

Perioperative Care of Elderly Surgical Patients

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ABSTRACT

Advancing age is characterized by functional impairment of the many regulatory processes that provide integration between organs and therefore, may lead failure to maintain homeostasis under conditions of physiological stress. There are two main factors helping to identify the high risk for surgery. The first relates to the type of surgery and the second to the scope of cardiopulmonary functional capacity of the patient. There are major cardiovascular, respiratory, renal and musculoskeletal changes in elderly patients. Preoperative assessment of risk in elderly patients must consider patient factors, the surgical problem and the treatment options. Medical co-morbid conditions are common with age and may markedly increase the risks associated with surgical intervention. Postoperative care of elderly includes respiratory Care, renal function and fluid and electrolyte management, cardiovascular Care, management of pain and maintenance of function. In conclusion, health providers should pay attention to the quality of care in elderly patients because they are vulnerable surgical and anaesthetic stress. Minimizing perioperative risk in those patients requires thoughtful preoperative assessment of organ function and reserve, meticulous intraoperative management and postoperative care. Management of surgical elderly patients is both complex and different from younger patients. Assessment of the surgical problems and physiologic status of elderly persons must take into account the changes associated with advancing age, changes in the incidence, prevalence and natural history of certain disease processes; and the increased likelihood of multiple medical diagnoses and polypharmacy.

Keywords: Elderly, Preoperative, Operative, Postoperative Care

1. INTRODUCTION

Aging is generally characterized by gradual decline in both physiological function and the ability to respond to stress and homeostatic imbalance leading to increasing susceptibility to disease (Lui *et al.*, 2010). Advancing age is also accompanied with important pharmacokinetic and pharmacodynamic changes. Pharmacokinetic changes include a reduction in renal and hepatic clearance of many drugs whereas pharmacodynamic changes involve altered sensitivity to several classes of drugs such as anticoagulants, cardiovascular and psychotropic drugs (Mangoni and Jackson, 2004). The definition of "elderly" is controversial and the traditional demographic definitions include those patients exceeding 65 years of age as the functional deterioration is more frequently apparent beyond the age of 70 years. For the elderly, one should categorize age-related pre-existing

chronic illness; age related functional physical decline, or preoperative risk status. The decision-making process is complex in elderly surgical candidates (Saber, 2011). Among the currently available risk assessment tools, American Society of Anesthesiologists (ASA) scoring system despite does not measure operative risk, rather it assesses the degree of sickness or physical state prior to anesthesia and surgery. The assessment of cardiac risk is addressed by the Cardiac Risk Index (CRI) in noncardiac surgery and the risks of postoperative respiratory complications are age over 70; perioperative bronchodilator use; abnormal chest x-ray and high ASA grade (Saber, 2011; Girbes, 2000). The Acute Physiological and Chronic Health Evaluation (APACHE) is the best known physiological scoring system. It is based on twelve physiological variables and is currently being used in general and surgical intensive care patients. Age is an independent risk factor built into

above mentioned risk prediction tools; ASA, Cardiac Risk Index (CRI) an APACHE. Such as adverse drug effects, drug-drug interactions, or drug toxicities. The greater the number of medications taken, the greater the risk of a clinically serious drug-drug interaction and the adverse drug reactions experienced by elderly patients often tend to be more severe than those experienced by younger patients. The reduced organ reserve capacity of elderly persons contributes to this as every organ system loses reserve capacity with age (Saber, 2011; Girbes, 2000).

Risk is a term that is understood differently by different individuals depending on expectation and previous experience. From a practical point of view 'high risk' can probably be defined in two different ways: the first is relevant to an individual and suggests that the risk to an individual is higher than for a population; the second compares the risk of the procedure in question with the risk of surgical procedures as a whole. Surgical risk, in turn, has two components: the extent and the duration of the procedure both can cause an increase in postoperative oxygen demand and an increase in cardiac output or an increase in oxygen extraction. The classification of surgical interference is done in accordance with the extension and/or complexity of the procedure. The second item is the functional capacity of the patient that determines his ability to support the postoperative demand of increased oxygen consumption and therefore of cardiac output. Myocardial ischemia only becomes part of this equation if the ischemia limits ventricular function and cardiac output (Saber, 2011; Girbes, 2000).

1.1. Physiological Changes with Age

1.1.1. Cardiovascular System

There are major cardiovascular changes in elderly patients, where the ability of aorta and great arteries for elasticity and compliance is reduced. Higher systolic arterial pressure, increased impedance to left ventricular ejection with left ventricular hypertrophy and interstitial fibrosis were seen. The wall of left ventricle becomes stiffer and as a result it takes longer to relax and fill in diastole (Hiitola *et al.*, 2009; Mangoni and Jackson, 2004).

The left ventricular hypertrophy and decreased diastolic pressure both are accompanied with subendocardial ischemia and interstitial fibrosis. These four changes force the left ventricular compliance to reduce and the relaxation time of the left ventricle to increase. Because of the delayed left ventricular relaxation and the stiffer left ventricle, the force of left atrial contraction increases and the contribution of the atrial contraction to left ventricular end-diastolic volume increases (Swinne *et al.*, 1992). By the age of fifty, apoptosis causes the atrial pacemaker cells to lose up to 50-

75%. The number of atrioventricular nodal cells is preserved and there is fibrosis and cellular loss in the bundle of His (Cheitlin and Zipes, 2001). The response to postural changes differs with age where in the younger's, the cardiac output is maintained by increasing heart rate and the increase in stroke volume acts to compensate in elderly subjects (Mangoni and Jackson, 2004; Hiitola *et al.*, 2009).

1.2. Respiratory System

There are various anatomical, physiological and immunological changes occurring with age in respiratory system (Sharma and Goodwin, 2006). Important four changes in the structure and function of the respiratory system are seen with aging. The first is known as "senile emphysema" and means reduction in the elastic recoil of the lung as a result of reduction in the alveolar surface area without alveolar destruction. This senile emphysema is associated with hyperinflation, reduction in alveolar-capillary diffusing capacity and dorsal kyphosis and "barrel chest" due to decreased compliance of the chest wall and calcification of its articulations. The second change is a decrease in the strength of respiratory muscles that is concomitant with cardiac index, nutritional status and hyperinflation leading to reduced ventilatory response to hypoxia and hypercapnia. The third change is due to increased static lung compliance and decreased chest wall compliance resulting in an increase in the functional residual capacity with aging. These changes lead to an increase in residual volume and decreased maximal expiratory airflow rates and vital capacity (Oyarzun, 2009).

The last and the 4th point of changes is the structural change including the chest wall and thoracic spine deformities which impairs the lung compliance and increase work of breathing (Oyarzun, 2009; Sharma and Goodwin, 2006).

1.3. Kidneys

Loss of kidney function has been recognized with advanced age as progressive decreases in glomerular filtration rate and reduced renal blood flow. The overall reduced glomerular filtration rate is a result of reduction in the glomerular capillary blood flow rate as well as the glomerular capillary ultrafiltration coefficient. The primary reduction in afferent renal arteriolar resistance is associated with an increase in glomerular capillary hydraulic pressure. There are important structural changes that occur in the kidneys due to advanced age. These changes are loss of renal mass; hyalinization of afferent arterioles and development of what is called tubulointerstitial fibrosis such as

agglomerular arterioles and sclerotic glomeruli. Aging is associated with altered activity and responsiveness to vasoactive stimuli leading to increased responses to vasoconstrictor stimuli while the vasodilatory responses are impaired. Changes in the activity of the renin-angiotensin and nitric oxide systems may predispose the aging kidney to acute kidney injury, normotensive ischemic nephropathy and progressive chronic kidney disease (Weinstein and Anderson, 2010). With age, renal mass decreases as a result of the reduction in nephrons. Intra-renal vascular changes also occur, consisting of hyalinization of the vascular tuft leading to reduced blood flow in the afferent cortical arterioles (Pannarale *et al.*, 2010). The ability to concentrate the urine during water deprivation is reduced as a result of the reduced number of nephrons and its inability to deal with the increased solute load or to the increased perfusion of the juxtamedullary glomeruli producing medullary washout (Mangoni and Jackson, 2004).

1.4. Gastrointestinal System

With advanced age, the basic functions of the digestive system such as motility, secretion, intraluminal digestion and absorption show marked changes. Elderly individuals frequently complain of altered swallowing due to oropharyngeal muscle dysmotility. The esophageal peristalsis is usually reduced and esophageal sphincter pressures are lowered in the aged subjects as well as delayed motility and gastric emptying (Grassi *et al.*, 2011). Impairment of gastric secretions and the mucous-bicarbonate barrier are frequently seen in the elderly and may lead to gastric ulcer (Saber, 2011). These functional changes are responsible for the symptomatic gastrointestinal dysfunctions such as dysphagia, gastroesophageal reflux disease, dyspepsia, chronic constipation, maldigestion and reduced absorption of nutrients (Grassi *et al.*, 2011). Anorexia of ageing is a term for loss of appetite in the elderly aged over 65 years as ageing is associated with the inability to increase food intake after under-eating in the short- and long-term. Also, with age the elderly report lower feelings of hunger and increased feelings of satiety and fullness (Moss *et al.*, 2012). It was suggested that with advancing age there is an increase in satiety hormones, such as CCK and PYY and a decrease in the hunger hormone, ghrelin (Grassi *et al.*, 2011; Moss *et al.*, 2012).

1.5. Muscular System

There are two main phenomena associated with aging, loss of lean muscle mass and senile sarcopenia which is one of the main causes of muscle weakness and reduced locomotor ability in elderly subjects. The main

cause of senile sarcopenia in elderly subjects are neuropathic processes, nutritional, hormonal, immunological factors and a reduction in physical activity (Narici and Maganaris, 2006). Sarcopenia reflects the progressive catabolic status and reduction of the anabolism along with a reduced capacity of muscle regeneration as a result of decreased muscle force and power more than muscle dimensions (Narici and Maffulli, 2010).

By the age of fifty, a gradual loss of muscle fibers begins and continues so that by the age of eighty, approximately 50% of the fibers are lost from the limb muscles (Faulkner *et al.*, 2007). The combined effect of changes in muscular architecture and mechanical properties of the tendons, are accompanied by a 10% decrease in tendon stiffness (Narici and Maganaris, 2006; Narici *et al.*, 2008).

1.6. Neuroendocrine System

The neuroendocrine responses to various types of stress show marked changes with age. The Hypothalamic-Pituitary-Adrenal (HPA) axis shows an altered function with excessive activation and hypersecretion of glucocorticoids leading to dendritic atrophy in neurones in the hippocampus, with consequent learning and memory impairment (Mangoni and Jackson, 2004; Gust *et al.*, 2000). The glucocorticoid cascade hypothesis is the result of loss of hippocampal neurones with impaired feedback inhibition of the Hypothalamic-Pituitary-Adrenal axis and glucocorticoid secretion, leading to further damage caused by elevated glucocorticoid concentrations (Gust *et al.*, 2000). The functional impairment effect of glucocorticoids on hippocampal neurones is likely to be age-dependent. The status of chronic stress causes insufficient adjustments in Hypothalamic-Pituitary-Adrenal axis activity in response to sustained glucocorticoid levels as a result of impaired feedback regulation of the HPA axis activity (Garrido, 2011).

1.7. Risk assessment in Surgical Patients

There are a number of tests that can be used to preoperatively stratify risk in surgical patients. These can be divided into general tests and scores and those specific for myocardial problems; specifically, postoperative myocardial infarction and sudden cardiac death (Saber, 2011; Saber *et al.*, 2012).

1.8. General Preoperative Risk Stratification

There are two major factors by which the risk can be assessed preoperatively; surgery and the patients

themselves. Risk factors related to the surgery include the surgical procedure and whether that procedure situation is elective or emergency. Risk factors related to the patient are the patient's age, comorbidity or physiological reserve. The American Society of Anesthesiologists (ASA) is considered as the simplest and most widely used method for assessing the comorbidity and is grading on a scale of I to IV. When ASA is combined with the type of urgency of surgery tone can predict the postoperative mortality (Boyd and Jackson, 2005). Other clinical tools for assessments of preoperative comorbidity are used to identify the higher-risk patients vulnerable to morbidity and mortality following surgery (Shoemaker *et al.*, 1988; Boyd *et al.*, 1993). These clinical criteria for high-risk surgical patients are:

- The cardiorespiratory status: as acute myocardial infarction, chronic obstructive pulmonary disease, or stroke
- Chronic vascular disease
- Age over seventy years with reduced organ physiological reserve
- Extensive oncologic surgery in case of oesophagectomy, gastrectomy or cystectomy
- Abdominal catastrophe with haemodynamic instability as seen in peritonitis, perforated viscus or pancreatitis
- Acute massive blood loss > 8 units
- Septicaemia
- Positive blood culture or septic focus
- Respiratory failure
- Acute renal failure

The ASA classification has stood the test of time, probably because its simplicity to calculate without requiring additional resources. While there are other more complex scoring systems have been advocated with more prognostic accuracy but ASA scoring remains useful. ASA has been used outside operating theatres to assess patients fitness for endoscopy and to help non-anaesthetists to consider potential procedural-related risks (Table 1).

1.9. Preoperative Risk Stratification for Myocardial Events

Two cardiac risk indices are well known. The first is the Goldman Index. This index has the advantage of being practical and inexpensive method for identifying cardiac risk. A second score was developed by Detsky and colleagues and both this score and the Goldman Index are good predictors of perioperative cardiac events (Boyd and Jackson, 2005).

Table 1. American Society of Anaesthesiologists' status classification: Modified from Wolters *et al.* (1996)

Class	Description	Mortality (%)
I	Healthy	0.1
II	Mild systemic disease -no functional limitation	0.7
III	Severe systemic disease -definite functional limitation	3.5
IV	Severe systemic disease -constant threat to life	18.3
V	Moribund patient unlikely to survive 24 hours with or without operation	93.3
E	Emergency operation	

1.10. Postoperative Risk Stratification

The Acute Physiology and Chronic Health Evaluation (APACHE) scoring system is the most widely used scoring system for postoperative risk stratification.

The APACHE system includes chronic health data concerning the individual patient and physiological data collected during the patients first 24 hours of intensive care treatment. The Physiological and Operative Severity Score for the enumeration of Mortality and morbidity (POSSUM) score has been specifically designed for surgical patients to predict both morbidity and mortality. This is generally accepted to be a good scoring system for routine use (Tekkis *et al.*, 2004).

1.11. Comprehensive Geriatric Assessment

The Comprehensive Geriatric Assessment (CGA) is a multidimensional interdisciplinary diagnostic process to determine the medical, psychological and functional capability of the elderly person in order to develop a coordinated and integrated plan for treatment and long-term follow-up. The comprehensive geriatric assessment may reduce short-term mortality and improve physical and cognitive function and often requires a trained multidisciplinary team and enough time. Members of the comprehensive geriatric assessment team generally include the geriatrician (internist or family physician), a social worker and nurse. Other health care disciplines are often involved neurologist, dietitian, pharmacist, physical therapist, occupational therapist and psychologist (Ellis and Langhorne, 2005).

1.12. Office Assessment of the Surgical Elderly Patient

1.12.1. Source of Referrals

The patient's family or caregivers are often the source of the patient referral.

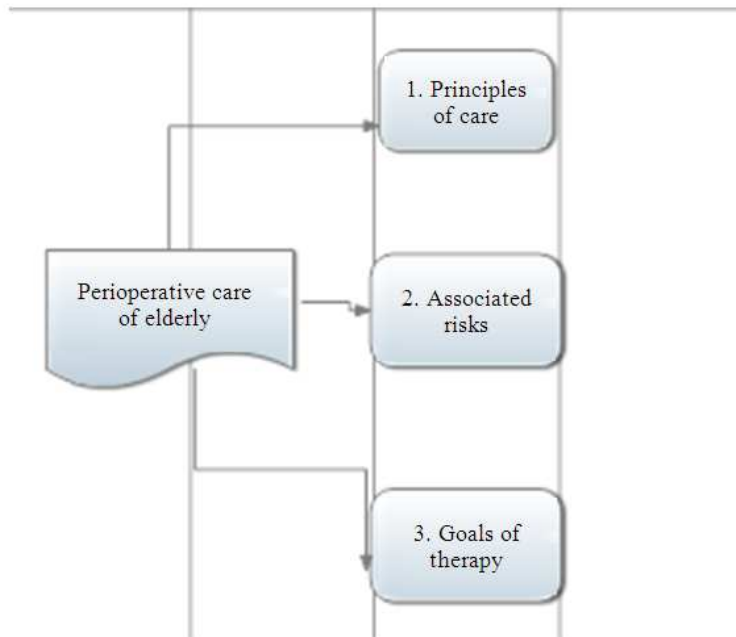


Fig. 1. Preoperative care of elderly patients

Trained office staff should be able to ascertain the need for a comprehensive functional assessment and plan physician time accordingly.

1.13. Who Benefits from CGA?

It is useful to gather as much information as possible about the patient and living situation prior to the visit. The combination of age, physical disease, geriatric syndromes, impairment of functional ability and social problems are the most common targeting criteria to be collected (Bernabei *et al.*, 2000)

1.14. Patient Background Information

The following points should be collected by patient or caregiver : hearing aids, eyeglasses and medications through the initial assessment visit via review assessment questionnaire (Ellis and Langhorne, 2005).

1.15. Preoperative Care of Elderly (Flow Fig. 1)

Elderly patients are more likely to be mentally and physically compromised at baseline with increasing risk of delirium and postoperative cognitive dysfunction. Elderly patients are also at increased risk of postoperative decline in their physiological reserve, which can lead to organ failure. General recommendations for the perioperative care of elderly patients include avoiding drugs that raise the risk of

delirium, ensuring adequate caloric and fluid intake, enhancing early mobilization and planning for physical therapy as soon as possible and also early planning for discharge. Family conferences are recommended to address the many questions and challenges that surgery in an elderly person can pose (Palmer, 2009).

1.16. Principles of Care

Traditional outcomes from surgery are defined within a period of thirty days after the surgical procedure and tend to focus on morbidity and mortality. Thirty-day mortality varies by procedure, but tends to be higher for patients aged >80 years. Logically, the incidence of complications increases with age and the impact of these complications on mortality and functional recovery increases with age. Twenty percent of patients aged >80 years had more complications than others and the presence of a complication increased mortality from 4-26%. Respiratory and urinary tract complications are the most common among those patients (Deiner and Silverstein, 2012). Dealing with and management of surgical illness in elderly patients is quite different from that in younger patients and typically more complex. Assessment of the surgical problems and physiologic status of elderly persons must take into account: (1) Marked physiological changes associated with advancing age (2) Changes in the incidence, prevalence and natural history of certain disease processes and (3) Increased

likelihood of multiple medical diagnoses and polypharmacy (Rothschild *et al.*, 2000).

1.17. Associated Risks

For identification, the high risk can probably be defined in two different ways related to individual and procedure. The first would be if the individual's risk of mortality is either >5% or twice the risk of the population undergoing that procedure. The second description suggests that a high-risk procedure is one with mortality greater than 5%. Furthermore, surgical patients for whom the probable mortality is greater than 20% should be considered 'extremely high-risk' patients (Saber, 2011; Saber *et al.*, 2012). The risks associated with surgical treatment depend on: (a) the nature of the proposed procedure and (b) the patient's physiological status (Watters *et al.*, 2008). In case of emergency procedures, mortality rate is markedly higher than mortality from the electives. Elective surgery may therefore be indicated to avoid complications if emergency intervention will be inevitable. Physiologic status is a more fundamental determinant of risk than age is. No matter how fit, active and free of comorbidity the elderly individual appears, there is a gradual loss of physiologic reserve in various organ systems associated with aging (Saber *et al.*, 2012; Watters *et al.*, 2008).

There are five factors which are very important to obtain the best outcomes from the surgical treatment of elderly patients:

- Careful preoperative preparation of the patient
- Optimization of medical and physiologic status
- Minimization of perioperative starvation the stresses of hypothermia, hypoxemia and pain
- Meticulous perioperative care
- Careful surgical judgment and technique (Watters *et al.*, 2008)

Elderly patients' care requires and the involvement of a multidisciplinary clinical team interested in the management of the elderly surgical patient. With a comprehensive approach, preoperative assessment and planning for major operations can be completed with low risk, a short hospital stay and a rapid return to full function (Bardram *et al.*, 2000).

1.18. Goals of Therapy

- The major concern of an elderly patient may be whether he or she will be able to enjoy the same level of function and independence as before the onset of the problem

- Relief of symptoms and maintaining quality of life may be more important than long-term survival
- Maintaining reasonable function in the short term may be of special importance
- Major surgical procedures to maximize longevity may be entirely appropriate in an elderly patient who is fit from physiologic, functional and cognitive perspectives (Watters *et al.*, 2008)

1.19. Preoperative Assessment:

1.19.1. Risk Assessment

Assessment of risk in elderly patients must consider patient factors, the surgical problem and the treatment options. Coexisting medical conditions are common and may markedly increase the risks associated with surgical intervention. A rational approach to risk assessment should take into account those specific factors that predict important adverse clinical outcomes, allowing risks and treatment goals to be weighed (Saber, 2011; Saber *et al.*, 2012; Carpenter *et al.*, 2000).

Decisions about surgical care should rely on clinical specific data which are predictive than chronologic age. Abnormalities seen in chest x-rays and preoperative ECG usually increase with age. Preoperative hypokalemia are known to be associated with a higher incidence of perioperative arrhythmia and a greater need for cardiopulmonary resuscitation (Watters *et al.*, 2008).

1.20. Respiratory Assessment

Respiratory complications are among the most common postoperative complications specially when major surgical procedures are performed and these complications are more frequent in elderly patients. Postoperative pulmonary complications are considerably more common than cardiac complications and are equally likely to cause postoperative death after abdominal procedures (Saber, 2011; Watters *et al.*, 2008). Smoking, poor exercise capacity, Chronic Obstructive Pulmonary Disease (COPD), active pulmonary infection and cognitive impairment are well-known significant patient-related risk factors for prediction of postoperative pulmonary complications (Moller *et al.*, 2002). Procedure-related risk factors should also be traced. The risk of pulmonary complications is greatest after upper abdominal and thoracic procedures and is lower with laparoscopic procedures than with open procedures (Watters *et al.*, 2008; Hall *et al.*, 1991). The aim should be to optimize the patient's respiratory status by exercise capacity

determination. Bronchodilators, glucocorticoids and chest physiotherapy may be helpful. A careful history and a thorough physical examination are the most important elements of preoperative assessment and should be completed in elderly patients undergoing abdominal and thoracic procedures (Arozullah *et al.*, 2001).

1.21. Cardiovascular Assessment

The coronary artery disease, the risk of perioperative myocardial infarction and cardiac death increase with advancing age. As The postoperative pulmonary complications, the risk of adverse cardiac events is strongly influenced by the nature of the surgical procedure. Logically, the risk is very low in low-risk patients undergoing minor surgical procedures. By contrast, the risk of major cardiac complications is relatively high after abdominal, noncardiac thoracic and suprainguinal vascular procedures in elderly individuals. It is well-known that cerebrovascular disease, renal insufficiency and type 1 (insulin-dependent) diabetes are significant predictors of cardiac complications (Watters *et al.*, 2008).

1.22. Cognitive Assessment

Preexisting impairment of cognitive function from dementia, delirium, or depression is associated with an increased risk of postoperative complications. In patients with preoperative cognitive dysfunction, the risk of postoperative pulmonary complications after abdominal procedures reaches up to nearly six fold. The risk factors for postoperative delirium are advanced age, preexisting dementia, visual impairment and alcohol use (Eeles *et al.*, 2012). Assessment of cognitive function should be completed as a preoperative routine tool in patients older than seventy five years subjected to major elective surgery and in patients with existing cognitive impairments or other risk factors for postoperative delirium (Yoshida *et al.*, 2012).

1.23. Nutritional Assessment

While there is no single accepted standard for assessment of nutritional status, the elderly surgical patients should routinely be screened for malnutrition. Elderly persons are at risk for malnutrition for several reasons Such as limited dietary range by their physical and cognitive disabilities, social isolation, poverty, poor dentition and the adverse effects of medication on appetite, nutrient absorption and metabolism (Oh *et al.*, 2012).

Micronutrient such as vitamin and trace element supplementation tends to improve the immune function and lowers the incidence of clinical infections in elderly

persons. Assessment of nutritional status should be routine in elderly patients for whom a major elective procedure is planned or who are admitted to hospital with an acute illness (Hinds *et al.*, 2011).

1.24. Psychological Preparation

Psychological factors are of considerable importance in preparing the elderly patient for elective operation. Preoperative patient education has been shown to enhance patient confidence (Watters *et al.*, 2008).

1.25. Anaesthesia

1.25.1. Key Points

- Prevention of intraoperative hypothermia
- As Ephedrine is ineffective in the elderly; another α -agonists such as metaraminol or phenylephrine should be used instead.
- Resuscitation should begin as soon as possible for all trauma patients, especially the elderly Together with recording of the fluid balance
- Hypotension should be treated by cautious use of fluids and early use of a vasopressor (Murray and Dodds, 2004)

1.26. Practical Points

- Care of pressure areas is essential to avoid the development of pressure sores that may delay discharge and can lead to fatal sepsis. Arthritis is almost universal in the elderly and joint movement restriction may lead to difficulty in obtaining a satisfactory position for surgery or regional anaesthesia and excessive joint manipulation may lead to severe pain postoperatively
- The invasive and non-invasive monitoring of elderly patients must be tailored to their physical status and not to the proposed procedure and the invasive monitoring may be necessary for minor surgical procedures. Temperature should be recorded from entry into the holding area and maintained at normal values throughout the perioperative period
- Venous access may be easy to achieve but may be lost because of the thin fragile vessel walls
- Airway management using either an endotracheal tube or laryngeal mask airway according to the situation. Ventilation should maintain normal awake values for carbon dioxide tension and oxygenation (Murray and Dodds, 2004; Dodds and Murray, 2001)

1.27. Pharmacokinetics and Pharmacodynamics in Elderly

With aging, there are three important factors tend to alter the volume of distribution and redistribution of drugs and alter their rates of clearance and elimination. These factors are decreased both lean body mass and total body water and an increased proportion of body fat. The age-related changes in plasma proteins show decreased protein binding activity and increased the free fraction. These changes have the potential to increase the pharmacologic effect of drugs used. Furthermore, alterations in cardiac output and renal or hepatic clearance may change drug plasma concentrations and their duration of action. Neuronal loss as a result of advancing age and decreased levels of neurotransmitters may increase sensitivity to anesthetics. Pharmacokinetic and pharmacodynamic changes, together with drug interactions and polypharmacy, collectively make the elderly prone to adverse drug effects (Cook and Rooke, 2003).

1.28. Choice of Anaesthetic Technique

The anaesthetic technique may be local, regional, or general anaesthesia. Local anesthesia should be considered wherever possible especially in the elderly patient. Day-case surgery has advantages for the elderly because it allows the patient to return home as soon as possible and can help reduce the anxiety and disorientation. Difficulty in patient positioning, calcification of spinous ligaments and vertebral collapse caused by osteoporosis in the elderly patients are challenging for performing regional blockade. Regarding regional and general anaesthesia, there is little evidence to suggest that one technique is better than the other (Murray and Dodds, 2004).

1.29. Intraoperative Care

1.29.1. Positioning

Particular attention must be put in mind for positioning the elderly patients for operation because they commonly have diminished range of joint mobility. Postoperative back pain is a well-recognized complication of the lithotomy position in elderly patients. The remarkable prevalence of osteoporosis and the high incidence of related fractures in the geriatric population emphasize the fragility of these patients' bone and the importance of gentleness and care in turning and positioning them, particularly when discomfort and protective musculoskeletal reflexes have been suppressed by anesthesia. As the skin of elderly individuals is easily injured by tape, adhesive electrodes,

cautery pads and warming blankets, careful padding is necessary to prevent localized pressure, which may result in nerve compression and skin injuries and to maintain appropriate positioning throughout anesthesia. The head and neck should be kept in a position that is comfortable and limits hyperextension so that cerebral blood flow is not compromised (Watters *et al.*, 2008).

1.30. Maintenance of Core Temperature

In elderly individuals, a fall in core temperature is common especially when major operative procedures are planned because they are less well able to maintain normothermia (Blatteis, 2011). Maintaining normothermia usually results in a marked reduction in morbid postoperative cardiac events in elderly patients. The incidence of surgical site infection is increased by even mild hypothermia because of reduced cutaneous blood flow and tissue oxygen delivery. Impaired platelet function and decreased activation of the coagulation cascade are believed to contribute to the increased blood loss and the greater need for blood transfusion associated with hypothermia. Controlling room temperature, minimizing exposure of body surfaces, warming I.V. fluids are methods to be put in mind for minimizing and preventing hypothermia in the operating room (Watters *et al.*, 2008).

1.31. Prevention of Deep Vein Thrombosis

Advanced age is well recognized as a contributing factor for the development of postoperative Deep Vein Thrombosis (DVT). Prophylaxis of DVT may be Mechanical or/ pharmacological. Mechanical methods of prophylaxis against DVT include intermittent pneumatic compression device, graduated compression stocking and the venous foot pump. Intermittent pneumatic compression enhances blood flow in the deep veins of the leg, preventing venous stasis and hence preventing venous thrombosis (Kesieme *et al.*, 2011). Pharmacological method includes the use of unfractionated heparin, low-molecular-weight heparins and the new oral direct selective thrombin inhibitors and factor Xa inhibitors are effective pharmacological agents for prophylaxis of DVT (Leonardi *et al.*, 2006).

1.32. Postoperative Management (Flow Fig. 2)

1.32.1. Respiratory Care

The traced postoperative respiratory complications such as respiratory failure and inadequate oxygen transport remain the important causes of death in the elderly individuals.

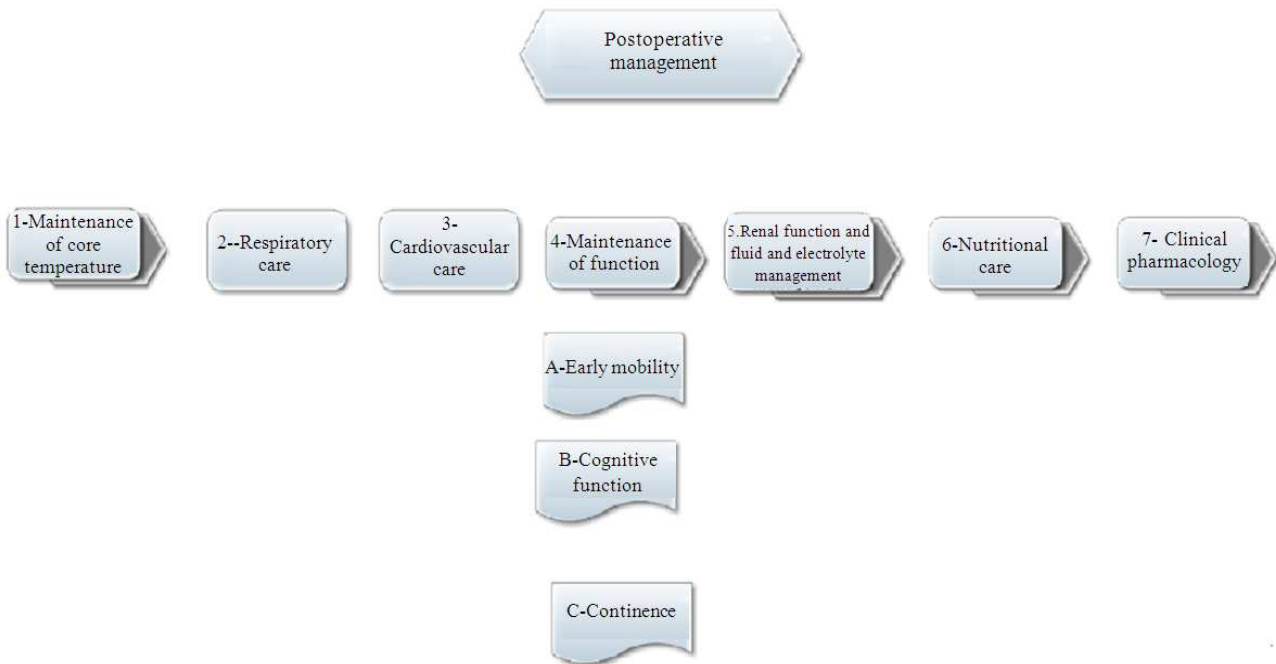


Fig. 2. Postoperative Management of elderly patients

Resting arterial oxygen tension decrease progressively with advancing age and the further decrease associated with operation is more marked in elderly patients. Both postoperative hypothermia and postoperative shivering markedly increase oxygen demand. Abdominal procedures with general anesthesia induce decreases in vital capacity and forced expiratory volume (Watters *et al.*, 2008).

Protective airway reflexes are less sensitive in elderly persons, mucociliary transport is less efficient and coughing is less effective in the elderly subjects and this is because strength, elastic recoil of the lungs, vital capacity and maximum expiratory flow rate are all diminished. The use of parenteral narcotics during the postoperative course for postoperative analgesia has been associated with striking episodic falls in oxygen tension. As previously noted, effective regional analgesia is associated with less marked postoperative decreases in vital capacity and functional residual capacity and appears to be superior to parenteral narcotic analgesia in this regard. The prolonged supine position usually not preferred because it is accompanied by obliteration of small airways in dependent areas of the lung, ventilation-perfusion mismatch, an increased alveolar-arterial oxygen gradient and hypoxemia. Simply changing from the supine position to the sitting position increases functional residual capacity and improves gas exchange

in patients who have undergone abdominal procedures (Watters *et al.*, 2008; Craig, 1981).

Spirometers, breathing exercises and intermittent positive-pressure breathing are of some benefit in reducing pulmonary complications after upper abdominal operations and may help shorten the hospital stay. Supplemental oxygen should be routinely provided to elderly patients who have undergone abdominal or thoracic procedures for a period of several days or until physical mobility is restored (Watters *et al.*, 2008).

1.33. Renal Function and Fluid and Electrolyte Management

Elderly patients are less able to restore and maintain acid-base balance, extracellular space fluid and other fluid compartments and electrolyte homeostasis during surgical illness. Renal handling of salt and water is less efficient, the physiology of aldosterone and vasopressin is altered and renal and other mechanisms of acid-base regulation are more limited (Allison and Lobo, 2004). The minimum requirement for water is increased in older patients as a result of increased insensible losses through thinned skin and impairment of the concentrating ability of the kidneys. Thirst is an important response to fluid deprivation, but it is known to be diminished in older persons (Schols *et al.*, 2009).

Careful management in the elderly is necessary to avoid disturbance of fluid, electrolyte and acid-base status. The ability of aged persons to conserve or excrete water or solute is further reduced by the diminished efficiency of tubular processes. Inefficient renal conservation of salt and water exacerbates hypovolemic states in the elderly patient with delayed onset of oliguria which considered as an important clinical sign. Hyponatremia coupled with water intoxication is a serious disorder in older persons, presenting as anorexia, weakness, lethargy, delirium and, if severe, seizures or coma (Watters *et al.*, 2008; Schols *et al.*, 2009).

Although the pH of body fluids is normally only slightly affected by age, the efficiency of acid-base homeostasis is decreased in elderly persons. Maintenance of normal pH depends on integration of three systems; the buffer system, the respiratory and the renal. The chemical buffer systems are in body fluids, the respiratory mechanism is via ventilation and elimination of carbon dioxide and the renal pathway is through excretion of excess acid or base. The slight decreases in extracellular volume and in bicarbonate concentration that occur with advancing age may limit the capacity of rapid chemical buffering systems. Similarly, decreased plasma volume and lean body mass and bone demineralization decrease the availability of slower buffers (e.g., plasma and intracellular proteins and hydroxyapatite). Bicarbonate buffering depends on the rapid elimination of carbon dioxide by the lungs. Ventilatory responses to hypercapnia are significantly diminished in healthy elderly persons (Watters *et al.*, 2008).

1.34. Cardiovascular Care

Cardiovascular complications are a major cause of postoperative death in elderly patients and the assessment of cardiac risk should be the basis for preventive and monitoring strategies in the perioperative period. As mentioned above, aggressive reduction of coronary risk factors should be pursued preoperatively. The effectiveness of perioperative beta blockers in limiting increases in heart rate and blood pressure and reducing myocardial ischemia and cardiac mortality has been suggested. Continuous Electrocardiogram (ECG) monitoring in the postoperative period may be a sensitive method for detecting myocardial ischemia and determining whether intensive therapy is needed (Watters *et al.*, 2008). The goal of postoperative hemodynamic management is the maintenance of adequate oxygen delivery to vital tissues. A basic initial hemodynamic assessment includes a review of current

medications, heart rate and rhythm, mean arterial pressure, central venous pressure and Electrocardiogram (ECG) to exclude ischemia and conduction abnormalities. Cardiac output, pulmonary and systemic vascular resistances can be calculated when a pulmonary artery catheter is present. Patients with a history of hypertension or significant peripheral vascular disease probably will benefit from higher blood pressure; patients who are bleeding or who have suture lines in fragile tissue are best served with tighter control. Peripheral vascular tone needs to be sufficient to provide the patient with adequate blood pressure and excess vasoconstriction can create dangerous levels of hypertension and decrease cardiac output (Khalpey *et al.*, 2008).

Inadequate intraoperative myocardial protection may be a cause of postoperative ischemia and infarction in aging persons. Ongoing ischemia should prompt consideration of standard strategies, including anticoagulation, beta blockade and nitroglycerin. Intra-aortic balloon placement should be considered to minimize inotrope requirements, decrease myocardial oxygen requirements and/or minimize infarct size (Khalpey *et al.*, 2008).

1.35. Management of Pain

Effective analgesia and pain management play a critical role in allowing early resumption of physical activity, increasing lung volumes and improving respiratory gas exchange after operation. Postoperative pain is a stimulus for the elaboration of stress hormones and stress responses. As the author previously said, age-related changes in pharmacokinetics and pharmacodynamics are more relevant in the elderly patients with marked CNS depression than younger patients do. Parenteral administration of narcotics can be associated with profound arterial oxygen desaturation. NSAIDs have been used in combination with narcotics and other analgesics in the management of postoperative pain. Such agents should be used with caution in elderly surgical patients (Watters *et al.*, 2008).

Control of postoperative pain is important in preventing delirium as increased levels of both preoperative and postoperative pain are risk factors for development of postoperative delirium higher pain scores at rest during the first three postoperative days are associated with postoperative delirium in patients undergoing non-cardiac surgery. Opioids themselves may induce delirium and elderly patients have increased cerebral sensitivity to opioids. For this reason, non-opioid analgesics are increasingly utilized as a part of a multimodal pain management regimen (Sieber and

Barnett, 2011). As previously stated, the aging patients have co-existing diseases and concurrent medications, diminished functional status and physiological reserve and age-related pharmacodynamic and pharmacokinetic changes. For pain assessment in elderly patient, the treating team should keep in mind the cognitive impairment of the patient and difficulties in measurement of such pain. The elderly are also at higher risk of adverse consequences from surgery and unrelieved or undertreated pain. Multimodal analgesia, using acetaminophen, non-steroidal anti-inflammatory drugs or other non opioid drugs, is the best way to decrease opioid consumption and thus opioid-related adverse events (Aubrun and Marmion, 2007).

1.36. Maintenance of Function

The goal of postoperative care is maximum function. Achievement of optimal functional level depends on three principal areas -- mobility, continence and cognition.

1.37. Early Mobility

Early mobility should be encouraged for all elderly patients who have recently undergone surgery. Multiple organ systems can be affected by immobility, including the skin, the cardiovascular system, the lungs, the musculoskeletal system and the gastrointestinal and genitourinary tracts (Beliveau and Multach, 2003). Elderly patients are at increased risk for pulmonary complications after operation and early mobilization helps minimize their incidence. Bed rest results in a significant decrease in tissue sensitivity to insulin, exaggerating age-related glucose intolerance. Bed rest is also associated with an increased incidence of DVT. Constipation and fecal impaction are frequent in immobilized patients as a result of alterations in gastrointestinal motility. Pressure ulcers are well-recognized complications of immobility to which elderly patients are predisposed because of diminished subcutaneous fat and decreased skin elasticity (Watters *et al.*, 2008; Beliveau and Multach, 2003).

Effective pain management is essential to start early mobility in the immediate postoperative period. These interventions conserve the patient's capacity for mobility and help prevent pressure ulcers. The intravenous lines, drains, catheters and other forms of physical restraint should be made to minimize to allow early mobility. If such devices must be employed, they should not be allowed to prevent planned activities, though they may necessitate accompaniment and assistance (Watters *et al.*, 2008).

1.38. Cognitive Function

Postoperative cognitive impairment is a frequent phenomenon and comprises three major clinical items; Post Operative Delirium (POD), Postoperative Cognitive Dysfunction (POCD) and dementia, with POD and POCD being the most common following surgery (Spiegel and Chen, 2012).

Postoperative cognitive difficulties are a common complication and are associated with significant morbidity and mortality in geriatric patients undergoing major procedures. Postoperative cognitive impairment encompasses both postoperative delirium and postoperative cognitive decline. The postoperative cognitive decline is multifactorial with potential causes being surgery type, sleep disturbances, neuroinflammation, cerebral hypoperfusion, anesthesia, metabolic syndrome and decreased cognitive reserve (Beliveau and Multach, 2003; Spiegel and Chen, 2012).

Delirium is a clinical syndrome with acute disruption of attention and cognition. Up to 20% of elderly surgical patients experience delirium as a postoperative complication. Due to postoperative hypoxia and hypotension. Pain and pain medications, particularly meperidine, sepsis and metabolic abnormalities may also play a role (Beliveau and Multach, 2003).

Careful preoperative assessment, ongoing postoperative assessment, cautious use of medications, correction of metabolic abnormalities and attention to environmental factors remain the most effective ways to prevent postoperative delirium. Comprehensive geriatric assessment and follow-up seems to be effective because it focuses on minimizing these risk factors (Beliveau and Multach, 2003).

1.39. Continence

Constipation, faecal impaction and faecal incontinence are particularly prevalent in the older population and there is a lack of clear advice uniformly agreed upon for the management of constipation and impaction (McCrea *et al.*, 2008). Hospital wards lack privacy and patients tend to ignore the urge to defecate due to embarrassment or the physical discomfort of using a bedpan. Post-operative causes of constipation are opiate use, immobility and bed rest (Gallagher *et al.*, 2008). Efforts to help the older patient achieve and maintain continence should begin preoperatively and should be reestablished postoperatively as soon as possible. Catheters should be removed as soon as possible to allow mobility (McCrea *et al.*, 2008).

The protocol to prevent postoperative constipation consists of lifestyle measures such as adequate fluid and fibre intake, mobility and adequate toileting habits should be attempted before medications. Patients with swallowing difficulties who may be unable to maintain adequate fluid and fiber intake may require more rapid progression to pharmacological intervention with minimizing anticholinergic burden. However, laxatives play an important role in the management of constipation, as they can improve stool consistency and the frequency of bowel movements (Hsieh, 2005). A high fiber diet can diminish the symptoms of constipation by increase stool weight and bowel frequency and promoting normal transit time. Osmotic agents (e.g., lactulose) and bulking agents, followed by enemas and stool softeners, with suppositories as needed; toileting should be performed 1 h after each meal, as well as in response to urge (Lin *et al.*, 2010).

1.40. Nutritional Care

Prevention of malnutrition should begin preoperatively with identification of patients at highest risk and nutritional status should be monitored and addressed from the first postoperative day specially in the elderly. Preexisting malnutrition is relatively common in elderly persons and is exacerbated in hospital by the periods of fasting and by the rapid erosion of skeletal muscle that accompanies the stress of major surgery and acute surgical illness. With aging, both lean body mass and body cell mass decrease considerably and during prolonged or severe illness, the rapid erosion of muscle mass may reduce an elderly patient's muscle strength below that required for moving about in bed, sitting and coughing effectively. The losses of muscle protein may be uniquely detrimental in elderly patients (Beliveau and Multach, 2003).

Nutritional support of the elderly patient should begin early, should take into account age-related changes in body composition, should include appropriate micronutrients and should anticipate diminished tolerance of substrate and fluid loads. Daily supplementation with physiologic amounts of vitamins and trace elements has been shown to enhance immune function and reduce the rate of clinical infection in healthy elderly persons (Oh *et al.*, 2012; Hinds *et al.*, 2011).

In hospitalized elderly patients the food intake is often inadequate and fortified meals and between-meal snacks have been shown to improve elderly patients' energy and protein intake. Oral supplements are usually well tolerated and do not necessarily lead to a decrease in volitional intake. Enteral feeding should be initiated

promptly in any elderly patient whose voluntary intake is not adequate and parenteral feeding can be used alone or as an adjunct when enteral feeding is being established or when prescribed nutrients cannot be fully administered via the enteral route (Beliveau and Multach, 2003).

1.41. Clinical Pharmacology

Drugs and doses causing adverse drug reactions increase substantially with age and drug reactions are an important cause of hospital admission, morbidity and mortality. The term pharmacokinetics refers to the absorption, distribution, protein binding, metabolism and excretion of drugs and their metabolites (drug disposition), whereas the term pharmacodynamics refers to the interaction of drugs with receptors and the resulting physiologic responses. Alterations in both pharmacokinetics and pharmacodynamics are predictable in elderly patient (Hutchison, 2007). Changes in body composition specifically, an increase in the proportion of body fat and a decrease in the proportion of lean tissue may influence the distribution of drugs. The use of pharmacotherapy in the elderly requires caution because of increasing with age drug sensitivity and risk of dangerous adverse effects. The process of ageing induces alteration in pharmacokinetics of drugs. Modifications affect practically each pharmacokinetic phase. Processes of distribution and, first of all, drug elimination are the most essential for clinical practice (Jablecka *et al.*, 2008).

Clearance of drugs that are primarily excreted by the kidneys declines with advancing age and the concomitant decrease in glomerular filtration rate. Drugs for which the dosage may require adjustment according to the patient's level of renal function include aminoglycosides, vancomycin, penicillins, cephalosporins, imipenem-cilastatin, metronidazole, digoxin, low-molecular-weight heparins, bisphosphonates and procainamide. Drug levels should be monitored, particularly when drugs with a low therapeutic index are used (Watters, 2002). The drug clearance by the liver depends on the capacity of the liver to extract the drug from the blood passing through the organ and the amount of hepatic blood flow. Clearance of drugs that are metabolized relatively slowly is dependent on the function of hepatic enzymes; given that hepatic mass decreases with age, clearance of such drugs tends to be reduced. Recently, it has been observed that a reduction in renal function may significantly affect not only renally excreted drugs but also drugs undergoing extensive metabolism in the liver (Mangoni and Jackson, 2004).

2. CONCLUSION

Elderly patients are vulnerable and particularly sensitive to the stress of surgery and anesthesia. Due to the increasing numbers of elderly undergoing surgery, it is important to pay attention to the quality of care in elderly patients. Minimizing perioperative risk in elderly patients requires thoughtful preoperative assessment of organ function and reserve, meticulous intraoperative management and postoperative care.

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