

Review Article

Types of regional anesthesia in orthopedic surgery and the role of the nurse

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Abstract

Anesthesia, and, more specifically, regional anesthesia which is the focus of this review, is the most commonly used method in orthopedic surgery and is considered a rather complicated and delicate procedure. Therefore, nurses working in the anesthesiology department are of great importance due to the services and support they provide to both doctors and patients, by facilitating the anesthesiologist during the procedure as well as by monitoring, treating and supporting the patient. Nonetheless, the role of these nurses is generally understudied in scientific research and needs further investigation. For the purpose of this review a variety of articles relevant to orthopedic surgery, regional anesthesia and the role of nurse working in anesthesiology departments were gathered and analyzed in order to highlight the importance of the services they provide, using empirical evidence.

Keywords: Nurse's role, Orthopedic surgery, Perioperative and postoperative care, Preoperative, Regional anesthesia

Introduction

The role of the nurse is extremely important in every type of surgical procedure. More specifically, during orthopedic procedures which require regional anesthesia methods that may often appear complex and require prompt interventions by those skilled in the art, nursing staff trained in anesthesia may prove extremely helpful. However, outside the scope of surgery, adequately trained staff carries out pre-operative preparation procedures that are just as important as surgery, to avoid possible complications during the procedure, as well as during the post-operative phase, as patients need care for pain management and subsequent symptoms for at least 48 hours after surgery¹.

In this review we will discuss the complex processes associated with the various regional anesthesia techniques and their role in orthopedic operations of the upper and lower extremities of the body, as well as the possible ways in which nurses specializing in anesthesia can intervene in order to facilitate the procedure for both the patient and the anesthesiologists.

Method

For the purposes of this review, an analysis of the literature relating to the role of nurse anesthetists in orthopedic surgeries of the upper and lower limbs was conducted. Data

were selected from various books, manuals, online journals and databases such as PubMed, Medline, Google Scholar and ScienceDirect, with the use of the following keywords: Regional Anesthesia, Orthopedic Surgery, Nurse's Role, Preoperative, Perioperative And Postoperative Care, in different combinations either in the Greek or English language. The data was retrieved from sources ranging from 1996 to 2019. Of the 55 articles and sources originally identified, 24 were used in this review. Inclusion criteria were data relating to regional anesthesia outcomes in relation to general anesthesia, regional anesthesia in orthopedic surgeries and positive outcomes and anesthesia nursing in regional anesthesia. Exclusion criteria were data relating to regional anesthesia administered to specific orthopedic patient groups (elderly, children), the use of regional

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anesthesia for the treatment of illnesses, studies involving specific anesthetic medications, studies relating to regional anesthesia administered in non-hospital settings, regional anesthesia and obstetrics, side effects of regional anesthesia and data from studies in developing countries.

Results

Anesthesia is defined as the controlled temporary loss of sensation or consciousness used for medical procedures. It can involve analgesia, paralysis, amnesia or loss of consciousness². There are three basic types of anesthesia: general anesthesia, local anesthesia and regional anesthesia, and for the purposes of this article we will focus in regional anesthesia. Depending on the medical case and the procedure to which the patient will be subjected, the appropriate type is used, while the physical and psychological status of the patient also plays an important role before a decision is reached³. The personnel responsible for anesthesia and the administration of the drugs in each case are the anesthesiologists and the nurses working in the Department of Anesthesia (nurse anesthetists in the USA and the UK). From the beginning to the end of the procedure, regardless of the type of anesthesia, there should be a complete record of the patient's vital signs, his received medication, as well as the anesthesia technique and the complications presented⁴. For the process of anesthesia to begin, the consent of the patient must be obtained, and in case the patient is unable to do so, it must be provided by the patient's next of kin. For the purposes of this article only methods in regional anesthesia are going to be explained in depth².

Regional anesthesia

Regional anesthesia is used in order to block the sense of pain in a specific area of the body. The patients do not suffer loss of consciousness and are aware of what is happening while feeling relaxed due to the use of sedatives. Over the past decade, a 25% reduction in complications and deaths due to anesthesia has been observed, since anesthesiologists and physicians in general are now able to monitor the patient's condition during the intervention by monitor^{5,6}.

The administration of the regional anesthetic drug is injected while the patient is lying on the side or sitting. It is painless and targets a single nerve or a specific nerve network of the area undergoing the surgery. For example, in order to eliminate pain in the lower part of the body for an orthopedic surgery, the injection is made near the spine. This type of anesthesia is more common in lower limbs, hips, in gynecological interventions, as well as in childbirth (epidural anesthesia)². However, like all types of anesthesia, regional anesthesia also has side effects that are rarer and more manageable than the ones found in general anesthesia, such as nausea and vomiting, dizziness or headaches and breathing problems. It should only be performed by professionally trained personnel since there is a possibility of permanent or transient

paralysis after spinal or epidural anesthesia⁷.

The main difference that may be considered an advantage of regional anesthesia in comparison to general anesthesia is that regional anesthesia is used in extensive interventions affecting only the area of the body that will undergo the surgery, while general anesthesia inevitably affects the whole body, regardless of the point of interest. Regional anesthesia can also be used as analgesia after surgery².

Central nerve blocks

The types of regional anesthesia vary depending on several factors. When the anesthesia is administered around the nerve or the network of nerves associated with the sensation of an area, it is called nerve block, and it is divided into central and peripheral nerve blocks. For the purposes of central nerve blocking, the local anesthetic is injected into the central nervous system, and it includes the spinal or subarachnoid anesthesia and the epidural anesthesia/analgesia⁷.

i. Spinal anesthesia

In spinal anesthesia, small doses of medication (mainly local anesthetics - opioids) are administered into the subarachnoid space, usually with a 9 cm needle, numbing the area of the body from the waist down. It causes anesthesia, analgesia and kinetic and sensory blocking⁸. It is used in cases where the surgery site is located in the lower extremities, lower body wall or perineum. It is a safe and effective form of anesthesia performed by anesthesiologists and nurses specialized in anesthesiology - in developed countries, such as the US and the UK - and can be used as an alternative to general anesthesia, as the sole source of anesthesia⁷. Spinal anesthesia, due to the lack of major complications was the most widely used type of neuraxial anesthesia from the late 19th century, when it was first used, well into the 20th century⁹.

ii. Epidural anesthesia

On the other hand, the medication for epidural anesthesia is administered to the epidural area around the spinal cord. The epidural route is often used by physicians and specialized nurse anesthetists (in countries such as the US and the UK) to administer local anesthetic agents (e.g. during labor) and occasionally for the administration of diagnostic (e.g. radiofrequency) and therapeutic (e.g. glucocorticoid) chemicals. The epidural techniques often involve injection of drugs through a catheter that has been placed via an epidural needle in the epidural space. The injection can lead to a loss of sensation - including the sense of pain - preventing the transmission of signals through nerve fibers in or near the spinal cord¹.

iii. Combined Spinal- Epidural Anesthesia

During the past decades the combined spinal- epidural technique (CSE) is becoming increasingly popular. It involves the administration of medication in the subarachnoid space

and the placement of a catheter in the epidural space at the same time. The advantages of this procedure are that the neuraxial block is quickly achieved, while the catheter positioned in the epidural space can be used for further administration or modification of the block. The techniques used for the CSE are varied (needle through needle, separate needle, double-barrelled needles,) and all require the placement of the needle(s) by qualified specialists, because it is considered a delicate procedure with various complications if not performed correctly. The CSE is widely used in labor and obstetrics, as well in orthopedic, urological, vascular, and general surgery interventions¹⁰.

Peripheral nerve blocks

The other most common type of regional anesthesia is the peripheral nerve blocking, which refers to the process where a local anesthetic is injected close to a nerve or network of nerves associated with the sensation of an area and causes anesthesia or analgesia. It can be used as the sole source of anesthesia, in combination with general anesthesia or as postoperative analgesia¹.

The most common peripheral nerve blocks used in orthopedic surgeries for the upper extremities are: the interscalene block, the supraclavicular block, the infraclavicular block, the axillary block, the intercostobrachial block, the radial nerve block, the median nerve block and the ulnar nerve block. The most common nerve blocks in surgeries for the lower extremities include the lumbar plexus block, the femoral nerve block, the fascia iliaca block, the obturator nerve block, the sciatic nerve block, the popliteal nerve block and the saphenous nerve block. Depending on the block and the technique used, the equipment used includes a peripheral nerve stimulator, ultrasound machines and continuous catheters (e.g. standard epidural kit)^{11,12}.

Regional anesthesia in orthopedic surgeries of the upper and lower limbs

Regional anesthesia is an excellent anesthetic for many different types of ambulatory orthopedic surgeries. Benefits in terms of clinical outcomes, such as pain, are readily available in the literature. There are also benefits for the daily surgery units to reduce the time patients spend on the Postanesthesia Care Unit (PACU), for better surgery results, and for the facilitation of quick release from the hospital¹³.

Regional anesthesia presents many advantages in comparison to general anesthesia, and seems to be the preferred type of anesthesia for most orthopedic surgeries¹⁴. In the ambulatory setting, the neuraxial blocks with local anesthetic medication and shorter periods of effect offer better recovery outcomes and fewer side effects than general anesthesia. Furthermore, there is an increased trend towards the use of peripheral nerve blocks, especially as postoperative analgesia. Perineural catheters seem to offer better analgesia during surgery and can safely be used postoperatively with excellent results¹³.

According to studies, epidural anesthesia reduces thromboembolic complications such as hypercoagulation¹⁵, and the use of peripheral nerve blocks reduces the risk of urine retention and ileus¹⁶.

Overall, orthopedic patients receiving regional anesthesia generally require fewer nursing interventions in the postoperative period, have better recovery rates and are discharged sooner from the hospital than patients receiving general anesthesia¹⁷.

The role of the nurse during orthopedic surgeries performed with regional anesthesia

Preoperatively and in the surgery room

The method of anesthesia is determined by factors such as the clinical condition and the degree of anxiety of the patient, the patient's ability to co-operate and communicate, the type of surgery and the presence or absence of a full stomach¹⁸.

Regional anesthesia, whether administered in the form of central or peripheral nerve blocks, presents a plethora of advantages, making it an especially useful anesthetic practice. It is evident that its effective and safe administration requires the harmonious cooperation of anesthesiologists with nurses. It is clear that prior to the application of any technique of regional anesthesia, it is imperative to observe the guidelines, as they apply to general anesthesia¹⁹.

Prior to initiating the procedure, nurses should prepare and assemble all the necessary material they will need on a wheel tray with sterile conditions. This material includes the necessary skin sterilization materials, sterile dishes, local infiltration syringes, subarachnoid needle or eyelid or combination needle set, needles for preparing the doses of drugs to be administered via the subarachnoid or epidurally, and the necessary medications¹⁹.

There is a variety of equipment used in each surgery, that might include special mattresses, pillows, rolls, hand and foot rests, straps and so on, with the aim of rendering the redistribution of the pressure exerted, and the prevention of falls^{1,20}.

All the devices and electronic equipment and monitors relating to the anesthetic procedure are very sensitive; therefore a day-to-day functional check by the nurse working in the Department of Anesthesia is required. Moreover, various sizes of endotracheal tubes should be readily available during the procedure, in order to keep the airway open¹¹. The tube of choice is usually the largest possible that passes through the tongue and the sublingual physiological narrowing of the trachea, while allowing a small amount of air to escape²².

Preoperative assessment starts with the nurse checking the surgeon's program for: the identity of the patient, the type of surgery, the desired surgical site and answering patient questions about his condition, skin lesions, limited mobility, implants or pre-existing diseases²³.

Proper placement of patients on the surgical table is

one of the most important aspects of the duties of the modern nurse¹⁸.

In 1997, the American Society of Nurses of Survival Medicine (AORN) presented the first guidelines for Nurses regarding the correct placement of patients during the perioperative period, and in 2000 the American Society of Anesthesiology (ASA) issued practical advice on the prevention of perioperative appearance of peripheral neuropathies¹⁹.

Based on the above, the goals of patient placement at the surgical table are summarized as: Maintaining the dignity of the patient by avoiding unnecessary physical exposure, sufficient exposure of the surgical site, ensuring optimal ventilation, maintaining airway clearance and avoiding chest wall pressure, sufficient access to intravenous lines as well as vital function monitoring equipment, protection against peripheral nerve damage by avoiding stress on muscles, nerves and bones, maintaining good blood circulation, avoiding pressure on all parts of the body and taking measures to prevent tissue hyperventilation due to reduced blood supply^{1,23}.

In order to achieve the above, it is important to have sufficient knowledge of the physiological disturbances of the various functions caused by the different surgical positions (supine, sedentary, prone etc.) and their variants (Trendelenburg/Anti-Trendelenburg). In addition, it is considered particularly important to identify parameters that may play a significant role, such as the type and duration of surgery, the type of equipment and the type of anesthesia administered¹⁹.

Regardless of the position - which depends on the characteristics and needs of the patient's clinical condition and the anesthesiologist's preferences- the goal is to achieve the maximum possible spine curvature and to maximize the intervertebral spaces, in order to widen the puncture site in surgeries in the lower extremities, and the best possible exposure of the site of puncture in the case of surgery in the upper extremities. The role of the nurse in each case is to keep the patient in the right position throughout the duration of the insertion of the needle and to prevent a possible fall. Both the anesthesiologist and the nurse should wear the necessary clothing for an operation such as surgical caps, masks and gloves, while the area should be sterilized with antiseptic solution²⁴.

During the process of anesthesia, the nurse is responsible for helping the anesthesiologist administer the anesthesia, for recording the patient's vital signs, for monitoring the patient, and for noting any change that is outside the normal scope. Furthermore, the nurse has to provide psychological support to the patient while at the same time being aware of the steps taken by the anesthesiologist in order to work in sync. The latter is extremely important for the successful implementation of the surgical procedure^{20,24}.

Last but not least, the nurse, along with the anesthesiologist is responsible for the safe delivery of the patient to the PACU¹².

In summary, the nursing care at this stage focuses mainly on the safe application of the anesthesia technique, the assessment of the establishment of the exclusion, the early recognition of the possible side effects, the preparedness of the nurses for timely and appropriate treatment, and the support of the patient²⁴.

Post-surgery

After the surgery, the nurse should evaluate the patient to identify any potential complications and examine his/her current state. At this stage the patient recovers with complete reversal of hypnosis and muscle relaxation. The analgesia is maintained postoperatively and possible complications are treated with the aim of regaining full consciousness and smooth transition to the hospital room^{1,20}.

At the stage of post-operative care, the task of the nurse is also the inspection of the high-risk areas identified during the preoperative assessment. The nurse should reposition the patient immediately to avoid the continued pressure applied during surgery. The nurse's duties include the monitoring of the patient, assisting in the clinical assessment and monitoring the vital signs and the intensity of the pain reported. Close and ongoing monitoring of the patient may contribute to the early recognition and treatment of possible complications^{20,24}.

Continuous patient monitoring is mandatory until the drug is discontinued from the catheter or until the patient is free of anesthetic medication. Patients should also be visited by the anesthesiologist or the nurse, and during those visits a checkpoint should be carried out on the puncture site, which should be covered with a transparent membrane to allow the catheter to have an entry point to the skin. The catheter's entry point should be palpably controlled daily for the first days after surgery and then every other day when changing the patch, in order to detect early signs of inflammation. The catheter should be removed in the event of inflammation at the puncture site. In the event of clinical signs indicating a complication, the nurse should immediately inform the anesthesiologist in charge²⁴.

Although postoperative nausea and vomiting are minor postoperative side effects, nurses are responsible for taking preventative treatment measures such as monitoring the stomach suction, and making prophylactic use of anti-emetic drugs¹. Particularly in patients receiving opioids epidurally, great alertness is required for the immediate recognition of respiratory depression, and for those receiving large amounts of local anesthetics, it is advisable to seek out signs of CNS toxicity^{20,24}.

Discussion

In the current era of the economic crisis, the shortcomings of nurses in the departments of anesthesiology cannot go unnoticed or ignored. In the majority of operations in Greece, the total number is less than one nurse anesthetist per surgical table, when at the same time in Europe the ratio is 3-4, per surgical table²³.

Although in everyday clinical practice nurses working in the department of Anesthesiology intervene and help modify vital functions that might be affected, they fail to persuade the Greek medical world and the hospital administrations about the importance and the necessity of their interventions. It is noteworthy, that in Greece, although at graduate level a student can opt for residency in nursing, the departments available are only four: Pathology, Surgery, Pediatrics and Mental Health. Anesthesiology is not included, not even as a specialization.

The nurses working in the department of Anesthesiology, as well as those who offer their services in other high-dependence departments, do not necessarily have specialized training, and their knowledge derives from their undergraduate education and their invaluable working experience. Nonetheless, according to the Greek law, the nurses can at anytime be transferred to any department, according to the needs of the medical facility.

With these facts in mind, as well as the continuous modernization of both the medical science and the devices that serve it, the nursing sector needs continuous upgrading and feedback, with the aim of improving and perfecting education, aiming at the best possible results and the addressing of the ever-increasing medical incidents and needs. However, scientifically, the role of the nurse remains rather understudied and in need of further investigation.

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