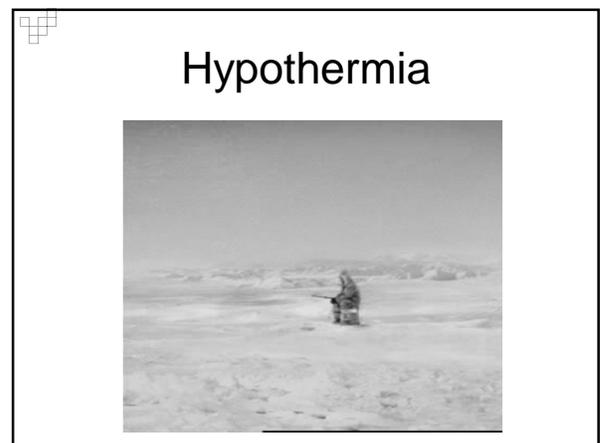
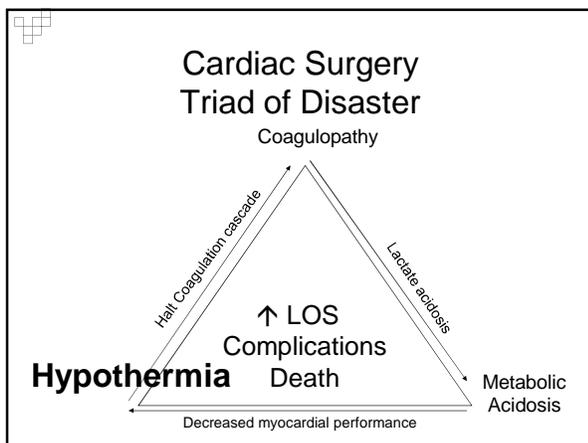
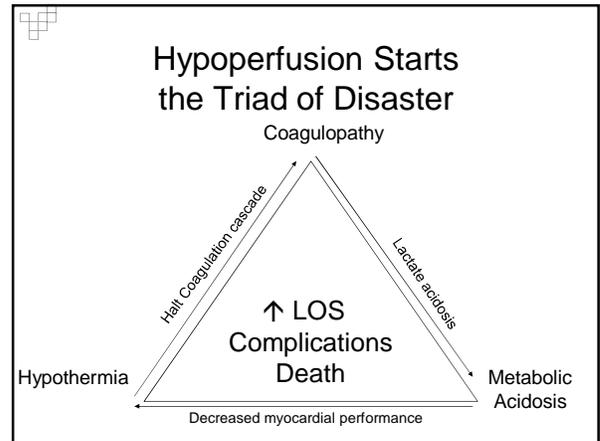
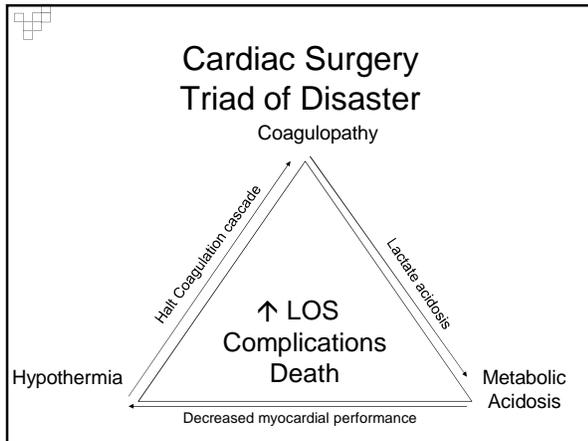
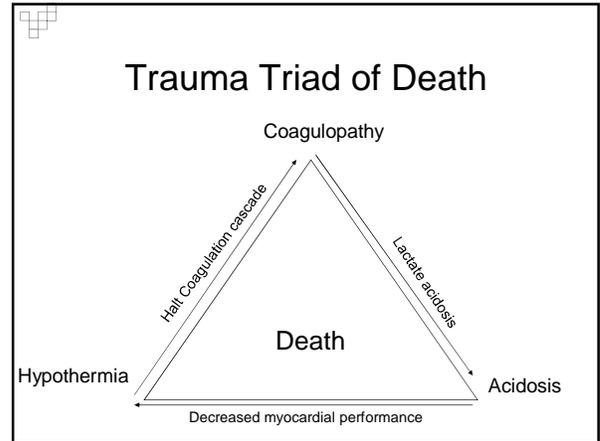


**Conquering Complications:  
Care of the Cardiac Surgery  
Patient in the Immediate Post op  
Period**

*Cheryl Herrmann*  
CARDIAC CLINICAL NURSE SPECIALIST  
APRN, CCRN, CCNS-CSC-CMC  
www.cherylherrmann.com



### Causes of Heat Loss

- ▼ Cooled during cardiopulmonary bypass
- ▼ Cold OR room
- ▼ Cool room and/or fan on
- ▼ Cold fluids
  - 1 unit of pRBC can lower body Temp 0.25° C
  - 1 liter of fluids unit can lower body Temp 0.5° C
- ▼ No blankets
- ▼ Head uncovered

### Alarming Consequences of Hypothermia

1. Increased oxygen debt
  - Cold hemoglobin can not release oxygen to the cells
  - Left shift of the oxyhemoglobin dissociation curve
  - Prolonged ventilation
2. Increased lactic acid production
  - Change from aerobic to anaerobic metabolism
  - Leads to acidosis
3. Coagulopathy
  - Prolonged clotting cascade
  - Platelet dysfunction – platelets are extremely temperature dependent
  - Altered fibrinolytic system
4. Altered cardiovascular function
  - Decreased cardiac output/contractility
  - Risk of arrhythmias
  - Increased SVR due to vasoconstriction



### Alarming Consequences of Hypothermia (cont)

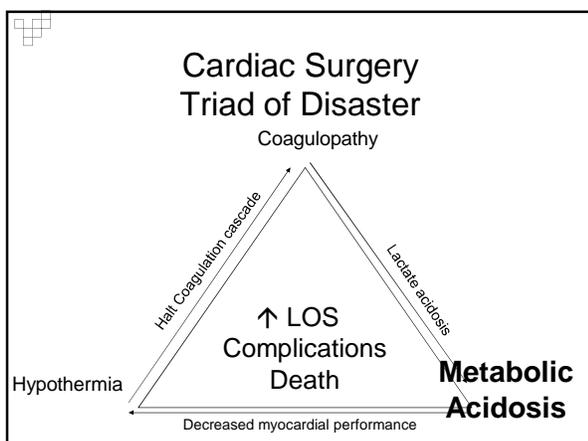
5. Hyperglycemia
  - Decrease insulin production
6. Increased Risk of Infection
  - Impairs neutrophil function
  - Tissue hypoxia from vasoconstriction
7. Altered drug metabolism
  - Delayed emergence from anesthesia
8. Shivering
  - Increases myocardial oxygen demand and consumption



### Rewarming techniques



- ▼ Warm room – no fan
- ▼ Warm blankets – keep patient covered
- ▼ Bare Hugger
- ▼ Use blood warmer to give blood products
  - Have blood warmer and bare hugger in room



## Acidosis Pathophysiology

From Allen C Wolfe Jr., MSN, RN, CFRN, CCRN, CMTE  
Clinical Education Director/Clinical Specialist, Air Methods Corporation Denver, Colorado

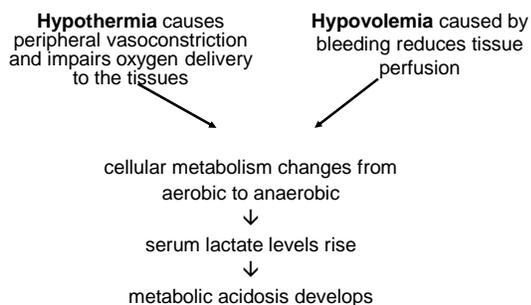
Ph < 7.20 = decrease in cellular function causing failure to produce ATP (energy stores) to transport proteins across cells and slows or stops transmission of messages

# Driving in a Snow Storm

## Alarming Consequences of Acidosis

- ♥ Decreased cardiac contractility & cardiac output
- ♥ Impaired response to catecholamine
  - (ie intropes are not effective)
- ♥ Increased PVR
- ♥ Vasodilation - decreased SVR
- ♥ Bradycardia
- ♥ Increased arrhythmia risk
- ♥ Coagulopathy
- ♥ Compensatory hyperventilation.

## Pathophysiology of Acidosis



## Identify Cause of Lactic Acidosis

- ♥ Type A Lactic Acidosis
- ♥ Type B Lactic Acidosis

Treat the Cause!

## Metabolic Acidosis

- ♥ Type B Lactic Acidosis
  - Occurs in the absence of tissue hypoxia
  - May be catecholamine-induced metabolic effect (especially with epinephrine)
  - May be caused by hyperglycemia & alterations in fatty acid metabolism

## Disruption of normal regulatory mechanisms during surgery

- ♥ Plasma glucose elevates
- ♥ Insulin secretion is depressed
- ♥ Elevated blood levels of catabolic hormones render patient resistant to insulin
- ♥ Ketones form as a result of incomplete oxidation.
- ♥ If not treated, metabolic acidosis may develop within hours
- ♥ Insulin corrects abnormality

Date/Time	1600	1830	2030	2300	0200	0600
PH	7.47	7.32	7.27	7.19	7.28	7.38
PCO2	31	42	44	34	33	34
PO2	192	156	92	115	85	87
CO2 conc	24	24	20	14	16	21
O2 Sat	99	99	95	97	95	96
BE	-1	-4	-8	-14	-10	-5
O2 flow	100%	80%	60%	60%	50%	50%
Rate/mode	IMV 10	IMV 10	IMV10	IMV 10	IMV 6	CPAP
K+	3.9	4.0	2.9	3.5	4.9	
Glucose				414	322	221
Treatment				Regular insulin 5 Units IV 20 SQ 2 amps Bicarb	20 units SQ insulin	

Date/Time	2400	0600
PH	7.40	7.26
Pco2	34	46
PO2	110	91
CO2 conc	22	22
O2 Sat	98	96
BE	-3	-7
O2 flow	50%	50%
Rate/mode	IMV10	IMV 4
K+	5.0	5.3
Glucose		327
Treatment		

If Potassium is LOW, Be Careful when giving...

- ♥ Insulin
- ♥ Calcium
- ♥ Digoxin

Serum glucose should not decrease more than 75 - 100 ml/dl per hour to prevent...

- ♥ Hypoglycemia
- ♥ Hypokalemia
- ♥ Cerebral Edema

Severe hypoglycemia can lead to coma and death!

Admission ABGs

	Patient A	Patient B	Interpret these
ph	7.29	7.33	1. Pt A = Respiratory Acidosis Pt B = Metabolic Acidosis
pCO <sub>2</sub>	60	32	2. Pt A = Metabolic Acidosis Pt B = Respiratory Acidosis
pO <sub>2</sub>	132	100	3. Both metabolic Acidosis
TCO <sub>2</sub>	31	20	4. Both Respiratory Acidosis
O <sub>2</sub> %	98	98	
BE	-1	-8	

## Admission ABGs

### Answer

Interpret these

1. Pt A = Respiratory Acidosis  
Pt B = Metabolic Acidosis
- 2.

## Metabolic Acidosis

Ongoing Metabolic Acidosis means something is not being perfused

### ♥ Type A Lactic Acidosis

- Reflects impaired tissue oxygenation & anaerobic metabolism resulting from circulatory failure
- The lactate ion more than the acidemia contributes to potential cardiovascular dysfunction

## The Value of Lactate

- ♥ Serum lactate levels are used to assess the acid-base state and adequacy of tissue perfusion
- ♥ By product of anaerobic metabolism if tissue hypoxia (from hypoperfusion) exists
- ♥ A change from aerobic to anaerobic metabolism

- ♥ Lactate is primarily excreted by liver.
- ♥ Treatment: Treat the Cause
- ♥  $\text{NaHCO}_3$  (Bicarb) is truly only a "Band-Aid" and should only be used for severe metabolic acidosis =  $\text{pH} < 7.2$  &  $\text{HCO}_3 < 6\text{mEq/L}$

Treat the Cause!

## The Value of Lactate

Serial lactate levels predictor of perfusion

- Normal  $< 2.5\text{mmol/L}$
- Mild acidosis  $2.5-4.9\text{mmol/L}$   
(mortality 25-35%)
- Moderate acidosis  $5.0-9.9\text{mmol/L}$   
(mortality 60-75%)
- Severe acidosis  $> 10\text{mmol/L}$   
(mortality  $> 95\%$ )

Shoemaker, WC et al. Textbook of critical care. 1995. WB Saunders

## Lactate Levels

"Surviving Sepsis 2014"

- ♥ Normal 1-2
  - Cells are alive & well
- ♥ Moderate 2 – 4
  - DECREASED cellular perfusion
  - Cells STRUGGLE to survive
  - May indicate severe sepsis
- ♥ Severe  $> 4$ 
  - COMPLETE TISSUE HYPOXIA
  - Cells DIE
  - Hypotension refractory to adequate fluid resuscitation indicates septic shock

Surviving Sepsis Campaign 2014

## Serum Lactic Acid Levels

- ♥ May be the first indication that something is wrong
- ♥ Excess lactate demonstrates measurement of tissue oxygen debt
- ♥ Results in metabolic acidosis due to tissue hypoperfusion and "starvation"

## Serum Lactic Acid Levels

- ♥ Increasing lactic acid levels mean the tissues are hypoperfused and patient is getting worse.
- ♥ Decreasing lactic acid levels mean the tissues are getting perfused and the patient is getting better.

Do not draw lactate levels more than every 4 hours  
Lactate level takes 4 hours to rise and 4 hours to release

## Base deficit/excess

- ♥ Amount of total base (buffer) that is needed to achieve acid-base balance.
- ♥ BD/BE is depicted by  $\text{HCO}_3^-$ , Cl, phosphates, sulfates, proteins and organic acids. To figure BD/BE, lab uses the PH, PaCo<sub>2</sub> and Hct.
- ♥ Normal -2- +2
- ♥ If < - 2, the patient is not perfusing

## Base deficit

- ♥ Normal -2 to +2
- ♥ Mild Hypoperfusion: -2 to -5
- ♥ Moderate Hypoperfusion: - 6 to -14
- ♥ Severe Hypoperfusion: < - 15

Source: Davis J et al: Journal of Trauma, 1996. Davis K et al. Journal of Trauma, 2002

## Which patient are you more concerned about?

	1.0600	2.0800
PH	7.37	7.35
PCO <sub>2</sub>	36	32
PO <sub>2</sub>	77	87
CO <sub>2</sub>	22	18
O <sub>2</sub> %	94	96
BE	-4	-8

## Which patient are you more concerned about?

Answer 2

## Acidosis Summary

- ♥ Acidosis is the #1 negative inotrope!
- ♥ Acidosis decreases cardiac contractility!
- ♥ Treat acidosis so alpha inotropes work!
  - Direct therapy to improve oxygen delivery and reducing demand and thus decrease acid production.

### Treat the Cause!

214

### Ask the Experts

#### Use of Bicarbonate in Patients With Metabolic Acidosis

**Q** Please elaborate on why bicarbonate is not used unless the pH is 7.2 or less. Many nurses, particularly cardiovascular nurses, have difficulty understanding this when the patient's blood pressure is low and the patient is acidotic with large negative base excess. Please explain the physiological basis for the decision and clarify why "it doesn't work" or "it is not beneficial."

**A** Myra F. Ellis, RN, MS, CNSCC, CCRN, explains...

Bicarbonate therapy is sometimes prescribed to treat acute metabolic acidosis, an acid-base disorder that is characterized by a primary decrease in the concentration of bicarbonate ions (HCO<sub>3</sub><sup>-</sup>). A secondary decrease in the partial pressure of carbon dioxide (P<sub>a</sub>CO<sub>2</sub>) and a decrease in serum pH (acidosis) is considered severe when the pH is less than 7.20. Assuming an appropriate ventilatory response, this blood pH would be associated with a serum HCO<sub>3</sub><sup>-</sup> concentration of less than 18 mg/dL. The general mechanism cause metabolic acidosis is a decrease in bicarbonate (renal or gastrointestinal losses) or a reduction of strong acids (such as toxins, diabetic ketoacidosis, or lactic acid production).<sup>1,2</sup> Bicarbonate replacement is beneficial for patients with true bicarbonate deficits, but not to patients with metabolic acidosis caused by an increase in acid production.<sup>3,4</sup>

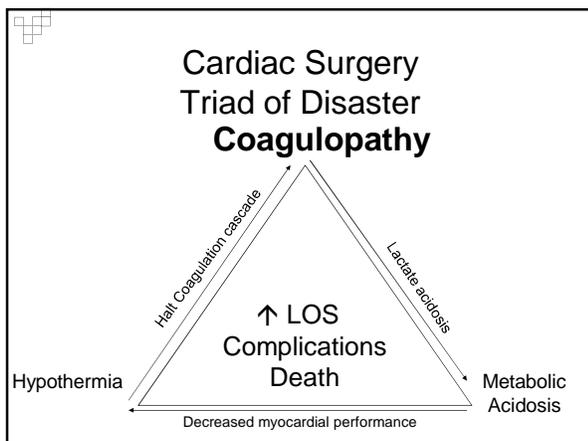
Most reports recently mentioned regarding bicarbonate replacement for patients with acute acidemia (pH < 7.1) and serum HCO<sub>3</sub><sup>-</sup> of 4 mg/dL or less because of the potential harm associated with its use.<sup>5,6</sup> The Surviving Sepsis Campaign recently published recommendations against the treatment of acidosis in patients with pH remaining 7.15 even for the purpose of improving hemodynamic status.<sup>7</sup> Although bicarbonate may increase pH, the available evidence suggests its use only in cases of severe acidosis.

The pathologic effects of severe metabolic acidosis are well documented and affect multiple systems. Severe acidosis cause relaxation of vascular smooth muscle (vasodilation) and vasoconstriction. Severe acidosis cause decrease in both blood pressure and cardiac output as a result of decreased myocardial contractility. In addition, acidosis decrease the binding of oxygen to its receptors and is associated with hyperventilation to endogenous and infused carbon dioxide.<sup>8,9</sup> Patients in severe acidosis have a sympathetic to cardiac arrhythmias such as ventricular fibrillation, which can contribute to sudden death.<sup>10</sup> Acidosis adversely affects cell function such as myocardial receptors, generation of adenosine triphosphate, fatty acid metabolism, and base formation and reabsorption. Patients are more susceptible to infection because of the suppressed immune response and leukocyte function.<sup>11</sup> It is now clear that if acidosis causes multiple-organ dysfunction, correcting pH with alkaline

**Ask the Experts**  
Myra F. Ellis  
Use of Bicarbonate in Patients With Metabolic Acidosis  
Crit Care Nurse October 2015 35:73-75doi:10.4037/ccn2015502

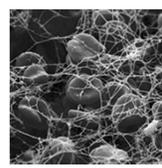


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### Causes of Coagulopathy

- ♥ Hypothermia
- ♥ Acidosis
- ♥ Underlying diseases
- ♥ Medications
- ♥ Dilution with fluids



### Causes

- ♥ Mechanical Causes
  - Bleeding from suture lines
  - Clip comes off graft
  - Aortic or ventricular rupture
  - Chest wall bleeders
- ♥ Abnormal clotting factors due to
  - Preop anticoagulant meds
  - Systemic heparinization during CPB
  - Breakdown of factors during CPB



### Signs & Symptoms

- ♥ CT bleeding > 100 – 200 cc/hr
- ♥ Low or labile B/P
- ♥ Low CVP or PAD
- ♥ Falling SvO<sub>2</sub> and CO/CI
- ♥ Abnormal clotting Factors
- ♥ Bleeding from line sites, incisions



## Treatments

- ♥ Monitor CT output. May need to replace CT output cc for cc with packed cells
- ♥ Keep sedated and keep B/P < 140 to prevent stress on suture lines
- ♥ Keep CT patent by gently milking and stripping
- ♥ Use warming blanket to keep normal thermic.
  - Hypothermia interferes with clotting factors

## Treatment: Blood and Blood Products

- ♥ Give blood and blood products
- ♥ FFP for ↑ PT or PTT
- ♥ Platelet Phoresis for ↓ Platelet count
- ♥ Cryoprecipitate for ↓ Fibrinogen level
- ♥ Packed cells for ↓ H & H

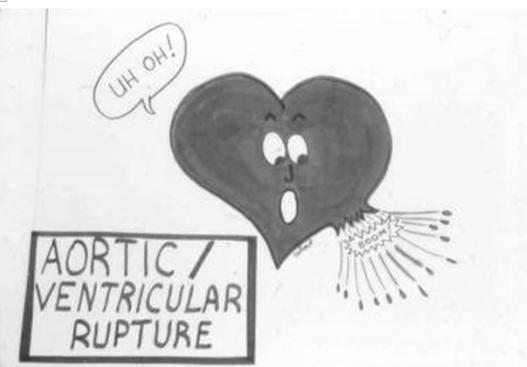


## Rule of thumb

- ♥ Replace CT output ml for ml
- ♥ Minimum after every 4<sup>th</sup> unit pRBCs
  - Calcium Chloride
  - FFP
- ♥ Recommend 1 pRBC to 1 FFP

## Treatments

- ♥ Pharmacological Interventions
  - Protamine to reverse effects of systemic heparinization
  - Aminocaproic Acid (Amicar) to inhibit conversion of plasminogen to plasmin
  - Desmopressin to improve platelet function
  - Recombinant Activated Factor VII (NovaSeven) stimulates the generation of thrombin
- ♥ May need to return to surgery to repair mechanical cause of bleeding



Keep blood on HOLD --- communicate with blood bank that you have a bleeder



- ♥ May need to use type specific blood

# Massive Hemorrhage Protocol

UnityPoint Health Methodist/Proctor	Page # 1 of 7	Section: Emergency Situations	Policy # 11-14
CARE COORDINATION	Approved by CNO: <i>[Signature]</i>	Date: 12/9/15	Review by: 12/9/15
	Approved by Pathologist: Elizabeth Bauer-Marsh MD	Supersedes: 9/10/13, 7/23/14	Date Revised: 12/9/15
	Primary Responsible Parties: Jeannette Murray, Elizabeth Bauer-Marsh, MD	Secondary Responsible Parties: Amy Hill	Joint Commission Standard: PC
SUBJECT: MASSIVE HEMORRHAGE / TRANSFUSION			

**I. POLICY:**  
In the event of a life threatening massive hemorrhage, a physician may initiate the massive hemorrhage/transfusion policy. Acute Care areas are to transfer patients to a Critical Care unit (e.g. ICU, CVICU).

**II. PURPOSE AND STANDARD:**  
To ensure effective restoration of circulating volume (euvolemia), arrest of bleeding where there is major blood loss/massive hemorrhage, restoration of oxygen-carrying capacity (RBC's), and correction of hemostatic abnormalities/coagulopathy.

# Massive Hemorrhage Protocol

Cooler #	PRBC's	Plasma (FFP) Expire in 24 hrs	Platelets – Given per Lab results	Cryoprecipitate – per physician order – for fibrinogen <100mg/dL; 8 min. to thaw
1	4 units O neg, uncrossmatched			
2	6 units	4 units - Given after 10 units PRBC's and/or per labs	1 apheresis	
3	6 units	4 units	1 apheresis	2 units (pooled)
4	6 units	4 units	1 apheresis	2 units (pooled)

Physician can adjust orders at any time as needed

81 y/o male CABG x 3 LAD, Marginal, PDA  
Admission vital signs & labs.  
What are your priorities?

	Adm 2000
Art B/P	142/52
MAP	83
HR	68
Temp	97.2
PAS/PAD	32/17
CVP	14
SVO <sub>2</sub>	69
CO	3.5
CI	1.8
SVR	1685
SpO <sub>2</sub>	97
UO	750
CT	210

Treat high glucose  
Treat low Magnesium  
Fluids for low CI

Order Status	Final Report
PHASIT	7.21*
PO2	39*
PO2	93.1F
CO2 ART	27*
O2 SAT	91*
BE	-3.3*
ACT	27.84*
POTASSIUM	4.1*
MAGNESIUM	2.04*
PHOSPHORUS	1.1*
LACTIC-A	1.6*
GLUCOSE	135*
GLUCOSE	69*
PO2 LAMB	31*
PH CORR	7.388*
PH CORR	91.1F
TEMP	98.4*

Postop recovery going well. Extubated at 0015.  
Now what?

	Adm 2000	2100	2200	2300	2400	0100	0200
Art B/P	142/52	148/57	106/38	151/45	161/51	142/47	138/48
MAP	83	86	62	82	94	79	79
HR	68	64	83	74	85	81	86
Temp	97.2	97.7	99	99.1	98.6	99.3	99.1
PAS/PAD	32/17	36/17	29/14	28/12	36/16	23/10	22/11
CVP	14	16	13	12	12	8	8
SVO <sub>2</sub>	69	72	64	71	71	70	66
CO	3.5	4.4	3.3	4.5	6.1	4.5	3.8
CI	1.8	2.2	1.7	2.3	3.1	2.3	1.9
SVR	1685	1308	1186	1234			1392
SpO <sub>2</sub>	97	100	100	97	97	98	99
UO	750	250	375	175	250	425	100
CT	210	40	60	20	30	250	290

1. Routine surgery – continue to monitor
2. Bleeding – call surgeon
3. Hypertensive – start antihypertensive

Postop recovery going well. Extubated at 0015.  
Now what?

	Adm 2000	2100	2200	2300	2400	0100	0200
Art B/P	142/52	148/57	106/38	151/45	161/51	142/47	138/48
MAP	83	86	62	82	94	79	79
HR	68	64	83	74	85	81	86
Temp	97.2	97.7	99	99.1	98.6	99.3	99.1
PAS/PAD	32/17	36/17	29/14	28/12	36/16	23/10	22/11
CVP	14	16	13	12	12	8	8
SVO <sub>2</sub>	69	72	64	71	71	70	66
CO	3.5	4.4	3.3	4.5	6.1	4.5	3.8
CI	1.8	2.2	1.7	2.3	3.1	2.3	1.9
SVR	1685	1308	1186	1234			1392
SpO <sub>2</sub>	97	100	100	97	97	98	99
UO	750	250	375	175	250	425	100
CT	210	40	60	20	30	250	290

1. ANSWER
2. Bleeding – call surgeon

It's 0500.  
What are your priorities?

	2400	0100	0200	0300	0400	0500
Art B/P	161/51	142/47	138/48	111/40	113/43	91/38
MAP	94	79	79	64	71	58
HR	85	81	86	79	86	108
Temp	98.6	99.3	99.1	99.5	99.5	99.7
PAS/PAD	36/16	23/10	22/11	23/10	26/11	20/12
CVP	12	8	8	8	8	6
SVO <sub>2</sub>	71	70	66	63	62	59
CO	6.1	4.5	3.8	3.5	4.2	3.6
CI	3.1	2.3	1.9	1.8	2.1	1.8
SVR			1392	1161		1006
SpO <sub>2</sub>	97	98	99	100	97	98
UO	250	425	100	115	185	
CT	30	250	290	130	300	190
	200 cc IV fluid	288 cc PRBC			300cc PRBC 40 cc platelets	

It is 0700, calculate the CT output and the blood products given.... Are you keeping up with the bleeding?

Chest tube output 1660 ml

0100: 250

0200: 290

0300: 130

0400: 300

0500: 190

0600: 200

0700: 300

	2400	700
Art B/P	145/44	91/38
HR	82	108
PAS/PAD	28/12	20/10
CVP	12	6
SVO <sub>2</sub>	71	59
CO	4.5	3.6
CI	2.3	1.8
SVR	1186	1006
Temp	98.6	97

▼ Pt received 3 units of pRBCs

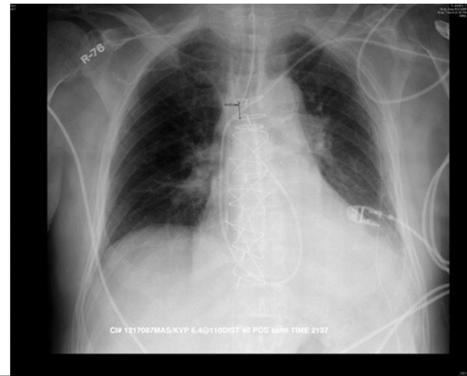
0800 sedated to keep from bleeding. Did not return to OR

	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400
Art B/P	91/38	117/40	109/42	116/47	106/43	113/46	148/73	145/54	130/58	141/56
MAP	58	75	67	71	65	69	92	83	84	84
HR	108	92	101	92	90	88	83	85	101	99
Temp	99.7	99.3	99.5	99.3	99	99.1	98.8			
PAS/PAD	20/12	37/15	43/16	32/17	31/16	67/20	51/20	414/19	33/19	41/20
CVP	6	9	8	12	11	12	13	11	10	11
SVO <sub>2</sub>	59	56	61	66	67	65	68	70		68
CO	3.6	4.9	4.2	3.6	3.8	3.5	3.7	3.8		3.4
CI	1.8	2.5	2.1	1.8	1.9	1.8	1.9	1.9		1.7
SVR	1006		1160	1265		1370				
SpO <sub>2</sub>	98	98	94	96	95	94	93	93	92	91
UO		75	75	105	475	375	200	425	325	150
CT	190	200	300	70	50	250	150	50	50	50
		500 cc Hespan, 300 cc PRBC, 250 cc albumin		325 cc PRBC, 195 cc platelets	325 cc PRBC, 299 cc platelets		325 cc PRBC	325 cc PRBC		

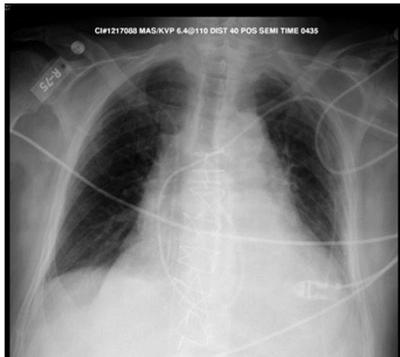
Preop of bleeding patient



9/22 2135 DOS – Just before extubation

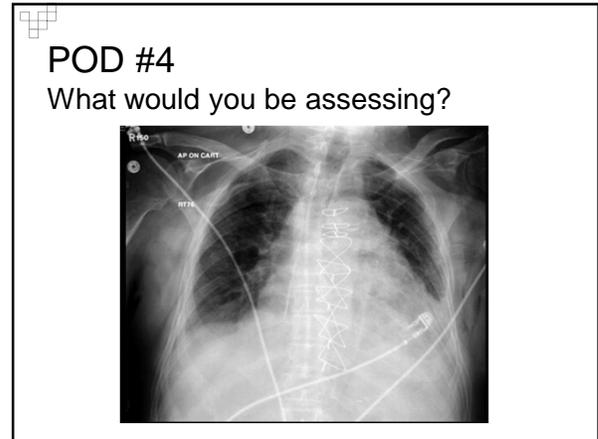
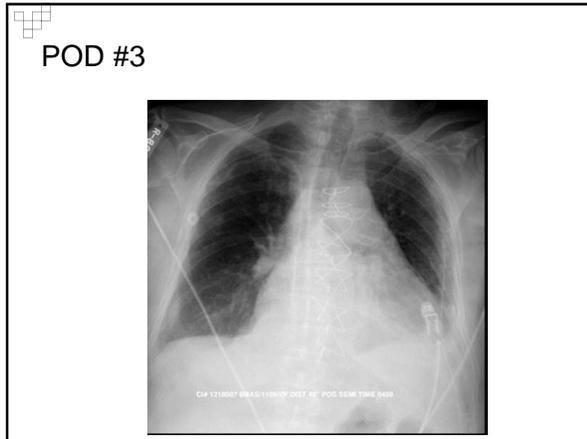


9/23 0500 POD #1



POD #2





2<sup>nd</sup> Case:  
Based on these coag values, what blood products do you expect to be ordered?

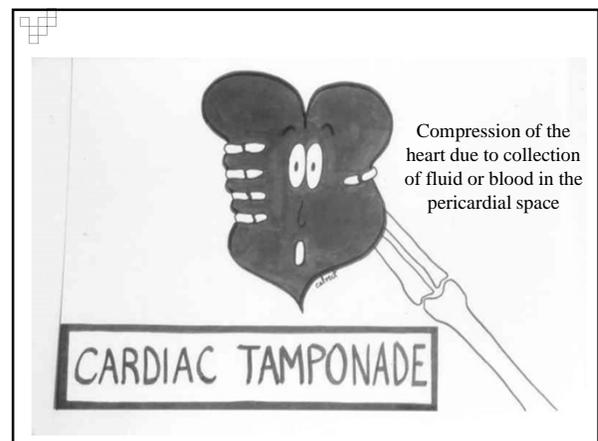
Hgb	7.3	1. Packed cells
HCT	21.3	2. Packed cells, FFP
Platelets	186	3. Packed cells, FFP, Cryoprecipitate
PT	21.7	
INR	2.23	4. Packed cells, FFP, Cryoprecipitate.
PTT	43.4	platelets
Fibrinogen	108	
Lactic Acid	3.1	

2<sup>nd</sup> Case:  
Based on these coag values, what blood products do you expect to be ordered?

Hgb	7.3	1. ANSWER
HCT	21.3	2.
Platelets	186	3. Packed cells, FFP, Cryoprecipitate
PT	21.7	
INR	2.23	
PTT	43.4	
Fibrinogen	108	
Lactic Acid	3.1	

After 5 pRBCs, 1 platelet pheresis, 3 FFP, 10 cryo.  
Would you anticipate any further blood products?

Hgb	7.3	9.8
HCT	21.3	28.1
Platelets	186	115
PT	21.7	18.7
INR	2.23	1.09
PTT	43.4	32.5
Fibrinogen	108	240
Lactic Acid	3.1	2.8



## Cardiac Tamponade: Causes

- ▼ Blood accumulated in the chest from:
  - CTs clotted off and unable to drain excess blood
  - Epicardial wire removal
- ▼ May occur quickly within minutes of hours or may occur slowly over days or weeks

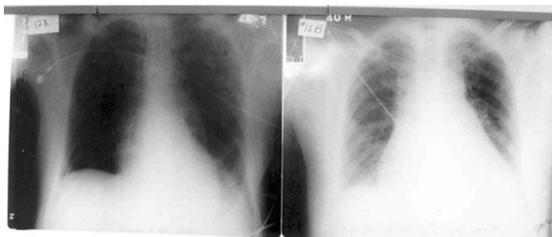
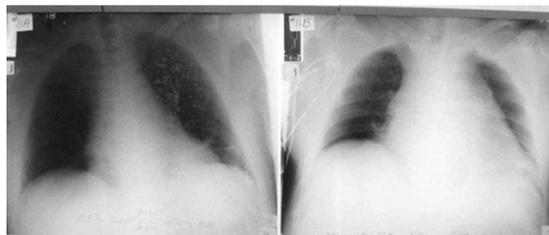
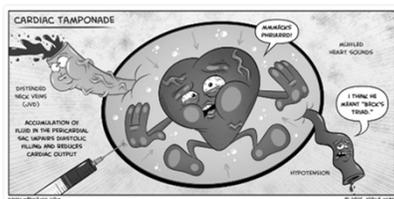
## Cardiac Tamponade: Signs & Symptoms

- ▼ Hypotension
  - ▼ Low urine output
  - ▼ Rising & equalization of CVP & PAD
  - ▼ Falling SVO<sub>2</sub>, CO/CI
  - ▼ Sudden decrease in CT output
  - ▼ Widening mediastinum on CXR
  - ▼ Neck Vein Distention
  - ▼ Tachycardia
  - ▼ Pulses Paradox > 20 mmHG
  - ▼ Diminished heart sounds
- For tamponade that occurs slowly may also see these S/S:
- ▼ Shortness of Breath
  - ▼ Chest Pain
  - ▼ Ischemic changes on EKG
  - ▼ Nausea

## Cardiac Tamponade

### Beck's Triad

- Hypotension
- Neck vein distention
- Muffled heart sounds



## Cardiac Tamponade: Treatment

- ▼ Urgent surgical exploration to evacuate excess blood & correct cause of the tamponade
- ▼ Bedside echo may be used to make differential diagnosis between tamponade & LV failure
- ▼ Administer fluids & inotropes or Calcium Chloride until patient can be returned to OR
- ▼ Prepare for possible exploration of chest at bedside

DOS		POD #1					
	1900	2400	0500	0900	1500	2200	2300
Art BP	106/85	136/66	122/56	147/59	140/65	123/59	92/47
MAP	72	81	90	79	81	76	68
HR	68	99	105	106	111	124	125
PASPAD	32/15	32/18	40/21	36/21	38/23	33/22	37/26
CVP	10	11	15	14	16	16	19
SVO <sub>2</sub>	83	84	85	86	89	80	82
CO	5.8	8.3	11	9.8	6.7	5.2	3.6
CI	2.5	3.5	4.8	3.8	2.9	2.2	1.6
SVR	964	674	634	559			
SpO <sub>2</sub>	95	96	93	92	93	92	92
SV	85	83			62	42	30
UO	600	325	1000	60	400	40	30
CT	60	100	150	50	50		

It's 2300, what do you want to do?

1. Fluids for hypovolemia
2. Surgery for tamponade
3. Inotropes for cardiogenic shock
4. Diuretics for fluid overload

▼ ANSWER

It's 2300, what do you want to do?

2. Surgery for tamponade

		POD #2									
	2200	2300	0400	0800	0900	1100	1300	1600			
Art BP	123/59	92/47	129/67	141/67	108/68	101/62	118/71	126/53			
MAP	75	68	88	83	78	73	80	75			
HR	124	125	129	137	147	110	107	125			
PASPAD	33/22	37/26	34/22	34/25	48/21	33/24	37/26	29/20			
CVP	16	19	16	19	17	19	23	25			
SVO <sub>2</sub>	40	32	37	48	40	42	45	72			
CO	5.2	3.8	5.3	6.3	6.9	3.2	4.2	7.9			
CI	2.2	1.6	2.3	2.7	2.9	1.4	1.8	3.3			
SVR				670		1521	1316	831			
SpO <sub>2</sub>	92	92	90	91	91	95	95	99			
SV	42	30	41		42		39	63			
UO	40	30	550	180			45	60			
CT							25				

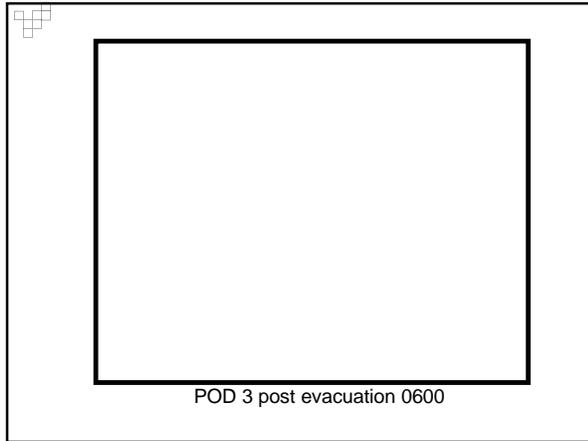
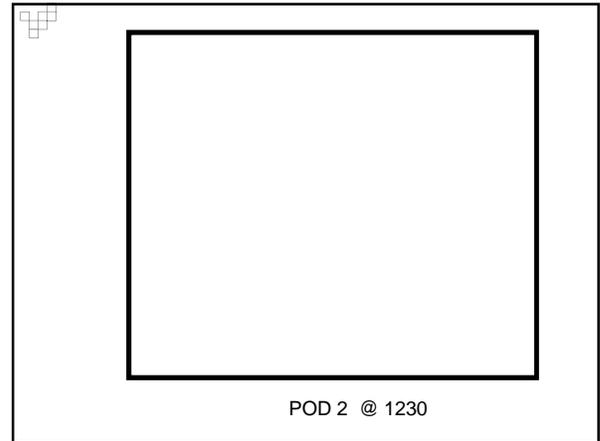
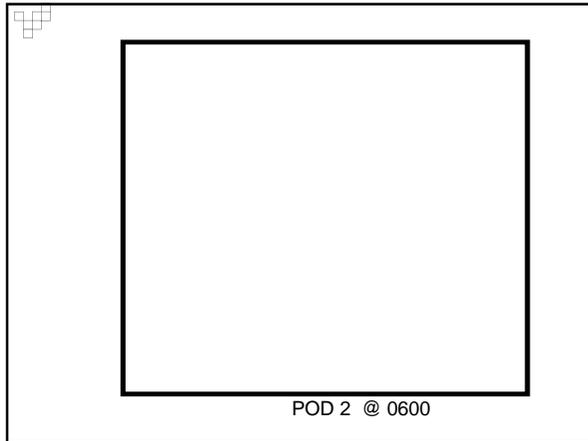
2300 – started tamponading  
 Started on Dopamine 2.5 mcg/kg/min  
 Epi 3.07 mcg/min  
 Milrinone 0.5 mcg/kg/min  
 1300 – back to OR  
 1600 – back to CVICU post removal of blood

**TAMPONADE!**

Preop

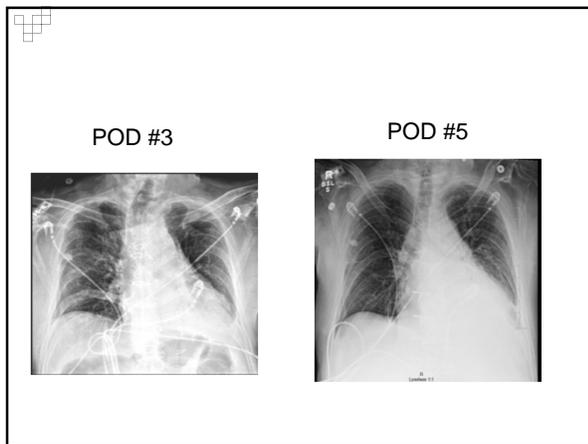
DOS post op

POD 1 @ 2300



RRT on Progressive unit called for hypotension CABG POD # 5

	0800	0900	1057	1218	1220	1240	1250
BP	119/56	107/59	90/59	70/46	71/48	67/38	68/48
MAP	61	78	65	53			
HR	67	68	65	72			
RR	20	18	20	20			
Temp				36.9			
	Epicardial wires pulled			Pale, diaphoretic, CXR ordered			



**Tamponade Pearl**

- ♥ Hypotension in a cardiac surgery patient..... Think tamponade or you will miss it!
- ♥ May occur fast or slow (weeks)

## Treatment of Cardiac Arrest

Cardiac Surgery Advanced Life Support

University Health Partners  
Heart of IL ACHI - President  
www.heartofill.com

### Cardiac Arrest...

- In the immediate postop recovery in a cardiac surgery patient is typically related to reversible causes
  - Tamponade
  - Bleeding
  - Ventricular arrhythmias
  - Blocks associated with conduction problems
- Survival to discharge can be up to 79%
  - If treated promptly



### EACTS Guidelines

European Association for Cardio-Thoracic Surgery

Guideline for resuscitation in cardiac arrest after cardiac surgery

Joel Dunning\*, Alessandro Fabiani†, Philippe H. Kohl‡, Adrian Levine§, Uri Lockowandt¶, Jonathan Mackay||, Alain J. Pavie¶, Tim Strong¶, Michael L.K. Venetangh¶, Sander A.M. Nashed¶, on behalf of the EACTS Clinical Guidelines Committee

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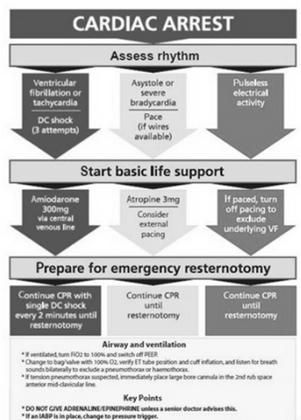
Journal of Cardiothoracic Surgery 34 (2009) 3–10

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### Cardiac Advanced Life Support-Surgery

#### Key Concepts

- Assess Rhythm
- Shock before Compressions
- Pace/Atropine – not Epi
- Identify reversible causes
- Early re sternotomy



**CALS-S**

### Pulseless Electrical Activity (PEA)

- Cardiac surgery patients who arrest with PEA are typically experiencing treatable causes
  - Hypovolemia -- severe
  - Hypoxia
  - Tamponade
  - Tension pneumothorax
- Prompt treatment results in good outcomes
- To assess for causes of PEA/nonschockable rhythm
  - Consider the 4 "Hs" and 4 "Ts"

### Assess for Reversible Causes

Four Hs	Four Ts
Hypoxia *	Tamponade *
Hypovolemia*	Tension Pneumothorax
Hypokalemia/ Hyperkalemia	Thromboembolism
Hypothermia	Toxin

\* = Most common causes of cardiac surgery arrests

### Treatment of PEA causes

Hypoxia	Hypovolemia and Tamponade
<ul style="list-style-type: none"> <li>Treat per airway management and assessment</li> </ul>	<ul style="list-style-type: none"> <li>Severe hypovolemia is typically due to bleeding</li> <li>Severe hypovolemia and tamponade both require emergent re-sternotomy to correct</li> </ul>

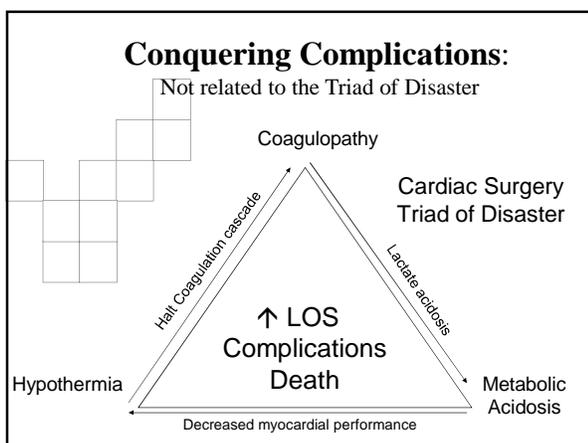
- ### Steps to Ensure Adequate Airway and Ventilation
- Check endotracheal tube (ET) position and end tidal carbon dioxide (EtCO<sub>2</sub>) waveform and reading
  - Listen for an ETT airleak and verify that is properly inflated
  - Listen and look for bilateral breath sounds.
    - Consider removing the patient from the ventilator and give 100% oxygen via bag-mask-valve to more easily assess lung sounds and determine lung compliance
    - If bilateral lung sounds are present, reconnect the ETT to ventilator.

- ### Steps to Ensure Adequate Airway and Ventilation (continued)
- Feel the trachea to verify it is midline.
  - If a tension pneumothorax is suspected, insert a large bore needle into the 2<sup>nd</sup> intercostal space, mid-clavicular line.
  - If unable to ventilate the patient with a bag-mask-valve, attempt to suction the ET tube.
    - If unable to pass the suction catheter, ETT occlusion or malposition should be suspected.
    - Remove the ETT and ventilate with a bag-mask-valve.

### Prepare for Emergency Re-sternotomy

#### Six Key Roles

- External cardiac massage
- Management of airway and breathing
- Defibrillation
- Team leader
- Medication administration
- ICU nursing Coordinator



## Cardiac Vasoplegic Syndrome post Cardiac Surgery

Sara Caruso, RN, BSN, CCRN-CSC

CABG x 3, on Insulin drip, Epinephrine drip, & precedex drip

PMH: ½ ppd smoker x20 years, depression with use of SSRI's, EF = 30%, HF -- Coreg and Lisinopril

	Admission Vitals
MAP	60
CVP	3
CO/CI	4.5/2.5
SVR	1012

250ml of 5% albumin x 2 administered with no change in SVR/CVP, Neosynephrine drip is started

CABGx3, on Insulin drip, Epinephrine drip, and precedex drip

PMH: ½ ppd smoker x20 years, depression with use of SSRI's, EF = 30%, HF -- Coreg and Lisinopril

	Admission Vitals	One Hour Later after albumin & Neosynephrine
MAP	60	40
CVP	3	1
CO/CI	4.5/2.5	4.2/2.1
SVR	1012	770

### What is Cardiac Vasoplegic Syndrome? (Vasodilatory Shock)

- ♥ Arterial vasodilatory state resistant to the usual vasopressors post cardiac surgery
- ♥ Severe and persistent form of hypotension with:
  - Normal or high cardiac output
  - Low CVP and PAOP
  - Decreased systemic vascular resistance (SVR) <800
- ♥ Low filling pressures that are poorly responsive or unresponsive to volume
- ♥ 5- 8 % of all patients post cardiac surgery
- ♥ Increased morbidity and mortality

### Why does this happen?

- ♥ Huge inflammatory response post cardiac surgery -- large quantities of nitric oxide released
    - Cardiopulmonary bypass
    - Surgical trauma
    - Blood loss
    - Blood transfusions
    - Hypothermia
    - Neutralization of heparin with protamine
  - ♥ Nitric Oxide produces profound vasodilation and vasoplegia
- Result: Loss of vasomotor tone and vasodilation

### At Risk population:

- ♥ Preoperative heart failure
  - EF < 35%
  - End stage HF requiring assist device
- ♥ Numerous preop antihypertensive medications
  - ACE inhibitors, ARBs, Beta Blockers, Calcium Channel blockers
- ♥ Use of pre and post Amiodarone and Phosphodiesterase inhibitors (Milrinone)

### Treatment for Cardiac Vasoplegic Syndrome

- Methylene Blue (Tetramethylthionin chloride)
- ♥ Interferes with the nitric oxide pathway and inhibits the vasorelaxant effect on smooth muscle
  - ♥ Can raise mean arterial pressures while minimizing the use of vasopressors
  - ♥ Usually given pre-op or inter-op to prevent CVS
  - ♥ Bolus dose of 1-2mg/kg over 10-20 min followed by an infusion of 0.25mg/kg/hr for 48-72 hours, do not exceed 2mg/kg

### Treatment for Cardiac Vasoplegic Syndrome

Phenylephrine, Norepinephrine  
or Vasopressin

- ♥ Treats refractory hypotension when used in conjunction with Methylene Blue
- ♥ Potent vasoconstrictor

### Nursing Role

- ♥ Early identification of Cardiac Vasoplegic Syndrome
- ♥ Notification to cardiac surgeon
- ♥ DO NOT KEEP GIVING VOLUME!

CABGx3, on Insulin drip, Epinephrine drip, and precedex drip

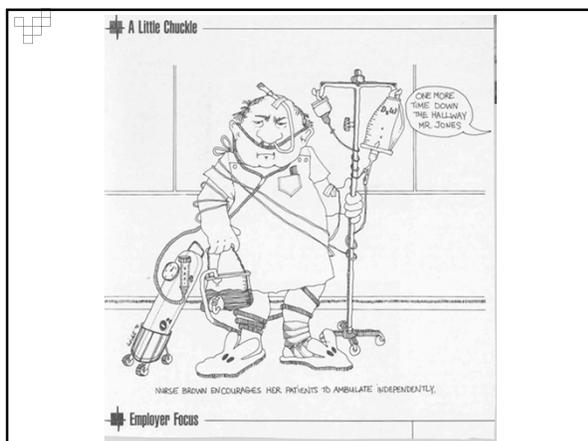
PMH: ½ ppd smoker x20 years, depression with use of SSRI's, EF = 30%, HF -- Coreg and Lisinopril

	Admission Vitals	One Hour Later after albumin & Neosynephrine
MAP	60	40
CVP	3	1
CO/CI	4.5/2.5	4.2/2.1
SVR	1012	770

Needs  
Methylene Blue and  
Vasopressin

### Walk To Recovery

- ♥ Chairs for Meals
- ♥ Scheduled Walks
  - 1<sup>st</sup> Walk: Between 06 – 08
  - 2<sup>nd</sup> Walk: Before Lunch
  - 3<sup>rd</sup> Walk: Before 1330
  - 4<sup>th</sup> Walk: Before Dinner
  - 5<sup>th</sup> Walk: After Dinner
  - 6<sup>th</sup> Walk: Before Bed



Do you  
feel like  
you  
ran a  
marathon?



### Warning Signs of Trouble

- ♥ Tachycardia
  - Persistent tachycardia is a compensatory mechanism
- ♥ Cool extremities
- ♥ Diminished peripheral pulses
- ♥ Changes in mentation
- ♥ Decreased urine output
- ♥ Hypotension



### AN OUNCE OF PREVENTION IS WORTH A POUND OF CURE.



### PAY ATTENTION TO THE THINGS

You will save more lives by being **METICULOUS** than by being **BRILLIANT**



### Don't miss the obvious!



### Next Steps

- ♥ Make a study action plan
- ♥ Set the target test date
- ♥ Get a study partner

- ♥ Take out your cell phone
- ♥ Take a selfie

CCRN or CSC

▼ By \_\_\_\_\_  
(insert date)

Place selfie here

**Challenging Complex**

**Cardiac Pulmonary**

**Case Studies**

**Tomorrow!**

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