DISCLAIMER

The opinions expressed by the speakers at the Oral and Maxillofacial Surgery Assistants Training Course do not necessarily represent those of Oral & Facial Surgeons of California.

Treatment protocols reviewed in this course may differ from those which you are familiar. They are only offered as guidelines.

Ultimate responsibility for patient care rests with the treating oral and maxillofacial surgeon.
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Cardiovascular System

ANATOMY AND PHYSIOLOGY

Cardiovascular Anatomy

- Heart
- Blood vessels
- Coronary blood supply
- Blood supply to the head and neck
- Venipuncture sites
- The conduction system

Heart – Anatomy

- **Atria**
  - Thin walled, low pressure chambers
  - Reservoirs of blood
  - 70% passive flow in systole
  - Right - systemic return via vena cavae
  - Left - pulmonary return via pulmonary veins

- **Ventricles**
  - Major pumping mechanism of heart
  - Thick walled
  - Right - deoxygenated blood to lungs via pulmonary artery
  - Left - oxygenated blood to systemic circulation via aorta
THE HEART'S VALVES

The Tri-cuspid, Mitral (Bi-cuspid) and Aortic Valves

The Heart's Valves

The Heart's Valves and the Cardiac Cycle
The Heart Exposed

It is covered by a layer of fat...

We note during systole...

A writhing pattern as...

Cardiac Output

Stroke Volume = 60 cc's

Cardiac Output = 60 cc's x 80 bpm ≅ 5 L ≅ 5 quarts/min

80 bpm
4 QT
1 QT
4 QT + 1 QT = 5 QT

Circulation - Right Heart

- Receives venous blood from the body.
- Deoxygenated blood (Blue).
- Low pressure.
- Sends blood through pulmonary circulation to replenish oxygen.
- Note: exception to the rule: the Pulmonary Artery carries deoxygenated blood to the lungs.

Left Heart and Arterial System

- Receives oxygenated blood (red) from the lungs
- Pumps the oxygenated blood into the systemic circulation
- High pressure
- Another exception: Pulmonary Vein carries oxygenated blood back to heart.

The Right Heart and Venous System

- Veins
- Capillaries
- Arteries
- Venules
- Pulmonary Artery
- Arterioles
- Capillaries
- Venous return to heart
THE CORONARY ARTERIES

Coronary arteries extend over the surface of your heart...

Coronary Arteries

Clinical Correlation

• Atherosclerotic cardiovascular disease (ASCVD) or coronary artery disease (CAD)
• Angina pectoris
• Myocardial infarction (MI)

Control and Coordination of the Cardiovascular System

• Blood Pressure
• Heart Rate
• Rhythm

Physiologic Control of Blood Pressure
CV System obeys same laws of physics as pumps, pipes and hoses
The Influence of Diameter on Pressure

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Pressure</th>
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<tr>
<td>↑'d diameter = vasodilation</td>
<td>↓ Diameter</td>
</tr>
<tr>
<td>↓'d diameter = vasoconstriction</td>
<td>↑ Diameter</td>
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</table>

So... the three major factors which control blood pressure are:
- The force and rate of the contraction of the heart.
- The constriction and dilation of the blood vessels.
- The volume of fluid in the system.

These three factors are regulated by the autonomic nervous system (ANS) and the endocrine system.

The Autonomic Nervous System

A. α
   Arteries & Veins (Vasoconstriction)

B. β
   The Big Organs
   1. Heart – ↑ BP, ↑ HR
   2. Lungs – Bronchodilation

Sympathetic (Adrenergic) Effects

α - Arteries & Veins (Vasoconstriction)

β - The Big Organs

β₁
   ONE HEART

β₂
   TWO LUNGS
Sympathetic Effects

β - The Big Organs

β\textsubscript{1} ONE HEART - ↑ BP, ↑ HR

β\textsubscript{2} TWO LUNGS - Bronchodilation

PARASYMPATHETIC INNERVATION (CHOLINERGIC)

We are familiar with parasympathetic innervation because it...

- Stimulates the salivary glands to produce saliva
- Salivary secretions are decreased by drugs such as atropine or Robinul\textsuperscript{®} which block these nerves

However, another very important function of parasympathetic innervation is:

- Regulation of heart rate.
- Normally there is a balance between sympathetic ("The accelerator") and parasympathetic ("the brakes") effects on the heart.

Parasympathetic Innervation

- One's resting heart rate is largely controlled by this parasympathetic innervation.
- Atropine interrupts the parasympathetic nerve supply, thereby “taking the foot off the brakes” which increases the heart rate.

Clinical Correlation

- Dysrhythmias e.g. tachycardia, bradycardia and asystole
- Blood pressure problems:
  - Hypertension
  - Hypotension
  - Asthma
Components of the Conduction System

- Sinoatrial (SA) Node – the pacemaker
- Right & Left Bundle Branches
- Atrioventricular (AV) node
- Internodal pathways and atria
- AV Bundle (Bundle of His)
- Purkinje fibers

In review... the components of the conduction system:

- SA node
- Bundle of His
- Bundle branches
- Internodal pathways and atria
- Purkinje fibers
- AV node

Components of the Conduction System

- Autonomic input

So, how does the heart generate electricity?

- Certain myocardial cells are easily excitable.
- At rest, their membranes are polarized: positive charges on the outside and negative charges on the inside.

So, how does the heart generate electricity?

- Once the cell is excited, channels open up in the membrane, allowing the positive charges on the outside to travel to the inside of the cell.
- This is called depolarization

Conduction of the Impulse

- Depolarization and generation of the action potential

CARDIOVASCULAR SYSTEM

DISEASES AND CONDITIONS
Assessing Patients with Cardiovascular Disease

- Effects 10 million adult Americans
- 1.3 million MI’s occurs each year
- 500,000 deaths annually
- 50% of MI victims have undiagnosed ischemic heart disease

Risk Factors of Cardiovascular Disease

- Smoking.
- Hypercholesterolemia – LDL (“bad”) vs. HDL (“good”).
- Family history of premature heart disease.
- Diabetes.

Risk Factors of Cardiovascular Disease (cont’d)

- Obesity
- Sedentary life style
- Hypertension
- Increasing age

Yet More Cardiac Risk Factors

- History of MI
- Congestive heart failure (CHF)
- Heart valve malfunctions
- Irregular heartbeats (dysrhythmias)

END OF CARDIOVASCULAR SYSTEM

PART I
Cardiac Evaluation
- Past medical history
- General medical health
- Physical evaluation
- ECG
- Type of surgery planned

Role of the Medical Consultant – Good Communication Essential
- Review available patient data, history and his/her examination.
- Communicate severity and stability of the patient’s cardiovascular status – and get clearance in writing! Faxes are great.
- Determine if patient is in optimal medical condition, given context of surgical illness.

Diseases of the Cardiovascular System
“CARDIO”
- ANGINA
- Myocardial infarction (MI)
- Congestive heart failure (CHF)
- Valve damage
- Cardiac dysrhythmias

“VASCULAR”
- Hypertension
- Low blood pressure
- Cerebro-vascular accident (CVA) – Stroke

“Cardio”
- PLUMBING – THE CORONARY ARTERIES
  - Angina pectoris
  - Myocardial infarction (MI)
- THE PUMP – THE MYOCARDIUM AND VALVES
  - Congestive heart failure (CHF)
  - Valve damage and malfunction
- THE CIRCUITRY – THE CONDUCTING SYSTEM
  - Irregular heart beats – dysrhythmias

Cardiac Diseases – Ischemic Heart Disease
DEFINITION: Ischemia is a restriction in blood supply, generally due to partial or complete occlusion of the blood vessels, with resultant damage or dysfunction of tissue.
Classification of Ischemic Heart Disease

Acute Coronary Syndrome
- Angina pectoris
- Myocardial Infarction

Angina Pectoris

DEFINITION:
A primary symptom of coronary heart disease which occurs when myocardial oxygen demand exceeds supply.

Angina Pectoris - Diagnosis

DIAGNOSIS – HISTORY:
- When was the last attack?
- How frequently do the attacks occur?
- What exercise level leads to the attacks?
Acute Coronary Syndrome - Treatment

Early Plaque + Significant Plaque = ANGINA

MONA
Morphine
Oxygen
Nitroglycerin
Aspirin

O₂ +

Angina Pectoris - Treatment

• Terminate surgery
• Suction, pack surgical site
• 100% O₂ by mask
• Semi-recumbent position
• Loosen clothing

O₂ – the “O” of MONA

Angina Pectoris Treatment

• Nitroglycerin sublingually (tablet or spray)
• Monitors – BP, HR, EKG, Pulse Ox
• Nitroglycerin 2nd and 3rd dose q 5 min prn
• If no relief, assume MI – call 911

Nitroglycerin – the “N” of MONA

Myocardial Infarction – The Second Component of the Acute Coronary Syndrome

DEFINITION:
Necrosis or death of heart muscle precipitated by decreased oxygenation from partial or complete blockage of blood flow in the coronary arteries.

Myocardial Infarction

Irreversible with cell death
Vs
Injury as seen in angina

Signs and Symptoms:
• Crushing chest pain not relieved by nitroglycerin.
• Pain radiating to the arm, shoulder or jaw.
• Sweating, pallor.
Radiation of Chest Pain in Myocardial Infarction (MI)

Just as in angina...
- Pain may radiate to:
  - The jaw
  - The shoulder
  - The arm
- Jaw pain may be mistaken for tooth pain.

Myocardial Infarction - Diagnosis

- Weakness, anxiety and a feeling of impending doom
- Hypotension
- Crushing chest pain, but no response to NTG
- Systemic symptoms:
  - Nausea & vomiting
  - Pallor
  - Diaphoresis (sweating)

Thrombus

Partially restricted blood flow

Myocardial Infarction

- Induced by:
  - Exercise, emotion, heavy meal
  - Stress - surgery
- Cause:
  Inadequate coronary circulation leading to permanent muscle damage

Medications Used to Manage Ischemic Heart Disease

- BETA BLOCKERS – decrease myocardial oxygen requirements (e.g. atenolol, Lopressor®)
- NITRATES – vasodilation (e.g. nitroglycerin)
- CALCIUM CHANNEL BLOCKERS – reduction in cardiac contractility (e.g. Adalat®, Procardia®)
- ASPIRIN – reduction of clumping of blood platelets which can lead to clot formation
- LIPID-LOWERING DRUGS – reduce plaque formation (e.g. Lipitor®)

Myocardial Infarction

Treatment Considerations for patients with a history of MI:
- Oxygen during the procedure
- Stress reduction
- Sedation
Anesthetic Considerations and Intraoperative Management

For minimally invasive procedures normally performed in an office setting, moderate (“conscious”) sedation may be considered for a patient with significant history of cardiovascular disease.

Anesthetic Considerations and Intraoperative Management

For more complex procedures requiring general anesthesia, consider an operating room with an anesthesiologist monitoring the patient.

Myocardial Infarction - Treatment

TREATMENT SUMMARY:
- Terminate surgery
- 100% O₂
- Call 911
- Place patient in comfortable position and loosen clothing

MONA

- Morphine ✓
- Oxygen ✓
- Nitroglycerin ✓
- Aspirin ✓

When MI suspected, call 911 at outset and be prepared to transfer care to EMT's

Myocardial Infarction

TREATMENT SUMMARY (cont’d):
- Monitor vital signs
- Establish IV
- Medicate for pain (Morphine, Fentanyl)
- Give ASA

PREVENTION:
- Thorough medical history
- 100% O₂ throughout procedure
- Oral premedication or sedation
- Profound local anesthesia
Valve Abnormalities

Murmur:
Turbulent blood flow across an abnormal valve

Cardiac Valves
- Mitral
- Aortic
- Tricuspid
- Pulmonic

Murmurs

- STENOSIS –
  - Valves do not open all the way
- PROLAPSE –
  - Valves flex backwards
- REGURGITATION –
  - Valves do not close all the way

Considerations with Valve Abnormalities

- Sub-acute Bacterial Endocarditis
- Congestive Heart Failure
- Poor cardiac reserve
- Predispose for cardiac dysrhythmias

Bacterial Endocarditis

What is it?
- Infection of the lining of the heart chambers and heart valves caused by bacteria

Who gets it?
- Usually people who have underlying heart disease or valvular disorders

What causes it?
A bacteremia (bacteria in the blood) which can happen during dental, upper respiratory, urologic and lower GI diagnostic and surgical procedures

So what actually happens?
The infection can cause growths on the heart valves, the lining of the heart, or the lining of the blood vessels. These growths may form clots that break off and travel to the brain, lungs, kidneys, or spleen.
**Congenital Heart Disease**
- Present from birth
- Poorly formed valves, chambers
- Abnormal communications between vessels or chambers

**Antibiotics Required**
Patients at the greatest danger of bad outcomes from endocarditis and for whom preventive antibiotics are worth the risks include those with:
- Artificial heart valves.
- A history of having had endocarditis.
- A cardiac transplant which develops a problem in a heart valve.

**Antibiotics Required (cont’d)**
- Unrepaired congenital defects.
- A completely repaired congenital heart defect with prosthetic material or device during the first six months after the procedure.
- Any repaired congenital heart defect with residual defect at the site or adjacent to the site of a prosthetic patch or prosthetic device.

**American Heart Association Guidelines for Antibiotic Prophylaxis**
- Standard regimen
  - Amoxicillin: Adults 2.0 g; Child: 50 mg/kg one hour prior to procedure
- Allergy to Penicillin:
  - Clindamycin: Adults 600 mg; Child 20 mg/kg one hr. prior to procedure – p.o. or I.V.
  - Azithromycin: Adults 500 mg; Child 15 mg/kg one hr. prior to procedure

**Cardiac Diseases**
Congestive Heart Failure:
A clinical syndrome in which the heart fails to maintain an adequate output, resulting in diminished blood flow to the tissues, and congestion in the pulmonary and/or the systemic circulation.

**Congestive Heart Failure**
LEFT SIDED HEART FAILURE:
- Poorly functioning left ventricle
- Fluid backs up into lungs – pulmonary edema, shortness of breath (“SOB”)
Congestive Heart Failure

RIGHT SIDED HEART FAILURE:
- Poorly functioning right ventricle.
- Fluid backs up into body tissues – peripheral edema & ascites (abdominal swelling from fluid accumulation).

MANIFESTATIONS OF CONGESTIVE HEART FAILURE:
- With time the heart becomes enlarged (Cardiomegaly).
- Left sided heart failure often leads to right sided heart failure and the patient develops symptoms of both.

MEDICATION USED TO TREAT CHF:
- Digitalis – Increase force of contraction
- Diuretic – Flush Fluids e.g. furosemide (Lasix®)

TREATMENT OF CHF:
- A comfortable Semi-Fowler’s position
- Short procedures
- Low IV fluid rate
- Supplemental oxygen

But remember to remind the patient to uncross his legs!

END OF CARDIOVASCULAR SYSTEM

PART 2
Hypertension
DEFINITION:
Abnormally high arterial blood pressure (>140/90)

“Vascular”: Hypertension
- Primary (essential) - 95% of all cases
- Secondary (caused by another disease)
>140/90

Anesthetic Management of Hypertensive Patients
- Determine adequacy of control
- Review antihypertensive medications
- Evaluate associated organ dysfunction (ischemic heart disease, renal dysfunction, orthostatic hypotension)

Hypertension
OTHER CAUSES:
- Atherosclerotic cardiovascular disease (ASCVD).
- Cessation of medications by patient ("rebound" hypertension)
- Renal failure
- A rare adrenal tumor

Control of Hypertension Determines the Safety of the Procedure
- A patient with well controlled blood pressure can be managed like a normal patient.
- Diastolic >120 – refer for immediate treatment.
**Hypertension**

Treatment Considerations:
- Know baseline blood pressure
- Set limits for treatment
- Stress reduction
- Question use of epinephrine in local anesthetics

**Anesthetic Management of Hypertensive Patients**

- Expect somewhat exaggerated blood pressure changes during the patient’s course of treatment.
- Avoid myocardial ischemia by assuring adequate oxygenation, stress reduction and pain control.

**Hypertension**

Concerns:
- Hypertensive Crises
- CVA (stroke)

**Hypertension – Hypertensive Crisis**

- Sudden significant increase in blood pressure (may approach BP > 240-250 / 140)
- Risk to brain, heart, kidneys
- May lead to stroke

**Hypertensive Crisis - Pathophysiology**

Precipitating factors: pain, anxiety, ↓O₂, ↑CO₂ or cardiopulmonary compromise (usually excessive adrenergic stimulation)

**Hypertensive Crisis - Diagnosis**

- The anesthesia team should be vigilant in monitoring blood pressure throughout the surgical procedure.
- A trend of increasing blood pressure should be noted on the monitor long before a crisis level is reached.
**Hypertension**

**SIGNS AND SYMPTOMS:**
- Headache
- Dizziness

**Hypertensive Crisis - Treatment**

- Try to determine cause and treat if possible e.g. pain
- AN ADRENERGIC BLOCKER (e.g. Labetalol) OR VASODILATOR (e.g. hydralazine)
- ↓ RATE, FORCE OF CONTRACTION

**Hypertension**

**TREATMENT – INITIAL:**
- Terminate procedure
- Place patient in comfortable position and loosen clothing
- Pain control
- 100% O₂
- Reassure patient, if conscious.

**Prevention:**
- Thorough medical history.
- MD consult and medication adjustment when necessary.
- Maintain anti-hypertensive medications
- Profound local anesthesia.
- Consider sedation.

**Cerebrovascular Accident “CVA”**

- Brain damage from lack of blood supply

**Cerebrovascular Accident “CVA” – terminology**

- STROKE – Major neurologic deficit lasting greater than 24 hours
- TRANSIENT ISCHEMIC ATTACK (TIA) – Lesser manifestations lasting less than 24 hours.
The Warning Signs of Stroke

- Sudden numbness or weakness of the face, arm or leg, especially on one side of the body.
- Sudden confusion or difficulty understanding.
- Trouble speaking.
- Sudden trouble walking, dizziness, loss of balance or coordination.

The Warning Signs of Stroke (cont’d)

- Sudden, severe headache with no known cause.
- Sudden trouble seeing in one or both eyes.

CVA Patients

TREATMENT CONSIDERATIONS:

- May be on anticoagulants
  - Coumadin®
  - Plavix®
  - ASA
- Lipid-lowering drugs – reduce plaque formation (e.g. Lipitor®)
- Need to keep blood pressure “normal”

Hypotension

DEFINITION:

- Abnormally low arterial blood pressure (<90/60)

Hypotension - Pathophysiology

Pooling of blood in:

- Vasodilation
- Extremities
- Abdomen

CAUSES:

- Excessive dose of anesthetic or sedative medication
- Allergic reactions
- Myocardial infarction
- Cardiac dysrhythmias
- Sepsis

Hypotension
**Hypotension**

**SIGNS AND SYMPTOMS:**
- Dizziness
- Orthostatic changes
- Fainting

**Hypotension - Diagnosis**

- BP $\downarrow \geq 20$
- Dizziness
- Skin - pallor
- Weakness - may lead to loss of consciousness
- Nausea
- Tachycardia

**Hypotension - Treatment**

- Terminate procedure
- Attempt to determine cause
- $100\%$ $O_2$
- Give adrenergic agents such as ephedrine or phenylephrine to:
  - Vasoconstrict - $\alpha$
  - Increase rate and force of contraction of the heart $\beta$

**Hypotension**

**PREVENTION:**
- Titrate doses of anesthetic and sedative medications and avoid excessive doses, especially in the elderly.
- Avoid stress
- Avoid rapid positional changes
- Recognize dehydration

**Cardiac Surgery Patients**

**Surgical Procedures:**
- Coronary angioplasty
- Intravascular stents and filters
- Cardiac artery bypass grafts (CABG)
- Valve replacements
- Heart transplants

**Cardiac Surgery Patients**

**TREATMENT CONSIDERATIONS:**
- May be on anticoagulants
- Coumadin® (Warfarin)
- ASA (aspirin)
- Plavix® (Clopidogrel)
- Persantine® (Dipyridamole)
Cardiac Surgery Patients
Treatment Considerations:
• May need prophylactic antibiotics
• May need steroids

Cardiovascular System
Monitoring to assure an adequate supply of oxygenated blood to the body’s tissues.

Cardiovascular System
Monitoring parameters:
• Heart rate (pulse).
• Blood pressure.
• The conducting system (EKG).

Taking the Pulse to Determine Heart Rate
• Automated pulse determination – commonly used during anesthetic procedures.
• Manual pulse determination – an important skill when a monitor is not available and during emergencies.

Monitoring Heart Rate with a Manual Pulse
The Commonly Utilized Pulses:
• The radial pulse.
• The brachial pulse.
• The carotid pulse.

The Radial and Brachial Pulses
• The radial pulse –
  • Routine determination of pulse in adults.
  • To take pulse, use two fingers, not the thumb.
• The brachial pulse – utilized for infants and small children.
The Carotid Pulse

- The pulse is taken with two fingers placed in the groove between the trachea and the sternocleidomastoid muscle.
- This location is preferred for determining the pulse in the event of emergencies.

Changes in Pulse with Age

- Pulse decreases from age 2-12, then remains relatively constant thereafter.

Manual Determination of Blood Pressure

- Mercury Manometer - More accurate, but less portable.
- The Aneroid Manometer – Slightly less accurate, but more portable and practical to use in the OMS office.

The Sphygmomanometer

- Cuff sizes -
  - Average Adult
  - Pediatric
  - Thigh cuff – can be used on obese adult patients
- Cuff width should be greater than 1/3 the circumference (C) of the arm
- Using an improperly sized cuff can cause erroneous blood pressure determination, e.g. too small a cuff gives a low BP reading

Blood Pressure Determination – Systolic Pressure

- At cuff pressure = 140
  - Brachial artery closed
  - No Sound
- At systolic pressure = 120 mmHg
  - 1st Korotkoff Sounds
  - Brachial artery only partially constricted
  - Brachial artery sounds begin – due to turbulent blood flow
Blood Pressure Determination – Diastolic Pressure

- Cuff pressure 5’s to 80
- At systolic pressure = 80mmHg

Variations in Korotkoff Sounds

- Auscultatory gap – after the initial sounds that begin at the systolic pressure, there is a silent period before sounds resume – more often seen in hypertensive patients.
- In some patients the last Korotkoff sound is not followed by silence, but merely muffled sounds at a much lower volume.

Automated Blood Pressure Measurement

- Blood pressure is usually included in monitors along with the EKG and pulse oximetry.
- There is an indicator symbol on the cuff which should be aligned over the brachial artery to assure accurate determination.

Blood Pressure:

- Systolic Pressure - maximum pressure of arterial system and indicates the force of the ventricular contraction.
- Diastolic Pressure - measure of pressure during the relaxation portion of the cardiac cycle.

Changes in Blood Pressure with Age

Blood pressure increases fairly rapidly from age 5-20. From 20-70 there is a gradual increase in systolic blood pressure with little change in diastolic pressure.

Monitoring of the Conduction System of the Heart

- EKG (or ECG) monitoring must be available.
- Many use EKG throughout anesthesia, whether local or intravenous.
- A defibrillator, as well as the EKG monitor, must be available.
The Normal Conduction System

- Internodal pathways and atria
- AV node
- Bundle of His
- Right & Left Bundle branches
- Purkinje fibers
- SA node
- Vagus Nerve

Conduction of the Impulse Through the Heart

- Depolarization is initiated by the passage of sodium ions through the ion channels.
- This results in a wave of depolarization which moves along the conduction system.
- Movement of positively charged ions such as potassium out of the cell leads to repolarization.

How does the EKG monitor the impulse as it passes through the conduction system of the heart?

- The EKG monitors the change in voltage as the wave of depolarization passes through the conduction system.
- The EKG machine "draws" a picture of the impulse.

In order to determine what is abnormal...

One must first fully understand what is normal. So before we study the various types of dysrhythmias, we must have a thorough understanding of the heart’s normal rhythm – the Normal Sinus Rhythm.
Normal Sinus Rhythm

So what do these waves represent?

- P-wave = atrial depolarization (atrial contraction)
- QRS complex = ventricular depolarization (ventricular contraction)
- T wave = ventricular repolarization (recharging of the ventricles)

Words to Ponder

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<th>Repolarization</th>
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<tr>
<td>Contraction</td>
<td>Relaxation</td>
</tr>
<tr>
<td>Systole</td>
<td>Diastole</td>
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What the EKG Sees

Einthoven's Triangle

Einthoven invented the EKG in 1901. The three classic leads of Einthoven's Triangle are leads I, II & III.

What the EKG Sees

The EKG study as generated by three leads. Each depicts a slightly different picture because it is looking at the passage of the impulse through the conduction system from a different perspective.
Important terms in discussing dysrythmias...

- Focus (pl. foci) – a central point for the origin of an impulse (a pacemaker).
- Ectopic – displaced.
- Thus “ectopic foci” are displaced central points in various parts of the heart where impulses can start (a displaced pacemaker).

Cardiac rhythms can have a number of other pacemakers besides the SA node...

<table>
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<tr>
<th>Level</th>
<th>Inherent Rate</th>
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<tbody>
<tr>
<td>Supraventricular foci</td>
<td>SA Node 60 - 100/min.</td>
</tr>
<tr>
<td>Atria</td>
<td>60 - 80/min.</td>
</tr>
<tr>
<td>AV Junction</td>
<td>40 - 60/min.</td>
</tr>
<tr>
<td>Ventricles</td>
<td>20 - 40/min.</td>
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</tbody>
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Rhythm Disturbances

In the SA node

Pacemakers for dysrythmias may be:
- Supraventricular - above the level of ventricles in the atria
- Combined Dysrythmias - above and within the ventricles
- Ventricular - within the ventricles

Arrhythmia or Dysrythmia?

- Arrhythmia – without rhythm
- Dysrhythmia – abnormal rhythm

The terms are often used interchangeably.

Rules of EKG Interpretation

Look for the 3 R’s:
- Rhythm
- Rate
- Regularity

The 3 R’s guide us through a series of questions which enable identification of dysrythmias...

As you ask yourself the questions, remember this very important point...

The small, short wave corresponds to the small chambers, the atria.

But the larger, tall wave corresponds to the larger chambers, the ventricles which pump blood...so you always look for it first!!
Your first question – Is there a rhythm?

Do you see normal-looking QRSs surrounded by normal-looking P and T waves in a consistent pattern?

A = B = C = D

Most importantly, can you dance to it?

If there is a rhythm, your second question...

Are the QRS’s...

Narrow and normal looking like this...

Which indicates that the pacemaker is probably in the atria.

Or wide and abnormal looking like this?

Which indicates that the pacemaker is probably in the ventricles.

What is the normal width of the QRS complex?

Normal is no more than ½ large block

Your next question – What is the rate?

How fast is the heart beating? Our second R for determining the identity of a rhythm.

Start where an R wave falls on a heavy line

Then count off your 1st triplet: 300, 150, 100

Followed by your 2nd triplet: 75, 60, 50

85 beats per minute

Another approach is to divide the number 300 by the number of large boxes between R waves

In this case we divide 300 by 6: 300 ÷ 6 = 50

In this case we divide 300 by 2: 300 ÷ 2 = 150

As You Count the Boxes, How Do You Know When Your Patient May Be in for Trouble?

When there are less than two boxes between R waves

When there are more than five boxes between R waves (in this example 8 boxes)
The 3rd R – Regularity
Do all the beats look the same?
Is it like wallpaper?

If the rhythm is not regular, it often means that the impulse has been blocked.

Is the P-R interval normal and consistent from beat to beat?

Normal Sinus Rhythm (NSR) –
- All components present i.e. P, QRS and T waves
- Regular rate and rhythm of 60 -100 bpm
- This is the rhythm to which we compare other rhythms.

Sinus Arrhythmia – a variation of NSR
- Similar to NSR except for irregular rate
- Rate varies somewhat with inspiration and expiration
- Usually a normal finding

Now that we know that we know what normal looks like...

What Types of Abnormal Heart Rhythms Are There?
- Too slow = Bradycardia
- Too fast = Tachycardia
- Heart quivers = Fibrillation
- Heart stops = Asystole
How Rhythms and Dysrhythmias Get Their Names

Most heart rhythms and dysrhythmias consist of two terms:
• The first indicates the pacemaker for the rhythm
• The second usually provides an indication of the rate, i.e. bradycardia, tachycardia, etc.
• For example –

![ECG Waveform]

| Pacemaker = Sinus | Rate = Bradycardia |

Now let’s examine the slow rhythms, i.e. the bradycardias more closely.

Sinus Bradycardia

• Like NSR, but slow with a rate < 60
• Often seen as a normal finding in athletes

![ECG Waveform]

Now we’ll look at the dysrhythmias in which the rate is too fast, i.e. the tachycardias...

Sinus Tachycardia

• Similar to NSR except for rate of > 100 bpm.
• Frequently seen during sympathetic stimulation.

![ECG Waveform]

Supraventricular Tachycardia (SVT)

• Often demonstrates a sudden (paroxysmal) onset.
• Regular, narrow complex tachycardia (150-250 bpm).
• There are often merged P-T waves.

![ECG Waveform]
Atrial Fibrillation (A Fib)

- Multiple ectopic foci within the atria create a wavy baseline
- Occasionally an impulse conducts into the ventricles to generate a QRS.
- Irregular ventricular rate (irregularly irregular)

Atrial Flutter (A Flutter)

- Chaotic circular conduction path in the atria.
- “Sawtooth” baseline of “flutter waves”.
- Since only every 3rd or 4th impulse conducts into the ventricles, there is a slower ventricular rate.

Although atrial or supraventricular tachycardias may be serious and require treatment, they are usually not life-threatening.

However, tachycardias in the ventricles are extremely serious and are life-threatening dysrhythmias that often lead to cardiac arrest (asystole).

Are there ever any warning signs for ventricular dysrhythmias?

Fortunately there are!
- They are called premature ventricular contractions or PVCs
- There are many types, but we will look at only a few of the more significant ones.

- Ventricular Tachycardia
- Ventricular Fibrillation
- Asystole

These Rhythms Will Kill!
**Multifocal PVC’s**

- Normal sinus rhythm with two or more irritable ventricular foci
- The PVC’s from the different foci have a different appearance
- More ominous sign than unifocal PVC’s

**Runs**

- Ectopic focus generates multiple PVC’s
- Three or more PVC’s in a row constitute ventricular tachycardia
- A warning sign calling for identification of etiology such as hypoxia

**Ventricular Tachycardia (V Tach)**

- Here starting from NSR...
- A wide complex tachycardia with no P’ and separate T’s cannot be discerned
- Rapid ventricular rate (140 – 200)
- Can only support life for a short time
- No pulse, consider as if V Fib

**Ventricular Fibrillation (V Fib)**

- Irregular baseline
- No discernable waveforms
- No depolarization of the ventricles
- No pumping of blood
- Precedes asystole
- Cardiac arrest!!!!

**Asystole**

- Nothing happening
- Cardiac arrest!!!
- Cannot be successfully treated with defibrillation

**CONDUCTING SYSTEM OF THE HEART**

**DISEASES AND CONDITIONS**
**Cardiac Dysrhythmias**

Variations of normal heart beats
- Physiologic (non-harmful)
- Pathologic (harmful)

**Medical Management of Cardiac Dysrhythmias**

- Oral anti-arrhythmic drugs e.g.
  - Beta blockers
  - Amiodarone
- Synchronous cardioversion
- Cardiac pacemakers – battery-powered implantable pacing devices

**Implantable Devices**

- **CARDIAC PACEMAKERS** – battery operated implantable device which regulates heart rhythm. It takes the place of the normal impulse from the sinus node.
- **IMPLANTABLE ELECTRONIC DEFIBRILLATORS** – battery-operated implantable device which can provide defibrillation in patients who are prone to develop ventricular fibrillation.

**Pacemakers**

- Establish reason for implant insertion:
  - Bradycardia
  - Heart block
  - SVT
- Establish that pacemaker functions normally, recent evaluation by cardiologist, asymptomatic patient.
- Prophylaxis is not required.

**Implanted Cardiac Defibrillator**

The pacemaker is placed within the subcutaneous tissue, and its location can usually be determined by a bulge in the overlying soft tissues.
Implanted Cardiac Defibrillators (ICD’s)

- Presence of ICD is not a risk in itself.
- Electromagnetic interference can cause dysfunction or incorrect delivery of shock: CAUTION – electrosurgery!
- Discharge of ICD is not harmful to caregivers in contact with patient

Monitoring

- EKG Monitoring – the electrocardiograph
- EKG must be available
- Most use EKG throughout anesthesia
- A defibrillator must be available

Equipment Electrocardiogram (EKG)

- Used to monitor the electrical activity of the heart’s conduction system.
- Chest or wrist leads.
- Most have a recording device.
- Maintenance and checks.
  - Periodic check of batteries.
  - Check paper.

Equipment – Defibrillator

- Device to deliver a controlled electrical shock to the patient.
- The shocks are measured in Joules (watts/second)
- Only practical definitive treatment for ventricular fibrillation
- There are manual and automatic types

And... They have other important uses as well!
**AED – Automatic External Defibrillator**

- **Universal AED Sign**
  - Determines if shock is necessary

**Maintenance and Checks of Defibrillator**

- Conventional manual defibrillators –
  - Periodic check of appropriate output to paddles.
  - Periodic maintenance checks by technician.
- AED’s – Periodic replacement of batteries and paddles/pads.

**Conducting System of the Heart**

- Medical and Anesthetic Emergencies

**Cardiac Dysrhythmias**

- **Signs and Symptoms:**
  - Changes in rate or rhythm on cardiac monitor
  - May be asymptomatic
  - Irregular pulse
  - Hypotension
  - Chest pain

**How Do We Treat Critical Life-threatening Dysrhythmias?**

- Epinephrine
- Amiodarone
- Hydrocortisone
- ECG strips
- 1:10,000 epinephrine
- 1 mg (0.1 mg/ml)
- 150 mg/3 ml
- 50 mg/1 ml
Cardiac Dysrhythmias with a Pulse

- Bradycardia (symptomatic): Too slow to function properly
- Tachycardia: Too fast to function properly
- SVT (supraventricular tachycardia) - focus above the level of ventricles
- V Tach (Ventricular Tachycardia) – focus in ventricles
- Ominous PVC’s – your warning sign

Cardiac Dysrhythmias – Arrest Rhythms

- Ventricular Fibrillation or Pulseless V Tach
- In ventricular fibrillation the ventricles quiver so fast that the heart cannot pump
- Cardiac Arrest (Asystole) and PEA
- The heart ceases to contract and stops

Cardiac Dysrhythmias – Treatment

- Terminate procedure, 100% O₂
- Appropriate medications, e.g.
  - Bradycardia – atropine
  - Tachycardias – antiarrhythmics e.g. amiodarone, lidocaine, metoprolol
  - Ventricular fibrillation and asystole – epinephrine
- Electrical interventions
  - Synchronized cardioversion
  - Defibrillation
- CPR for Arrest Rhythms
- Monitor vital signs

BRADYCARDIA – Should we treat the 23 year old marathon runner?....

- ...But may we need to treat a 78 year old medically compromised patient with bradycardia?

Bradycardia

Defining cardiac Tachycardia, Treat With:

- Like NSR, but with rate < 60
- Spontaneous normal finding in athletes, but can be associated with inadequate perfusion which can require treatment.
- For serious heart blocks transthoracic pacing
Bradycardia - Treatment

- Atropine effect takes “foot off of the brake”
- Epinephrine effect puts “foot on the gas”

Sinus Tachycardia

- Rate
- **Signs/Symptoms:**
  - Anxiety
  - Pain
  - Exercise
  - Hypovolemia
  - Fever
- **Defining Characteristics:**
  - Similar to NSR except for ↑’d rate of > 100 bpm
  - Frequently seen during sympathetic stimulation
  - Never attempt cardioversion

Although sinus tachycardia should not be treated with cardiac drugs or cardioversion...

- Severe tachycardias with pacemakers in the atria or ventricles usually require treatment with antiarrhythmic drugs or synchronized cardioversion.
- Since most OMFS offices are not equipped to provide synchronized cardioversion, antiarrhythmic drugs will often be the primary means of management of serious tachycardias in the OMFS office until help arrives.

Paroxysmal Supraventricular Tachycardia (PSVT)

- Rate
- **Defining Characteristics:**
  - Vagal maneuver by bearing down
  - The antiarhythmic drug adenosine
  - Regular, narrow complex tachycardia (150-250 bpm)
  - Often see merged P-T waves

Multiform Premature Ventricular Contractions (PVC’S)

- **Defining Characteristics:**
  - Attempt to detect rhythms interrupting the normal cardiac cycle.
  - Lidocaine IV
  - Usually considered a more ominous sign than unifocal PVC’s.

Ventricular Tachycardia (V Tach)

- **Defining Characteristics:**
  - Rate is wide, blunt, rapid wave form
  - No P’s, and T’s usually cannot be discerned
  - Can only support life for a short time
  - If no pulse, consider as if V Fib
- Rate
**Ventricular Fibrillation (V Fib)**

- CPR / Pads / Shock.
- CPR / IV / Shock.
- CPR / Epi 1 mg. IV / Shock.
- CPR / Amio 300 mg. IV / Shock.

**Defining characteristics:**
- Rhythm consists of a rapidly vacillating baseline.
- No P’s, QRS’s and T’s.
- No pumping of blood.
- Often precedes asystole.
- Must be treated by electrical defibrillation immediately.

---

**Asystole**

- CPR / IV, no defibrillation.
- CPR / Epi 1 mg. IV.
- CPR / Hospital.

**Defining characteristics:**
- No waveform of any type i.e. no P’s, QRS’s or T’s.
- Flatline!!!
- Cannot be successfully treated with defibrillation.

---

**Cardiac Arrest**

**TREATMENT:**
- BLS
- Call 911.
- Place monitors (Defibrillate if appropriate).
- Establish IV.
- ACLS.
- An advanced airway such as an LMA or endotracheal tube PRN.

---

**The 2010 CPR Changes from AHA**

- Enough to tap your foot to...
- ...This
- Which is 100 compressions per minute.

---

**If your patient’s EKG strip looks like this**

- ...but he has no pulse.
- Then by definition he has P.E.A.
- So, start CPR, give epinephrine and determine the cause.

---

**And exactly how many chest compressions should you give per minute?**

- 100 compressions per minute.
Cardiac Arrest

MEASURES TO DECREASE RISK:
• Consider the medical history
• Appropriate consultation
• Appropriate anesthetic

In summary, we’ve now reviewed the major types of dysrhythmias
• Too slow = Bradycardia
• Too fast = Tachycardia
• Heart quivers = Fibrillation
• Heart stops = Asystole

In summary (con’t)
• We’ve seen how the EKG monitors the function of the conduction system.
• We’ve learned how rhythms and dysrhythmias get their names.
• We’ve used a simple approach to identify what the various rhythms are.
• You’ve learned how to treat critical life-threatening dysrhythmias.

The Conducting System of the Heart, EKG’s and Dysrhythmias

The End
Respiratory Anatomy

Upper Airway - Pharynx

The Sinuses

When it comes right down to it, what are sinuses anyway?

- Yep, they’re just holes in your head...
- But these holes have some really important functions...
**Sinuses – Functions**
- Lighten the head
- Phonation (sound of your voice)
- Response to inhaled irritants and allergens

**Respiratory Pathology**
- Upper airway
  - Colds
  - Allergies
  - Surgical concern:
    - Tooth roots extending into the maxillary sinuses (antra)

**Pharynx**
- Separation of air and food passages – the epiglottis
- Regulation of ear pressure
- Lymphatic tissue – tonsils and adenoids

**Larynx – External Anatomy**
- Thyroid Prominence ("Adam’s Apple")
- Cricothyroid ligament
- Tracheal cartilage
- Trachea

**The Vocal Cords in the Larynx**
- View of the vocal cords through a laryngoscope

**Let’s explore the upper airway and go over the top of the tongue, and then behind it to the epiglottis**
Now let’s go over the tip of the epiglottis and see what is beneath it

So this is what it really looks like....

Clinical Correlations

- Laryngospasms
- Foreign bodies in the airway

THE LARYNX AND THE TRACHEOBRONCHIAL TREE

Lower Airway (Tracheobronchial tree)

Trachea

Tracheal ring

Bronchi

Bronchioles

Alveoli
Cilia: Hair-like projections of the cells which have a “sweeping effect”

Bronchi
- Right Mainstem Bronchus
  - Wider
  - Straighter
- Left Mainstem Bronchus
  - Narrower
  - Acute Angle

Cilia move mucus and debris away from lungs

Bronchoscopy enables us to...
Explore the hundreds of branches of the tracheobronchial tree.

And as we explore this branch of the right mainstem bronchus...
Is that really a premolar?...

As the organs glide over the ribs...
The diaphragm contracts downward and...

THE THORACIC CAGE
The Thoracic Cage
- 12 Pair of ribs
- Expands and contracts to move air

Xiphoid process
Clavicle
Sternum

Muscles of Respiration
- Intercostal—literally “between the ribs”
- Diaphragm

Mechanics of Respiration
- Active
- Forced exhalation by muscles
- Constricts thoracic cavity

INSPIRATION
- Intercostal muscles and diaphragm
- Expands thoracic cavity

EXPIRATION
- Passive
- Constricts thoracic cavity

Lungs
- Right lung
- Three lobes
- Left lung
- Two lobes

When you breathe...

Bronchioles
- Walls - smooth muscle
- Provide airway resistance
Alveoli

Gas exchange takes place between the capillary network and the air within the alveoli.

Terminal portion of airway

Clinical Correlations

Lower airway disease
- Asthma
- Emphysema
- Chronic Obstructive Pulmonary Disease (COPD)
- Bronchitis
- Pneumonia

Clinical Correlations

Life threatening emergency – emesis with aspiration

Respiration

- EXTERNAL RESPIRATION – O₂ inspired air enters the body by coming in contact with blood in the alveoli
- INTERNAL RESPIRATION – At the cellular level when O₂ from the blood enters the cell and CO₂ leaves the cell and returns to the blood

Normal Ventilation

Conducting portion – Pharynx and the tracheobronchial tree
- Airway patency
- Dead space

External Respiration
Each molecule of hemoglobin requires the uptake of oxygen from the air in the lungs.

At the lung...

CO₂ molecules enter the red blood cells.

The Components of Blood

Hematocrit Values
- Male 45-52%
- Female 37-48%

Control of Respiration
- Chemical – CO₂ and O₂ levels
- Neural – Respiratory Center in the medulla
- Voluntary Control

Clinical Correlation

In respiratory depression the normal control mechanisms are impaired and respiration becomes slow and shallow.
**RESPIRATORY SYSTEM**

**DISEASES AND CONDITIONS**

---

**Normal Lung**

Terminal Bronchioli, Alveoli

---

**Asthma**

A disease marked by recurrent Dyspnea caused by episodic bronchoconstriction

---

**Some Important Respiratory Terms**

- Hyperpnea – Rapid breathing
- Dyspnea – Difficulty breathing
- Apnea – Absence of breathing

---

**Pathophysiology of Asthma**

- Often associated with allergies.
- Increased secretions within the small airways.
- Mucous plugs block small bronchi, restricting air movement.
- Bronchospasm ♦ wheezing.

---

Sympathetic Stimulation (Adrenergic)

Parasympathetic Innervation (Cholinergic)
**Sympathetic (Adrenergic) Effects**

A. Arteries & Veins (Vasoconstriction)

B. The Big Organs
   1. Heart – \( \uparrow \) BP, \( \uparrow \) HR
   2. Lungs – Bronchodilation

**Sympathetic Effects \( \beta \) - The Big Organs**

\( \beta_1 \) ONE HEART

\( \beta_2 \) TWO LUNGS

**Sympathetic Innervation**

- Strenuates the salivary glands to produce saliva for digestion of foods
- Is counteracted by anticholinergic drugs such as atropine or glycopyrrolate which diminish salivary secretions

**Parasympathetic Innervation**

Hi! I'm Mr. Couch Potato, your vegetative state

**Assessment of Patients with Asthma**

- Frequency of attacks
- Precipitating factors
- Duration of attacks
- Management of attacks
- Current prevention therapy

**Management of Asthma**

First Line Preventative Medications:
- Corticosteroids – anti-inflammatory (inhaled) - Aerobid®, Azmacort®, Flovent®, Pulmicort®
- Selective beta-2-agonists - Bronchodilators (short/long acting) - acts on smooth muscle - Vanceril®
Management of Asthma

First Line Preventative Medications:
- Combination therapy - a combination medication that includes a corticosteroid plus a long acting bronchodilator drug - Advair®

Anesthetic Considerations of Patients with Asthma

- Defer treatment until uncontrolled asthma is controlled
- Keep inhaler available for acute attacks, bronchodilator not steroid inhaler
- Manage possible adrenal suppression if patient taking corticosteroids
- Stress reduction

COPD (Chronic Obstructive Pulmonary Disease)

Pulmonary Emphysema

Normal alveoli

Weakened & collapsed alveoli with excess secretions

Chronic Bronchitis

Normal

Chronic Bronchitis

Bronchitis

- Daily cough and sputum production
- Excess secretions
  - Prone to laryngospasm and bronchospasm
### Treatment of COPD
- Stop smoking
- Supplemental oxygen
- Bronchodilators will give most patients 10% increase in expiratory airflow

### Preoperative Evaluation
- Determine the severity of the disease
- Determine if there are any reversible components such a bronchospasm or infection

### Smoking
Concerns:
- COPD and Cardiovascular Disease
- Increases anesthetic risk
  - Reactive airways (laryngospasm)
  - Increased secretions
- Increased postoperative infections
- Increased dry sockets

### Preoperative Cessation of Smoking
Stopping smoking for > 8 weeks

### Upper Respiratory Infections
- Colds (URIs) increase secretions in the airway
- Increase the risk of anesthesia
- Best to delay surgery

### Respiratory System
MONITORING TO ASSURE THAT THERE IS ADEQUATE VENTILATION AND OXYGENATION
Monitoring of Ventilation

- Listen to breath sounds with a pretracheal stethoscope
- Observe patient - watch chest and reservoir bag
- Observe patient - mucosa, skin tone, nail beds, blood color – cyanosis
- Observe patient - nasal flaring
- Observe patient - retraction

Listen for gurgling, stridor, wheezing or loss of breath sounds.

Pulse Oximeter

- Measures the level of oxygenated hemoglobin compared with total hemoglobin at the site of the probe
- Measures pulse rate, perfusion at the probe and ventilation
- Normal “healthy” patients on room air >96%

Maintenance and Checks

- Periodically check probes as they are fragile.

Pulse Oximetry Probes

- The probe can be placed on either a finger or the thumb
- The lead wire should be taped to the finger to prevent the probe from becoming dislodged
- Alternatively an ear probe can be placed on the earlobe
- Earlobe readings may be more accurate, but the probe and leads can interfere with surgery

Monitoring of Oxygenation – the Pulse Oximeter

Limitations:

- Lag time (20 to 40 seconds)
- Patient movement
- Fingernail polish (black blue or green)
- Venous congestion
- Abnormal hemoglobins (e.g. carboxyhemoglobin in smokers)

Determination of Oxygen Saturation

- The oximeter does not directly measure arterial $O_2$
- The device determines the amount of oxygenated hemoglobin based upon the difference in color of oxygenated and deoxygenated hemoglobin

When hemoglobin is oxygenated, it has a reddish coloration
When hemoglobin has been de-oxygenated, it assumes a bluish coloration

Pulse Oximeter – Relationship Between Arterial $O_2$ and $O_2$ Sat

The Oxyhemoglobin Desaturation Curve:

Large drops in arterial oxygen pressure (below 70mm of Hg) can occur before oxygen saturation drops significantly

At an oxygen saturation of approximately 93% the actual arterial oxygen pressure is only 70 mmHg.
The Capnograph

- The capnograph measures the amount of CO₂ in expired air
- The capnograph displays a wave form – as well as a digital readout
- In the open system often used in OMFS, the wave form shows trends but the digital readout is not accurate
- The CO₂ is measured as end tidal CO₂ (ET CO₂)

Capnometer / Capnograph

- Measures the level of exhaled CO₂
- Used to determine adequacy of ventilation (increase CO₂ = decreased ventilation)
- Best for closed systems
- An optional monitor which should be used in combination with the pretracheal stethoscope and pulse oximetry

Maintenance and Checks
- Check probe to make sure it is in correct position.

Using the Capnograph in an Open System

- The sensing catheter can be placed within a nasal mask or nasal prongs.
- The tube must be protected from condensation which will occlude the catheter.

Capnometer / Capnograph

- Increased CO₂
  - Airway obstruction
  - Respiratory depression
- No CO₂ detected ➔ System disconnect

Monitoring your patient’s asthma management with the Peak Flow Meter

1. Patient inhales as deeply as possible
2. Exhalation with maximal force into the peak flow meter
3. Repeat x 3 and compare maximal flow with table norms

MAINTENANCE OF THE AIRWAY TO PREVENT RESPIRATORY EMERGENCIES
### Airway Maintenance

**Routine Airway Equipment:**

<table>
<thead>
<tr>
<th>Nasal Hood</th>
<th>Nasal Cannula</th>
</tr>
</thead>
</table>

### Routine Airway Techniques

**Airway support:**

- Head tilt /chin lift
- Jaw thrust using the angles of mandible

### Nasopharyngeal Tube

- Supports tongue
- Easy to insert - lubricate, slide along nasal floor
- Can be used on awake patient
- Well tolerated

### Full Face Mask

- Useful for induction & emergency
- Use with airway support
- Can be used with:
  - Nasopharyngeal tube
  - Oral airway

### Oral Airway

- Useful for emergency
- Supports tongue in anterior position
- Use tongue depressor
- Alternatively insert inverted and rotate 180 degrees
- Not well tolerated in awake patient – nausea
- Interferes with oral procedures

### Laryngeal Mask Airway

- LMA
### Tongue Manipulation
- Traction suture
- Tongue forceps
- Towel clip

### Suction Equipment
- Equipment to clear secretions from the pharynx
- Induction a critical time
- Backup system
- Hand pump

### Suction Equipment
- Equipment to clear secretions from the pharynx
- Induction a critical time
- Backup system
- Hand pump

### Airway Maintenance
- Endotracheal Intubation
  - Nasal
  - Oral
  - Through a tracheostomy site
- Placement
  - Direct Vision
  - Blind

### Endotracheal Intubation Preparation
- Endotracheal tube
- Stylet
- Laryngoscope
- Muscle relaxant
- Connectors
- Oxygen
- Suction
- Mask
- Ambu bag

### Intubation with a laryngoscope with a curved blade
- Blade deflects tongue to left
- Tip of blade between base of tongue and epiglottis
Anesthetic Gases
- Standard Colors:
  - Oxygen - green
  - Nitrous Oxide - blue
- Fail-Safe System
- Accessible gauges
- Reserve supply
- Check regularly for leaks

Equipment – Pin Index System
- A second method for minimizing connection errors
- Configuration of pins on valve attachment matches configuration of holes around tank delivery orifice

Anesthetic Machine
- Receives gas from supply lines and delivers to patient
- Ratio of gases and delivery rate determined by flow meters
- A gas delivery system capable of providing 100% oxygen or a combination of oxygen and anesthetic gases
- Fail-safe (never less than 22% Oxygen)

Equipment Anesthetic Machine Maintenance and checks
- Oxygen analyzer to check incoming gases
- Flow meters, reservoir bag and delivery tubes should be checked daily
- Calibration to manufacturer recommendation
- Turn off all gases daily

Anesthetic Machine Vaporizer
- Converts liquid anesthetic agents to a gas
  - Fluothane®
  - Suprane®
  - Ultane® (Sevo)
- Maintenance and Checks
- Periodic check by manufacturer

Anesthetic Machine - Ventilator
- Breathes for the patient with positive and negative pressure in a closed system with an endotracheal tube
- Soda lime canister to absorb carbon dioxide
- Should have a high and low pressure alarm to indicate excessive pressure or a disconnection
- Maintenance and Checks
**Nitrous Oxide Delivery System**

- Scavenging System
- Removes nitrous oxide and volatile anesthetic agents from the operating room
- Must be accompanied by high quality room ventilation system
- Routine checks for leaks and patency

---

**Respiratory Emergencies**

If you woke up breathing congratulations! You have another chance

---

**Emergency of the Respiratory System**

Emergencies involving the tracheobronchial tree and alveoli

---

**Respiratory Emergencies**

- Airway obstruction
- Laryngospasm
- Bronchospasm
- Emesis / Aspiration
- Hyperventilation
- Respiratory Depression / Arrest
The Tongue

To maintain the airway

Airway obstruction

DEFINITION:
Complete or partial blockage of the airway resulting in insufficient gas exchange.

Always be prepared to manage foreign body obstruction!!!

- Foreign Bodies
- Teeth and tooth fragments
- Implant wrenches and cover screws
- Pieces of soft tissue or bone
- Gauze packs

Signs and Symptoms:

- Stridor, wheezing
- Use of accessory breathing muscles
- Decreased $O_2$ saturation
- Cyanosis

Foreign Body Obstruction – Abdominal Thrusts (the Heimlich Maneuver)

Thrusts delivered just above the umbilicus and well below the tip of the xiphoid process (GR. – “sword”)

Foreign Body Obstruction – Direct Laryngoscopy

- Place laryngoscope
- Suction with tonsillar suction
- Visualize the Foreign Body
- Retrieve with Magill forceps
**Persistent Obstruction – Cricothyrotomy (Coniotomy)**

The trocar is removed and...

The cannula is placed through the overlying soft tissues and the cricothyroid membrane into the trachea.

The cannula secured to its tubing...

Which is attached to the oxygen supply.

**Airway Obstruction**

**PREVENTION:**

- Appropriate head position
- Throat Packs
- Adequate suction
- Good visualization

**Laryngospasm**

**DEFINITION:**

A protective reflex closure of the vocal cords that attempts to prevent passage of foreign matter, such as blood or saliva, into the larynx, trachea and lungs.

**The Vocal Cords in The Larynx**

- Epiglottis
- Vocal folds (cords)

Actual view of vocal cords through a laryngoscope.

**Pathophysiology for Laryngospasm**

**Laryngospasm Diagnosis**

- Early crowing, but no sound for complete spasms
- Decreased respiratory effort and decreased exchange
- Suprasternal retraction
- Decreased O₂ Saturation

**CALAOMS’ OMSA Course Syllabus**

Rev. 2017
Laryngospasm – But what does it look like when it’s happening?

Initial treatment for Laryngospasm

Laryngospasm Treatment

Laryngospasm

PREVENTION
- Throat packs
- Effective suctioning
- Head position
- Careful titration

Respiratory Emergencies
- Airway obstruction
- Laryngospasm
- Bronchospasm

Bronchospasm - Pathophysiology

Constriction of the bronchioles due to asthma, an allergic reaction or chemical irritation

Results in restriction of air flow to and from the lungs
Bronchospasm - Diagnosis

- Labored breathing, difficulty with expiration
- Wheezing
- ↑ O₂, ↑ CO₂ resists ventilation
- ↓ O₂ Saturation

Skin and mucous membranes - cyanosis

Bronchospasm Treatment

- Beta 2 Drugs: Albuterol, Epinephrine
- Constricted Bronchile
- And, positive pressure O₂

Bronchospasm

PREVENTION:
- Keep a dry field
- Pre-operative inhaler puffs
- Avoid histamine releasing drugs (Demerol®)
- Careful with Brevital®

For the awake patient – the spacing chamber...

When the inhaler is activated the mist lifts the spacing chamber.

Now the patient inhales deeply. And the mist “cloud” is inhaled into the tracheobronchial tree.

Respiratory Emergencies

- Airway obstruction
- Laryngospasm
- Bronchospasm
- Emesis / Aspiration

"I'll get you an emesis basin, paper or plastic?"
Emesis and Aspiration

**DEFINITION**
- Vomiting when the patient has depressed or absent laryngeal reflexes which may allow stomach contents to enter the lungs

**Pathophysiology**
Acidic stomach contents digest the walls of the alveoli

**Emesis and Aspiration**

**SIGNS AND SYMPTOMS:**
- Retching
- Large amounts of fluid in throat
- Gurgling sounds
- Signs of airway obstruction
- Wheezing

**Emesis and Aspiration Diagnosis**
- Skin and mucous membranes cyanosis
- Large amounts of fluid in throat
- Pre-tracheal steth gurgling / abdomen heaving
- Dyspnea (difficulty breathing)
- Tachycardia
- Rales (bubbling sound)
- Skin and mucous membranes cyanosis

**Emesis and Aspiration - Treatment**
- Trendelenburg, head to right, finger sweeps
- Magill forceps
- Visualize with laryngoscope and remove large particles with Magill forceps
- Intubate
- To hospital!!

**Management of Emesis to Prevent Aspiration**
- Tip patient back into the Trendelenburg position
Management of Emesis to Prevent Aspiration – Rolling the Patient

Do Roll Patient On Their Right Side

Do Not Roll Patient On Their Left Side

Prevention of Emesis with Aspiration

• Standards of the American Society of Anesthesiologist (ASA)
  • Solid foods – 6 hours before
  • Clear liquids – 2 hours before
  • Many surgeons prefer patient to be NPO (nothing by mouth) for 8 hours

Gastric Emptying

• Normal emptying time
  • 30-90 minutes
• Emptying time can be prolonged:
  • Apprehension
  • Pain
  • Opiate analgesics
  • Sedatives

Aspiration

• Preoperative normal X-ray
  • Note definition of ribs and lacy radiodensity pattern in lungs.
• Aspiration pneumonia
  • Note loss of definition of ribs and increased radiodensity in lungs.

Respiratory Emergencies

• Airway obstruction
• Laryngospasm
• Bronchospasm
• Emesis / Aspiration
• Hyperventilation

Hyperventilation

DEFINITION:
Increased minute volume ventilation which results in a lowered carbon dioxide level.
Hyperventilation - Pathophysiology

- \( \text{Blood CO}_2 \rightarrow \text{CO}_2 \rightarrow \text{Cerebral Vasoconstriction (light headedness)} \)

- \( \text{Blood CO}_2 \downarrow \)

Hyperventilation - Diagnosis

- Anxiety
- Impaired consciousness
- Tachycardia
- Rapid breathing
- Tingling and muscle spasm
- Chest pain
- Hyperventilation RUSH

Hyperventilation - Treatment

- \( \text{O}_2 \text{ at } .5 \text{ liters per minute} \)
- \( \text{Versed} \)

Respiratory Emergencies

- Airway obstruction
- Respiratory depression/arrest
- Laryngospasm
- Bronchospasm
- Emesis / Aspiration
- Hyperventilation
- Respiratory Depression/Arrest
**Respiratory Depression**

DEFINITION:
A decrease in the normal breathing rates and/or volumes
The many possible causes include:
- Narcotics
- Sedative drugs
- Muscle relaxants
- Hyperventilation
- Seizures

**Respiratory Depression Diagnosis**

- Loss of Consciousness
- Mental clouding, drowsiness
- Skin: pallor, and ultimately cyanosis
- Hyperventilation - rate and depth (dyspnea) or absence of breathing (apnea)
- Low \( \text{O}_2 \) saturation
- And ultimately: Hypoxia

**Respiratory Depression - Treatment**

**ABC's of CPR**
- Airway
- Breathing
- Circulation
- Defibrillation

- Patient not breathing - positive pressure \( \text{O}_2 \)
- Attempt to determine cause and consider administration of Naloxone or Romazicon if depression due to narcotics or benzodiazepines

**Narcotic Overdose**

REVERSAL OF NARCOTICS:
- Narcan® (naloxone) 0.4-2mg IV
- Repeat at 2-3 minute intervals, not to exceed 10mg
- IM or SubQ can be used if IV not available
- Observe for re-sedation

**Benzodiazepine Overdose**

REVERSAL OF BENZODIAZEPINES:
- Flumazenil® (Romazicon) 0.2mg IV initially
- Then 0.1mg/minute up to 1mg
- Observe for re-sedation

**RESPIRATORY SYSTEM**

THE END
The Pancreas and Its Hormones

Insulin’s Role

Insulin is the key to glucose (energy) management.

The Function of Glucagon

Glucagon stimulates the conversion of stored sugar in the liver and its release into the bloodstream to provide energy when needed.
DIABETES
Diabetes mellitus: A disease of insulin production and metabolism

Diabetes
Opening of glucose gates.

Management of Patients with Diabetes
Diabetes develops if the body does not produce enough insulin or does not use insulin properly

Without Insulin
- The body’s cells starve
- High sugars (hyperglycemia) in blood cause the kidneys to produce excess urine with excess amounts of both sugars and proteins leading to dehydration

Without Insulin
- Chronic high glucose levels damage the nerves and small blood vessels of the eyes, kidneys, and heart
- Predispose to atherosclerosis (hardening) of the large arteries that can cause heart attack and stroke

Types of Diabetes
- Type I (Insulin dependent - juvenile)
- Type II (non-insulin dependent/maturity onset)
**Type 1 Diabetes**
- Not enough insulin
- Autoimmune
- Young age

**Type 2 Diabetes**
- Not enough or poor response to insulin
- Obesity
- Usually > 40
- 85 to 90% of patients

**The Symptoms of Diabetes**
- Frequent urination
- Excess thirst
- Recent weight change
- Episodes of sweating
- Mental confusion
- Fruity odor of breath

**Symptoms of Diabetes**
- Frequent urination
- Excess thirst
- Recent weight change
- Episodes of sweating
- Mental confusion
- Fruity odor of breath

**Type 1 - Insulin**
Need to take Insulin:
- Regular insulin- onset 30 minutes, duration 6-8 hours
- NPH, Lente- onset 2 hours, duration 24 hours
- Ultralente, glargine- onset 6-8 hours, duration 36 hours

**Type 2 - Oral Medications**
- Improve insulin's ability to move glucose into cells especially into the muscle cells
- Prevent the liver from releasing stored glucose
Preoperative Evaluation of Diabetic Patients

- Control of diabetes
- Medications needed for control
- Hospitalizations
- Secondary diseases
- History of infections

Treatment Considerations

- Poor wound healing - antibiotics
- Alteration of medications and diet
- Early morning appointments
- Preoperative blood sugar
- Consultation with physician

The Glucometer to Determine Blood Glucose Levels

The release button activates the lancet to puncture the skin of the finger.

The tip of the test strip is placed next to the drop of blood and the blood sugar level is displayed on the screen. A normal reading will usually be 70-100.

Interpretation of Glucometer Readings

LEVELS OF HYPOGLYCEMIA:

- Mild (< 60-65 mg/dL) cold, clammy, trembling
- Moderate (< 50 mg/dL) anxiety, irritability, weakness
- Severe (< 30 mg/dL) seizures, loss of consciousness

The Endocrine System

Monitoring the level of glucose in the blood and assessing the status of the patient's diabetic management.
Monitoring Your Patient’s Diabetic Management – Hemoglobin A₁c

- Glucose attaches to some of the hemoglobin in the RBC’s to form glycated hemoglobin (hemoglobin A₁c or Hb A₁c).
- HbA₁c can be used to monitor how high the patient’s blood sugar has been.
- The reference range (in healthy persons) is about 4%–6%.

Correlation of Average Blood Glucose with the A₁c Value

- Higher levels of HbA₁c are found in people with persistently elevated blood sugar.
- The American Diabetes Association recommends that the HbA₁c be below 7.0% for most patients.
- A “good” HbA₁c level of 4-6 in a patient with diabetes may mean that there is a history riddled with recent hypoglycemia.

ENDOCRINE SYSTEM

MEDICAL AND ANESTHETIC EMERGENCIES

Diabetes mellitus – a disease of insulin production and metabolism

DEFINITION: An abnormally low level of sugar in the blood due to an insulin imbalance.

Insulin Shock - Diagnosis

Anxiety and mental clouding
Hypersalivation
Coolness of the skin, diaphoresis (sweating)
Loss of consciousness and seizure
Tachycardia

Insulin Shock – Pathophysiology

When the patient takes his normal insulin dose, but has no oral intake (e.g. fasting).

When glucose drops below the critical level for brain function, the patient loses consciousness.
**Insulin Shock – Treatment**

- Glucose is given IV or PO to re-store the low level of sugar in the blood.
- Or, glucagon can be administered IM, which will stimulate breakdown of glycogen in the liver and provide sugar through this route.

**Treatment Considerations**

- Awake - sugar containing fluids
- Unconscious
  - IV glucose solutions – if IV access is possible
  - IM Glucagon – if intravenous access cannot be obtained

**Hypoglycemia**

**PREVENTION:**
- Careful patient history
- Watch time of day for surgery – schedule early in the day
- Check patient’s blood sugar – glucometer preop, intraop, postop
- Intravenous dextrose infusion if somewhat hypoglycemic. However, routine intraoperative fluids should be NS or LR

**ENDOCRINE SYSTEM**

**THYROID DISEASE**

**Thyroid Disease**

The thyroid gland produces hormones which control metabolism and growth

**Hypothyroidism**

- Lethargic
- Weight gain
- Cold intolerance
- May have decreased blood pressure
**Hypothyroidism**
- Sensitive to depressive drugs:
  - Narcotics
  - Barbiturates
  - Controlled with medications

**Hyperthyroidism**
- Tremors
- Nervousness
- Insomnia
- Weight loss
- Heat intolerance
- HTN

**Hyperthyroidism**
- Fine hair
- Exophthalmus – protruding eyes
- Flushing
- Goiter – enlarged thyroid glands
- Fast reflexes

**Severe Exophthalmos in Poorly Controlled Hyperthyroidism**

**Hyperthyroidism – Medical and Surgical Management**
- Susceptible to thyroid storm - anesthetic risk
- Controlled with medications or surgery
  - In mild cases, medications to suppress the thyroid
  - In more severe cases, partial or total removal of the thyroid glands
  - Following surgical removal of the glands, the patient must receive thyroid supplementation

**Thyroid Storm**
**DEFINITION:**
A severe, life-threatening condition caused by an excess of thyroid hormone.
Thyroid Storm

Symptoms include:
- Fever: 105-106 degrees
- Racing pulse
- Nausea
- Vomiting
- Diarrhea
- Irregular heart beat
- Confusion
- Weakness

Thyroid Storm

Thyroid storm may lead to heart failure and requires emergent medical treatment.

Thyroid Disease

Treatment Considerations
- Increased work load on the pulmonary and cardiovascular systems
- Sensitive to epinephrine
- Stress reduction
- Utilize sedation when possible

ENDOCRINE SYSTEM

ADRENAL GLANDS

Adrenal Gland – Functions

Medulla:
- Secretes epinephrine and norepinephrine
- Fight or flight mediators

Cortex:
- Secretes corticosteroids
- Physiologic stress mediators
Cushing Disease (Syndrome)
- Adrenal gland hyperplasia
- Caused by a tumor of the pituitary gland
- Results in too much hormone production by the adrenal glands

Cushinoid Patient
Findings:
- Red cheeks
- Moon face
- Buffalo hump
- Slender extremities
- Pendulous abdomen
- Purple striae
- Poor healing

Adrenal Dysfunction
Addison's disease
- Potential life threatening
- Chronic adrenocortical insufficiency
- Inadequate corticosteroid production by adrenal cortex
- Poor physiologic response to stresses such as surgery

Adrenal Suppression
- Patients on steroid medication
  - Cortisone
  - Prednisone
- Feedback inhibition
- Adrenal gland atrophies - becomes non-functional
- Poor response to stress

Acute Adrenal Insufficiency
Predisposing Factors:
- Primary adrenal insufficiency
- Secondary adrenal insufficiency
- Bilateral adrenalectomy
- Destruction of pituitary gland
- Stress-physiologic or psychological

Acute Adrenal Insufficiency
- Rule of Two's used previously:
  - 20 mgs or more of cortisone or its equivalent daily
  - 2 weeks or longer of therapy
  - 2 years or less prior to dental therapy
- The Rule of Two's is no longer used it as a rigid guideline:
  - Currently suppression is thought to probably only last for a few months
  - It is likely that doses larger than 20 mg per day would be necessary to cause suppression
- Consultation with Pt's M.D. is appropriate

Warning: "Patients on Corticosteroids need special attention."
**Acute Adrenal Insufficiency**

Prevention:
- Thorough medical history
- Treatment considerations:
  - Corticosteroid coverage when indicated
  - Stress reduction modalities
  - Other considerations – infections
Your Immune System

The body reacts to attack by pathogens (often viruses or bacteria) with the release of histamine.

Important Immune System Conditions in OMFS

- Allergic rhinitis and sinusitis
- Allergies to anesthetic drugs and antibiotics
- Allergies to components of commonly used equipment and supplies in OMFS
- Suppression of the immune system in patients undergoing chemotherapy
- Altered immune response in patients with diabetes mellitus
- HIV

Allergic Rhinitis and Sinusitis

These secretions can precipitate a laryngospasm and create a serious threat to the airway.
**HIV**

**Concerns:**
- Decreased patient resistance
- Opportunistic infections
- Doctor and Staff exposure

**Treatment Considerations:**
- Optimal patient health
- Antibiotic coverage
- Universal precautions

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**Immune System**

**Monitoring**

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**Immune System**

**Medical and Anesthetic Emergencies**

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**Monitoring – Observe for...**

- Rash
- Watery eyes
- Lip swelling
- Hives
- Swollen eyes
- Itching

Also: Listen for wheezing and watch monitors.

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**Allergy To Drugs - Pathophysiology**

**The Timing of Allergic Reactions**

**DELAYED ALLERGIC REACTION:**
- 1 hour or more after exposure
- Usually mild reactions

**IMMEDIATE:**
- Usually within 1 hour of exposure
- In most cases these are severe reactions
Allergic Reactions To Drugs – Most Common

ANTIBIOTICS:
- The penicillins (natural and synthetic)
- Cephalosporins – 10% cross reactivity with penicillin (1 in 10 allergic to penicillin are also allergic to Cephalosporins)

SKIN REACTIONS MOST COMMON:
- Rash
- Urticaria (itching)
- Erythema (redness)
- Angioedema (swelling of the lips)

Allergy To Drugs - Diagnosis

Anaphylaxis

Allergic Reaction Treatment - Mild Reactions
- Stop administration of all drugs
- 100% O₂
- Very mild reactions may require no treatment other than observation
- Mild reactions requiring treatment -
  - Rash
  - Itching
  - ′d nasal secretions
  - Watery eyes
  - Diphenhydramine (Benadryl®) 25-50 mg IV or IM followed by Rx

Severe Allergic Reactions - Treatment
- α - Vasoconstriction
- β Effects
  - β₁ ′s HR, ′d BP
  - β₂ Bronchodilation
- Vasoconstriction of edematous (swollen) membranes of throat - α
Treatment Of Allergic Reactions – Additional Medications

Dexamethasone (Decadron®):
• To stabilize membranes, which will reduce swelling
• To combat the other symptoms of inflammation

Allergic Reactions - Prevention

• Thorough medical history with details of previous reactions
• Avoid administering or prescribing any drug which has produced an allergic reaction (check chart and ask patient!)

Natural Latex Allergy

Yes, we are all well aware of the risks of latex surgical gloves for our latex-sensitive patients.

But... have you checked on all the other equipment and supplies in your office to see if any of them might also contain latex?

OTHER BODY SYSTEMS

ANESTHETIC MANAGEMENT

An Overview of Your Liver’s Functions...

The Liver

Important Aspects of Liver Function In OMFS

Functions of the liver:
• Blood filtration
• Drug metabolism
• Blood coagulation
Liver Disease

- Cirrhosis - fibrosis or scar tissue within the liver
- Toxins
- Alcohol
- Viral Disorders - Hepatitis
- Metabolic Disorders

Liver Disease – Treatment Considerations

- Alter drug therapy
- Prolonged mental depression due to decrease metabolism of anesthetics and analgesics
- Postoperative bleeding
- Cirrhosis – Ascites (collection of fluid in the abdomen) and peripheral edema in the lower extremities
- Universal precautions

Liver Disease

Findings:

- Jaundice – yellow color of skin and eyes
- Multiple bruises
- Increased PT, INR

Anticoagulation Therapy

- Stroke patients
- Atrial fibrillation
- Prosthetic valves
- Prevent Emboli

Coumadin® Therapy

- Competitive inhibition of clotting factors
- Prothrombin time or INR is used to follow Coumadin® therapy

International Normalized Ratio

\[
\text{INR} = \frac{\text{Patient’s PT/normal PT}}{\text{ISI}}
\]

INR was recommended by WHO to standardize PT for Coumadin therapy
Surgery in Patients on Coumadin®

- Most patients do not have to stop or alter their Coumadin® dose.
- Consider local hemostatic measures e.g. SurgiCel or Gelfoam.
- Consult with physician on higher INR levels or more extensive procedures.

Surgery in Patients on Coumadin®

- Therapeutic levels of INR range from 2.0-3.5
- Minor surgeries can be performed at 2.8 or less
- A pre-op INR should be obtained
- Takes 3 to 5 days for effect of Coumadin to wear off and 3 to 5 days to get the effect back

Substance Abuse

Concerns:
- Risk of infection
- Related diseases
  - Hepatitis
  - AIDS
- Drug tolerance
- Cardiac problems
- Drug-seeking behavior

Drug Addiction

Treatment Considerations:
- Increased doses of drugs
- Question recent use of street drugs
- Universal precautions
- Postoperative prescription problems

Kidney Disease

Functions:
- Filters blood
- Waste elimination
- Fluid and electrolyte balance
Kidney Disease

Concerns:
- Drug elimination
- Hypertension
- Renal dialysis
- Risk of infection

Pregnancy

Concerns:
- Question to determine if normal pregnancy
- Drug effects on mother and fetus
- Patient position

Pregnancy

Treatment Considerations:
- Second trimester best for relatively elective procedures
- Last trimester - venous return - flat or on side
- Use of sedation / general anesthesia - obtain medical consultation

Pregnancy

Treatment Considerations (cont'd)
- Consult with physician re:
  - Postoperative prescriptions
  - Nursing mother
  - Radiographs - lead apron

Malignant Hyperthermia

DEFINITION:
A rare, inherited condition characterized by intense muscle spasm which leads to a rapid, extreme, and often fatal rise in body temperature following the administration of general anesthesia.

Patients at Risk

- Family history - is hereditary
- Underlying muscle disease such and muscular dystrophy and myotonia
In Malignant Hyperthermia, a triggering agent such as succinylcholine or an inhalation anesthetic agent elicits a massive outflow of calcium from the tubular network, and the great expenditure of energy generates heat and the body's temperature rises rapidly out of control.

Malignant Hyperthermia (MH)
- Rare condition seen in 1:15,000 children and 1:40,000 adults
- Family history helpful, but not definitive
- Muscle biopsy in highly suspect patients

MONITORING FOR MALIGNANT HYPERHERMIA
WHEN A TRIGGERING AGENT SUCH AS A HALOGENATED HYDROCARBON AND/OR SUCCINYLCHOLINE IS UTILIZED.

Malignant Hyperthermia (MH)
SIGNS & SYMPTOMS:
- Masseter spasm
- ↑'d CO₂
- ↑'d HR, ↑'d BP, followed by ↓'d BP
- Dysrhythmias
- ↑'d temperature (up to ↑ of 1°C q 5 min)

Monitoring for Malignant Hyperthermia During Anesthesia
- Many of the initial signs may be picked up by the conventional monitoring parameters of pulse, blood pressure, rhythm, O₂ Sat and ET CO₂
- In addition, when inhalation agents and/or succinylcholine are utilized, a temperature sensor should be placed

TREATMENT:
- Discontinue all anesthetic drugs
- 100% O₂
- Call 911
- Ice packs
Malignant Hyperthermia

- Iced saline IV fluids.
- Stomach / bladder / rectum / lavage with ice water.
- Dantrolene IV to stop the flood of calcium ions through the ion channels.
- Treat hyperkalemia and acidosis as needed.

MHAUS

- Malignant Hyperthermia Association of the United States
- Emergency Hotline 800-644-9737 (800 MH HYPER)
- Non-emergency or patient referral 607-674-7901

IMMUNE AND OTHER BODY SYSTEMS

THE END
**Venipuncture Sites**

- Antecubital fossa
- Dorsal venous plexus of hand
- Cephalic vein
- Basilic vein
- Median cubital vein

**Prevent Intra-arterial Injection**

- Biceps muscle
- Brachial artery
- Artery may lie just beneath the bicipital aponeurosis

**Dorsal Venous Plexus of Hand**

- Cephalic at wrist

Highly variable pattern from patient to patient which does not allow for naming of the individual veins.
Intravenous fluid management

- IV bag of normal saline
- Flash-ball infusion set

Preferred Maintenance IV Fluid

- In the past - 0.45% normal saline in 5% dextrose (D5/.45) was preferred
- However, it has been shown that the dextrose in such solutions is rapidly metabolized, which effectively results in the administration of an infusion fluid that is too dilute
- Consequently, it is now recommended that maintenance fluids in outpatient surgery consist of a solution such as normal saline (NS) or Lactated Ringer’s Solution (LR)

Preparing to Set Up the Intravenous Infusion

- The IV bag and infusion sets are individually wrapped in plastic to assure that each patient gets a new set

When they infusion set is removed...

...from its plastic packaging, the rate control wheel must be closed

Remove the protective plug from the IV bag...

...and the protective cover from the infusion set. Then insert the infusion set into the port on the IV bag.

Hang the IV bag...

...and squeeze the drip chamber once or twice until it fills to the line
Open the line and run the intravenous fluid... through the line to eliminate bubbles.

Stabilize the IV line... while the tape is being placed.

Arm Secured With Arm Extender and Velcro Arm Restraint

IV infusion port securely taped to patient’s arm.

During the procedure...
- the venipuncture site should be monitored to assure that there is no erythema, swelling or rash, and
- the infusion monitored to assure it is running at the predetermined rate.

Various Types of Vial and Ampoules Used in the OMFS Office

- Glass Ampoule
- Glass Multidose Vial
- Plastic Multidose Vial
- Mix-o-vial For Special Medications

A Typical Multidose Vial

- Medication
- Expiration Date
- Contents of vial
- Concentration
DOSES OF DRUGS IN METRIC UNITS

1 CUBIC CENTIMETER OF WATER = 1 MILLI-LITER = 1 GRAM

CONCENTRATION OF DRUGS IN METRIC UNITS

- We know that:
  - 1 cc = 1 ml
  - 1 cc H₂O = 1 gram

Now let’s calculate:
\[
\text{mg} / \text{cc} \\
\text{or} \\
\text{mg} / \text{ml}
\]

From percent concentration (%):

- 1% solution – 1 g. in 100 cc (which weighs 100 g.)
  Since there are 1000 mg / 1 g,
  1% solution = \( \frac{1000 \text{ mg}}{1 \text{ cc}} = 10 \text{ mg} / \text{cc} \)
  \( = 10 \text{ m}\)l / 1 cc

Therefore:
- 1% solution = 10 mg / cc
- 2% solution = 20 mg / cc
CONCENTRATION OF VASOCONSTRICTORS

- Epinephrine 1:100,000 (1 g. in 100,000 cc)
- Since there are 1000 mg / 1 gm,
  \[ \frac{1000 \text{ mg}}{100,000 \text{ cc}} = \frac{1 \text{ mg}}{100 \text{ cc}} \]
- Then, divide both the numerator and denominator by 100:
  \[ \frac{1 \text{ mg}}{100 \text{ cc}} \]

Prepare the vial for withdrawal of medication...

...by wiping the rubber diaphragm with alcohol.

Withdraw the same volume of air into the syringe...

...as the amount of medication to be withdrawn and inject the air into the vial.

After the appropriate volume of air has been injected into the vial...

...Withdraw the plunger and double check to make sure that the correct volume of medication has been withdrawn.

To assure that an inappropriate medication is not administered, the staff member should show the medication to the surgeon before it is injected.

And...

Administer Drugs With a Safe Needle

Recapping the Safe Needle
**Administering Drugs Intravenously**

- Bolus administration – the drug is administered rapidly all at once
- Fluid bolus – a large volume of intravenous fluid is given rapidly as a bolus
- Incremental bolus – small boluses are given intermittently
- Continuous infusion – the drug is given continuously, usually with an infusion pump

**To discontinue the IV, stop the infusion...**

...and with gloved hands begin to remove the tape securing the IV line.

**Have a sponge ready...**

...for placing pressure over the venipuncture site.

**As the cannula is withdrawn...**

...place the sponge over the venipuncture site

**Maintain pressure over the venipuncture site...**

...for several minutes to prevent hematoma formation

**Once you are sure that there is no further leakage...**

...tape the sponge securely in place.
**Venipuncture Complications**

The less severe venipuncture complications are due to:

- Inflammation (phlebitis) or clotting (thrombosis) inside the vein due to chemical or physical trauma
- The extravasation or infiltration of fluids or medications outside the vein into the surrounding tissues causing ecchymosis, hematoma formation or infection

**Treatment for Most of the Less Severe Venipuncture Complications Include:**

- Pressure to prevent hematoma
- Elevation of extremity
- Moist heat
- Aspirin or other anti-inflammatory
- Severe cases may need steroid and/or antibiotic

**Prevention of the Less Serious Complications of Venipuncture:**

- Use plastic catheters e.g. angiocathsrather than metal needles
- Don’t continue to needle if a couple of attempts are unsuccessful
- For exceedingly difficult cases consider the foot or internal jugular

**The Signs and Symptoms of Less Severe Venipuncture Complications:**

**Early**
- Pain on injection
- Swelling
- Redness
- Loss of effectiveness of IV medication
- Skin is stretched

**Late**
- Tenderness
- Palpable cord-like feeling

**Additional Measures to Prevent Complications:**

- Confirm placement with blood in flash chamber
- Firmly secure the IV
- After removal, apply adequate pressure to prevent hematoma

**Less Severe Complications Can Become Quite Serious When:**

- The patient is on anticoagulants
- There are multiple entries into the vein
- The catheter passes through the vein
- There is inadequate pressure at the IV site
Mechanical trauma
- Excessive manipulation of vein
- Infusion rate too fast
- Infusion volume too large
- Chemical irritation
- pH of medication – irritant
- Medication toxic to vein lining

Thrombophlebitis – Inflammation and Clotting Secondary To:

Clinical Example of Thrombophlebitis

- Often described as having a “ropey” consistency
- The vein comes erythematous (red)
- The patient complains of tenderness
- In severe cases will require a vascular consult

Major Venipuncture Complications

- Intra-arterial injection
- Air embolism
- Compartment Syndrome

Intra-arterial Injection

Intended injection into:
Veins of arm or hand to heart and then to brain

Intra-arterial Injection: Artery in arm to small arteries and arterioles of the hand

Intra-Arterial Injection - Pathophysiology

- Intense chemical inflammation destroys the endothelial and subendothelial layers
- Which can lead to:

Intra-arterial Injection - Diagnosis

STOP

STOP
**Intra-arterial Injection - Treatment**

- Draw up 10 ml of 1% procaine
- Ice-pack to area
- Ambulance
- To hospital STAT
- Leave needle in place

**Intra-arterial Injection - Prevention**

- BE OBSERVANT!
- PALPATE before stick → Pulsation?
- Bright red blood?
- Does the needle shoot out?
- Is there pulsation of blood?

**Air Emboli - Causes**

Entry of air due to loose connections or improper removal of air:
- May obstruct pulmonary artery
- Potentially fatal

Air Emboli – Signs/Symptoms:
- SOB Chest pain
- Shoulder/low back pain
- Weak/rapid pulse
- Hypotension
- LOC
- Cardiac arrest

**Air Emboli – Prevention**

- Clamp catheter when not in use
- Purge all air
- Use Luer-loc IV connections

**Air Emboli – Treatment**

- Trendelenburg position
- Check for source of air
- Activate 911
- Monitor VS, O₂
- Call “Dial-A-Prayer”

**Another Possible and Extremely Serious Venipuncture Emergency**

“Compartment Syndrome”, another uncommonly encountered serious venipuncture complication, has occasionally been reported in OMFS offices.

It is important to realize that Compartment Syndrome can occur following venipuncture. In one OMFS, a patient who was a cellist had to have his arm amputated.

**The Arterial Supply And Venous Drainage Of The Forearm**

- The veins which we utilize for venapuncture are usually relatively superficial and lie just beneath the skin.
- Deeper in the forearm are the muscles as well as the major arteries and nerves.
Thick fascial tissue enshrouds the muscles.
The arteries and nerves pass between the muscles.

- Layers of fascia divide the muscles into “compartments.” (marked with green and blue lines in this diagram).
- The fascia does not expand, and when there is inflammation, swelling causes pressure to build within the compartments.

Compartment Syndrome

Repeated “needling” causes pressure build-up which compresses the nerves and blood vessels. Symptoms include pain, numbness, tingling, and paralysis.

Treatment: A fasciotomy (incision) must be performed rapidly to allow release of the pressure to decompress the blood vessels and nerves.

The Muscle Compartments of the Forearm

Intravenous Therapy and the Administration of Intravenous Drugs

THE END
PHARMACOLOGY

First we’ll look at what drugs do to the body and how they do it.

- INTENDED EFFECTS IN THE BRAIN
- CONCOMITANT EFFECTS
- CARDIOVASCULAR SYSTEM & THE LUNGS

Then we’ll examine the fate of the drug in your body (what your body does to it).

- DISTRIBUTION: THE BRAIN
- MUSCLE MASS
- FAT STORES
- ABSORPTION: FROM THE GUT OR VASCULAR SYSTEM
- METABOLISM: LIVER
- EXCRETION: THE KIDNEYS

BALANCED ANESTHESIA

- ANALGESIA
- AMNESIA
- RELAXATION
- HYPNOSIS

Additional Desirable Attributes of Anesthetic Drugs

- Maintenance of the homeostatic mechanisms.
- Provide a rapid, smooth and comfortable induction.
- Rapid recovery and emergence euphoria.
- No nausea, vomiting or laryngospasms.
- Easily adapted for use in children and seniors.
- Administered with familiar anesthetic equipment and supplies.
- Use of these drugs must be consistent with current anesthesiology principles and techniques.
- A technique which is cost-effective.
How do these drugs work? Let's take a look inside your brain.

**NEURONS – THE CELLS OF THE BRAIN**

**MULTIPLE INTER-CONNECTIONS SIMILAR TO A HUGE COMPUTER NETWORK**

**NEURONS**

**AXON**

**CELL BODY**

The “Secret” of Nerve Conduction and the Action of Anesthetic Agents

**DEPOLARIZATION**

**CONDUCTION OF THE NERVE IMPULSE**

Depolarization and generation of the action potential

**CONDUCTION OF NERVE IMPULSES**

Anesthetics alter nerve conduction by interfering with the passage of ions through membrane channels which prevents depolarization

**DEPOLARIZATION moves down the membrane as a wave as the action potential causes adjacent Na⁺ channels to open**

This wave of depolarization is followed by:

**REPOLARIZATION as Na⁺ and K⁺ pass back out of the cell**
Virtually all anesthetic agents function by interfering with the opening and closing of these membrane channels.

They do so by interfering with the opening and closing mechanism of the channels.
Where do Anesthetics Work in the Central Nervous System?

Vital centers

The Central Relay Station

Center for Emotion

The Wakefulness System

The Central Relay Station

HOMEOSTASIS
(Similar to the heating and air conditioning system in your home)

• HOMEOSTASIS - A state of equilibrium (or balance) of the various physiologic systems and processes which control bodily functions
• From the Greek meaning “standing the same”

RESPIRATORY DEPRESSION – SECONDARY TO ANESTHETIC AGENTS

Blood pCO₂↑

Sensor increases respiratory rate and depth

THE AUTONOMIC NERVOUS SYSTEM

• The “automatic” system that regulates most of the physiologic processes of the body:
  The Sympathetic or Adrenergic side
  The Parasympathetic or Cholinergic side
The components of the autonomic nervous system keep you on “cruise control”

**PARASYMPATHETIC INNERVATION (CHOLINERGIC)**

Parasympathetic innervation is like the “brakes” of your nervous system, helping to slow down and relax your body, especially in settings like the digestive system.

**SYMPATHETIC STIMULATION (ADRENERGIC)**

Sympathetic stimulation is like the “accelerator,” preparing your body for stress or “emergency” situations. When activated, it increases heart rate, blood pressure, and other responses to prepare for action.

**METABOLISM (Biotransformation)**

Metabolism is the process by which drugs are changed into different forms, often more water-soluble, making them easier to eliminate from the body. This usually occurs in the liver, and the new form of the drug can be excreted more easily.

**ELIMINATION OF DRUGS FROM THE BODY**

Drug elimination includes processes like reabsorption by the kidneys, which make the metabolized form of the drug less likely to be reabsorbed, and excretion through the lungs, sweat, saliva, and feces, helping to clear the body of toxins.

**PHARMACOLOGY OF THE DRUGS USED IN MODERN ORAL AND MAXILLOFACIAL SURGERY**

This course focuses on understanding how drugs work in the context of oral and maxillofacial surgery, ensuring effective and safe patient care.
The Fate of Drugs in the Body

Routes of Administration

Oral Administration
- Convenient
- Painless
- Economical
However:
- Delayed Onset
- Unpredictable Effect
- Patient Compliance may be sub-optimal
- Not good for patients with nausea and vomiting!

Topical Administration
- More rapid absorption than oral
- Drugs enter systemic circulation without going to the liver first
- Most drugs poorly absorbed by this route

Rectal Administration
- Can give drug if patient is nauseous
- Most patients, including you, would say that they would prefer almost any other route in preference to this one

Subcutaneous Administration
- Delayed absorption vs. IM or IV
- Hurts just about as much as an IV but does not have the advantage of the operator being able to titrate the amount of drug for the desired effect

Intramuscular Administration
- Good absorption due to vascularity of the muscle mass
However:
- There is a variable and somewhat unpredictable onset of the drug effect
- Can’t titrate dose
INTRAVENOUS ADMINISTRATION

- Most rapid method of administration & onset of action.
- Can titrate dose
- Rapid dilution of caustic substances
- Greater volume possible
- BUT most hazardous route because local damage can occur

THE INHALATION ROUTE OF ADMINISTRATION

- Rapid absorption into systemic circulation through lungs
- Most inhalation agents, except nitrous oxide, are general anesthetics
- For longer cases inhalation general anesthetics might require intubation and support of ventilation

SEVOFLURANE (ULTANE®)

- Used for General anesthesia or sedation
- Volatile liquid
- Rapid induction and emergence
- Non-irritating to airway
- Bronchodilator

THE "MASK" INDUCTION

- Mask placed over face when patient falls asleep
- IV is started with the advantage of vasodilation
- Gas must have rapid onset, pleasant smell and be non-irritating!

Our Approach to the Study of Anesthetic Drugs and Associated Medications

- Since most oral and maxillofacial surgery offices utilize a total intravenous technique as the primary therapy, we will break down how these drugs work in a typical surgical setting.
- We will discuss the pharmacology of the drugs in the setting in which they are utilized – starting from when he enters the office in an anxious state, through the surgical procedure, and then ending with our preparation for discharge.
We will break down the anesthesia technique into segments and review the pertinent drugs along the way. We want to keep the patient safe, relaxed, and comfortable throughout his treatment.

<table>
<thead>
<tr>
<th>LEVEL OF CONSCIOUSNESS</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>1. Pre-op oral sedation</td>
<td></td>
</tr>
</tbody>
</table>

**Surgical Anesthesia**

**Hypnosis**

**Heavy Sedation**

**Light Sedation**

---

**LEVEL OF CONSCIOUSNESS**

1. Pre-op oral sedation

---

**Nitrous Oxide / Ethyl Chloride**

- Stored in green tanks
- Use with all sedations and general anesthetics
- 21% in room air
- Use 30% or greater concentration when using other agents
- Use 100% in emergencies
- Use with caution in COPD patients (2-3 L/min)

---

**Nitrous Oxide**

- Blue tanks, Non-flammable
- Euphoria, relaxation
- Analgesic, weak anesthetic
- Slight respiratory and myocardial depression

---

**Oxygen**

- Stored in green tanks
- Use with all sedations and general anesthetics
- 21% in room air
- Use 30% or greater concentration when using other agents
- Use 100% in emergencies
- Use with caution in COPD patients (2-3 L/min)

---

**Nitrous Oxide / Oxygen Delivery System**

Must be able to administer positive pressure O2
NITROUS OXIDE - SCAVENGING SYSTEM

SCAVENGER TUBE removes exhaled N₂O

LARGER TUBE carries N₂O/O₂ to patient

Removal of exhaled N₂O for protection of office staff

NITROUS OXIDE

N₂O at "O"
O₂ at 5 l/min.

• Quick recovery
• Diffusion hypoxia – The N₂O diffuses from the bloodstream to the lungs, and the alveoli in the lungs fill up with it. If the patient is placed directly on room air, he can become hypoxic.
• Administer 100% O₂ for 5-10 minutes after the N₂O is turned off

STRATEGIES FOR DEALING WITH “NEEDLE PHOBIA”

ADULTS - ETHYL CHLORIDE SPRAY

Rapid evaporation numbs by quickly cooling (“freezing”) the surface

CHILDREN – GENERIC EMLA

TOPICAL ANESTHESIA FOR VENIPUNCTURE USING EMLA

• Topical anesthetic cream or ointment consisting of:
  • Lidocaine
  • Prilocaine
• EMLA is applied and then covered with a Tegaderm patch
• Must be left in place for at least 60 minutes before a needle stick for effective pain relief

PATIENT: Robert AGE: 28
TREATMENT: Removal #’s 1, 16, 17 & 32

Surgical
Anesthesia

Hypnosis

Heavy
Sedation

Light
Sedation

1. Pre-induction IV meds
2. Nitrous Oxide / Ethyl Chloride
3. Pre-op oral sedation

LEVEL OF CONSCIOUSNESS

TIME

5 10 15 20 25 30 35 40 45 50 55 60 65

Now let’s see what other drugs we can use to get Robert’s third molars out as comfortably as possible for him - and us.

Back to TOC

Rev. 2017
PRE-OPERATIVE AND PRE-INDUCTION MEDICATIONS

• To relax and sedate the patient
• Provide analgesia and additional sedation

THE BENZODIAZEPINES

• Diazepam (Valium®)
• Midazolam (Versed®)

EFFECT OF SEDATIVE/ANXIETY-REDUCING AGENTS ON THE CENTER FOR EMOTION

VERSED

Primary site of action - Center for Emotion
Dose 2-20mg IV

DIAZEPAM - DESIRED ACTIONS

• Reduces anxiety, relaxes patient
• Dose-dependent anterograde amnesia
• Reversible with flumazenil

DIAZEPAM - CONSIDERATIONS

• Anticonvulsant
• Contraindicated in patients with acute narrow-angle glaucoma
• Minimal change in respiration
• Mild decrease in blood pressure
• Relaxes muscles

DIAZEPAM - DISADVANTAGES AND COMPLICATIONS

Ouch!

• Insoluble in water
• Dissolved in propylene glycol which CAN CAUSE VEIN IRRITATION (PHLEBITIS), so inject slowly
• Half-life 20-40 hrs
MIDAZOLAM (VERSED®)

- Greater sedation than diazepam
- More profound anterograde amnesia than diazepam
- Water-soluble and no propylene glycol, so less vein irritation
- Dose 1-10mg IV
- Shorter-acting than diazepam - half-life 1-4 hrs
- Reversible with flumazenil

MORPHINE SULFATE - THE PROTOTYPE NARCOTIC

- Produces analgesia, drowsiness, mental clouding, euphoria
- Pupils become constricted
- May cause constipation, nausea, vomiting (due to stimulation of the vomiting center in the brain stem)
- Use with caution in asthmatics
- Bradycardia is first sign of overdose
- May see skin rash due to histamine release

MORPHINE AND IT’S RELATIVES

- All are potent analgesics
- All are respiratory depressants
- Minimal cardiovascular effects at normal doses
- Relieve pain without altering other senses (e.g. sight, hearing, touch)
- All are reversible with naloxone (Narcan)

Trends – Versed vs. Valium:

- More offices using Versed
- Fewer offices using Valium

NARCOTICS

<table>
<thead>
<tr>
<th>NATURAL</th>
<th>SYNTHETIC</th>
</tr>
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<tbody>
<tr>
<td>The opium poppy</td>
<td>Chemical synthesis of meperidine during a search for an atropine-like drug</td>
</tr>
<tr>
<td>Friedrich Wilhelm Sertürner - isolated morphine from opium in 1803</td>
<td>Eisleb &amp; Schaumann, 1939</td>
</tr>
</tbody>
</table>
MEPERIDINE (DEMEROL®)

- A synthetic narcotic
- One-tenth as potent as morphine, but equally effective for pain relief
- Mild histamine release
- May produce hypotension

FENTANYL (SUBLIMAZE®)

- About 100 times more potent than morphine
- Rapid onset (<1 min)
- Short duration (30-60 min)
- Cardiovascular system remains stable, but may see bradycardia
- Chest wall rigidity?
- Best narcotic for asthmatics and patients with a history of nausea and vomiting

NARCOTIC AGONIST-ANTAGONISTS

- Have properties that cause simultaneous stimulation and suppression of opioid receptors
- Ceiling effect for respiratory depression and analgesia with Nubain® and Stadol®
- Otherwise no clear-cut advantage over traditional narcotics

PRE-OPERATIVE AND PRE-INDUCTION MEDICATIONS

- To reduce secretions
- To reduce surgical swelling

ANTICHOLINERGIC AGENTS – ATROPINE AND GLYCOPRYRROLE (ROBINUL®)

- Decrease salivary, bronchial, gastric secretions
- Atropine increases heart rate
- Atropine crosses blood-brain barrier
- Glycopyrrolate twice as potent antiallogogue, less tachycardia

CORTICOSTEROIDS

- Dexamethasone (Decadron®)
- Methylprednisolone (Solumedrol®)
- Prednisone

- Decrease swelling and inflammation
- Depress immune system
- Increase blood glucose
- Caution with infections, ulcers, depression, tuberculosis, glaucoma
PHARMACOLOGY OF THE DRUGS USED IN MODERN ORAL AND MAXILLOFACIAL SURGERY

END - PART 2 OF 3

Major Intravenous Anesthetic Agents

Methohexital (Brevital®)

Propofol (Diprivan®)

Sodium Methohexital (Brevital®) Barbiturate 10mg/Ml (1% solution)

- Induces sleep (or hypnosis) by disrupting the radiations of the wakefulness system to the cortex
- Ultra-short acting barbiturate, due to its rapid redistribution
- Decreases blood pressure 10-25%
- Increases heart rate 10-30% (compensation for decreased blood pressure)

SITE OF ACTION - THE WAKEFULNESS SYSTEM

Major Intravenous Anesthetic Agents

Ketamine

Propofol and Ketamine

Sodium Methohexital (Brevital®) Barbiturate 10mg/Ml (1% Solution)

- Dose dependent respiratory depression
- Can predispose the patient to developing a laryngospasm
- No reversal drug

SITE OF ACTION - THE WAKEFULNESS SYSTEM
**Trends – Propofol vs. Brevital**

- More offices using propofol.
- Fewer using Brevital.

**Propofol (Diprivan®)**

A potent sedative-hypnotic which has gained wide acceptance and has now replaced Sodium Pentothal and Brevital® in many operating rooms (and OMS offices) throughout the world.

**Propofol Vehicle and Preservative Strategies**

- Medical questionnaire entries for:
  - Sulfites
  - Soy products
  - Eggs
- Severe asthma or sulfite allergy - consider a formulation with EDTA or benzyl alcohol.

**Propofol Anesthesia and Egg Allergy**

- Egg yolk – Component used in the propofol emulsion is lecithin from the yolk.
- Egg white – Most patients allergic to eggs are allergic to albumin in the white.

**Propofol (Diprivan®) Site of Action**

- Primary site of action – The Wakefulness System
- Receptors in additional areas may be responsible for other characteristics such as emergence euphoria and anti-nausea effects.
Propofol (Diprivan®) – Nervous System Effects

- Antiemetic (antinausea) effects
- Anticonvulsant properties
- Pain on injection - 1cc of lidocaine 1%
- “Smooth” emergence, feeling of well-being and euphoria

Propofol (Diprivan®) Distribution

- Highly fat (lipid) soluble
- Produces anesthesia as rapidly as IV barbiturates
- More rapid recovery (distribution half-life 2-8 min.)
- Redistributed rapidly to muscle, fat and skin (peripheral compartments)

Propofol (Diprivan®) Distribution Groups

- Elderly – Decrease dose
- Women – Higher dose than men
- Children – 50% increase in dose on a pound for pound basis

Propofol (Diprivan®) Biotransformation

- Metabolized in the liver (10x faster than thiopental)
- Not affected by moderate cirrhosis
- There is also metabolism in other sites besides the liver

PROPOFOL (DIPRIVAN®) ELIMINATION

- Metabolism results in inactive metabolites which are eliminated by renal clearance (< 1% excreted unchanged)
- Chronic renal failure does not affect clearance

PROPOFOL (DIPRIVAN®) CARDIOVASCULAR SYSTEM EFFECTS

Hypotension
- ↓ in arterial pressure due to ↓ vascular resistance (inhibition of sympathetic vasoconstriction)
- Largely reversed by stimulation - e.g. local anesthesia
- Exacerbating factors – ↑ doses, ↑ rate of administration, ↑ age
PROPONFOL (DIPRIVAN®)
HEART RATE

- Usually little change with no tendency for reflex tachycardia
- May cause a modest bradycardia

PROPONFOL (DIPRIVAN®)
RESPIRATORY SYSTEM EFFECTS

- Respiratory depressant
- Apnea after induction, largely reversed by stimulation
- Upright upper airway reflexes, so allows suctioning – FEWER laryngospasms than Brevital
- Modest bronchodilation in asthmatic patients

PROPONFOL - DISADVANTAGES AND CONTRAINDICATIONS

- May burn on injection due to oil in water emulsion, but no increase in the incidence of thrombophlebitis
- Contraindications - allergy to egg yolk or soy
- Use with caution in patients with seizure disorders (administer a benzodiazepine prior to propofol)
- No reversal drug

KETAMINE IN OFFICE-BASED ANESTHESIA

- Potent analgesia
- Amnesia
- Emergence delirium - can be largely prevented with benzodiazepines
  - ↑ in cerebral blood flow and intracranial pressure

KETAMINE (KETALAR®)
NERVOUS SYSTEM EFFECTS

- Potent analgesia
- Amnesia
- Emergence delirium - can be largely prevented with benzodiazepines
  - ↑ in cerebral blood flow and intracranial pressure
KETAMINE (KETALAR®) DISTRIBUTION

- Highly lipid soluble
- Rapid uptake in brain
- Redistribution to peripheral compartments
- Distribution half-life of 10-15 minutes

CARDIOVASCULAR EFFECTS OF KETAMINE

- ↑ in BP, HR and cardiac output
- Effects due to central stimulation of the sympathetic nervous system
- Peak effect in 2-4 minutes with a ↓ over 10-20 min.

KETAMINE AND MIDAZOLAM COMPLEMENTARY EFFECTS

- Increase of centrally mediated BP
- Decrease of centrally mediated BP
- Emergence delirium +
- Profound Amnesia +++

RESPIRATORY SYSTEM

- Minimal affect on ventilatory drive
- Potent bronchodilator
- ↑'d secretions (can be attenuated with atropine or glycopyrrolate)

KETAMINE (KETALAR®) RESPIRATORY SYSTEM EFFECTS

- Functional Residual Capacity
  Maintained in children

INDICATIONS FOR USING KETAMINE

- Allergy to egg yolk or soy products which precludes the use of propofol
- In low-doses in combination with propofol to enhance the quality of a propofol-based anesthetic

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CALAOMS' OMSA Course Syllabus

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Back to TOC

Rev. 2017
Trends – Ketamine:

- Less reservation about its use
- More frequent use of ketamine with propofol

**BOTTOM LINE ANALYSIS - A COMPARISON OF PROPOFOL AND KETAMINE**

- Many of the effects of propofol are the opposite of those of ketamine
- The pharmacologic characteristics tend to complement one another

**PROPOFOL VS. KETAMINE**

**CNS AFFECTS**

- Hypnosis
- Amnesia +
- Analgesia -0
- Nausea ↓↓↓↓'
d
- Emergence
- Dysphoria +

**CARDIOVASCULAR AND RESPIRATORY AFFECTS**

- Respiratory Depression ++
- Bronchodilation +
- BP ↓↓'
d
- Pulse – no change or slightly ↓↓'
d
- Respiratory Depression + / 0
- Bronchodilation +++

**THE TWO AGENTS IN COMBINATION**

- Can be utilized in conjunction with a benzodiazepine, a narcotic, and an anticholinergic to satisfy the triad of an office “balanced anesthetic”
- This combination satisfies most of our “wish list” of desirable attributes of anesthetic drugs
**LOCAL ANESTHETICS**

- Local anesthetics act on nerve fibers by altering the passage of ions through the nerve membrane
- This prevents the nerve from depolarizing
- The two chemical types of local anesthetics are:
  - Esters - Procaine (Novocaine)
  - Amides - Lidocaine (Xylocaine)

**LOCAL ANESTHETICS - ESTERS**

- Esters are infrequently used today due to the high incidence of allergic reactions
- Procaine (Novocaine®) is the most commonly known
- It can be used as an alternative for patients allergic to amide anesthetics

**LOCAL ANESTHETICS - AMIDES**

- Lidocaine is the most commonly used amide
- The amides are more effective than the esters and cause fewer allergic reactions

**LOCAL ANESTHETICS - OVERDOSE**

- Early signs – Patient may become anxious, talkative and disoriented
- At higher doses the patient may develop seizures which can require emergency treatment

**LOCAL ANESTHETICS – VASOCONSTRICTORS**

The two commonly used vasoconstrictors are epinephrine and Neo-Cobefrin which are added to local anesthesia to:

- Make the anesthesia more profound and increase the duration of action
- Limit absorption of the local anesthetic into the systemic circulation, which minimizes the risk of toxicity
- Provide vasoconstriction which helps to minimize surgical bleeding
THE ASPIRATING SYRINGE - When blood pulls back into the syringe...

β₁ ONE HEART ↑ BP, ↑ HR

Surgical Anesthesia
Hypnosis
Heavy Sedation
Light Sedation
LEVEL OF CONSCIOUSNESS

TIME

5. Maintenance
6. Emergence

Stop giving propofol or Brevital
Turn off the nitrous oxide

Infusion of propofol by pump
Incremental bolus "bumps" of propofol or Brevital

LEVEL OF CONSCIOUSNESS

TIME

Surgical Anesthesia
Hypnosis
Heavy Sedation
Light Sedation

DRUG REVERSAL AGENTS

- Naloxone (Narcan®) - narcotic reversal
- Flumazenil (Romazicon®) - benzodiazepine reversal
- Neither will reverse propofol, Brevital® or ketamine

For both agents:
- Titrate slowly to effect
- Resedation possible
- Both drugs are competitive antagonists

POST-OPERATIVE MEDICATIONS

Narcotic analgesics and NSAIDS

Anti-nausea medications (anti-emetics)
SITES OF ACTION - ANALGESICS

NARCOTICS
- Skin
- Thalamus
- Limbic cortex
- Spinal cord

NON-NARCOTIC ANALGESICS

COUNTERACT INFLAMMATION AT THE SITE OF INJURY

NARCOTIC PAIN MEDICATION – SIDE EFFECTS
- Mental clouding and dizziness
- Respiratory depression
- Nausea
- Constipation
- Urinary retention

PRECAUTIONS WITH NSAIDS
- Gastrointestinal upset
- Kidney damage

ACETAMINOPHEN (TYLENOL) PRECAUTIONS
- Liver damage

ANESTHESIA FOR THE PREGNANT PATIENT
- Local anesthetics - safe, but make sure to avoid intravascular injection
- Sedative-Hypnotic Agents - avoid
- Diazepam and midazolam possibly linked to cleft lip and palate and other congenital anomalies

ANALGESICS CONSIDERED SAFE IN THE PREGNANT PATIENT
- Tylenol® (acetaminophen) is considered safe
- Demerol® safe with minimal use, but chronic use of Demerol and morphine lead to poor weight gain and neonatal addiction
- Vicodin® not linked to congenital defects but can cause neonatal depression
ANALGESICS CONSIDERED UNSAFE IN PREGNANCY

- NSAIDS contraindicated
- Codeine associated with congenital anomalies
- Fentanyl not linked to congenital defects, but causes respiratory depression, decreased heart rate and decreased blood pressure in the developing baby
- Talwin® not linked to congenital defects but can cause neonatal depression

PHARMACOLOGY OF THE DRUGS USED IN MODERN ORAL AND MAXILLOFACIAL SURGERY

END – PART 3 OF 3
"Anesthesia"

• Greek: “want of feeling”
• Greek adjective: anesthetos
  • An: without
  • Aesthesis: feeling, sensation

“Lack of pain"

Anesthesia

• Local
• Regional
  • Spinal
  • Epidural
  • Peripheral nerve blocks
• General

Spectrum of Anesthesia

• Sedation occurs along a spectrum.
• Patients can quickly slide from being lightly sedated to experiencing a complete general anesthetic.
• Always prepare as if the patient were undergoing a general anesthetic.
Levels of sedation and anesthesia (ASA) –

- Minimal Sedation (anxiolysis)
- Moderate ("conscious") Sedation
- Deep Sedation
- General anesthesia

Minimal Sedation (anxiolysis)

- Normal response to verbal stimulation
- Airway, ventilation and cardiovascular function unaffected

Moderate Sedation ("conscious")

- Purposeful response to verbal or tactile stimulation
- Able to maintain airway independently & continuously
- Cardiovascular function usually maintained

Deep Sedation

- An induced state of depressed consciousness.
- Partial loss of protected reflexes, including inability to maintain an airway independently and/or to respond purposefully to verbal commands.

General anesthesia

An induced state of unconsciousness accompanied by a partial or total loss of protective reflexes, including the inability to maintain an airway independently and/or to respond purposefully to verbal commands.

Administration of Anesthesia

- Inhaled
- Topical
- Oral (PO)
- Subcutaneous (SQ)
- Intramuscular (IM)
- Intravenous (IV)
PATIENT SELECTION

Felsenfeld’s Rule of Office General Anesthesia

“That we can do an office general anesthetic does not mean that we must!”

Choice of Anesthetic Technique

- Surgical pain
- Patient fear, apprehension
- Disabled patients: physical, mental, dental
- Inability to use local anesthetic
  - Infection
  - Allergy
  - Failure

Choice of Anesthetic Technique

- Prolonged procedures
  - Sedation
  - General anesthesia
- Compromised patient
  - Treatment requirements - e.g. inability to cooperate, fragile hypertensive patient
  - Surgeon’s ease of operation – e.g. complex procedure

Objectives

- Safety
- Cost
- Ease of administration
- Rapid onset
- Rapid recovery
- Ambulatory patient
- Tranquility
- Euphoria
- Amnesia
- Surgical field
- Hypnosis
- Analgesia

Patient Selection

Or….How much risk do you undertake??

- Physiologic risk
- Pathologic risk
- Hidden risk
Physiologic Risk – Age

Geriatric VS Pediatric

Physiologic Risk – Size

Obese VS Anorexic

Pathologic Risk

- Known Diseases
- Medications
- Allergies

Hidden Disease

I'm perfectly healthy!

- Unknown diseases
- Liars

Review Medical History

- Cardiovascular Disease
- Pulmonary Disease
- Hepatic or Renal Disease
- Hematologic Disease
- Neurologic Disease
- Past surgical history: experience with previous anesthetics
- Medications
- Allergies

ASA Physical Status Classification

- Class I - Healthy patient
- Class II - Mild systemic disease, non-debilitating
- Class III - Modest systemic disease, limits activity but not incapacitating
- Class IV - Incapacitating systemic disease, constant threat to life
ASA Classification Examples
• ASA I: 16 y/o male on no medication, no significant PMH for routine third molar surgery
• ASA II: 46 y/o female with well controlled HTN that does not affect her daily activities for implant #9
• ASA III: 76 y/o male with COPD requiring supplemental oxygen, limited mobility, brittle diabetes, for surgical removal of endodontically treated #19

Airway Assessment
• Why is this important?
• What happens if the patient stops breathing?
• We have to be able to ventilate the patient!
• How easy or difficult will this be?
• If we had to intubate this patient, how difficult would that be?

Airway Assessment
• Take seriously a history of prior difficulty
• Head and neck movement (extension)

Airway Assessment
• Jaw Movement
• (Ability to open)
• Receding mandible
• Protruding Maxillary Incisors

Airway Assessment
• Mallampatti Classification
• Sitting position, protrude tongue, do NOT say “Ah”

Auscultate Lungs
• Breath sounds should be clear bilaterally
• No wheezing or congestion
• Can also listen to heart sounds: should be regular and strong
**Protective Reflexes of the Respiratory System**

- Apnea
- Coughing
- Sneezing

Helps prevent particulate or liquid/mucous from entering the airway

---

**Preparation**

NPO guidelines. Why is this important?

“Reduce severity of complications related to pulmonary aspiration of gastric contents, should it occur.”

---

**Table 1. Summary of Fasting Recommendations to Reduce the Risk of Pulmonary Aspiration – Anesthesiology. 90(3):896-905, March 1999.**

<table>
<thead>
<tr>
<th>Ingested Material</th>
<th>Minimum Fasting Period [h]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear liquids†</td>
<td>2</td>
</tr>
<tr>
<td>Breast milk</td>
<td>4</td>
</tr>
<tr>
<td>Infant formula</td>
<td>6</td>
</tr>
<tr>
<td>Non-human milk‡</td>
<td>6</td>
</tr>
<tr>
<td>Light meal§</td>
<td>8</td>
</tr>
</tbody>
</table>

*These recommendations apply to healthy patients who are undergoing elective procedures. They are not intended for women in labor. Following the guidelines does not guarantee complete gastric emptying.† The fasting periods noted above apply to all ages.‡ Examples of clear liquids include water, fruit juices without pulp, carbonated beverages, clear tea, and black coffee.§ Seize non-human milk is similar to solids in gastric emptying time. the amount ingested must be considered when determining an appropriate fasting period.¶ A light meal typically consists of toast and clear liquids. Meals that include bread or fatty foods or meat may prolong gastric emptying time. Both the amount and type of foods ingested must be considered when determining an appropriate fasting period.*

**NPO Guidelines**

- 1 hour: Medications
- 2 hours: Clear Liquids
- 4 Hours: Breast Milk
- 6 Hours: Non human milk, infant formula, light solid foods

---

**Anesthetic Plan**

Consider:

- Anesthetic: Easy or difficult?
- Surgery: Easy or difficult?

---

**Anesthetic Plan**

Easy Surgery:

- Consider local anesthetic only, especially if patient is difficult anesthesia patient
- Possibly minimal IV sedation
Anesthetic Plan
Difficult Surgery:
• Consider moderate to deep sedation
• Possibly general anesthetic
• If patient is a potentially difficult anesthetic patient, may consider hospitalization

INTRAOPERATIVE ANESTHESIA
TYPES OF ANESTHETIC AGENTS

So, how does an anesthetic agent work?
Target organ: Brain

So, how does it work in the brain?
Theory: Prevents synaptic transmission in the CNS/brain

Fate of Drugs in the Body

Inhalational Anesthetics – Currently Used Agents
• Hospital based anesthesia:
  • Isoflurane (Forane)
  • Desflurane (Suprane)
• Office based anesthesia:
  • Nitrous Oxide
  • Sevoflurane (Ultane)
Pathway for Inhaled Anesthetics

Intravenous Anesthetic Agents

Benzodiazepines
- Agents
  - Valium
  - Versed
- Properties
  - Reduces anxiety
  - Sedates
  - Amnesia
  - Minimal effects on HR and BP
  - Does produce respiratory depression

Intravenous Anesthetic Agents

Opioids/Narcotics Agents:
- Morphine
- Fentanyl
- Remifentanil
- Alfentanil
- Sufentanil

Properties:
- Analgesia (relief of pain)
- Sedation
- Respiratory depression
- BP, HR unchanged
- Side effects
  - Nausea/Vomiting
  - Chest Wall Rigidity
  - Seizure activity
  - Suppression of GI motility

Intravenous Anesthetic Agents

Barbiturates
- Agents:
  - Thiopental (Sodium Pentothal – “truth serum”)
  - Brevital (methohexital)
- Properties:
  - Used for sleep
  - Lack analgesia and amnesia properties
  - Also cause respiratory depression/apnea

Intravenous Anesthetic Agents

Alkylphenols
- Agents:
  - Propofol
- Properties:
  - Milky appearance is actually emulsion containing soybean oil, glycerol & egg lecithin
  - Rapid onset
  - Rapidly metabolized
  - May induce apnea on bolus administration & respiratory depression
Intravenous Anesthetic Agents

Dissociative Anesthetic

- Agent: Ketamine
- Properties:
  - Similar in chemical structure to phenylcyclidine (PCP)
  - Patient is in a “dissociative state”: has analgesia & amnesia but is dissociated from external events
  - Eyes are open with slow nystagmus
  - Sympathetic stimulation: increase in HR, BP
  - Respiratory function not depressed

Monitoring

Vital Signs:
- Pulse
- Blood Pressure
- Respiration
- Temperature

Monitoring

Automated Monitor:
- Pulse (electrocardiogram)
- Blood Pressure
- Oxygen saturation (pulse oximeter)
- End tidal CO₂
- (capnograph)

Visual Inspection

- Skin color & temperature
- Blood color
- Pulse strength & regularity
- Chest excursions & ventilation

END OF MODULE I

AIRWAY MANAGEMENT

MAINTAINING A PATENT (OPEN) AIRWAY

Part 2
Airway Anatomy

- Induction of anesthesia produces upper airway relaxation and possible collapse
- Downward displacement of mask with thumb and index finger

Anatomy of the Larynx

- Upward traction of remaining fingers upward
- Fingers on bony mandible
- Fifth digit at angle displacing mandible anteriorly

Mask Ventilation

- Two-handed technique
  - Oral airway

LMA Placement

- Should be held like a pencil
- Balloon deflated for placement
- Directed posteriorly and upwards towards the palate
- Jaw thrust and sniffing position may help placement
**Endotracheal Intubation**

- Open the mouth with right hand – “Scissor technique”
- Gently insert laryngoscope into right side of mouth pushing tongue to the left
- Care taken during insertion to not hit teeth
- Advance laryngoscope further into oropharynx with applied traction 45 degrees

**Stages of Anesthesia**

**Stage 1**

The period between administration of an anesthetic and loss of consciousness

**Stage 2**

The period after loss of consciousness which may include actions such as uncontrolled movement, delirium, vocalization

**Stage 3**

The level at which surgery can be performed. Stage 3 anesthesia is divided into four planes

- Plane 1: “Light” Anesthesia – still has blink and swallowing reflexes and regular respiration
- Plane 2: “Surgical” Anesthesia – lost blink reflexes, pupils become fixed and respiration is regular
- Plane 3: starts to lose ability to use the respiratory muscles and breathing becomes shallow; may require assisted ventilation
- Plane 4: loss of all respiratory effort, breathing may stop entirely

**Endotracheal Intubation**

- Look for epiglottis
  - If initially not found, insert laryngoscope further
  - If this maneuver does not work, slowly pull laryngoscope back
- Once epiglottis visualized, push laryngoscope into vallecula and apply traction at 45 degree angle to “push” epiglottis up and out of the way

**STAGES OF ANESTHESIA**

DETERMINING DEPTH OF ANESTHESIA
**Stage 4**

Anesthetic Crisis! Respiratory arrest and death from circulatory collapse imminent.

* These planes and stages are less distinct with intravenous anesthetics as compared to ether, for which they were originally described.

**Stages of Anesthesia**

**Reflexes**

Used to estimate depth of anesthesia
- Pupillary reflex: shine light in eyes, pupil constricts
- Palpebral reflex: touch corner of eye, get blink
- Corneal reflex: touch cornea and get blink
- Withdrawal reflex: pull limb gently, pinch toe, patient pulls back limb
- Laryngeal (swallowing) reflex: stimulation of larynx causes patient to swallow

**Signs of Anesthetic Depth**

- Reflexes e.g. Eyelid Response
- Pain response
- Alterations in blood pressure, pulse and respiratory rate in response to surgical stimulation
- Relaxation - Muscle relaxants inhibit “signs.”

**POST ANESTHETIC RECOVERY**

FROM TERMINATION OF SURGERY TO DISCHARGE

**General Principles**

One:
- Can patient maintain his/her own airway?
  If not, do head-tilt/chin-lift procedure.

**Recovery**

What’s going on with the patient?
All surgical stimulation stopped.
Patient is still sedated – sleepy.
Local anesthetic on board – no painful stimulus to wake them up.

*Patient is at high risk for anesthetic complications at this point!!*
Two:
• Can patient maintain oxygen saturation on room air?

Three:
• Is patient awake? Appropriate to discharge to home?
• Oriented to person, place & time.
• Able to understand postoperative instructions.
• Able to tolerate oral fluids.
• Able to void and walk unassisted.

Recovery Area
• Oxygen
• Suction
• Monitors
• Lighting
• Quiet area
• Staff visualization at all times!

Documentation of Discharge Criteria
• Respiratory function, including respiratory rate, airway patency, and oxygen saturation;
• Cardiovascular function, including pulse rate and blood pressure;
• Mental status;
• Temperature;
• Pain;
• Nausea and vomiting; and
• Postoperative hydration.

Modified Aldrete Scoring System

Activity: able to move, voluntarily or on command
• 0: Confused or drowsy
• 1: Confused
• 2: Alert
• 3: Able to follow commands

Respiratory:
• 0: Cannot breathe deeply and cough freely
• 1: Coughing present
• 2: Cannot breathe

Blood pressure:
• 0: Normal (90-160 mm Hg)
• 1: Hypotension
• 2: Hypertension

Oxygen saturation:
• 0: Saturations 90-94%
• 1: Saturations 85-89%
• 2: Saturations < 85%

Pain:
• 0: None
• 1: Discomfort
• 2: Distress
• 3: Crying

Nausea:
• 0: None
• 1: Mild
• 2: Moderate
• 3: Severe

Modified Aldrete Scoring System

Score: 0-10

Scoring:
• 0-3: Patient requires continuous monitoring
• 4-7: Patient requires intermittent monitoring
• 8-10: Patient meets discharge criteria
Post Anesthesia Discharge Scoring System (PADS)

<table>
<thead>
<tr>
<th>Category</th>
<th>Description or Value</th>
<th>PADS Score</th>
</tr>
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<tbody>
<tr>
<td>Vital signs</td>
<td>Within 20% range of pre-op value</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Within 20% to 40% range of pre-op value</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>&gt;40% range of pre-op value</td>
<td>0</td>
</tr>
<tr>
<td>Respiratory status</td>
<td>Oxygen saturation ≥95% on room air</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Oxygen saturation ≥94% on nasal prongs @ 4 LPM or less</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Oxygen saturation ≥94% on PM @ 12 LPM or less</td>
<td>0</td>
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<tr>
<td>House and heating</td>
<td>Minimal, treated with oral medications</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Moderate, treated with parenteral medications</td>
<td>1</td>
</tr>
<tr>
<td>Pain</td>
<td>Continues after repeated treatments</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Acceptable to patient with or without medications</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Pain not acceptable to patient</td>
<td>1</td>
</tr>
</tbody>
</table>

Differences in Geriatric Population

- Impaired thermoregulation and water balance.
- Therefore, greater risk for hypovolemia and hypothermia.

Geriatric Anesthesia

Aging of the general population means an increase in the number of elderly patients we will see in the future.

Differences in Geriatric Population

- Limited physiologic reserve:
  - Decreased HR response to hypotension
  - Decreased ventilatory response to hypoxia (↓'d O₂) & hypercarbia (↑'d CO₂)

Differences in Geriatric Population

Alterations in pharmacokinetics:
- Limited renal clearance
- Hepatic function altered

Therefore:
Decrease the dosage of medication and TITRATE
### Geriatric Anesthesia

- Beware of delirium
- Choice of agent:
  - short half-life
  - Minimal active metabolites
  - Limited side effects
  - Avoid using standard dosages

- Versed & fentanyl: use smaller doses
- Propofol has reduced clearance; so use lower doses
- Administer slowly, allow longer time for peak effect

### Other considerations:

- Allow increased time for procedure to be accomplished.
- Many elderly patients require special equipment.
- Fragile skin: avoid tape, pad areas.

### Pediatric Anatomy

- Tongue relatively large compared to remainder of airway, along with relatively small jaw.
- Oblique angle of vocal cords, slanting downward anteriorly.
- Epiglottis shape is larger, longer and curved ("omega-shaped"), creating floppy characteristics.
- Narrowest segment at the cricoid, creating an inverse cone-shape of the airway.
Edema Effect on Airway

Pediatric Cardiac Physiology
- Know pediatric “normal” vital signs and parameters
- Cardiac output = Stroke volume x Heart rate
  - Younger children’s hearts are relatively non-compliant.
  - Therefore, stroke volume is fixed and cardiac output in children is rate dependent.
- Higher heart rates and lower blood pressures than adults.
- Congenital heart defects, e.g. patent foramen ovale.

Pediatric Pulmonary Physiology
- Small airway diameter - increased resistance.
- Little support from the ribs.
- Oxygen consumption twice that of adults.
- Diaphragm and intercostal muscles do not achieve type-1 adult muscle fibers until age 2.
- Obligate nasal breathers.

Pediatric Pharmacology
Increased total body water:
- Large initial dose required e.g. on a mg/lb basis, kids require more propofol.
- Less fat ⇔ longer clinical drug effect.
- Redistribution of the drug into muscle will increase duration of clinical effect (fentanyl).
- Consider liver and kidney immaturity.

AAP Guidelines
American Academy of Pediatrics:
Guidelines for Monitoring and Management of Pediatric Patients During and After Sedation for Diagnostic and Therapeutic Procedures: An update

American Academy of Pediatrics, American Academy of Pediatric Dentistry, Charles J. Cole, MD, Stephen Wilson, DDS, MA, PhD the Work Group on Sedation
Equipment Checklist

- S: Suction
- O: Oxygen
- A: Airway
- P: Pharmacy
- M: Monitors
- E: Equipment

Emergency Equipment

- IV catheters (24, 22, 20, 18, 16 ga)
- IV tubing: (pediatric drip)
- Intraosseous bone marrow needle
- Airways: face masks: (infant, child, small adult)
- Oropharyngeal airways (infant, child, small adult)
- Nasopharyngeal airways (small, medium, large)
- LMA’s: (1, 1.5, 2, 2.5, 3, 4 & 5)

Emergency Equipment

- Laryngoscope handle/blades: Miller 1, 2, 3, MacIntosh 2 & 3
- Endotracheal tubes: 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0 uncuffed
- Stylets
- Suction catheters
- Yankauer suction
- Nebulizer

Drug Doses

Broselow tape: Doses & equipment according to size/weight of patient

Broselow Tape

- Eliminates all calculations and thus minimize risk of error.
- Provides the full array of resuscitative drugs and interventions.
- Utilizes a visually simple and accurate format.

The tape is laid next to the patient with the red arrow at the top of the patient’s head...

The color-coded zone is determined by where the bottom of the patient’s foot falls on the tape.

James Broselow, MD
University of Florida College of Medicine

Bob Luten, MD
University of Florida College of Medicine
The dosages and other guidelines ...

<table>
<thead>
<tr>
<th>BLUE</th>
<th>ORANGE</th>
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<tbody>
<tr>
<td></td>
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- Are printed on both sides of the tape.
- On one side are the dosages for resuscitation, intubation etc.
- And on the opposite side are equipment guidelines and dosages for other medications.

FINALLY...

"The concept of rescue is essential to safe sedation. Practitioners of sedation must have the skills to rescue the patient from a deeper level than that intended for the procedure."

AAP Policy: Guidelines for the Monitoring and Management of Pediatric Patients During and After sedation for Diagnostic and Therapeutic Procedures: An Update
Anesthetic and Medical Emergencies
A Systems Approach

- Respiratory System
- Cardiovascular System
- Nervous System
- Endocrine System
- Immune System

Our Overall Goals in the Treatment of Emergencies

Hypoxia

- A deficiency of oxygen in the body’s tissues
- Can result in dysrhythmias, cardiac arrest, brain damage and death
Hypoxia
Therefore, the airway must be maintained and breathing uncompromised for life to be sustained.

The ABC’s of CPR have been changed to CAB
- C: Circulation
- A: Airway
- B: Breathing
- D: Defibrillation

Respiratory Emergencies
- Laryngospasm
- Airway obstruction
- Bronchospasm / Asthma
- Emesis / Aspiration
- Respiratory Depression/Arrest

Respiratory Emergencies
If you woke up breathing congratulations! You have another chance

Emergencies of the Respiratory System
Emergencies involving the tracheobronchial tree and alveoli

ASSESS AIRWAY
- BREATHING
- NOT BREATHING
  - DRUG INDUCED RESPIRATORY DEPRESSION
  - NARCOTIC OR BENZODIAZEPINE
  - FOREIGN BODY
  - LARYNGOSPASM
  - BRONCHOSPASM
**RESPIRATORY SYSTEM**

**LARYNGOSPASM**

**DEFINITION:**
A protective reflex closure of the vocal cords that attempts to prevent passage of foreign matter, such as blood or saliva, into the larynx, trachea and lungs.

**The Vocal Cords in The Larynx**

- Epiglottis
- Vocal folds (cords)
- Glottic opening
- Actual view of vocal cords through a laryngoscope

**Pathophysiology for Laryngospasm**

**Laryngospasm Diagnosis**

- Early crowing, but no sound for complete spasms
- Suprasternal retraction
- ↑↑ respiratory effort and ↓↓ exchange
- ↓↓ O₂ saturation

**Laryngospasm**

**SIGNS AND SYMPTOMS**
- Little or no air movement with respiratory effort
- Decreased O₂ saturation
- “Crowing”
- Labored respiratory efforts
Initial treatment for Laryngospasm

TREATMENT
- 100% oxygen
- Pack off surgical site
- Suction oropharynx
- Positive pressure O₂
- Succinylcholine (10-20 mg) IV
  - Support respiration

PREVENTION
- Throat packs
- Effective suctioning
- Head position
- Careful titration

Laryngospasm

Case #1-Presentation

History and Planned Treatment:
A 14 year old female presented to your office for extraction of her bicusps for orthodontic purposes. Her past medical history is negative. She takes no medications and denies any allergies. Because of her anxiety and apprehension, the decision is made to perform the procedure under conscious sedation.

Case #1- Clinical Course

- NPO is confirmed, breath sounds are clear bilaterally pre-op, monitors applied and an angiocath was inserted in the right AC fossa with NS.
- Vital signs pre op: BP = 104/68, P = 82, R = 16
- 5 mg Versed, 50mcg Fentanyl were administered intravenously. 4 carpules of 2% lidocaine with 1:100,000 epi were administered as well.
- Midway through the procedure, the patient is noted to have abdominal rocking and “crowing” sounds. Her pulse oximeter drops to 94% and then to 92%

What is your differential diagnosis and next course of action?
Case #1 - Diagnosis & Treatment

Diagnosis: Laryngospasm

- The surgery was terminated and the site was packed off. The head was repositioned to open the airway and the oropharynx was suctioned with a Yankauer suction.
- However, these measures failed to resolve the laryngospasm and the saturation continued to decline.
- Succinylcholine 10 mg was administered intravenously.
- Shortly thereafter, the crowing ceased, the patient drew a deep breath and resumed breathing spontaneously.

What are the side effects of succinylcholine?

Case #2 - Presentation

Same scenario as Case #1: healthy 14 y/o for bicuspid extraction.
Clinical course nearly identical: midway through procedure, patient exhibits abdominal rocking, decrease in saturation.

Case #2 – Clinical Course

- The surgery was terminated, the sites were packed off, the head was repositioned and the patient was placed on 100% O₂.
- Succinylcholine 20 mg total was administered intravenously.
- No chest excursions were noted and now the “crowning” sounds had stopped.
- The oxygen saturation decreased to 88% and then to 85%.

Case #2 - Clinical Course

- The oxygen saturation continued to drop to 79%. The patient’s skin now exhibits a dusky grey color.
- Attempts were made to ventilate the patient with positive pressure O₂, but failed.
- 911 is called.

What is your differential diagnosis at this point?

Case #2 - Diagnosis & Treatment

Diagnosis: Probable airway obstruction

Treatment:

- At this point, the doctor performs a direct laryngoscopy, and using the laryngoscope and Macgills’ forceps, the doctor pulls out a throat pack from the trachea.
- The patient immediately draws a big breath and begins to breathe spontaneously.
- The EMT’s have arrived and the patient is transported to the ER.

Respiratory Emergencies – Airway obstruction

DEFINITION:
Complete or partial blockage of the airway resulting in insufficient gas exchange.
Airway Obstruction

**DEFINITION:**
Complete or partial blockage of the airway resulting in insufficient gas exchange.

---

**The Tongue**
- Tongue closes off throat
- Head tilt chin lift
- Oropharyngeal airway
- Nasopharyngeal airway
- To maintain the airway

**Always be prepared to manage foreign body obstruction!!!**
- Foreign Bodies
- Teeth and tooth fragments
- Implant wrenches and cover screws
- Pieces of soft tissue or bone
- Gauze packs

---

**Airway Obstruction**

**SIGNS AND SYMPTOMS:**
- Stridor, wheezing
- Use of accessory breathing muscles
- Decreased O₂ saturation
- Cyanosis

**TREATMENT:**
- Conventional methods first
- Intubation
- Cricothyrotomy
- Tracheostomy
Foreign Body Obstruction – Abdominal Thrusts (the Heimlich Maneuver)

Thrusts delivered just above the umbilicus and well below the tip of the xiphoid process (GR. – "sword")

Foreign Body Obstruction – Direct Laryngoscopy

• Place laryngoscope
• Suction with tonsillar suction
• Visualize the Foreign Body
• Retrieve with Magill forceps

Persistent Obstruction – Cricothyrotomy (Coniotomy)

Point of penetration is through the cricothyroid membrane

Airway Obstruction

PREVENTION:
• Appropriate head position
• Throat Packs
• Adequate suction
• Good visualization

Case #3 – Clinical Course

• NPO was confirmed and breath sounds were clear bilaterally on pre-op evaluation. The patient was given instructions to use two puffs of her inhaler immediately prior to the procedure.
• Monitors were applied and an angiocath was used to start an IV in the right AC fossa with NS.
• Versed 5 mg/Fentanyl 50 mg/Decadron 4 mg is administered and Propofol is administered via a volumetric infusion pump.
• Midway through the procedure, the team notices wheezing through the precordial stethoscope, particularly on expiration.
• The pulse oximeter drops to 90%

Case #3 – Presentation

This 43 year old female presented to your office for extraction of fractured, endodontically treated #15. Her past medical history includes asthma, which she says is triggered by exercise and colds and hypertension, which is controlled with medication. Because of the potential for a difficult procedure, her anxiety level and her hypertension, the decision is made to do the procedure under conscious sedation.
Case #3- Diagnosis & Treatment

**Diagnosis:** Bronchospasm / Asthma attack

**TREATMENT:**
- Surgery was immediately terminated and the site was packed off.
- Patient is placed on 100% O₂
- Attempts were made to ventilate the patient with positive pressure, but this was difficult.
- Albuterol inhaler was administered with an ambu-bag and extension chamber
- Despite administration of inhaler, respirations continue to be difficult and the oxygen saturation drops to 82%
- Epinephrine 1:1000 ; 0.3 ml SQ was administered
- Within minutes, the oxygen saturation rises to 92% and the breathing becomes easier

---

**RESPIRATORY SYSTEM**

**BRONCHOSPASM**

**Bronchospasm - Pathophysiology**

Generalized contraction of smooth muscles of the bronchioles

- Constricted bronchiole
- Fully dilated bronchiole
- Constriction of the bronchioles due to asthma, an allergic reaction or chemical irritation
- Results in restriction of air flow to and from the lungs

**Bronchospasm - Diagnosis**

- Wheezing
- Labored breathing, difficulty with expiration
- Skin and mucous membranes - cyanosis
- Decreased resistance to ventilation
- Decreased O₂ Saturation

**Bronchospasm Treatment**

- Beta 2 Drugs
  - Albuterol
  - Epinephrine
- And, positive pressure O₂
- For the awake patient – the spacing chamber...

When the inhaler is activated the mist fills the spacing chamber.

Now the patient inhales deeply. And the mist “cloud” is inhaled into the tracheobronchial tree.

---

CALAOMS' OMSA Course Syllabus

Rev. 2017
**Bronchospasm**

**PREVENTION:**
- Keep a dry field
- Pre-operative inhaler puffs
- Avoid histamine releasing drugs (Demerol®)
- Careful with Brevital®

**RESPIRATORY SYSTEM**

**EMESIS / ASPIRATION**

**Case #4 - Presentation**

A 38 year old male presented to your office for extraction of a very painful, badly decayed #31. His past medical history includes borderline hypertension, which his MD does not feel warrants medication yet and gastro-esophageal reflux disease (GERD), for which he takes Prilosec. Because of the potentially difficult nature of the extraction, he is requesting the extraction be done under conscious sedation.

**Case #4 - Clinical Course**

- NPO is confirmed, breath sounds clear bilaterally.
- Monitors were applied, an angiocath was placed in the AC fossa with NS.
- A total of 7.5 mg of Versed and 75 mcg of fentanyl were administered as well as 4 mg of Decadron.
- Midway through the procedure, your assistant notices paradoxical rocking of the abdomen.
- Seconds later, you see gastric contents arising in the posterior oropharynx.

**Case #4 - Diagnosis & Treatment**

**Diagnosis:** Emesis with aspiration

**TREATMENT:**
- The patient was immediately rolled onto his right side and placed into Trendelenburg position.
- The oral cavity was suctioned with a Yankauer suction.
- Gastric contents were simply bilious liquid (no solids present).
- Surgery was terminated, the ED was notified and arrangements were made to have the patient evaluated by a pulmonologist.
- Bronchoscopy in the ED confirmed gastric contents in the right lower lobe.
- The patient was placed on antibiotics and steroids post-operatively.
**Emesis and Aspiration**

**DEFINITION**
- Vomiting when the patient has depressed or absent laryngeal reflexes which may allow stomach contents to enter the lungs

**Pathophysiology**
- Acidic stomach contents digest the walls of the alveoli

**Signs and Symptoms:**
- Retching
- Large amounts of fluid in throat
- Gurgling sounds
- Signs of airway obstruction
- Wheezing

**Diagnosis**
- Pre-tracheal steth gurgling / abdomen heaving
- Dyspnea (difficulty breathing)
- Tachycardia
- Rales (bubbling sound)

**Treatment**
- Tonsil suction
- Trendelenburg position on right side
- 100% O₂
Management of Emesis to Prevent Aspiration

Tip patient back into the Trendelenburg position

Prevention of Emesis with Aspiration
- Standards of the American Society of Anesthesiologist (ASA)
  - Solid foods – 6 hours before
  - Clear liquids – 2 hours before
  - Many surgeons prefer patient to be NPO (nothing by mouth) for 8 hours

Gastric Emptying
- Normal emptying time
  - 30-90 minutes
- Emptying time can be prolonged:
  - Apprehension
  - Pain
  - Opiate analgesics
  - Sedatives

Aspiration
- Preoperative normal X-ray
  - Note definition of ribs and lacy radiodensity pattern in lungs.
- Aspiration pneumonia
  - Note loss of definition of ribs and increased radiodensity in lungs.

Case #5- Presentation
A 27 year old female presented to your office for extraction of her third molars. Her past medical history is negative, she takes no medications and denies any allergies. She has never undergone any surgeries or had any sedative medication before.
Case #5 – Clinical Course

- NPO was confirmed, breath sounds clear bilaterally.
- Monitors applied. An angiocath IV was inserted into the AC fossa with NS.
- The extractions proved difficult with curved roots and root tips. The patient was also somewhat agitated at various points in the procedure.
- A total of 10 mg Versed, 150 mcg of Fentanyl and 4 mg of Decadron were used.
- Due to the unexpected length of the procedure, you are now behind schedule 30 minutes. The staff is preoccupied with starting the next surgery.
- The patient is left to recover in the chair with a staff member checking in on her from time to time.

Case #5 – Diagnosis & Treatment

- Approximately 10 minutes after the procedure ended, a staff member checks on the patient and finds her nearly unarousable.
- Her skin is pale.
- The pulse oximeter was noted to be off. Further investigation revealed it was not plugged into the outlet all the way and had been running on a charge which ran out.
- When plugged back in, the pulse oximeter read 86% and her respirations are only 7/minute.

Diagnosis: Respiratory depression

- Monitors were immediately reapplied.
- Assisted ventilation with 100% O₂ was initiated with ambu-bag.
- The IV which had been removed was reinserted.
- Narcan .4 mg/cc was administered intravenously.
- Pulse oximetry readings improved rapidly to 98%
- The patient became arousable and was assessed to be appropriately oriented.

Respiratory Depression

**DEFINITION:**
A decrease in the normal breathing rates and/or volumes

The many possible causes include:
- Narcotics
- Sedative drugs
- Muscle relaxants
- Hyperventilation
- Seizures

**Respiratory Depression Diagnosis**

- Low O₂ saturation
- Skin: pallor, and ultimately cyanosis
- Mental clouding, drowsiness
- Respiratory rate and depth (dyspnea) or absence of breathing (apnea)
- And ultimately: Hypoxia
Respiratory Depression - Treatment

ABC's of CPR
- Airway
- Breathing
- Circulation
- Defibrillation

Patient not breathing – positive pressure O₂

Attempt to determine cause and consider administration of Naloxone or Romazicon if depression due to narcotics or benzodiazepines.

Narcotic/Analgesic Overdose

MANAGEMENT:
- Supine position
- Airway and Oxygen
- Narcan® (Naloxone) 0.4-2mg IV
- Repeat at 2-3 minute intervals
- Not to exceed 10mg.
- IM or SubQ can be used if IV not available.

Sedative/Hypnotic Overdose

MANAGEMENT:
- Supine position
- Maintain airway – O₂ and
- Reverse Benzodiazepine-derived drug
- Flumazenil® (Romazicon) 0.2mg IV initially
- Then 0.1mg/minute up to 1 mg.
- Observe for re-sedation

Respiratory Depression

PREVENTION:
- Titrate sedative and narcotic medications
- If respiratory depression occurs after a seizure or local anesthetic overdose, support airway and provide positive pressure O₂ prn

Cardiovascular Emergencies

- Acute Coronary Syndrome
  - Angina Pectoris
  - Myocardial Infarction
- Blood Pressure Problems
  - Hypertension
  - Hypotension
- Cardiac Dysrhythmias
  - Non-arrest Dysrhythmias
  - Arrest Dysrhythmias

ANESTHETIC AND MEDICAL EMERGENCIES
CARDIOVASCULAR SYSTEM

CALAOMS' OMSA Course Syllabus
Rev. 2017
Case #6 - Presentation

This 78 year old female presented to your office for extraction of a root tip #29. Her past medical history includes an MI 6 years ago, hypertension, occasional angina controlled by nitroglycerin. In addition to her nitroglycerin (Nitrostat), she takes Norvasc. She denies any allergies. She would like to do the procedure under a local anesthetic.

Case #6 - Clinical Course

- Cardiology clearance for the procedure was obtained.
- Monitors were applied.
- Local anesthetic 3% carbocaine was administered as a right mandibular block
- After the local anesthetic was administered, but before the beginning of the surgical extraction, the patient complained of a tightness, squeezing sensation in her chest.
- She begins to appear anxious.

Case #6 - Diagnosis & Treatment

Diagnosis: Angina

- 100% O₂ was administered by nasal hood.
- Nitroglycerin spray was administered sublingually.
- After a few minutes, the patient stated the chest pain was resolving and she felt much less anxious.

ACUTE CORONARY SYNDROME:

ANGINA PECTORIS

Angina Pectoris

DEFINITION:

A primary symptom of coronary heart disease which occurs when myocardial oxygen demand exceeds supply

Angina - Pathophysiology
**Acute Coronary Syndrome**

- Early Plaque
- Significant Plaque
- Thrombus
- Infarction

**Angina - Diagnosis**

- Plaque begins
- Plaque begins to partially occlude arteries
- Thrombus totally occludes artery

**Angina Pectoris**

**SIGNS AND SYMPTOMS:**

- Pressure-like chest pain
- Radiation to arm, shoulder, neck, mandible, or teeth
- Relieved by nitroglycerin

**Angina Pectoris - Diagnosis**

**DIAGNOSIS – HISTORY:**

- When was the last attack?
- How frequently do the attacks occur?
- What exercise level precipitates the attacks?

**Angina Pectoris Treatment**

- Terminate surgery
- Suction, pack surgical site
- 100% $O_2$ by mask
- Semi-recumbent position
- Loosen clothing

**Angina - Treatment**

- MONA
  - Morphine
  - Oxygen
  - Nitroglycerin
  - Aspirin

- $O_2$ – the “O” of MONA
Angina Pectoris Treatment

- Nitroglycerin sublingually (tablet or spray)
- Monitors – BP, HR, EKG, Pulse Ox
- Nitroglycerin 2nd and 3rd dose q 5 min prn
- If no relief, assume MI – call 911

Case #7 - Presentation

- Same scenario as case #6: 78 year old female with history of MI, HTN, angina, for extraction of #29 root tip under a local anesthetic.
- Except this time, despite administration of sublingual nitroglycerin three times, the chest pain continues.
- The patient is now very anxious, pale and diaphoretic (sweaty).

What do you suspect may be causing her chest pain?

Angina Pectoris

PREVENTION:
- Oral premedication or sedation
- 100% O₂ during surgery
- Profound local anesthetic
- Pre-operative nitroglycerin

Case #7 – Diagnosis & Treatment

Diagnosis: Suspect myocardial Infarction

- Monitors were already applied, including EKG
- 911 was activated
- 100% O₂ was administered via nasal hood
- As a precaution, an angiocath was used to start an IV in the AC fossa with NS
- Morphine 5 mg IV was administered
- The patient was asked to chew an aspirin tablet

Myocardial Infarction

DEFINITION:
Necrosis or death of heart muscle precipitated by decreased oxygenation from partial or complete blockage of blood flow in the coronary arteries
Partially restricted blood flow

Thrombus

An Atherosclerotic Plaque and Thrombus

Plaques develop from fatty deposits within the blood vessel walls. These eventually tend to ulcerate and rupture, inducing the formation of a blood clot (thrombus).

A photomicrograph of an actual atherosclerotic plaque and thrombus occluding a coronary artery.

Myocardial Infarction - Pathophysiology

SIGNS AND SYMPTOMS:

- Chest pain not relieved by nitroglycerin
- Sweating, pallor

Myocardial Infarction

SIGNS AND SYMPTOMS:

- Nausea
- Arm, shoulder or jaw pain
- Hypotension
- Cardiac dysrhythmias

Myocardial Infarction - Diagnosis

- Weakness, anxiety and a feeling of impending doom
- Cardiac dysrhythmia
- Hypotension
- Crushing chest pain, but no response to NTG
- Systemic symptoms:
  - Nausea & vomiting
  - Pallor
  - Diaphoresis (sweating)
Myocardial Infarction

TREATMENT:
• Terminate surgery
• 100% O₂
• Place patient in comfortable position and loosen clothing
• Call 911

Myocardial Infarction

TREATMENT:
• Monitor vital signs
• Establish IV
• Medicate for pain (Morphine, Fentanyl)

Myocardial Infarction - Treatment

MONA
Morphine ✓
Oxygen ✓
Nitroglycerin ✓
Aspirin ✓

When MI suspected, call 911 at outset and be prepared to transfer care to EMT's

Myocardial Infarction

PREVENTION:
• Thorough medical history
• 100% O₂ throughout procedure
• Oral premedication or sedation
• Profound local anesthesia

Cardiovascular Emergencies

• Acute Coronary Syndrome
  • Angina Pectoris
  • Myocardial Infarction
• Blood Pressure Problems
  • Hypertension
  • Hypotension

Case #8 - Presentation

A 64 year old male presented to your office for extraction of root tips #2 and 3. His past medical history includes hypertension, for which he takes Tenormin, Norvasc and Micardis. You plan on performing this procedure under a local anesthetic.
However, before your staff can seat the patient, your building conducts a fire drill. The patient is required to evacuate the building. When the all clear is sounded, the patient returns. He is short of breath and fatigued. Your assistant takes his blood pressure and it is 235/130. You take it manually and confirm the blood pressure measurement.

What is your next step?

Diagnosis: Hypertensive crisis

- Monitors were immediately applied.
- The patient complained of a headache.
- 911 was activated.
- The patient was placed on 100% oxygen.
- An IV was started in the AC fossa with NS.
- Labetolol 20 mg was administered.
- The patient’s blood pressure decreased to 200/112.
- Paramedics arrive, transport the patient to the ER.
- In the ER, he is given three rounds of nitroglycerin to lower his blood pressure and was admitted for hypertensive crisis.

**Hypertension**

**DEFINITION:**
Abnormally high arterial blood pressure (>160/90)

**CAUSES:**
- Stress
- Pain
- ASVD
- Cessation of medications (“rebound” hypertension)
- Renal failure
- Adrenal tumors

**SIGNS AND SYMPTOMS:**
- Headache
- Dizziness
Hypertensive Crisis Diagnosis

Precipitating factors: pain, anxiety, \( O_2 \), \( CO_2 \), or cardiopulmonary compromise (usually excessive adrenergic stimulation)

Hypertensive Crisis: BP > 240-250 / 140

Hypertensive Crisis - Treatment

TREATMENT:
- Terminate procedure
- Place patient in comfortable position and loosen clothing
- Pain control
- 100% \( O_2 \)

PREVENTION:
- Thorough medical history.
- MD consult and medication adjustment when necessary.
- Maintain anti-hypertensive medications
- Profound local anesthesia.
- Consider sedation.
Case #9 - Presentation

A 19 year old female presented to your office for extraction of her third molars. Her past medical history includes an eating disorder, for which she was treated two years ago and has since been "fine". She is still relatively thin. She takes no medications and has no allergies. Her appointment is at 1:00 pm in the afternoon.

Case #9 – Clinical Course

- NPO was confirmed, breath sounds are bilaterally clear.
- Monitors were applied. An angiocath IV was started in the right AC fossa with NS.
- Pre op BP = 91/63, P = 70, R = 16
- Versed 5 mg, Fentanyl 50 mcg and Decadron 4 mg was administered through the IV.
- Within the first 5 minutes of the procedure, the vital signs are as follows: BP = 84/56, P = 52, R = 12
- In 5 more minutes, the vital signs are: BP = 70/43, P = 46, R = 12

What is your next step?

Case #9 – Diagnosis & Treatment

Diagnosis: Hypotension

- A fluid challenge of 500 cc NS was given rapidly.
- Further anesthetic medications were deferred and within minutes, the patient’s sedation level lightened
- Blood pressure after several minutes was back to 90/64.

Hypotension

DEFINITION:

Abnormally low arterial blood pressure (<90/60)

Hypotension - Diagnosis

- Nausea
- Tachycardia
- Weakness - may lead to loss of consciousness
- Skin - pallor
- Blood pressure decreased > 20%
 **Hypotension - Pathophysiology**

Pooling Of Blood In:
- Extremities
- Abdomen

**Hypotension - Treatment**

- Terminate procedure
- Attempt to determine cause
- 100% O₂
- Supine or Trendelenburg

**Hypotension**

**PREVENTION:**
- Titrate doses of anesthetic and sedative medications and avoid excessive doses, especially in the elderly.
- Avoid stress
- Avoid rapid positional changes
- Recognize dehydration

**Cardiac Dysrhythmias**

- Non-arrest Dysrhythmias
  - Bradycardia
  - Sinus Tachycardia
  - Supraventricular Tachycardia
  - Premature Ventricular Contractions
- Arrest Rhythms
  - Ventricular Tachycardia
  - Ventricular Fibrillation
  - Asystole and PEA

**Definition:**
Abnormal rate or rhythm of heart contractions as measured by the cardiac monitor
Represent disruptions in the heart's conduction system:

Cardiac Dysrhythmias

Abnormal Heart Rhythms (Cardiac Dysrhythmias)

- Too slow = Bradycardia
- Too fast = Tachycardia
- Heart quivers = Fibrillation
- Heart stops = Asystole

Bradycardia (symptomatic)

- Too slow to function properly

Tachycardia

- Too fast to function properly
- PSVT (Paroxysmal supraventricular Tachycardia focus above the level of ventricles)
- V Tach (Ventricular Tachycardia) – focus in ventricles

Cardiac Dysrhythmias

Ventricular Fibrillation or Pulseless V Tach

In ventricular fibrillation the ventricles quiver so fast that the heart cannot pump

Cardiac Arrest (Asystole)

The heart ceases to contract and stops

Cardiac Dysrhythmias

SIGNs AND SYMPTOMS:

- Changes in rate or rhythm on cardiac monitor
- May be asymptomatic
- Irregular pulse
- Hypotension
- Chest pain

TREATMENT:

- Terminate procedure
- 100% O₂
- Appropriate medications – e.g.
  - PVCs - Lidocaine
  - Bradycardia - Atropine
  - Monitor vital signs

Cardiac Dysrhythmias

Cardiac Dysrhythmias

Cardiac Dysrhythmias

Cardiac Dysrhythmias
Cardiac Dysrhythmias

Non-arrest Dysrhythmias:
- Bradycardia
- Sinus Tachycardia
- Supraventricular Tachycardia
- Premature Ventricular Contractions

Bradycardia

Defining characteristics:
- Like NSR, but with rate < 60
- May be due to increased parasympathetic tone
- Seen as a normal finding in athletes, but can be associated with inadequate perfusion which can require treatment

BRADYCARDIA – Should we treat the 23 year old marathon runner?....

...But may we need to treat a 78 year old medically compromised patient with bradycardia?

Sinus Tachycardia

Defining characteristics:
- Similar to NSR except for ↑d rate of > 100 bpm
- Frequently seen during sympathetic stimulation

Causes:
- Anxiety
- Fever
- Exercise
- Hypovolemia
- Fever

Signs / Symptoms:
- As related to the underlying cause

Bradycardia - Treatment

Epinephrine effect puts “foot on the gas”

Atropine effect takes “foot off of the brake”
A 46 year old woman presented to your office for implant placement #3, which you plan on doing under a conscious sedation. Her past medical history is positive for paroxysmal supraventricular tachycardia (PSVT), however, you have obtained clearance from her cardiologist for the procedure.

**Case #10 - Presentation**

![Image of a patient](image)

**Case #10 – Clinical Course**

- NPO is confirmed, breath sounds are clear bilaterally.
- An angiocath IV was started in the AC fossa with NS
- Versed 5 mg/Fentanyl 50 mcg/Decadron 4 mg was given IV slowly
- Midway through the procedure, the EKG alarm goes off and the EKG monitor shows this:

**Case #10 – Clinical Course**

- What is your diagnosis?
- What is your treatment?

**Case #10 – Diagnosis & Treatment**

*Diagnosis: Paroxysmal Supraventricular Tachycardia*

- Vagal maneuvers slowed the heart rate down, but upon cessation of maneuvers, the heart rate increased again
- Adenosine 6 mg was given intravenously with resolution of the SVT

**Paroxysmal Supraventricular Tachycardia**

- Regular, narrow complex tachycardia (150-250 bpm)
- Sudden (paroxysmal) onset
- Merged P – T waves

**Multiform Premature Ventricular Contractions**

*Defining characteristics:*

- Normal sinus rhythm is interrupted by periodic firing of two or more irritable ventricular foci.
- Usually considered a more ominous sign than unifocal PVC’s.
Cardiac Dysrhythmias

Arrest Dysrhythmias:

- Ventricular Tachycardia
- Ventricular Fibrillation
- Asystole and Pulseless Electrical Activity (PEA)

Ventricular Tachycardia (V Tach)

Defining characteristics:

- There is a wide, blunt, rapid wave form
- No P’s, and T’s usually cannot be discerned
- Can only support life for a short time
- If no pulse, consider as if V Fib

Case #11 – Presentation

A 55 year old male presents to your office for a biopsy of a white lesion to the lateral border of his tongue. He is apprehensive about the procedure and wants to be sedated. His past medical history is positive for hypertension, high cholesterol, and smoking. His medications include Norvasc and Lipitor. He denies any allergies.

Case #11 – Clinical Course

Case #11 – Diagnosis & Treatment

Diagnosis: Ventricular fibrillation

- Ventricular fibrillation was confirmed by confirming pulselessness & checking the EKG leads.
- 911 was immediately called.
- Chest compressions were started while the AED was obtained.
- Once applied, the AED delivered a shock to defibrillate the patient.
- 1 mg epinephine was administered intravenously
- Chest compressions were resumed.
- The patient finally converted to normal sinus rhythm with occasional ventricular ectopy.
You would see that...

a rapidly vacillating "jagged" baseline with no P's, QRS's or T's.

Ventricular Fibrillation (V Fib)

Defining characteristics:
- Rhythm consists of a rapidly vacillating baseline
- No P's, QRS's and T's
- No pumping of blood.
- Often precedes asystole
- Must be treated by electrical defibrillation immediately.

Defining characteristics:
- No wave form of any type i.e. no P's, QRS's or T's
- No rapid spiked oscillations ventricular fibrillation
- Cannot be successfully treated with defibrillation

Asystole - Treatment

ABC's of CPR with ventilations and chest compressions
Epinephrine – sympathetic stimulation

Cardiac Arrest

TREATMENT:
- BLS
- Call 911 (Defibrillate if appropriate)
- Place monitors
- ACLS
- Establish IV
- Intubate or other advanced airway prn
Cardiac Arrest

MEASURES TO DECREASE RISK:
• Consider the medical history
• Appropriate consultation
• Appropriate anesthetic

Other Systems

• Nervous system
  • Syncope
  • Seizures
• Endocrine System – Hypoglycemia
• Immune system
  • Mild Allergic Reactions
  • Severe Reactions – Anaphylaxis

NERVOUS SYSTEM:

SYNCOPE
SEIZURES

Case #12 – Presentation

A 20 year old college student presented to your office for extraction of her third molars. Her past medical history is negative. She is on oral contraceptives and denies any allergies. She is very apprehensive about the procedure.

Case #12 – Clinical Course

• She arrives the morning of surgery with her mother.
• They are ushered into the operatory.
• The staff member leaves the room momentarily and suddenly the mother calls for help.
• The staff member rushes back to the room to find the patient crumpled to the floor.
The patient is immediately placed in the chair and monitors are applied.

- BP = 86/51, P = 42 (sinus bradycardia), R = 14
- The patient appears pale & diaphoretic.

What is your diagnosis?

What is your treatment?

The patient was placed on 100% oxygen by nasal hood.
- The chair was positioned in Trendelenburg
- Within seconds, the patient regained consciousness

Case #12 – Diagnosis & Treatment

Diagnosis: Syncope

Syncope

DEFINITION:
Loss of consciousness due to a sudden sharp, usually transient drop in blood pressure.

Syncope – The “Simple” Faint

In the operatory or, in the waiting room

Syncope

CAUSES:
- Fear
- Orthostasis
- Hyperventilation
- Hypoglycemia

Syncope – Pathophysiology
(A Misdirected Adrenalin Rush)

In the normal “Flight or Flight” response, muscle contraction returns blood back to the heart which then pumps it to the brain.

Pooling of Blood

Blood Flow
Syncope

SIGNS AND SYMPTOMS:
• Light headedness
• Dizziness
• Wet palms
• Pallor
• Low blood pressure
• Slow heart rate

Syncope - Diagnosis

- Disorientation
- Dizziness, light headedness
- Pallor
- Loss of consciousness (fainting)
- Nausea
- Initially rapid, then very slow pulse, low BP
- Wet palms

Syncope - Treatment

- Blood flow back to heart
- Monitor blood pressure and pulse
- Cool cloth on head
- Consider: Atropine 0.4 mg. IV
- Ammonia vaporole

Prevention:
• Patient positioning
• Stress reduction
• Oral premedication
• Second faint

Case #13 - Presentation

A 12 year old female presented to your office for a consultation regarding bicuspid extractions. Her past medical history includes that of grand mal seizures for which she takes Dilantin. She denies any allergies.

Case #13 – Clinical Course

- The patient is seated in your consultation room. You are discussing her case with her mother, who is also present.
- Suddenly, you are alerted to the patient by a strange sound. You see her eyes roll back and she exhibits tonic-clonic jerking.

What is your diagnosis?
What is your treatment?
Case #13 – Diagnosis & Treatment

- The patient’s chair is reclined
- The seizure is self-limiting
- After the seizure, the patient exhibits drowsiness.
- Valium or Versed could be contemplated, but the mother declines, stating that she does not need it.

Seizures

DEFINITION:
A sudden attack of abnormal and involuntary muscle contractions.

Seizures - Pathophysiology

The intricate “wiring” of the brain – like a switchboard with millions of fibers and inter-connections

Seizures - Diagnosis

Change in sense of smell, sight, sound – an “aura”

Seizures - Treatment

MOST REQUIRE NO MEDICATION

IF PROLONGED:
- Valium or Versed IV, or
- Versed IM
- Support airway prn, 100% O₂ if possible

CAUSES:
- Pre-existing disorder
- Hypoxia
- Hypoglycemia
- Syncope
- Local anesthetic toxicity

Respiratory depression
Muscle spasm and flailing
Altered emotional state
Loss of consciousness
Epileptic cry
Loss of bowel and bladder control

Support airway prn
Protect tongue prn

Do not restrain, but protect from injury
Seizures

PREVENTION:
• Check drug levels (Dilantin)
• Valium® premedication for pre-existing condition
• Avoid Hypoxia
• Monitor dose of local anesthetic – Excessive doses can cause seizures

ENDOCRINE SYSTEM

HYPOGLYCEMIA

Case #14 – Presentation
A 44 year old female presented to your office for extraction of a fractured bicuspid. Her past medical history is positive for non-insulin dependent diabetes mellitus (NIDDM) for which she takes Metformin & Actos. She denies any allergies. Your plan is to perform the surgery under a conscious sedation.

Case #14 - Presentation
• NPO is confirmed. Breath sounds are clear bilaterally.
• The patient states she does not feel well. She appears very pale and tremulous.
• Her blood sugar is tested and found to be extremely low at 50 mg/dl.

What is your diagnosis and next course of action?

Case #14 – Diagnosis & Treatment
• The patient was given a small amount of orange juice orally.
• An IV was started with dextrose.
• 50 ml of 50% Dextrose was administered intravenously.

Hypoglycemia
Diabetes mellitus – a disease of insulin production and metabolism

DEFINITION: An abnormally low level of sugar in the blood due to an insulin imbalance.
Opening of glucose gates.

**Diabetes**

**Insulin Shock – Pathophysiology**

When the patient takes his normal insulin dose, but has no oral intake (e.g. fasting)

When glucose drops below the critical level for brain function, the patient loses consciousness.

**Hypoglycemia**

**Signs and Symptoms:**
- Pallor
- Tremor
- Confusion
- Tachycardia
- Loss of consciousness
- Seizures

**Insulin Shock – Diagnosis**

Anxiety and mental clouding

Hypersalivation

Loss of Consciousness and seizure

Tachycardia

Coolness of the skin, diaphoresis (sweating)

**Hypoglycemia**

**Insulin Shock – Treatment**

Glucose is given IV or PO to re-store the low level of sugar in the blood

Or, glucagon can be administered IM, which will stimulate breakdown of glycogen in the liver and provide sugar through this route

**TREATMENT:**
- Conscious patient
  - High sugar beverages/food
- Unconscious patient
  - 50% dextrose solution IV
  - Glucagon IM

**ADRENALIN RUSH**

**TREATMENT:**

- Conscious patient
  - High sugar beverages/food
- Unconscious patient
  - 50% dextrose solution IV
  - Glucagon IM
The mixing vial for glucagon...

A special syringe is provided for mixing the powdered glucagon.

Hypoglycemia

PREVENTION:
- Careful patient history
- Watch time of day for surgery
- Check patient’s blood sugar
- Intravenous dextrose infusion

IMMUNE SYSTEM:

MILD ALLERGIC REACTIONS
SEVERE REACTIONS – ANAPHYLAXIS

Case #15 - Presentation

A 23 year old female presented to your office early yesterday morning complaining of progressive swelling to her left mandible from an infected lower third molar. She also complained of low grade fever, pain on swallowing and trismus. You were concerned about an abscess spreading, so you sent the patient for a CT scan with contrast. The next day, she presents to your office with a rash on her torso, arms and legs which looks like this:

Case #15 – Clinical Course

This rash is itchy and seems to be getting worse.

What caused the rash?
How would you treat this?
Case #15 – Diagnosis & Treatment

Diagnosis: Urticarial rash due to allergic reaction from the CT contrast agent

- The patient was given a prescription for a Medrol Dosepack (steroid) as well as an antihistamine.
- The rash gradually improved over the next 3 days.

Allergic Reactions

DEFINITION:
The immunologic response of the body to any substance to which an allergy has developed.

The Timing of Allergic Reactions

DELAYED ALLERGIC REACTION:
- 1 hour or more after exposure
- Usually mild reactions

IMMEDIATE:
- Usually within 1 hour of time of exposure)
- In most cases these are severe reactions

Allergic Reactions to Drugs

SKIN REACTIONS MOST COMMON:
- Rash
- Urticaria (itching)
- Erythema (redness)

- Angioedema (swelling of the lips)

Allergy To Drugs - Pathophysiology

Within 5-10 minutes of time of exposure...

Life-threatening components of anaphylaxis are broncho-constriction, laryngeal edema and cardiovascular collapse

Allergy To Drugs - Diagnosis

- Watery eyes
- Sneezing
- Labial swelling
- Coughing

Skin: Rash, “Flushing”
- Hives, itching
- Shortness of breath, wheezing
- Hypotension
- Nausea
Allergic Reactions
To Drugs - Most Common

ANTIBIOTICS:
• The penicillins (natural and synthetic)
• Cephalosporins – 10% cross reactivity with penicillin (1 in 10 allergic to penicillin are also allergic to Cephalosporins)

Allergic Reactions - Most Common

Case #16 - Presentation
A 12 year old female presented with a grossly carious #30. She complained of 24 hour onset of swelling, pain and trismus. Her clinical examination showed a fever of 101.3, opening at 20 mm, swelling to her right buccal and submandibular spaces. Due to the severity of the infection, you decided to administer Unisyn 1 gm IV (antibiotic related to Penicillin). Her past medical history is non-contributory. She does not take any medications and denies all allergies.

Case #16 – Clinical Course
Within minutes, the patient exhibited difficulty swallowing and breathing, swelling of her upper lip, and a generalized red rash.

What is your diagnosis?
How would you treat this?

Case #16 – Diagnosis & Treatment
Diagnosis: Anaphylaxis (severe allergic reaction)
• 911 was called immediately.
• Epinephrine IV was administered
• The patient was intubated
• Benedryl was also administered as well as a corticosteroid (Solu-Medrol)

Severe Allergic Reactions - Treatment
• α Vasoconstriction
• β Effects
  • β1 ↑ HR, ↑'d BP
  • β2 Bronchodilation
• Vasoconstriction of edematous (swollen) membranes of throat - α

• Stop administration of all drugs
• 100% O₂
• Very mild reactions may require no treatment other than observation
• Mild reactions requiring treatment -
  • Rash
  • Itching
  • ↑'d nasal secretions
  • Watery eyes
Diphenhydramine (Benadryl®) 25-50 mg IV or IM followed by Rx
Treatment Of Allergic Reactions – Additional Medications

Dexamethasone (Decadron®):
- To stabilize membranes, which will reduce swelling
- To combat the other symptoms of inflammation

Allergic Reactions - Prevention

- Thorough medical history with details of previous reactions
- Avoid administering or prescribing any drug which has produced an allergic reaction (check chart and ask patient!)

Natural Latex Allergy

Office Anesthesia Emergencies

- Respiratory Emergencies
- Cardiovascular Emergencies
- Emergencies Involving Other Body Systems

THE BEST WAY TO TREAT AN EMERGENCY IS NOT TO HAVE ONE!

OFFICE ANESTHESIA EMERGENCIES
THE END