"Basic" Cardiology

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Paramedic, Emergency Physician, Flight Physician, & EMS Medical Director
Bon Secours Mercy Health Emergency Medicine and Life Flight
Toledo, Ohio

1

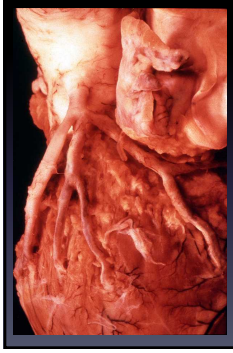
My Primary Sources

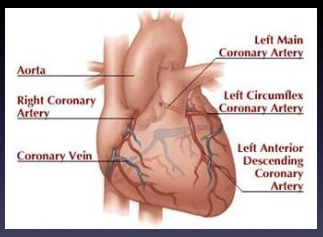
3

ANATOMY & PHYSIOLOGY

4

Cardiac Anatomy

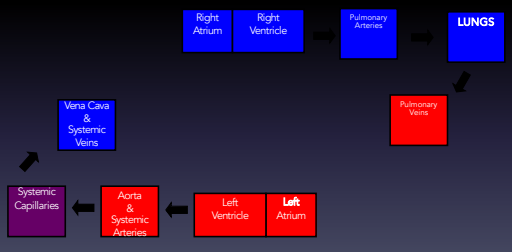




5

Cardiac Physiology

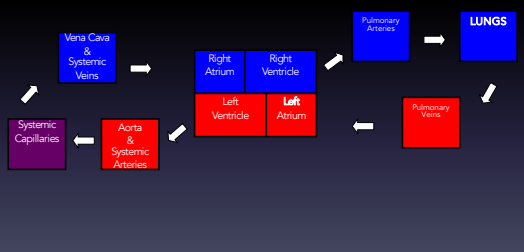
Right Heart (PULMONARY PUMP)



Left Heart (SYSTEMIC PUMP)

6

Cardiac Physiology

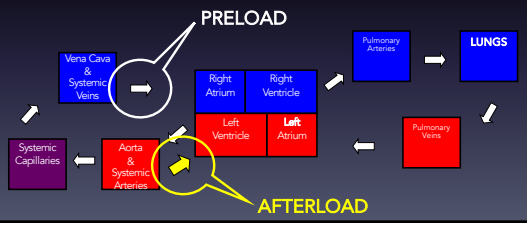


7

Cardiac Physiology

- Contractility- amount of squeeze
- Preload- blood entering heart
- Afterload- pressure in the aorta

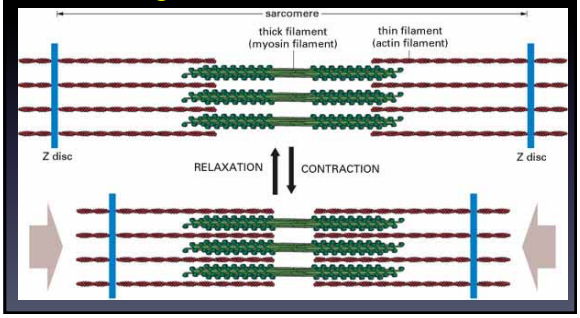
WORKLOAD VARIABLES



8

Frank-Starling

The more you stretch the heart, the greater its contraction.



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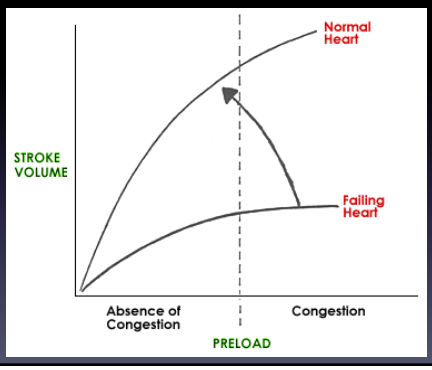
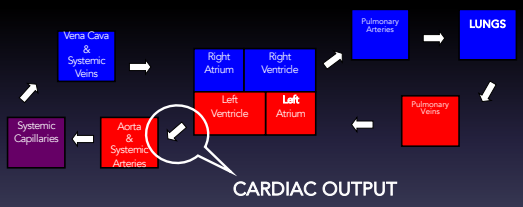
Frank-Starling

The more you stretch the heart, the greater its contraction.



10

CO = HR x SV



11

BP = CO x SVR

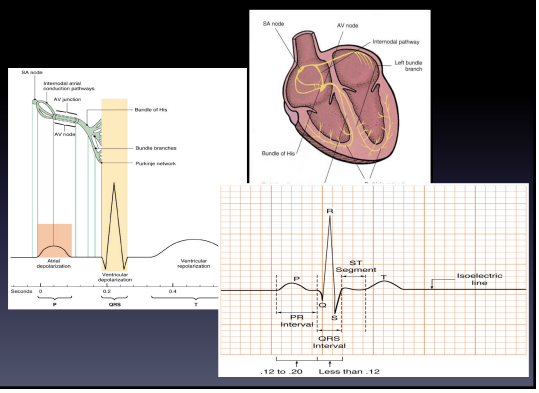
1. Systolic Pressure
   - Measure of LV function
   - Close measure of CO
   - Equal to resistance

   SBP
2. Diastolic Pressure
   - Measure of SVR
   - Equal to volume

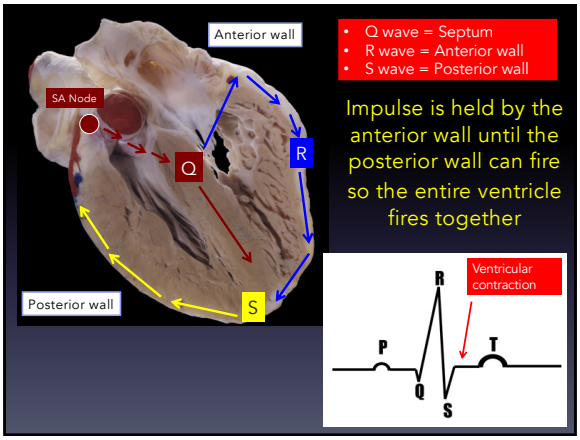
   DBP

12

Cardiac Electrophysiology



13



14

Bradycardia

- Sinus Bradycardia

CO = HR x SV

- Idioventricular

BP = CO x SVR

15

Tachycardia

- Supraventricular Tachycardia (SVT)

CO = HR x SV

- Ventricular Tachycardia (V-Tach)

BP = CO x SVR

16

Rural emergency medical technician pre-hospital electrocardiogram transmission

AM Powell, JM Halom, J Nelson
Landsbaum Center for Health Education, Indiana State University, Indiana, USA
Indiana University Health West Hospital, Avon, Indiana, USA

Submitted: *5 June 2013;* ***Revised:*** *13 September 2013;* ***Accepted:*** *14 September 2013;* ***Published:*** *2 May 2014*

This study suggests that if cost factors (equipment and training) are not significant, non-paramedic ECG acquiring and transmission should be considered. This study used EMT-B, EMT-A, EMT-I providers.

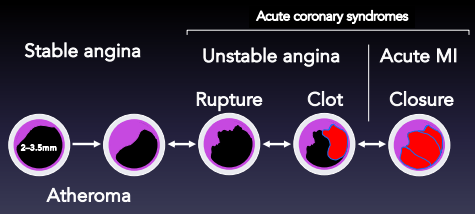
17

PATHOPHYSIOLOGY

ACUTE CORONARY SYNDROME (ACS)
&
ACUTE HEART FAILURE

18

Pathophysiology



19

Annals of Internal Medicine ORIGINAL RESEARCH

Warning Symptoms Are Associated With Survival From Sudden Cardiac Arrest

Eloi Marijon, MD, PhD*; Audrey Uy-Evanado, MD*; Florence Dumas, MD, PhD; Nicole Karam, MD, MPH; Kyndaron Reinier, MPH, PhD; Carmen Teodorescu, MD, PhD; Kumar Narayanan, MD; Karen Gunson, MD; Jonathan Jui, MD; Xavier Jouven, MD, PhD; and Sumeet S. Chugh, MD

- 839 sudden cardiac deaths from Oregon
- In depth review of victims' prior 4 weeks
- Family, friends, med records & survivors questioned
- CP, SOB, palpitations, syncope, N/V, back pain??

Sudden Death? Not really so sudden…

20

Annals of Internal Medicine ORIGINAL RESEARCH

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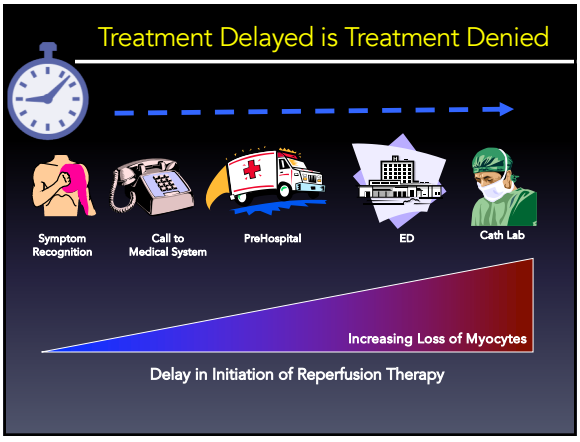
- 51% had at least one symptom in preceding 4 weeks of SCA
- ½ had CP (46.3%, 2:1 M vs F)
- 18.1% had SOB (2:1 F vs M)
- 2/3 of pts ignored symptoms

Almost all (93%) had sx or worsening within 24 hours of their cardiac arrest

21



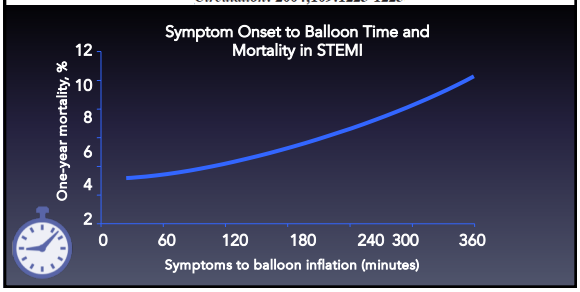
22

Time Delay to Treatment and Mortality in Primary Angioplasty for Acute Myocardial Infarction

Every Minute of Delay Counts

Giuseppe De Luca, MD; Harry Suryapranata, MD, PhD; Jan Paul Ottervanger, MD, PhD; Elliott M. Antman, MD

Circulation. 2004;109:1223-1225



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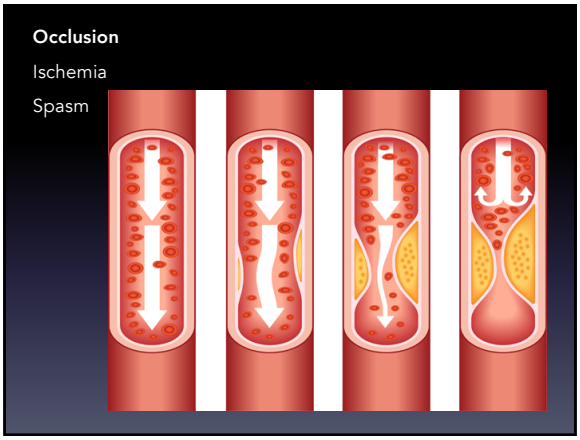

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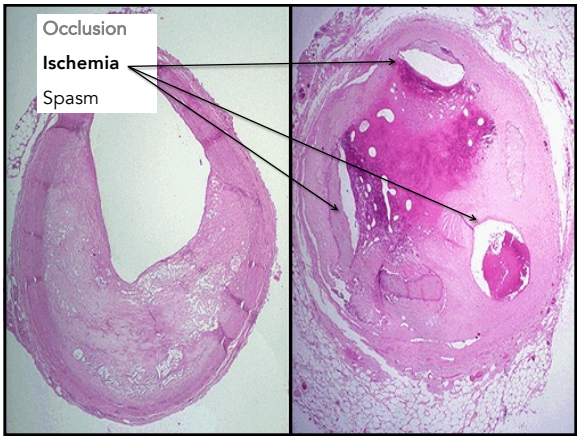
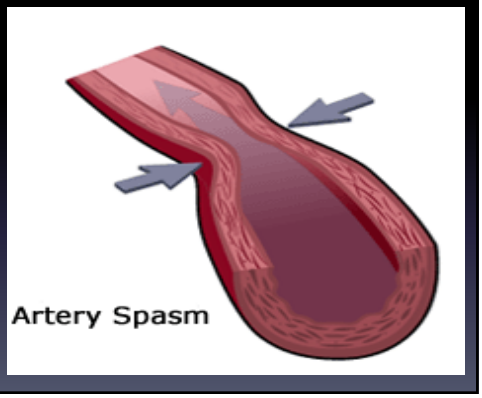


27

Occlusion
Ischemia
Spasm



28

BLS Management of ACS

- Oxygen
- Nitrates
- Aspirin

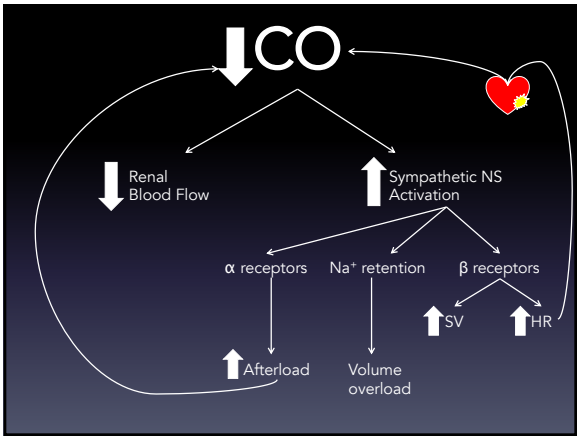
29

The Basics of Heart Failure

- Systolic dysfunction
  - Can't contract
- Diastolic dysfunction
  - Can't relax

ONLY distinguishable by Echo
•SHF- Low EF and dilation
•DHF –Normal EF

30



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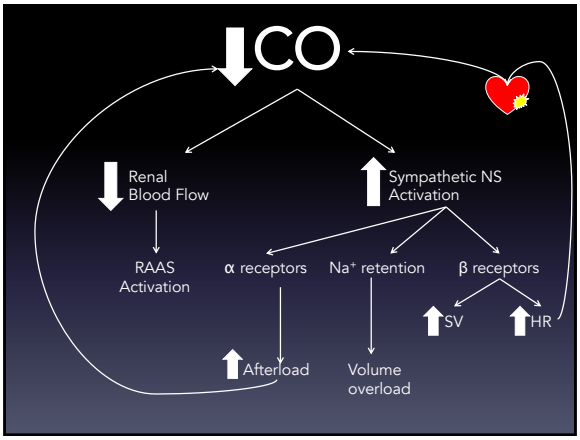

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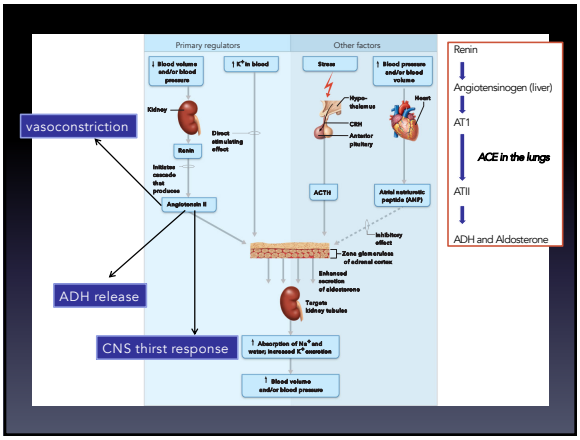

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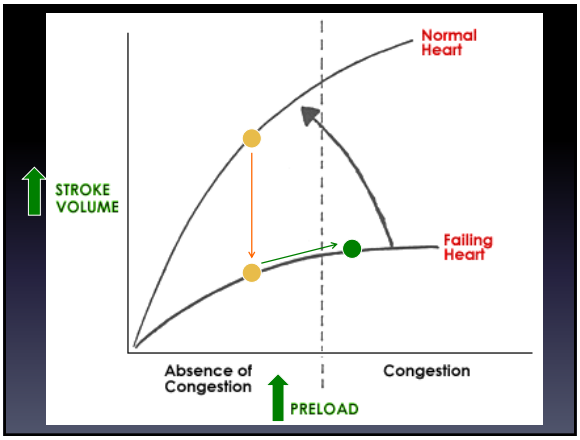
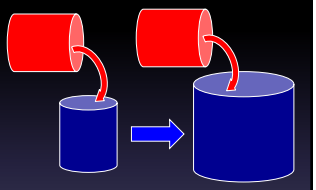


34

Systolic Dysfunction – Can't Contract

Infarction
Dilation
Regurgitation
CHF

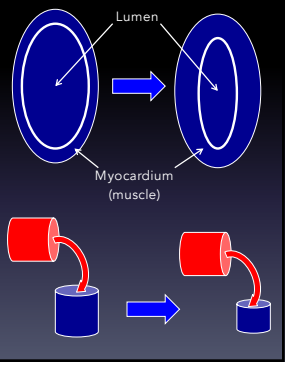


After an infarct, no one becomes more efficient

35

Diastolic Dysfunction – Can't Relax

HTN/Ischemia
Hypertrophy
Loss of capacity
CHF



36

The Basics of CHF

- In CHF, all three components are not working:
  - Contractility- not squeezing
  - Preload- too much fluid
  - Afterload- too much pressure

All 3 of these parameters must be corrected to improve cardiac function

CO = HR x SV

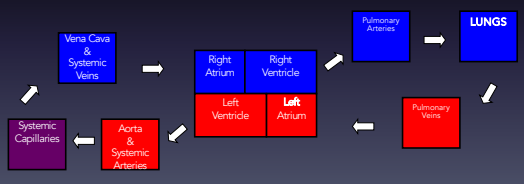
BP = CO x SVR

37

Clinical Signs of Heart Failure

- Right Sided Symptoms
  - Systemic edema
- Left Sided Symptoms
  - Pulmonary Edema

Left Heart Failure often leads to Right Heart Failure



38

Left Ventricular Failure

- Blood is delivered to the left heart but there is not enough contractile force to eject all of the volume
- The increase in end-diastolic blood volume increases left ventricular end-diastolic pressure, which is transmitted to the left atrium and subsequently to the Pulmonary veins and capillaries.

39

BLS Management of AHF

- Oxygen
- CPAP
- Nitrates

40

BLS MANAGEMENT OF ACS & AHF

41

Applying Classification of Recommendations and Level of Evidence

"SIZE of TREATMENT EFFECT"

"Estimate of Certainty (Precision) of Treatment Effect"

	Class I (Do it!)	Class IIa (???)	Class IIb (???)	Class III (Hail Mary)
	Benefit >>> Risk *No additional studies needed* Procedure/Treatment SHOULD be performed/administered	*Benefit >> Risk* *Additional studies with focused objectives needed* IT IS REASONABLE to perform procedure/administer treatment	*Benefit ≥ Risk* *Additional studies with broad objectives needed; Additional registry data would be helpful* IT IS NOT UNREASONABLE to perform procedure/administer treatment	*Risk ≥ Benefit* *No additional studies needed* Procedure/Treatment should NOT be performed/administered SINCE IT IS NOT HELPFUL AND MAY BE HARMFUL
Level A *Multiple (3-5) population/risk strata evaluated* *General consistency of direction and magnitude of effect*	• Recommendation that procedure or treatment is useful/effective • Sufficient evidence from multiple randomized trials or meta-analyses	• Recommendation in favor of treatment or procedure being useful/effective • Some conflicting evidence from multiple randomized trials or meta-analyses	• Recommendation's usefulness/efficacy less well established • Greater conflicting evidence from multiple randomized trials or meta-analyses	• Recommendation that procedure or treatment not useful/effective and may be harmful • Sufficient evidence from multiple randomized trials or meta-analyses
Level B *Limited (2-3) population/risk strata evaluated*	• Recommendation that procedure or treatment is useful/effective • Limited evidence from single randomized trial or non-randomized studies	• Recommendation in favor of treatment or procedure being useful/effective • Some conflicting evidence from single randomized trial or non-randomized studies	• Recommendation's usefulness/efficacy less well established • Greater conflicting evidence from single randomized trial or non-randomized studies	• Recommendation that procedure or treatment not useful/effective and may be harmful • Limited evidence from single randomized trial or non-randomized studies
Level C *Very limited (1-2) population/risk strata evaluated*	• Recommendation that procedure or treatment is useful/effective • Only expert opinion, case studies, or standard-of-care	• Recommendation in favor of treatment or procedure being useful/effective • Only diverging expert opinion, case studies, or standard-of-care	• Recommendation's usefulness/efficacy less well established • Only diverging expert opinion, case studies, or standard-of-care	• Recommendation that procedure or treatment not useful/effective and may be harmful • Only expert opinion, case studies, or standard-of-care

American Heart Association Recommmendations - 2016

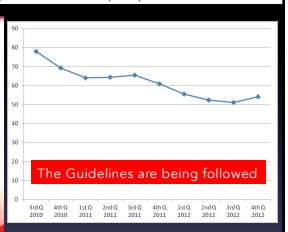
42

Prehospital Oxygen Administration for Chest Pain Patients Decreases Significantly following Implementation of the 2010 AHA Guidelines

Elliot Carhart, EdD, RRT, NRP, Joshua G. Salzman, MA, EMT-B

Acute Coronary Syndromes (ACS)

- Support for STEMI systems of care
- Continue to implement prehospital 12-lead ECG program
- Triage to hospitals capable of performing PCI
- Supplementary oxygen is not needed for patients without evidence of respiratory distress if the oxyhemoglobin saturation is ≥ 94%.
- Use morphine with caution



Data also revealed that 50% of patients not meeting criteria for administration still received supplemental O2. [1]

2014

43

Effects of supplemental oxygen administration on coronary blood flow in patients undergoing cardiac catheterization

Patrick H. McNulty,[1] Nicholas King,[1] Sofia Scott,[1] Gretchen Hartman,[1] Jennifer McCann,[1] Mark Kozak,[1] Charles E. Chambers,[1] Laurence M. Demers,[2] and Lawrence I. Sinoway[1]
Departments of [1]Medicine and [2]Pathology, Pennsylvania State College of Medicine, Milton S. Hershey Medical Center, Hershey, Pennsylvania

- supplemental oxygen can
  - Increase coronary vascular resistance
  - decrease coronary blood flow
  - increase infarct size
  - increase mortality

Ok for anyone in the 1st 6 hours of a cardiac event [2]

2005 & 2009

44

Journal of the American College of Cardiology
© 2002 by the American College of Cardiology Foundation
Published by Elsevier Science Inc.
Vol. 39, No. 11, 2002
ISSN 0735-1097/02/$22.00
PII S0735-1097(02)01856-9

Influence of Prehospital Administration of Aspirin and Heparin on Initial Patency of the Infarct-Related Artery in Patients With Acute ST Elevation Myocardial Infarction

- Aspirin [1]
  - Inhibits platelet aggregation (blocks TxA_2)
  - Platelet half-life 5 - 7 days
  - Decreased MI by 47%
  - Prehospital administration of aspirin and heparin results in a higher initial patency of the IRA in patients with acute MI.
  - **31% vs. 20% overall flow and angioplasty success rate of 94% vs. 89%.**

45

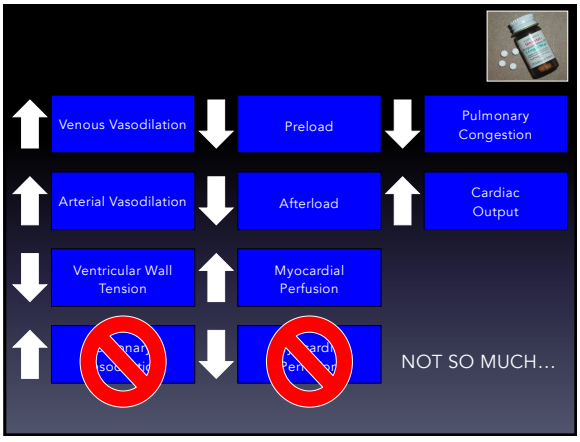
NAEMSP Abstracts

Abstracts for the 2014 NAEMSP Scientific Assembly

PREHOSPITAL ASPIRIN ADMINISTRATION FOR ACUTE CORONARY SYNDROME (ACS) IN THE UNITED STATES: AN EMS QUALITY ASSESSMENT USING THE NEMSIS (NATIONAL EMS INFORMATION SYSTEM) DATABASE

Of the total 14,371,941 EMS incidents in the 2011 database, there were 198,231 patients who met ASA inclusion criteria (1.3%). Only 45.4% received aspirin from the EMS provider.

46



47

NAEMSP Abstracts

Abstracts for the 2014 NAEMSP Scientific Assembly

PREHOSPITAL NITROGLYCERIN IN TACHYCARDIC CHEST PAIN PATIENTS: RISKY OR NOT?

There was a statistically significant increase in the relative risk of hypotension with NTG administration in patients who were tachycardic.

48

CPAP for AHF

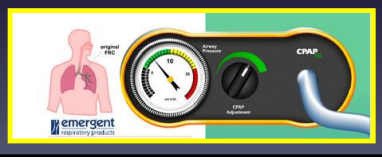
- The Benefits
  - improvement in oxygen saturation
  - improvement of vital signs
  - decreased incidence of pre-hospital intubation
- Constant throughout cycle
  - it is described as being similar to breathing with your head stuck out the window of a moving car

Used extensively in the prehospital environment. [1]

49

CPAP

- Continuous Positive Airway Pressure
  - Single airway pressure is maintained throughout all phases of the respiratory cycle.
  - Decreases WOB and improves alveolar ventilation while resting the respiratory musculature.
  - The positive pressure also helps keep diseased bronchioles open, and promotes the inhibition of fluid accumulation in the alveoli



50

BiPAP vs CPAP

EUROPEAN RESPIRATORY *journal*
OFFICIAL SCIENTIFIC JOURNAL OF THE ERS

Effects of biphasic positive airway pressure in patients with chronic obstructive pulmonary disease

E. Katz-Papatheophilou, W. Heindl, H. Gelbmann, P. Hollaus, M. Neumann

- BiPAP resulted in overall higher intrathoracic pressures – reduces myocardial perfusion
- BiPAP resulted in lower tidal volumes
- BiPAP resulted in higher WOB

51

Effectiveness of Prehospital Continuous Positive Airway Pressure in the Management of Acute Pulmonary Edema

Michael W. Hubble, PhD, NREMT-P, Michael E. Richards, MD, MPA, Roger Jarvis, EMT-P, Tori Millikan, EMT-P, Dwayne Young, BS, EMT-P

CPAP

CPAP was associated with a substantially lower rate of intubation and mortality.

Intubation Rate
- 25.26% Non-CPAP
- 8.92% of CPAP

Mortality Rate
- 23.15% Non-CPAP
- 5.35% of CPAP

52

Quick Discussion on some ALS stuff

- ACS
  - Morphine
    - STEMI 1
    - NSTEMI 2
  - Beta Blockers
  - Plavix (clopidogrel) 1
    - Decreases Stroke and MI Mortality
    - Increases Bleeding risk
- AHF
  - Morphine
  - Beta Blockers
  - Diuretics
  - Inotropes
  - ACE-I 1

53

CATH LAB CASES

54

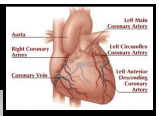
CASE 1

- 54 yo female
- Hx of poorly controlled DM, hyperlipidemia, HTN
- CC:
  - –6 hours of substernal chest pain

55

CASE 1

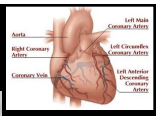
LAD bifurcation pre PCI



56

CASE 1

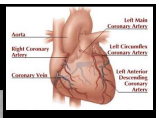
LAD bifurcation post angioplasty, pre-stent



57

CASE 1

LAD bifurcation post-stenting



58

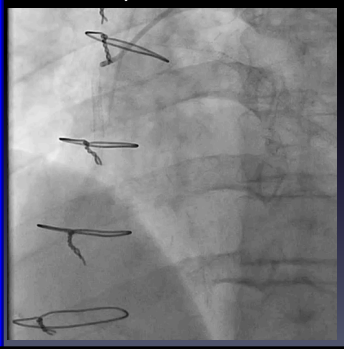
CASE 2

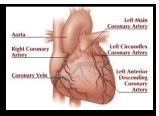
- 70 yo male
- Hx of bypass surgery 1-year ago
- Hx of DM and CVA 1-year ago with
- Current CC:
  - –recurrent CP over the last 2 months

59

CASE 2

Vein graft occlusion 1 year post CABG

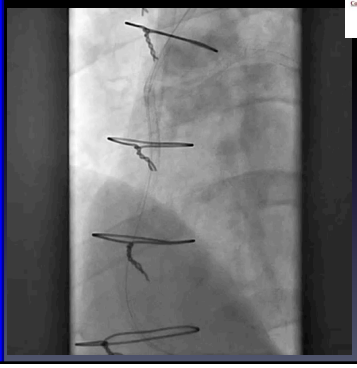


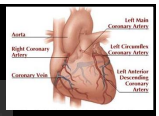


60

CASE 2

Vein graft stenting





61

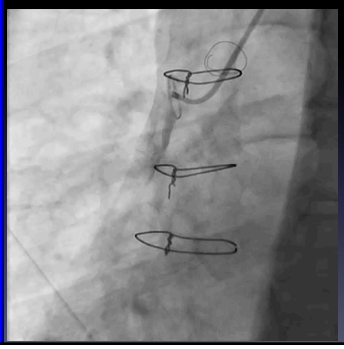
CASE 2

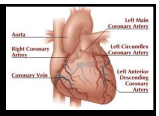
- Vein graft stenting was successful…
- Less than 24 hours after stent placement, the patient develops significant 9/10 CP
- Patient is taken back to the cath lab

62

CASE 2

Vein graft stent had become re-occluded

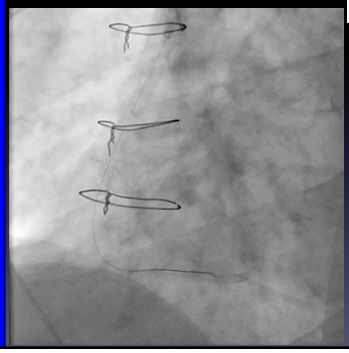


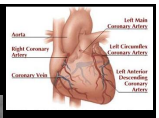


63

CASE 2

Additional stent placed in the vein graft





64

CASE 2

CASE CLOSED WITHOUT EVENT

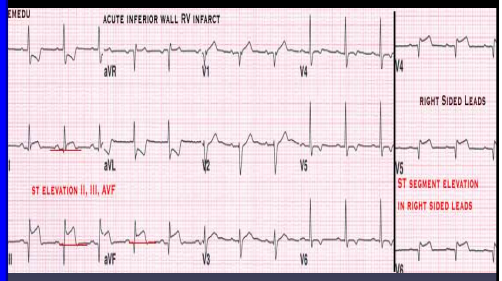
65

CASE 3

- 50 yo male
- Hx of HTN and dyslipidemia
- Current CC:
  - 30 minutes of excrutiating 11/10 CP, nausea, vomiting, diaphoresis, SICK GUY!

66

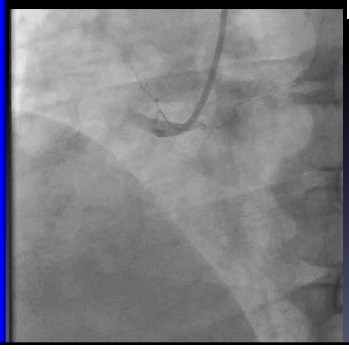
CASE 3

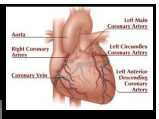


67

CASE 3

Squirting the RCA

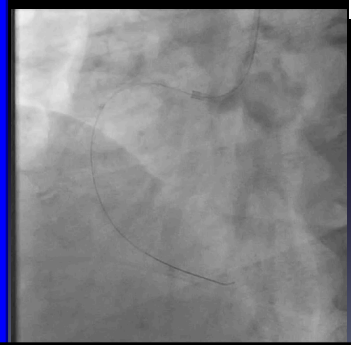


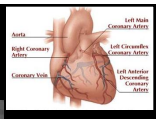


68

CASE 3

Post stenting of the RCA





69

CASE 3

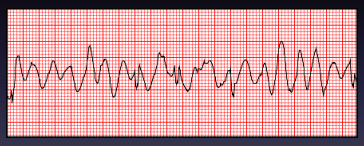
5 min post stenting, patient is completely pain free and ready to go home…

CASE CLOSED

70

CASE 5

- 62 year old male… wife (RN) heard him gasp while laying in bed… immediately began CPR, called 911
- Presents S/P Arrest – arrived to the ED in the following rhythm:



- Pt sent to Cath lab and "CODE ICE" protocol initiated

71

CASE 5

Therapeutic Hypothermia
"Code ICE"

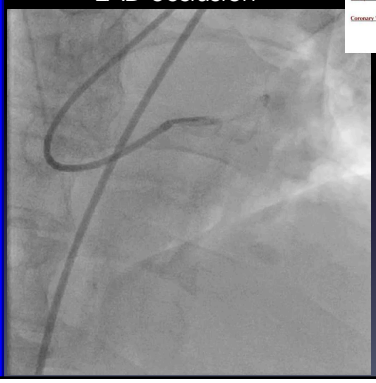
Now called "targeted temperature management"

Hypothermia works by cooling down the body and brain to reduce inflammation and protect the brain from further damage

72

CASE 5

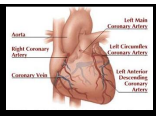
Nearly complete LAD occlusion

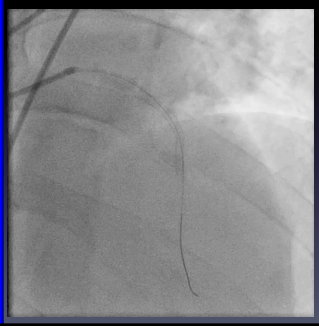


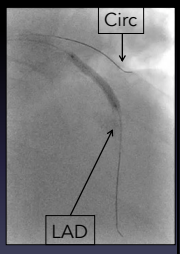
73

CASE 5

Recanalized LAD







Why would there be a wire in the circ?

74

CASE 5

Patient arrives in VF and walks out of the Hospital with no deficits

CASE CLOSED

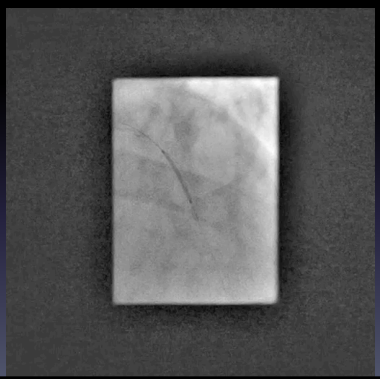
75

CASE 5

- 61 yo female
- Hx of HTN
- Current CC:
  - –45 minutes of excruciating CP!

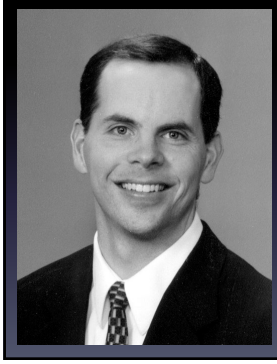
76

Stent being deployed



77

Big Thanks to David J. Meier, MD
Interventional Cardiologist



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78

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79