Regional anesthesia for geriatric population

ABSTRACT

Advancements in modern health care over 20 years have substantially increased the average lifespan in developed countries, and the fastest growing population is the elderly population. The proportion of people in Saudi Arabia aged 60 or more is predicted to be 25 percent of the total population of 40 million by the end of 2050. Moreover, the number of people aged 80 or more is expected to reach 1.6 million or 4 percent of the total population in the same period. Improvements in surgical techniques, anesthesia, and intensive care units make surgical interventions in older and sicker patients possible. It is estimated that over half of the population older than 65 years will require surgical intervention at least once during the remainder of their lives. Therefore, elderly patients are becoming an even larger part of anesthetic practice. Regional anesthesia (RA) is frequently used in elderly patients, especially during orthopedic surgery, genitourologic and gynecologic procedures, and hernia repair. Although age can no longer be considered a contraindication to anesthesia and surgery, anesthesia-related morbidity and mortality remain higher among elderly than among young adult surgical patients. Undoubtedly, peripheral nerve (PN) blocks improve analgesia and reduce opioid consumption and their associated side effects. This is beneficial in the perioperative care of elderly patients who may have less physiologic reserve to withstand the side effects of general anesthesia (GA).

Key words: Anesthesia, geriatrics, regional

Introduction

Advancements in modern health care over 20 years have substantially increased the average lifespan in developed countries, and the fastest growing population is the elderly population. The proportion of people in Saudi Arabia aged 60 or more is predicted to be 25 percent of the total population of 40 million by the end of 2050. Moreover, the number of people aged 80 or more is expected to reach 1.6 million or 4 percent of the total population in the same period.[1] Improvements in surgical techniques, anesthesia, and intensive care units make surgical interventions in older and sicker patients possible. It is estimated that over half of the population older than 65 years will require surgical intervention at least once during the remainder of their lives.[2] Therefore, elderly patients are becoming an even larger part of anesthetic practice. Regional anesthesia (RA) is frequently used in elderly patients, especially during orthopedic surgery, genito-urological and gynecological procedures, and hernia repair. Although age can no longer be considered a contraindication to anesthesia and surgery,

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DOI: 10.4103/sja.sja_424_23	

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How to cite this article: Al Harbi MK, Alshaghroud SM, Aljahdali MM, Ghorab FA, Baba F, Al Dosary R, *et al*. Regional anesthesia for geriatric population. Saudi J Anaesth 2023;17:523-32.

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Submitted: 21-May-2023, **Revised:** 22-Jun-2023, **Accepted:** 24-Jun-2023, **Published:** 18-Aug-2023

anesthesia-related morbidity and mortality remain higher among elderly than among young adult surgical patients.[3] Undoubtedly, peripheral nerve (PN) blocks improve analgesia and reduce opioid consumption and their associated side effects. This is beneficial in the perioperative care of elderly patients who may have less physiologic reserve to withstand the side effects of general anesthesia (GA).[4]

Upper Limb

RA has emerged as a crucial element in perioperative pain management, particularly in geriatric patients. RA has been found to be more effective in providing pain management in upper limb surgery than in GA.[5] Furthermore, it has been observed to reduce the incidence of postoperative cognitive dysfunction and mitigate the probability of adverse effects such as deep vein thrombosis, pneumonia, and pulmonary embolism.[6,7] PN blocks are frequently utilized in surgical procedures involving the upper extremities, particularly in patients suffering from perioperative pain in the upper extremity.[8] To perform RA of the upper extremity, the anesthesiologist must be well-versed in the anatomy of the brachial plexus (BP) to optimize block selection and placement.[9] Besides surgical anesthesia, RA also allows postoperative pain control by serving as an adjunct to GA, minimizing generalized adverse effects.[10] Each peripheral nerve block (PNB) of the upper extremity is associated with specific indications determined by the target location of surgery.[11,12]

Elderly patients are four times more likely to undergo surgery than younger individuals. This is also associated with higher anesthesia-related mortality and morbidity rates in elderly patients.[13,14] RA in geriatric patients is considered a safe approach owing to the reduced occurrence of thromboembolic complications and stress response, in conjunction with good postoperative analgesia.[15] We will further explore and highlight PNB and associated techniques utilized in administering RA in geriatric patients.

Anatomy of brachial plexus

The BP constitutes the sensory and somatic motor nerve supply of the upper extremities. The anterior primary rami of C5 to C8 and T1 combine to form the BP. The BP is further composed of terminal branches, cords, divisions, trunks, and nerve roots. The roots of the BP are made by the ventral rami of spinal nerves, from C5 to T1. These arrange together to give rise to the superior trunk (ST) (C5–C6), middle trunk (C7), and inferior trunk (C8–T1). In the posterior triangle of the neck, the BP trunks are located between the anterior scalene and middle scalene muscles.[16] Nerve fiber bundles arising from the trunks are known as divisions. There are six BP divisions present anteriorly and posteriorly, which further give rise to medial, lateral, and posterior cords. The name of each cord is designated based on the relationship of the cord with the axillary artery. The terminal branches refer to the nerves arising from the cords of the BP. These include ulnar, musculocutaneous, axillary, median, and radial nerves. The BP also gives rise to collateral nerves, responsible for the innervation of proximal limb muscles.[16]

The generalized anatomy of the BP does not consider the anatomical variant of this structure. While some individuals have the BP anatomy described above, the BP in other individuals comprises additional nerve fibers originating from C4, T2, or T3 spinal nerves.[17] Coursing in a proximal to distal direction, the BP is associated with four topographical regions including the interscalene gap (ventral rami), the posterior triangle of the neck (trunks), the infraclavicular fossa (cords), and the axillary fossa (cords and terminal branches).[17]

Approaches to BP blocks

Different approaches to BP nerve blocks include axillary, interscalene, infraclavicular, ST, and supraclavicular nerve (SN) blocks.[18]

Axillary BP block

The superficial location of the axillary fossa facilitates easier recognition of the nerves using ultrasonography or nerve stimulator techniques. The nerves situated in the axillary space, namely the median, ulnar, radial, and musculocutaneous nerves, are the primary focus of the axillary BP block.[19] During the procedure, the anesthesiologist may utilize a high-frequency ultrasound linear probe to visualize neural structures in the axillary space and spread local anesthetic (LA) agents and block needles.[20] The axillary block indications include elbow, forearm, wrist, or hand surgery.[21]

Interscalene BP block

Patients subjected to surgical procedures involving the shoulder, elbow, or upper arm tend to undergo interscalene BP block. Owing to the sparing of the inferior trunk of the BP, interscalene block is not performed in patients undergoing hand surgery.[18,22] The potential contraindications of interscalene block include diaphragmatic hemiparesis. This is an outcome of ipsilateral phrenic nerve block, which is associated with a 25% decline in pulmonary function in affected individuals. Interscalene block can also result in airway obstruction in individuals with underlying vocal cord palsy. This is due to a recurrent laryngeal nerve block.[22]

Infraclavicular BP block

This nerve block is utilized as a GA adjunct in surgical procedures of the upper limb; however, it can be given alone as well. The target locations include the hand, elbow, and forearm; however, the shoulder is spared in the infraclavicular block. This anesthetic technique is developed to prevent pneumothorax and other complications associated with supraclavicular BP block.[23,24] Infraclavicular block reduces the risk of tourniquet pain during surgical procedures, shortens the performance time of the nerve block, and is more reliable for the blockade of the musculocutaneous nerve.[25] The costoclavicular approach to infraclavicular block allows faster sensory blockade compared with the lateral sagittal approach.[26]

Superior trunck brachial plexus (ST BP) block

ST BP block is considered a safe alternative to interscalene block, as it reduces the risk of developing hemidiaphragmatic paresis (HP). An ST block is also useful in the provision of non-inferior postoperative analgesia.[27] Although ST block can lower the likelihood of phrenic nerve palsy, it can cause significant weakness or paralysis of the diaphragm in certain patients.[28]

Supraclavicular BP block

This nerve block is utilized in upper extremity surgeries targeting the mid-humerus region to the hand of the patient. Given the arrangement of BP nerves in this approach, there is a rapid nerve blockade.

Kulenkampff was the first to describe the supraclavicular block, a nerve-blocking technique. This technique provides a consistent and uniform occlusion of the entire upper extremity, plus the cephalad (musculocutaneous) and caudad (ulnar) nerves, without sparing any of the nerves of the BP.[29] In recent years, the supraclavicular approach has become increasingly prevalent, largely due to the development of ultrasound technology. This technology has significantly decreased the incidence of pneumothorax, a procedure-related complication.[30] Before the implementation of ultrasonography, the incidence rate of pneumothorax occurring during surgical interventions ranged from 0.6% to 5%.[31]

Nerve supply to the shoulder

The shoulder joint is supplied with sensory and motor innervation by multiple PNs, including the suprascapular nerve (SSN) and axillary nerves, originating from the posterior cord, and the lateral pectoral nerve, originating from the lateral cord.[32] Besides small axillary nerve branches, the SSN innervates the posterior shoulder joint and adjacent soft tissues such as the rotator cuff, subcoracoid bursa, subacromial bursa, coracoclavicular ligament, coracohumeral ligament, and coracoacromial ligament.[28,29] In shoulder surgeries, the BP must be targeted at the level of its trunks to provide adequate anesthesia for the shoulder and its surrounding structures. The SSN originates from the ST of the BP, making it an important target for shoulder surgery.[33] The interscalene or supraclavicular approach typically blocks the BP at this level. The skin overlying the shoulder joint is supplied by the SNs, which originate from the superficial cervical plexus.[32,34]

Hence, to guarantee comprehensive coverage for skin incision and closure during shoulder surgery, it is imperative to concomitantly administer superficial or intermediate cervical plexus blocks alongside PN blocks. These blocks can be performed easily with ultrasound guidance and LA infiltration along the posterior border of the sternocleidomastoid muscle.[35] The infraspinatus and supraspinatus muscles at the shoulder are innervated by the SSN. This nerve originates from the upper trunk of the BP, corresponding to the C5–C6 roots. The lower subscapular nerve corresponding to the C5–C6 roots is responsible for the innervation of the teres major. Both the upper and lower subscapular nerves innervate the subscapularis muscle. These nerves arise from the posterior cord.[36,37]

Diaphragm sparing techniques for BP blocks in shoulder surgeries

Interscalene nerve blocks are widely used for providing RA in shoulder surgeries. A systematic review found that the utilization of an interscalene block resulted in a significant decrease in pain levels, as assessed by the visual analog scale (VAS), for up to 24 hours post-surgery. Additionally, there was a significant reduction in the need for supplemental analgesia in patients who received the interscalene block compared with those in the control group.[38]

The implementation of an interscalene BP block presents a notable risk for respiratory complications, such as phrenic nerve weakness and one-sided diaphragm paralysis. These complications may persist in the long run and not just temporarily.[39] Moreover, the technique presents an elevated likelihood of neural impairment given that it focuses on nerve roots in the cervical region instead of PN.[40]

Ipsilateral phrenic nerve block gives rise to a decrease in forced expiratory volume and forced vital capacity of the affected patients. A decline in breathing capacity is a major concern among geriatric patients with a preexisting compromised respiratory system.[41] According to research studies, costoclavicular blocks have been demonstrated to be safe in providing postoperative analgesia in shoulder surgeries, which is comparable to interscalene block, with a HP incidence rate of 0%. Similar effects are observed in the case of the anterior suprascapular block; however, the HP risk of this approach is not quantitatively established.[42-44]

Another RA approach implicated in shoulder surgeries is the selective suprascapular and axillary nerve (SSAX) block. This technique leads to effective anesthesia and is not associated with the onset of diaphragm palsy.[45] The SSN and axillary nerve provide innervation to the shoulder joint. After undergoing GA, the SSN block is a commonly used method for managing postoperative pain in shoulder surgeries. Recent medical research has shown that the combination of an axillary block and an SSN block yields better analgesic outcomes when compared to a suprascapular block administered alone. The SSAX block provides a proficient approach for pain management during shoulder surgeries, while avoiding the possible complication of diaphragm palsy.[45]

Erector spinae plane block (ESPB) is a recently developed block that was first introduced in 2016 for the treatment of chronic thoracic neuropathic pain.[46] ESPB provides analgesia for the thoracic, abdominal, lumbar, and even extremities,[47] and it acts as a central neuraxial block by targeting both the ventral and dorsal rami of the spinal nerves. Recent studies have reported its effectiveness in shoulder surgeries.[48,49] Even though ESPB is an interfascial plane block, Chin *et al*.[50] classified it as a paraspinal block due to its injection site and mechanism of action.

Geriatric patients undergoing shoulder surgeries require appropriate RA to limit postoperative pain and/or to serve as an adjunct to GA. The use of interscalene block is still prevalent in shoulder surgeries for RA; however, it is now being used with caution due to concerns about diaphragm hemiparesis. Anesthesiologists should consider alternative techniques to avoid potential adverse events. Anesthesiologists must evaluate the utility of alternative approaches to interscalene block in geriatric patients when performing RA. This not only reduces the incidence of diaphragm paralysis but also improves morbidity and mortality rates related to anesthesia. Future implications include additional clinical trials of different RA approaches in a large pool of geriatric patients undergoing shoulder surgeries.

Lower Limb

Lower limb PN blocks can be used as a sole anesthetic technique, postoperative analgesia, or as adjunct to facilitate positioning for neuraxial techniques. The comparison between RA and GA for efficacy and safety is not new. Multiple previous studies have compared the outcomes of patients undergoing RA or GA. A meta-analysis concluded that RA has superiority over GA in terms of myocardial infarction, early mortality, delirium, postoperative hypoxia, and risk of deep vein thrombosis after hip fractures.[51] Similarly, a nationwide study involving 96,289 patients concluded that RA was associated with reduced mortality, delirium, less ventilatory care, and less intensive care admissions in old patients undergoing hip fracture surgery.[52] Furthermore, one major advantage of RA is that it helps in avoiding the use of opiates and GA medications, which are associated with postoperative delirium, especially in patients with hip fractures. Postoperative delirium results in poor functional outcomes, prolongs time to mobilization and hospital stay time, and can lead to depression and anxiety.[53] Similarly, a retrospective propensity-matched cohort study involving 722 geriatric patients experiencing lower limb revascularization for peripheral arterial disease concluded that RA had lesser short- and long-term mortality rates, which might be secondary to fewer cardiopulmonary complications.[54] Another study further complemented these results, which concluded that RA was associated with decreased mortality and reduced one-month stay in the hospital.[55] Furthermore, a continuous PN catheter or a single injection block may help reduce ischemic pain in patients with a peripheral arterial obstruction or after orthopedic surgeries and trauma.[56]

Although several factors favor using RA over GA, the risk factors and adverse events cannot be ignored. Administration of LA agents can result in severe systemic complications, notably in the elderly population due to the physiological changes associated with aging and associated comorbidities. The central nervous and cardiovascular systems are the predominantly involved body systems due to their susceptibility to anaerobic metabolism. The underlying functional status of the kidney, liver, heart, and other comorbidities plays a major role in systemic complications, particularly in the geriatric population, as it affects drug distribution, clearance, and metabolism.[57,58] Low muscle mass is another vital factor contributing to LA toxicity since the skeletal muscles also take up these agents.[59] Therefore, careful dose selection and administration techniques are vital in preventing unwanted and avoidable adverse effects, especially when taking into account that lower limb blocks are relatively high volume blocks and in most instances they are performed to supplement each other.

Femoral nerve (FN) block

The origin of the FN is the ventral rami of the L2–L4 spinal nerve roots, as part of the lumbar plexus. After accessing the femoral triangle, which is situated just below the inguinal ligament, it runs laterally. It distributes close to the level of the circumflex artery into anterior and posterior divisions. FN block is recommended for surgical procedures involving the anterior aspect of the thigh and can be employed in conjunction with sciatic nerve (SN) and lateral femoral cutaneous nerve (LFCN) blocks for more comprehensive coverage of the lower limb.[60] It is also used for pain management and can be employed as a single injection or continuous infusions to relieve pain following knee replacement surgery, although now adductor canal block is currently considered the standard of care.[61,62]

The ultrasound-guided procedure involves placing a transducer transversely at the inguinal crease to locate the nerve and adjacent structures. Subsequently, the needle tip is directed below the fascia iliac toward the FN. While FN block provides effective analgesia with less opioid intake and helps in early hospital discharge, several complications must be considered. Vascular puncture, nerve compression, nerve injury, postoperative falls, due to muscle weakness, and catheter infections are notably the most common complications.[63]

Fascia iliaca compartment block

Sensory nerves to the lower extremities are provided by the FN, LFCN, obturator nerve (ON), and sciatic nerve (SN). Except for the SN, which originates from the sacral plexus, all other nerves originate from the lumbar plexus.[64] The fascia iliaca compartment block is a regional anesthetic technique used primarily for femur and hip joint surgeries but is also used for femoral neck fractures and above-knee amputations. It is a second fascial plane in the proximal lower extremity when visualized under ultrasound. It runs below the fascia lata band and is anterior to the iliacus, psoas, and pectineus muscle.

The LA agent is injected proximally beneath the fascia iliaca, to block the FN, ON, and LCN. In contrast to the FN block, this procedure does not involve needle positioning in close proximity to the FN, thereby reducing the risk of neuropraxia. Utilizing an ultrasound guidance technique, specifically the suprainguinal and infra-inguinal approach, can be performed with a high-frequency linear transducer and improves the procedure's safety and efficacy.[65] The suprainguinal approach has higher efficacy when compared to the infra-inguinal approach in terms of patient satisfaction and reduced pain intensity.[66] It must be noted that the suprainguinal approach is different in that it also covers the articular branches of FN improving analgesia of surgeries involving the femoral head. The most commonly reported complications from LA administration are complications due to LA injection, hematoma, and neuropathy.[67]

Pericapsular nerve group (PENG) block

The pericapsular nerve group (PENG) block is a new regional anesthetic technique used primarily to decrease the pain after total hip arthroplasty while sparring motor function. An interfascial plane block blocks the FN's articular branches, the obturator, and the accessory ONs. It is always performed under ultrasound guidance using out-of-plane and in-plane techniques.[68] In the out-of-plane technique, the pubic ramus and psoas muscle is identified before inserting the needle,[69] whereas in the in-plane technique, femoral artery (FA) and iliopubic eminence is identified.[70]

Adductor canal block

Adductor canal block is an effective substitute for FN block for postoperative knee discomfort, especially after knee arthroplasty. A needle is inserted into the musculoaponeurotic canal that extends from the apex of the femoral triangle to the adductor hiatus during this procedure.[71] The main structures passing through it are the superficial FA, femoral vein, and saphenous nerve.[72]

Adductor canal block can also be used to supplement medial ankle and foot surgery with SN block, thus providing complete anesthesia for below-knee surgeries. To facilitate access to the medial thigh, the nerve block is optimally conducted with the patient supine and the thigh abducted and externally rotated. The saphenous nerve (adductor canal) block is easily performed with ultrasound guidance and has substantially high success rates.[73]

Infection, nerve damage, hematoma, myositis of quadriceps muscle, and LA systemic toxicity are the known complications. The weakness of the quadriceps muscles may result in a prolonged rehabilitation period and might cause falls in some patients.[74] However, this can be easily avoided by decreasing the anesthetic dose.[75]

Popliteal nerve block

The distal SN block, also called the popliteal fossa block, is a frequently used RA technique that provides analgesia and anesthesia for surgeries below the knee. This method can be employed as a standalone technique or in conjunction with saphenous and FN blocks to facilitate various medical procedures, including but not limited to corrective foot surgery, foot debridement, short saphenous vein stripping, and Achilles tendon restoration.[76]

The origin of the SN is the ventral rami of the lumbosacral plexus (L4–S3). It leaves the pelvis through the greater foramen just inferior to the piriformis muscle, passes between the ischial tuberosity and the greater trochanter, and descends posteriorly into the thigh toward the popliteal fossa. It divides mostly proximal to the popliteal crease, medially into the tibial nerve, and laterally into the common peroneal nerve.[76] The SN can be blocked at any point through its course with increasing difficulty for more proximal blocks.

The SN can be approached either laterally, posteriorly, or in the supine position. The posterior approach is considered to be the easiest. Ultrasound-guided popliteal block has a higher success rate, is less time-consuming, and is associated with less periprocedural pain. It is also associated with higher success rates of catheter placement and fewer vascular punctures, making it cost-effective. A high-frequency ultrasound probe is placed over the popliteal fossa, and the injection is performed at the level of bifurcation of the tibial and common peroneal components of the SN. Like all other PN blocks, block failure, hemorrhage, infection, nerve damage, and allergy to LA drugs are the complications associated with popliteal nerve block.[77]

Geriatrics neuraxial anesthesia

Neuraxial anesthesia is a RA technique that has been first described and experimented in 1885 by Dr. James Leonard Corning, an American neurologist. His experiments are the first published description of the principles of neuraxial blockade.[78] Neuraxial anesthesia includes spinal anesthesia where a LA is injected into the cerebrospinal fluid, epidural anesthesia in which a catheter is introduced in the epidural space that allows for continuous infusion or boluses of LAs to provide anesthesia and analgesia, and combined spinal epidural technique.

Neuraxial anesthesia is a safe and effective option for anesthesia in the geriatric population, with multiple advantages over general anesthesia. However, positioning and performing neuraxial anesthesia in geriatric patients can be challenging due to several anatomical and physiological changes with advancing age, comorbidities, and polypharmacy.

The vertebral column and surrounding tissues in the central nervous system can have significant changes that lead to increasing difficulty in achieving neuraxial block, and these include degenerative changes in the intervertebral disks, osteophyte formation, spinal stenosis, and ligament calcification. The intervertebral foramen becomes increasingly dense and firm with advancing age, and this change reduces the overall epidural space and leads to increased cephalad spread of LAs in epidural anesthesia.[79] The reduction in cerebrospinal fluid total volume in the geriatric population can lead to a higher spread of LAs in spinal anesthesia.[79] In a study published by Simon *et al*.,[80] they investigated the effects of age on neural blockade and hemodynamics after epidural. The study concluded that with advancing age the level of analgesia increased; in addition, motor blockade was more pronounced in elderly compared with the youngest patients. The study also showed that the maximum decrease in mean arterial blood pressure was more intense in the oldest group (>60 years old), and the number of patients who had one or more episodes of hypotension or bradycardia was also increased in the same age group.[80]

Age-related alterations in the pharmacodynamics and pharmacokinetics of LAs lead to increased sensitivity of LAs in the geriatric population, and it includes the deterioration of myelin sheaths, decline in the number of neurons, decrease in conduction velocity in PN s, and the anatomical changes in the spine and intervertebral foramen.[81,82] The difficulty in performing neuraxial block can lead to a higher chance of developing complications such as nerve injury or hematoma development. Even though spinal hematoma is rare, it is a serious complication and the risk of developing hematoma is particularly higher in elderly patients with coagulopathy or receiving anticoagulation treatment. In a study published by Moen *et al*. in 2004,[83] serious neurological complications were investigated following neuraxial block, and it included 1,260,000 spinal and 450,000 epidural blocks performed over a 10-year period in Sweden. They reported that the incidence of spinal hematoma in elderly females undergoing total knee replacement after the neuraxial block was 1:3600, which was significantly higher than the incidence of developing hematoma after obstetric epidural block 1:200,000. Due to the advancements in the management and prevention of perioperative venous thromboembolism, and the continuous evolution of antithrombotic medications, it is recommended to follow the latest evidence-based guidelines published by the American Society of Regional Anesthesia.[84]

Perioperative morbidity and mortality outcomes of neuraxial anesthesia compared with GA have been extensively investigated with conflicting data, yet there are no meta-analysis results that show superiority in perioperative outcomes when GA is used. Multiple systematic reviews and meta-analysis confirm either that there are some advantages of using neuraxial techniques, or equivalent perioperative outcomes when compared to GA.[85]

The Regional versus General Anesthesia for Promoting Independence after Hip Fracture (REGAIN) trial has been conducted to investigate multiple outcomes in patients 50 years or older who were undergoing hip fracture surgery. The first analysis of the data found that spinal anesthesia was not superior to GA in the risk of death or new inability to walk at 60 days; in addition, it showed no difference in new-onset delirium and hospital length of stay between the two anesthesia types.[86] Further data analysis from the REGAIN trial was conducted to compare pain, analgesic use, and satisfaction after hip fracture surgery. Spinal anesthesia was associated with worse pain in the first 24 hours after surgery and more analgesic use at 60 days compared with GA. Pain after surgery was not different after the first 24 hours and up to 365 days after discharge, and the satisfaction of the patients with care did not differ also across groups.[87]

In a systematic review and meta-analysis assessing the perioperative outcomes in geriatric patients undergoing hip fracture surgery with different anesthesia techniques, the authors found that GA was associated with increased risk of acute respiratory failure, inhospital mortality, longer length of stay in the hospital, and readmission after discharge compared with RA. However, the 30-day mortality, acute kidney failure, myocardial infarction, heart failure, postoperative pneumonia, cerebrovascular accidents, postoperative delirium, deep vein thrombosis, and pulmonary embolism were not significantly different between GA and RA.[88] In a systematic review and meta-analysis published in anesthesia and analgesia, the authors compared perioperative outcome between combined neuraxial or GA and GA (alone) and neuraxial (alone) compared with GA in patients undergoing major lower limb and truncal surgeries. The data showed no difference in 30-day mortality when combined neuraxial or GA and neuraxial anesthesia were compared to GA. In the comparison between neuraxial or GA and GA, there was decreased risk of pulmonary complications, blood transfusion, thromboembolic events, surgical site infections, ICU admission, and decreased length of hospital stay in favor of the combined neuraxial or GA subgroup. Even though there was no significant difference in the risk of developing pneumonia or cardiac complications between the two groups, the study showed an increased risk of developing myocardial infarctions associated with the combined technique compared with GA.[89] In the comparison of neuraxial anesthesia with GA, there was a decreased risk of pulmonary complications, blood transfusion, thromboembolic events, surgical site infection, ICU admission, and length of hospital stay in favor of the neuraxial anesthesia group. However, there was no difference in the risk of developing cardiac complications, myocardial infarction, or pneumonia between the two groups.[89]

Performing neuraxial anesthesia in geriatric patients using conventional landmark techniques can be challenging for the reasons we mentioned previously, and the use of alternative techniques and additional incorporation of imaging modalities can help improve the success rate of achieving neuraxial block. Pre-procedural ultrasound scanning can identify the desired level of the vertebral interspace, spine midline, depth to the spinal canal, best puncture point, and the optimal angle of the needle while performing the procedure.[90] A systematic review and meta-analysis of randomized controlled trials demonstrated that the use of ultrasound imaging reduces the risk of failed or traumatic spinal punctures or epidural catheterization; in addition, it showed a reduction in the number of insertion attempts and needle redirections with the use of ultrasound.[91]

In 1940, Taylor described a modified paramedian approach to spinal anesthesia via L5–S1 interspace; it uses the posterior–superior iliac spine as a landmark. The L5–S1 interspace is a space with a low likelihood of being disturbed by a pathological or degenerative disease process, and thus, the technique can offer an advantage in patients with difficult neuraxial anatomy.[92] Using the landmark technique to perform Taylor's approach can be challenging, and the utilization of imaging modalities can reduce the failure rate. In a retrospective study published in 2023, the authors assessed the success rate of using three-dimensional (3D) pelvis computed tomography (CT) scans to assist the physician in locating needle insertion point, in patients undergoing hip arthroplasty. 276 patients were reviewed and only 25 had a failed block, with a success rate of 90.9%.[93] A modified technique to Taylor's approach using pre-procedural lumbar X-ray to locate the space and insertion point in elderly patients had been described too.[94] Imaging modalities such as X-ray, fluoroscopy, and pre-procedural CT scans can be utilized; however, they have the disadvantages of not being readily available and the risk of radiation.

Performing neuraxial anesthesia in geriatric patients can be challenging due to anatomical changes associated with aging, comorbidities, and polypharmacy. However, with careful patient selection, appropriate technique, and vigilant monitoring, neuraxial anesthesia can be a safe and effective option for anesthesia in geriatric patients. The use of ultrasound and other imaging modalities in neuraxial anesthesia can further improve safety and efficacy in this population. Overall, neuraxial anesthesia is a valuable tool for anesthesiologists and can help improve outcomes for geriatric patients undergoing surgery.

In summary, RA in the geriatric population is growing widely due to its many advantages in controlling postoperative pain and reducing postoperative delirium in the short term. Also, a major role in enhanced recovery protocols is to expedite early ambulation and discharge.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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