

EXPERIENCE WITH THREE THOUSAND CASES OF BRACHIAL PLEXUS BLOCK; ITS DANGERS

Report of a Fatal Case

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IN JULY OF 1936 we published a paper dealing with 250 cases of Block Anesthesia of the Brachial Plexus.²⁰ We expressed at that time our surprise at the lack of interest which the majority of surgeons manifest in this procedure. Moreover, we pointed out that a definite dearth of literature existed concerning brachial plexus block. Shortly after our report in July of 1936 a thesis for doctorate¹⁵ was published dealing with 403 cases of block anesthesia of the brachial plexus.

Owing to the great number of war casualties with wounds of the upper extremities which came under our care at the Orthopedic Services of the Casa de Salud-Valdecilla and the Hospital Militar Cantabro, we have been able to compile 3000 cases in which block anesthesia of the brachial plexus has been used. In the present paper we shall not discuss fundamental considerations of this procedure, nor anatomic details and technics. Instead, drawing from our experience, we shall confine ourselves to a discussion of the accidents encountered in the use of brachial plexus block, one of which in our series proved fatal. We hope, also, to elucidate the causes of such accidents; thus aiding in their prevention and raising the procedure of brachial plexus block to a more deserved place in the surgery of the upper extremity.

In practically all of our cases, the technic described by Kulenkampff,¹⁴ and expanded by us in our previous paper, was employed.

The supraclavicular region contains important anatomic structures with which we must be completely familiar if we would obviate accidents. It is situated over the dome of the pleura and is traversed by major nerves and blood vessels. This region is also noted for the rapidity with which drugs are absorbed by it; hence the dosage and toxicity of the anesthetic agent should be carefully borne in mind. With the foregoing facts as a basis, the accidents encountered in brachial plexus block are classifiable into pleuropulmonary, neural and vascular. However, before discussing these accidents, we shall point out the importance of choosing the proper anesthetic and its dosage. At present we are using novocain "Bayer," a 2 per cent solution "without adrenalin," and in none of our cases have we observed lipotemias or syncopes; only once did a mild degree of cerebral excitation, as is seen in the first stage of ether anesthesia, occur, when the dose exceeded the currently used dose of 20 cc., or when the latter dose was employed in children. Reducing the dose to a suitable amount, we have succeeded in obtaining adequate anesthesia in babies as young as one and one-half years of age. On the other hand, when

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constrained by circumstances to employ substitutes for novocain, such as, sincaïn, sedocain, alocain, etc., it was not uncommon to observe untoward effects of tachycardia, chills, bouts of sweating, and angina pectoris. In one case, when by error novocain with adrenalin was used, tachycardia and

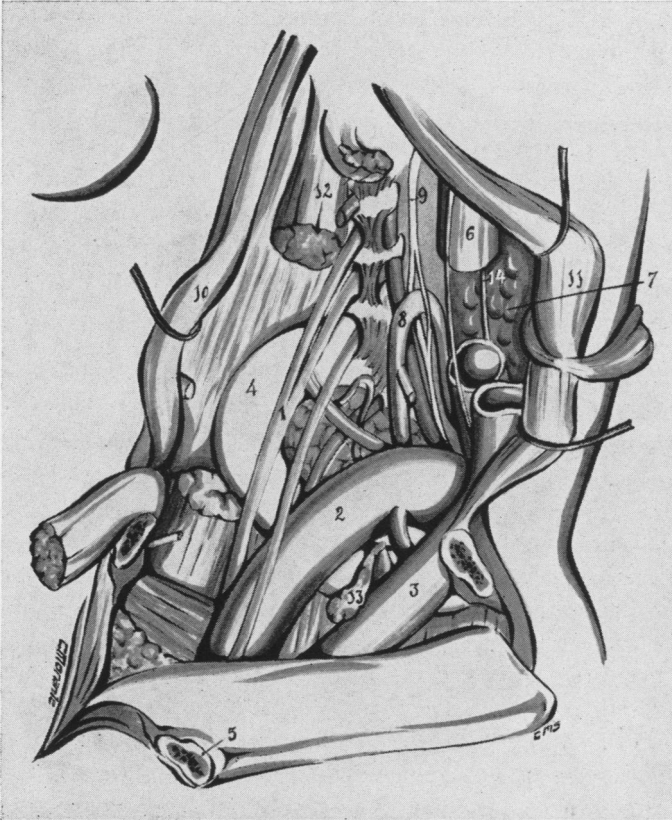


FIG. 1.—Right supraclavicular region, head being turned to the opposite side; the sterno cleido mastoid and trapezius muscles are drawn aside by means of retractors; the omohyoid and the clavicle are sectioned and the latter is pulled down. (1) brachial plexus, (2) subclavian artery, (3) subclavian vein, (4) 1st rib, (5) clavicle, (6) vasculo-nervous plexus of the neck, (7) thyroid, (8) inferior hyoid artery, (9) chain of sympathetic ganglia, (10) trapezius, (11) sternocleidomastoid muscle, (12) posterior scalenus, (13) anterior scalenus, (14) recurrent nerve.

arrhythmia resulted of such a degree, that, though the patient did not expire, death seemed imminent.

To obtain a prolonged anesthesia, we have never employed percain; in all our cases an anesthesia of two hours, produced with novocain, being sufficient. Concentrations of novocain of less than 2 per cent produce poor results, and we deem greater than 2 per cent to be dangerous.

To obviate the untoward effects resulting from both the toxic action of

the drug and from its rapid absorption in the cervical region, we believe it a prudent measure to inject the drug very slowly and to record the rate of the radial pulse.

In the foregoing accidents Coramine has been found efficacious.

Pleuropulmonary Accidents. From a careful review of the literature on brachial plexus block, we have gleaned three reports of death following this procedure; namely, Capelle in 1916,⁴ Vischer in 1918,²² and Hering in 1920.⁷

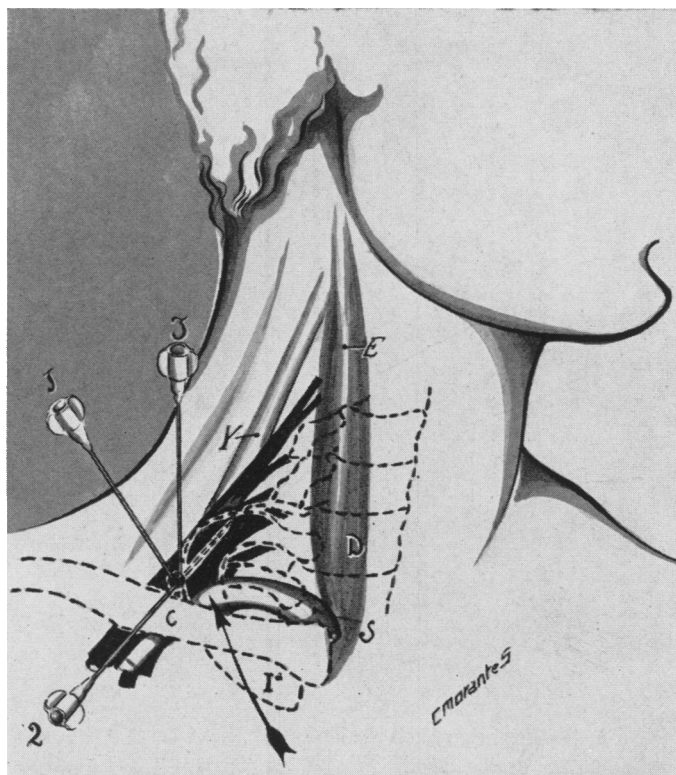


FIG. 2.—Technic of Kulenkampff. (1) 1st stage, (2) 2nd stage, (3) 3rd stage. The arrow indicates the point where one should place the index finger to protect the subclavian artery. (S) subclavian artery; (C) clavicle; (E) anterior border of the trapezius; (Y) posterior border of the sternocleidomastoid muscle; I (a) 1st rib.

All of these deaths resulted from trauma to the apical pleural and lung parenchyma. The trauma was produced by incorrect insertion of the injecting needle beneath the first rib as a result of respiratory movement. The supraclavicular technic of Kulenkampff was used by all these surgeons. Following such trauma there supervened rapidly a subcutaneous emphysema, pneumothorax, hemothorax and dyspnea, successively; and in Capelle's case the patient died on the second day. An autopsy revealed, in addition to pneumo-

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sema. All the cases showed emphysema and cardiovascular insufficiency. Weil²³ reported a case of spontaneous recovery following mediastinal emphysema.

On five occasions we punctured the parietal pleura the sibilant sound produced by the intrushing air, however, placed us on guard, and the needle was withdrawn carefully. Roentgenograms disclosed the presence of moderate

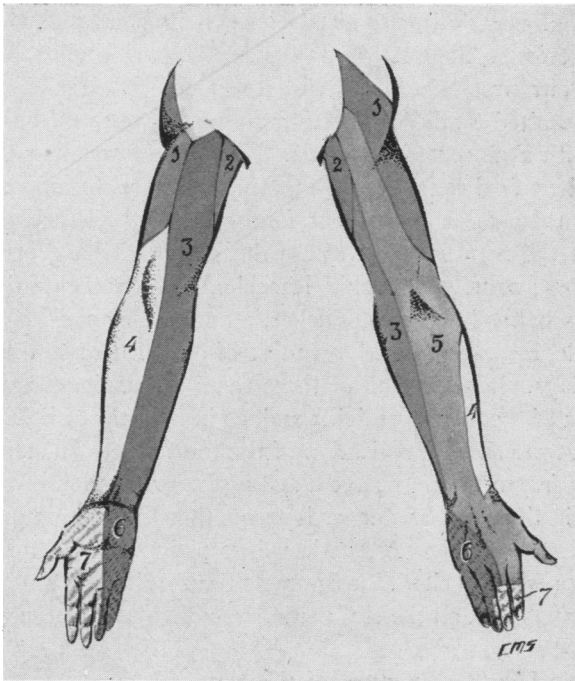


FIG. 3.—Zone of innervation of each of the branches of the brachial plexus. (1) circumflex, (2) accessory of the internal cutaneous brachial nerve and intercostal nerves, (3) internal brachial cutaneous nerve, (4) musculo-cutaneous, (5) radial, (6) cubital, (7) median.

pneumothorax which, together with the consequent dyspnea, subsided in 48 hours.

In order to obviate pleuropulmonary accidents Capelle adopted the axillary route of Hirschel,⁸ but as we shall presently point out, this route is no less dangerous than the supraclavicular route. Mulley,¹⁶ in 1919, with the same intention modified the technic of Kulenkampff, placing the point of injection 3 cm. above the clavicle and 2 cm. lateral to the external jugular vein, and maintaining the needle in a more horizontal position. We believe that this modification renders the procedure of brachial plexus block less certain. The same can be said for the infraclavicular technic of Balog,² or and of the Anglada Santoni, technic as well as of the Kinn modification.¹²

We consider the paravertebral technic of Kappis¹¹ to be unusual. To avert pleuropulmonary accidents we maintain that adherence to the technic of Kulenkampff alone is necessary.

Neural Accidents. We shall not consider here the transient aphonias and Claude Bernard-Horner syndromes that supervene from the anesthesia of the recurrent laryngeal nerve and of the cervical sympathetic chain respectively. Hemidiaphragmatic paralysis can occur as a result of phrenic nerve block if excessive infiltration of the region, or incorrect technic is practised. We have, however, on four occasions, produced bilateral brachial plexus block without any untoward effects. Siebres²¹ and Klauser¹³ report similar successes.

Following our first experience with the technic of Kulenkampff, on one patient there resulted a mild contraction and paresthesia of the lower extremity together with a moderate lipotemia. We conjectured that the needle may have entered the spinal canal through an intervertebral foramen.

Of the neural complications that follow brachial plexus block especially interesting are the meralgias with paresthesias which have been pointed out by many authors; namely, Babitzki,¹ Raechke,¹⁹ Flesch-Telesius,⁵ Hartler and Keppler,⁶ Hirschel,¹⁹ Borchers,³ Pacher,¹⁷ and Hylkema.¹⁰ These complications all subside, some very slowly. In five of our own cases the complications abated in 20 days. In almost all of these cases a tourniquet was employed to obtain ischemia of the operative field; and, as in the case of Babitzki, meralgias did not occur at the site of application of the tourniquet. In some of the cases, displaced bony fragments may have aided in the production of these complications. Lastly, in the cases of Pacher it seems that the trauma produced by the intraneural injection of the anesthetic will explain these complications.

A thesis¹⁵ previously cited, incorporates the results of a study of the effects of brachial plexus block on the chronaxie. We have never been able to observe any alteration.

Vascular Accidents. Puncture of the common carotid, subclavian, vertebral, and inferior thyroid arteries can, and, in fact, does occur. It has very frequently happened in our own experience. Simple withdrawal of the needle alone is necessary, when it does occur. At times a hematoma will form, but will disappear with the application of a compression bandage. In one of our cases edema of the upper extremity supervened, but subsided after 48 hours with the extremity in the position of abduction.

Intra-arterial injection of the anesthetic produces only a transient state of anesthesia. On the other hand, intravenous injection is dangerous, for the anesthetic is carried to the heart. Moreover, part of the drug may reach the medulla oblongata and produce cardiorespiratory difficulties. Intravenous injection is eight to ten times more toxic than intra-arterial injection, according to Pauchet,¹⁸ even though only one-sixth of the drug ever reaches the cerebrum. We know of no case of death reported as resulting from this mechanism. In the absence of other explanations we believe that perhaps the single case of death in our own series resulted from intravenous injection of the anesthetic.

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Report of a Fatal Case. An emaciated woman, age 67, was to be treated for an old fracture of the clavicle at the junction of its middle and inner thirds. The fragments were misplaced and an exuberant callus, the size of an orange, had formed. The patient presented no signs nor symptoms suggestive of pleuropulmonary disease. The supraclavicular technic of Kulenkampff was to be employed. But due to the abnormal anatomic conditions that prevailed, the pulse of the subclavian artery, which is a landmark, could not be felt and a point above the customary midpoint on the clavicle was elected. The needle was directed obliquely to avoid the obstacle presented by the callus, and perhaps in searching for the brachial plexus, the subclavian vein was entered. We suspected that intravenous injection had occurred, when the patient became pallid and cold, and her pulse became weak. The patient lost consciousness, and died in two minutes, despite the

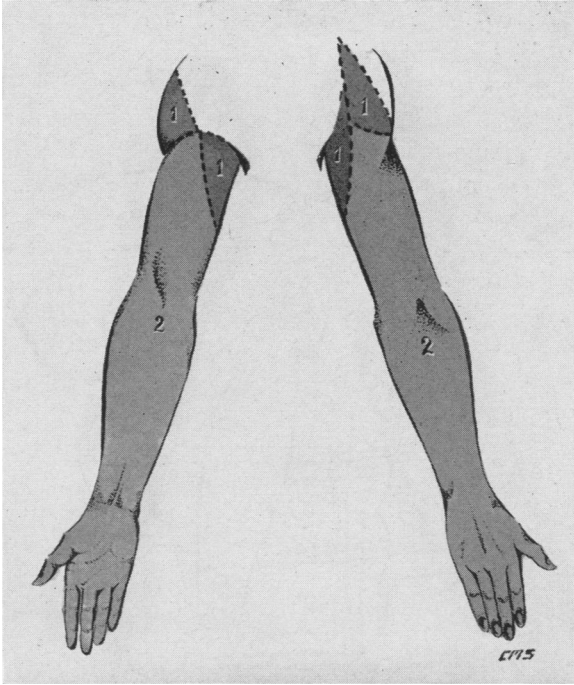


FIG. 4.—Zones of anesthesia of the brachial plexus. (1) Hypoesthesia corresponding to the territories innervated by the branches of the circumflex nerves, 1st and 2nd intercostals. (2) complete anesthesia.

use of cardiovascular tonics and artificial respiration. The anesthetic used was 25 cc. of 2 per cent novocain.

An autopsy performed by Doctor Sanchez-Lucas of the Casa de Salud-Valdecilla, failed to disclose any lesion that would explain this fatality. We believe that the drug entered the venous system through the subclavian vein, was carried to the heart, and subsequently produced its mischief in the central nervous system.

This accident, though fatal, is insufficient to make us abandon this procedure which is so beneficial to the patient and so helpful to the surgeon. In another article we have discussed the advantages of brachial plexus block, and hence we shall not do so here.

Since this fatality, we have successfully employed brachial plexus block in more than 1200 cases. The supraclavicular technic of Kulenkampff was used, and we are favoring this technic more and more each day. We consider the infraclavicular technic of Balog or that of Anglada, Santoni, and above all, the axillary technic of Hirschel to be very dangerous. Our reasons for this statement are that the artery and vein are in proximity in the infraclavicular

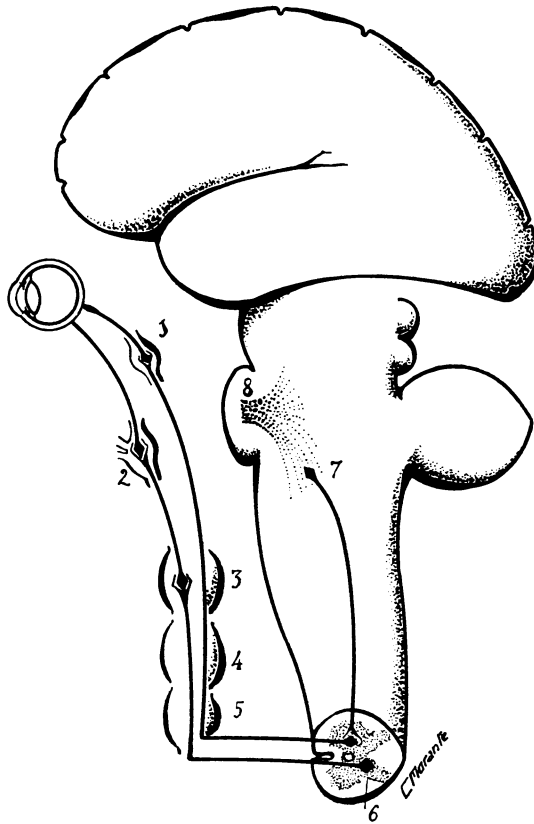


FIG. 5.—Claude Bernard-Horner syndrome. (1) ciliary ganglion, (2) Gasserian ganglion, (3) superior cervical ganglion, (4) median cervical ganglion, (5) inferior cervical ganglion, (6) cilio-spinal center of Budge, (7) Oculo sympathetic bulbar center, (8) descending root of the trigeminus.

region, and that the nerves of the plexus form a network around the vein at the level of the axilla; thus the veins are more easily exposed to accidental puncture.

All of the cases of death and accident, including our own, can be imputed to errors in technic which are easily averted. To present the dangers attending brachial plexus block, and a few methods of preventing them, has been the object of this paper.

SUMMARY

This article, based on a series of 3000 cases, treats of the dangers attending brachial plexus block. It completes a study of this method which was begun with a former publication. We prefer the use of 20 cc. of novocain (2 per cent) without adrenalin. The supraclivacular technic of Kulenkampff is followed, and the dangers attending the infraclavicular technics of Balog, Anglada, Santoni, and the axillary technic of Hirschel, are pointed out. A consideration of meralgias with paresthesias as observed by different authors has been given. To three cases of death following brachial plexus block gleaned from the literature, we add our own case which is of a different origin. We indicate methods of relieving accidents and of obviating them. We believe this type of anesthesia is preferable for all surgery of the upper extremity.

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