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REVIEW ARTICLE

Anaesthetic consideration in geriatric population

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ABSTRACT

Elderly patients requiring surgery for injuries or other medical conditions are at higher risk of peri-operative morbidity and mortality due to physiologic and pathologic changes that occur with age.

Geriatric anesthesia is a subspecialty of medical science focuses on anaesthetic care of elderly patients in terms of pre-operative, peri-operative, post-operative anaesthesia care and highlights the role of the interprofessional team in managing these patients while undergoing anaesthesia and post-anaesthetic care.

Objectives:

- Describe in brief the aging phenomenon
- Age dependent physiologic & pathophysiologic changes and anesthetic implications.
- Anaesthetic techniques & intra-operative & postoperative management.
- To summarize common geriatric complications and their management.

Keywords: Aged, anaesthesia, frailty, geriatric, perioperative care.

INTRODUCTION

Advances in modern medical science have increased the average life span of human population worldwide and the fastest growing populations are elderly. By the year 2040, people aged 65 or older expected to make up 24% of population and account for 50% of health expenditure. While advances in primary and preoperative care have increased the safety of anaesthesia for geriatric patients, still they are at considerable risk for severemorbidity and mortality. With advancing age older patients have peri-operative risk for anaesthesia and associated primary pathologic processes further increases morbidity and mortality. Understanding physiologic and pathologic aging, a thorough preoperative examination can improve patient safety and outcomes [1,2].

AGING

Aging is a universal, enigmatic, and complex phenomenon with a irreversible changes at cellular level. Broadly aging mechanism includes genomic instability and damage, senescence and stem cell exhaustion along with altered intercellular communications. First sign of aging starts around age of 25(at cellular level)--- fine lines on skin surfaces then wrinkles due to loss of volume and elasticity. Our bodies are born to die and decay starts to kick around 55 years of age, DNA starts to degenerate. Age dependent physiologic changes typically result in a decrease in the physiologic and functional reserve capacity of each organ system, increase in co-morbid conditions, vary from person to person. Molecular, cellular and organ level mechanism of aging associated with cumulative oxidative stress involves a plethora of biological pathways– altered intercellular communications --- stem cell exhaustion --- cellular senescence --- mitochondrial dysfunction ---deregulated nutrient sensing --- loss of proteostasis ---epigenetic alteration ---telomere attrition –genomic instability and mutation [3].

ORGAN SPECIFIC AGE RELATED PHYSIOLOGIC AND PATHOLOGIC CHANGES

Aging is associated with decreased reserve and function of all major organ system vulnerable to stress. Extent of each systems loss of function is

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highlyvariable due to many variables affecting each system, including genetics, life style and preventive measures. Proper assessment of each organ system's reserve should be obtained through careful preoperative evaluation, history, physical examination and focused diagnostic workup. Understanding patient physiology is vital for safe aneasthetic plan.

CARDIOVASCULAR SYSTEM

With advancing ageatherosclerosis and decreased B2 adrenergics vasodilation results in arterial stiffening, increased after load, increased myocardial oxygen consumption and wall stress, As a result geriatric patients depends more on preload to maintain cardiac output. Decreased cardiac contractility and hypovolemia results in decreased cardiac output.[4]

Elderly patients have wider pulse pressure and small changes in preload and contractility result in large changes in blood pressure. Haemodynamic instability results from dehydration, intravenous anaesthetic agents and inadequate postoperative hypertension control.[5] Geriatric patients have higher incidence of CAD and perioperative coronary ischemia. Left ventricular hypertrophy, widened pulse pressure, decreased diastolic blood pressure and chronic hyperglycemia result in increased myocardial oxygen consumption and decreased coronary perfusion.[6]

Geriatric patients should not be subjected to tachycardia and arrhythmia as they rely more on cardiac filling, thus arrhythmia and LVH results in myocardial ischemia and diastolic heart failure.[7] Avoiding tachycardia and hypotension, to improve coronary perfusion and to avoid myocardial ischemia are the hallmark for better preoperative and postoperative outcome.[8] Conduction pathways disorder due to fibrotic changes result in atrial fibrillation, premature atrial and ventricular complexes, AV blocks or bundle branch block can complicate the care of geriatric patients..[9]

RESPIRATORY SYSTEM

Functional capacities of the respiratory system are all reduced in the geriatric patients. Decrease in chest wall compliance and the strength of respiratory muscles, making the lungs more difficult to ventilate and there is decline in maximum inspiratory and expiratory force. Increased alveolar noncompliance with collapse of small airways and subsequent alveolar hypoventilation, air trapping leading to ventilation perfusion mismatch. Additionally, collapse of small airways, consequent alveolar hypoventilation and air trapping may lead to ventilation perfusion mismatch. The residual volume is also increased. Hypoxemia can develop easily. Moreever the prevalence of chronic obstructive pulmonary disease intensely increases with age. Atelectasis and pulmonary infections are more common in these patients. Administration of premedication could increase the patient's risk for aspiration. Combination of residual effects of anaesthetic agents prolonged the effect of neuromuscular blocking drugs and postoperative pain, could significantly contribute to the respiratory complications.

During anaesthesia these risks can be reduced by minimizing and fully reversing neuromuscular blockade, using opioids and other sedative agents with cautions. GI contents neutralization to minimize aspiration risk.[10,11,12]

RENAL SYSTEM

Aging is associated with steady deterioration in renal function, declination of functional nephrons, reduced renal blood flow, declination of GFR, and reduced capability to concentrate urine. So that older patients are at increased risk of acute kidney injury secondary to nephrotoxic agents, NSAIDS and IV contrast. Aging is associated with decrease response to renin, angiotensins, aldosterone and vasopressin and so have difficulty with volume status, electrolyte abnormalities and acid base derangements. [13,14,15] Risk factors for acute postoperative failure include advance age, diabetes mellitus, preexisting renal insufficiency, major vascular surgery and recent exposure to nephrotoxins. Sympathetic stimulation, pain, surgical stress and the use of vasoconstrictive drugs may induce subclinical renal insufficiency.[15] A 75 years old have 20 % to 30 % less plasma and intracellular volume, these volume explain the larger volume of distribution for lipophilic agents such as propofol and simultaneously have decrease required doses of many medications and have increased duration of the effects.[16]

NERVOUS SYSTEM

Aging results in a reduction in nervous tissue mass, neuronal density, CSF and dendritic synapses (neurotransmitter). Functionally the above changes results in memory loss, cognitive decline, sleep disorders, delirium, depression, and decreased neuroplasticity. Prevalence of dementia sharply rises as patients age increases, thus increase the risk of delirium and postoperative cognitive dysfunction. 60% of all patients are affected by the age of 90.[17,18] Older patients have many changes within the central and peripheral nerve system, have susceptibility to medications and postoperative complications, anaesthetized with upto a 30% decrease in concentration than a young adult. Geriatric patients are sensitive to centrally acting anticholinergics drugs. Regional anaesthesia or combined general and regional anaesthesia are modality of choice. [19,20]

ENDOCRINE AND METABOLISM

There are wide range of endocrine dysfunction and metabolic changes as patients age increases. Average patients weight begins to decline in the sixth decade of life. As patients age increases muscle mass decreases, decline in daily calorie intake, weight loss

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and even chronically body mass index of less than 18 is observed. For elective surgery a careful nutritional screening should be done.[21] Heat production, insulation and the ability to thermoregulate commonly decline with age. Incorporating temperature goals into the anaesthetic plan and keeping the patients normothermic decreases serious complication including dysrhythmias, infection and delayed wound healing.[22] Type 2 diabetes is increasing day by day complicating comorbidity in the aging population. Depending on the extensiveness of the disease and the proactivity of glucose management, perioperative management can range from checking blood sugar several times from admission to ICU. Patients with uncontrolled diabetes are at significantly higher risks for coronary and peripheral artery disease, chronic kidney and end stage renal disease, peripheral neuropathy, autonomic dysfunction, neurogenic bladder, gastroparesis, wound dehiscence and infection and have insulin resistance. [23,24]

PREOPERATIVE ASSESSMENT

The geriatric preoperative assessment should follow multidimensional assessments, sound principles of general medical evaluation with additional consideration to several issues of significance. ASA physical status score does not explicitly list age as a predictor of risk for adverse outcomes increased likely hood of serious pathologies attributes to a higher median ASA score for older patients. [25] Preoperative geriatric assessment includes functional physical status, neurocognitive function, systematic evaluation of co-morbidities, substance abuse, frailty, nutrition, medication, complete history and clinical assessment and laboratory testing.[26] All elderly patients benefit from neurocognitive assessment as more than 20% of patients over 65 undergoing surgery have baseline cognitive deficit, have higher risk of worsened outcome postoperatively. Brief cognitive screening tool such as Minicog or Mini Mental State Examination (MMSE) are efficient tools to identify cognitive deficit result in decrease risk of postoperative delirium and cognitive dysfunction.[27,28,29]

A patient must comprehend and have rational discussion concerning their condition, treatment options and risk associated with these options. If there is any concern, the right thing is to seek additional help from colleagues and the patients family, so that a proper decision must be taken that align with their values. [30]**Frality** refers to loss of physiologic reserve that makes a person more vulnerable to disability during and after stress. Frality syndrome components are decreased mobility, muscle weakness, poor exercise tolerance, weight loss, malnutrition and muscle wasting. Incidence about 6.9% in people older than 65. Grips strength, weight loss, gait assessment, cognitive tests and medical history (including recent fall) are typical variables measured as frailty indicators. Frality is a pre-operative stratification of preoperative vulnerability and correlates to increased mortality, lengthier hospital admission and discharge to a skilled nursing facility. There are several validated screening tools that predicts outcomes such as mortality and 30 days postoperative complications. Frality assessment can guide anaesthetic and surgical plans, plan postoperative admissions and discharges and anticipate postoperative delirium. When correctly assessed, frailty should also be a sensitive indicator for the necessity of in depth conversations concerning complication risks, likely outcomes, goals of care and alternative to surgery. [31,32]Preoperative testing should be guided by the patients comorbidities and anticipated surgical complications. Some screening tests such as pulmonary function test, endoscopy, colonoscopy, bronchoscopy and echocardiography require coordination with multiple departments and discussions days before surgery. [33,34]

CLINICAL SIGNIFICANCE

Monitoring: Monitoring decisions should be patient and procedure specific with little datasupporting use of more invasive monitoring. A qualified anaesthetist as per ASA basic standard protocol throughout surgery to monitor haemodynamic stability,adequate anaesthesia and analgesia,additionally to monitor oxygenation,ventilation circulation,and analgesia are essential.Evidencearelacking regarding use of EEG,BIS and PCOD.Evidence supports use of lower doses of anaesthetic drugs in decreasing postoperative delirium.

Positioning: Geriatric patients are prone to injuries as they have significant musculoskeletal changes, increases risk of nerve, joint and skin injury. Oversight during initial patient positioning and neglect during intraoperative shifting can cause injury, pain and infection risks. Optimal patient positioning is difficult in patients of stiff joints and cervical spine, hips and shoulder, thus needs of supporting cushioning and avoidance of applying force against resistance. Fragile skin are prone to skin tears and bruising; thus apply extra care particularly at risk of pressure ulcers including sacrum and heels.

General Anaesthesia: The Judgment to use general anaesthesia in geriatric patients is determined by type of surgery and anaesthesiologist and surgeon preference. Most general anaesthetic agents depress cardiovascular and respiratory function as well as changes in consciousness. Geriatric patients are often edentulous, making mask ventilation more challenging, and have decreased cervical extension, impairing direct laryngoscopy, thus a thoughtfull airway management plan is mandatory.Alterations in pharmacokinetics and pharmacodynamics of anaesthetic drugs in geriatric patients increases the adverse effects, so dose requirement often reduced for

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all anaesthetic agents. Induction dose is substantially reduced. There are widerange of hypotensive response to induction agents and hypertensive response to laryngoscopy. Vasopressors and antihypertensive drugs should be available to maintain safe and adequate blood pressure. Clinical recovery from neuromuscular blockade is obviously increased in geriatric patients, so short or intermediate acting muscle relaxant is planned. Use of LMA is recommended when paralysis is not compulsory with low risk of aspiration. Hypothermia is a concern so must be carefully managethe temperature. During maintenance and emergence phases of general anaesthesia, tempered dosing and patience are valuable principles. [38’39]

Neuraxial Anaesthesia :In comparison to general anaesthesia, neuraxial anaesthesia have benefits of less thromboembolic events, less confusion and have less respiratory problems post-operatively. Regional anaesthesia today became a primary anaesthetic modality for orthopaedic surgery and obstetrical and gynaecological surgery. Regional anaesthesia can be combined with general anaesthesia for pain relief, also have uses in cardiac surgery, thus have decreased postoperative complications. [40]
Neuraxial anaesthesia is not ideal for long surgeries as anxiety, difficulty in lying comfortably and pulmonary function preservation are major concerns. Neuraxial anaesthesia are relatively contraindicated in patients with coagulopathies (pathologic or from anticoagulant or antiplatelet medications), aortic stenosis or haemodynamic instability secondary to hypovolemia. Relative contraindications are anticoagulation, local tissue infection, and respiratory dysfunction for nerve block near the phrenic nerve (interscalene block).[41]

Intravenous Anaesthetic Agents: Geriatric patients due to altered pharmacodynamics response and decreased drug clearance lower doses of intravenous anaesthetic agents. An aggressive dosing can lead to apnea or aspiration thus care and precision should be taken into consideration when administering these agents. Propofol in particularly requires only 50 to 70 % of dosing in elderly in comparison to young patients. Etomidate that preserved haemodynamicstability is often a favourablechoicewith a small dosing to achieve a good response. Ketamine is rarelyused due to emergent delirium postoperatively. However bronchodialating effects is valuable with reactive airway disease. Other valuable drugs are midazolam,fentanyl andremifentanyl. In sedation practice fentanyl, midazolam, remimazolam, dexmeditomidine and/ or propofol are frequently used in combination technique in the geriatric patients.[42,43

Opioids: Geriatric patients have decreased hypoxic and hypercarbic respiratory drive to compensate for oversedation and are at higher risk of oversedation. Opioids clearance decreased in geriatric patients, also geriatric patients have increased neurologic sensitivity, so aggressive pain treatment with opioids should be avoided in geriatric patients, if needed starts with smaller doses then gofor higher doses on incremental basis,also less potent opioids given first and then go for strong opioids. Meperidine used with caution due to risk of postoperative delirium. Morphine and its metabolite morphine 6 glucuronide clearance delayed, so in renal dysfunction patients used with caution, as it causes apnea and needs supportsometime. In conclusion, in geriatric patientssmaller initial doses should be prescribed and titrated up to requirements safely.[44,45]

Muscle Relaxants (Neuro Muscular Blockers): There is a prolonged duration of neuromuscular blockade for all muscle relaxant used as there is decreased availability of neurotransmitters and neuroreceptors with normal aging. In neurological disease patents there are profound decline neurotransmitters and neuroreceptors. Also clearance due to metabolism are slowed so have increased chance of postoperative complications and reintubation. So if used should be used with caution with less dosing in comparison to adult. Consideration should be given to agents that have ester hydrolysis or hoffmann degradation such as atracurium, cis- atracurium and mivacurium. Further a weaker pharyngeal muscle and its reflexes place older patients at higher risk for aspiration pneumonia, so complete reversal must be taken into consideration before Extubation. [46,47,48]

Monitoered Anaesthesia Care (MAC):MAC is one of the most common anaesthetic technique. In diagnostic procedure it is used most commonly. It is suggested for those short procedures as day care, that do not need hospitalization. MAC is classically selected for older patients who require supervision and use of sedative-analgesic drugs to supplement local infiltration or regional anaesthesia.
Most commonly used drugs are midazolam, fentanyl, propofol, and remifentanil. Midazolam reduces the slope of the carbon dioxide response curve and decreases the ventilatory response to hypoxia. Propofol having short context sensitive half life and high plasma clearance, produces quick awakening. Remifentanyl is anultrashort acting agent, peak effects occurs 1to 2 minutes after bolus administration. Distribution and metabolism permit early offset and return of spontaneous ventilation. [49,50,51]

FLUID MANAGEMENT

In geriatric patients, fluid management is particularly challenging due to associated cardiac and renal

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abnormalities, thus have poor tolerance for hypovolemia and hypervolemia. Most commonly geriatric patients are either overloaded or dehydrated. Dehydrated patients benefit from pre-operative fluid resuscitation, while overloaded patients needs dieresis (particularly in CHF patients). In general moderate amount of crystalloids or colloids be given to maintain euvolemia and thus to avoid CHF exacerbation, pulmonary edema and dilutional coagulopathies. Blood products transfusion are beneficial. [52]

POSTOPERATIVE COGNITIVE IMPAIRMENT

Ostoperative cognitive complications are the most common complication of elderly patients and often neglected during preoperative screening. Risk factors include underlying cognitive dysfunction, history of cerebrovascular accident, depression, advanced age more than 70 years old, alcohol use, poor functional status at base line, abnormal electrolytes including sodium, potassium and glucose. Contributing factors might be narcotics, sedatives, anticholinergics, infection, anaesthetic techniques, pain, sleep deprivation and hospitalization. The ASA developed the Brain health initiative to help improve postoperative cognitive assessment and post operative cognitive dysfunction prevention guidelines, also DSM-5 (Diagnostics and Statistical manual of mental disorder) may also improve perioperative neurologic outcomes. Postoperative cognitive impairment are of two types: postoperative delirium (POD) and postoperative cognitive dysfunction (PCOD). POD &/or POCD incidence are 5-50%.

Delirium: Acute alteration in cognitive function, that progresses over a brief period of time lasting for a few days to a few weeks. It depends upon type of surgery, patients peri-operative physical and cognitive status and age of patients. Overall incidence is 10%. Etiology is multifactorial; and include drug intoxication or withdrawal, drug interaction, anticholinergics agents, metabolic disturbances, hypoxia, abnormal carbon dioxide levels, sepsis, inadequate analgesia and organic brain disease. As obvious incidence less in outpatients than in hospitalized patients. Multicomponent interventions, antipsychotics, bispectral index guidance and dexmedetomidine treatment could successfully decrease the incidence of POD in elective non-cardiac surgery patients.

POCD

A syndrome defined as deterioration from baseline in neuro-psychological functioning which could last for months to years. Incidence is 79% in 7 days, 12.7% in 3 months.in noncardiac surgery patients. No difference between regional or general anaesthesia. Outpatients have superior cognitive outcomes than Inpatients. [53,54,55]

OTHER CONSIDERATIONS

Postoperative nausea and vomiting and pain are two most common causes. Risk factor for PONV includes: female gender, previous PONV or motion sickness, non smoking status and opioid use. More ever geriatric patients are at higher risk for drowsiness, confusion, urinary retention, and adverse drug interactions than the younger patients. For geriatric outpatients an escort should stay with the patient for at least 24 hours postoperatively. [56]

MORTALITY

Morbidity and mortality in older patients are more in geriatric patients than younger patients. As per medicare data base review incidence 0.23% on day of surgery and thirty day mortality is 0.66% for outpatients surgery, with higher risk over age 85.

For Inpatient over age 80, thirty day mortality risk incidence is 8%, with a 5% increase in relative risk each year. Additional mortality risk factors are ischemic or non-ischemic heart failure, emergency surgery, invasive surgeries (abdominal surgery, aortic aneurysm repair and thoracic surgery) and delay in emergent surgical intervention. Even minor procedure such as endoscopy, colonoscopy, bronchoscopy and cataract surgery patients have significant risk although efforts should be taken to minimize complications. [57,58,59]

CONCLUSION

Geriatric patients are vulnerable and particularly sensitive to stresses of hospitalization, and surgical procedures. No anesthetic agent or technique is clearly superior for all conditions or settings. Suitable pre-operative, intraoperative, and postoperative management is needed for geriatric patients, so anesthesiologists must have adequate knowledge of the physiological, pharmacokinetics, pharmacodynamics differences before they utilize their anaesthetic technique. The role of interprofessional team may include anaesthesiologist, surgeon, nurses, surgical technicians, geriatricians, palliative care physicians, pharmacist, chaplains or more for better outcome, thus reducing mortality and morbidity. Assessment by team members should especially focus at cardiopulmonary risk factors, cognitive function and common geriatric pathologies.

Intraoperatively the surgical and anaesthetic plan should minimize known risk for elderly patients. Regional anaesthesia be a safer choice as have less morbidity and mortality in comparison to general anaesthesia. Postoperative cognitive dysfunction is a concern as it increases each year, so early detection and guidelines for management should be implemented earliest.

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