CHAPTER – 10

Frailty and regional Anaesthesia/peripheral nerve blocks

Background:

As the number of older adults has continuously increased in recent years, healthcare practitioners have been increasingly focused on providing appropriate management of acute perioperative pain in all patients, but notably in older adults. [1] An improved understanding of the pathophysiology of pain, the development of new opioid and non-opioid analgesic drugs, the incorporation of regional techniques that reduce or eliminate reliance on traditional opioid analgesics, and novel methods of drug delivery have all contributed to an increase in the number of older patients undergoing major surgery. [2]

There are a slew of other concerns that could jeopardise the capacity to give older patients with optimal and effective acute pain management. The medications utilised in treating these sick conditions, as well as the increased danger of drug-to-drug and disease-to-drug interactions, are a result of the comorbid diseases that plague this patient population more frequently. Any acute pain management care strategy for older people must include a better understanding of age-related changes in physiology, pharmacodynamics, and pharmacokinetics. [3] Alterations in pain responses among the aged, as well as challenges in pain assessment for certain individuals with cognitive impairment, are potential issues that must be taken into account.

Several theories have been proposed to characterise the multifaceted characteristics and repercussions of ageing, emphasising the complexities and challenges of creating appropriate localised anaesthetic and analgesic choices for senior patients. As a result, the purpose of this chapter is to discuss the physiologic and pharmacologic effects of ageing on surgical anaesthetic and acute pain treatment in geriatric patients, as well as the risks and benefits of neuraxial blockade combined with peripheral nerve/nerve plexus blockade.

Age-related physiological changes and considerations for regional anesthesia/analgesia:

The homeostatic reserves of practically every organ system are gradually depleted as people age. Declining organ function, also known as homeostenosis, can be gradual or progressive, and by the third decade of life, it is noticeable. Each organ system's degraded function happens independently of changes in other organ systems and is impacted by a variety of factors such as nutrition, environment, behaviours, and genetic predisposition. [4] An understanding of normal age-related changes in anatomy, physiology, and sensitivity to pharmacologic drugs is required for optimal anaesthetic management employing regional approaches in older patients. It's also crucial to distinguish between normal physiologic changes in the central nervous system (CNS), cardiovascular, pulmonary, and hepatic systems and disease-related pathophysiologic changes.

Nervous System Function:

The brain, spinal cord, and peripheral nervous system (PNS) undergo structural and biochemical changes as people age, resulting in qualitative and quantitative changes in function[5, 6] (Table 1). Furthermore, senior age is

linked to decreased brain volume, which is a symptom of neuron loss, as well as a reduction in cerebral white matter nerve fibres. The number of cholinergic and dopaminergic neurons decreases, and neuronal fibre morphology changes, resulting in fewer synaptic connections and neuroreceptors.

Table 1: CNS changes associated with aging and effects on pharmacokinetic variables [7]

Physiologic Process	Magnitude of Change	Variable Kinetic/ Dynamic Consequences	General Dosing Strategy
Cerebral blood flow, metabolism, and volume	↓ 20% ↓ 20%	↓ distribution to the CNS ↓ apparent volume in the CNS	Little net effect o
Active blood–brain barrier transport (efflux)	Drug-specific ↓	↑ apparent volume in the CNS	↓ bolus dose during drug titration ↓ maintenance dose
Pain threshold sensitivity	Little change	↑ apparent sensitivity of the CNS	Need for titration is unchanged
Concentration response (opioids)	↑ 50% for some opioids	↑ response to opioids	↓ bolus dose during titration ↓ maintenance dose

A decrease in acetylcholine, dopamine, and other neurotransmitters is also observed, as is an extraneuronal amyloid buildup, which is thought to be the cause of neurocognitive dysfunction. [8] In the elderly, alterations in brain phospholipid chemistry are connected with changes in second messengers such as diacylglycerol. [9] Overall, elderly people have lower brain electrical and metabolic

activity than younger people, which could be due to the myriad of anatomic, structural, and biochemical changes that come with ageing. Alterations in nerve conduction velocity and disruption of normal neuronal circuit timing may occur as a result of degenerative changes in the myelin sheaths of nerve fibres in the CNS and PNS.Reduced spinal cord volume and deterioration of the bony spinal canal are two further morphological alterations that impair nervous system function.

Changes noted in the somatic nervous system of the PNS associated with ageing are:[7]

- Peripheral nerve deterioration
- Dysfunction of genes responsible for myelin sheath protein components
- Decreased myelinated nerve fibre conduction velocity
- Motor and sensory discriminatory changes in the feet, and
- Changes in sensation such as pain, touch, etc.

The autonomic nervous system (ANS) of the PNS, which controls most of the body's involuntary physiological activities via the parasympathetic and sympathetic divisions, also undergoes age-related alterations.

Signs of ageing of the ANS are:[7]

- Reduced stress adaptation;
- Decreased parasympathetic nervous system basal activity and overall net sympathetic nervous system activation;
- Decreased baroreflex sensitivity; and
- Slowing and weakening of homeostatic functions are all.

When choosing a sympathomimetic anaesthetic, take into account the rise in sympathetic tone in older patients, as sympathomimetic anaesthetics may be poorly tolerated by some people with cardiovascular disease.

Changes in the PNS and CNS may have an impact on functional outcomes throughout the recovery phase after surgery and anaesthesia, and should be taken into account during the preoperative evaluation. [10] Aging can cause changed pharmacodynamics, resulting in increased sensitivity to anaesthetic drugs, as well as signs and symptoms such as altered reflexes, degradation of gait and mobility, altered sleep patterns, memory and cognition impairment, and sensory decrements. [4]

Considerations for the Use of Peripheral Regional and Neural Blockade in Elderly Patients:

Due to a variety of secondary concerns, such as patient age, comorbidities, safety profile issues, and concurrent medications, there are few evidence-based guidelines for the use of specific regional analgesic modalities in older patients.[11] Elderly patients are frequently excluded from clinical trials. Many of these variables, as well as several additional concerns connected to old age, must be considered when selecting a procedure-specific analgesic regimen that may be more beneficial than more traditional pain management choices like unimodal opioid analgesics. The health status of the older patient, the surgery being performed, and the competence of the perioperative pain management healthcare providers should all be considered when making decisions about regional alternatives and peripheral nerve blocks.

To ensure safe use of regional and peripheral nerve blockade techniques in the elderly and undertake evidence-based research, needs should be addressed on a patient-by-patient basis and focused toward regional

pain medication alternatives that target the surgical site. [12] In recent years, the number of elderly patients seeking anaesthesia and surgery has increased dramatically, and neuraxial and peripheral nerve blocking procedures are routinely used in this patient population. [13] Regional modalities of perioperative pain treatment can help elderly patients.

One important clinical observation that has emerged from the literature on regional anesthesia/analgesia is evidence that the use of regional techniques allows for the minimization or elimination of the negative side effect profiles of other systemic pain management options, such as bowel and bladder dysfunction, hemodynamic derangements, and cognitive effects commonly experienced with opiates and other analgesic adjuncts, as well as sedative/hypnotics, to which older patients are exposed. [14] Surgical results in older patients are influenced by a variety of factors, including the nature, duration, and invasiveness of the procedure, underlying medical or mental status disorders, and the ability and expertise of both the anesthesiologist and the surgeon.

These and other considerations make determining whether or not one localised analgesic treatment is unequivocally better than another challenging. As a result, until evidence-based research can provide definitive guidelines on regional anesthesia/analgesia in the elderly, it's critical to concentrate on improving overall perioperative pain management options for elderly patients by implementing patient- and procedure-specific modes of regional anaesthesia.[15]

In the senior population, anatomic changes associated with age may make neuraxial and regional peripheral nerve anesthesia/analgesia more technically challenging. Because of osteoarthritic changes, decreased range of motion in the limbs, difficulties associated with severe

osteoporosis and rheumatoid arthritis, and cartilage calcification, elderly people may develop dorsal kyphosis, a propensity to flex their hips and knees. [16]

All of these concerns could complicate situating older individuals for regional block implantation. Neuraxial procedures can be challenged not only by patient positioning issues, but also by degenerative disc and vertebral joint alterations, as well as the aging-related distortion and compression of intervertebral and epidural spaces. With age, the ligamentum flavum gets more calcified, making an epidural block or dural puncture more difficult to perform due to difficult needle placement and progress through such dense, calcified ligaments.[17] Osteophytes can also reduce the size of the intervertebral gap, making access to the subarachnoid region more difficult.

A lateral (paramedian) needle approach to the epidural or subarachnoid area can help avoid problems including calcification of the vertebral midline ligament and dorsal vertebrae deformation.[18] In addition, reaching the L5–S1 interspace, which is often the biggest intervertebral space, may make entry to the epidural or subarachnoid space easier in patients with severe osteoarthritis and ossified ligaments. [19]

Regional Anesthesia and Analgesia Using Peripheral Nerve and Nerve Plexus Blockade:

Consider the postoperative problems usually associated with regular surgical procedures and then analyse how peripheral nerve and nerve plexus blocking could lessen these difficulties in geriatric patients as one method to perioperative pain management.[21] In any surgical setting, elderly patients are more likely to have underlying neurologic, pulmonary, and cardiovascular disease, all of which can lead to catastrophic consequences. While there are established clinical practises and theoretical indications

for using safe and effective regional techniques for elderly patients, a lack of consistency among studies has prevented the development of firm recommendations to guide which regional anaesthetics and analgesia techniques offer the most benefits for elderly patients undergoing specific surgical procedures.

Peripheral nerve blockade can be used as a supplemental analgesic for medical operations and can provide enough analgesia for a variety of surgical procedures involving the upper and lower extremities, abdomen, groin, and chest wall. The definitions and descriptions of regional peripheral nerve block procedures, as well as the definitions of other analgesia and anaesthetic techniques, are all different (Table 2).[7] In clinical studies, neuraxial anaesthesia (with or without analgesia) is frequently used to define regional anaesthesia.[7] Other researches, on the other hand, define localised anaesthesia as simply peripheral nerve and nerve plexus blocking, local anaesthetic infiltration, and local anaesthetic injection.[7]

Table 2: Analgesia and anesthesia techniques[7]

Local Monitored Anesthesia Care (LMAC) (LMAC)	**LMAC with or without Intravenous and Oral Sedatives, Hypnotics, Analgesics (Opioid and Nonopioid)**
General Anesthesia and analgesia Anesthesia Analgesia	With or without perioperative medicationsInhalation agents, intravenous agents, and/or total intravenous anesthesia (TIVA) Systemically administered analgesia with opioids, nonopioids, and other adjuncts • Intramuscular injections • Intravenous boluses • Patient-controlled analgesia (PCA) • Transdermal, mucous membrane, and oral routes

Regional Anesthesia and Analgesia Neuraxial Peripheral nerve/ nerve plexus blockade Infiltration/field block	With or without other intravenous perioperative medications (analgesics, sedation)Spinal (subarachnoid) and/or epidural anesthesia and/or analgesia • Single injection, with or without catheters • Local anesthetic (type, concentration) with or without opioids and other adjuncts • Vertebral level of block placement/ initiation • Level of blockade achieved • Length or duration of postoperative anesthesia and analgesia Peripheral nerve block • Local anesthetic with or without additives • Single injection or continuous catheter technique Brachial plexus blockade • Femoral block • Sciatic/popliteal blockade • Paravertebral block • Transverse abdominis plane block, etc. Local anesthetic infiltration/injection (diffusion blockade) • With or without indwelling catheters

Peripheral anesthesia versus neuraxial anesthesia:

Following total knee replacement surgery, Zaric et al compared epidural analgesia to a combination of femoral and sciatic peripheral nerve blocking.[21] The incidence of side effects, such as urine retention, moderate to severe dizziness, pruritus, drowsiness, nausea, and vomiting during the postoperative period, were the primary outcome measures. Three days following surgery, the intensity of motor blockage, discomfort at rest and on movement, and

rehabilitation indices were all recorded. In the epidural group, 87% of patients experienced side effects (one or more), but only 35% of individuals in the femoral and sciatic block group experienced side effects.[21]

Furthermore, in the epidural group, motor blockage was more acute (operated and non-operated limbs) on the day of surgery and the first postoperative day. The pain on mobilisation was well controlled in both groups, rehabilitation indices were identical, and the length of hospital stay was not different. In comparison to the epidural group, the femoral and sciatic nerve block group had a lower frequency of side effects. Similarly, epidural analgesia is thought to be a better way to relieve pain following major thoracic surgery. However, utilising a paravertebral blockade (PVB) catheter to implant a PVB can provide equivalent analgesic effectiveness and a better side effect profile than using an epidural catheter for neuraxial alternatives. [22]

Systematic reviews and meta-analyses of relevant randomised controlled clinical trials suggested that there was no significant difference in terms of pain relief, when comparing PVB with epidural analgesia for thoracic surgery. [23, 24] Additionally, it wasfound that hemodynamic variability, urinary retention, increased plasma cortisol concentrations, nausea, pruritus, respiratory depression, prolonged operative time, reports of incomplete/failed epidural, and paraplegia were recounted more frequently in the epidural groups when compared to those in the paravertebral groups. Thus, it is recommended that PVBs had less respiratory difficulties, nausea and vomiting, and hypotension, as well as a lower rate of failed blocks and a lower incidence of urine retention, which were all prevalent and often serious compromising side effects.[25]

As previously stated, there are several factors that influence the distribution of both local anaesthetics and adjuncts into the epidural area. But it has to be ascertained if a paravertebral approach, when inserted in the neuraxial area of elderly people, can provide effective anaesthesia or analgesia without the distribution of local anaesthetics. Patients over 65 years old who underwent urological surgery after receiving a paravertebral lumbar plexus blockade (using ropivacaine or bupivacaine) demonstrated improved pain levels, lower incidence of cognitive dysfunction, and stable heart rate and blood pressure in a research by Akin et al. [26] Patients receiving paravertebral nerve block treatments for the management of persistent pain were studied by Cheema et al. [27] Unlike the varying spread of local anaesthetics supplied for epidural analgesia, the age of the patient had no effect on the spread of bupivacaine when placed in the thoracic paravertebral region, according to the findings of this study.

The contraindication to regional anaesthesia in anaesthetized patients is another crucial element to consider in all patients. Unlike neuraxial anaesthesia, paravertebral blocks may be performed safely in profoundly sedated or anaesthetized individuals with no obvious risk of neurological harm. As a result, paravertebral blocks can be performed under severe sedation or general anaesthesia in older patients who experience pain or discomfort during placement for neuraxial or paravertebral blockade procedures without risking serious brain harm.

Summary:

When properly delivered (timed correctly and coupled with the appropriate sort of surgical intervention), proper patient selection and surgery-specific peripheral nerve and nerve plexus blockade can provide good perioperative pain control in all patient demographics. However, there

is some evidence that the effects of peripheral nerve blockade can be extended in some older individuals, lowering or eliminating the requirement for opioid drugs for breakthrough pain after discharge from the hospital. Furthermore, when considering the long-term effects of peripheral nerve blockade, elderly patients should be properly counselled about these effects prior to block placement, and care should be taken to ensure that older patients have adequate home assistance if peripheral nerve blocks are to be placed for outpatient surgery.

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