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Paresthesia in Spinal Anesthesia

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1. Introduction

Spinal anesthesia is induced by injecting small amounts of local anesthetic into the cerebro-spinal fluid (CSF), which solution must be capable of blocking nerve paths, and non-toxic, that is, it should not hinder the proper functioning of the bulbar centers, or interfere with the metabolic processes of the more important organs. The injection is usually made in the lumbar spine below the level at which the spinal cord ends (L_2). Recently the anatomy of the thoracic spinal canal was investigated with magnetic resonance image (RMI) 19 [1] and 50 [2] patients, and it has been demonstrated the safety of the segmental spinal anesthesia at T10 by using the combined spinal-epidural technique [3] or single puncture [4].

If the anesthetist has an adequate knowledge of the relevant anatomy, physiology and pharmacology, safe and satisfactory anesthesia can easily be obtained to the mutual satisfaction of the patient, surgeon and anesthetist. To become expert in the art of spinal anesthesia is no simple matter for the beginner, for many solutions and techniques are available and many problems present themselves which form subjects for discussion and disagreement. The literature is abundant, very illuminating and worthy of very close inspection for begin. Direct trauma to nervous tissue may occur at the level of the spinal cord, nerve root, or peripheral nerve. During attempts to insert a spinal needle into the subarachnoid space, patients occasionally experience paresthesia with a report ranging from 6.3% to 20% [5-8]. Two thirds of anesthesia related neurological complications are associated with either paresthesia (direct nerve trauma) or pain during injection (intraneural location) [9]. Although the etiology of paresthesia has not been precisely determined, the widely held conventional wisdom is that they result from needle to nerve contact. Some anesthesiologists believe paresthesias occur when the needle contacts a spinal nerve within the epidural space or the subarachnoid space and as such indicates that spinal needle is misdirected. Because of this, several authors advocate withdrawing the spinal needle and redirecting it away from side where the paresthesia occurred [5-9].

2. Definition

Paresthesia during regional anesthesia is an unpleasant sensation for patients and, more importantly, in some cases it is related to neurological injury. Paresthesia is an abnormal condition in which patients feel a sensation of burning, numbness, tingling, itching or prickling. Paresthesia can also be described as a pins-and-needles or skin-crawling

sensation. Paresthesia most often occurs in the extremities, such as the hands, feet, fingers, and toes, but it can occur in other parts of the body. Paresthesia during spinal anesthesia increases patient discomfort and the risk of abrupt movement but, more importantly, paresthesia may be associated with neurological damage. The sensation is unpleasant and it usually has two phases: the first one is the sudden excitation of the muscle involved with that nerve if it is a motor one (fast conduction). And second, one form of pain sensation if the fibers are of a sensitive nerve (slow conduction). In the mixed nerves the shock dominates the sensation. The consequences may be none or, if confirmed, resolved by time in the benign cases, eventually with the aid of physiotherapy, or it may leave a sequel after the treatment. The sequel is usually reduced strength or impotence because of atrophy of the muscles and ankylosis of the involved joint.

3. Anatomy of the vertebral column

To understand the neuraxial anatomy it is necessary to develop a concept of the relationship between surface and bony anatomy pertinent o the neuraxial structures. The vertebral column is formed by the superposition of the 33 vertebrae that stand from the occipital to the sacrum and coccyx. Each vertebra is formed by a body in the anterior aspect and a ring in its posterior region. From each ring, except from the first one, appendixes are given off to the sides and posteriorly. One over the other produces the vertebral column and the posterior arches form a tube with lateral holes, from which the nerves leave the spinal canal where the spinal cord resides.

Surrounding the spinal cord in the bony vertebral column are three membranes: the pia mater, the arachnoid mater, and the dura mater. The pia mater is a highly vascular membrane that closely invests the spinal cord. The arachnoid mater, nonvascular membrane that is closely attached to the outermost layer, the dura mater. Between the pia mater and the arachnoid mater is the space of interest in spinal anesthesia, the subarachnoid space. In this space are the CSF, spinal nerves, a trabecular network between the two membranes, blood vessels that supply the spinal cord, and the lateral extensions of the pia mater, the dentate ligaments. In the adult, the lower extent of the spinal cord, the conus medullaris, ends approximately at L1. In the infant the conus medullaris may extend until to L_3. To produce a spinal anesthesia the subarachnoid space is reached by a needle that comes from the skin through the intervertebral space between their posterior spines and pierces the dura mater. Confirmation relies on back flow of CSF to permit the injection of the local anesthetic.

4. Incidence

Paresthesia is an abnormal sensation that occurs during the insertion of a spinal, epidural, combined spinal-epidural (CSE) or continuous spinal needle, a reported frequency ranging from 6.3% to 20% [4-6,8]. It is a widespread assumption that needle-induced paresthesia could be produced by contact of the tip of the needle with a spinal nerve root in the epidural space or with a spinal nerve within the intervertebral foramen. Various factors may influence the occurrence of paresthesia, including the needle-tip configuration, the use of needle-through-needle CSE technique versus single-shot spinal technique, the use of CSE kits with longer spinal needles, or the technique of puncture.

Serious neurologic complication is a rare event. Among the lesions, very little has been written on persistent paresthesia or motor inability. Paresthesia occurred during lumbar spinal block is very frequent in our everyday practice. The nerves, derived from the union of the sensitive and motor roots of the spinal cord are independent structures that macroscopically have their origin in the union of the posterior and anterior rootlets that emerge from the spinal cord in the posterolateral sulcus (sensitive rootlets) and from the anterolateral sulcus (motor rootlets). Each species travel to the intervertebral foramina where anterior and posterior rootlets unite to form a motor root and a sensitive root before joining together to emerge the spinal canal as a nerve. Motor rootlets (anterior) and sensitive rootlets (posterior) occupy the central axis of the spinal canal from the conus medullaris downward.

During the lumbar puncture, the needle is introduced in the dural sac and enters a short distance where there is no nerve rootlets. If the needle goes further, it will make contact with the nerve rootlets that occupy the posterior zone and central posterior zone of the dural sac. Paresthesia would be originated from central zone if the lumbar space was approached sagittally. Or from more lateral rootlets if the needle is deviated from the sagittal plane.

5. Approaching the subarachnoid space

5.1 Position

During lumbar puncture, the position of the patient and adequate flexion of the lumbar backbone must be searched. It will open the space between the vertebrae and will facilitate the approach of the spinal needle to the dural sac, avoiding its contact with the bones. Spinal puncture is carried out in three positions: lateral decubitus, sitting position and jackknife prone position. In both the lateral decubitus and sitting positions, the use of a well-trained assistant is essential if the block is to be easily administered by anesthesiologist in a time-efficient manner. In some patient, the sitting position can facilitate location of the midline, especially in obese patients.

The position of the patient during lumbar puncture may influence the incidence of paresthesia. The incidence of paresthesia is more probable when blocks are preformed with the patient in the lateral position, because of inadvertent spine rotation [10].

5.2 Level

Spinal anesthesia is unparalleled in the way a small mass of drug, virtually devoid of systemic pharmacologic effect, can produce profound, reproducible surgical anesthesia. Spinal anesthesia can be performed at any level of the spine, depending on what the anesthesiologist wants or what the patient needs. Most of the spinals are made in the lumbar interspaces of L_3-L_4 or L_4-L_5, through the puncture of the dura/arachnoid mater, which is deliberately done [3,4].

5.3 Needle

One of the first decisions to be made in considering spinal puncture is what kind of needle to use. For spinal needles there are two main categories: those that cut the dura mater and those that spread the dural fibers. The former include the traditional disposable spinal needle, the Quincke-Babcock needle, and the latter category contains the Greene, Whitacre,

and Sprotte needles. The use of small bore needles reduce the incidence of postdural puncture headache. Theoretically, Sprotte needles should present a higher index of paresthesia than the Quincke needles. But this theory has not been proved, and there are many papers that state the same incidence.

5.4 Paramedian or median access

It was not found in the literature any study comparing the incidence of paresthesia with the use of the paramedian *vs* median approach of the spinal canal.

5.5 Combined spinal-epidural

The combined spinal-epidural (CSE) technique is designed to combine the advantages of spinal and epidural anesthesia. Spinal anesthesia can offer a rapid complete conduction block, and epidural anesthesia using an epidural catheter can easily prolong anesthetic duration and may be used to provide postoperative analgesia. CSE anesthesia was first performed using the double segment technique [11]. However, the needle-through-needle technique has gained popularity [12]. In terms of spinal needle insertion, paresthesia frequency was more than twice as high for the needle-through-needle group than for the double segment technique group, although we were not able to establish a statistical difference between the two techniques [13]. According to others authors, the frequency of paresthesia was 9% for single-shot spinal anesthesia and 37% during spinal needle insertion of needle-through-needle, which was significant [14]. One possible reason for the higher frequency of paresthesia during spinal needle insertion in the needle-through-needle was the length of spinal needles introduced into the subarachnoid space. A spinal needle guided by an epidural needle rarely meets tissue resistance until it reaches the dura mater, and thus the dura mater is easily and deeply perforated [15,16].

The majority of these papers were observed in obstetric patients. Comparing single shot spinal anesthesia, combined spinal-epidural blocks and continuous spinal anesthesia in orthopedic surgery of elderly patients no significant difference was observed among population [17].

5.6 The use of the introducer

During lumbar puncture, the interaction of the needle and the tissue may produce a deflection of the needle tip. This deflection of the needle may increase the incidence of paresthesia. The use of introducers reduce the deflection of the needles [18,19]. The deflection is greater with beveled needles as compared to the pencil point needles, and also greater when using thinner needles as compared to the larger bore needles. In the single shot subarachnoid technique, removing the stylet when the needle tip still is in the interspinous ligament plus a continuous forward movement until CSF is drained may reduce the incidence of paresthesia [10].

6. Conclusion

Paresthesia during regional anesthesia increases patient discomfort and the risk of abrupt movement but, more importantly, paresthesia may be associated with neurological damage.

A large prospective study conducted in France reported that nerve injury is rare, but that it is often associated with paresthesia during the administration of a block or pain on injection [9]. Compared to non-paresthesia patients, long-term neurological sequela have been reported more frequently in patients that have experienced paresthesia during regional anesthesia [6]. Direct trauma to nerve roots or the spinal cord may manifest as paresthesia. When transient paresthesias occur during spinal needle placement it is appropriate to stop and assess for the presence of CSF in the needle hub, rather than withdraw and redirect the spinal needle away from the side of paresthesia as some authors have suggested.

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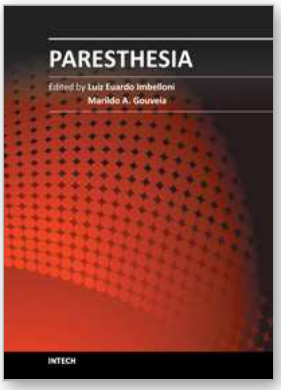

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Paresthesias are spontaneous or evoked abnormal sensations of tingling, burning, pricking, or numbness of a person's skin with no apparent long-term physical effect. Patients generally describe a lancinating or burning pain, often associated with allodynia and hyperalgesia. The manifestation of paresthesia can be transient or chronic. Transient paresthesia can be a symptom of hyperventilation syndrome or a panic attack, and chronic paresthesia can be a result of poor circulation, nerve irritation, neuropathy, or many other conditions and causes. This book is written by authors that are respected in their countries as well as worldwide. Each chapter is written so that everyone can understand, treat and improve the lives of each patient.

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