Review Article

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Old anatomy and new anatomical concepts for single shot and continuous spinal anesthesia

Abstract

This educational article shows the anatomy studied in cadavers and the latest imaging technology for spinal anesthesia. Neuraxial anesthesia is one of the regional anesthetic options that can be done by blocking the spinal cord neural transmission through the administration of local anesthetics either via intrathecal, epidural, continuous spinal anesthesia, or combined epidural-spinal anesthesia. Several descriptions of the spinal canal anatomy have been reported since the 16th century by Leonardo da Vinci, and the use of modern radiological imaging technology has provided important insights into understanding anatomical and pathophysiological aspects implicated in spinal anesthesia. The vertebral level at which the spinal cord finishes varies widely from T12 to the L3-L4 intervertebral disc and the spinal cord extends to the L1-L2 and the L2-L3. In this educational study, cadaver anatomy and new approaches with ultrasound, magnetic resonance imaging, computed tomography, and fluoroscopy will be covered, to approach spinal and continuous spinal anesthesia. Between the medulla and any given level of the spinal cord, the fibers of the anterolateral system and posterior columns are dissociated. Despite all the new imaging studies to assist in performing subarachnoid punctures for single shot or continuous spinal anesthesia, anatomical landmarks remain the most used for both the lumbar and thoracic approaches.

Keywords: regional anesthesia, single shot spinal anesthesia, continuous spinal anesthesia, lumbar approach, thoracic spinal approach, ultrasound, magnetic resonance imaging, computed tomography, fluoroscopy

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Luiz Eduardo Imbelloni,[1] Marildo A Gouveia,[2] Sylvio Valença de Lemos Neto,[3] Tolomeu A A Casali[4]

[1]Instituto Nacional de Câncer INCA Senior Researcher, Brazil
[2]Former President of LARSA Internacional, Brazil
[3]INCA Anesthesiologist, Responsible for CET-SBA of the National Cancer Institute, Brazil
[4]Adjunct professor of Anesthesiology, UFG Faculty of Medicine, Responsible for the CET-SBA of the Hospital CRER, Brazil

Correspondence: Dr Luiz Eduardo Imbelloni, MD, PhD, Instituto Nacional de Câncer INCA Senior Researcher, Rio de Janeiro, RJ, Brazil, Tel + 55.11.99429-3637, Email dr.luiz.imbellon@gmail.com, luiz.imbellon@edu.inca.gov.br

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Key points

Question

Are imaging studies applicable in the clinical practice of single-shot and continuous spinal anesthesia?

Computed tomography CT, magnetic resonance imaging MRI, ultrasound US and fluoroscopy methods are used to access the subarachnoid space.

What studies have shown?

a) The use of CT for daily clinical application is not routinely applicable due to the complexity of the device and its use during the procedure.

b) The use of MRI in adults and children showed a large space between the dura mater and the spinal cord in the thoracic region, MRI is also not used for clinical practice.

c) The use of US is increasing for several patients for spinal anesthesia however, it must be learned for all possibilities of puncture and all local anesthetics solution.

d) Fluoroscopy-guided spinal drain insertion is an alternative to the conventional procedure however, fluoroscopy is not routinely used to perform subarachnoid puncture.

e) Anatomy studies on cadavers began in the 16th century and remain the preference of anesthesiologists in daily clinical practice.

Purpose

Despite the imaging advances used for peripheral regional anesthesia, anatomic landmark approaches are routinely used for single-shot and continuous spinal anesthesia.

Introduction

Leonardo da Vinci was considered the discoverer of human and animal anatomy. He dissected over 20 cadavers in the School of Medicine, describing the vertebral column anatomical concepts that remain up to date in what concerns the cadaver.[1] The absence of anatomical studies on cadavers, it allowed the performance of different types of anesthesia since tracheal intubation was only described in 1913.[2] In 1909, with the anatomical knowledge of the time, it was proposed to perform spinal anesthesia by thoracic puncture.[3] The author proposed two levels of puncture: the high thoracic site T1-T2, and the low thoracic site T12-L1, since it was thought that the midpoint thoracic approach was more difficult to be do and unnecessary. In 1932, segmental spinal anesthesia was described for the first time, by approaching the subarachnoid space in dorsal decubitus, with an aspiration of cerebrospinal fluid CSF and injection of air, and subsequently a hypobaric solution of nupercaine.[4] Two years later, segmental spinal anesthesia was described by approaching the thoracic intervertebral spaces.[5] Spinal anesthesia has progressed greatly since the first spinal anesthesia was performed in 1898 and has become a standard technique in a few different clinical situations.[6] In 1900, the best spaces for spinal puncture were idealized, considering the access between L3-L4, which was named after its author, a French surgeon.[7] The administration of spinal anesthesia requires appropriate positioning and understanding of neuraxial anatomy. The goal is to deliver appropriately dosed anesthetic into the intrathecal subarachnoid space.

Cadaver anatomy

Anatomy and physiology allow the knowledge of the subarachnoid space and its possibilities for practical medicine. The study of the subarachnoid space was carried out to elucidate several doubtful points and to seek some practical deduction for its use.[8] The subarachnoid space may be reached by several routes: 1 By trephining the skull; 2 The atlo-occipital route followed by Magendie in demonstrating the constant presence of CSF; 3 The dorsal route, with or without laminectomy; 4 The sacro-lumbar route; 5 Through the central spinal canal, and the second, third, and fifth routes are seldom used, on account of the difficulty and danger encountered; 6 The cervical route. In six out of seven cadavers we found the dorsal route accessible as high as the sixth space, without preliminary laminectomy.

Recently a Tuffier's line usually used as the sole method to identify a lumber spinous process for a correct needle placement, was used in fifty-eight cadaver specimens were placed in a lateral position and a flexion in the lumbar spine performed to achieve a neutralization of the lumbar lordosis , having shown that accuracy of the focused lumbar spinous process depends on the right bedding and the orientation of the given landmarks, so Tuffier's line stays the most important tool for anesthetists if palpation is performed very precisely.[9]

The anatomy described on the cadaver allows knowledge of the spine, the spinal cord, and the dermatological metameres of the emerging nerves, allowing an adequate performance of the techniques in the neuroaxis. The vertebral column consists of 33 vertebrae, 7 cervical, 12 thoracic, 5 lumbar, 5 sacral and 4 coccygeal, providing a bony framework where the spinal cord is located. It contains three curves, two of which are convex anteriorly cervical and lumbar, and the thoracic curve is convex posteriorly. These three curvatures, together with the baricity of the local anesthetic, the patient's position and the gravity influence the spread of local anesthetics in the subarachnoid space. To hold the spine together there are five ligaments: supraspinous ligaments, interspinous ligaments, ligamentum flavum, posterior and anterior ligaments. There are two ways to approach the intervertebral space: the midline 9 layers of anatomy or the paramedian approach 7 layers of anatomy (Table 1). In addition to the ligaments three membrane protects the spinal cord, the dura mater, arachnoid mater, and pia mater. The length of the spinal cord varies with age. At birth, the spinal cord ends at approximately L3, and in the adult, the cord ends at approximately L1 with 30% of people having a cord that ends in T12 and 10% in L3.[10]

Table 1 The layers of anatomy that are crossed (from posterior to anterior)

Midline approach	Paramedian approach
1. Skin	
2. Subcutaneous fat	1. Skin
3. Supraspinous ligament	2. Subcutaneous fat
4. Interspinous ligament	3. Ligamentum flavum
5. Ligamentum flavum	4. Epidural space
6. Epidural space	5. Dura mater
7. Dura mater	6. Arachnoid mater
8. Arachnoid mater	7. Subarachnoid space
9. Subarachnoid space	

Computed tomography

The evolution of computed tomography CT was based on the discovery of X-rays, the development of digital X-ray data acquisition systems, and the development of informatics. An understanding of CT characteristics will provide more effective and accurate patient care in the fields of diagnostics and radiotherapy and can lead to the improvement of image quality and the optimization of exposure doses. CT examinations of the spine are performed for different indications including fracture detection and trauma evaluation, assessment of degenerative changes, postoperative complications, and guidance of interventional procedures, such as periradicular infiltration.[11] To verify the value of applying the CT localization method to perform lumbar spinal anesthesia access, reducing the damage caused by anesthesia, 120 patients were evaluated by three methods: 30 patients method of anatomical landmarks, CT group with 50 patients the CT localization, and ERAS group with 40 patients the CT localization and the ERAS management.[12] The results proved that the CT localization was helpful in improving the difficulty of anesthesia puncture as well as the anesthesia effect. CT localization has clear imaging, which can not only evaluate the puncture plane but also show the malformation of the spine, so it helps facilitate the customization of the puncture path and improve safety.[13] Due to the existence of ionizing radiation, the clinical adoption of CT localization is limited to a certain extent. Needle insertion for spinal anesthesia using the Taylor approach is challenging as the L5-S1 space is difficult to locate from the surface anatomy. In a retrospective observational study on 280 patients who underwent hip arthroplasty with 3D pelvis CT, access to the space between L5-S1 was evaluated.[14] Three-dimensional pelvis CT-assisted Taylor approach of spinal anesthesia can be an alternative method for subarachnoid block in the L5-S1 space with an acceptable success rate. CT scan is often used along with the frame to help the neurosurgeon guide a hollow needle into the tumor. The use of CT for daily clinical application of single shot or continuous spinal anesthesia is not routinely applicable due to the complexity of the device and its use during the procedure.

Magnetic resonance imaging

Over the years, the imaging of spinal disease has evolved from plain film diagnosis and polytomography to advanced CT and magnetic resonance imaging MRI. Each step of the evolution of spinal anesthesia, which allowed us to move from the anatomy of the cadaver to the technology of studies of MRI, is explained by apparently random factors that are connected to the development of technology and history. Cerebrospinal fluid CSF and fat act as natural contrast agents in spinal MRI. The spinal cord is difficult to evaluate on CT, given the inherent contrast limitations. The addition of intrathecal contrast during myelography allows the evaluation of spinal cord size and morphology.[15] It also permits adequate evaluation of the intradural nerve roots. MRI has provided studies of the nerves cauda equina inside the dural sac. MRI is the most significant technological advancement in the diagnostic examination of the spine, one should have a basic understanding of the normal MRI anatomy. One of the major concerns during needle insertion for spinal anesthesia is the location of the conus medullaris terminus CMT. The varying point at which the spinal cord terminates in the lumbar spinal canal may affect the incidence of spinal cord injuries associated with needle insertion for spinal anesthesia.

Anesthesiologists remain aware that any maneuver which places the spinal needle in contact with the spinal cord may lead to serious neurological injury.[16] The position of the CMT has been studied previously in 129 cadavers, but a possibly better evaluation of its

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true position, and one which might translate into clinical practice more readily, might be MRI. Studying 1,047 Chinese patients to determine CMT using MRI, the result of the study shows that performing spinal anesthesia at the L2-L3 interspace would seem to be ill-advised in this patient population.[17] Two studies with MRI in the thoracic region showed that there is substantially more space in the dorsal subarachnoid space at the thoracic level, which might lead to potential applications in regional anesthesia.[18,19] In contrast, the cauda equina sits more dorsally in the lumbar region. The MRI can currently be performed in different positions, facilitating the approach to the subarachnoid space and nerves. The use of MRI in adults[19] and children[20], showed a large space between the dura mater and the spinal cord in the thoracic region, allowing the use of thoracic spinal anesthesia. An MRI is often used along with the frame to help the neurosurgeon guide a hollow needle into the tumor. In the same way that the use of CT is not applicable for the routine use of subarachnoid puncture for spinal anesthesia, MRI is also not used for the clinical practice of single shot or continuous spinal anesthesia.

Ultrasound imaging

Neuraxial blocks epidural and spinal anesthesia using traditional palpation and landmarks are a reliable technique to provide postoperative anesthesia and analgesia and have been used for a long time. Several factors such as obesity, spinal deformity, and previous spinal surgery can make both neuraxial procedures difficult, and the use of ultrasound US imaging can help in these scenarios. The anatomy of the spine, relevant ultrasonographic views, and the techniques used to perform the neuraxial blocks using ultrasound imaging was recently published.[21] The use of US can help both in performing epidural and spinal anesthesia.[22] The US promotes identification of the skin to the epidural space and subarachnoid space, showing its depth and the trajectory of the needle, being performed in real-time. [23,24] However, the technique, with limited clinical utility, was indicated as interesting but not mandatory and not an obligation.[25] Knowledge of the anatomy of the cadaver and the sonoanatomy of the vertebrae and the spinal canal is fundamental for understanding neuraxial imaging.[21] Knowledge of typical lumbar vertebrae and thoracic vertebrae is essential. How the body and arch of vertebrae are formed. The arch is composed of pedicles, a spinous process, lamina, superior and inferior articular processes, and transverse processes. The vertebral canal is formed by the spinous process and lamina posteriorly, pedicles laterally, and vertebral bodies anteriorly, and inside the vertebral canal lie the thecal sac and its contents, and CSF. Thus, the epidural space is outside the subarachnoid space. The identification of these anatomical parasagittal and transverse structures allows better performance of ultrasound-guided neuraxial interventions.

Surface anatomy refers to structures close enough to the integument that they are palpable. However, due to body habitus, this may not be possible. Neuraxial US allows sonoanatomical visualization of these structures and deeper structures. However, as the US beam cannot penetrate the bony vertebrae specialized ultrasonic windows are required to visualize the neuraxis. Ultrasound assistance US_{AS} and real-time ultrasound guidance techniques US_{RTG} can facilitate lumbar neuraxial blocks were studied in 114 elderly patients ≥70 years of age with hip fractures and showed that spinal anesthesia with the US_{RTG} technique is not superior to the US_{AS} technique since it has a lower success rate, longer procedure time, lower satisfaction score, and is more difficult to perform.[26] So, US_{AS} technique may be more suitable for elderly patients. In a recent editorial, different spinal anesthesia puncture positions were reported, as well as the use of three local anesthetic solutions hypobaric, isobaric, hyperbaric, showing that most of the articles and books consulted use the sitting position to study the US. Several studies have suggested an evidence base for US guidance for the lumbar puncture, although increasing, may be insufficient, as a basis for the various positions are insufficient to create a standard of hospital care.[25] For the US to be a routine method for performing spinal anesthesia, all puncture positions sitting, lateral decubitus, prone and under the table must be thoroughly studied otherwise, only the sitting position will be privileged.[27] In addition, the US should be used more than in a sitting position. Thus, the routine US technique for spinal anesthesia would be interesting to study in thoracic puncture, as recently published.[28] Several services have used the US to assist in performing neuraxial anesthesia epidural and spinal anesthesia. However, it has been more indicated to assist with a puncture in obese pregnant patients, with previous measurements. The use of US simultaneously during the puncture is rarely used.

Fluoroscopic imaging

Fluoroscopic imaging has been used successfully in the operating room to guide the placement of a technically difficult spinal anesthetic in a morbidly obese patient. A fluoroscopy may be ordered for a few reasons, especially for spinal procedures. Fluoroscopic needle guidance provides visual confirmation to direct accurate needle lumbar puncture placement in patients without palpable bony landmarks, or during other injections into the spinal canal. The routine use of fluoroscopy for spinal needle guidance, however, would be time-consuming and may expose the anesthesiologist and patient to unnecessary radiation.[29] In a retrospective study of 11 patients referred by anesthesiologists to an interventional neuroradiologist for fluoroscopy-guided lumbar spinal drainage for thoracic aortic aneurysm repair, successful spinal drain insertion was achieved in all patients.[30] Fluoroscopy-guided spinal drain insertion is an alternative to the conventional procedure. However, fluoroscopy is not routinely used to perform subarachnoid punctures.

Spinal anesthesia

The central nervous system CNS comprises the brain and spinal cord. The term neuraxial anesthesia refers to the placement of local anesthetic in or around the CNS. Spinal anesthesia is a neuraxial anesthesia technique in which local anesthetic is placed directly in the subarachnoid space. Intraspinal anesthesia is a kind of local anesthesia, which is currently very common in clinics. According to the different injection positions, it can be divided into epidural anesthesia, combined spinal epidural anesthesia, subarachnoid anesthesia single shot, and continuous spinal anesthesia which can be performed in the lumbar or thoracic region. This article will only cover the anatomy for performing spinal anesthesia, with a single injection or continuous spinal anesthesia. The technique of administering spinal anesthesia can be described as: preparation, position, projection, and puncture. Understanding dermatomal anatomy is imperative for an understanding of the level of the blockade of target structures. For lower abdominal cesarean sections, the incision is usually made below the T10 dermatome. However, coverage of up to T4 dermatome is required to prevent discomfort or pain from peritoneal tugging; this is especially evident with uterine manipulation. Some corresponding dermatomal landmarks are: C8 fifth finger, T4 nipple, T7 xiphoid process, and T10 umbilicus.

The midline is identified by palpating the spinous processes. The iliac crests usually are at the same vertical height as the fourth lumbar spinous process or the interspace between the fourth and fifth lumbar vertebrae. An intercristal line can be drawn between the iliac crests to help locate this interspace. Care must be taken to feel for the soft area

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between the spinous processes to locate the interspace. Depending on the level of anesthesia necessary for the surgery and the ability to feel for the interspace, the L3–L4 interspace or the L4–L5 interspace can be used to introduce the spinal needle. Because the spinal cord commonly ends at the L1 to L2 level, it is conventional not to attempt spinal anesthesia at or above this level. More recently, segmental thoracic spinal anesthesia has been described.

Single shot spinal anesthesia

Spinal anesthesia can be performed by lumbar or thoracic puncture. Likewise, the puncture position can be seated, in lateral decubitus and in prone position, thus obtaining posterior spinal anesthesia.[30] Both lumbar puncture below L2 and thoracic puncture T4 to T10 can be performed via the median or paramedian route, which is a better access in elderly patients. Likewise, the most frequently used needles are the cutting point Quincke and the pencil point Whitacre. The most used Whitacre needle gauges are 25G and 27G, while the most used Quincke needle gauges are 25G, 26G, 27G and 29G. Using anatomical parameters in 122 patients, the concordance rate between clinical examination and using assessment of intervertebral space identification for lumbar puncture is 64% among patients undergoing lower limb surgery.[31] No statistically significant differences were found regarding the choice of positioning for lumbar puncture, or intervertebral space. The identification of lumbar puncture levels according to this traditional method is not accurate in some groups of patients.

The doses used in single shots of different anesthetics will depend on the location and duration of the surgery, and the surgeon's experience. Likewise, the use of the three local anesthetic solutions such as hypobaric, isobaric, and hyperbaric will depend on the type of surgery. A recent study, it was shown what happens to different solutions when injected in the three puncture positions sitting, lateral decubitus, prone position and the surgical table position to perform the surgery.[32] In a study comparing the position of 100 patients between 65 and 85 years old, with patients sitting with their legs supported on the table LT versus legs placed on the side stool LS, it showed that the time in the LS group was significantly longer than the group LT, and the patients generally felt more comfortable with their legs placed on the Table 1.[33] Studying 5050 spinal anesthesia with a single shot of isobaric and hyperbaric solutions, using disposable needles such as Quincke, Whitacre or Atraucan, all three without an introducer, with a puncture between L2 and L4, via the median or paramedian route, in the sitting or lateral decubitus position, with 40 patients 0.8% developed postdural puncture headache PDPH, with the lowest incidence being with a 29G Quincke needle.[34] The conclusion of this study showed that non-cutting needles can be used in patients at high risk for PDPH, and that smaller needles can be used for all patients. The total incidence of failures occurred in 132 2.6% patients, and the appearance of failure concerning the gauge and type of needle is shown in Table 2.[34]

Table 2 Incidence of failures in relation to the type and caliber of needles

Needles (n)	Failure
Quincke 25G = 324	4 (1.2%)
Quincke 26G = 138	2 (1.4%)
Quincke 27G = 3,234	79 (2.4%)
Quincke 29G = 924	40 (0.4%)
Atraucan 26G = 220	2 (0.9%)
Whitacre 27G = 210	5 (2.3%)

Continuous spinal anesthesia

The concept of continuous spinal anesthesia was initially described in 1907, which advocated the puncture of the intrathecal space and the maintenance of the needle in situ to facilitate the reinjection of the anesthetic.[35] Other techniques were described, from the use of malleable needles, which also included a special mattress containing a slit through which the needle was kept in situ without touching the surgical table[36] to the use of a rubber ureteral catheter, introduced into the subarachnoid space through a 15G needle.[37] Supporters of spinal anesthesia decided to use continuous spinal anesthesia and as there was no material designed for this technique, it was initially performed by placing an epidural catheter in the subarachnoid space.[38] Recently continuous spinal anesthesia can be performed with a microcatheter 28-32G[39], a catheter outside the needle Spinocath[40] and a new spinolong catheter.[41] Continuous spinal anesthesia with microcatheter was discontinued due to a high incidence of failure.[42] Due to a methodological error because of the four cases, three were with a microcatheter 28G and 5% lidocaine hydrochloride with 7.5% glucose and one was with an epidural catheter 20G and 1% tetracaine with 10% dextrose and were suggested to be discontinued (Table 3).[43] In these four cases, we cannot compromise the 28G microcatheter, as one of the cases was performed with a 20G epidural catheter. Likewise, we cannot compromise 5% lidocaine with 7.5% glucose, as one of the cases was carried out with 1% tetracaine with 10% glucose. In the 16th century, the physician and philosopher Paracelsus and toxicology stated that the difference between medicine and poison is the dose. In all four cases, the dose of local anesthetics and glucose was what triggered the cauda equina syndrome.

Table 3 Data taken from the four cases[43]

Sex	Age	Surgery	Catheter	Anesthetic	Glucose	Dose
M	68	TURP	28G	Lidocaine 5%	7.5%	150 mg
F	45	BBWO	28G	Lidocaine 5%	7.5%	250 mg
M	56	RSN	28G	Lidocaine 5%	7.5%	190 mg
M	67	FPTAB	20G	Tetracaine 1%	10%	37 mg

TURP, transurethral resection of the prostate; BBWO, bilateral bunionectomy and wedge osteotomy; RSN, right saphenous neuroma; FPTAB; Femoral posterior tibia1 artery bypass

Continuous spinal anesthesia can be performed in the lumbar region and, also in the thoracic region.[41,44] The catheter used for continuous spinal anesthesia is a 22G and 24G catheter, 72 cm long, mounted outside a 27G and 29G spinal anesthesia needle with a Quincke tip. It has an open tip and a side hole 0.5 cm from the tip, requiring only 1 cm to be introduced into the subarachnoid space. Puncture the epidural space with an 18G tip needle Crawford type and through this needle the set needle and catheter until the touch of the needle in the dura mater. The dura mater is punctured, and cerebrospinal fluid is observed CSF inside the catheter, which refluxes through a side hole on the back of the needle. The needle and catheter are then advanced to make it enter another 0.5 centimeter into the space subarachnoid. By a steel wire at the end proximal to the catheter, pull the needle until you remove it completely. CSF or wait for reflux to fill the catheter, confirming its position. Remove the needle from an epidural. The catheter is fixed. The volume of the catheter is 0.1 ml, and the filter is 0.5 ml. The connector is assembled, and the anesthetic is injected at the desired dose. Then another 0.1 ml is injected to cover the catheter's dead space. If you are using the filter must be filled before connection. If there is a need for a second dose, do not It will be necessary to consider the volume of the catheter. How the catheter caliber 22G or 24G is larger than the spinal anesthesia needle caliber 27G or 29G, it immediately seals the hole puncture, avoiding loss of CSF and anesthetic through the hole caused in the dura mater, reducing the risk of headaches poor quality puncture, or blocking post. Because the catheter has a wide internal diameter 22G or 24G, the appearance of CSF as a local anesthetic injection is easy, providing good distribution of the anesthetic. The epidural puncture was paramedially performed in the left lateral position or sitting position at L2-L3 or L3-L4 interspace with an 18G Crawford needle. After that, the dura mater was punctured with a 27G needle and 22G catheter set or with a 29G needle and 24G catheter set. With the patient still in the puncture position, 2.5 to 5 mg of 0.5% isobaric bupivacaine were injected, depending on the patient's height, when they were immediately placed in the supine position.[45] In case of pain or inadequate level, 2.5 mg of 0.5% bupivacaine was injected through the spinal catheter, which was removed at the end of surgery.

Continuous thoracic spinal anesthesia can be performed between T6 and T12, using the spinolong kit that includes a 21G Tuohy-shaped spinal needle and a 24G intrathecal catheter. After the free flow of cerebrospinal fluid was obtained, the catheter was inserted 3 – 4 cm beyond the tip of the needle. Once inserted, the catheter was secured and covered with a sterile transparent dressing from the insertion site to the ipsilateral shoulder, and the catheter was connected to a bacterial microfilter. Hyperbaric bupivacaine 0.5% and/or levobupivacaine 0.5% not diluted at a dose of 2.5 mg were injected intrathecally followed by an equal dose 3 minutes later. In a recent study with 455 patients over 17 years, it was suggested that continuous spinal anesthesia with the catheter outside the needle for elderly orthopedic patients shows minor insertion problems, a low incidence of hypotension, paresthesia, and headache.[46] No neurological complications were observed, such as cauda equina syndrome or transient neurological symptoms. With the advent of intermediate catheters catheter through the needle, caliber 22G and 24G for continuous spinal anesthesia, and their low incidence of headache and neurological symptoms, the technique has been gaining credibility and is safe with high doses of bupivacaine 0.5% hyperbaric with 1.6% glucose 25 mg associated with hyperbaric 2% lidocaine with 1.6% glucose 160 mg, and morphine 100 µg, surgery lasting seven hours.[47] This case report suggests that neither lidocaine nor glucose contributes to cauda equina syndrome when used with intermediate catheters and doses within the normal range. With the use of the 27G needle and 22G catheter set, there was no maldistribution with any of the drugs, resulting in rapid recovery from a motor block and sensitivity, without transient or definitive neurological complications.

Conclusion

Several descriptions of the anatomy of the spinal canal began in the 16th century and new descriptions appeared at the end of the 19th century, and it might be assumed that the structures relevant to spinal anesthesia were well described before the inception of local anesthetic, adjuvants, or other drugs administration into the CSF gently bathing the delicate neuraxial structures. The use of modern radiological imaging technology has provided new and important information for understanding of the anatomical and pathophysiological aspects involved in spinal anesthesia. The functional anatomy of the spinal block, an intimate knowledge of the spinal column, spinal cord, and spinal nerves must be present. When preparing for a spinal anesthetic block, it is important to accurately identify landmarks on the patient. The technique of administering single shot or continuous spinal anesthesia can be described as: preparation, position, projection, and puncture. With the improvement of imaging technology of the central and peripheral nervous system, knowledge of the anatomy and physiology of spinal anesthesia has been improved. Despite technological advances in imaging for spinal anesthesia, the technique using landmark anatomy remains the most used worldwide. In this article, the lumber and thoracic puncture were discussed to obtain a single shot or continuous spinal anesthesia.

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Conflicts of interest

The author declares that there are no conflicts of interest.

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