Special Considerations in the Anesthetic Management of the Polytraumatized Elderly Patient

Essay

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TABLE OF CONTENTS

LIST OF ABBREVIATIONS

Abbreviation	Tends For
20-HETE	20-HydroxyEicosaTetraEnoic acid
ABDC	Airway, Breathing, Circulation and Disability
ACS	American College of Surgeons
ACS-COT	American College of Surgeons Committee on Trauma
AP	Antero-Posterior
APACHE	Acute Physiological and Chronic Health Evaluation
ARDS	Adult Respiratory Distress Syndrome
ATLS	Advanced Trauma Life Support system
C1-C2	First and second cervical spine
CBF	Cerebral Blood Flow
CC	Closing Capacity
CNS	Central Nervous System
CO	Cardiac Output
COPD	Chronic Obstructive Pulmonary Disease
CPP	Cerebral Perfusion Pressure
CT	Computed Tomography
CV	Closing Volume
CVS	Cardio-Vascular System
CXR	Chest X Rays
CYP4A	Cytochrome P450 4A
DCO	Damage Control Orthopedics
ECG	Electro-Cardio Gram
ED	Emergency Department
EF	Ejection Fraction
ET	Endothelin-1
FEV_1	Forced Expiratory Volume in one second
FRC	Functional Residual Capacity
FVC	Forced Vital Capacity
GCS	Glasgow Coma Scale

GFR	Glomerular Filtration Rate
HPA	Hypothalamic Pituitary Adrenal axis
HR	Heart Rate
ICP	Intracranial Pressure
ICU	Intensive Care Unit
LMA	Laryngeal Mask Airway
MMSE	Mini Mental State Examination
NEXUS	National Emergency X-Radiography Utilization Study
PCO_2	Partial Pressure of Carbon Dioxide
PO_2	Partial Pressure of Oxygen
PE	Phenylephrine
POCD	Post-Operative Cognitive Disorder
PONV	Post-Operative Nausea and Vomiting
RTA	Road Traffic Accidents
RTS	Revised Trauma Scale
RV	Residual Volume
SCI	Spinal Cord Injury
SV	Stroke Volume
T_5	Thoracic spine number 5
TI	Trauma Index
TLC	Total Lung Capacity
WBCs	White Blood Cell
VC	Vital Capacity

LIST OF FIGURES

LIST OF TABLES

Introduction

Geriatric population is the fastest growing part of the population in many parts of the developed world. Aging increases the probability of a person to undergo surgery. Moreover, perioperative morbidity becomes more frequent in the elderly with steep increases after the age of 65. The functional capacity of organs declines and co–existing diseases further contribute to this decline, thus aging alters both pharmacokinetic and pharmacodynamic aspects of anesthetic management **(Kanonidou and Karystianou, 2007)**.

Traumatic injury is the foremost cause of mortality in patients aged over 44 years. These patients are susceptible to a distinctive injury pattern. They respond differently to trauma, recover more slowly and have higher morbidity and mortality **(Coronado et al., 2005)**.

The pattern of injuries among geriatric patients is predominated by blunt trauma such as falls, motor vehicle collisions and pedestrian events **(Coronado et al., 2005)**.

Geriatric anesthesia is as challenging as pediatric anesthesia but with more variable responses and complications to anesthesia stress because of tremendous physiologic abnormalities, co–morbid diseases and decreased cardio–respiratory reserve **(Bajwa et al., 2014)**.

The elderly are more sensitive to anesthetic agents and generally require smaller doses for the same clinical effect, and drug action is usually prolonged. Common diseases in the elderly have a significant impact on anesthesia and require special care **(Sheila, 2011)**.

In terms of cardiac function, geriatric patients experience an increased incidence of conduction abnormalities, bradyarrythmias and hypertension. Elderly patients also have an increased reliance on Frank–Starling mechanism for cardiac output. It is therefore important to consider fluid administration carefully *(Bajwa et al., 2014)*.

Chronic Obstructive Pulmonary Disease (COPD), pneumonia, sleep apnea are very common among the elderly. Closing volume increases with age, and Forced Expiratory Volume in one second (FEV_1) declines 8–10% per decade due to reduced pulmonary compliance *(Kanonidou and Karystianou, 2007)*.

Meanwhile, age related changes in nervous system function have compelling implications for anesthetic management *(Paqueron et al., 2002)*.

The optimal physiological management is required to produce the best surgical outcome. The need for shorter hospitalization cannot be overemphasized. Minimal–invasion surgery and regional over general anesthesia when possible, could probably lead to a more favorable outcome for geriatric patients *(Kanonidou and Karystianou, 2007)*.

Chapter One

Pathophysiology of the geriatric age group

The definition of "elderly" is controversial. The traditional demographic definitions include those patients exceeding 65 years of age. Functional deterioration is more frequently apparent beyond the age of 70 years No two elderly individuals are same: they differ in their physical fitness, cognitive level, presence of co–morbidities, quality of life, and life expectations. Surprisingly, few objective instruments have been made available to categorize age–related pre–existing chronic illness; age related functional physical decline, or preoperative risk status (Hodigere et al., 2006).

Ageism attitudes are deep–rooted in mankind and are reflected in language, attitude, beliefs, behaviors, and policies (Penson et al., 2004).

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 which 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).

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:

Table (1): ASA physical status classification system

(Last approved by the ASA House of Delegates on October 15, 2014)

ASA Classification		Examples:
ASA I	A normal healthy patient	Healthy; no smoking, no or very minimal drinking.
ASA II	A patient with mild systemic disease	Smoker; more than minimal drinking; pregnancy; obesity; well controlled diabetes, well controlled hypertension; mild lung disease.
ASA III	A patient with severe systemic disease, not incapacitating	Diabetes, poorly controlled hypertension; distant history of MI, CVA, TIA, cardiac stent; COPD, ESRD; dialysis; active hepatitis; implanted pacemaker; ejection fraction below 40%; congenital metabolic abnormalities.
ASA IV	A patient with severe systemic disease that is a constant threat to life	Recent history of MI, CVA, TIA, cardiac stent; Ongoing cardiac ischemia or severe valve dysfunction; implanted ICD; ejection fraction below 25%.
ASA V	A moribund patient who is not expected to survive without the operation	Ruptured abdominal or thoracic aneurism; intracranial bleed with mass effect; ischemic bowel in the face of significant cardiac pathology..
ASA VI	A patient who has already been declared brain-dead and whose organs are being removed for transplant.	
The addition of an 'E' indicates emergency surgery.		

The assessment of cardiac risk is addressed many cardiac risk indices and one of them is the Goldman Cardiac Risk Index in noncardiac surgery as shown in the following table: *(Goldman et al., 1977)*.

Table (2): Goldman Cardiac Risk Index in non-cardiac surgery
(Goldman et al., 1977)

History
○ **Age > 70 years (5 points)** ○ **Myocardial infarction within 6 months (10 points)**
Cardiac Exam
○ **Signs of CHF: ventricular gallop or JVD (11 points)** ○ **Significant aortic stenosis (3 points)**
Electrocardiogram
○ **Arrhythmia other than sinus or premature atrial contractions (7 points)** ○ **5 or more PVC's per minute (7 points)**
General Medical Conditions
○ **PO2 < 60; PCO2 > 50; K < 3; HCO3 < 20; BUN > 50; Creat > 3; elevated SGOT; chronic liver disease; bedridden (3 points)**
Operation
○ **Emergency (4 points)** ○ **Intraperitoneal, intrathoracic or aortic (3 points)**

Risk Index

0-5 Points:	**Class I 1% Complications**
6-12 Points:	**Class II 7% Complications**
13-25 Points:	**Class III 14% Complications**
26-53 Points:	**Class IV 78% Complications**

The Acute Physiological and Chronic Health Evaluation (APACHE) is the best known physiological scoring system. It is based on twelve physiological variables:

1. **Partial Pressure of Oxygen (PaO2).**
2. **Temperature (rectal).**
3. **Mean arterial pressure.**
4. **PH arterial.**
5. **Heart rate.**
6. **Respiratory rate.**
7. **Sodium (serum).**
8. **Potassium (serum).**
9. **Creatinine.**
10. **Hematocrit.**
11. **White Blood Cell (WBCs) count.**
12. **Glasgow Coma Scale (GCS).**

And is currently being used in general and surgical intensive care patients. *(Zimmerman et al., 2006)*.

The reduced organ reserve capacity of elderly persons contributes to this as every organ system loses reserve capacity with age *(Girbes, 2000 and Saber, 2011)*.

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. *(Owen and Neil, 2005)*.

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 *(Girbes, 2000; Saber, 2011)*.