# N EUR-AXIAL BLOCKADE IN ELDERLY PATIENTS

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# Abstract

There has been a dramatic rise in the elderly throughout the last century in one century the number of people aged 65 older has increased three times By 2030, up to 20% of western population will be more than 65 years old. With this increasing number about 50% of the population older than 65 years will require surgical intervention the number of operations preformed in the elderly is increasing , especially the number of emergency procedures in high risk elderly patients have multiple medical problems .

In general, a fragile geriatric patient should be handled gently and choice of anesthetic technique should be tailored according to the patient's condition Although there is no ideal anesthetic agent or technique for central neuraxial blockade has been traditionally popular

There is no ideal anesthetic for all elderly patients. A through understanding of the physical changes which occur with aging and the altered pharmacokinetic and pharmacodynamic responses of the elderly to a variety of anesthetic drugs help in the design of an optimal anesthetic technique for each elderly patient.



**Key Words:**



There has been a dramatic rise in the elderly throughout the last century. In one century the number of people aged 65 older has increased three times There is widespread conviction among anesthesiologists that regional anesthesia offers significant advantages over general anesthesia in certain settings.

Aim of the study: - Is to discuss the advantage , disadvantages and complications of central neuraxial blockade in elderly patient.

# List of *abbreviations*

| | |
|---|---|
| ANS | Autonomic Nervous System |
| ACLS | Advanced Cardiac Life Support Protocols |
| ASAS | Anterior Spinal Artery Syndrome |
| APTT | Activated Partial Thromboplastin Time |
| ASRA | American Society of Regional Anesthesia |
| ANP | Atrial Natriuretic Peptide |
| ASU | Ambulatory Surgery Unit |
| BNP | Brain Natriuretic Peptide |
| BCLS | Basic Cardiac Life Support Protocols |
| CC | Closing Capacity |
| CO | Cardiac Output |
| CC | Closing Capacity |
| CP | Closing Pressure |
| CV | Closing Volume |
| CNS | Central Nervous System |
| CSF | Cerebrospinal Fluid |
| CAM | Confusion Assessment Method |
| CNB | Central Neuraxial Block |
| CV | Cardiovascular |
| CAD | Coronary Artery Disease |
| CAGB | Coronary Artery Bypass Grafting |
| CSE | Combined Spinal and Epidural blockade |
| DVT | Deep Venous Thrombosis |
| DO2 | Oxygen Delivery |
| EBP | Epidural blood patch |
| FRC | Functional Residual Capacity |
| $FEV_1$ | Forced Expiratory Volume in first second |
| GFR | Glomerular Filtration Rate |
| GA | General Anesthesia |
| HDU | High Dependency Unit |
| HPV | Hypoxic pulmonary vasoconstrictor |
| ISPOCD | International Study of Postoperative Cognitive Dysfunction |
| INR | International Normalised ratio |
| KCCT | kaolin Cephalin Clotting Time |
| LMWH | Low Molecular Weight Heparin |
| LA | Local Anesthetic |

| | |
|---|---|
| LV | Left ventricle |
| MIDCAB | Minimally invasive Direct CABG |
| MAC | Minimum Alveolar Anesthetic Concentration |
| MPH | Meningel Punctural Headache |
| MAP | Main Arterial Blood Pressure |
| NSAIDs | Nonsteroidal antinflammatory drugs |
| OPCAB | Off-pump CABG |
| PACU | post Anesthesia Care Unit |
| PE | Pulmonary Embolism |
| PCEA | Patient-Controlled Epidural Analgesia |
| POCD | Postoperative Cognitive Dysfunction |
| POD | postoperative Delirium |
| pKa | Pharmacokinetics |
| PNS | Parasympathetic Nervous System |
| PAO2 | Alveolar oxygen tension |
| PDPH | Postdural Puncture Headache |
| PONV | postoperative Nausea and Vomiting |
| **RCTs** | Randomized Controlled unblinded studies |
| S2 | Sacral |
| SNS | Sympathetic Nervous System |
| SV | Stroke Volume |
| SVR | Systemic Vascular resistance |
| TENS | Transcutaneous Electrical Nerve Stimulation |
| TXA2 | Thromboxane A2 |
| THR | Total Hip Replacement |
| TNF | Tumor Necrosis Factor |
| TEA | Thoracic Epidural Anesthesia |
| TIVA | Total-IV Anesthesia |
| TNS | Transient Neurologic Symptoms |
| TLC | Total Lung Capacity |
| Vmax | maximal rate of depolarization |
| V/Q | ventilation to perfusion mismatching |

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# introduction

Increased life expectancy and reduced mortality from chronic age-related disease continue to enlarge that fraction of the surgical patient population considered elderly. Although they represent only 12 percent of the United States population, individuals 65 years of age or older undergo almost one-third of the 25 million surgical procedures performed annually, and they consume about one-third of all health expenditures and fully one-half of the $140 billion annual U.S. federal health care budget[1] Therefore, every anesthesiologist in contemporary practice eventually becomes a sub specialist in geriatric medicine, with a special responsibility for delivering cost-effective health care to older adults.

Two important principles must be kept in mind when discussing the physiology of aging. First, aging is associated with a progressive loss of functional reserve in all organ systems. Second, the extent and onset of these changes are highly variable from person to person. In the vast majority of older patients, physiologic compensation for age-related changes is adequate, but the resultant limitation in physiologic reserve may become evident only during times of physiologic stress, including exercise, illness, and the perioperative period[2].

Processes of aging are usually distinguishable from age-related disease by the fact that they are universally present in all members of an elderly population and, in longitudinal studies of aging subjects, become progressively more apparent with increasing chronological age. Aging is a universal and progressive physiologic phenomenon characterized by degenerative changes in both the structure and the functional reserve of organs and tissues. It produces many physical manifestations due to reduced connective tissue flexibility and elasticity or the degeneration of highly structured molecular arrangements within specialized tissues. mechanism by which the obvious susceptibility of elderly patients to stress- and disease-induced organ system decompensation occurs[3].

In general, a fragile geriatric patient should be handled gently and choice of anesthetic technique should be tailored according to the patient's condition .

In certain surgical procedure, regional anesthesia in the elderly may have the advantage of :

1} reduced postoperative negative nitrogen balance,
2} amelioration of endocrine stress responses to surgery,
3} reduction in blood loss,

4} reduced incidence of postoperative thrombo-embolic complication and
5} reduced postoperative mental confusion.

## Aim of the study: -

Is to account for the advantages , disadvantages and complications of central neuraxial block in elderly patient .

Aging is the accumulation of changes in an organismal object overtime. Aging in humans is balance between gradual maturation and senescence, which is a phenomenon where capacity for cell division and the capacity for growth and function are lost overtime.

Organismal senescence is characterized by a decline in ability to respond to stress, increased haemostatic imbalance and increased risk of disease .These irreversible changes inevitably end in death. Normal aging describes the change attributed to aging itself, but these are often associated with common complex disease and functional impairments. People age differently, some develop disease with impaired organs while others seem to escape disease[4].

"Healthy aging" refers to process by which the deleterious. effect are minimized, preserving function until senescence makes continued life impossible. Progressive cell loss occurs at a variable rate in individual patients and their organ systems. Functional reserve is the difference between basal level of organ function at rest and maximum level achieved in response to increased demand functional reserve declines with age leading to increased morbidity and mortality.

Age related changes occur in all organs but are more pronounced in the cardiovascular, renal and central nervous systems.

## I - pathophsyiologic changes in elderly

### a) Aging and the Central Nervous System

Classically, it has been thought that the physiologic function of most organs, including the central nervous system, undergoes a gradual decline during the aging process. There is a continual loss of neuronal substance with advancing age.. The reduction in neuronal density that occurs with age is accompanied by a parallel reduction in cerebral blood flow and cerebral oxygen consumption ($CMRO_2$) [5].

In the absence of neurological disease, intellectual performance tends to be unchanged until at least the age of 80, but tasks may take longer to perform. Verbal skills are well maintained until the age of 70, after which some healthy elderly gradually develop a reduction in vocabulary and tend to make semantic errors. The elderly with neurological disease are especially susceptible to the action of many anesthetic drugs.

Regional cerebral blood flow remains as tightly coupled to cerebral metabolic activity in the healthy elderly individual as it does in young adults., it is generally agreed that geriatric patients have a reduced requirement for anesthetic agents.[6]

***Effects of aging on the nervous system include:***

1. Selective attrition of cerebral and cerebellar cortical neurons .
2. Neuron loss within certain areas of the thalamus, locus ceruleus, and basal ganglia .
3. General reduction in neuron density, with loss of 30 percent of brain mass by age 80 .
4. Decreased number of serotonin receptors in the cortex .
5. Reduced levels of acetylcholine and acetylcholine receptors in several regions of the brain
6. Decreased levels of dopamine in the neostriatum and substantia nigra and reduced number of dopamine receptors in the neostriatum.

The association of serotonergic, cholinergic and dopaminergic systems, respectively with mood, memory, and motor function, may partially account for depression, loss of memory and motor dysfunction in the elderly. age-related diseases such as cerebral arteriosclerosis, Alzheimer's and Parkinson's disease are all more common with advancing age. Most strokes affect those older than 70 years and the risk doubles every 10 years after age 55. The prevalence rates for dementia and Alzheimer's disease double approximately every five years from rates of 2 to 3 percent in the age category of 65 to 75 years to more than 30 percent in persons age 85 and older. Onset of symptoms in Parkinson's disease usually occurs between ages 60 and 69, although in 5 percent of patients the first signs are seen prior to age 40. About 1 percent of persons age 65 and older and 2.5 percent of those older than age 80 have Parkinsaon's disease .It is estimated that a loss of 70-80% of dopaminergic function is necessary before symptoms are seen in patients with Parkinson's disease[7].

- **Postoperative congitive dysfunction in the Elderly**

Postoperative delirium, a transient mental dysfunction, can result in increased morbidity, delayed functional recovery and prolonged hospital stay in the elderly. The distinguishing features of this transient global disorder are impaired cognition, fluctuating levels of consciousness, altered psychomotor activity, and a disturbed sleep-wake cycle. It is usually seen on the first or second postoperative day and symptoms are often worse at night[8]. The condition can be silent and go unnoticed, or it may be misdiagnosed as depression. Postoperative delirium is defined as clinical situations in which patients think and speak incoherently, are disoriented and show impairment of memory and attention.

Aging, pathologic states in the brain, polypharmacy and drug interaction, alcohol and sedative-hypnotic withdrawal, endocrine and metabolic problem, depression, dementia and anxiety and gender are considered to be preoperative risk factors. Hypoperfusion and microemboli of air or blood cells in cardiac surgery, fat embolism in orthopedic surgical patients, regular use of anticholinergic drugs or drops and severe bilateral loss of vision in ophthalmologic patients may also contribute to the postoperative confusion[9]. Anticholinergics, barbiturate premedication and benzodiazepines are implicated in the development of postoperative delirium. There is no difference in the effects of general, epidural or spinal anesthesia on postoperative confusion. Perioperative hypoxia, hypocarbia and sepsis are also risk factors for postoperative confusion. Cognitive impairment increases with ageing, and dementia may affect up to 20% of patients over the age of 80 but diagnosis should be only reached when other causes are excluded . Dementia should be diagnosed only by formal testing, and ideally by experts in geriatric psychology. It is not a diagnosis to be made lightly because it has a 50% life expectancy of fewer than 5 years- similar to most malignant carcinomas.

Prevention of delirium will therefore involve control of many more factors than just the drugs used during surgery, but in hospitalized elderly medical patients a regimen designed to manage pre-existing cognitive impairment, sleep deprivation, immobility, visual impairment, hearing impairment and dehydration reduced the incidence of delirium to 10% in comparison to a 15% incidence in patients who received standard ward medical care[10].pre operative assessment of patient physical and mental status and medication is very important.

Glycopyrrolate may be a better choice than atropine as the former is a quaternary amine and should penetrate the blood-brain barrier less

effectively than will atropine. Ambulatory surgery should be encouraged because elderly patients are maintained in the familiar home environment. Adequate postoperative analgesia, especially in patients who cannot communicate easily because of endotracheal tubes or tracheostomy, is crucial. [11]

Once postoperative confusion has been diagnosed, the patient should be managed with extra vigilance. First, the underlying organic cause of the confusion should be found and treated. For acute control of delirium, doses of 0.25-2 mg oral haloperidol 1-2 h before bedtime is the preferred treatment. For more agitated patients, IM haloperidol can be used. A small dose of 0.5 mg is given every hour until symptoms are adequately controlled. Droperidol has been used for rapid tranquilization. Although chlorpromazine is extremely effective, but it can lead to a severe drop in blood pressure[12]. Diazepam, used alone or in combination with other antipsychotic drugs, is especially effective for delirium tremens. Thiamine is the key drug for the management of Korsakoff's psychosis. neither muscle relaxants nor physical restraints are particularly effective Finally, if delirium progresses to coma, standard treatment for control of airway, breathing and circulation should be instituted. After recovery from an acute episode, a psychiatric or psychosocial referral may aid early functional rehabilitation[13].

## b) Aging and the Respiratory System

It is important for anesthesia providers to understand how aging affects the respiratory system. Characterizing the effect of the normal aging process on the respiratory system is a complex concept as it is difficult to separate the changes associated with age from those attributable to diseases of the aged. However, there are four hallmarks of the aging process: 1) a decline in elasticity of the bony thorax, 2) a loss of muscle mass with weakening of the muscles of respiration and reduced mechanical advantage, 3) a decrease in alveolar gas exchange surface and 4) a decrease in central nervous system responsiveness, which have anatomical, mechanical and functional consequences.[14]

There are a number of striking anatomic changes which occur in the respiratory system with age. As a consequence of a generalized loss of all muscular and neural elements (muscle fibers, mucosal receptors, nerve fibers, etc.), laryngeal structures undergo a slow but continual decline in function. Protective reflexes involved in the regulation of coughing and swallowing are diminished. The end result is chronic pulmonary inflammation from repeated aspirations with frequent contamination of the lower airway with oral and gastric organisms.[15].

With aging, the larger and more central airways increase in diameter, as noted by an increase in anatomic and physiologic dead space. The trachea and large bronchi increase in size about 10 percent from youth to old age. beyond age 40, the diameter of the small airways, not privileged to have cartilaginous support, decreases significantly. Despite the decrease, overall airway resistance does not appear to increase significantly. The end result is smaller distal airways with a tendency to early collapse, dilated alveolar ducts and fewer gas exchange surfaces. These changes are manifest functionally by air trapping, increased closing capacity, frequency-dependent compliance and gas exchange problems[16].

The tendency of the lung to assume a larger resting volume and the limitations imposed by a stiffer chest wall plus a decrease in motor power result in a change in the components of the total lung capacity. Vital capacity declines progressively with age.. In fact, the ratio of RV to TLC increases from 25 percent at 20 years of age to about 40 percent in a 70-year-old man, which gives the chest wall a somewhat barrel-like appearance. With the age-related loss in total lung capacity (TLC), plus the very modest increase in FRC, the ratio of FRC to TLC tends to increase with age.

The reduction in motor power of the accessory muscles of breathing as well as the decreased expansion of the chest wall cause the dynamic lung volumes and capacities to decrease progressively with age (e.g., $FEV_1$). there is a clear age-related increase in the closing volume (CV) The volume at which small dependant airway start to close and closing capacity (CC).. During active breathing, closing pressure in young subjects is about -1.25 cm $H_20$ pressure, and opening pressure is +2.5 cm $H_20$, the difference being attributable to hysteresis. The values for closing pressure (CP) and opening pressure (OP) in subjects aged 65-75 years are 0 and 4.5 cm $H_20$, respectively The higher values for both CP and OP will decrease the elderly patient's ability to keep some ventilated areas open and to re-open those areas that have collapsed[17].

The aged lung possesses less elastic recoil. This change in compliance is quite regional rather than being evenly distributed across the lung.. Thus as breathing rate increases, lung expansion becomes less effective particularly in some areas, thereby increasing the maldistribution of ventilation to perfusion..

The efficiency of alveolar gas exchange decreases progressively with age for a number of reasons. Alveolar surface area decreases with age from about 75 m2 at age 20 years to about 60 m at age 70 years. there

is also evidence that the distribution of pulmonary blood flow changes with aging. The change in blood flow, combined with the altered distribution of inspired gas, promotes even more V/Q mismatching. Alveolar dead space, which is a good index of the distribution of pulmonary blood flow, increases with age. The increased V/Q mismatch plus the increased alveolar dead space adversely affect the aged patient's blood gas values.[18].

Arterial blood gases become integral components in the interpretation of lung function during anesthesia. There are reference values available to aid in the interpretation of arterial blood gases in middle-aged and elderly persons (40-70 yr). The normal alveolar oxygen tension PAO2 is fairly constant from infancy to senescence. A number of studies have demonstrated the mean PaO2 declines from 95 ± 2 mmHg at age 20 to 73 ± 5 at age 75 years. This decline in arterial oxygen tension is modest: approximately 0.4 mmHg/year. After age 75, however, PaO2 stays relatively constant at approximately 73 mmHg.

In humans there is a normal amount of relative hypoxemia due to shunt, diffusion block and ventilation/perfusion mismatch. Age and anesthesia worsens hypoxia mostly by increasing ventilation/perfusion maldistribution. The efficiency of vascular distensibility and recruitment decreases with age. The increasingly rigid pulmonary vasculature probably blunts the hypoxic pulmonary vasoconstrictor (HPV) reflex. Thus the ability of the aged lung to respond to altered ventilation/perfusion matching is compromised..

Finally, it is important to recognize that the ventilatory response to hypercapnea and hypoxia is blunted in the elderly patient. The ventilatory response (change in minute ventilation) in the healthy aged patient (70-year-old) to either a hypercapnic or hypoxic stimulus is half that seen in the 25-year-old. The clinician should also realize that, together with these age-related decreases in reserve in the awake state, the ventilatory responses to hypercapnea are reduced by narcotic premedication and by thiopentone and narcotic and inhalational anesthetics in a dose-related manner.

Aged patients may be hypoxemic during normal spontaneous ventilation postoperatively because of the mechanical changes of the aged lung and chest wall.. The risk is increased by the supine position and by the use of narcotic analgesics in an age group that already has blunted ventilatory reflexes to hypoxia and hypercapnea. Any residual anesthetic will also exert an additive effect. The elimination of narcotics and muscle relaxants may be delayed due to the impaired renal function in older