Dexmedetomidine Added to Local Anesthetic Mixture of Lidocaine and Ropivacaine Enhances Onset and Prolongs Duration of a Popliteal Approach to Sciatic Nerve Blockade

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ABSTRACT

Purpose: A literature review of multiple clinical studies on mixing additives to improve pharmacologic limitation of local anesthetics during peripheral nerve blockade revealed inconsistency in success rates and various adverse effects. Animal research on dexmedetomidine as an adjuvant on the other hand has promising results, with evidence of minimum unwanted results. This randomized, double-blinded, contrastable observational study examined the efficacy of adding dexmedetomidine to a mixture of lidocaine plus ropivacaine during popliteal sciatic nerve blockade (PSNB).

Methods: Sixty patients undergoing varicose saphenous vein resection using ultrasonography-guided PSNB along with femoral and obturator nerve blocks as surgical anesthesia were enrolled. All received standardized femoral and obturator nerve blocks, and the PSNB group was randomized to receive either 0.5 mL (50 μg) of dexmedetomidine (DL group) or 0.5 mL of saline (SL group) together with 2% lidocaine (9.5 mL) plus 0.75% ropovacaine (10 mL). Sensory onset and duration of lateral sural cutaneous nerve, sural nerve, superficial peroneal nerve, deep peroneal nerve, lateral plantar nerve, and medial plantar nerve were recorded. Motor onset and duration of tibial nerve and common peroneal nerve were also examined.

Findings: Sensory onset of sural nerve, superficial peroneal nerve, lateral plantar nerve, and medial plantar nerve was significantly quicker in the DL group than in the SL group ($P < 0.05$). Sensory onset of lateral sural cutaneous nerve and deep peroneal nerve was not statistically different between the groups ($P > 0.05$). Motor onset of tibial nerve and common peroneal nerve was faster in the DL group than in in the SL group ($P < 0.05$). Duration of both sensory and motor blockade was significantly longer in the DL group than in the SL group ($P < 0.05$).

Implications: Perineural dexmedetomidine added to lidocaine and ropivacaine enhanced efficacy of popliteal approach to sciatic nerve blockade with faster onset and longer duration. (*Clin Ther.* 2017;39:89–97)

Key words: adjuvant, adrenergic α_2-receptor agonists, dexmedetomidine, peripheral nerve blockade, sciatic nerve, ultrasonography.

INTRODUCTION

Pain medicine parameters for lower-extremity surgery using sciatic, femoral, and obturator nerve blockade have proven effective[1,2] and provide added value for patients with severe cardiovascular and/or respiratory disease(s).[3,4] However, pharmacology and duration of current long-acting local anesthetics (LAs) used during regional anesthesia can limit blockade effectiveness. Adding various adjuvant(s) to LAs during regional anesthesia to enhance peripheral nerve blockade (PNB) has been previously investigated and found to have varying degrees of efficacy.[5,6]

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Dexmedetomidine[7,8] is a selective α_2-adrenoceptor agonist with sympatholytic, sedative, amnestic, and analgesic properties. In recent years, as an adjuvant to LAs during PNB, it has been investigated and found effective in both clinical studies[9] and animal models.[10,11] Esmaoglu et al[12] found advantages in the quality of the block (shortened onset time and extended duration) in their axillary brachial plexus that was formed with dexmedetomidine as an adjuvant to levobupivacaine. Brummett et al[11] reported that adding dexmedetomidine to ropivacaine caused an approximately 75% increase in the duration of analgesia in rats. However, these investigations have often been confined to single terminal nerve branches (ulnar nerve[13]) or upper extremity brachial plexus blockade.[12] This randomized, double-blinded, contrastable observational study was designed to examine the effects of dexmedetomidine as an adjuvant to LAs (mixture of lidocaine and ropivacaine) on sensory and motor onset and duration of popliteal sciatic nerve blockade (PSNB).

PATIENTS AND METHODS

Patient Demographic Characteristics

Informed consent was obtained from 60 patients enrolled in a clinical trial receiving regional anesthesia for unilateral varicose saphenous vein resection and high ligation. All received ultrasonography-guided femoral, obturator nerve block and groin skin infiltration. In addition, patients were randomized to receive PSNB with 0.5 mL (50 μg[12–14]) of dexmedetomidine (DL group) (lot No. 13071034, Jiangsu Hengrui Medicine Co Ltd, Lianyungang, China); or 0.5 mL of saline (SL group) mixed with preservative-free 2% lidocaine (9.5 mL) and 0.75% ropivacaine (10 mL). This study received ethics committee approval from the First Affiliated Hospital of Wenzhou Medical University, Zhejiang Province, China February 21, 2014, and was identified as trial ChiCTR-TRC-14004592 in the Chinese Clinical Trial Registry on April 30, 2014.

Using a table of random numbers, a dedicated nurse anesthetist selected a random number from 1 to 60 for each patient and recorded each patient identification data, including corresponding natural number, hospital number, and hospital name. Odd and even numbers were then defined as group A and B, respectively, corresponding to the DL and SL groups with either 50 μg of dexmedetomidine or 0.5 mL of saline mixed with lidocaine and ropivacaine, respectively. The same nurse anesthesiologist prepared LAs with labels, including the patient's name and hospital number, and was not involved in any direct patient contact, block placement, or assessment. The block anesthetist and examiners were masked to LA adjuvant mixtures being administered as well. Patient demographic characteristics are given in Table I.

The American Society of Anesthesiologists standard monitors (pulse oximetry, electrocardiography, noninvasive blood pressure, and respiratory rate) were used. For sedation, each patient received IV midazolam (1 mg) and fentanyl (20 μg) before block placement. Exclusion criteria were defined as patient refusal, diabetes, allergy to LAs or dexmedetomidine, preexisting neurologic or neuromuscular disease, infection at intended injection site, psychiatric disorders or those unlikely to cooperate during the study, patients treated with α_2-adrenoceptor agonist, pregnant patients, and those younger than 18 years.

Ultrasonography-guided PSNB and Femoral and Obturator Nerve Block Technique

Patients were positioned in lateral decubitus position after standard skin preparation with povidone-iodine (lot No. Q/JKL 005-2010, Hangzhou Xinpu Biological Technology Co Ltd, Hangzhou City, China). The sciatic nerve in the popliteal fossa was identified by ultrasonography (Edge, Sonosite, Bothell, Washington) using a linear array 6 to 15-MHz ultrasonography probe and imaged along its course to a position where the tibial nerve and common peroneal nerve converge. After LA skin infiltration, a 21-G short-bevel insulated needle (0.7 × 80 thin wall long bevel (TWLB), Kangdelai Medical Instrument Co Ltd, Yuhuan, China) was advanced under a short axis view of the target using an in-plane needling approach. With direct ultrasonographic visualization, the LA mixture was deposited (total volume of 20 mL) below and above the sciatic nerve where the tibial nerve and common peroneal nerve unite (inside the facial plane of the common paraneural sheath[15]). The LA volume was injected in 5-mL aliquots with intermittent confirmation of negative blood aspiration.

Ultrasonography-guided femoral and obturator nerve blocks were then performed with patients in the supine position according to approaches described by Szűcs et al[16] and Taha.[17] LA solutions of preservative-free 2% lidocaine and 0.75% ropivacaine (1:1 ratio) were injected using10 mL for the femoral