THE SHORT-NEEDLE TECHNIQUE IN BRACHIAL PLEXUS BLOCK[1]

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REGIONAL ANAESTHESIA of the brachial plexus has been associated for a long time with the unpleasant complication of pneumothorax. We have been very much concerned about this complication, particularly with residents in anaesthesia who are beginning to learn the supraclavicular approach. There is no doubt that inexperienced anaesthetists account for the majority of the pneumothoraces which occur.

While attempting to find a way to reduce the incidence of this complication, we were impressed by the frequency with which paraesthesias occurred during the preliminary skin-wheal procedure and subcutaneous infiltration with a short ½-in. intradermal needle. Consequently, hoping to reduce the chances of producing what we consider a serious complication, we devised a technique of brachial plexus block with a short needle as a routine procedure.

In this series, ¼-in. (0.635 cm.), 25-gauge, ½-in. (1.27 cm.), 24-gauge and 1-in. (2.54 cm.), 23-gauge needles were used exclusively. Adriani (1) recommends the routine setting of a marker at 1.5 cm. from the point of an 8-cm., 22-gauge needle. Unless the marker is fixed and not freely movable, this cautious procedure is not applicable to our technique in which free needles are preferred. The recommended marker setting still leaves exposed a needle shaft which is usually too long for our requirements. Moreover, a needle with a smaller gauge is also an essential part of our technique.

To test the reliability and relative safety of our method the majority of our anaesthesias were administered by residents who had not received previous instruction in brachial plexus block anaesthesia. All types of major and minor surgical procedures on the upper extremities were performed under brachial plexus block anaesthesia established with the short needle. Therapeutic blocks are not included in this series.

The familiar supraclavicular approach is used and the point of injection lies 1 cm. above the mid-point of the clavicle, posterolateral to the subclavian artery where it crosses the first rib.

The success of the short-needle technique depends on the brachial plexus bundle in the neck being brought as close as possible to the skin surface of the supraclavicular region. This condition can best be realized by observing the following recommendations.

The patient is placed on the table in dorsal decubitus. A small, firm, narrow pillow, about 18 in. long, 7 in. wide, and 5 in. thick, is placed lengthwise between the shoulders. The head of the patient rests back on the table and is turned in the opposite direction to the side being blocked. The anaesthetists moulds the shoulders around the pillow by depressing them until they touch the table. The

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pillow pushes up the thoracic cage from behind and elevates the first rib which in turn pushes the divisions of the brachial plexus closer to the skin at the point of injection. When the shoulders are pushed back, the shoulder girdle pivots backward around the immobilized thoracic cage, thus pulling the clavicle and adherent overlying tissues in close proximity to the first rib and brachial plexus. A final postural manœuvre which also contributes to lower the supraclavicular skin surface closer to the brachial plexus is achieved by asking the patient to lower his shoulders. If the patient were asked to assume the same posture standing up, he would resemble a soldier at attention, with arms well down, chest out, and shoulders back.

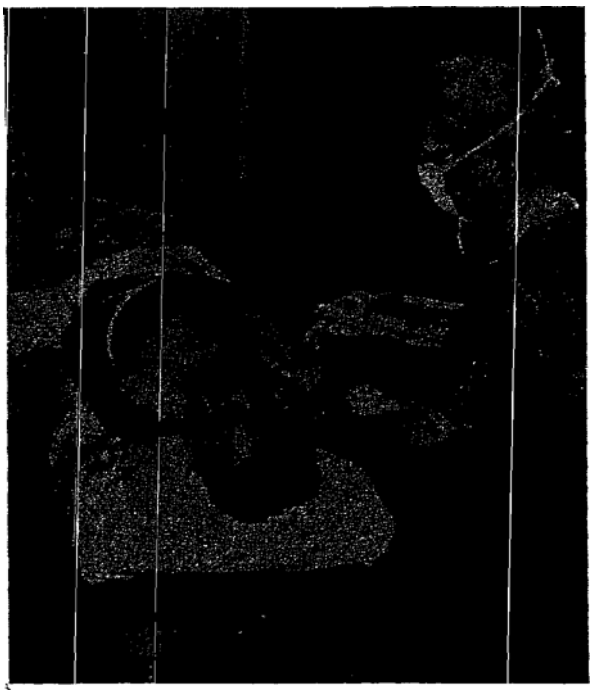

FIGURE 1. Brachial plexus block on the right side. Note anaesthetist's position behind the patient, depressing supraclavicular tissues with index finger.

The operator helps bring the point of injection closer to the brachial plexus by depressing the tissues with the index finger of his free hand, close to the needle. The anaesthetist takes an unorthodox but comfortable and relaxed position. Instead of standing at the side of the patient, he stands at the head of the table, behind the shoulder of the patient on the side to be blocked. In this way, he has a better perspective of the over-all anatomical position of the patient and avoids strained movements (see Figs. 1 and 2).

If the subclavian artery is not palpable when the anaesthetist is ready to raise the skin wheal, the external jugular vein can be made prominent by obstructing its return flow with the edge of the free hand pressed down against the soft tissues just above the superior border of the clavicle. Blowing out the patient's cheeks achieves the same result, but with this method the patient need not be

disturbed The skin wheal site is located at 1 cm above the point where the prolongation of the vein crosses the clavicle at approximately its mid-point

After the injection site has been located, the short needle (usually the ½-in 24-gauge size) is mounted on a 10 cc Lock syringe with finger rings and the skin wheal is raised At all times the anaesthetist carries the syringe with needle attached and filled with solution He holds the syringe through the control rings, ready to inject

With the short, small-gauge, non-traumatic needle, less precaution is required in locating paraesthesias Deliberate, moderately quick, but controlled needle thrusts are made in rapid succession until satisfactory paraesthesias, reaching

FIGURE 2 Brachial plexus block on the left side
Note position of patient

down to the hand, are elicited The patient is instructed beforehand to respond by a spoken word as soon as the sensation of "electric shocks" runs down his arm The anaesthetist must train himself to "freeze" the needle at the proper time A slight pause at the end of each thrust will avoid withdrawing the needle to the skin prematurely after the production of paraesthesias

The initial needle thrust follows the well-established, downward, backward and inward direction Subsequent thrusts are fanned out in all directions from the initial puncture until paraesthesias are produced If unsuccessful, the same procedure is repeated at other injection sites, slightly lateral or slightly medial to the initial wheal

Contrary to recommended practice (2), it is undesirable and unnecessary with the short-needle technique to strike the first rib Indeed, the first rib is completely ignored as a deep landmark and is regarded only as a protective shield to the pleural dome Striking the first rib only indicates that the needle is unnecessarily

close to the pleura and is no guarantee to a successful block without concomitant paraesthesias. It also accounts for unpleasant periosteal irriatation and there is a possible hazard of breaking the slender shaft of the small-gauge needle. Our only criterion, therefore, for a properly placed needle is paraesthesia.

Should it be impossible to identify the brachial plexus by paraesthesia, massive infiltration of the region is not attempted and the method is abandoned. The relative anatomical distribution of the nerves underlying the supraclavicular area appears to be too variable to rely on criteria other than paraesthesia to produce complete anaesthesia with rapid onset.

A 1½ per cent solution of Xylocaine with epinephrine 1:2,000 was used for all blocks. The average volume used was 24.5 cc.

After paraesthesias have been felt, and a test aspiration performed, the solution is initially injected under pressure. If the progression of the needle has been arrested with split-second timing, paraesthesias will again be felt owing to the pressure of the solution as it is being injected (3). Should paraesthesias not be produced this time, the experienced anaesthetist may risk withdrawing the needle very slightly until the force of the injection again produces paraesthesias. This method ensures that the needle is not beyond the fascial compartment which encloses the plexus. Since even a small amount of injected solution can distort the relation of the plexus to the overlying tissues, the entire volume of the anaesthetic solution is injected at the spot where paraesthesias were felt without reorienting the needle. A massage of the supraclavicular region follows each block. If a tourniquet is required, a ring infiltration of the upper arm is performed.

The entire block procedure in our series averaged about 5 min. In order to test the efficiency of our method, all blocks were performed in the operating room, a few minutes before surgery.

Preliminary testing for the degree of anaesthesia, such as skin-testing and diminished motor power, with the possible exception of loss of position sense (4) when it occurs, does not give information on the rapidity of onset of complete anaesthesia. The initial skin incision is the only test which will determine whether the block has been a total failure, a partial success, or a complete success, in so far as rapid onset is concerned. Allowance being made for preparation, draping, etc., the average interval of time before initial skin incision after termination of the block procedure was 16 min., 30 sec. For practical reasons, blocks which did not develop complete anaesthesia at the time of incision were classified as unsuccessful. All blocks requiring supplementary anaesthesia in any form were classified as failures. Although infiltration was not attempted in those cases where paraesthesias did not occur, they were tabulated as unsuccessful.

Table I shows the results of 82 cases of brachial plexus block anaesthesia performed with the short needle. Complete anaesthesia developed within the required interval of time in 75 blocks. If we exclude from the series cases in which infiltration was not attempted owing to failure to locate paraesthesias, and if we classify the delayed onsets as successful blocks, then our failure rate, given as 8.5 per cent, would be reduced to 2.5 per cent.

In spite of the short needles used in this series, we were impressed by the number of patients in whom the first rib was struck unintentionally. Among the 82 patients, the first rib was contacted 39 times. An attempt was made to corre-

TABLE I

RESULTS OF 82 CASES

	Length of needle				
	¼ inch	½ inch	1 inch	Total	Percentage
Successful blocks	8	59	8	75	91 5
Failures					
Absence of paraesthesias	0	3	0	3	
Partial anaesthesia	0	0	1	1	
Delayed onset	0	2	0	2	
Single division anaesthesia	0	1	0	1	
Total failures				7	8 5

late needle size with the weight and height of the patient. From Table II it can be seen that the ¼-in. needle was used in a few thin patients, but only to satisfy our curiosity. The 1-in. needle should be used only on rare occasions for heavy-set individuals with big bone structure. As shown in Table II, the ½-in. needle was used for the majority of patients including one 6 ft. 1 in. tall, weighing 205 pounds (in whom the first rib was struck). So much depends on the individual anatomical relation between the brachial plexus and supraclavicular skin surface that no clear-cut connection can be established between needle length and height of the patient. It may be said, in general, that the divisions of the brachial plexus are closer to the supraclavicular skin surface in tall heavy patients than they are in short heavy patients.

The duration of the operations ranged between 10 min. and 5 hr. with an average duration of 1 hr. 25 min. Complementary superficial narcosis was administered to seven patients. In all successful cases, the intensity of the block anaesthesia was adequate for the full duration of the operation.

Application of ultrasound as a means of rapid diffusion for the anaesthetic solution was attempted in a few patients during the course of this series. An average dose of 2 watts per square centimetre for 4 min. was applied to the supraclavicular region in nine patients immediately following brachial plexus block. In view of the restricted number of patients sonated, it is impossible at this time to give a serious evaluation on the efficiency of this physical agent as a spreading factor. It is our impression that motor paresis required less time to become more intense after the application of ultrasound. Therefore, there is a possibility that the onset of anaesthesia may be accelerated by the application of ultrasound over the infiltrated region.

TABLE II

RELATION BETWEEN NEEDLE LENGTH AND WEIGHT AND HEIGHT OF PATIENT

	Needle length		
	¼ inch	½ inch	1 inch
Weight (lb.)			
Range	98–146	110–205	165–205
Average	130	149	186
Height			
Range	5′6″–5′8″	5′1″–6′1″	5′5″–6′
Average	5′7½″	5′6½″	5′7½″

There were no serious immediate or late complications in our series. There was no evidence of clinical symptoms of pneumothorax. There was one case of drug intolerance. The mild manifestations of cortical stimulation in this patient were easily controlled. To emphasize the futility of striking the first rib, we consider contact of the needle with the first rib as a complication.

The ½-in. needle was bent on two occasions. Curiously enough, this did not occur on striking the first rib but rather during the withdrawal period of the needle toward the skin surface. When bending occurs, it is assumed that the slender needle has become weakened and it is discarded. There were no broken needles. The periosteum of the first rib seems to cushion the shock when it is struck by the needle. The subclavian vessels were penetrated on ten occasions, but there were no subsequent haematomas. The small-gauge atraumatic needle probably leaves such a small puncture hole that the blood vessel seals up instantly upon its withdrawal.

Owing to the relatively small volume of solution injected, there was only one case of stellate ganglion infiltration as evidenced by Horner's syndrome. There was no clinical evidence of phrenic nerve block. There were no cases of nerve injury.

Discussion

The short-needle technique presents certain advantages which justify discussion. The short length of the needle and its small gauge make the method of brachial plexus block anaesthesia readily acceptable. Many unwilling patients when shown the small needle readily submitted to the procedure. The needle insertions cause no discomfort to the patient. With the small needle, practical instruction in teaching brachial plexus block anaesthesia does not require the "nail-biting" supervision which occurs when a 2-in. needle is being inserted to its shank. Indeed the absence of pneumothorax in our series is evidence that the multiple blind punctures are not a hazard. Since the needle is almost instantly withdrawn after each thrust until paraesthesias are felt, it is doubtful whether the alveoli would tear and produce a pneumothorax from within should the pleura be accidently punctured (5).

When the short, sharp needle inserted with a quick thrust strikes the divisions of the brachial plexus, the nerves are transfixed and paraesthesias occur readily. With a longer, larger needle, advanced cautiously and s owly, the nerves are more likely to roll off from its path and paraesthesias are more difficult to establish.

Nothwithstanding the possibility of needle breakage, there does not appear to be any other gross disadvantage to the short-needle technique in brachial plexus block.

Summary

In the hope of reducing the incidence of pneumothorax associated with brachial plexus block anaesthesia, a short-needle technique, using the supra-clavicular approach, is described and the results in 82 cases are analysed.

Rather than use a mobile marker on a long needle shaft, the short needle is preferred as a safety precaution. The penetration of the short needle is necessarily limited to its length when the shank impinges upon the depressed skin surface. A ½-in., 24-gauge needle was used in the majority of cases. Since the success of the short-needle technique depends on causing the brachial plexus bundle to come as close as possible to the supraclavicular skin surface, special recommendations with regard to posturing of the patient are given.

The anaesthetist performs the block while standing at the head of the table behind the shoulder of the patient, on the side to be blocked.

The only criterion for a properly placed needle is paraesthesia, and the first rib is never sought as a deep landmark. Contact of the first rib with the needle is considered a hazard and an accident.

The short needle makes it possible to locate paraesthesias rapidly without fear of penetrating the pleura. Quick needle thrusts are made and the nerves of the brachial plexus are easily transfixed by the short, sharp, rapidly moving needle. The nerves are more likely to roll off from the path of a longer, larger gauge needle which is advanced cautiously and slowly.

An average of 24.5 cc. of a 1½ per cent Xylocaine solution was used. The entire volume of solution is injected at the spot where paraesthesias are felt.

Complete anaesthesia developed rapidly in 75 patients. Delayed onsets were classified as failures. Absence of paraesthesias was also included in the failures although infiltration was not attempted in these cases. This accounts for the relatively high failure rate of 8.5 per cent.

An attempt was made to accelerate onset of anaesthesia by the application of ultrasound in eight patients. No definite conclusions were reached regarding the diffusion of anaesthetic solutions by ultrasound.

There were no pneumothoraces or other serious immediate or late complications.

The anaesthetist is cautioned against the possibility of needle breakage.

Advantages of the short-needle technique are set forth in the discussion. It is pointed out that practical training in brachial plexus block anaesthesia is greatly facilitated by the short-needle technique.

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Résumé

Dans le but de réduire la fréquence du pneumothorax, complication redoutable, associée à l'anesthésie régionale du plexus brachial, les auteurs présentent une modification d'une technique classique. Ils décrivent les résultats obtenus dans 82 cas pratiqués au moyen d'une aiguille courte passant par la voie d'approche sus-claviculaire.

Au dire des auteurs, l'aiguille courte apporte plus de sécurité qu'une aiguille longue sur laquelle on a placé un guide mobile. Tout en pratiquant une pression sur les tissus mous au niveau du creux sus-claviculaire, la pénétration en profondeur de l'aiguille est nécessairement limitée à sa longueur. Une aiguille de ½ pouce de longueur et de calibre 24 a été utilisée dans la majorité des cas.

Attendu que le succès de cette technique dépend de la proximité du plexus vis-à-vis la région sus-claviculaire, certaines recommandations sont données sur la façon de placer le patient.

L'anesthésiste prend place à l'arrière de la table du côté de la région à infiltrer.

Le seul critère qui indique que l'aiguille est bien en place est la paresthésie et la première côte n'est jamais recherchée comme point de repaire profond. Le contact de l'aiguille avec la première côte est un danger à éviter.

L'aiguille courte permet de faire rapidement le repérage de la paresthésie sans danger de perforer la plèvre. En donnant les coups de pointe de repérage rapidement, l'aiguille courte, de petit calibre, embroche facilement le nerf. Au contraire, une aiguille longue de plus grand calibre, avancée lentement et avec prudence, glisse plus facilement à côté des nerfs.

Une moyenne de 24.5 cc. d'une solution de Xylocaine à 1½% ont été injectés à l'endroit même ou la paresthésie a été obtenue.

Une anesthésie rapide, presque immédiate, a été observée chez 75 patients. Les anesthésies à retard ont été classifiées parmi les échecs. Les absences de paresthésie ont été également classifiées dans le groupe des échecs, bien que en l'occurrence, l'infiltration n'ait pas été pratiquée. Ceci explique un taux d'échecs relativement élevé, se chiffrant à 8.5%.

Dans une tentative d'accélérer le début de l'anesthésie, huit cas ont reçu des applications d'ultrasons au niveau de la région infiltrée. Aucune conclusion définitive n'a été énoncée en ce qui regarde la rapidité de diffusion des solutions anesthésiques par les ultrasons.

Dans toute la série, il ne s'est pas présenté de pneumothorax ni d'autres complications sérieuses immédiates ou tardives.

Les auteurs mettent le lecteur en garde contre la possibilité de briser l'aiguille.

Les avantages de la technique sont présentés dans la discussion. Entre autres, elle rend plus pratique et moins dangereuse l'enseignement d'une technique délicate.

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