional anesthesia (IVRA) technique (a) cannula inserted and above-knee double-cuffed tourniquet applied; (b) Esmarch bandage applied to lower limb; (c) below-knee tourniquet applied; (d) exsanguination of distal segment.

amplitude⁴ of the big toe. The Esmarch bandage was removed and 40 mL of 0.5 % lidocaine were injected through the plastic cannula.

Immediately after injection, another single cuffed tourniquet was arranged below the knee joint (Figure 1c) and the distal segment was re-exsanguinated using a rubber bandage (Figure 1d). The distal tourniquet was also inflated to 270 mmHg. Examination of the patient showed complete anesthesia in the inter-cuff segment around the knee joint and patchy anesthesia in the distal segment.

After preparing the surgical site the procedure was performed. Arthroscopy confirmed the diagnosis of osteoarthritis and subcondylar drilling of the femur and tibia was done. During the 45 min procedure no further analgesia was required and the patient was given 5 mg of midazolam *iv* as a sedative. At the conclusion of surgery, the distal tourniquet was deflated first then the proximal one. The patient was discharged on the same day of surgery with no complications.

Discussion

The aim of modern regional anesthesia is to provide a fast, safe and effective technique. IVRA is an effective method for extremity surgery with a published success rate of 94–98%.^{3,5} It is easy to perform and the only necessary technical skill is venous cannulation. IVRA, however, is underutilized for surgery on the lower extremity. Concerns about its use include the use of large doses of local anesthetic, inadequate vascular iso-

lation, and inadequate anesthesia.³ In the case presented, only 40 mL of 0.5% lidocaine were enough for surgery on the knee joint by isolating the injected local anesthetic between two tourniquets.

The cuff pressure of the above knee tourniquet was set to 100 mmHg above the LOP as described before in the literature.⁶ The distal below-knee cuff was inflated arbitrarily at the same pressure aiming at isolating the injected local anesthetic between the two cuffs.

The inter-cuff block, as named by Hannington-kiff,⁷ is not new. The original method introduced by Bier in 1908⁸ used two tourniquets, one above and one below the elbow or the knee. He performed a cut-down to cannulate a large vein in the region of the elbow or knee. Hannington-kiff, in 1990, revisited the technique and used it to perform surgery on the upper limb. Our modification uses veins distally on the dorsum of the foot and therefore avoids the technical difficulty of cannulating veins around the knee joint. Another disadvantage of the Hannington-kiff inter-cuff method is that the injection is made near the tourniquet and any rapid local rise in the *iv* pressure may defeat the cuff. In our modification, as in the currently popular method of IVRA, the injection is made at a distance from the cuff with less hydraulic challenge to the tourniquet.

In addition to the small volume of local anesthetic used, the release of the distal tourniquet before the proximal one at the end of surgery may add safety to the technique as the local anesthetic will recirculate again in the empty veins of the lower limb.

A potential extension of the technique is the use of small volumes with a high concentration of local anesthetic isolated in the same way at the elbow or the knee to perform surgery on hands or feet. Lai *et al.*⁹ showed that 2% lidocaine injected between two tourniquets applied above and below the elbow produces analgesia rapidly in the inter-cuff area and slowly on the forearm and hand developing from finger tips upwards. They concluded that the principal site of action of lidocaine depends on the concentration; a lower concentration acts on the sensory nerve endings and a higher concentration acts on both nerve trunks and sensory nerve endings.

In conclusion, in this case, knee arthroscopy was performed safely and effectively using small volumes of local anesthetic with the described modification of IVRA. The technique should be less toxic when the tourniquet is released compared to current IVRA technique. Further studies are required to confirm the efficacy and safety of this approach and to explore the possible modifications with different surgical procedures.

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