Comparison of supplementation rates for perivascular axillary and coracoid infraclavicular blocks in ambulatory upper extremity surgery

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Abstract

Background and Objectives: Efficacy of perivascular axillary block (AXB) and double-stimulation infraclavicular block (ICB) techniques in providing brachial plexus anesthesia have not been previously compared.

Methods: After IRB approval, we reviewed a regional anesthesia database to compare supplementation rates for 141 axillary and 157 infraclavicular blocks.

Results: Supplementation rates for AXB and ICB were 52% and 20%, respectively (OR = 2.57, 95%CI 1.61 – 4.12). Conversion to general anesthesia was infrequent in both groups although higher in the AXB group (OR = 6.78, 95%CI 1.05 – 43.38).

Discussion: Although ICB has significantly higher initial success, AXB provides reliable anesthesia when appropriately supplemented.

Keywords: ambulatory surgery; axillary block; infraclavicular block; regional anesthesia; supplementation rate.

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Introduction

Axillary and infraclavicular blocks have been used to provide brachial plexus anesthesia for similar surgical indications [1]. Results from previous studies comparing supplementation rates for nerve stimulator-assisted axillary block (AXB) and infraclavicular block (ICB) are conflicting [2, 3].

Perivascular AXB is an efficient multiple-injection technique performed without electrical nerve stimulation; whereas the coracoid ICB using a double-stimulation technique has a high degree of success [4–7]. We performed this study to determine which of these two approaches most consistently provides complete brachial plexus anesthesia.

Methods

After IRB approval, we retrospectively reviewed the regional anesthesia database of one staff anesthesiologist (ERM) from a university hospital outpatient surgery center collected over one year as part of an ongoing quality assurance (QA) project. Data from patients who received perivascular AXB or coracoid ICB were included. Nerve blocks were performed preoperatively using sterile technique in a regional anesthesia induction area with 30 ml of 0.5% bupivacaine + epinephrine 2.5 mcg/ml or 1.5% mepivacaine + epinephrine 5 mcg/ml.

Perivascular Axillary Block

With the shoulder abducted 90º and elbow flexed, the axillary artery was identified in the proximal axilla. While palpating the axillary pulse, 20 ml of local anesthetic (LA) was injected incrementally in a fan-like perivascular distribution above and below the artery using 22-gauge B-bevel needles and 10 ml control syringes following negative aspiration of blood [8]. Five ml of LA was injected within the coracobrachialis muscle, and another 5 ml was infiltrated along the medial aspect of the upper arm to anesthetize the intercostobrachial nerve distribution for a total injectate volume of 30 ml.

Coracoid Infraclavicular Block

With the ipsilateral arm positioned at the patient's side, a 22-gauge insulated needle was inserted plumb-bob approximately 2 cm medial and 2 cm caudad to the coracoid process with an initial stimulating current of 1.0 mA, pulse width of 0.1 msec, and frequency of 2 Hz using the landmarks described by Wilson et al (6). Upon elicitation of a sustained motor response from the radial, median, or ulnar nerves at <0.5 mA current, 15 ml of LA was injected incrementally following negative aspiration of blood. The remaining 15 ml of LA was injected after a second distinct motor response from one of the previously-mentioned nerves was elicited at <0.5 mA current.

Block Assessment

A complete brachial plexus block was defined as anesthesia of the musculocutaneous, radial, median, ulnar, and medial antebrachial cutaneous nerves. Strength of elbow flexion and extension against resistance assessed the quality of *musculocutaneous* and *radial* nerve blockade, respectively. Pinprick sensation of the index finger, small finger, and medial aspect of the forearm assessed anesthesia in the distribution of the *median, ulnar,* and *medial antebrachial cutaneous* nerves, respectively.

Distal supplementation

For patients with incomplete anesthesia after 20 min, individual supplementary nerve blocks (median, ulnar, radial, lateral antebrachial cutaneous, or medial antebrachial cutaneous) were performed at the elbow using nerve stimulation or at the wrist using infiltration.

Outcome Measures and Statistical Analysis

Data were collected immediately post-procedure and on the first postoperativeday (POD 1). The primary outcome of interest was rate of supplementation following initial block placement. Secondary outcomes included: rate of conversion to general anesthesia (GA), patient satisfaction on a Likert scale (5=Outstanding to 1=Poor), and whether or not patients would choose regional anesthesia again for future surgery.

Descriptive statistics were used to summarize study data. Normality was determined using the Kolmogorov-Smirnov test. Odds ratios (OR) with 95% confidence intervals (CI) were calculated for comparisons of supplementation and GA conversion. Statistical analysis was performed using Student's t test for continuous normallydistributed variables or Pearson's $\chi 2$ test for categorical variables (NCSS 2004, Kaysville, UT, USA) with $p<0.05$ considered statistically significant.

Results

Of the 298 subjects, 141 received AXB, and 157 received ICB. Demographic data are displayed as Table 1. There was a higher proportion of patients in the ICB group who underwent elbow surgery ($p<0.001$) and received bupivacaine as their local anesthetic ($p<0.01$) compared to the AXB group.

The rate of supplementation following AXB was 52% compared to 20% following ICB (OR = 2.57, 95%CI 1.61–4.12). The number of nerves requiring supplementation for each block technique is shown in Figure 1. Six patients following axillary block (4.9%) and 1 patient following infraclavicular block (0.7%) did not achieve complete anesthesia despite supplementation and were converted to GA (OR = 6.78, 95%CI 1.05 – 43.38).

On POD 1, 185 (62%) patients were successfully contacted via telephone. Median patient satisfaction score was 5/5 with >95% of patients reporting that they would choose a nerve block again for future surgery for both groups.

Table 1 Demographic data and frequencies of various surgical sites by peripheral nerve block technique presented as percent (%) unless otherwise specified.

	Axillary (n=141)	Infraclavicular (n=157)	P value*
Age in Years (mean ± SD)	45 ± 17	44 ± 18	NS
Gender (% male)	63	48	0.02
Surgical Site			
Hand	52.5	37.6	
Wrist	19.9	14.0	
Forearm	24.1	24.2	
Elbow	3.5	24.2	<0.001
Planned MAC	86	84	NS
GA Conversion	4.9	0.7	NS
Local Anesthetic			
Mepivacaine	43	24	<0.01
Bupivacaine	57	76	<0.01

*p-value is based on Student's t test for continuous normally-distributed variables and Pearson's c2 test for categorical variables.

Discussion

Patients who receive perivascular AXB are 2.5 times more likely to require supplementation compared to coracoid ICB. Although AXB may be efficient in terms of preparation time and equipment, ICB using a double-stimulation technique has a significantly higher rate of complete brachial plexus anesthesia following initial block placement.

Our findings are consistent with the results of Rodriguez et al who found low rates of supplementation (21%) following double-injection coracoid ICB [7]. A previous study comparing nerve stimulator-guided AXB and lateral ICB demonstrated a greater extent of anesthesia with ICB [9]. Multiple injections have been shown to improve the efficacy of nerve stimulator-assisted nerve blocks [2, 3] at the cost of increased patient discomfort [10].

The efficacy of the fan technique perivascular axillary block has not been described previously, and there have been no studies to date comparing this technique to other methods of brachial plexus blockade. Despite a paucity of scientific data on this approach in the published literature, we have successfully utilized the perivascular axillary block in our clinical practice with appropriate supplementation. A randomized prospective study to compare these techniques is warranted.

Ultrasound may improve the success of the perivascular axillary block without employing electrical stimulation. In a study comparing nerve stimulation-guided axillary block to ultrasound-guidance and ultrasound-guided electrical stimulation, nerve stimulation alone achieved complete brachial plexus anesthesia only 62.9% of the time; ultrasound with or without electrical stimulation improved the success rate to >80% [11].

By extrapolating this data, the supplementation rate of the perivascular axillary block will most likely decrease by adding image-guidance to a traditionally "blind" technique.

Limitations include the retrospective design and lack of randomization. However, data regarding block performance and patient satisfaction are collected prospectively as a part of our ongoing QA process. Since subjects were not randomly assigned, choice of nerve block technique was left to the discretion of the anesthesiologist, which accounts for the unequal distribution of surgical sites between the 2 groups. A potential confounder is the use of two local anesthetic solutions with different predicted onset times. Despite the higher proportion of bupivacaine use in the ICB group, the supplementation rate after 20 min is still significantly lower than in the AXB group. A randomized prospective study to confirm these results is warranted.

Although perivascular AXB has a higher rate of supplementation, rates of conversion to GA following either technique in our practice are low, and patient satisfaction is consistently high. An important consideration is the "block room" model employed in our regional anesthesia practice which facilitates successful supplementation of incomplete blocks prior to scheduled surgery.

In conclusion, the clinical utility of the perivascular AXB depends on the answer to the question: "Is the glass half-empty or half-full?" For a busy ambulatory anesthesia practice without a block room model, 50% supplementation may be considered unacceptable. Alternatively, the perivascular AXB technique may be viewed as a rapid procedure which may be performed in between cases without electrical stimulation, and only 50% of blocks require supplementation to provide surgical anesthesia. The addition of ultrasound may reduce the need for supplementation with this technique. When adequately supplemented, perivascular AXB remains a reasonable alternative to ICB for ambulatory upper extremity surgery.

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