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Clinical experience

Single or double-injection technique in axillary block: the success of motor and sensor blockade

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Abstract

Background and Purpose: *Axillary brachial plexus block is the method of choice for surgical procedures of upper arm except shoulder region. Distribution of local anaesthetic toward neurovascular space may be a reason for failed block. We investigated the axillary block effectiveness by singe- and double-injection technique.*

Materials and Methods: *Ninety patients (21–81 old; ASA I-IV) scheduled for upper arm surgery were divided in three equal groups during prospective, double-blind study. Nerve position was located with neurostimulator (Stimuplex® HNS 11) (0.5 mA, 2Hz and 0.1 ms). In Group S (single-shot), mixture of 30 mL (15 mL 0.5% bupivacaine and 15 mL 2% lidocaine) was injected only above axillary artery (25 mL around median and 5 mL around musculocutaneus nerve). In Group U and R (double-shot), the same mixture of local anaesthetic was applied above (10 mL around median and 5 mL around musculocutaneus nerve) and below axillary artery (15 mL around radial or ulnar nerve). Motor and sensor block were determined (Bromage scale, Pinprick method). Statistic analysis was done (SSP11.0).*

Results and Conclusions: *Effective block analgesia and anaesthesia was achieved in shorter time in Group R (18+/4 and 26+/–3 min) (Group U: 34+/–4 and 41+/–3 min, Group S: 35+/–4 and 45+/–2 min) (P=0.0000) (Table 2). Block effectiveness was significantly higher after radial nerve stimulation (92%) (Group U 88% and S 76%) (P=0.630). Faster motor block was achieved in Group R (18+/–4) (Group U 26+/–3 and S 35+/–4 min) (P=0.000). Double-shot technique with primar radial nerve stimulation, allows better motor and sensor axillary block in comparison with single-shot technique.*

INTRODUCTION

Surgical procedures to the distal humerus, elbow, and proximal ulna and radius are ideally suited to regional techniques. According to the innervations fields, axillary brachial plexus block is the method of choice for longer surgical procedures in the forearm, elbow and hand region as the partial parts of upper arm *(1)*. Selection of the preferred approach is determined by the innervation of the surgical site. The axillary approach to the brachial plexus eliminates the risk of respiratory compromise due to pneumothorax or diaphragmatic paresis to commpare with infrascalene and supraclavicular approach. Inadequate local anaesthetic distribution toward the retro-arterial region of the

neurovascular space often delays anaesthesia in one or more nerves. It may be a reason for frequent unsatisfactory surgical block in single- and double-injection technique *(2)*. Injection of larger volumes (50 mL) of local anesthetic solution has been proposed to facilitate spread of local anesthetic proximally to the level at which the brachial cutaneous nerves exit the sheath. In these circumstances, recently recommendations follow the multiple-injection technique that include selective nerve location (neurostimulation, ultrasound) and separate blockade of each nerve *(3, 4)*.

The aim of our study was to evaluate the block effectiveness as well as success rate of motor and sensor blockade after single- and double-injection technique of axillary brachial plexus block.

MATERIAL AND METHODS

Ninety patients (female 49, male 41; 21–81 old; BMI: 23–31, ASA I-IV) scheduled for forearm, elbow and hand surgery were divided in three equal groups. They were included in prospective, double-blind study during six months period. Ethic Comity of University Hospital of Traumatology approved the investigation. All patients were premedicated by midazolam 7.5 mg orally 30 min preoperative and sufentanil 2.5 μg iv 10 min before procedure. Electrical nerve stimulation was performed by Stimuplex® HNS 11 nerve stimulator, (B/Brown, Germany) and 1 Stimuplex®D stimulating needle 22G, 0.7×50 mm (B/Brown, Japan). When the slight twitching of the motor response from the relevant muscles was achieved (at 0.5 mA, 2Hz, 0.1 ms) local aesthetic was applied. In Group S (single- shot), mixture of 30 mL of 15 mL 0.5% bupivacaine + 15 mL 2% lidocaine was injected only above axillary artery (25 mL around median and 5 mL around musculocutaneus nerve). In Group U and R (double- shot), the same mixture of local anaesthetic was applied above (10 mL around median and 5 mL around musculocutaneus nerve) and below axillary artery (15 mL around radial or ulnar nerve). Motor block was determined by the modified Bromage scale. Progression of sensory block was assessed every 5 min during 45 min by pinprick method. Pain was assessed using a 0–10 verbal numerical rating scale. Data was analysed by ANOVA, Chi-Squere test and Fisher exact test. P value <0.05 was accepted as significant.

TABLE 1

Patient demographic data and surgery characteristics.

Technique		Single-injection	Double-injection		
Group		S	U	R	
		N.musculocutaneus N. medianus	+ N.ulnaris	+ N.radialis	
Variable		(N=30)	(N=30)	(N=30)	P value
Age (years)		54+/–18	56+/–20	52+/–22	0.7278°
BMI (kg m^{-2})		25+/– 4	28+/– 6	28+/– 7	0.2003
Sex	Female	15 (50%)	16 (53%)	18 (60%)	
	Male	15 (50%)	14 (47%)	12 (40%)	0.3606
ASA	I	5 (17%)	4 (13%)	3 (10%)	
	II	13(42%)	12 (40%)	16 (53%)	
	III	8 (27%)	10 (33%)	6 (20%)	0.2394
	IV	4 (14%)	4 (14%)	3 (17%)	
Surgical site	Elbow	3 (10%)	3 (10%)	5 (17%)	
	Forearm	5 (17%)	4 (13%)	3 (10%)	
	Wrist	5 (17%)	4 (13%)	2 (7%)	0.2580
	Hand	17 (58%)	19 (64%)	20 (66%)	
Surgery	Acute	14 (47%)	17 (57%)	16 (53%)	
Type	Elective	16(53%)	13 (43%)	14 (47%)	0.3350
Tourniquet	Yes	26 (87%)	27 (90%)	25 (83%)	
	No	4 (13%)	3 (10%)	5 (17%)	0.1070
Duration of surgery (min)		81+/–20	80+/–30	82+/–28	0.6287°

Values are mean +/– standard deviation or n (%)
° One-way analysis of variance (ANOVA), · Chi – Squere Test
* P value <0.05 statistical significant

TABLE 2

Characteristics of axillary block.

	Group S (N=30)	Group U (N=30)	Group R (N=30)	P °
Performance time (min)	4.6+/–0.3	4.8+/–0.4	5.0+/–0.5	0.093
Time to effective block analgesia (min)	35+/–4	26 +/– 3	18 +/– 4	0.000*
Time to block anaesthesia (min)	45+/–2	41 +/– 3	34 +/– 4	0.000*
Block effectiveness (%)	23 (76%)	26 (88%)	27 (92%)	0.063□
Venous puncture (%)	0 (0%)	2 (7%)	0 (0%)	0.007□*
Accidental elicitation of parasthesia (%)	1 (3%)	4 (13%)	1 (3%)	0.008□*
VAS at block performance (mm)	10+/–2	13 +/– 4	14 +/– 4	0.336

Values are mean +/– standard deviation or n (%)
°One-way analysis of variance (ANOVA), □Chi-Squere test
*P value <0.05 statistical significant

RESULTS

Study groups were comparable and did not differ in demographic data (Table 1). Performance time of axillary block was similar in all groups (less than 5.0 min) (P=0.093).

The time of achieving effective block analgesia and anaesthesia was significantly shorter in Group R (18+/4 and 34+/–4 min) than in Group U (26+/–3 and 41+/–3 min) and Group S (35+/–4 and 45+/–2) (P=0.0000) (Table 2).

The sensory block was more successful at the time of effective block analgesia in Group R (P=0.032) but did not significantly differ at the time of block anaesthesia between studied groups (P=0.755) (Figure 1).

The sensory block in C_5 and C_6 dermatomes was higher by primary stimulation of radial nerve at the time of block analgesia (C_5: 85% vs. 48% in group U and 24% in Group S; C_6: 99% vs. 78% in group U and 77% in Group S) (P=0.000). There was no difference in sensory block by C5 et C6 dermatomes et the time of block anaesthesia between study groups.

Significantly better motor block of fist and elbow was achieved in Group R already at the time of block analgesia (88%; Group U 43% and Group S 30%) (P=0.000). Motor block between Group S and U did not differ et the time of effective block analgesia and anaesthesia (P=0.111) (Figure 2). Block effectiveness was significantly higher after radial nerve stimulation (92%) (Group U 26%, Group S 76%)(P=0.630).

DISCUSSION

The main results from our study are comparable with Handoll HH and Koscielniak-Nielsen ZJ meta-anaysis

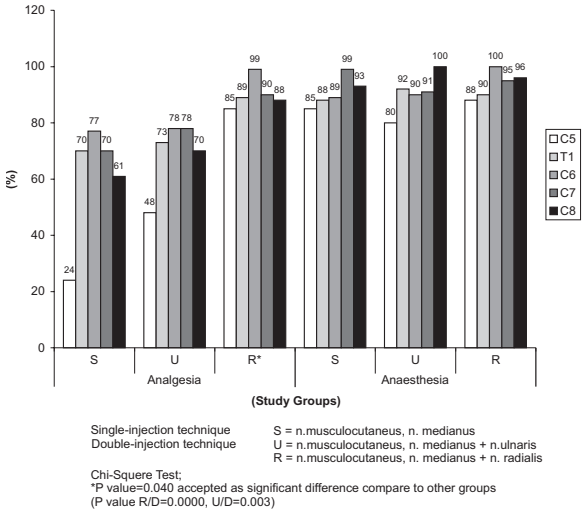

Figure 1. *Sensor block at the time of effective block analgesia and anaesthesia.*

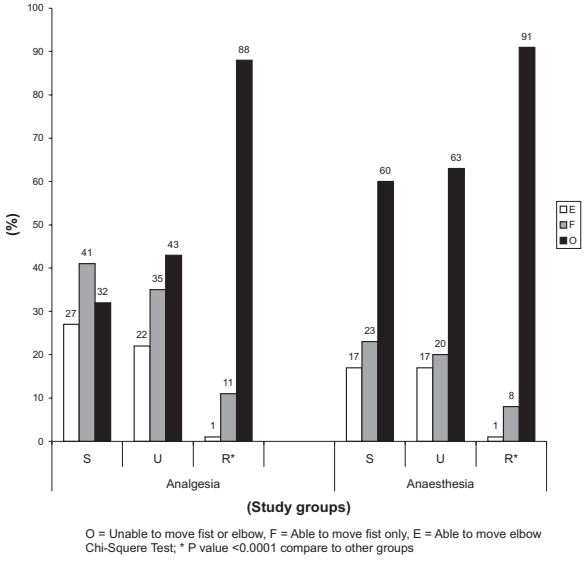

Figure 2. *Motor block at the time of effective block analgesia and anaesthesia.*

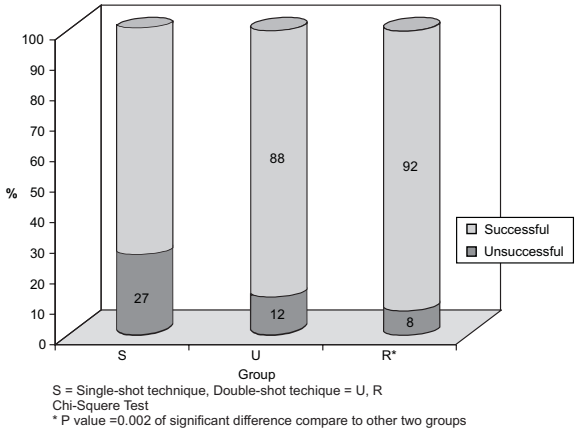

Figure 3. *Success and unsuccess of axillary block in three study groups.*

data *(5)*. Thay pointed out that double injections technique with nerve electrolocation in axilary brachial plexus block was significantly more effective than single injection. Double injections technique also decreases primary anaesthesia failure and incidence of incomplete motor block. On the other hand multiple injection technique provides more effective anaesthesia than either double or single injection techniques.

Significantly faster sensor and motor block involving local anaestetic injections of the musculocutaneous, median and radial nerve in axillary block et the effective time of block analgesia in our study correlate with De Tran QH rewiev and Rodriguez J results *(6, 7)*.

The four stimulations pattern provides faster onset and improves higher success rate with largely clinical results but my causes more time consuming in presence of more difficult technique than other axillary block methodes. Morros C and co-workers showed that four nerves were located only in 38% and 43% of the patients where neurostimulator or ultrasound with neurostimulator were used *(8)*.

Double-shot technique, especially with primary radial nerve stimulation allows better motor and sensory blockade of axillary brachial plexus in comparison with single-shot technique. It is quite appropriate technique for successful sensor and motor block for surgery of the forearm, elbow and fist.

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