PERIOPERATIVE MANAGEMENT OF PATIENTS WITH SEVERE SEPSIS

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Anesthetists' role in severe sepsis management

A central role in the multidisciplinary management of patients with severe sepsis from their initial deterioration at ward level, transfer to the diagnostic imaging suite, intraoperative management for emergency surgery and postoperative care

Epidemiology

- Severe sepsis occurs in 1–2% of all hospitalizations and accounts for as much as 25% of intensive care unit (ICU) bed utilization

- It is common in elderly, immunocompromised, and critically ill patients and is a major cause of death in ICUs worldwide

The epidemiology of sepsis in the United States from 1979 through 2000. N Engl J Med 2003; 348: 1546–54

Causes of SIRS

Infections are common
& amenable to treatment

actively sought&controled

Infective causes	Non-infective causes
CNS infections	Severe trauma
CVS infections	Haemorrhage
Respiratory infections	Complication of surgery
Renal infections	Complicated aortic aneurysm
GIT infections	Myocardial infarction
Skin and soft tissue infections	Pulmonary embolism
Bone and joint infections	Cardiac tamponade
	Subarachnoid haemorrhage
	Burns
	Acute pancreatitis
	Drug overdose/toxicity
	Diabetic ketoacidosis
	Adrenal insufficiency
	Anaphylaxis

Community-acquired infections in previously well patients are easier to recognize than nosocomial infections in debilitated hospitalized patients

BJA2010,105 (6): 734–43

Severe sepsis → sepsis-induced tissue hypoperfusion or organ dysfunction

Sepsis-induced hypotension
Lactate above upper limits laboratory normal
Urine output < 0.5 mL/kg/hr for more than 2 hrs despite adequate fluid resuscitation
Acute lung injury with Pao_2/Fio_2 < 250 in the absence of pneumonia as infection source
Acute lung injury with Pao_2/Fio_2 < 200 in the presence of pneumonia as infection source
Creatinine > 2.0 mg/dL (176.8 μmol/L)
Bilirubin > 2 mg/dL (34.2 μmol/L)
Platelet count < 100,000 μL
Coagulopathy (international normalized ratio > 1.5)

Crit Care Med 2013; 41:580–637

Preoperative assessment

- It is prudent to examine patients systematically looking for a source of infection
  - → self-evident (e.g. trauma, burns)
  - → difficult to identify (e.g. empyema of the gall bladder, pancreatitis)
- The examination should focus on…
  - The severity of SIRS
  - The state of intravascular hydration
  - The presence of shock or multi-organ dysfunction
  - The adequacy of hemodynamic resuscitation

SURVIVING SEPSIS CAMPAIGN BUNDLES

TO BE COMPLETED WITHIN 3 HOURS:
1) Measure lactate level
2) Obtain blood cultures prior to administration of antibiotics
3) Administer broad spectrum antibiotics
4) Administer 30 mL/kg crystalloid for hypotension or lactate ≥4mmol/L

TO BE COMPLETED WITHIN 6 HOURS:
5) Apply vasopressors (for hypotension that does not respond to initial fluid resuscitation) to maintain a mean arterial pressure (MAP) ≥ 65 mm Hg
6) In the event of persistent arterial hypotension despite volume resuscitation (septic shock) or initial lactate ≥4 mmol/L (36 mg/dL):
   - Measure central venous pressure (CVP)*
   - Measure central venous oxygen saturation ($Scvo_2$)*
7) Remeasure lactate if initial lactate was elevated*

*Targets for quantitative resuscitation included in the guidelines are CVP of ≥8 mm Hg, $Scvo_2$ of ≥70%, and normalization of lactate.

Crit Care Med 2013; 41:580–637

Antibiotic therapy

- Appropriate samples should be obtained for culture then **antibiotics** should be started as early as possible
- The choice of agents should be based on..
  - clinical history
  - physical examination
  - likely pathogen(s)
  - optimal penetration of anti-microbial drugs into infected tissues
  - the local pattern of sensitivity to anti-microbial agents

Hemodynamic resuscitation

- The objective of preoperative resuscitation measures is to rapidly restore adequate oxygen delivery to peripheral tissues
- Unstable septic patients..
  - invasive arterial pressure monitoring
  - central venous access
  - ICU admission

The first 6 h of resuscitation of septic patients, the so-called 'golden hours', are crucial and frequently coincide with the time for 'emergency surgery'

Goal-directed therapy: a summary of clinical targets

Clinical parameter	Goal
Central venous pressure	8–12 mm Hg (≥8 mm Hg in spontaneously breathing patient, ≥12 mm Hg in ventilated patients)
Mean arterial pressure	Between 65 and 90 mm Hg
Central venous oxygen saturation	≥70 mm Hg
Urine output	≥0.5 ml kg^{-1} h^{-1}
Haematocrit	≥30%

BJA2010,105 (6): 734–43

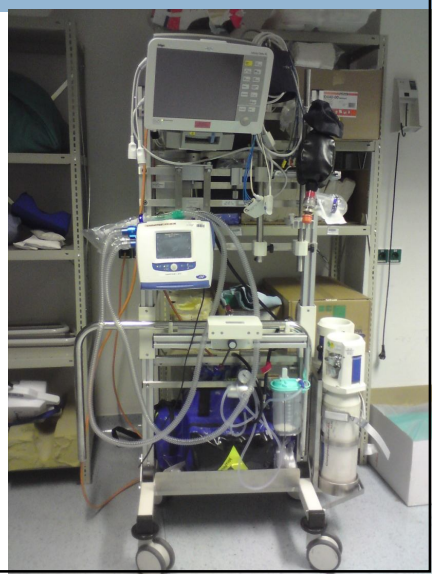
Hemodynamic resuscitation

- **Colloid** with pentastarch therapy was associated with higher rates of acute renal failure and renal replacement therapy than Ringer's lactate
- **Vasopressor** support with norepinephrine may be considered even before optimal i.v. fluid loading has been achieved
- **Inotropes** are added to volume resuscitation and vasopressors, if there is evidence of continued low cardiac output despite adequate fluid resuscitation

Resuscitation efforts should be continued as long as haemodynamic improvement

Diagnostic imaging

- If diagnostic imaging studies are considered appropriate, it is important that all other therapeutic measures are continued in a comprehensive manner



Source control

- The immediate goal is to achieve adequate control of the source of infection with the least physiological embarrassment
- Source control intervention may cause further complications
- In some patients, immediate surgery or within 1–2 h of presentation (e.g. upper airway infections, necrotizing fasciitis) is lifesaving

Postoperative management of patients with severe sepsis

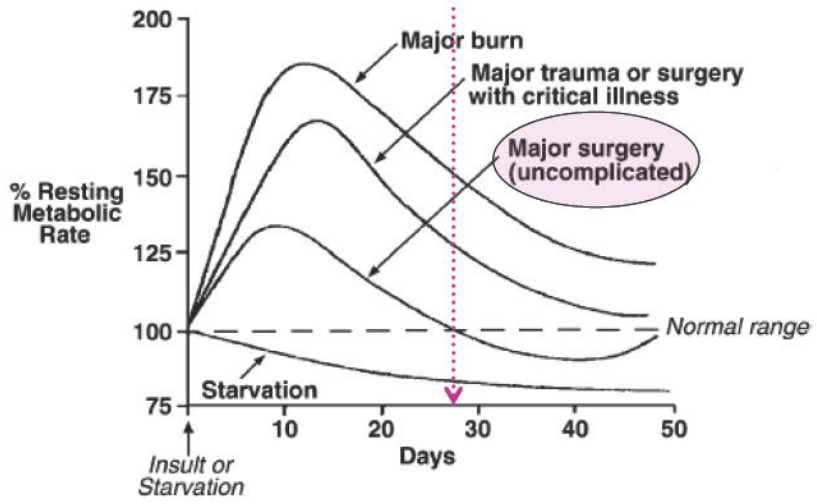
- Ongoing infusions of vasopressor medication should be adjusted to match the present intravascular volume and the new mechanical ventilator settings
- Minimizing ventilation-induced volutrauma and barotraumas to the lungs→low-pressure settings
- Antimicrobial therapy, which was started before operation, should be continued in the ICU

Postoperative management of patients with severe sepsis

Nutrition

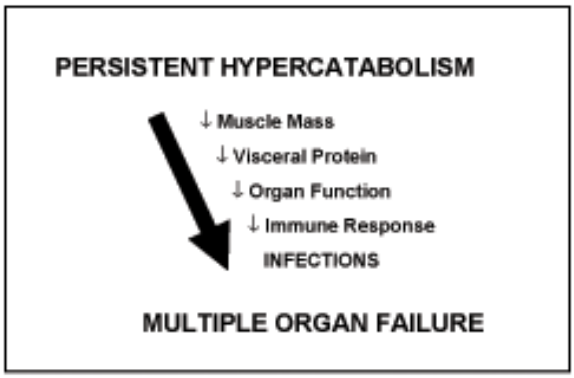
- Enteral nutrition via a nasogastric tube is the best choice to maintain enterocyte integrity and nourish the patient
- Stress ulcer prophylaxis and antiemetic drugs are also prescribed
- Total parenteral nutrition (TPN) should be considered if there is a surgical contraindication to enteral nutrition
- Patients may become rapidly hypoglycaemic if TPN or enteral nutrition is stopped during the perioperative period

To meet this increased metabolic demand, endogenous substrates are mobilized



Injury stress response increases Resting Energy Expenditure (REE)

NUTRITION FOR PREVENT ACUTE PROTEIN MALNUTRITION



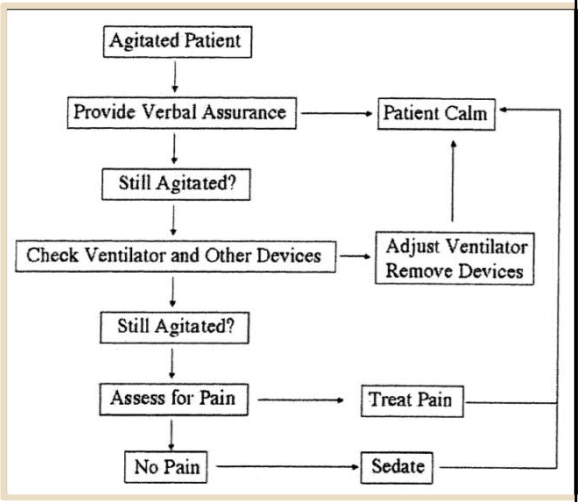
Role of persistent hypercatabolism

Postoperative management of patients with severe sepsis

- Acute renal failure occurs in 23% of patients with severe sepsis
- Renal replacement therapy may be initiated to correct acidosis, hyperkalaemia, or fluid overload and may be continued until acute tubular necrosis has recovered
- Continuous renal replacement may be more practical in hemodynamic unstable patients

Postoperative management of patients with severe sepsis

- Analgesia and sedative medication is continued by infusion
- But excessive use of sedation or neuromuscular blocking agents is not recommended



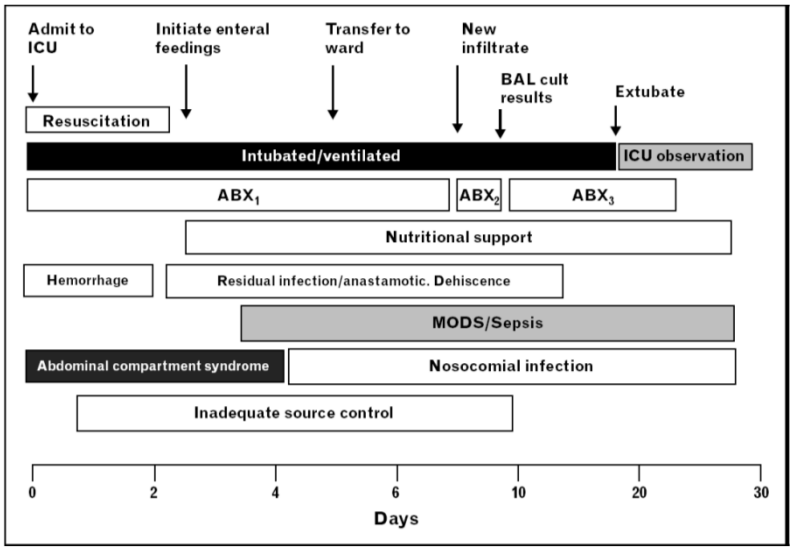
Monitoring of sedation

Table 1. Ramsay sedation score criteria

1. Patient anxious and agitated or restless or both
2. Patient cooperative, oriented, and tranquil
3. Patient responds to commands only
4. Patient asleep, shows brisk response to light glabellar tap or loud auditory stimulus
5. Patient asleep, shows sluggish response to light glabellar tap or loud auditory stimulus
6. Patient asleep, shows no response to light glabellar tap or loud auditory stimulus

Adjust the sedative dose to achieve adequate but not excessive sedation

postoperative conditions



Current Opinion in Critical Care 2006, 12:333–339

Considerations in Critically Ill Surgical Patients

THE ENDOCRINE RESPONSE

Glucagon & Insulin response to injury can lead to major changes in glucose metabolism →close monitoring of blood glucose, electrolytes, & acid-base status

Control of blood sugar has been shown to improve outcome in surgical ICU patients

ANTIDIURETIC HORMONE & ALDOSTERONE

Blood loss, pain, fasting, nausea or vomiting→predispose the surgical patient to release of ADH & aldosterone

↓

sodium & water retention

↓

difficult to monitor the state of hydration of the patient by relying entirely on urine volumes

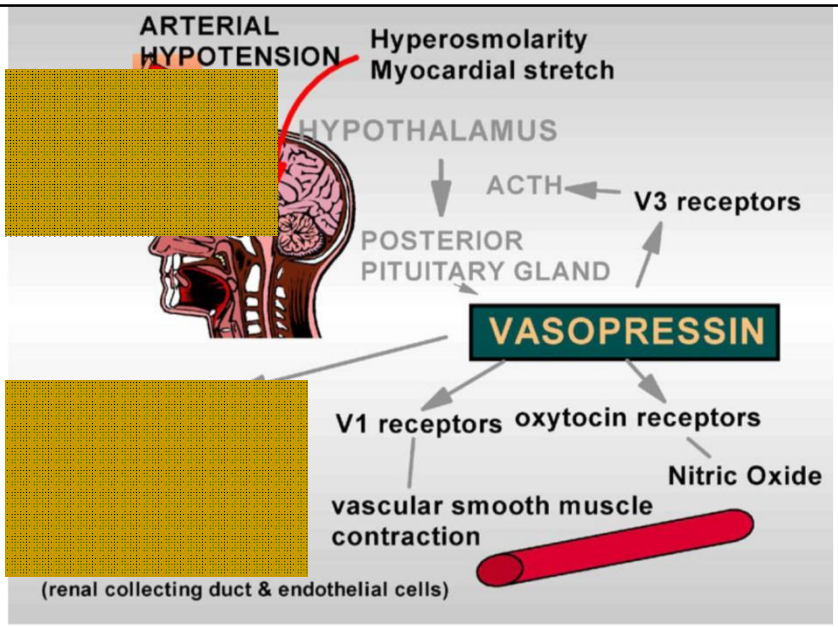


Fig. 1. Schematic representation of key factors involved in regulation and secretion of endogenous vasopressin.

Crit Care Clin 22 (2006) 187– 197

SIADH is relatively common in the postoperative period

water intoxication & severe hyponatremia

Treatment is guided by frequent routine monitoring of electrolytes & fluid volume status

THIRD-SPACE FLUID SEQUESTRATION

Extravascular fluid may accumulate in the interstitial & intracellular spaces, as well as in the retroperitoneal space & gut during intraabdominal manipulation

- ❑ not easily measured by clinical
- ❑ close titration of fluid balance is crucial
- ❑ central hemodynamic monitoring may be required

HYPERCOAGULABLE STATE

Necessitates monitoring of clotting parameters in the surgical patient

The institution of prophylactic measures against thromboembolic sequelae

MAGNITUDE & DURATION OF SURGICAL INSULT

Affect the intensity of the metabolic and endocrine response

In the multiply-injured patient requiring massive blood transfusions that can lead to hypothermia, coagulopathy, and severe cardiorespiratoryandrenal compromise

"damage-control laparotomy"

Abdominal compartment syndrome

Damage Control

Novel management strategy designed to abbreviate operative times (avoid hypothermia, acidosis, and coagulopathy) for injured patients with nearly exsanguinating hemorrhage

An era of new management problems for the saved patients

↓

Intra Abdominal Hypertension (IAH)

Intra-Abdominal Pressure & Intra-Abdominal Hypertension

- Normal intraabdominal pressure (IAP) is 5 - 7 mmHg
- The upper limit of IAP is generally accepted to be 12 mm Hg (obesity & COPD)
- IAH may be divided into 4 grades
  - grade I (12–15 mmHg)
  - grade II (16–20 mmHg)
  - grade III (20–24 mmHg)→ ± ARF
  - grade IV (>25 mmHg)

Intra-vesical Pressure Monitoring

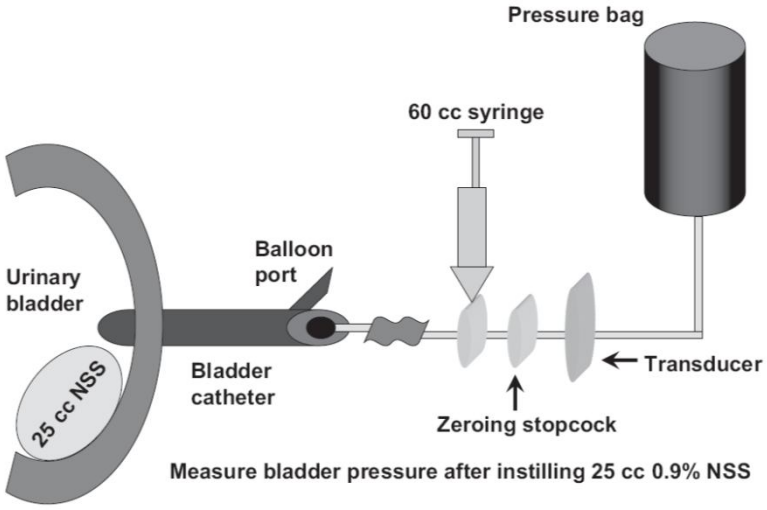


Figure 1. The intravesical method of monitoring intra-abdominal pressure. *NSS*, normal saline solution.

Crit Care Med 2008; 36[Suppl.]:S212–S215

Abdominal Perfusion Pressure

= Mean Arterial Pressure - IAP

(normal = 60 mmHg)

Abdominal Compartment Syndrome

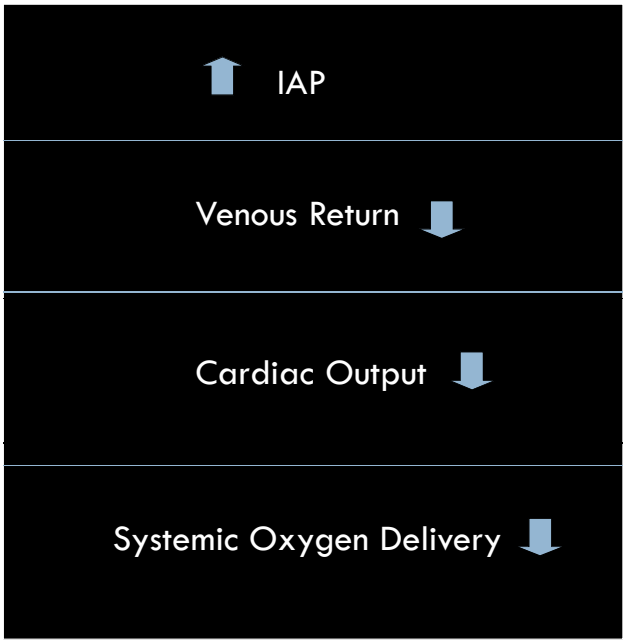
A sustained IAP > 20 mm Hg

& abdominal perfusion pressure < 60 mm Hg

+ a new & attributable organ dysfunction or failure

Table 1. Abdominal compartment syndrome–associated signs and organ failures

Hypovolemic shock
Systolic hypotension, narrow pulse pressure, lactic acidosis, tachycardia
Increased core to peripheral temperature gradient, weak pulses
Abnormal mentation
Acute kidney injury/acute renal failure
Oliguria, increased serum creatinine
Acute respiratory failure (new or worsened if pre-existing)
Hypoxia and hypercarbia
Increased peak airway pressures (volume cycled ventilation)
Decreased resultant tidal volumes (pressure-cycled ventilation)
Decreased release volumes (airway pressure release ventilation)
Acute hepatic failure
Increased liver function tests
Jaundice, coagulopathy



Tissue edema from extravascular organ water

↓

↑ distance from capillary beds to metabolically active cells

↓

further cripples organ metabolic integrity

This viscous cycle compromises organ viability

Renal Injury

	GFR criteria	Urine output criteria
Risk	Serum creatinine increased 1·5 times	<0·5 mL kg^{-1} h^{-1} for 6 h
Injury	Serum creatinine increased 2·0 times	<0·5 mL kg^{-1} h^{-1} for 12 h
Failure	Serum creatinine increased 3·0 times or creatinine=355 µmol/L when there was an acute rise of >44 µmol/L	<0·3 mL kg^{-1} h^{-1} for 24 h or anuria for 12 h
Loss	Persistent acute renal failure; complete loss of kidney function for longer than 4 weeks	
End-stage renal disease	End-stage renal disease for longer than 3 months	

GFR=glomerular filtration rate.

Table 1: RIFLE classification[4]

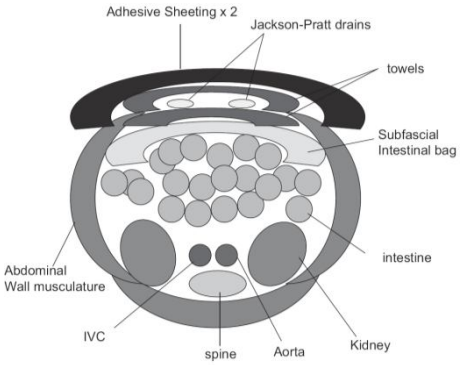
Bellomo R, Ronco C, Kellum JA:Crit Care 2004; 8:204–212

Once IAH and the ACS have led to oliguria, no amount of fluid resuscitation reverses the renal injury

Therapeutic Interventions

Decompressive laparotomy with temporary abdominal wall closure

⬆ peritoneal space & ⬇ the intraabdominal pressure to normal level



Crit Care Med 2008; 36[Suppl.]:S212–S215

Respiratory distress in ICU

Mr. Somchai…..

- It's 1:10 a.m. on New Year Day. A new nurse & her instructor are taking care of Mr. Somchai, who had an emergent exploratory laparotomy for a bowel obstruction.
- During the new nurse's post-op assessment, Mr. Somchai's blood pressure (BP) is 80/43. (prior to surgery it was 102/50)

Mr. Somchai…..

- New nurse "How are you feeling?"
- Mr. Somchai replies, "I don't feel so well &difficult breath in.Please call my wife to come in."
- The nurses become more concerned about Mr. Somchai as he slowly exhibits signs of rapid deterioration. His extremities are noticeably mottled, he's breathing rapidly(RR 30), and his BP is 80/40.
- The instructor asks the new nurse to stat call the doctor

Mr. Somchai…..

- The doctor (by phone)

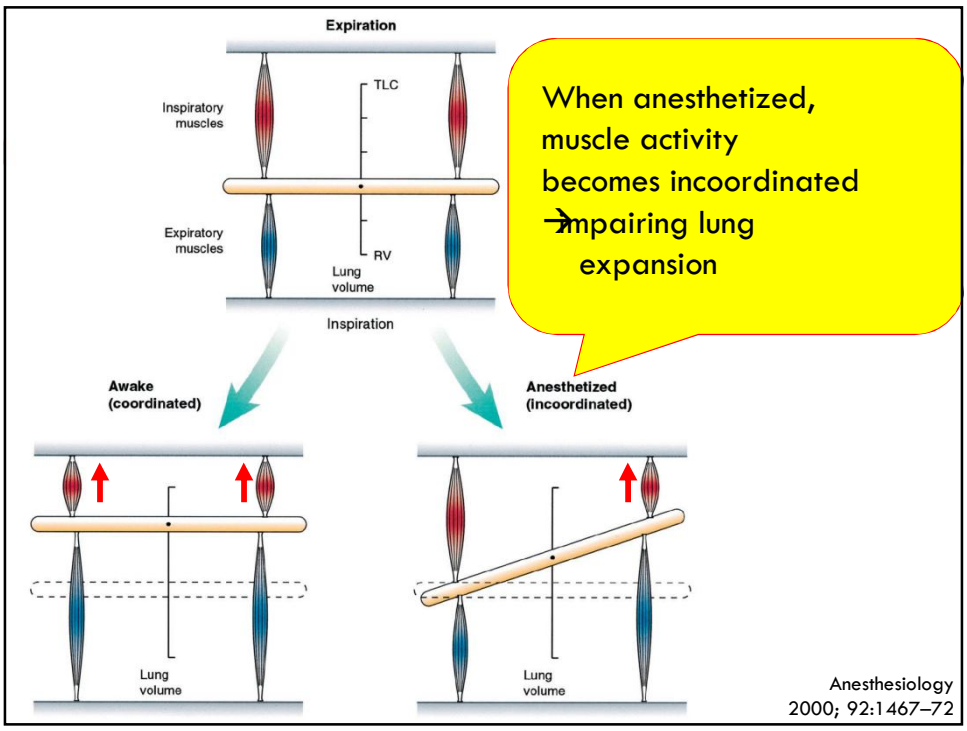
  "Give 1 liter of normal saline at 250 mL/hr & recheck vital signs"
- Mr. Somchai continues to deteriorate rapidly and soon codes.

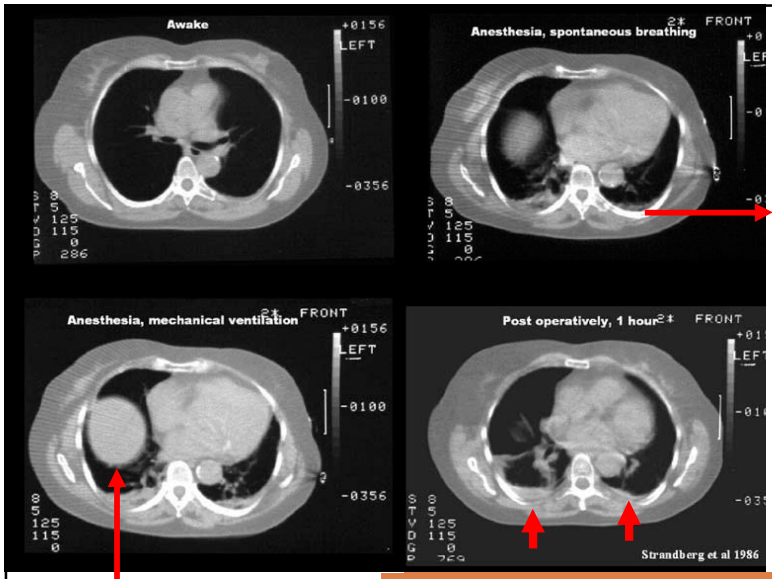
Is the above situation all too familiar?

Warning signs in the form of physiologic instability!!

- Tachypnea
- Decreased oxygen saturation
- Tachycardia
- Hypotension
- Changes in conscious state

if abnormal physiology is identified & corrected, outcome may improve

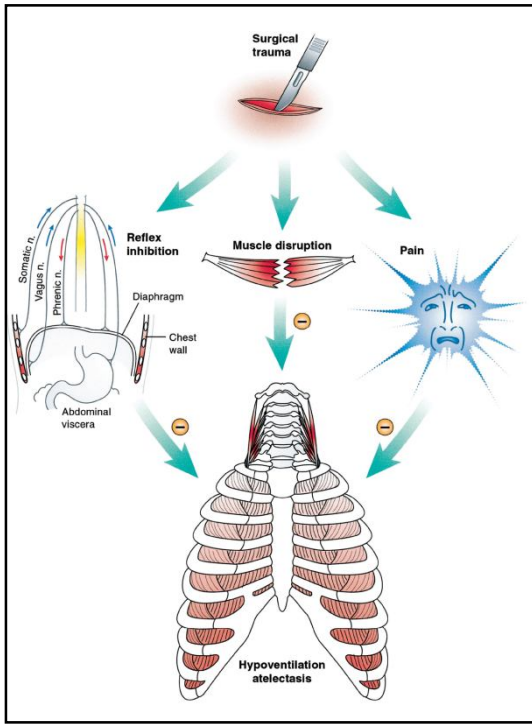




atelectasis

diaphragm & liver

regions of atelectasis develop in nearly all patients after a few minutes of anesthesia



Factors producing respiratory muscle dysfunction :

(1) surgical trauma stimulates CNS →produce reflex inhibition of the phrenic and other nerves innervating respiratory muscle

(2) mechanical disruption of respiratory muscles impairs efficiency

(3) pain produces voluntary limitation of respiratory motion

Anesthesiology 2000; 92:1467–72

Oxygenation failure

- Altered conciousness
- Arrhythmia, BP
- Diaphoresis
- Cyanosis
- Refractory hypoxemia
  - $FiO_2 > 0.5$ and $SaO_2 < 90\%$

Ventilatory failure

- Respiratory distress
  - บ่นเหนื่อย ร่วมกับ vital signs change,พูดไม่ได้
- Impending failure
  - RR > 35 /min + respiratory paradox ,alternan
- Acute CO_2 retention
  - $PaCO_2 > 50$ mmHg ร่วมกับ pH < 7.3
- Bradyspnea or respiratory arrest

Prevention of respiratory failure

- To prevent or reverse atelectasis
  - eg. postoperative
- To prevent ventilatory muscle fatigue
  - eg. severe sepsis, acidosis
- To stabilize the chest wall
  - eg.large flail chest

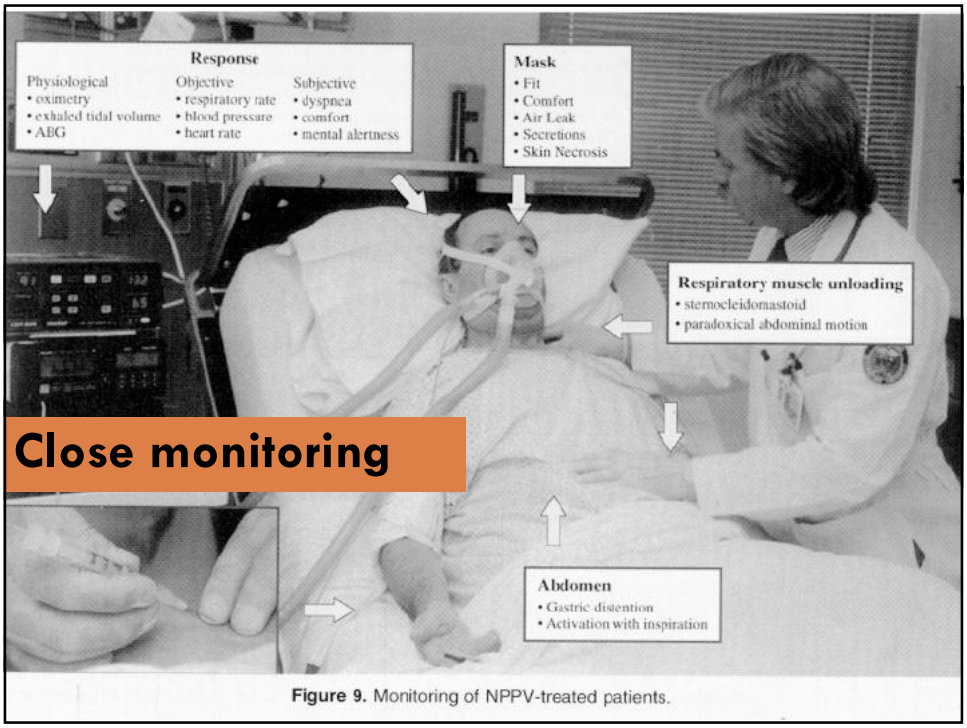


Figure 9. Monitoring of NPPV-treated patients.

Monitoring of NIV for ARF

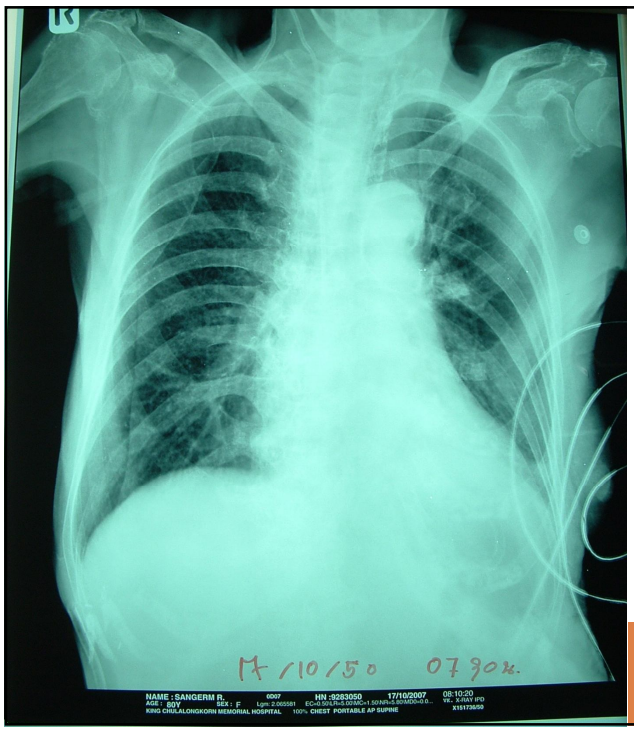
- **Subjective**
  - Mask comfort
  - Tolerance of ventilator settings
  - Respiratory distress
- **Physical findings**
  - Respiratory rate
  - Other vital signs
  - Accessory muscle use
  - Abdominal paradox
- **Ventilator parameters**
  - Air leaking
  - Adequacy of pressure support
  - Adequacy of PEEP
  - Tidal volume (5–7 mL/kg)
  - Patient-ventilator synchrony
- **Gas exchange**
  - Continuous oximetry (until stable)
  - ABGs, baseline and 1–2 hrs, then as indicated
- **Location**
  - Usually ICU or respiratory care unit to start
  - General ward may be OK if patient stable
  - Depends on monitoring needs of patients and monitoring capabilities of unit

Crit Care Med 2007; 35:2402–2407

Atelectasis occurs when alveolar closing volume rises above FRC (is rarely due to proximal airway obstruction by mucus)

Bronchoscopy for atelectasis

Critically ill patients with acute whole lung, lobar, or segmental atelectasis without air bronchograms who are unable to maintain airway hygiene independently and remain symptomatic after 24 hours of aggressive chest physiotherapy(Q 4 hrs)



80 year old female patient with underlying Parkinson dis. undergoing free flap operation at right side of face

Post operation day 2

Dyspnea

& tachycardia

Post operation day 4

Reintubation

& suction

Post operation day 4

Post bronchoscopy for suctioning through ET tube

Post operation

day 5

Strength of the Evidence for Specific Interventions To Reduce the Risk for PPCs

Risk Reduction Strategy	Strength of Evidence*	
Postoperative lung expansion modalities	A	good evidence
Selective postoperative nasogastric decompression	B	fair evidence
Short-acting neuromuscular blockade	B	
Laparoscopic (vs. open) operation	C	may reduce PPCs
Smoking cessation	I	insufficient evidence
Intraoperative neuraxial blockade	I	
Postoperative epidural analgesia	I	
Immunonutrition	I	
Routine total parenteral or enteral nutrition†	D	not reduce PPCs
Right-heart catheterization	D	

Ann Intern Med. 2006;144:596-608

The quality of patient care in the ICU

Protocols

- enhancing the efficiency, safety, & efficacy of care; enabling research; & facilitating education

Checklists

- routinely used to improve safety

Physicians' rounds

- daily rounds at the bedside by intensivists may result in better outcomes

PILOT VS. INTENSIVIST

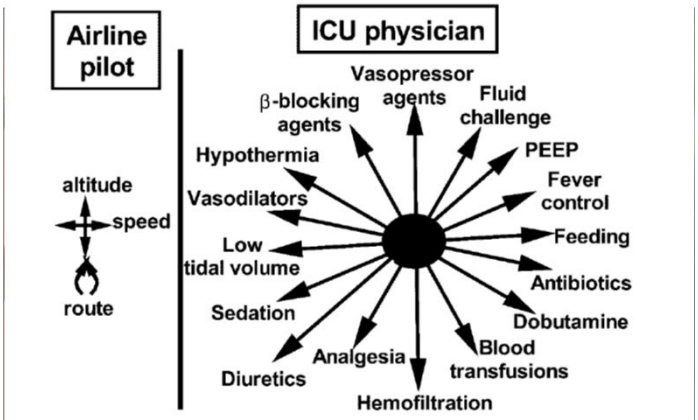


Figure 1. Simplified comparison of the complexities of the intensive care unit (*ICU*) physician's options and those of the airline pilot. *PEEP*, positive end-expiratory pressure.

Fast Hug approach

Table 1. The seven components of the Fast Hug approach

Component	Consideration for Intensive Care Unit (ICU) Team
Feeding	Can the patient be fed orally, if not enterally? If not, should we start parenteral feeding?
Analgesia	The patient should not suffer pain, but excessive analgesia should be avoided
Sedation	The patient should not experience discomfort, but excessive sedation should be avoided; "calm, comfortable, collaborative" is typically the best level
Thromboembolic prevention	Should we give low-molecular-weight heparin or use mechanical adjuncts?
Head of the bed elevated	Optimally, 30° to 45°, unless contraindications (e.g., threatened cerebral perfusion pressure)
Stress Ulcer prophylaxis	Usually H_2 antagonists; sometimes proton pump inhibitors
Glucose control	Within limits defined in each ICU

Useful to anybody working in an ICU

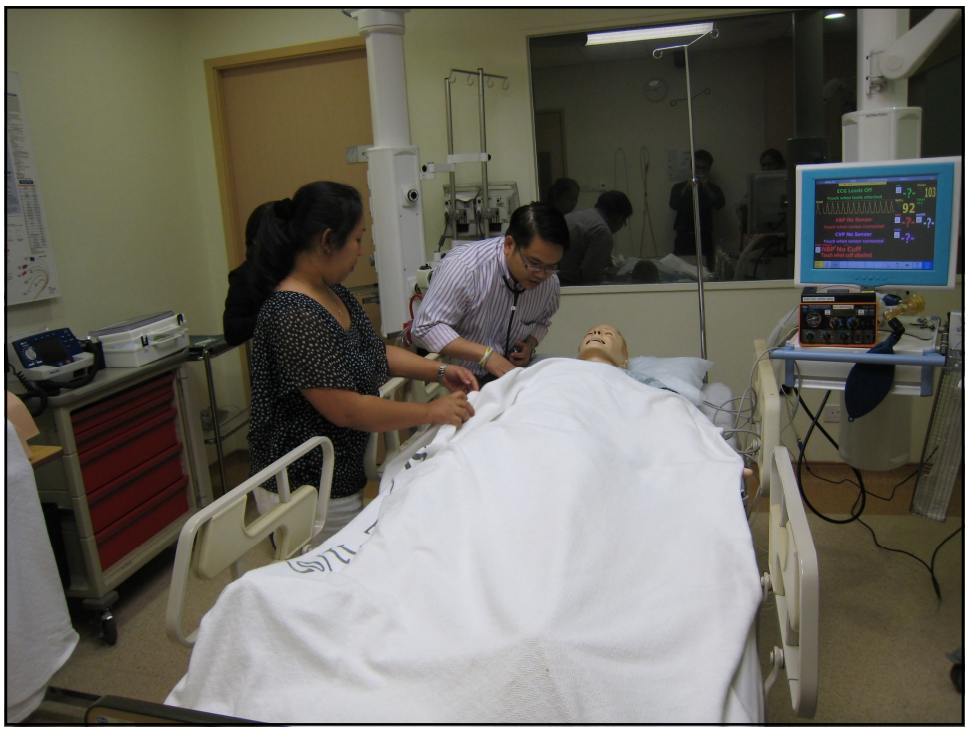
Jean-Louis Vincent :Crit Care Med 2005; 33:1225–1229

The complexity of transforming accepted clinical science into routine clinical practice!!

Critical care simulation

:recreates the essence of real emergencies where patient management is not only a test of individual knowledge but also one of knowledge application and teamwork

Goal :to develop objective measures of both knowledge-based skill and teamwork performance in the management of sepsis

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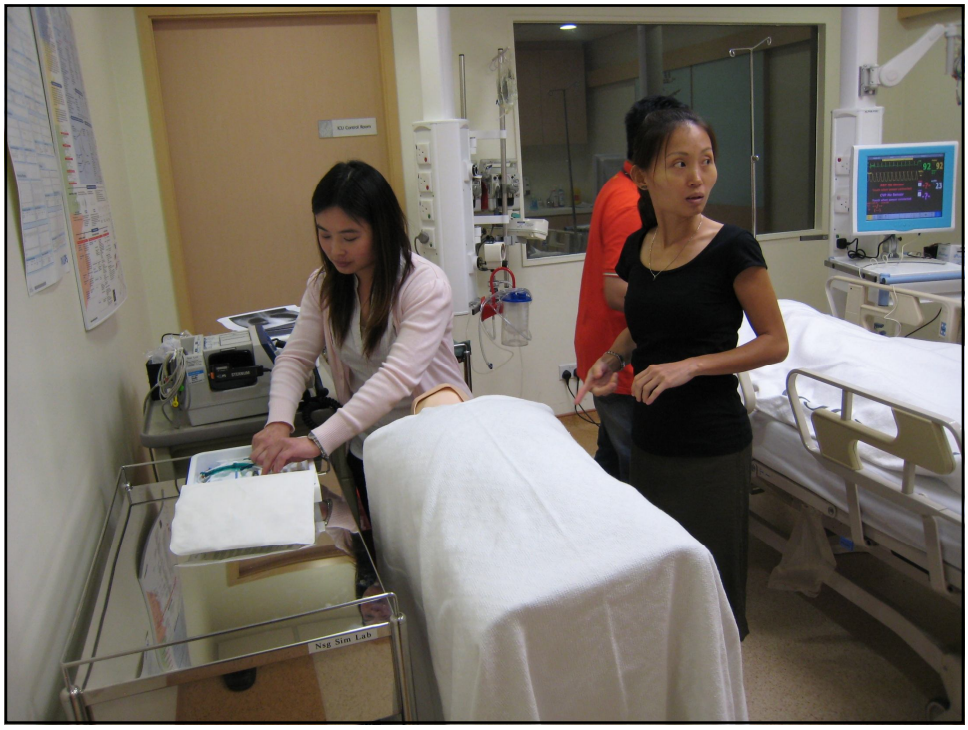
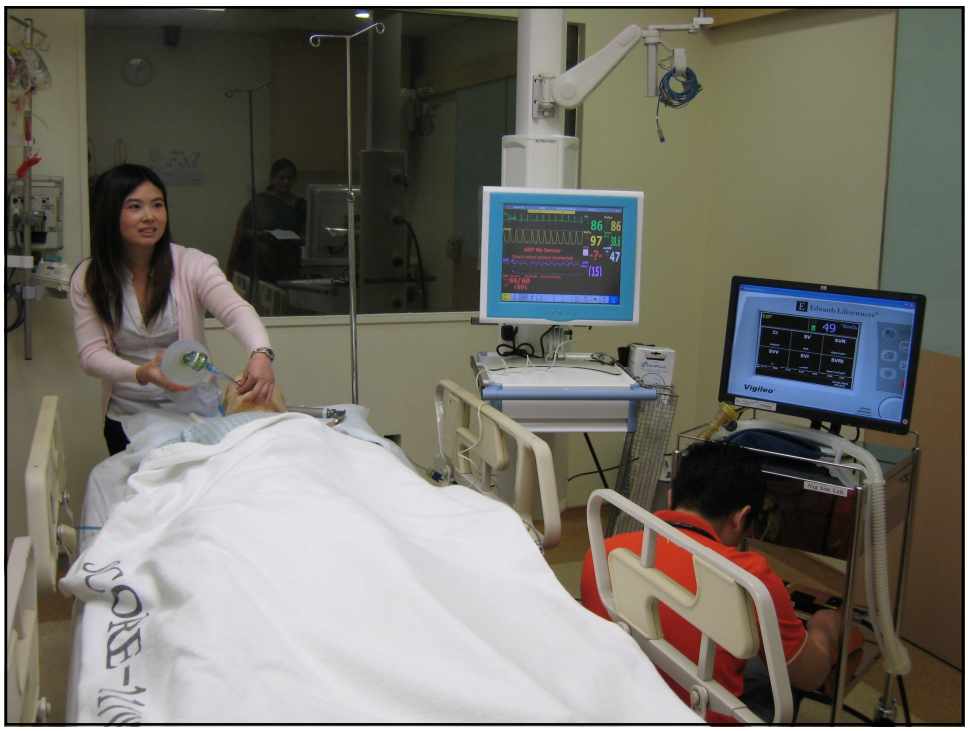

Nsg Sim Lab


Edwards Lifesciences
Vigileo

Conclusions

The anesthetist has a crucially important role in coordinating and delivering resuscitation and therapeutic strategies to optimize patient survival outcome…

- ❑ Early i.v. effective antimicrobial therapy is essential
- ❑ Preoperative resuscitation
- ❑ Intraoperative management→ careful induction of anesthesia, optimal volume status, avoidance of lung injury, ongoing monitoring of ABG and hematological indices
- ❑ Postoperative care overlaps with ongoing management of the severe sepsis syndrome patient in the ICU

ขอบคุณและสวัสดีครับ