ANESTHETIC MANAGEMENT OF THE CRITICALLY ILL PATIENTS

Essay

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Abstract

Anaesthetic management of the critically ill patient who requires operative intervention remains a significant challenge and source of anaesthetic mortality. The goal of the anaesthetist has always been to facilitate surgery (which is often potentially life-saving) in these patients but, in addition, choices and techniques chosen by the anaesthetist may have a significant effect on long term outcome. The anaesthetic management begins preoperatively by a careful assessment of the critically ill patient. Preoperative high risk consent must be taken from the patient or one of his close relatives. Transfer of the patient within the hospital must be safe and organized. Preanaesthetic warming appears to attenuate the redistributive hypothermia after anaesthetic induction and decrease the incidence of IPH.

Key word

Anesthetic-IPH- critically ill patients

بسم الله الرحمن الرحيم

{ وقل رب زدني علما }

صدق الله العظيم

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List of Abbreviations:

AIAGP	Alpha I acid glycoprotein
AIAT	Alpha-I-antitrypsin
ACS	American College of Surgeons
ADH	Antidiuretic hormone
APACHE	Acute physiology & chronic health evaluation
aPTT	activated partial thromboplastin time
ARDS	Acute Respiratory Distress Syndrome
ASA	American Society of Anaesthesiologists
ATLS	Advanced trauma life support
ATP	Adenosine triphosphate
BP	Blood pressure
BURP	Backwards, upwards, right, and pressure
°C	Degrees Centigrade
C3	Complement 3
CaO_2	Arterial oxygen content
CBF	Cerebral blood flow
CFM	Cerebral function monitoring
cm	Centimeter
CNS	Central nervous system
CO	Cardiac output
CO_2	Carbon dioxide
COAD	Chronic obstructive airways disease
COPD	Chronic Obstructive Pulmonary Disease
CT	Computerized tomography
CvO_2	Mixed venous oxygen content
CVP	Central venous pressure
DDAVP	1- desamino – 8 – d- arginine vasopressin (Desmopressin)
DIC	Disseminated intravascular coagulation
DO_2	Oxygen delivery
DPL	Diagnostic peritoneal lavage
EAdi	Electrical activity of the diaphragm
ECG	Electrocardiogram
EEG	Electroencephalography
EMLA	Eutectic Mixture of Local Anaesthetics

ER	Emergency Room
FAST	Focused abdominal sonography in trauma
FAW	Forced-air warming
FB	Complement factor B
FDPs	Fibrin degradation products
FFP	Fresh Frozen Plasma
FIO_2	Fractional inspired oxygen concentration
GCS	Glasgow coma score
g/dl	Gram per deciliter
GI	Gastrointestinal
gm	Gram
h	Hours
H_2O	Water
Hb	Heamoglobin
Hct	Heamatocrit
I	Current
ICP	Intracranial pressure
ICU	Intensiv Care Unit
I:E ratio	Inspiratory:Expiratory ratio
IPH	Inadvertent perioperative hypothermia
IPPV	Intermittent Positive Pressure Ventilation
ITP	Intrathoracic pressure
IV	Intravenous
kg	Kilogram
kPa	Kilopascal
L	Liter
LVSWI	Left ventricular stroke work index
MAC	Minimal alveolar concentration
MAP	Mean arterial pressure
Min	Minutes
ml	milliliter
mm^3	Cubic millimeter
mmHg	Millimeter Mercury
mmol/L	Millimole per Liter
mRNA	Messenger ribonucleic acid
MSCT	Multi-slice spiral computed tomography
N_2O	Nitrous oxide

NAVA	Neurally Adjusted Ventilatory Assist
NIRS	Near infrared spectroscopy
NMBA	Neuromuscular Blocking Agents
NMDA	N-Methyl-D-Aspartic acid
NSAID	Non-steroidal anti-inflammatory drugs
OR	Operating Room
PA	Pulmonary artery
$PaCO_2$	Pressure of arterial carbon dioxide
PaO_2	Pressure of arterial oxygen
PAOP	Pulmonary artery occlusion pressure
PAWP	Pulmonary artery wedge pressure
PCC	Prothrombin complex concentrate
PCO_2	Pressure of carbon dioxide
PCT	Procalcitonin
PCWP	Pulmonary capillary wedge pressure
PEEP	Positive end-expiratory pressure
pH	Power of hydrogen
pHi	Intramucosal pH
PO_2	Pressure of oxygen
PPV	Pulse pressure variation
PSV	Pressure support ventilation
PT	Prothrombin time
PVR	Pulmonary vascular resistance
R	Resistances
RA	Right atrial
RAP	Right atrial pressure
rFVIIa	recombinant activated coagulation factor VII
rhAPC	Recombinant human activated protein C
RSI	Rapid sequence induction
RV	Right ventricle
s	Seconds
SaO_2	Oxygen saturation of arterial hemoglobin
$ScvO_2$	Saturation of the central venous blood
SIRS	Systemic inflammatory response syndrome
SO_2	Saturation of oxygen
SpO_2	Oxygen saturation of pulsatile hemoglobin
SVR	Systemic vascular resistance

TPN	Total parenteral nutrition
TS	Trauma Score
TV	Tidal Volume
UK	United Kingdom
V	Potential difference
VE	Minute ventilation
VILI	Ventilator-induced lung injury
Vo_2	Oxygen uptake
vs	Against

A critically ill patient is one at imminent risk of death; the severity of illness must be recognized early and appropriate measures taken promptly to assess, diagnose and manage the illness.[1]

Mortality after surgery is substantial and an association was established between perioperative coma and death and anesthesia management factors like intraoperative presence of anesthesia personnel, administration of drugs intraoperatively and postoperatively, and characteristics of delivered intraoperative and postoperative anesthetic care.[2]

Traumatic injury is the leading cause of death worldwide among persons between 5 and 44 years of age and accounts for 10% of all deaths.[3]

The Advanced Trauma Life Support system, as prompted by the American College of Surgeons (ACS) since 1979, is one such system which has gained widespread acceptance.[4]

The Advanced Trauma Life Support (ATLS) programme describes a simple protocol for rapid assessment and early management of patients with multiple injuries. All anaesthetists should be familiar with its basic elements.
The first three steps are :
- Establish an adequate airway with cervical spine control;
- Breathing : is it adequate?
- Circulation : is it adequate ?

Emergency treatment of these 3 components is instituted as necessary. A rapid assessment of disability (neurological status) is performed, together with 3 basic radiographs of the chest, lateral cervical spine and pelvis. This whole sequence is the primary survey and should identify all immediately life-threatening injuries. Treatment or resuscitation is started without delay. This may include taking the patient to theatre for laparotomy or thoracotomy.

When circumstances permit, the secondary survey is performed. This is a full head-to-toe assessment and seeks to identify all remaining injuries. It includes a long roll to assess the posterior surface of the patient, look for evidence of spinal injury and assess anal tone or injury. Many centers include a trauma computerised tomography (CT) scan in their protocol, which replaces diagnostic peritoneal lavage and more reliably detects significant intra-abdominal injury. CT assessment can also include the spine, brain and thoracic structures as indicated. Definitive management of all injuries then planned.(5)

Despite improvements in trauma care, uncontrolled bleeding contributes to 30% to 40% of trauma-related deaths and is the leading cause of potentially preventable early in-hospital deaths.(6)

Resuscitation of the trauma patient with uncontrolled bleeding requires the early identification of potential bleeding sources followed by prompt action to minimize blood loss, to restore tissue perfusion, and to achieve haemodynamic stability. Massive bleeding in trauma patients, defined here as the loss of one blood volume within 24 hours or the loss of 0.5 blood volumes within three hours, is often caused by a combination of vascular injury and coagulopathy. Contributing factors to traumatic haemorrhage include both surgical and non-surgical bleeding, prior medication, comorbidities, and acquired coagulopathy.(7)

The time elapsed between injury and operation must be minimized for patients in need of urgent surgical bleeding control.

Trauma patients in need of emergency surgery for ongoing haemorrhage demonstrate better survival if the elapsed time between the traumatic injury and admission to the operating theatre is minimized.(8)

The extent of traumatic haemorrhage must be clinically assessed. An evaluation of the mechanism of injury (for example, blunt versus penetrating trauma) is a useful tool for determining which patients are candidates for surgical bleeding control. This type of grading system may be useful in the initial assessment of bleeding. The initial assessment can also assist in determining the next patient management goal to minimize blood loss and achieve haemodynamic stability.[3]

Hyperventilation or the use of excessive positive end-expiratory pressure (PEEP) is not suggested when ventilating severely hypovolaemic trauma patients .

There is a tendency for rescue personnel to hyperventilate patients during resuscitation[9], and hyperventilated trauma patients appear to have increased mortality when compared with non-hyperventilated patients.[10] The experimental correlates in animals in haemorrhagic shock may be an increased cardiac output in hypoventilated pigs[11] and a decrease in cardiac output due to 5 cm PEEP in rats . In contrast, the elimination of PEEP and, to an even greater extent, negative expiratory pressure ventilation increases cardiac output and survival of rats in haemorrhagic shock.[12]

Patients presenting with haemorrhagic shock and an identified source of bleeding must undergo an immediate bleeding control procedure unless initial resuscitation measures are successful .

The source of bleeding may be immediately obvious, and penetrating injuries are more likely to require surgical bleeding control. In a retrospective study of 106 abdominal vascular injuries, all 41 patients arriving in shock following gunshot wounds were candidates for rapid transfer to the operating theatre for surgical bleeding control. A similar observation in a study of 271 patients undergoing immediate laparotomy for gunshot wounds indicates that these wounds combined with signs of severe hypovolaemic shock specifically require early surgical bleeding control. This observation is true to a lesser extent for abdominal stab wounds.[13]

Patients presenting with haemorrhagic shock and an unidentified source of bleeding must undergo immediate further assessment.
A patient in haemorrhagic shock with an unidentified source of bleeding should undergo urgent clinical assessment of chest, abdominal cavity, and pelvic ring stability using focused abdominal sonography in trauma (FAST) assessment of thorax and abdomen and/or computerised tomography (CT) examination.[3]

Early FAST must be done for the detection of free fluid in patients with suspected torso trauma .
Patients with significant free intraabdominal fluid according to sonography (FAST) and haemodynamic instability must undergo urgent surgery.[3]
Liu and colleagues conducted a one year prospective comparison on the diagnostic accuracy of CT scan, diagnostic peritoneal lavage (DPL), and sonography in 55 adult patients with blunt abdominal trauma. The authors found a high sensitivity (0.92), specificity (0.95), and accuracy (0.93) of initial FAST examination for the detection of haemoperitoneum. Although CT scan and DPL were shown to be more sensitive (1.0 for DPL, 0.97 for CT) than sonography for detection of haemoperitoneum, these diagnostic modalities are more time-consuming (CT and DPL) and invasive (DPL).[14]
A number of patients who present free intra-abdominal fluid according to FAST can safely undergo further investigation with multi-slice spiral computed tomography (MSCT). Under normal circumstances, adult patients need to be haemodynamically stable when MSCT is performed outside of the emergency room. In the retrospective study of 1,540 patients (1,227 blunt, 313 penetrating trauma) who were assessed early with FAST, a successful non-operative management was achieved in 24 (48%) of the 50 patients who were normotensive on admission and had true positive sonographic examinations. These results justified an MSCT scan of the abdomen rather than an immediate exploratory laparotomy.[15]