

Regional Anesthesia for Upper Extremity Surgery – Our Experience

Eva Šmigovec, Branko Tripković, Melita Šulentić, Igor Šmigovec, Dinko Milavec¹, Zrinka Bukvić Mokos²

Department of Orthopedic Surgery, Zagreb University Hospital Center and School of Medicine; ¹Department of Anesthesiology, Resuscitation and Intensive Care, Dubrava University Hospital; ²University Department of Dermatology and Venereology, Zagreb University Hospital Center and School of Medicine, Zagreb, Croatia

Corresponding author:

Eva Šmigovec, MD, MSc
Department of Orthopedic Surgery
Zagreb University Hospital Center and
School of Medicine
Šalata 6
HR-10000 Zagreb
Croatia
ortopedija@yahoo.com

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SUMMARY Brachial plexus block using axillary approach is a simple and safe method of regional anesthesia often used for elbow, forearm and hand surgery. Different techniques can be used to achieve brachial plexus block. On using perivascular approach to brachial plexus, we neither searched for paresthesia nor used nerve stimulator to identify the correct needle position within the neurovascular sheath. Axillary artery was palpated and a mixture of local anesthetic agents was injected into the neurovascular sheath above and below axillary artery at the site of strongest artery pulsation. The local anesthetic solution comprised equal volumes of lidocaine 2% and bupivacaine 0.5% without adrenaline, in a total volume of 30-40 mL, depending on body mass. This technique is used in more than 150 patients *per year* at our department. In the present study, 158 patients undergoing upper extremity surgery under brachial plexus block were retrospectively assessed. Successful anesthesia was achieved in 135 (85.0%) patients using brachial plexus block alone, 19 (12.5%) patients required additional medication, two patients required supplementation with intravenous regional anesthesia, and another two patients required general anesthesia. The incidence of successful blocks, latency time of onset, local and systemic complications or allergic skin reactions were investigated. There were no significant complications attributed to the anesthetic technique.

KEY WORDS: anesthetic technique, regional, brachial plexus, axillary perivascular approach

INTRODUCTION

The majority of upper extremity surgical procedures can be done under brachial plexus blockade. Brachial plexus blockade by exposing nerve roots in the neck and injecting a cocaine solution

was first introduced by Halsted in 1884. The first percutaneous approaches were in 1911 when Hirschel injected the plexus through the axilla, and then Kulenkampff used the supraclavicular

approach. Different techniques and modifications of perivascular approach are described (1-6). Axillary approach to the brachial plexus is a simple, safe and effective technique often used for surgery of the upper extremity. Complications of other approaches (supraclavicular, infraclavicular or interscalene) including the risk of pneumothorax, block to the stellate ganglion, phrenic or recurrent laryngeal nerve (7-9) can be avoided using this approach. Various techniques have been described with different success rates. Some papers advocate the use of peripheral nerve stimulator or ultrasound for successful blockade (10-15). In our experience, brachial plexus block can be achieved without ultrasound or nerve stimulation with a high success rate.

PATIENTS AND METHODS

We retrospectively studied 158 patients aged 14-83 years, American Society of Anesthesiology (ASA) I-III, undergoing elective elbow, forearm or hand surgery (Tables 1 and 2). None had a history of skin allergic sensation during life or allergic skin reaction to anesthetics.

Table 1. Characteristics of the patients N=158.

Age (years)	49.5 (14-83)
Weight (kg.)	70 (46-118)
Sex, Male/Female	69 / 89

Table 2. Surgical procedures

PROCEDURE	No.
Peripheral nerve decompression	52
Tumor excision	22
Aponeurosectomy	15
Arthrodesis	14
Biopsy	14
Elbow capsule release	10
Hardware removal	10
Miscellaneous	21
TOTAL	158

Midazolam 5-7.5 mg orally was administered preoperatively. Brachial plexus block was achieved by axillary approach (2,4-6). On arrival in the preoperative room, the arm to be operated on was abducted by at least 90°, with the elbow flexed. Arterial pulse was palpated at the level of the axillary skin crease. A mixture of local anesthetic agents, equal volumes of lidocaine 2% and bupivacaine 0.5% without adrenaline, in a total volume of 30 mL for patients under 60 kg and 40 mL for patients over 60 kg was injected into



Figure 1. Regional anaesthesia for surgery of the upper extremity

the neurovascular sheath, half of the volume above and the other half below axillary artery. Before injection, it is necessary to check the needle position by aspiration and if necessary to withdraw the needle and reposition it alongside the vessel. No attempts were made to elicit paresthesias. The 23 G, 20 mm butterfly needles were used (Fig. 1). Immediately upon injection, Esmarch rubber bandage is applied below the shoulder for 10 minutes to allow the solution to spread proximally and the arm is adducted toward the body. Upon Esmarch rubber bandage removal, the hand was tested for sensitivity to pin prick every two minutes. Insensitivity to pin prick, decreased motor function (elbow flexion/extension, hand grip) and warm skin due to skin vessel dilatation were signs of a successful block and tourniquet device for bloodless surgery was applied.

Sedation with low dose of midazolam was used for agitated patients. If brachial plexus block was unsuccessful, additional medications (alfentanil, propofol) were used. If necessary, the density of the block was supplemented with intravenous regional anesthesia. General anesthesia was used if the block was unsuccessful.

The length of the operation, latency of onset, and duration of postoperative analgesia were measured. Patients were observed for local and systemic complications. The incidence of successful blocks was calculated.

RESULTS

During a one-year period, 158 patients were operated under brachial plexus block achieved by axillary approach. Bloodless surgical field was achieved by tourniquet device in all patients. The mean latency of onset was 13 (range 10-20)

Table 3. Latency of onset, duration of surgical procedure and postoperative analgesia.

Latency of onset (min.)	13 (10-20)
Duration of surgical procedure (min.)	35 (15-125)
Duration of postoperative analgesia (min.)	390 (185-640)

minutes, mean length of surgery 35 (range 15-125) minutes, and mean postoperative analgesia 390 (range 185-640) minutes (Table 3).

Out of 158 study patients, 135 patients proceeded directly to surgery without supplementation (85.0%), 19 (12.5%) patients required additional medication, two (1.25%) patients required supplementation with intravenous regional anesthesia, and another two (1.25%) patients required general anesthesia. Alfentanil, propofol or midazolam were used as additional medication. The initial success rate was 85.0%, however, with the use of additional medication it was improved to 97.5% (Table 4). There were no significant local or systemic complications attributable to the anesthetic technique. Bradycardia at the beginning of surgical procedure without hypotension was noted in three patients and one patient had elevated blood pressure.

DISCUSSION

This retrospective study demonstrated the axillary brachial plexus blockade using a mixture of local anesthetic agents (equal volumes of lidocaine 2% and bupivacaine 0.5% without adrenaline) injected into the neurovascular sheath without ultrasound or nerve stimulation to be a very safe technique allowing a pain-free upper extremity surgery in the vast majority of cases attempted.

Ultrasound and nerve stimulation is commonly used and well supported by the literature to aid in performing successful brachial plexus blockade (11,14-16). The technique that is utilized at our department is simple and safe, with a very high success rate of 97.5%. Less experienced residents performed blocks in 19 patients that needed additional medications and in two patients that required general anesthesia. The level of training and success of the block is addressed in the literature with different conclusions (11,17).

Trying to achieve ideal anesthesia (short latency of onset, long duration of analgesia and no toxic effects), a mixture of local anesthetic agents of different concentrations is used (15,18-20). The latency of onset time is shortened by administering a mixture of local anesthetic agents (30 mL 2% lidocaine and 30 mL 0.25% bupivacaine) to 6.65 minutes as opposed to over 21 minutes using 50 mL of 0.25 bupivacaine alone (21). Higher concentrations of anesthetic agents result in higher blood concentrations and longer duration of analgesia. Up to 400 mg of lidocaine without adrenaline and up to 900 mg of lidocaine with adrenaline can be used, while for bupivacaine maximal doses are up to 150 mg (22,23). Injecting 900 mg of lidocaine will result in good blockade, but also in a high risk of side effects, especially if the anesthetic is accidentally injected into axillary vein using perivascular or transarterial approach (13,18,23). Such accidents can be avoided by multiple aspirations before injecting. Significant toxic effects on cardiovascular or central nervous system are described in literature (18,24,25). In our series none were noted. Adrenaline added to local anesthetic mixture prolongs its effect and lessens the possibility of systemic toxic side effects (26,27). The possible hemodynamic effects of adrenaline, cardiac arrhythmia if accidentally administered intravenously, and the fact that the duration of analgesia is sufficient using anesthetic agents alone discouraged us from using adrenaline. The reported successful results using different methods differ significantly (62.5%-98.8%) as do the criteria of success (11,12,14-17). Less successful analgesia can be expected during distal humerus and elbow surgery due to inadequate block of the terminal nerves that arise from the medial, posterior, and lateral cords and provide sensory innervation to the upper arm (12). In our study, the success rate for surgery at this level was not lower (28-32). We

Table 4. Success rate

Success of brachial plexus block	Additional procedures	No.	%
Unsuccessful	General anaesthesia	2	2.5
	IVRA	2	
Successful using additional medication	Alfentanil, Propofol, Midazolam	19	12.5
Successful	-	135	85
	TOTAL	158	100

assume that it is due to Esmarch rubber bandage applied below the shoulder for 10 minutes immediately after injection to allow the solution to spread proximally. A similar effect can be achieved by digital pressure on the neurovascular sheath during perivascular axillary block (28).

CONCLUSION

The technique and experience are the keys to surgery success. High rates of success can be achieved by using an appropriate concentration of local anesthetic mixture in an adequate quantity. Esmarch rubber band should be applied for 10 minutes after injection of the anesthetic mixture. Using ultrasound and/or nerve stimulation is not necessary and does not guarantee an effective block. High success rate and no significant complications justify further use of the axillary-perivascular technique of regional anesthesia for upper extremity surgery.

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Light, air and Sun. And Nivea cream; year 1936.
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