

Perioperative Care of the ICU Patient: Things You Need to Know

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Objectives

- Describe the various modes of mechanical ventilation
- Review the commonly used anticoagulants and their reversal prior to the OR
- Review the management of enteral and parenteral nutrition and glycemic control
- Discuss the ethical impact of DNR's, directives, and end-of-life care

Disclosures

I have nothing to disclose,

"I'm only here so that I don't get fined." -Marshawn Lynch

A photograph of Marshawn Lynch, a professional football player, wearing a blue and white jacket and a white cap, sitting at a press conference.

History of Mechanical Ventilation

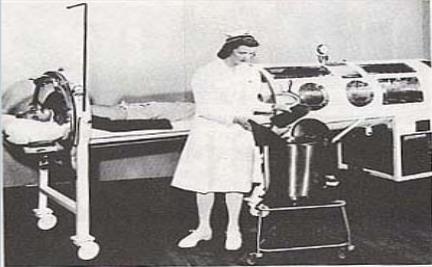
...mouth to mouth inflation of the victim's might be preferable to using a pair of bellows as "the lungs of one man may bear, without injury, as great a force as another man can exert; which by the bellows cannot always be determined..."

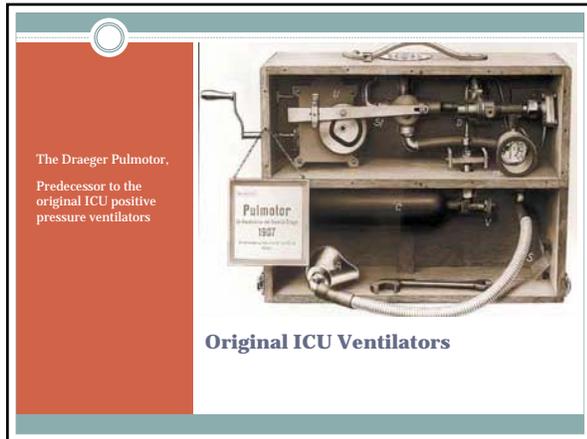
-John Fothergill, *Treatise on Resuscitation*, 1745

The ICU Patient

A photograph of a patient lying in a hospital bed in an intensive care unit (ICU). The patient is surrounded by various medical equipment, including monitors, IV stands, and a ventilator.

The Iron Lung 1931-1956

A black and white photograph of a woman in a white dress standing next to an iron lung. The iron lung is a large, cylindrical metal device used to provide mechanical ventilation to patients with polio.



Begin at the Beginning

- A **'mode'** of mechanical ventilation simply defines a sequence of breath **types** and the **timing** of those breaths

Mechanical Ventilation The then...

- Volume Control (VC)
- Pressure Control (PC)
- AC or CMV
- SIMV
- PSV

Basic Ventilator Lingo

- Volume
- Pressure
- Flow
- Trigger
- Limit
- Cycle

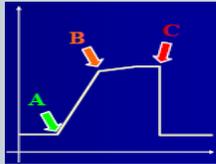
Mechanical Ventilation ...the Now (Ventilator Alphabet Soup)

- AC, CMV, PC, VC, PSV, IMV, SIMV
- VC+, PRVC, VS, APV, APRV, HFV
- BiPAP, CPAP, PS, ATC, PEEP
- OMG, WT...!!

Basic Ventilator Modes

- **Trigger: what the machine senses to initiate a breath**
 - Time: a time interval passes
 - Patient: flow, pressure
- **Limit: what limits the breath**
 - Pressure
 - Flow
- **Cycle: what terminates the breath and cycles the breath into expiration**
 - Time, pressure, volume
 - Flow

Breath characteristics



A= what initiates a breath - **TRIGGER**
 B = what controls / limits it - **LIMIT**
 C= What ends a breath - **CYCLING**

Vent modes

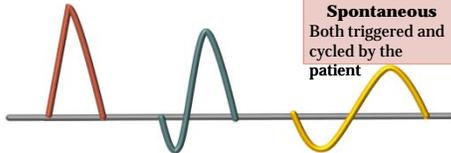
- No proven mortality benefit of one over another
- Mostly chosen for individual patient goals and to optimize synchrony
- Some might be more sensible for ARDS or “lung-protective” ventilation

Breath types

Control/Mandatory
 Machine triggered and machine cycled

Assisted
 Patient triggered but machine cycled

Spontaneous
 Both triggered and cycled by the patient



Preparation for the OR

- How is the lung compliance?
- How is the oxygenation (FiO₂, PaO₂, P/F, PEEP)?
- How is the ventilation (pH, pCO₂)
- Will they tolerate transport to the OR?
- Do they require an ICU ventilator
- Consultation with the ICU team or a Respiratory Therapist

VENTILATOR MODE	INITIATED	LIMITED	CYCLED
VC	Time	Volume	Volume/time
PC	Time	Pressure	Time
PRVC	Time	Volume	Volume
PS	Pressure/flow	Pressure	Flow
VS	Pressure/flow	Volume	Flow
CPAP	Pressure/flow	Pressure	Flow
SIMV	Time/pressure/flow	Volume	Volume/time

Some Words About Nutrition and Glycemic Control

- **What we know**
 - Malnutrition is associated with poor clinical outcomes
 - Critically ill patients are at high “nutritional risk”
- **What we do not know**
 - How to screen ICU patients for malnutrition
 - Anthropometry, screening tools, body composition are very unreliable in these patients
- **New Tools**
 - NUTRIC score
 - CT
 - Bedside ultrasound of quadriceps muscle

Nutrition Goals

- **Early enteral nutrition (EN)**
 - Start within 24 hours
 - Functional GI tract
 - Gastric or Jejunal access
- **Barriers:**
 - Delayed placement of feeding tubes
 - Interruptions for transport or procedures
 - (typical 2 week ICU stay interruptions = 8% protein deficit)
 - Protocolized feeding strategies result in greater days of EN compared to standard clinician guided feeding
- **Post pyloric feeding has not been shown to reduce nosocomial infection and prevent aspiration, although best practice recommendations favor it**

Parenteral Nutrition

- **Severely malnourished patients**
- **GI dysfunction for more than 5-7 days**
- **EN is contraindicated**
- **A combination of EN with supplementation by PN may be useful and well tolerated**

*Try to avoid disruption, disconnection, or contamination of the PN for operative procedures

Gastric Residual Volumes

- **Randomized studies to compare GRV of 500cc vs. 200cc have not shown a major difference in VAP, duration of MV, or ICU LOS**
- **Not monitoring GRVs is likely not inferior to routine measuring**
- **Most institutions: GRV between 300cc and 500cc every 4-6 hours as a cutoff for EN tolerance**

Glycemic Control

- **The optimal target blood glucose in ICU patients remains unclear**
- **The landmark study by Van den Berghe et al suggested that tight glycemic control (target of 81-108 mg/dL) would benefit patients and this theory was widely adopted**

Parenteral Nutrition

- **For a long time we believed that parenteral nutrition (PN) was bad (infection, overfeeding, organ dysfunction, mortality)**
- **Recent and emerging evidence does not suggest that**
 - Quality of the lipid emulsion
 - Central line care
 - Glucose management
 - Evaluation of organ dysfunction

Glycemic Control

- **A meta-analysis by Wiener et al published in JAMA in 2008 showed that tight glycemic control did not alter mortality in critically ill adults**
 - Patients assigned to the intensive glycemic control group had lower glucose levels, received more insulin, and had more episodes of hypoglycemia
- **The NICE-SUGAR trial published in the NEJM in 2009 suggested that tight glycemic control does not benefit critically ill patients and may actually be harmful**
 - Had more statistical power and longer follow up than the studies included in the meta-analysis

Glycemic Control The Bottom Line

- A blood glucose target of less than **180 mg/dL** may be associated with a lower mortality than tight glycemic control and is less likely to be associated with hypoglycemic events

Reversing Anticoagulants

- UFH: can be completely reversed with protamine
- LMWH: no reversal agents currently available, may be partially reversed with protamine
- Enoxaparin (single dose): factor Xa normal in 12h
- (twice daily): factor Xa normal in 24h
- Fondaparinux: 36h to 48h
- VKA's: Vitamin K for mildly increased INR
- PCC for life threatening conditions or intracranial hemorrhage
- FFP
- Off-label use of recombinant factor VII

Nutrition and Glucose Summary

- Remain proactive in promoting the delivery of EN to consensus targets
 - Limit fasting
 - Limit interruptions
- Continue PN when possible
- Much large scale research still needed to establish "nutritional risk", pre-op evaluation tools, intra-operative and post-operative goals, and post hospital outcomes

Reversing Anticoagulants

- Factor Xa inhibitors
 - Indirect inhibitors
 - Idraparinux – half life 80 hrs, hold for 1 week
 - Direct inhibitors
 - Rivaroxaban (Xarelto)
 - Apixaban (Eliquis)

Hold for 1-2 days before minor Sx, 3-4 days before major Sx
PCC?
- Oral direct thrombin inhibitors
 - Dabigatran: CrCl > 50 hold for 1-2 days minor Sx, 3-4 days major Sx
 - (Pradaxa) CrCl < 50 hold for 3-4 days minor Sx, 6-8 days major Sx

PCC?
- Parenteral direct thrombin inhibitors
 - Argatroban: half life 40-50 min; will falsely elevate the INR
 - Bivalirudin: half life 25 – 35 min; will falsely elevate the INR

Keeping up with Anticoagulants

- Options for thromboprophylaxis
 - ASA
 - Antiplatelet drugs and IIb-IIIa inhibitors
 - SQH
 - IV UFH
 - LMWH
 - VKA's
 - Indirect Factor Xa inhibitors
 - Direct Factor Xa inhibitors
 - Oral direct thrombin inhibitors
 - Parenteral direct thrombin inhibitors
- The burgeoning array of anticoagulation poses new challenges for perioperative patients

Novel Agents

- Odiparcil
 - An oral, indirect thrombin inhibitor which activates antithrombin II
- RB006
 - Direct factor IX inhibitor which inhibits the factor VIII-IX activation of factor X
 - Being developed in conjunction with its antidote, RB007
- Recombinant human soluble thrombomodulin(ART-123)
 - Binds to thrombin and activates protein C
- SR123781A
 - Inhibits both factor Xa and thrombin via antithrombin

Advance Directives and DNRs

- Advance Directives or *living wills* are becoming more common among patients
- Often unclear whether they are helpful to guide end-of-life care once patients are being treated in the ICU
- Many studies suggest that patient preferences set out in advance have little or no influence on end-of-life care in the ICU
- Patients with advance directives are more likely to have DNR orders and not get CPR, but are just as likely to get circulatory support, mechanical ventilation, hemodialysis, or an operation
- So why is there so much inconsistency??

DNR Orders on Operative Patients

- How do professional organizations view them
- What defines the perioperative period
- How does resuscitation differ in or out of the perioperative setting
- What ethical considerations are made for members of the perioperative team

Advance Directives

- The *validity* and *applicability* of advance directives are determined by whether the condition of the ICU patient matches the *hypothetical* conditions identified in the advance directive
- Wording may be ambiguous or incongruent (e.g. Is this condition likely to cause "imminent death")
- The uncertainties about prognosis and the potential benefit of certain therapies leaves physicians to make subjective value judgements concerning the patient's best interest
- Unwarranted legal concerns and lack of legal knowledge

DNR's on Operative Patients

- As the patient's advocate we have an ethical and moral responsibility to the patient
- As a leading member of the health care team we have a moral obligation to uphold a patient's rights to ..
 - Autonomy: respect the patient's right to decide for themselves regarding DNR status in the perioperative setting
 - Beneficence: do what is in the patient's best interest
 - Nonmaleficent: prevent harm to the patient
 - Justice: all individuals deserve mutual respect

DNRs in Operative Patients

- By some estimates **15%** of patients with DNR orders will undergo a surgical procedure
- Present a complex medical and ethical issue
- Outdated and unclear policies leave us unsure and misguided

DNR's on Operative Patients

- Most professional societies among nurses, surgeons, and anesthesiologists recommend **clarification** of the patient's wishes including a thorough review of the patient's directives and then **carefully documenting** that discussion and **disseminating** it to other members of the perioperative team

DNR's on Operative Patients

- The American Society of Anesthesiologists Ethical Guidelines for the Anesthesia Care of Patient with Do Not Resuscitate Orders or Other Directives that Limit Treatment affirms that patients have a *right to self-determination*
- It states that automatic suspensions of DNR in the OR does NOT address this right
- It states that existing directives should be reviewed before procedures, clarified and modified accordingly, and shared with the entire team

Summary

- Close consultation with a respiratory therapist and an ICU physician should occur prior to taking mechanically ventilated patients to OR
- Anesthesiologists should consider glycemic control and minimize interruptions in nutritional delivery
- Elective surgery should be timed according to a patient's anticoagulation and emergency surgery may require prompt reversal of anticoagulants used in the ICU
- Thoughtful consideration of a patient's advanced directives and DNR status should occur and may involve a multi-disciplinary discussion with patients, their proxies, medical ethicists, and the perioperative team

DNR's on Operative Patients

- Summarizing the position statements from the majority of professional organizations:
 - They do NOT support the common practice of routine rescinding of a DNR order for the perioperative period
- They do support a discussion with a patient and/or their proxy regarding how they wish the DNR to be handled
 - A period of "required reconsideration"

Recommendations on DNR's

- DNR's should not be automatically suspended
- "Required reconsideration" should occur
- The patient or surrogate determines the plan for resuscitation
- The perioperative setting should be clearly defined
- The discussion should be clearly documented and communicated
- A process should be included for team members who conscientiously object
- Additional discussion should occur post-operatively to direct care as the patient recovers