Emergency Medicine

CARDIOVASCULAR

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USC University of Southern California
Ostrow School of Dentistry of USC

Stanley F. Malamed, DDS

Dentist Anesthesiologist
Emeritus Professor of Dentistry
Herman Ostrow School of Dentistry of U.S.C.
Los Angeles, CA, USA

USC University of Southern California
Ostrow School of Dentistry of USC

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CODA Commission on Dental Accreditation

11 March 2019

ADA American Dental Association

The American Dental Association recognized

Anesthesiology

as the 10th dental specialty

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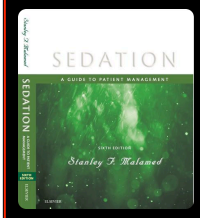

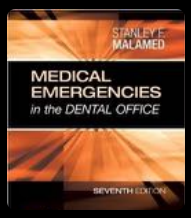

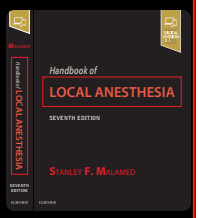

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4:00 - 5:30 Emergency medicine, part 2 - cardiovascular emergencies

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Medical emergencies
CAN and **DO**
happen
in the practice of
dentistry

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Medical emergencies
CAN and **DO**
happen
in the practice of
dentistry

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4,307 doctors in North America

- 94.9% have experienced at least one medical emergency in their office
- Average length of career 14.7 years
- 30,608 emergencies reported
- 7.1 emergencies per doctor during career

Malamed SF, J Amer Dent Assoc 1993;124(8):40-53

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Syncope	15,407 (50.3%)
Mild allergy	2,583 (8.4%)
Angina pectoris	2,552 (8.3%)
Postural hypotension	2,475 (8.1%)
Seizure	1,595 (5.2%)
Asthmatic attack	1,392 (4.5%)
Hyperventilation	1,326 (4.3%)
Epinephrine Rxn	913 (3.0%)
Hypoglycemia	890 (2.9%)
Cardiac arrest	331 (1.1%)
Anaphylaxis	304 (1.0%)
Myocardial infarction	289 (0.9%)
L.A. Overdose	204 (0.7%)

ALL patients
(Adult, Pediatric, Geriatric)

All ages
N = 4,307

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30,608 reported emergencies
4,307 doctors in North America

- 1 emergency every 2 years (includes syncope)
- 1 emergency every 4 years (excluding syncope)

1993

Malamed SF, J Amer Dent Assoc 1993;124(8):40-53

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PREPARATION

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Preparation of the Office & Staff

1. Basic Life Support training
2. Preparation of Dental Office Staff Members
3. Emergency Assistance
4. Emergency Drugs & Equipment

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Preparation of the Office & Staff

1. ***Basic Life Support - CPR***
2. ***Basic Life Support - CPR***
3. ***Basic Life Support - CPR***
4. ***Basic Life Support - CPR***
5. ***Basic Life Support - CPR***
6. ***Basic Life Support - CPR***
7. ***Basic Life Support - CPR***
8. Office Emergency TEAM
9. Emergency Assistance
10. Emergency Drugs & Equipment

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Preparation of the Office & Staff

1. Basic Life Support training
2. *Preparation of Dental Office Staff Members*
3. Emergency Assistance
4. Emergency Drugs & Equipment

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Preparation of the Office & Staff

1. Basic Life Support training
2. Preparation of Dental Office Staff Members
3. *Emergency Assistance*
4. Emergency Drugs & Equipment

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Emergency Medical Services

9 1 1

9 1 1

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Preparation of the Office & Staff

1. Basic Life Support training
2. Preparation of Dental Office Staff Members
3. Emergency Assistance
4. *Emergency Drugs & Equipment*

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Critical Drugs & Equipment
THE BASIC EIGHT
(as per Malamed)

1. Epinephrine
2. Histamine-blocker
3. Bronchodilator
4. Nitroglycerin
5. 'Sugar'
6. Aspirin
7. Naloxone
8. Oxygen

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Vasodilator

Angina pectoris

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Coronary artery VASODILATOR

Nitroglycerin

- Nitrolingual spray
- Nitrostat sublingual tablets
- 0.4 mg/dose

- INDICATION: Angina pectoris;
  Prehospital management of cardiac pain
- CONTRAINDICATION:
  - Hypotension (Systolic BP <90mmHg)

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Thrombolytic

Suspected myocardial infarction

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Thrombolytic

Aspirin (ASA)

- 325 mg
- Chewed / swallowed or
- Chewable or
- **Powdered**

- INDICATION: Suspected myocardial infarction
- CONTRAINDICATION: Allergy

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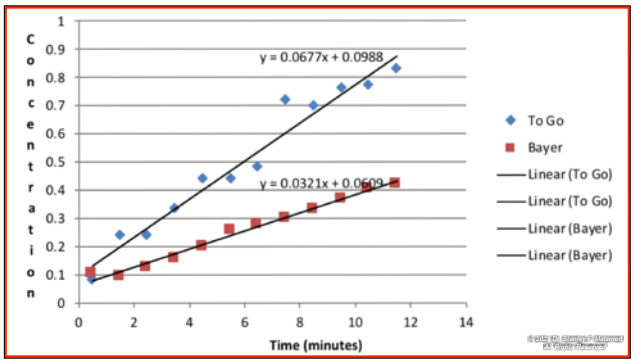

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Oxygen

All emergencies

Do not withhold O_2 from a patient during a medical emergency

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Oxygen

The 2nd most important drug in emergency medicine

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Oxygen

- Do NOT withhold OXYGEN from a patient during a medical emergency.
- It may not make them better, but it will not make them worse

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Emergency Medications and Indications
Prepared by Stanley Malamed, DDS

The table below outlines Dr. Stanley Malamed's recommended list of emergency medications for dental practices. Dr. Malamed is a Diplomate of the American Dental Board of Anesthesiology as well a continuing education lecturer on anesthesia, sedation, and emergency medicine. He has authored more than 170 scientific papers and three textbooks that are used around the world.

Medication	Indication	Adult Dose & Route (>40 lb; >30 kg)	Pediatric Dose & Route (33 to 66 lb; 15 to 30 kg)
Albuterol metered dose inhaler	Bronchospasm (acute asthma attack)	1 – 2 puffs Spacer recommended Repeat every 5 minutes, PRN	1 – 2 puffs Spacer recommended Repeat every 5 minutes, PRN
Aspirin	Suspected myocardial infarction ("heart attack")	325 mg, chewable or powdered preferred	N/A
Diphenhydramine	Allergy (non-life threating)	50 mg IM (vastus lateralis)	25 mg IM (vastus lateralis)
Epinephrine autoinjector	Anaphylaxis (life threating allergy)	0.3 mg IM vastus lateralis Repeat every 5 minutes, PRN	0.15 mg IM vastus lateralis Repeat every 5 minutes, PRN
Glucose gel (oral)	Hypoglycemia (conscious and able to cooperate)	Squeeze entire content of tube (15 grams glucose gel) into mouth and swallow	Squeeze entire content of tube (15 grams glucose gel) into mouth and swallow
Naloxone nasal spray	Suspected opioid overdose	1 spray (4 mg) naloxone, IN Repeat every 2 - 3 minutes in alternating nostrils	1 spray (4 mg) naloxone, IN Repeat every 2 - 3 minutes in alternating nostrils
Nitroglycerin translingual spray	Angina or suspected myocardial infarction	2 metered sprays (0.4 mg x2) on surface of tongue	N/A
Nitroglycerin sublingual tablets	Angina or suspected myocardial infarction	2 sublingual tablets (0.4 mg x2)	N/A
Oxygen	Any emergency (except hyperventilation)	15 liters/minute via face mask	15 liters/minute via face mask
Device: Automated External Defibrillator (AED)	Unconscious and no palpable pulse	As directed by AED	As directed by AED

PRN = as needed IM = intramuscularly IN = intranasally

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BASIC EQUIPMENT

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Disposable face masks (pediatric & adult for ventilation with supplemental O_2)

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Automated External Defibrillator (AED)

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Survival Rates from SCA

Survival - *to hospital discharge* - is dependent upon:

- Bystander initiated CPR
- Time from collapse to defibrillation

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Sudden Cardiac Arrest

70% of out-of-hospital SCA occur in the HOME of the victim. (2018)

As dentists we have TWO homes:

- The one in which we live
- The one in which we work

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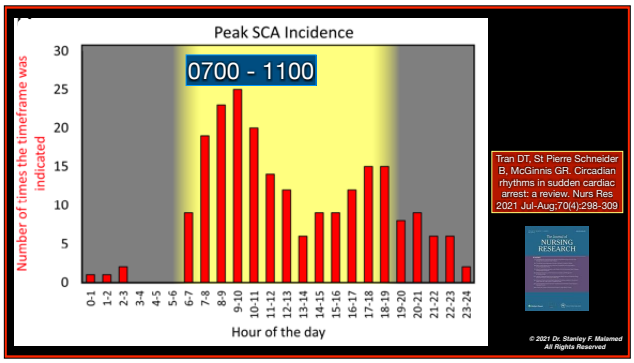

Tran DT, St Pierre Schneider B, McGinnis GR. Circadian rhythms in sudden cardiac arrest: a review. Nurs Res 2021 Jul-Aug;70(4):298-309

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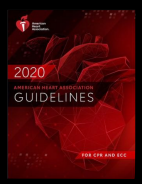
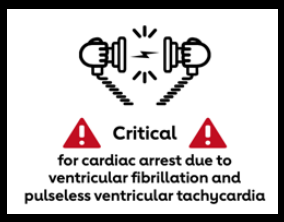
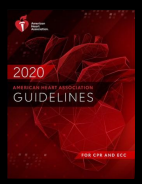
Defibrillation







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Automated External Defibrillator
(AED)

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EMERGENCY MANAGEMENT ALGORITHM

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P - C - A - B - D

P = Position . . . . . **Conscious** = comfortable; **Unconscious** = supine

C = Circulation . . . . . **Assess & chest compression** if needed

A = Airway . . . . . **Assess & maintain airway** (head tilt-chin lift) if needed

B = Breathing . . . . . **Assess & ventilate** if needed

D = Definitive Care . . . **Diagnosis**, **Drugs**, **Defibrillation**

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P = position

P = Position . . . . . **Conscious** = comfortable;

Unconscious = supine

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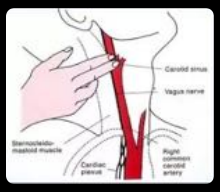
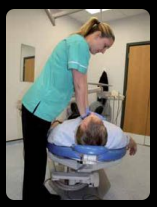
C = circulation





C = Circulation . . . . . **Assess & chest compression** if needed

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A = airway
B - breathing

A = Airway . . . . **Assess & maintain airway** (head tilt-chin lift) if needed

B = Breathing . . . . **Assess & ventilate** if needed

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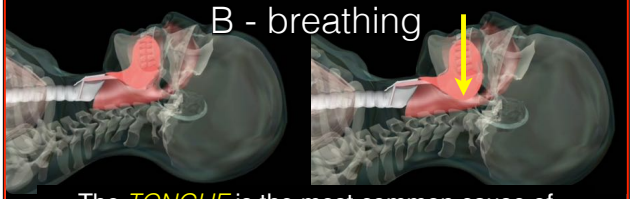
A = airway
B - breathing



The *TONGUE* is the most common cause of respiratory (airway) obstruction in the unconscious patient.

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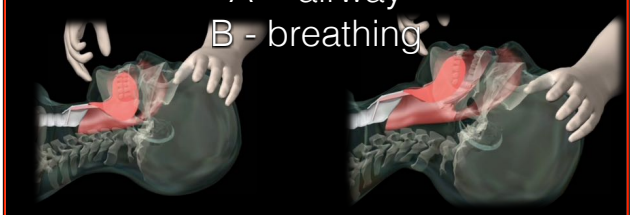
A = airway
B - breathing



- *BASIC airway maneuver:*
- **HEAD TILT - CHIN LIFT**

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D = Definitive Care . . .

Diagnosis

Drugs

Defibrillation

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Emergency Medicine

CARDIOVASCULAR

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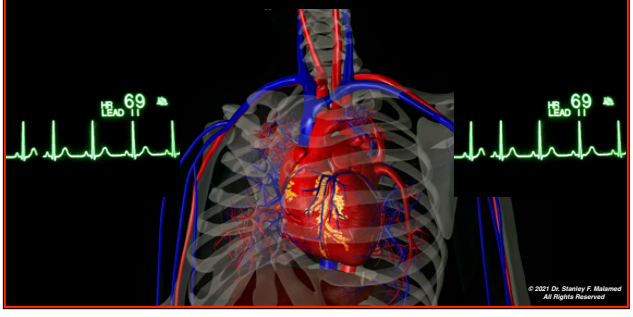
The HEART is a PUMP



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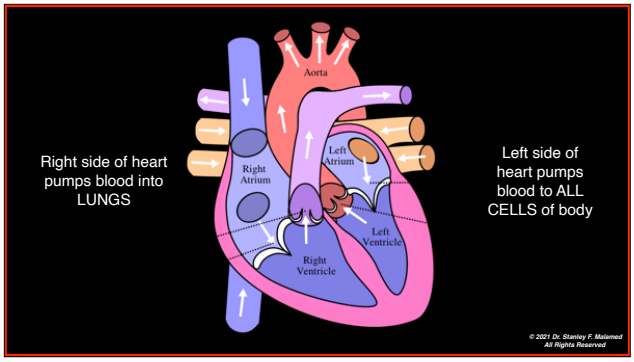

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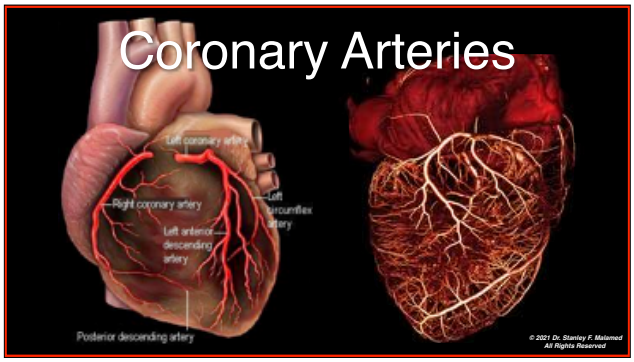

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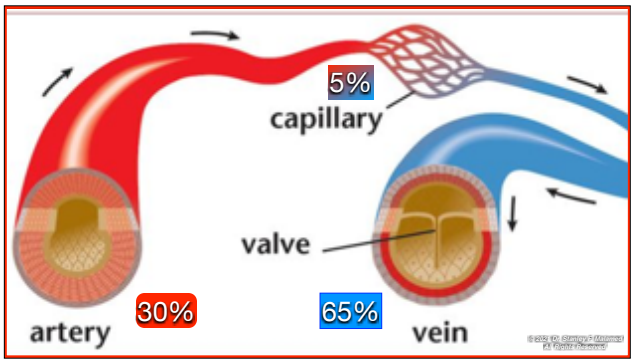

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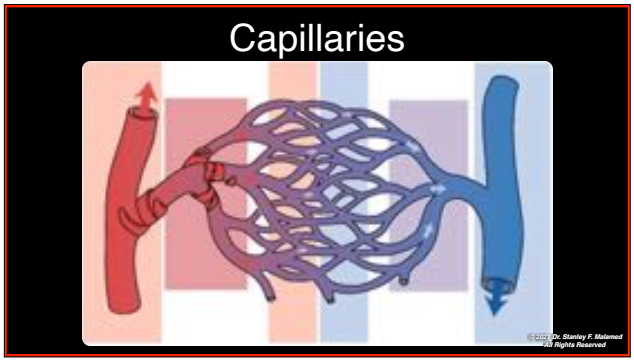

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MYOCARDIUM

Blood flows through coronary arteries only during DIASTOLE, not systole

Skeletal muscle extracts **25%** to **30%**

Cardiac muscle extracts **60%** to **80%** of available O_2 in blood;

Coronary arteries dilate when myocardial workload increases

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Let's look at
CARDIOVASCULAR DISEASE

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Syncope	15,407 (50.3%)
Mild allergy	2,583 (8.4%)
Angina pectoris	2,552 (8.3%)
Postural hypotension	2,475 (8.1%)
Seizure	1,595 (5.2%)
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Myocardial infarction	289 (0.9%)
L.A. Overdose	204 (0.7%)

ALL patients
(Adult, Pediatric, Geriatric)

All ages
N = 4,307

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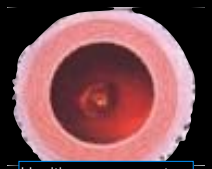
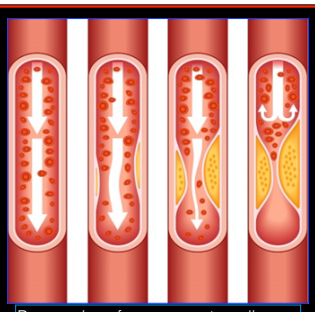


Healthy coronary artery



Progression of coronary artery disease

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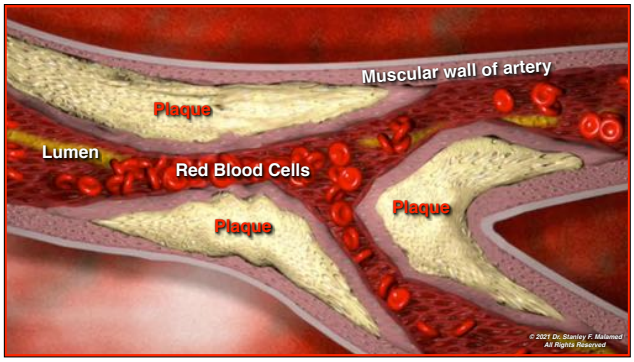

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Angina Pectoris

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Angina Pectoris

Stable angina
Unstable angina

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(stable) Angina Pectoris

Angina pectoris, commonly known as angina, is the sensation of chest pain, pressure, or squeezing, often due to ischemia of the heart muscle from obstruction or spasm of the coronary arteries.

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Angina of Exertion

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(stable) Angina Pectoris

Anything increasing the workload of the heart can induce an anginal episode

The 4 E's of angina

Exertion
Emotion
Eating
Extremely cold or hot weather

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Transient Myocardial Ischemia = Angina Pectoris

Myocardium not receiving an adequate blood supply becomes ischemic, leading to the onset of anginal 'pain'

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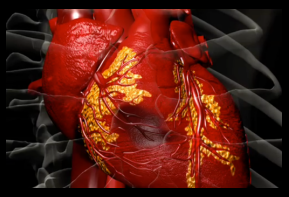
(stable) Angina Pectoris



With rest or administration of nitroglycerin the myocardial workload decreases and the chest 'pain' dissipates

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Angina Pectoris . . . Management

P . . . Conscious = Comfortable (usually upright preferred)

C . . . Assess . . . prn

A . . . Assess . . . prn

B . . . Assess . . . prn

D . . . **Nitroglycerin**, O_2

D . . . Determine cause, modify future treatment

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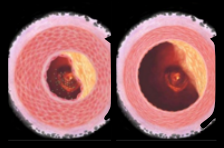
Nitroglycerin

Nitroglycerin produces a 28% increase in coronary artery lumenal diameter



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Angina pectoris and dentistry

The only time **ANGINA** should be considered as a diagnosis in acute chest "pain" is where the patient (victim) has a **PREEXISTING HISTORY of ANGINA**

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(stable) Angina Pectoris

On termination of the acute episode, the planned dental treatment MAY proceed if BOTH the patient and the dentist are comfortable doing so

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Angina Pectoris

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Acute Coronary Syndrome
ACS

Any condition brought on by a sudden reduction or blockage of blood flow to the heart

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Acute Coronary Syndrome

Unstable angina
Acute myocardial infarction
- STEMI
- Non-STEMI

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Consider
Myocardial Infarction:

ALWAYS
when there is no prior history
of
cardiovascular disease

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Consider Myocardial Infarction

In anginal patient when:

- 'Pain' worse than usual
- 3 doses of nitroglycerin fail to relieve discomfort
  - doses every 5 minutes
- Nitroglycerin relieves 'pain', but 'pain' returns.

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Myocardial infarction

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"Heart Attack"

Used to describe two very different emergency situations:

Myocardial infarction

Cardiac arrest

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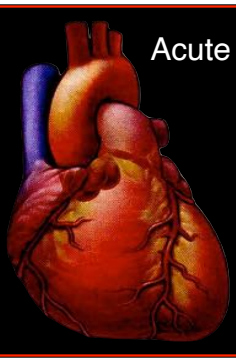
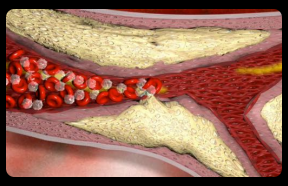
Acute Myocardial Infarction





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Prolonged Myocardial Ischemia

RUPTURE of the PLAQUE into the lumen of the coronary artery abolishes blood flow to an area of myocardium

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Prolonged Myocardial Ischemia = Myocardial Infarction

Prolonged myocardial ischemia leads to damage and then death (infarction) of myocardium

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Infarction

Obstruction of the blood supply to an organ or region of tissue, typically by a thrombus or embolism, causing local death of the tissue

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Activity at time of infarction

Activity	Percentage
At rest	51
Modest or usual exertion	18
Physical exertion	13
Sleep	8
During surgical procedure	6
Other	4

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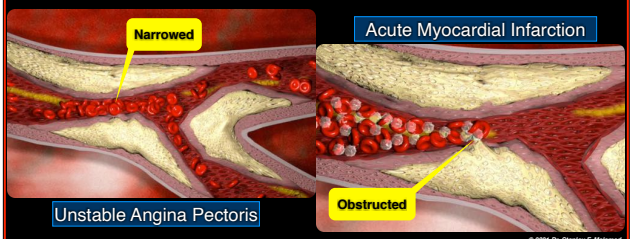
Acute Coronary Syndrome



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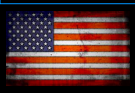
First Time Chest 'Pain"

911



P . . .
C . . .
A . . .
B . . .
D . . .

79

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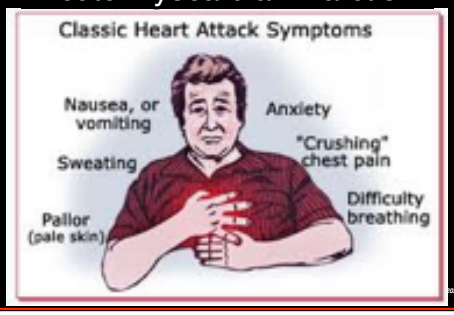
Acute Myocardial Infarction



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Acute Myocardial Infarction

SILENT MI

- Women (up to 50% of MIs)
- Elderly
- Diabetics

- Do not present with classic signs & symptoms

82

Suspected MI . . . Management

P . . . Conscious = Comfortable (usually upright preferred)

C . . . Assess . . . prn

A . . . Assess . . . prn

B . . . Assess . . . prn

D . . . **MONA** - Nitroglycerin, O_2

D . . . Activate EMS

83

MONA

Acronym for the *PRE-HOSPITAL MANAGEMENT OF A SUSPECTED MYOCARDIAL INFARCTION*

84

84

MONA

Morphine

Oxygen

Nitroglycerin

Aspirin

Prehospital management of suspected MI

85

NONA

N_2O-O_2
Oxygen
Nitroglycerin
Aspirin

NONA

Prehospital management of suspected MI
86

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Nitrous Oxide - Oxygen

50% - 50%

As analgesic as IV morphine (10 mg)
- Separates pain from suffering

Sedative
- Relaxes scared patient

50% O_2
- 2.5 times ambient air

Prehospital management of suspected MI

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Aspirin
in Myocardial Infarction

325 mg. **POWDERED**, if available, with water
20 minute onset

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Aspirin
in Myocardial Infarction

- Prevents blood clot (thrombosis) from increasing in size
- Increases chance of primary balloon angioplasty being successful

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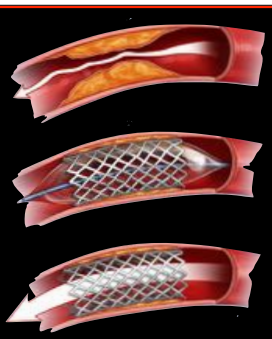

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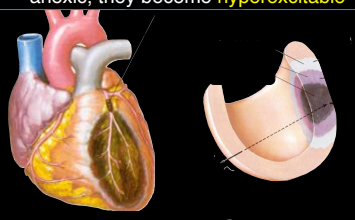
Acute Myocardial Infarction

When cells are damaged, hypoxic or anoxic, they become hyperexcitable



Myocardium = DYSRHYTHMIAS

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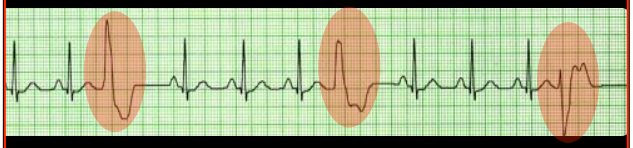
Premature Ventricular Complexes

Polymorphic (**Multi**focal)



PVC's vary in size & shape

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Premature Ventricular Contractions

PVC's

The problem with PVC's is that there is little to no cardiac output occurring.

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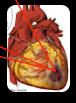
Premature Ventricular Contractions

PVC's

LVEF ranges from 0.55-0.70

Patient is CONSCIOUS
8 of 11 contractions (systoles) are normal, ejecting blood into the systemic circulation.

Output of blood is 73% of normal



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Premature Ventricular Contractions

PVC's

Patient is CONSCIOUS
yet demonstrating S&S of decreased blood flow to periphery:

- Cyanotic mucous membranes
- Ashen gray skin color
- Diaphoresis
- Generalized feeling of fatigue

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Premature Ventricular Contractions

Bigeminy

Cardiac output ~50%

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"Try to
keep the victim alive until they recover or until another - more qualified - individual assumes responsibility for treatment"

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So, what exactly has been done prior to EMS arrival to PREVENT the occurrence of cardiac arrest?

Morphine (N_2O-O_2)
Oxygen
Nitroglycerin
Aspirin

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NOTHING

Ischemic myocardium still exists;
Victim is symptomatic;
Dysrhythmias still occurring;
But the pump - though damaged - is still pumping

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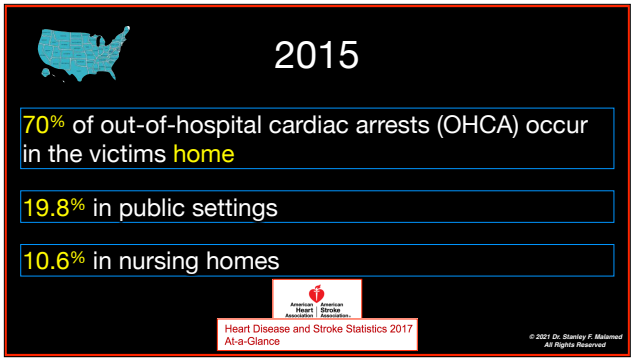

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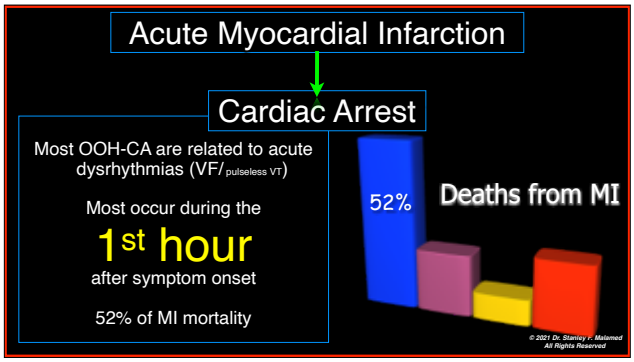

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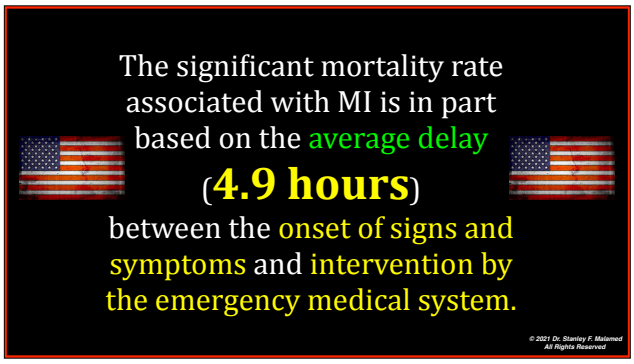

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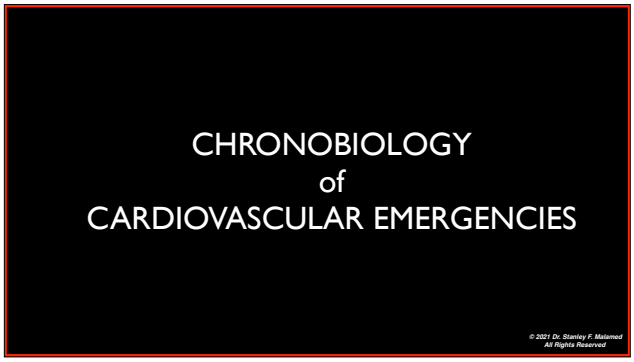

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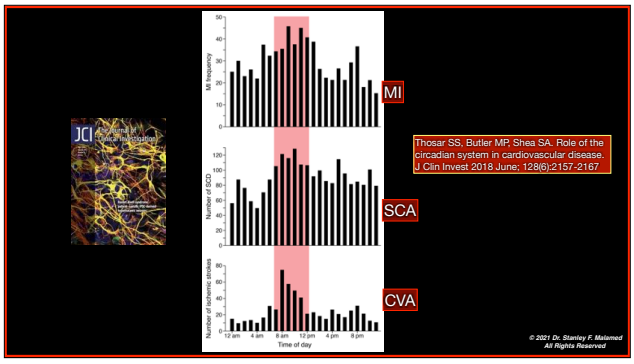

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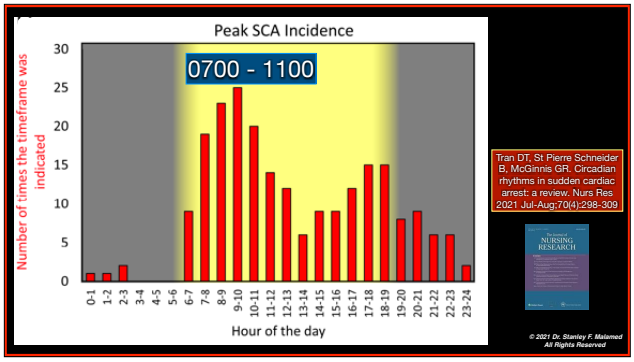

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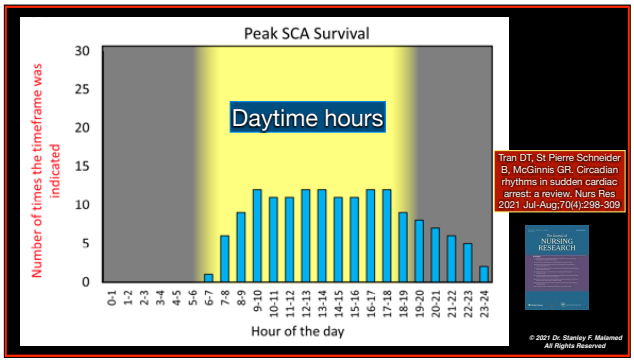

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Ventricular fibrillation is 15 times more likely to occur in the 1st hour after the onset of signs and symptoms than in the next 12 hours.

It develops in the first hour in approximately 36% of persons with acute MI.

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Myocardial infarction

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Cardiac arrest

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CARDIAC ARREST
occurs when the heart ceases to
PUMP BLOOD

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In CARDIAC ARREST
the heart, usually, is still
BEATING

It is no longer
PUMPING

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There are 4 rhythms that constitute cardiac arrest

(1) (pulseless) Ventricular Tachycardia
(2) Ventricular Fibrillation (coarse & fine)
(3) Asystole
(4) Pulseless Electrical Activity (PEA)

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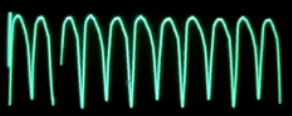

VT degenerates into a CHAOTIC, unorganized quivering of the myocardium - VENTRICULAR FIBRILLATION

Ventricular Tachycardia

Coarse Ventricular Fibrillation

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Coarse Ventricular Fibrillation

Then, as the myocardium continues to weaken . . .

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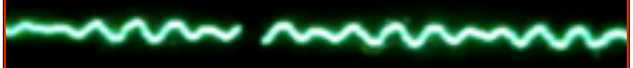
Fine Ventricular Fibrillation



Electrical activity lessens

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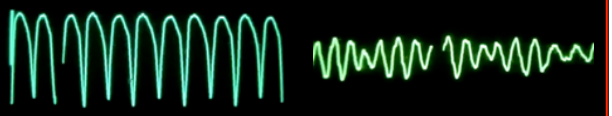
Cardiac Arrest

Shockable rhythms



Ventricular Tachycardia

Ventricular Fibrillation
coarse & fine

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Cardiac Arrest

Non-shockable rhythms

Asystole

Pulseless Electrical Activity

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What happens when the heart stops *PUMPING* blood?

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Blood stops circulating,

Pulse is not palpable,

Blood pressure falls to ??? (<60mmHg)

Consciousness is lost, and

Respirations cease.

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DEAD

UNCONSCIOUS

NO PULSE

NOT BREATHING

DEAD

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Clinical death

You LOOK like you're dead

Biological / Cellular death

You ARE dead

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Sudden Cardiac Arrest

In the absence of any treatment death is a certainty

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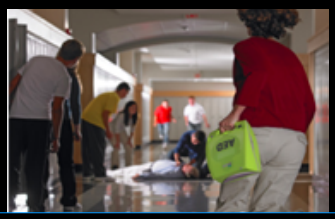
Sudden Cardiac Arrest



Doing 'something' gives the victim a chance at survival

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Cardiac Arrest

UNCONSCIOUS

NO PULSE

NOT BREATHING

Clinical Death

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Our goal in resuscitation is to prevent the *PERMANENT* death of the victim.

- Cells in the victims body will die when they use up all of the O_2 available to them
- **CELLULAR** or **BIOLOGICAL** death occurs
- Cellular or biological death is *irreversible*

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The time between the occurrence of CLINICAL and BIOLOGICAL DEATH represents the period in which RESUSCITATION may be successful

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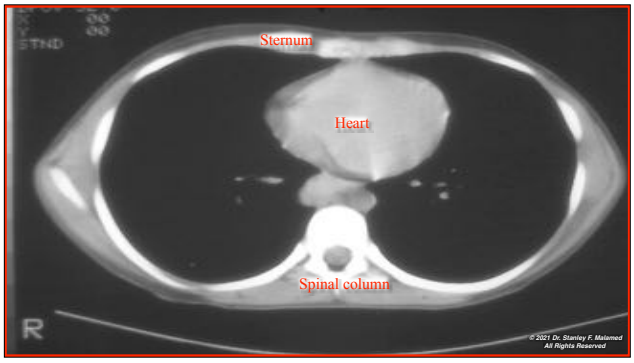

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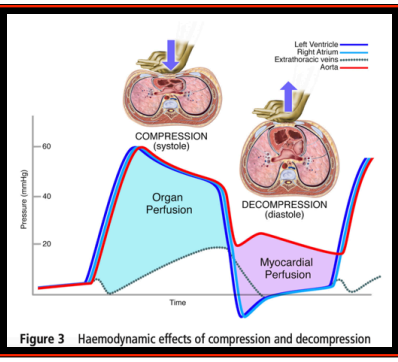

Figure 3 Haemodynamic effects of compression and decompression

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Chronology of Sudden Cardiac Arrest

Time = up to 1 hour before SCA	Signs & symptoms
Time 0	Cardiac arrest occurs
Time = less than 10 seconds	Loss of consciousness
Time = 4 to 6 minutes	Brain damage begins
Time = 10-14 minutes	Biological (cellular) death

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Therapeutic Hypothermia

Circulation

ILCOR Advisory Statement

Therapeutic Hypothermia After Cardiac Arrest
An Advisory Statement by the Advanced Life Support Task Force of the International Liaison Committee on Resuscitation

Unconscious adult patients with spontaneous circulation after out-of-hospital cardiac arrest should be cooled to 32°C to 34°C for **12 to 24 hours** when the initial rhythm was ventricular fibrillation (VF). Such cooling may also be beneficial for other rhythms or in-hospital cardiac arrest. 89.6 to 93.2 F

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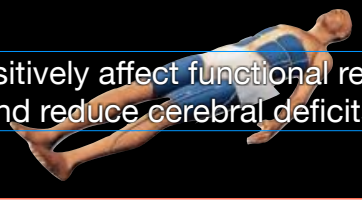
Therapeutic Hypothermia



. . . positively affect functional recovery and reduce cerebral deficits.

Induction of hypothermia after return of spontaneous circulation post cardiac arrest has been found to positively affect functional recovery and reduce cerebral deficits.

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How critical is response time to survival?

Survival to hospital discharge

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How critical is response time to survival?

In the absence of CPR, for every minute a victim is in cardiac arrest the chance of survival decreases by between 7% and 10%

Survival to hospital discharge

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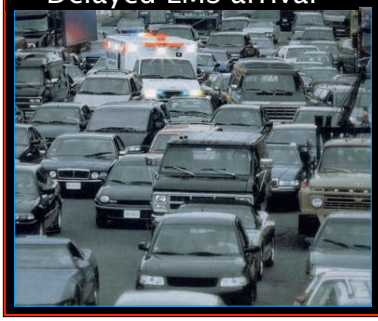
Delayed EMS arrival



Absence of BYSTANDER-INITIATED BLS

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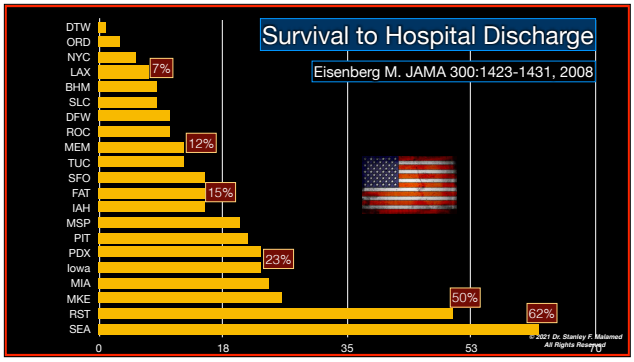

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Survival Rates from SCA

Survival - *to hospital discharge* - is dependent upon:

- ✓ Bystander initiated CPR
- ✓ Time from collapse to defibrillation

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How critical is response time to survival?

With CPR initiated prior to EMS arrival, for every minute a victim is in cardiac arrest the chance of survival decreases by between 3% to 4%

Survival to hospital discharge

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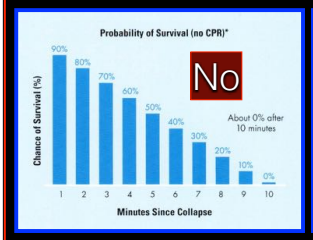
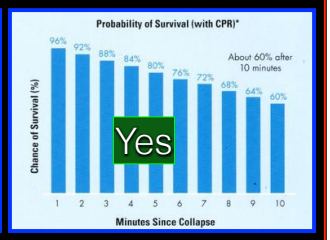
Bystander Initiated CPR





7% - 10% loss per minute

3% - 4% loss per minute

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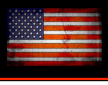
30 Day Survival from Cardiac Arrest



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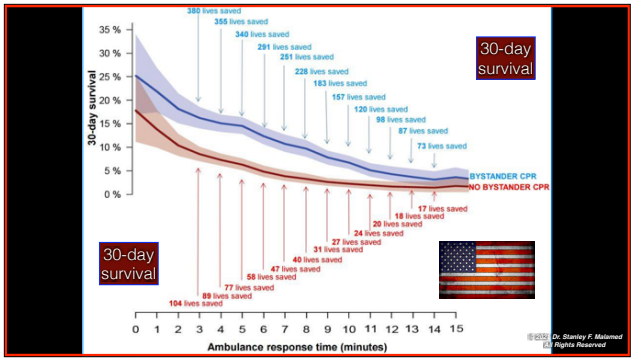

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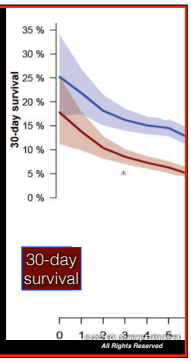
30-day survival

Time (min)	Saved YES	Saved NO
3	380	104
4	355	89
6	291	58
8	228	40
10	157	27
12	98	18



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Automated External Defibrillators
(AED's)

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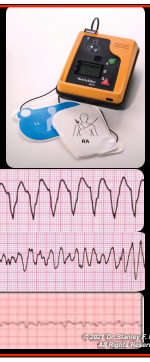
How to use an AED

- Simplistically, an AED is a battery operated computer which is capable of determining whether or not VF/VT is present.
  - VF/VT present:
    - 'SHOCK ADVISED"



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How to use an AED

- Any rhythm other than VF/VT
  - PEA, asystole, NSR
    - 'NO SHOCK ADVISED'
    - 'Check airway'
    - 'Check breathing'
    - 'Check pulse'
    - 'If no pulse, continue CPR'

145

AED accuracy in rhythm analysis

Atkins DL, Scott WA, Blaufox AD, Law IH, Dick M 2nd, Gehen F, Sobh J, Brewer JE **Sensitivity and specificity of an automated external defibrillator algorithm designed for pediatric patients**. Resuscitation 76(2):168-174, 2008

Overall accuracy for shockable & non-shockable rhythms =
99% (702/709)

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How to use an AED

VF . . . chaotic, uncordinated 'quivering' of myocardium

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How an AED works

AED delivers a biphasic (2 shocks) shock across the chest - through the myocardium - depolarizing all myocardial cells at the same time.

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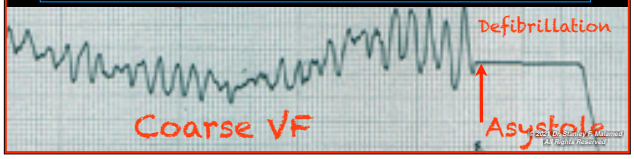
How an AED works

AED delivers a biphasic (2 shocks) shock across the chest - through the myocardium - depolarizing all myocardial cells at the same time, producing . . .

ASYSTOLE



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How an AED works

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The more ‘alive’ the myocardium when depolarized the more likely it is that the SA node will spontaneously depolarize inducing a normal sinus rhythm.

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Can the chest be compressed adequately with the victim in the dental chair?

YES

Lepere AJ, Finn J, Jacobs I
Efficacy of cardiopulmonary resuscitation performed in a dental chair
J Australian Dental Association 2003 Dec;48(4) 244-247

Yokoyama T, Yoshida K, Suwa K.
Efficacy of external cardiac compression in a dental chair
Resuscitation 2008 Oct;79(1) 175-176

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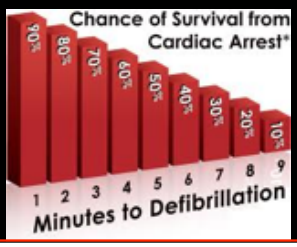
- Average response time in the USA: Call to shock is 10-minutes
- Can this be improved upon?



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Ambulance drone

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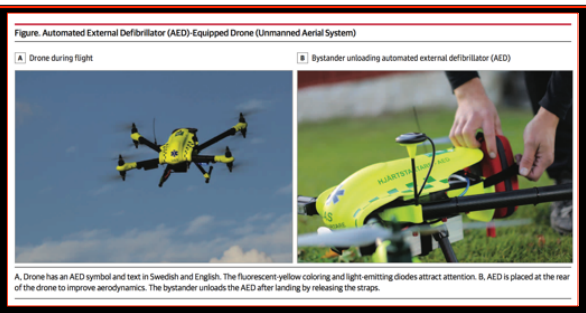
Figure. Automated External Defibrillator (AED)-Equipped Drone (Unmanned Aerial System)

A Drone during flight

B Bystander unloading automated external defibrillator (AED)

A, Drone has an AED symbol and text in Swedish and English. The fluorescent-yellow coloring and light-emitting diodes attract attention. B, AED is placed at the rear of the drone to improve aerodynamics. The bystander unloads the AED after landing by releasing the straps.

Claesson A, Backman A, Ringh M, Svensson L etal
J Amer Med Assoc 317(22): 2332-2333, 2017

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Time to delivery of an automated external defibrillator using a drone for simulated out-of-hospital cardiac arrests vs Emergency Medical Services

MedianMedian time from dispatch to arrival - **DRONE** = 5.21 minutes
Median time from dispatch to arrival - **AMBULANCE** = 22 minutes

Claesson A, Backman A, Ringh M, Svensson L etal
J Amer Med Assoc 317(22): 2332-2333, 2017

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Discussion:

- Drones carrying AEDs may reduce time to defibrillation in out-of-hospital cardiac arrest
- Saving 16 minutes is likely to be clinically significant

Claesson A, Backman A, Ringh M, Svensson L etal
J Amer Med Assoc 317(22): 2332-2333, 2017

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Northern NEVADA

February 2018

REMSA to use drones to deliver defibrillator for cardiac arrest emergencies

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So . . .

In Conclusion

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Rules to Remember

The very first step in management of all medical emergencies is

BASIC LIFE SUPPORT,

as needed

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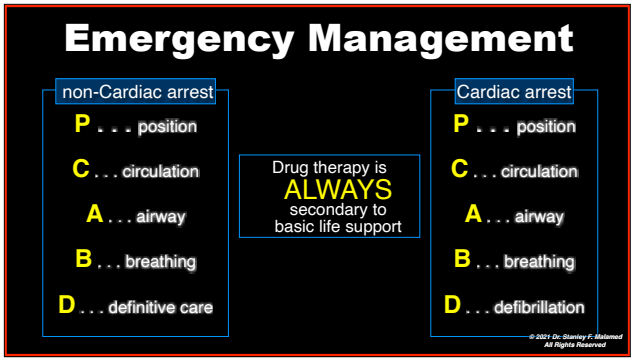
Emergency Management
non-Cardiac arrest
P . . . position
C . . . circulation
A . . . airway
B . . . breathing
D . . . definitive care
Drug therapy is
ALWAYS
secondary to
basic life support
Cardiac arrest
P . . . position
C . . . circulation
A . . . airway
B . . . breathing
D . . . defibrillation
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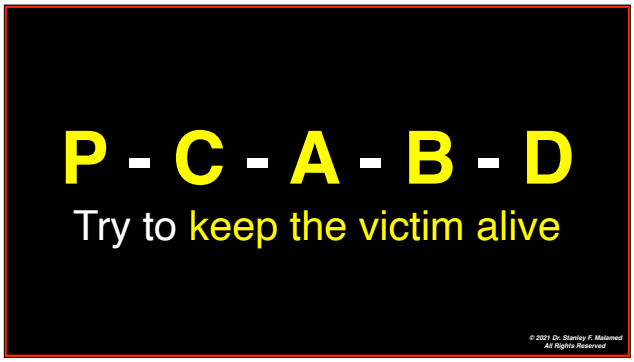
P - C - A - B - D
Try to keep the victim alive
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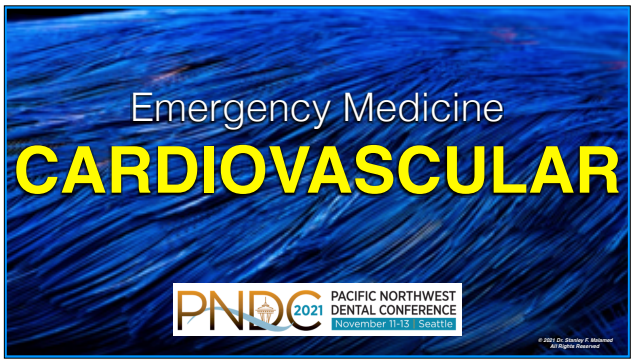
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