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LITERATURE REVIEW

Thoracic Segmental Spinal Anesthesia

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ABSTRACT

Thoracic segmental spinal anesthesia (TSSA) is a regional anesthesia technique that is increasingly used as an alternative to general anesthesia, especially for high-risk patients undergoing abdominal and thoracic surgeries. TSSA offers significant benefits, including better hemodynamic stability and a reduction in postoperative side effects such as nausea, vomiting, and respiratory depression. This technique also provides more optimal pain control and facilitates faster recovery, particularly in terms of postoperative mobilization and gastrointestinal function recovery. However, the use of TSSA requires a deep understanding of the relevant anatomy, physiology, and pharmacology to avoid complications such as iatrogenic injury or excessive spread of anesthesia. With the right understanding, TSSA can reduce the need for large volumes of local anesthetics, accelerate recovery, and deliver better outcomes in various surgical procedures. Further development of practice guidelines and research related to TSSA is also necessary to maximize its benefits in improving anesthesia safety and effectiveness in high-risk patients.

Keywords: Regional anesthesia, segmental anesthesia, thoracic segmental spinal anesthesia

INTRODUCTION

Background

Thoracic segmental spinal anesthesia (TSSA) is a regional anesthetic technique in which a local anesthetic is injected into the subarachnoid space at the thoracic level to block neural transmission at selected spinal segments.[1,2] This technique has gained increasing acceptance as an alternative to general anesthesia (GA), particularly in high-risk patients undergoing abdominal and thoracic surgery.[3] By providing a targeted segmental neural blockade, TSSA offers advantages in minimizing the systemic effects commonly associated with GA.[4]

The principal strength of TSSA lies in its ability to preserve superior hemodynamic stability, making it a favorable option for high-risk patients who may not tolerate the hemodynamic fluctuations frequently observed with GA.[3,5] In addition, TSSA is associated with fewer postoperative adverse effects, including a lower incidence of nausea, vomiting, and respiratory depression.[3,5] Previous studies have also reported higher patient satisfaction among individuals receiving thoracic spinal anesthesia, as this technique achieves effective analgesia with minimal clinically relevant side effects.[3,6]

The application of TSSA requires a thorough understanding of relevant anatomy, physiology, and pharmacology, given the potential for complications such as iatrogenic spinal cord injury or excessive spread of local anesthetic that may result in total spinal block.[7] Furthermore, TSSA can be combined with multimodal analgesic strategies or adjuvant agents, such as midazolam and dexamethasone, to enhance its safety profile and clinical effectiveness.[6,8] With continued refinement and growing clinical experience, TSSA holds substantial promise as an optimal anesthetic approach for patients with high perioperative risk or specific clinical requirements. Accordingly, it is essential for medical practitioners to continuously update their knowledge and technical skills related to TSSA as part of ongoing innovation in modern anesthetic practice.

LITERATURE REVIEW

Anatomy

The thoracic and lumbar spine share broadly similar anatomical features; however, several clinically relevant differences are particularly important for anesthetic procedures performed at the thoracic level.[7] Magnetic resonance imaging (MRI) studies have demonstrated that the middle to lower segments of the spinal cord in the thoracic region are positioned more anteriorly, leaving a cerebrospinal fluid (CSF)-filled space between the dura mater and the spinal cord. In contrast, in the lumbar region, the spinal cord and cauda equina are located more posteriorly and are in closer contact with the dura mater.[5,7] MRI-based analyses in 50 patients reported that the distance between the dura mater and the spinal cord in the thoracic region was 5.19 mm at the T2 level, 7.75 mm at T5, and 5.88 mm at T10.[7,9] These anatomical characteristics result in a deeper posterior subarachnoid space within the thoracic spine, providing a minimum safety margin during intrathecal injection at mid-thoracic levels before the spinal needle approaches spinal cord tissue.[7] This anatomical configuration may explain the relatively low incidence of neurological complications following inadvertent dural puncture during thoracic epidural block and supports the clinical safety of segmental spinal anesthesia when a thoracic approach is applied.[9]

Figure 1. Sagittal T1-weighted magnetic resonance imaging (MRI) of the thoracic spine demonstrates a greater volume of cerebrospinal fluid in the posterior compartment of the thoracic region.[5]

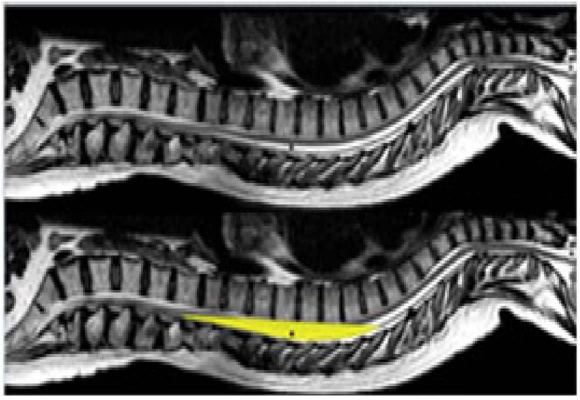


Figure 2 MRI of the Spinal Cord (demonstrates a relatively wide space at the thoracic level).[10]

The interlaminar space of the thoracic spine is narrower and less accessible than that of the lumbar region.[7] This difference is primarily attributable to the overlapping configuration of the thoracic vertebral laminae, whereas the lumbar laminae do not overlap and therefore provide a wider interlaminar window.[7] In addition, the thoracic spinous processes are angulated caudally, in contrast to the posteriorly oriented lumbar spinous processes.[7] This oblique orientation influences the needle trajectory during the midline approach and may increase technical difficulty during thoracic procedures.[7]

During thoracic segmental spinal anesthesia (TSSA), the anatomical layers traversed by the needle are similar to those encountered in lumbar spinal anesthesia.[2] With the midline approach, the needle passes sequentially through the skin, subcutaneous tissue, supraspinous ligament, interspinous ligament, ligamentum flavum, dura mater, subdural space, arachnoid mater, and ultimately the subarachnoid space.[2] In the paramedian approach, the needle advances through the skin, subcutaneous tissue, paraspinal muscles, ligamentum flavum, dura mater, subdural space, arachnoid mater, and the subarachnoid space.[2] A detailed understanding of these anatomical layers is essential to reduce the risk of procedural complications.[2]

In TSSA, the anesthetic effect is achieved through blockade of spinal nerves at selected thoracic levels. Thoracic spinal nerves exit through the intervertebral foramina and course within the thoracic paravertebral space, providing both somatic and sympathetic innervation to the corresponding thoracic dermatomes. These neural branches, known as intercostal nerves, play a critical role in the innervation of the thoracic and abdominal walls.[11] The intercostal nerves run along the costal grooves of the ribs, supplying sensory and motor innervation to the chest wall and upper abdominal region.[12] In addition, sympathetic fibers arising from the upper thoracic segments (T1–T4) contribute to autonomic regulation of thoracic organs, including the heart, and represent an important target for achieving sympathetic blockade in thoracic epidural anesthetic techniques.[13]

Indication

Thoracic segmental spinal anesthesia (TSSA) represents an appropriate anesthetic option for selected short-duration procedures in patients who are at high risk of perioperative morbidity and mortality under general anesthesia (GA), as well as in those who decline GA.3,7 Patients who are unsuitable candidates for conventional lumbar spinal anesthesia may also derive benefit from this approach.[7] Individuals at increased risk typically include older adults with reduced physiological reserve, multiple comorbidities, polypharmacy, cognitive impairment, and frailty.[7]

A range of surgical procedures has been successfully performed under TSSA, including abdominal oncologic surgery, breast cancer surgery, and laparoscopic cholecystectomy, even in otherwise healthy patients, with favorable outcomes reported.[7] Despite its potential advantages, the safety profile of TSSA requires further confirmation through larger clinical studies before routine clinical adoption can be recommended.[7] Prior to the procedure, informed consent is mandatory and should include a detailed explanation of the indications for TSSA, procedural steps, anticipated benefits, potential risks, and available alternative anesthetic techniques. Patients should also receive appropriate psychological preparation, including clear information that they will remain conscious during surgery and may experience certain sensations, such as traction or discomfort related to pneumoperitoneum during laparoscopic procedures, which may otherwise provoke anxiety.[7]

Contraindication

Several well-established contraindications apply to all forms of neuraxial anesthesia.[7] Absolute contraindications include patient refusal or the absence of informed consent, local infection at the planned puncture site, a true allergy to the anesthetic agents administered, and elevated intracranial pressure, which may increase the risk of uncal herniation secondary to cerebrospinal fluid loss through the spinal needle.[2,7] Relative contraindications encompass pre-existing neurological disorders, such as multiple sclerosis and other demyelinating diseases, sepsis, severe hypovolemia, and coagulopathy.[2,7] In patients with coagulation abnormalities, spinal anesthesia may be considered on an individual basis, depending on the severity of the disorder.[7] Additional relative contraindications include severe mitral or aortic stenosis, as well as left ventricular outflow tract obstruction, as observed in hypertrophic obstructive cardiomyopathy.[7]

Advantages

Thoracic segmental spinal anesthesia (TSSA) offers several advantages that make it an effective alternative and, in selected clinical settings, a potentially superior option compared with other anesthetic techniques.[14] When compared with general anesthesia (GA), TSSA is associated with a lower risk of respiratory and cardiovascular complications, more effective attenuation of the neuroendocrine stress response to surgery, and improved intraoperative and postoperative analgesia.[14] Additional benefits include faster recovery of gastrointestinal function, a reduced incidence of postoperative nausea and vomiting, earlier ambulation and hospital discharge, and a lower risk of deep vein thrombosis and surgical site infection.[14] TSSA also avoids airway instrumentation, thereby reducing the likelihood of airway-related complications.[14]

A key advantage of TSSA over lumbar spinal anesthesia lies in its greater efficiency in achieving neural blockade.[14] At the thoracic level, smaller nerve roots and a lower volume of cerebrospinal fluid allow local anesthetics to exert their effect with smaller doses.[9] This characteristic may reduce the risk of hypotension and hemodynamic instability when compared with lumbar spinal anesthesia.[9] Patients undergoing TSSA tend to regain mobility earlier because motor blockade of the lower extremities is minimal, facilitating faster postoperative mobilization.9 Available evidence further suggests that TSSA provides superior abdominal muscle relaxation and requires a lower volume of local anesthetic than thoracic epidural anesthesia.[9] TSSA has also been associated with high levels of patient comfort and satisfaction, in some reports exceeding those observed with other anesthetic techniques.[15] In a variety of surgical procedures, such as laparoscopic cholecystectomy, TSSA has been linked to reduced shoulder pain, a technically simpler approach, and improved abdominal relaxation.[14] The use of TSSA in combination with continuous intrathecal infusion or alongside epidural anesthesia has been described as a safe and effective option for older adults and high-risk patients who may not tolerate GA, particularly in healthcare settings with limited intensive care resources.[14,16,17] Furthermore, the addition of adjuvant agents, such as midazolam, ketamine, or dexamethasone, may further enhance the safety and effectiveness of TSSA, supporting its role as a valuable anesthetic strategy across a range of clinical scenarios.[14,17]

Patient Selection

Despite its numerous benefits, thoracic segmental spinal anesthesia (TSSA) is associated with potential risks and complications. Therefore, patient selection should not be based solely on surgical factors or individual clinical characteristics, but should also be guided by evidence derived from previous studies and published case reports in which TSSA has been performed.[14]

a. Surgical Factors

TSSA has been applied across a wide range of surgical procedures, including lower-limb orthopedic surgery, abdominal oncologic surgery, breast surgery, laparoscopic cholecystectomy, open nephrectomy, cystectomy, and cesarean section.[14] Owing to the relatively short duration of sensory blockade, TSSA is generally not recommended for prolonged procedures unless an intrathecal catheter is inserted or a combined spinal–epidural technique is performed.18 The shorter duration of motor blockade relative to sensory blockade makes this technique particularly suitable for day-care surgical procedures.[18] In published studies and case reports, operative times under TSSA have ranged from 23 to 136 minutes.14 Thoracic continuous spinal anesthesia has even been reported in surgical procedures lasting up to 191 minutes.[16]

b. Thoracic Surgery

Local anesthesia has been described as a sole anesthetic technique in both emergency and elective thoracic surgery and has proven particularly beneficial for procedures such as kyphoplasty and breast surgery, owing to its favorable hemodynamic profile and effective analgesia.[17,19,20] The advantages of awake thoracic surgery under local anesthesia include faster postoperative recovery, shorter hospital stay, reduced healthcare costs, comparable effectiveness to conventional approaches, and lower rates of minor and major morbidity.[14] Several procedures have been performed under thoracic epidural anesthesia in awake patients, including pulmonary nodule resection, posterior resection for non–small cell lung cancer, and talc pleurodesis.[14] Ongoing controversies include the limited number of large-scale randomized controlled trials, concerns regarding potential surgical risk, the need for specialized training, and adverse effects related to local or regional anesthesia.[14]

c. Cardiac Surgery

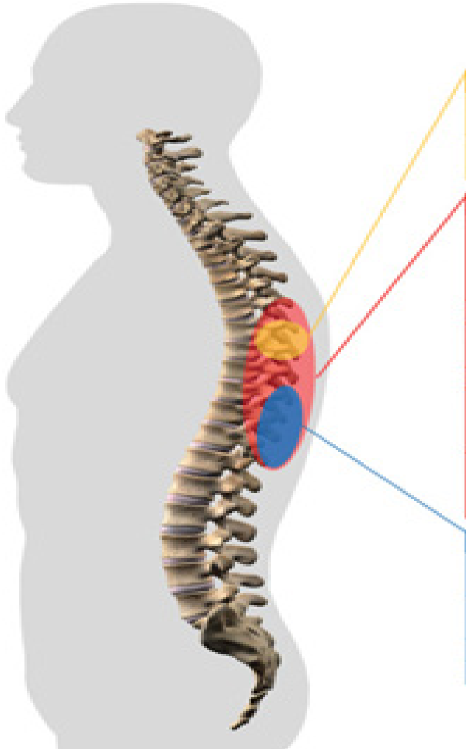
In cardiac surgery, anesthetic goals include maintaining hemodynamic stability, attenuating the neuroendocrine stress response, and optimizing the balance between myocardial oxygen supply and demand.[14] Several studies have suggested that TSSA can be safely applied in cardiac surgery, achieving sensory blockade at the T1 level while preserving stable intraoperative hemodynamics, particularly in high-risk surgical settings.[3] In addition, this technique has demonstrated meaningful benefits in reducing opioid requirements and facilitating faster postoperative recovery.[19]

d. Patient Factors

Patient-related considerations in TSSA are strongly influenced by individual clinical status and perioperative risk profiles.[14] In patients with impaired pulmonary function, TSSA represents a particularly valuable option, as anesthetic management aims to avoid agents that interfere with mucociliary clearance, prevent the need for mechanical ventilation, reduce the risk of atelectasis, provide adequate analgesia, and facilitate early mobilization.[14] General anesthesia is associated with an increased risk of ventilator dependence, postoperative respiratory complications, and mortality, especially in individuals with severe pulmonary disease.[14] In contrast, local and regional anesthetic techniques, including TSSA, exert minimal adverse effects on pulmonary function and have been associated with more favorable respiratory outcomes.[14] Several case reports have documented the successful use of TSSA as a sole anesthetic technique in patients with severe pulmonary disease.[14] TSSA also represents an effective alternative for patients at high risk of perioperative morbidity and mortality related to general anesthesia, particularly older adults with limited physiological reserve and complex comorbidities.[14,16]

Technical Considerations

Previous literature has described the performance of thoracic segmental spinal anesthesia (TSSA) at vertebral levels ranging from T4 to T12, depending on the type of surgical procedure.[14,17,21] For operations involving the thoracic region, such as breast surgery, TSSA is commonly performed at the T5–T6 interspace, with a local anesthetic volume of approximately 1.1–1.4 mL, resulting in a sensory block extending from T1 to T11.[14] For surgical procedures involving the upper abdomen, including colonic



Thoracic Surgery: T5-T6			
Surgical procedure	TSA needle insertion level	LA volume range	Sensory level
Breast surgery[22, 51, 54]	T5-T6	1.1-1.4 ml	T1-T12

Upper Abdominal Surgery: T4-T11			
Surgical procedure	TSA needle insertion level	LA volume range	Sensory level
Colon resection[46]	T4-T5	1.7 ml	T3-L5
Gastrectomy[25]	T6-T8	0.9-1.2 ml	T4
Gastrostomy[18]	T8-T9	1 ml	T3-T12
Laparoscopic cholecystectomy[20, 24, 26, 28, 31, 48, 49, 52, 56, 57]	T8-T11	1.5-2.5 ml	T2-L5
Laparotomy for other abdominal malignancies[23]	T9-T10	2 ml	T2-L3

Lower Abdominal Surgery: T8-T11			
Surgical procedure	TSA needle insertion level	LA volume range	Sensory level
Caesarean delivery[17]	T8-T9	1.4 ml	T4-L2
Cystectomy[29]	T10-T11	1 ml	T6-L2
Nephrectomy[30, 50]	T10-T11	1.3-2 ml	T3-T12

Figure 3. Schematic summary of the literature illustrating vertebral levels at which TSSA may be performed for various surgical procedures, the volumes of local anesthetic administered, and the resulting sensory blockade.[14]

resection, gastrectomy, gastrostomy, and laparoscopic cholecystectomy, TSSA has been performed at thoracic levels between T4 and T11.[14]

a. Determination of the Appropriate Level

Accurate identification of the puncture level is a critical step in thoracic segmental spinal anesthesia (TSSA), as precise localization of the vertebral level directly influences both procedural success and safety.[14] Evidence indicates that anesthesiologists correctly identify the intended vertebral level in only approximately 29% of cases.[14] Although the T10 level is frequently identified with high accuracy (up to 92%), only a small proportion of anesthesiologists perform TSSA at this level.[14] Other studies have demonstrated that palpation of anatomical landmarks is also unreliable for determining thoracic intervertebral levels.[22] Consequently, the use of ultrasonography to identify and confirm the correct thoracic intervertebral level during TSSA has increasingly been adopted and is recommended in several medical centers.[22]

Incorporating ultrasound examination into the preprocedural assessment allows accurate identification of the target thoracic intervertebral space, measurement of the depth to the ligamentum flavum and posterior dura mater, and detection of anatomical abnormalities of the vertebral column.[14] Several studies have reported that spinal anatomical variations may contribute to technical difficulty during spinal anesthesia. Therefore, the presence of vertebral pathology, such as ankylosing spondylitis, rheumatoid arthritis, or postural deformities including kyphosis and scoliosis, should be carefully considered when planning TSSA.[14]

b. Patient Positioning

Thoracic segmental spinal anesthesia is typically performed with the patient in either the sitting or lateral decubitus position, with patient comfort regarded as a primary consideration.[2]

The chosen position aims to create a straight needle trajectory through the intervertebral space.[2] The sitting position is most commonly preferred, as spinal anatomy tends to be more symmetrical than in the lateral decubitus position. In the sitting position, with the legs hanging freely at the side of the bed, patients should be instructed to maintain spinal flexion, which increases posterior separation between the dura mater and the spinal cord, particularly at the mid-thoracic level. This positioning may further reduce the risk of spinal cord injury.[2,14]

c. Needle Selection

The choice of spinal needle represents an important aspect of TSSA in minimizing procedural complications.[14] Available evidence suggests that both pencil-point and cutting-point needles can be applied in this technique, each with distinct characteristics that warrant consideration.[14] Pencil-point needles have an orifice located approximately 1.7 mm proximal to the tip, requiring at least 2 mm of advancement into the subarachnoid space to obtain cerebrospinal fluid.[14] This requirement may increase the risk of inadvertent penetration of the spinal cord.[14] In contrast, cutting-point needles have an orifice at the tip, allowing immediate cerebrospinal fluid return upon dural puncture, and are therefore considered safer

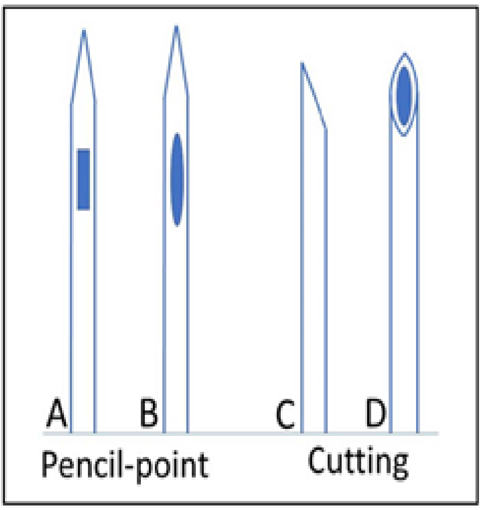


Figure 2. Spinal needle designs: (A) Whitacre, (B) Sprotte, (C and D) Quincke (side and front profiles).

Figure 4. Spinal Needles Commonly used for Spinal Anesthesia.[23]

for use in the thoracic region.[9] Moreover, at an entry point between T5 and T6 with an insertion angle close to 45°, magnetic resonance imaging measurements demonstrate a greater distance between the needle tip and the posterior surface of the spinal cord, further increasing the safety margin when using a cutting-point needle.[9] Accordingly, although atraumatic pencil-point needles are widely used, cutting-point needles may represent a safer alternative for TSSA, particularly when the thoracic approach is selected.[9]

d. Midline versus Paramedian Approach

Both the midline and paramedian approaches are commonly applied techniques in TSSA.[14] In the midline approach, the spinal needle is inserted along the midline of the body, passing sequentially through the supraspinous ligament, interspinous ligament, ligamentum flavum, epidural space, and dura mater before entering the subarachnoid space.[2,14] In contrast, the paramedian approach allows the needle to bypass the midline ligamentous structures and penetrate directly through the ligamentum flavum.[2,14]

The midline approach is often considered technically more challenging in TSSA than the paramedian approach.[14] Several factors may contribute to this difficulty, including the presence of gaps within the elastic fibers of the ligamentum flavum that are filled with epidural fat and communicating vessels of the venous plexus, potentially diminishing the characteristic tactile sensation during ligament penetration.[14] Ossification of the ligamentum flavum may further impede needle advancement, while the steep caudal angulation of the spinous processes between T4 and T9 can complicate needle insertion along the midline.[14] When the midline approach is selected, these anatomical considerations should be carefully taken into account, and particular attention should be paid to directing the needle at an appropriate cranial angle to access the subarachnoid space. Under such circumstances, the paramedian approach may offer a technically simpler alternative, especially when midline anatomical landmarks are difficult to identify.[14]

Figure 2.5. Needle placement at the T6–T7 Level: (A) Paramedian Approach and (B) Midline Approach.[21]

Advancement of the spinal needle should be performed slowly and with meticulous control until dural puncture is confirmed by the free flow of cerebrospinal fluid from the needle hub.[14] Only after unobstructed cerebrospinal fluid flow has been clearly observed should the local anesthetic be administered.[14]

e. Selection of Local Anesthetic Solutions

In thoracic segmental spinal anesthesia (TSSA), various local anesthetic solutions may be selected, including hypobaric, isobaric, and hyperbaric formulations, depending on the desired anesthetic profile.[14] Isobaric solutions, when injected at the T5 level, are capable of producing simultaneous sensory and motor nerve root blockade, thereby providing safe and effective anesthesia.[9] Hypobaric solutions exhibit distinct characteristics, with a tendency to produce a more pronounced motor block than sensory block, likely due to their preferential effect on anterior nerve roots.[9] In contrast, hyperbaric solutions, particularly when patients are positioned supine, exert a greater effect on posterior (sensory) nerve roots, resulting in a more dominant sensory blockade relative to motor blockade.[9]

This property allows hyperbaric solutions to produce a longer-lasting sensory block compared with motor block, making them suitable for procedures that require prolonged sensory anesthesia.[9] Therefore, the choice of local anesthetic solution should be tailored to the specific clinical objectives and the intended segmental distribution of spinal anesthesia to achieve optimal outcomes.[9]

Ropivacaine is available in both hypobaric and isobaric formulations. Hypobaric ropivacaine 0.25% at a dose of 8 mg has been shown to provide effective anesthesia for breast and axillary surgery without reported complications, whereas isobaric ropivacaine has been described as an adjunct (booster) during spinal surgery to address inadequate sensory blockade.[6,21] Bupivacaine is widely administered in both hyperbaric and isobaric formulations. The combination of 10 mg of 0.5% hyperbaric bupivacaine with fentanyl 25 µg has been associated with stable hemodynamics and prolonged postoperative analgesia in abdominal and laparoscopic surgery, with spinal needle insertion performed at the T9–T10 level.[24]

Isobaric bupivacaine, in addition to its favorable hemodynamic profile, is characterized by a slower onset of sensory blockade compared with other bupivacaine formulations.25,26 Nevertheless, isobaric bupivacaine provides effective surgical anesthesia with a longer duration of sensory blockade, which is particularly advantageous for prolonged surgical procedures.[26] Furthermore, isobaric bupivacaine tends to produce minimal motor blockade, thereby supporting faster postoperative recovery and earlier patient mobilization.[26]

Another study conducted in patients undergoing laparoscopic cholecystectomy performed spinal needle insertion at the T10–T11 level. This study compared isobaric levobupivacaine 0.5% (1.5 mL) combined with fentanyl 25 µg and hyperbaric levobupivacaine 0.5% (1.5 mL) combined with fentanyl 25 µg for thoracic segmental spinal anesthesia. The hyperbaric group demonstrated a faster onset and resolution of both sensory and motor blockade.[27] Sensory blockade reached the T4 dermatome more rapidly, and the maximum Bromage score was achieved earlier in the hyperbaric group. In addition, higher patient and surgeon satisfaction scores and lower patient discomfort scores were reported in the hyperbaric group. Although postoperative visual analog scale (VAS) pain scores were higher, the time to first rescue analgesia was shorter. Hyperbaric levobupivacaine was also associated with better hemodynamic stability, a lower incidence of hypotension, faster recovery, and fewer postoperative complications, such as pneumonia and atelectasis.[27] The administration of adjuvant agents, such as midazolam and ketamine, has been described to enhance anesthetic efficacy and patient satisfaction, particularly in breast and axillary surgery. In contrast, clonidine or dexmedetomidine has been reported in spinal surgery to improve anesthetic quality and to facilitate effective opioid-free pain control.[6,21]

Safety and Complications

Serious complications associated with thoracic segmental spinal anesthesia (TSSA) are rare but warrant careful consideration.[7] Potential major complications include direct needle-related trauma, infectious complications such as abscess formation and meningitis, vertebral canal hematoma, spinal cord ischemia, and arachnoiditis.[7] Total spinal anesthesia, cardiovascular collapse, and death have also been reported as extremely rare but potentially fatal complications.[2,7] Continuous monitoring during the procedure is therefore essential to minimize these risks.[7] Minor complications occur more frequently and are often considered clinically less significant, although they still require appropriate attention.[7] Common minor complications include hypotension, nausea and vomiting (often secondary to hypotension), bradycardia, paresthesia, mild transient hearing disturbances, back pain, urinary retention, and transient neurologic symptoms (TNS).[7,10,21]

One of the most frequently reported minor complications is post–dural puncture headache, which, despite being classified as minor, can cause substantial patient discomfort.[7] Accordingly, even though most of these complications are not life-threatening, appropriate management remains essential to ensure patient comfort and optimal recovery.[7] A systematic review and meta-analysis evaluating the effectiveness and safety of TSSA included a total of six studies.[28] The incidence of adverse events was assessed in three studies that specifically reported patient-reported nausea, vomiting, and hypotension. These studies suggested a higher risk of hypotension and a lower risk of nausea and vomiting in patients undergoing TSSA compared with control groups. However, no statistically significant difference was observed between groups with respect to the incidence of nausea. The review also addressed other complications, including bradycardia and urinary retention. In two studies, the incidence of bradycardia in patients receiving TSSA ranged from 6–7.5% and 8.6–15%, respectively, whereas urinary retention was reported in only one study, with an incidence of 0% in both the TSSA and control groups.[28]

CONCLUSION

Thoracic segmental spinal anesthesia (TSSA) is an effective regional anesthetic technique, particularly for high-risk patients undergoing abdominal and thoracic surgical procedures. TSSA offers several advantages, including superior hemodynamic stability compared with general anesthesia, as well as a lower incidence of postoperative adverse effects such as nausea, vomiting, and respiratory depression. By providing effective analgesia, TSSA enhances patient satisfaction and facilitates faster recovery, especially with respect to early postoperative mobilization and restoration of gastrointestinal function. Additional benefits include a reduced risk of cardiovascular and respiratory complications, along with a potential decrease in the incidence of deep vein thrombosis and surgical site infection.

Despite these advantages, the application of TSSA requires a comprehensive understanding of the relevant anatomy, physiology, and pharmacology, as well as awareness of potential risks, including iatrogenic spinal cord injury and excessive spread of local anesthetic. Other complications, such as hypotension, should also be anticipated and appropriately managed. Nevertheless, when performed with proper technique, TSSA may reduce the required volume of local anesthetic, accelerate postoperative recovery, and provide favorable outcomes across a range of surgical procedures.

With a balanced appreciation of both its benefits and risks, TSSA represents an optimal anesthetic option for patients with high perioperative risk or specific clinical needs.

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