This study compared the success rates between two accepted methods of performing axillary blocks, the peripheral nerve stimulator (PNS) and the transarterial (TA) techniques. Success was based on blocking the nerves involved in the surgery.

Following institutional review board approval and informed consent, 57 patients between the ages of 18 and 86 years of age scheduled for elective upper extremity surgery were studied. Patients were randomized and all blocks were performed according to the protocol for PNS and TA techniques using the dosage of local anesthetic based on patient weight. All patients were premedicated with fentanyl hydrochloride, 1 μg/kg, and midazolam, 1 to 5 mg. Scoring was accomplished on a standardized form by one of two physicians, unaware of the technique, for 5 of the major nerves at 20 and 30 minutes after injection. Sensory blockade was determined by pinprick. Motor blockade was assessed according to a scale ranging from complete block to no effect. Two of the patients had vascular procedures, and the remainder were orthopedic procedures.

There were no differences in the effectiveness on the musculocutaneous, radial, median, or ulnar nerves. There was a significant difference (P < 0.05) in the effectiveness at the axillary nerve. The transarterial technique was 66% effective as opposed to 47% for the PNS. There was no difference in the need for local supplementation or general anesthesia between the two groups. There were no significant side effects reported by the patients postoperatively.

The axillary nerve was the only nerve with an increased success rate using the TA technique. This indicates that both techniques are equally acceptable.

Key words: Axillary block, mepivacaine, peripheral nerve stimulator technique, transarterial technique.

Introduction

Axillary block is a technique of placing a quantity of local anesthetic solution in or around the brachial plexus sheath which is located in the axilla. Several techniques for locating the appropriate place to deposit the local anesthetic have been described. Previous researchers have defined “successful” block in a variety of ways also. One description is the absence of pain when all five nerve distributions are tested with a clamp. These five nerves include the ulnar, the radial, the median, and the musculocutaneous (MC), and the axillary. Another definition of a successful block is the ability of the surgery to proceed. In previous studies, the success rates have varied from 79% to 99% complete block using a transarterial (TA) technique and from 80% to 90% success using the peripheral nerve stimulator (PNS) technique. The excellent results of the transarterial technique were proba-
bly affected by the dosages used (750 mg mepivacaine) and the additional blocks given as required.

**Materials and methods**

Following the hospital institutional review board approval, the sample consisted of 57 patients between the ages of 18 and 86 years of age scheduled for elective upper extremity surgery. The patients signed a written consent form. Patients were randomized to receive an axillary block by one of two techniques. The weights varied from 40 to 117 kg, and dosage was administered between 40 and 60 mL of mepivacaine 1.25% with epinephrine. Exclusion criteria included any medical diagnosis which precludes the use of regional anesthesia, including systemic anticoagulation, neuropathy of the extremity, and mastectomy of the ipsilateral side.

The four experienced anesthesia providers performing the blocks were provided specific instructions on this protocol. Patient characteristics—age, gender, height, and weight—were recorded. Procedure details included surgical procedure, anesthetic technique, total dosage of local anesthetic, supplementation given, necessity for general anesthesia, and any complications. Premedication included fentanyl hydrochloride, 1 µg/kg, and midazolam, 1-5 mg, given intravenously. Monitoring techniques, including pulse oximetry, electrocardiography, and blood pressure, were performed in accordance with the usual standard of operating room practice. The TA technique was performed using a 22-gauge, 1.5-inch B bevel needle with extension tubing attached at the two-way stopcock to two 20-mL syringes. After palpation of the artery high in the axilla, half of the dose was administered on the posterior side of the artery and the other half of the dose was administered on the anterior side of the artery. Digital pressure was held over the injection site and maintained for 3 minutes while the arm was brought down to the patient's side.

The PNS technique was performed as described by Koons. A 20-gauge 1½-inch intravenous catheter with the stylet of a 25-gauge spinal needle wrapped around the hub of the needle was attached to a nerve stimulator. The needle was inserted parallel and slightly above the axillary artery with the minimum current turned on (2 to 5 volts). Attempts were made to stimulate the MC nerve and one other nerve. If the MC nerve could not be stimulated easily, then two of the nerves involved in the surgery were stimulated. When performing axillary blockade using a PNS, better results are obtained when stimulating either the five major nerves or the MC nerve plus a nerve implicated by the surgical site. Half of the total dose was injected on each of the two nerves stimulated. Digital pressure was held 2 to 3 cm distal to the injection site while injecting. The arm was brought down to the patient's side while massaging the anesthetic bolus toward the axilla.

There is a relationship between volume and extent of analgesia. According to DeJong, the estimated volume of the brachial plexus sheath is 42 mL. A solution of 1.25% mepivacaine was chosen so that any patient weighing more than 50 kg would receive a minimum of 40 mL of solution. Mepivacaine 1.25% with epinephrine 1:200,000 was used in both techniques: 40 mL for 50 to 70 kg; 50 mL for 71 to 90 kg; and 60 mL for greater than 90 kg.

Scoring was accomplished on a standardized form by a physician, unaware of the technique, at 20 and 30 minutes after the injection. Sensory blockade was determined by using a sponge clamp. Sensory testing was carried out in the areas supplied by the following nerves: axillary, musculocutaneous, radial, ulnar, and median (Figure 1). Analgesia was defined as the absence of touch perception or,
if pinprick was recognized, as touch perception of a blunt object. Motor blockade was assessed according to a scale set forth by Vester-Anderson. The gradation ranged from complete block to no effect. According to Gibbons, a successful block can only be determined after testing the level of analgesia in all dermatomes of the arm.

Results

Overall success rates of the two techniques were analyzed with chi square. Patient ages ranged from 18 to 86 with 33 males and 24 females. Two patients were excluded because of inability to puncture the artery and the necessity for using the nerve stimulator. Vascular surgery accounted for two procedures and the remainder were orthopedic procedures. There were no differences in the effectiveness of the MC, radial, median, or ulnar nerves. There was a significant difference in the effectiveness at the axillary nerve. The TA technique was 66% effective as compared to 47% for the PNS technique ($P < 0.05$). In the PNS group, general anesthesia was required in four of the patients: three had incomplete blocks and one had a complete block on awakening an hour later (Table I). Six required local infiltration. In the TA group, one patient required general anesthesia and six required local infiltration. There were no reported problems seen postoperatively in these patients. The anesthesia providers involved in the study have their own preferences for block technique; however, they adhered to the protocol for TA and PNS techniques. The guidelines of dosage and technique did not allow for individual variations. The difference in outcome might have been more significant with a larger number of providers.

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<td><strong>General or local anesthesia required before surgery</strong></td>
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<td>Peripheral nerve stimulator technique</td>
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<td>General anesthesia</td>
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Discussion

According to Brockway and Wildsmith, the first percutaneous axillary blocks were performed by Hirschel in 1911. The problem most frequently encountered in performing axillary blocks is missing one of the nerves involved in the surgery. Advantages and disadvantages have been demonstrated for the TA and PNS techniques; the TA technique has the risk of hematoma formation and possible intravascular injection. The PNS technique has the possibility of inadvertent vascular puncture and direct injection into the nerve.

Possible reasons for the disparity of success among techniques include the level of experience and the number of anesthetists participating as block administrators, the volume and the concentration of local anesthetic that is injected into the nerve sheath, and the number of injections and the patient's anatomy. By controlling all of the factors except the patient anatomy, it is apparent that both of these techniques have similar success rates for blocking the upper extremity and offer the advantage of extended analgesia for the patient.

REFERENCES


AUTHOR

Terri S. Jones, CRNA, MSN, earned a master of science degree in Nursing from Case Western Reserve University, Cleveland, Ohio, in 1994. She obtained her bachelor of science degree in Nursing from the University of New York in 1986. She received her certificate in nurse anesthesia from Wilford Hall Medical Center in 1978. This article was written while she was the chief anesthetist at the Keesler Air Force Base Medical Center, Biloxi, Mississippi.

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