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INTERSCALENE BRACHIAL PLEXUS BLOCK

(regional analgesia/brachial plexus block/anesthetic techniques)

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Patients undergoing acute or elective surgical procedures of the upper extremity and shoulder received an interscalene block of the brachial plexus, using the technique described by Winnie, with the slight modification that we did not search for paresthesias. The local anesthetic solution used was 30 ml of 1.5% mepivacaine without adrenaline.

The plexus block was successful in 24/35 (69%). A remarkable feature is the reliable analgesia obtained in the proximal part of the upper extremity, the shoulder and even part of the neck. However, analgesia of the forearm and hand, corresponding to the medial antebrachial cutaneous nerve and the ulnar nerve, was lacking in 20 and 29%, respectively.

Complications included were concurrent block of the phrenic (one case) and recurrent laryngeal (one case) nerves. Horner's syndrome was present in five patients.

This procedure has the advantage over other approaches for the brachial plexus block in that the risk of arterial puncture is minimized and the possible occurrence of pneumothorax can be avoided.

Several techniques for blocking the brachial plexus have been reported. Winnie seems to have been the first to introduce the interscalene brachial plexus (1). The advantages of this technique were reportedly that it is easy to learn, there were few complications and the extent of analgesia was constant, including the proximal part of the extremity and the shoulder.

To investigate the important factors of interscalene brachial plexus block, we undertook an investigation, based on 35

interscalene blocks and we focussed our study mainly on the area of analgesia and possible complications. The blood concentrations of local anesthetics were measured in 4 patients.

MATERIALS AND METHODS

The first part of our study included 35 patients subjected to acute or elective surgery of the upper extremity or shoulder, in particular, reductions of fractures and suture of nerve and tendon lesions. All patients were premedicated with hydroxyzine and atropine given intramuscularly, and all received interscalene block of the brachial plexus, using the technique described by Winnie (1), with the slight modification that we did not search for paresthesias.

The patients were supine with their arms by their sides. The patient's head was turned away from the side to be operated on and the lateral edge of the sternocleidomastoid muscle noted. Occasionally, we asked a patient to turn his head back to the front against resistance in order to outline this muscle. The cricoid cartilage was gently palpated and a line extended laterally over the surface marking of the sixth cervical transverse process. Along this line a finger was placed at the edge of the previously noted sternocleidomastoid muscle. This finger, which now lay on the scalenus anterior muscle, was gently moved laterally until a second, less distinct groove was felt. This was the groove between the scalenus anterior and middle muscles, and is the key to the interscalene space. Into this groove, at the point where it was crossed by the line projected from the cricoid cartilage, a 23 gauge one inch needle was inserted in a direction perpendicular to the skin in all planes, i.e. medially, slightly caudal and less slightly dorsal. The point of entry of the needle was frequently crossed by the external jugular vein acting as an additional landmark. The needle was then advanced slowly until paraesthesia was elicited. This frequently occurred very superficially, but if not, and bone was reached, the needle was partially withdrawn and redirected, usually in a more dorsal direction. When the first approach failed, the needle was frequently too far anterior. With this technique there was no mythical 'click' as the needle penetrated the fascia. When the needle was placed in the fascial compartment, aspiration was attempted and, if negative, the

calculated dose of anesthetic solution injected, care being taken not to move the needle. In this series the local anesthetic solution used was mepivacaine 1.5% without adrenaline. The volume used was 30 ml for adult.

RESULTS

Of the 35 patients undergoing plexus block, 17 were male and 18 female. The youngest was 12 and the oldest 73.

Table I. THE SITE OF SURGICAL INCISION AND THE EFFECTS OF INTERSCALENE BLOCK

Operation site		Supplemental block
Clavicle	1	
Shoulder	5	
Upper arm	5	A,E
Elbow	11	A,A,A,A,A,A,
Forearm	4	
Wrist	7	A,A,E
Hand	2	
Total	35	11

(A : Axillary block E : Epidural block)

The site of surgical incision and the effects of interscalene brachial plexus blocks are shown in Table I. Eleven patients received supplemental blocks and two received cervical epidural block following interscalene block. In 9, axillary block was done by giving 30 ml of mepivacaine 0.5% without adrenaline. The area of analgesia obtained with interscalene block is shown in Table II. Numbers indicate the frequency of analgesia of each cutaneous nerve. A remarkable feature is the reliable analgesia obtained in the proximal part of the upper extremity, the shoulder, and even the neck. Analgesia of the forearm and hand, corresponding to the medial antebrachial cutaneous nerve and the ulnar nerve, was lacking in 20 and 29%, respectively.

Table II. AREA OF ANALGESIA DETERMINED AFTER 15 MINUTES AND SUPPLEMENTAL BLOCK

Level	Cases	Supplemental block
C_3 - C_5	1	A
C_3 - C_6	4	E A
C_3 - C_7		
C_4 - C_7	2	A E
C_3 - C_8	3	A
C_4 - C_8		
C_3 - T_1	5	A A
C_4 - T_1	4	A
C_3 - T_1	8	
C_4 - T_2	8	A A
	35	

A : Axillary block
E : Cervical epidural block

Table III. DURATION OF ANALGESIA

Time(minutes)	Number	%
Less than 120	0	0
121 - 180	9	37.5
181 - 240	7	29.2
241 - 300	6	25.0
301 -	2	8.3
	24	

The duration of analgesia is shown in Table III. In the twenty-four patients in which the block was successful, the mean duration of analgesia was 206 minutes.

The complications and frequency are listed in Table IV. Horner's syndrome was present in five patients. Phrenic nerve palsy occurred in one patient, who complained of one sided sensation of diaphragmatic tightness and a feeling of insufficient deep breathing. Recurrent laryngeal nerve palsy was apparent in one patient, in whom hoarseness and a feeling of insufficient coughing developed.

Table IV. COMPLICATIONS OF 35 INTERSCALENE BLOCKS

Complication	No.of patients	%
Horner's syndrome	5	14.3
Phrenic nerve palsy	1	2.9
Recurrent laryngeal palsy	1	2.9

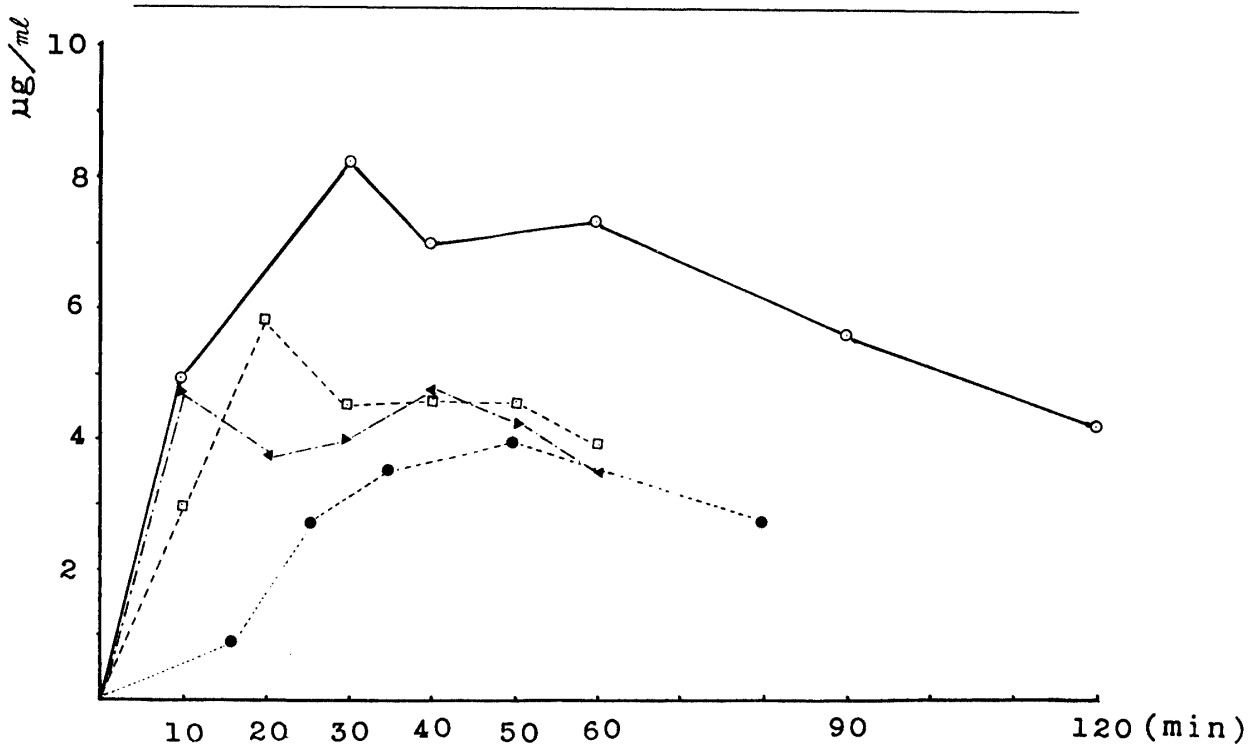

Fig. 1. Blood concentration of mepivacaine following interscalene brachial plexus block with 30 ml of mepivacaine 1.5% plain.

Using gaschromatography, we measured the blood concentration of mepivacaine following interscalene brachial plexus block with 30 ml of mepivacaine 1.5 % without adrenaline. The peak values were detected after 30 - 40 minutes (Fig. 1).

DISCUSSION

Regional analgesia is preferred over general anesthesia for certain surgical procedures on the upper limb and reliability and safety are always the concern of surgeons and anesthetists (2).

Halsted was the first to operate under brachial plexus block, when, in 1884, he exposed the nerve roots in the neck and blocked them with direct application of cocaine solution (2). In 1911, Hirschel (3) injected the plexus through the axilla and

then Kulenkampff (4,5) used a supraclavicular approach. The uncertainty of success seemed to be the main disadvantage of brachial plexus block.

Burnham (6) observed the nerve of the plexus and the close relationship to the brachial artery and noted the existence of a perivascular space enclosed by a fascial sheath. Eather (7) pointed out that the only landmark required was pulsation of the axillary artery. De Jong (8) showed the importance of injecting a sufficient volume of anesthetic solution to block the nerves arising from the plexus proximal to the site of injection.

In an effort to improve still further the scope and safety of brachial plexus block, Winnie (1) approached the brachial plexus sheath higher in the neck via the interscalene space opposite C6. He showed that it was possible at this level to produce excellent anesthesia of the upper limb and shoulder girdle without risk to the subclavian artery or the cupola of the lung.

In the series reported by Winnie (1), the interscalene technique was successful in 94% of 200 cases. He noted a delay in the onset of analgesia of the ulnar nerve and found that this difficulty could be overcome if the volume injected was sufficiently large. Success was affaired in 31/34 patients reported by Ward (2). He noted lack of analgesia of the ulnar nerve in three patients.

In our patients, we found an area of analgesia, which was constant in the shoulder region and upper arm, thus providing an excellent condition for surgery in this area and also for placing a tourniquet. The area of analgesia in the forearm and the hand, however, was more variable concerning the ulnar nerve and the medial cutaneous nerve of the forearm. As, stated by Vester-Andersen et al. (9) this may be due to the fact that the inferior trunk of the brachial plexus at the level of the sixth cervical vertebra is situated behind or even beneath the subclavian artery, and this long distance of diffusion of the local anesthetic solution may explain why there is a delay in onset, or even a lack of analgesia in this area. Another reason could be the uneven spread of the solution on a more proximal level, namely at the root level. Winnie (1) suggested that the extent of analgesia depends on the relation between the height of the patient and the volume of anesthetic solution. The interscalene block is a perineural/ perivascular space block, and

therefore it demands a rather large volume and amount of anesthetic. We consider that volume is most important for success of this block, when a large enough volume was injected, the rate of success was increased. When the interscalene block was insufficient, a supplemental axillary block proved to be effective.

The blood concentrations of local anesthetics in 4 patients were measured using gaschromatography. We found peak values after 20 to 40 minutes and the mean value was 5.7μg/ml. We used mepivacaine 1.5% without adrenaline. The peak value was slightly higher than the value reported Vester-Andersen (9).

Complications included concurrent block of the phrenic (one case) and recurrent laryngeal (one case) nerves. Horner's syndrome was present in five patients. We did not give intra-arterial, subarachnoid, or extradural injections reported in the literature (10-16).

As the phrenic nerve passes near the interscalene space over the ventral surface of the anterior scalene muscle, and has its origin in the cervical plexus at C3-C5, it can be anesthetically to blocked by bathing the roots of the cervical plexus. It is also possible that the recurrent laryngeal nerve block was produced by tracking of the local anesthetic solution along the path of the right subclavian artery or to a chance injection near its path with the vagus over the anterior scalene muscle. The possibility of both phrenic nerve palsy and recurrent laryngeal nerve palsy further indicates that bilateral interscalene block should be avoided.

The interscalene brachial plexus block does have advantages over other approaches, however, the patients and procedures should be carefully monitored.

REFERENCES

1) Winnie, A.P. (1970) Interscalene brachial plexus block. Anesth. Analg., 49, 455-466
2) Ward, M.E. (1974) The interscalene approach to the brachial plexus. Anaesthesia, 29, 147-157
3) Hirschel, G. (1911) Die anästhesierung des plexus brachialis bei operationen an der oberen extremität. Münch. Med. Wochenschr., 58, 1555-1556
4) Kulenkampff, D. (1911) Die anästhesierung des plexus

brachialis. Zentralbl. Chir., 38, 1337-1346
5) Kulenkampff, D. (1928) Brachial plexus anaesthesia. Ann. Surg., 87, 883-891
6) Burnham, P.J. (1958) Regional block of the great nerves of the upper arm. Anesthesiology, 19, 281-284
7) Eather, K.F. (1958) Axillary brachial plexus block. Anesthesiology, 19, 683-684
8) De Jong, R.H. (1961) Axillary block of the brachial plexus. Anesthesiology, 22, 215-224
9) Vester-Andersen, T., Christiansen, C., Hansen, A., Sorensen, M., and Meisler, C. (1981) Interscalene brachial plexus block: area of analgesia, complications and blood concentrations of local anesthetics. Acta Anaesth. Scand., 25, 81-84
10) Seltzer, J.L. (1977) Hoarseness and Horner's syndrome after interscalene brachial plexus block. Anesth. Analg., 56, 585-586
11) Edde, R.R. and Deutsch, S. (1977) Cardiac arrest after interscalene brachial plexus block. Anesth. Analg., 56, 446-447
12) Merril, D.G., Brodsky, J.B., and Hentz, R.V. (1981) Vascular insufficiency following axillary block of the brachial plexus. Anesth. Analg., 60, 162-164
13) Barutell, C., Vidal, F., Raich, M., and Montero, A. (1980) A neurological complication following interscalene brachial plexus block. Anaesthesia, 35, 365-367
14) Siler, J. N., Lief, P.L., and Davis, J.F. (1973) A new complication of interscalene brachial plexus block. Anesthesiology, 38, 590-591
15) Ross, S. and Scarborough, C.D. (1973) Total spinal anesthesia following brachial plexus block. Anesthesiology, 39, 458
16) Kumar, A., Battit, G.E., Froese, A.B., and Long, M.C. (1971) Bilateral cervical and thoracic epidural blockade complicating interscalene brachial plexus block: report of two cases. Anesthesiology, 35, 650-652