



Ain Shams University
Faculty of Medicine
Anesthesia, Intensive Care and Pain Management Department

REGIONAL BLOCKADE IN NECK AND SHOULDER SURGERY

An essay

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By

Goda Abdel Monem Mohamed
(M. B., B.Ch)

Supervised by:

Dr/ Mahmoud Sherif Mostafa

Professor of Anesthesia and Intensive Care
Faculty of Medicine, Ain Shams University

Dr/ Gamal Eldin Mohammad Ahmad Elewa

Professor of Anesthesia and Intensive Care
Faculty of Medicine, Ain Shams University

Dr/Hadeel Magdy Abdel Hamid

Lecturer of Anesthesia and Intensive Care
Faculty of Medicine, Ain Shams University

Ain Shams University
Faculty of Medicine
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رسالة

توطئة للحصول على درجة الماجستير فى الطب البشري

مقدمة من

الطبيب/ د. محمد مصطفى

بكالوريوس الطب والجراحة

د. محمد مصطفى

د. محمد مصطفى / د. محمود شريف مصطفى

أستاذ التخدير والرعاية المركزة

كلية الطب- جامعة عين شمس

د. محمد مصطفى / د. الدين محمد عليوه

أستاذ التخدير و الرعاية المركزة

كلية الطب – جامعة عين شمس

د. محمد مصطفى / د. هديل مجدى عبد الحميد

مدرس التخدير والرعاية المركزة

كلية الطب – جامعة عين شمس

جامعة عين شمس

كلية الطب

د. محمد مصطفى

INTRODUCTION

Regional anesthesia has enjoyed a tremendous increase in popularity over the past two decades (***Pollock, 2003***). With modern general anesthetic techniques, recovery after surgery can be both rapid and complete. However, in many day care patients, regional anesthetic techniques might be preferable. Regional anesthesia can reduce or avoid the hazards and discomforts of general anesthesia including sore throat, airway trauma, and muscle pain. It also offers a number of advantages to outpatients undergoing surgery. These techniques provide analgesia without sedation, allow earlier discharge and give prolonged postoperative analgesia. Regional anesthesia reduces the requirements of opioids, thus reducing the incidence of postoperative nausea and vomiting. It can be used alone, in combination with sedation techniques or as a part of balanced analgesia with general anesthesia (***Rawal, 2001***).

There is a wide variety of patients who present for shoulder surgery, ranging from the fit, robust patient with a sports injury requiring a stabilization procedure, to the frail, elderly rheumatoid patient requiring joint decompression or arthroplasty. Recent surgical advances have resulted in the

development of minimal access arthroscopic procedures with resulting improvements in speed of convalescence. However, the management of severe postoperative pain remains a major challenge for many anesthetists. Regional anesthetic techniques have the ability to control pain effectively both at rest and on movement, reduce muscle spasm, and allow earlier mobilization and co-operation with physiotherapy. Therefore, these techniques have the potential to improve both patient recovery and outcome after both open and arthroscopic surgeries. Management of these patients requires thorough preoperative assessment, careful intraoperative management, and appropriate use of regional anesthetic techniques to provide adequate dynamic pain relief in the initial postoperative period. When planning an anesthetic for shoulder surgery, surgical and patient factors need to be considered. An interscalene approach to the brachial plexus is the most appropriate block to provide analgesia for the shoulder. Many shoulder procedures can be carried out with regional anesthesia alone, but a combination of regional and general anesthesia may be more appropriate for prolonged major procedures or where discomfort in other areas may limit comfortable positioning on the operating table **(Beecroft and Coventry, 2008)**.

AIM OF THE STUDY

The aim of this essay was to throw lights on the role of regional anesthetic techniques in neck and shoulder surgery with explanation of different methods of regional anesthesia.

ANATOMICAL CONSIDERATIONS

A-Anatomy of cervical plexus(Ellis et al, 2004).

Formation of cervical plexus (Fig. 1)

The anterior rami of the upper four cervical nerves unite by a series of loops to form the cervical plexus, whose function is the supply of the skin and muscles of the neck and the innervation of the diaphragm.

The loops are three in number, C1–2, C2–3 and C3–4, with a further loop (C4–5) often present to connect the cervical plexus with the brachial plexus. They lie on the scalenus medius and legato scapulae muscles under the cover of the sternocleidomastoid muscle. The anterior primary ramus of C1 is entirely motor. It emerges from the vertebral canal in the groove on the posterior arch of the atlas immediately behind the superior articular facet. Here, the nerve intervenes between the posterior arch and the vertebral artery. The nerve then runs forward on the lateral side of the lateral mass, lying *medial* to the vertebral artery as this emerges from its foramen transversarium. Twigs of supply are given to rectus capitis lateralis and anterior and to longus capitis, then the nerve

descends to form a loop with the ascending branch of C2 in front of the transverse process of the atlas. The majority of the fibers in this loop run forward to join the hypoglossal nerve at the level of the atlas; through this link with XII, C1 supplies the geniohyoid and thyrohyoid muscles, and then runs downwards as the *descendens hypoglossi*, from which the nerve to the anterior belly of the omohyoid muscle is derived. Descendens hypoglossi joins *descendens cervicalis*, derived from C2 and 3, to form a loop termed the *ansa cervicalis*, which lies on the carotid sheath. From the ansa nerve, fibers pass to supply sternohyoid, sternothyroid and the posterior belly of omohyoid.

The anterior primary ramus of C2 emerges posteriorly to the superior articular process of the axis, and then passes forwards on the lateral side of the vertebral artery. It divides into an ascending branch, which joins C1, and a descending branch which loops to join C3. The remaining anterior primary rami of the cervical nerves emerge from the intervertebral foramina anterior to their articular pillars and lateral to the vertebral artery. Each root receives a grey ramus communicans from the superior cervical ganglion.

Branches of the cervical plexus(Fig. 1):

The branches of the cervical plexus can be divided into four groups.

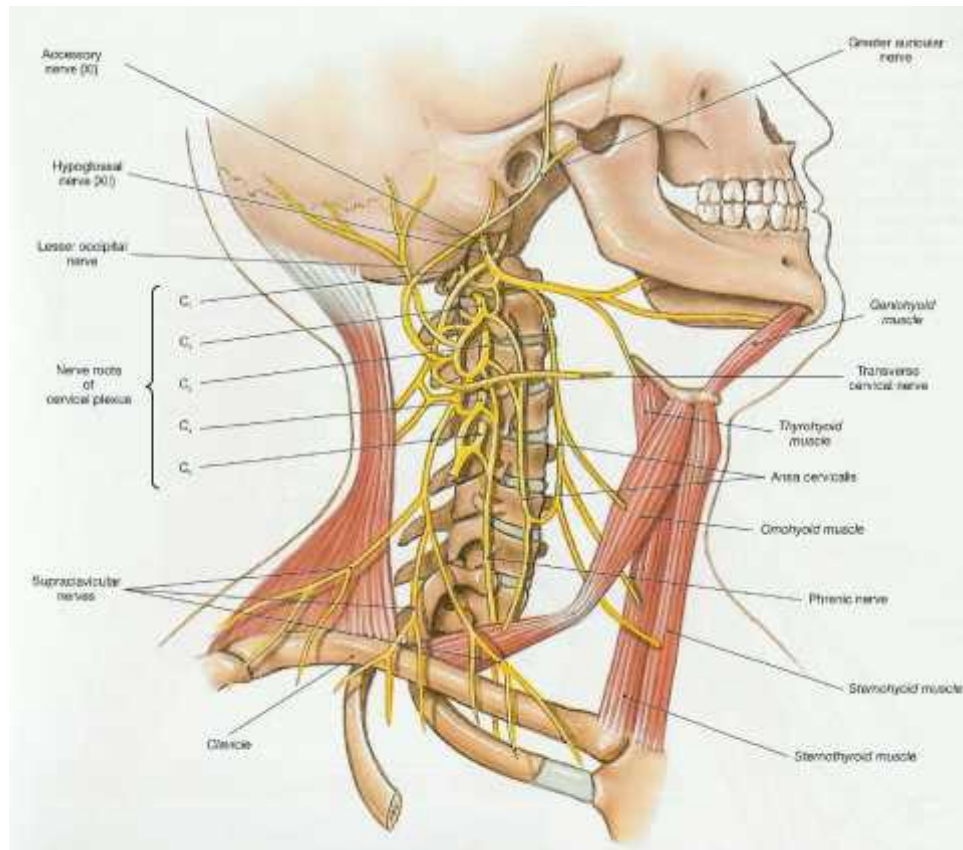


Figure (1): Formation and branches of cervical plexus (**Morgan et al, 2006**).

1-Communicating branches, which pass to the hypoglossal nerve and which also pass to the vagus and to the cervical sympathetic chain.

2- Superficial branches, which supply cutaneous fibres to the neck.

3- Deep branches, to the neck muscles.

4-The phrenic nerve, which is the motor nerve of the diaphragm (apart from an unimportant contribution to the crura

from T11 and 12) and which also transmits proprioceptive fibers from the central part of this muscle.

Obviously, the second and fourth groups are the ones of greatest interest and importance to the anesthetist.

The superficial cervical plexus:

The superficial cervical plexus comprises superficial branches, that can be tabulated into ascending, transverse and descending groups:

A- Ascending -lesser occipital nerve (C2); great auricular nerve (C2, 3).

B- Transverse -anterior cutaneous nerve of neck (C2, 3).

C- Descending -the supraclavicular nerves (C3, 4); C1 has no cutaneous branch.

The lesser occipital nerve (C2) hooks around the spinal accessory nerve (XI), then ascends along the posterior border of the sternocleidomastoid . It pierces the deep fascia in the upper part of the posterior triangle, then splits up into three branches:

1- Auricular -to the upper third of the medial aspect of the external ear.

2- Mastoid -to the skin over the mastoid process.

3- Occipital -to the occipital area immediately above and behind the mastoid.

The great auricular nerve (C2, 3) is the largest cutaneous branch of the cervical plexus. It hooks around the mid-point of the posterior border of sternocleidomastoid, then

passes across it in the direction of the angle of the mandible. On this muscle, it breaks up into three terminal branches.

1- **Auricular** -supplying the lower two-thirds of the medial aspect of the external ear and the lateral surface of the lobule.

2- **Mastoid** -to the skin over the mastoid process.

3- **Facial** -to the skin over the masseter and the parotid gland.

The anterior cutaneous nerve of the neck (C2, 3)

emerges close below the great auricular nerve at the posterior border of sternocleidomastoid, then passes horizontally forward on the muscle, deep (sometimes superficial) to the external jugular vein. At the anterior border of sternocleidomastoid, the nerve pierces the deep fascia and splits into branches to supply the skin of the whole front of the neck.

The supraclavicular nerves (C3, 4): arise as a common stem that emerges from behind sternocleidomastoid immediately below the other cutaneous nerves of the plexus. This stem soon splits into three branches medial, intermediate and lateral which pierce the deep fascia above the clavicle, cross this bone and supply the skin over the upper sternum, the upper chest wall (as far down as the 3rd rib) and the upper deltoid. On careful palpation, these nerves can be rolled over the subcutaneous anterior border of the clavicle. Although the supraclavicular nerves do not form part of the brachial plexus, they are often blocked by approaches to the upper plexus, e.g.

the interscalene approach. It is likely that this is due to cranial paravertebral spread of local anesthetic.

The deep cervical plexus:

This supplies the anterior vertebral muscles, the recti capitis, longus capitis and longus cervicis, as well as giving contributions to scalenus medius (the main scalene innervation is from the roots of the brachial plexus). In addition, branches pass to levator scapulae (C3, 4) and to two muscles whose principal innervation is from the spinal accessory nerve: sternocleidomastoid (C2, 3) and trapezius (C3, 4).

The phrenic nerve (C3–5):

The phrenic nerve is, of course, the most important branch of the cervical plexus. It provides the motor innervation of the diaphragm (apart from a clinically insignificant contribution to the crura from T11 and 12) and transmits proprioceptive sensory fibres from the central part of the diaphragm. In addition, filaments are supplied to the pleura and pericardium.

The principal component of the nerve is derived from the anterior primary ramus of C4 but contributions are also provided from C3 and 5. The three roots of the nerve join at the lateral border of scalenus anterior and then the fully constituted nerve runs downwards and medially across the anterior face of the muscle, covered by, and showing through, the prevertebral fascia. On scalenus anterior, the phrenic nerve is overlapped by

the internal jugular vein and the sternocleidomastoid muscle, and is crossed by the inferior belly of the omohyoid and by the transverse cervical and transverse scapular vessels. On the left side, in addition, the nerve is crossed by the thoracic duct.

The nerve then passes over the first part of the subclavian artery, behind the subclavian vein, to enter the thorax, where it crosses the internal thoracic artery posteriorly from the lateral to the medial side. This artery provides a pericardiophrenic branch that accompanies the nerve on its intrathoracic course. Within the thorax, the relations of the nerve differ on each side. On the right, the nerve hugs the great venous pathway, descending on the lateral sides successively of the right brachiocephalic vein, the superior vena cava, the right atrium (separated by pericardium) and the intrathoracic portion of the inferior cava, covered throughout laterally by the mediastinal pleura. On the left, the nerve has a longer and more oblique course. It passes down between the left subclavian and left common carotid arteries, crosses the arch of the aorta (passing here in front of the vagus nerve), descends anterior to the root of the lung and then along the pericardium covering the left ventricle. Laterally lies the mediastinal pleura.

On the right, the nerve pierces the central tendon of the diaphragm immediately lateral to the opening for the inferior

vena cava; some nerve fibres may actually accompany the vein through this orifice. The left nerve penetrates the diaphragm one cm lateral to the attachment of the fibrous pericardium. On both sides, the nerve fibres then supply the muscle on its abdominal aspect.

Occasionally, the contribution from C5 to the phrenic nerve may come as an accessory phrenic nerve, either directly from the root of C5 across scalenus anterior or from the nerve to subclavius. In the latter case, the filament crosses anteriorly (occasionally posteriorly) to the subclavian vein to join the main phrenic trunk behind the 1st costal cartilage.

B-Anatomy of brachial plexus

The brachial plexus is a somatic nerve plexus formed by intercommunications among the ventral rami of the lower four cervical nerves (C5-C8) and the first thoracic nerve (T1). The plexus is responsible for the motor innervations of the muscles of the upper limb with the exception of the trapezius and levator scapula. It supplies all of the cutaneous innervation of the upper limb with the exception of the area of the axilla (supplied by the intercostobrachial nerve), and an area just above the point of the shoulder (supplied by supraclavicular nerves) and the dorsal scapular area which is supplied by cutaneous branches of dorsal rami. The brachial plexus communicates with the sympathetic

trunk by gray rami communicate that join all the roots of the plexus and are derived from the middle and inferior cervical sympathetic ganglia and the first thoracic sympathetic ganglion.

Prefixed brachial plexus occurs when the C4 ventral ramus contributes to the brachial plexus. Contributions to the plexus usually come from C4-C8. **Postfixed brachial plexus** occurs when the T2 ventral ramus contributes to the brachial plexus. Contributions to the plexus usually come from C6-T2 (**Berg, 1999**). In two thirds of patients, the fourth cervical nerve contributes to the brachial plexus and in one third of patients the second thoracic nerve contributes to the brachial plexus (**Winnie, 1983**).

A continuous facial sheath extends from the cervical transverse processes to several centimeters beyond the axilla to enclose the entire brachial plexus from the cervical roots to the terminal nerves of the upper arm (**Bridenbaugh, 1988**).

Formation of the brachial plexus (Fig.2) :

The nerve roots emerge from the intervertebral foramina and course behind the vertebral artery. They then pass anterolateral and inferiorly between the anterior and middle scalene muscles, where they join to form the superior (C5, C6), middle (C7), and inferior (C8, Th1) trunks of the brachial plexus. The phrenic nerve (C3-5) lies anterior to the anterior

scalene muscle and is susceptible to block during interscalene brachial plexus block (**Benzon, 1999**).

These trunks emerge from the interscalene space at the lower border of these muscles and continue anterolaterally and inferiorly to converge towards the upper surface of the first rib where they are closely grouped (and they are arranged according to their designation “superior” middle” and “inferior”: i.e. one above the other vertically. At the lateral edge of the rib, each trunk divides into anterior and posterior divisions which pass inferior to the mid-portion of the clavicle to enter the axilla through its apex (**Bridenbaugh, 1988**).

The divisions are important because the destination of all the fibers contained therein is determined at this level; the fibers of the three anterior divisions (after grouping one last time) provide the nerves that innervate the shoulder girdle and the fibers of the posterior division innervate the posterior surface (**Winnie and Franco, 1998**).

As the brachial plexus emerges below the clavicle, the fibers combine again to form three cords that are named according to their relationship to the second part of the axillary artery: lateral, medial and posterior. The lateral cord is formed by the union of the anterior divisions of the superior and middle trunks and; the medial cord is the