High Risk Emergency Medicine

FEATURED FACULTY:
Michael Bresler, MD
Rachel Chin, MD
Michelle Lin, MD
Amal Mattu, MD
Ghazala Sharieff, MD
Matthew Strehlow, MD
Robert Vissers, MD

WEDNESDAY - FRIDAY (PRECEDES MEMORIAL DAY WEEKEND)
MAY 25-27, 2011
Westin San Francisco Market Street
San Francisco, CA

WHAT MAKES THIS COURSE STAND OUT
• World-Class Speakers
• Leaders in their Fields
• Focus on High Risk Topics

highriskEM.com
High Risk Emergency Medicine

May 25-27, 2011
Westin San Francisco Market Street
San Francisco, California

Course Chairs:
Jeffrey A. Tabas, MD, FACEP, FAAEM
Martine Sargent, MD

University of California, San Francisco

University of California, San Francisco School of Medicine
Acknowledgements

This CME activity was supported in part by educational grant(s) from the following:

Exhibitors

Lippincott, Williams & Wilkins
CARDIOPULMONARY, AND CRITICAL CARE

6:30am  REGISTRATION AND CONTINENTAL BREAKFAST

7:15  Welcome
Feel warm and loved as you receive this great welcome from the course chairs.
Dr. Jeffrey Tabas
Dr. Martine Sargent

7:30  Subtle ECG findings of Ischemia
That’s not artifact on the ECG – it’s a life-threatening finding of acute ischemia in a patient you almost sent home!
Dr. Amal Mattu

8:30  Heart Failure
You’ll breathe easier as you improve your diagnosis and treatment of heart failure
Dr. Matt Strehlow

9:30  BREAK

9:45  ECG Mimics of Acute Coronary Syndrome
Does cath lab activation for benign early repolarization get you down? Do you get GERD every time you read an ECG? Then it’s time to learn these ACS mimics!
Dr. Amal Mattu

10:45  Pharmacotherapies for Acute Coronary Syndrome
Anti-anginals, anti-coagulants, and anti-platelet agents- are we simply upping the ante by inducing hypotension and bleeding, or are we actually improving outcomes?
Dr. Amal Mattu

11:45  LUNCH ON YOUR OWN

1:15  The Acute Scrotum
Don’t get testy over testicular pain or end up having to testify – test your knowledge of the pearls and pitfalls!
Dr. Gary Tamkin
2:00  Pacemaker and AICD Emergencies
      You’ll be shocked and in awe of your understanding of these
devices when you finish!
      Dr. Ingrid Lim

3:00  BREAK

3:15  Trauma in Pregnancy
      Trauma in pregnancy is traumatic for the mother, the baby, and
doctor. Learn how to minimize the risks from this case based
approach!
      Dr. Susan Promes

4:00  Pulmonary Embolism - Challenging Cases
      Spot the clot without radiating the entire lot!
      Dr. Jeffrey Tabas

5:00  ADJOURN

THURSDAY, MAY 26, 2011

SURGICAL, AIRWAY, AND GENERAL EM

6:45am  CONTINENTAL BREAKFAST

7:30  Ultrasound in the Critically Ill Patient
      Use the force – ultrasound will take you to a new level of
diagnostic ability and allow you to throw away that crusty
stethoscope.
      Dr. Martine Sargent

8:30  High Risk Airway Management
      Breathe easier knowing you are prepared for the greatest
challenge in our field
      Dr. Robert Vissers

9:30  BREAK

9:45  Regional Anesthesia
      Perfect your painless performance of procedures…
      Dr. Robert Vissers

10:45  Low Back Pain
      Not only will you improve your diagnosis and management of low
back pain after this lecture, you will actually look forward to seeing
patients with this condition!
      Dr. Michelle Lin

11:45  LUNCH ON YOUR OWN
1:15  Tricks of the Trade
Anyone, anytime, anything – that’s our motto. Learn tips and tricks from the master
Dr. Michelle Lin

2:15  High Risk Medical Case Review
Bad outcomes do not necessarily mean bad care. Learn these pearls and pitfalls in using a case based format with actual closed cases and audience interaction
Dr. Michael Bresler

3:15  BREAK

3:30  The Medical Chart
Don’t practice defensively, but DO chart defensively. Learn how to protect yourself and your patient with these documentation pearls.
Dr. Michael Bresler

4:30  ADJOURN

FRIDAY, MAY 27, 2011

PEDIATRICS AND GENERAL EM

6:45am  CONTINENTAL BREAKFAST

7:30  Pediatric Fever
You’ll be burning with answers as this expert reviews the critical evaluation of fever in the neonate, the unimmunized child, or the atypical presentation of life-threatening disease such as early meningitis.
Dr. Judith Klein

8:30  High Risk Pediatric Case Review
From the pediatric airway to the crying baby, learn from the mistakes others have made so you don’t have to – taken from closed malpractice cases, quality assurance reviews, and personal experience!
Dr. Ghazala Sharieff

9:30  BREAK

9:45  Pediatric Procedural Sedation
How do you stop a baby from crying? Procedural Sedation! Learn the pearls and pitfalls
Dr. Ghazala Sharieff

10:45  Pediatric Trauma
You’ll be stunned by the advances in pediatric head, neck and abdominal trauma
Dr. Judith Klein
11:45   LUNCH ON YOUR OWN

1:15   **Tattoos and Body Modifications**
       *How benign is that ring in your daughter’s belly button? Come find out!*
       Dr. Rachel Chin

2:15   **Eye Emergencies**
       *Don’t be myopic in your care of the patient with ophthalmologic disease!*
       Dr. David Duong

3:00   BREAK

3:15   **Poisoning Pitfalls**
       *You’ll turn blue with this case based review of common errors in the evaluation and management patients with poisonings.*
       Dr. Craig Smollin

4:00pm   ADJOURN

  **T**  Satisfies American College of Surgeon requirements for Trauma CME

  **P**  Satisfies California Assembly Bill 487 requirements for Pain Management and End-of-Life Care CME
Course Overview

High Risk Emergency Medicine is a course designed to address those topics that, due to the risk of misdiagnosis or misadventure, produce the greatest anxiety and concern in the daily practice of emergency medicine. Offered by San Francisco General Hospital, nationally renowned for emergency medical and trauma care, we have pulled together educational leaders in the field of emergency medicine and related specialties to address topics posing the greatest risk from a medical and medico-legal standpoint. Come learn from the best!

This conference is designed to meet the needs of the practitioner who may encounter a high risk condition in their daily medical practice. This includes practicing emergency physicians as well as internists, family practitioners and others who practice in an urgent care, high risk, or emergency department setting.

High Risk Emergency Medicine is presented by the Emergency Department at San Francisco General Hospital and the Department of Emergency Medicine at the University of California, San Francisco. The conference is sponsored by the Office of Continuing Medical Education, University of California, San Francisco School of Medicine.

Educational Objectives

Describe common pitfalls in the diagnosis and treatment of the following conditions as well as approaches to minimize the risk of these pitfalls:

- Acute Myocardial Infarction;
- Heart Failure;
- Pacemakers and AICD Emergencies;
- Pulmonary Embolism;
- Scrotal Pain;
- Trauma in Pregnancy;
- Use of ultrasound in the critically ill patient;
- Pain management;
- High risk airways;
- Low back pain;
- Common errors associated with malpractice claims in adults and children;
- Pediatric Fever;
- Pediatric Trauma;
- Pediatric Procedural Sedation;
- Tattoos and Body Modification;
- Eye pain and visual loss;
- Poisonings.

Accreditation

The University of California, San Francisco School of Medicine (UCSF) is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians.
UCSF designates this educational activity for a maximum of 21.25 AMA PRA Category 1 Credit(s)™. Physician should only claim credit commensurate with the extent of their participation in the activity.

This CME activity meets the requirements under California Assembly Bill 1195, continuing education and cultural and linguistic competency.

The California Board of Pharmacy accepts as continuing professional education those courses that meet the standard of relevance to pharmacy practice and have been approved for AMA PRA Category 1 Credit™.

AAFP: This activity, High Risk Emergency Medicine, with a beginning date of May 25, 2011, has been reviewed and is acceptable for up to 21.00 Prescribed credits by the American Academy of Family Physicians.

Nursing: For the purpose of recertification, the American Nurses Credentialing Center accepts AMA PRA Category 1 Credit™ issued by organizations accredited by the ACCME.

Physician Assistants: AAPA accepts category 1 credit from AOACCME, Prescribed credit from AAFP, and AMA Category 1 Credit™ for the PRA for organizations accredited by the ACCME.

Pain Management and End-of-Life Care: The approved credits shown above include 5.75 credits toward meeting the requirement under California Assembly Bill 487, Pain Management and care of the terminally ill.

Trauma: The approved credits shown above include 7.50 credits toward satisfying the American College of Surgeons Committee on Trauma requirement for trauma related continuing medical education.

Approved by the American College of Emergency Physicians for a maximum of 21.25 hour(s) of ACEP Category I credit.

This course is endorsed by the American Academy of Emergency Medicine. www.aaem.org.

General Information

CME Certificates
You will receive an email on the last day of the course, Friday, May 27, 2011. It will contain a link to complete your evaluations and attendance verification. Your CME certificate will be issued electronically upon completion of both forms.

In order to verify that we have your correct email address on file, an email confirmation message has been sent to you already. If you did not receive this message, please visit the UCSF Registration desk to update your information.

Security
We urge caution with regard to your personal belongings and syllabi. We are unable to replace these in the event of loss. Please do not leave any personal belongings unattended in the meeting room during lunches or breaks.
Lunch
Lunch is not included with your course tuition. Please see the included local restaurant list here for nearby options.

Tourist Information
Some tourist information is available at the Registration Desk. If you need further information, contact the San Francisco Convention and Visitors Bureau at 415-974-6900. Additionally, the concierge at the Hotel Nikko will be pleased to assist with your inquiries.

Miscellaneous
Please turn cell phones and pagers to silent mode.

The room temperature tends to fluctuate; for your individual comfort, you may want to bring a sweater to the sessions.

Linguistic Access and Services for Limited English Proficient Persons

I. Purpose.
This document is intended to satisfy the requirements set forth in California Business and Professions code 2190.1. California law requires physicians to obtain training in cultural and linguistic competency as part of their continuing medical education programs. This document and the attachments are intended to provide physicians with an overview of federal and state laws regarding linguistic access and services for limited English proficient (“LEP”) persons. Other federal and state laws not reviewed below also may govern the manner in which physicians and healthcare providers render services for disabled, hearing impaired or other protected categories.

The Federal Civil Rights Act of 1964, as amended, and HHS regulations require recipients of federal financial assistance (“Recipients”) to take reasonable steps to ensure that LEP persons have meaningful access to federally funded programs and services. Failure to provide LEP individuals with access to federally funded programs and services may constitute national origin discrimination, which may be remedied by federal agency enforcement action. Recipients may include physicians, hospitals, universities and academic medical centers who receive grants, training, equipment, surplus property and other assistance from the federal government.

HHS recently issued revised guidance documents for Recipients to ensure that they understand their obligations to provide language assistance services to LEP persons. A copy of HHS’s summary document entitled “Guidance for Federal Financial Assistance Recipients Regarding Title VI and the Prohibition Against National Origin Discrimination Affecting Limited English Proficient Persons – Summary” is available at HHS’s website at: http://www.hhs.gov/ocr/lep/.

As noted above, Recipients generally must provide meaningful access to their programs and services for LEP persons. The rule, however, is a flexible one and HHS recognizes that “reasonable steps” may differ depending on the Recipient’s size and scope of services. HHS advised that Recipients, in designing an LEP program, should conduct an individualized assessment balancing four factors, including: (i) the number or proportion of LEP persons eligible to be served or likely to be encountered by the Recipient; (ii) the frequency with which
LEP individuals come into contact with the Recipient’s program; (iii) the nature and importance of the program, activity or service provided by the Recipient to its beneficiaries; and (iv) the resources available to the Recipient and the costs of interpreting and translation services.

Based on the Recipient’s analysis, the Recipient should then design an LEP plan based on five recommended steps, including: (i) identifying LEP individuals who may need assistance; (ii) identifying language assistance measures; (iii) training staff; (iv) providing notice to LEP persons; and (v) monitoring and updating the LEP plan.

A Recipient’s LEP plan likely will include translating vital documents and providing either on-site interpreters or telephone interpreter services, or using shared interpreting services with other Recipients. Recipients may take other reasonable steps depending on the emergent or non-emergent needs of the LEP individual, such as hiring bilingual staff who are competent in the skills required for medical translation, hiring staff interpreters, or contracting with outside public or private agencies that provide interpreter services. HHS’s guidance provides detailed examples of the mix of services that a Recipient should consider and implement. HHS’s guidance also establishes a “safe harbor” that Recipients may elect to follow when determining whether vital documents must be translated into other languages. Compliance with the safe harbor will be strong evidence that the Recipient has satisfied its written translation obligations.

In addition to reviewing HHS guidance documents, Recipients may contact HHS’s Office for Civil Rights for technical assistance in establishing a reasonable LEP plan.

The California legislature enacted the California’s Dymally-Alatorre Bilingual Services Act (Govt. Code 7290 et seq.) in order to ensure that California residents would appropriately receive services from public agencies regardless of the person’s English language skills. California Government Code section 7291 recites this legislative intent as follows:

“The Legislature hereby finds and declares that the effective maintenance and development of a free and democratic society depends on the right and ability of its citizens and residents to communicate with their government and the right and ability of the government to communicate with them.

The Legislature further finds and declares that substantial numbers of persons who live, work and pay taxes in this state are unable, either because they do not speak or write English at all, or because their primary language is other than English, effectively to communicate with their government. The Legislature further finds and declares that state and local agency employees frequently are unable to communicate with persons requiring their services because of this language barrier. As a consequence, substantial numbers of persons presently are being denied rights and benefits to which they would otherwise be entitled.

It is the intention of the Legislature in enacting this chapter to provide for effective communication between all levels of government in this state and the people of this state who are precluded from
utilizing public services because of language barriers.”

The Act generally requires state and local public agencies to provide interpreter and written document translation services in a manner that will ensure that LEP individuals have access to important government services. Agencies may employ bilingual staff, and translate documents into additional languages representing the clientele served by the agency. Public agencies also must conduct a needs assessment survey every two years documenting the items listed in Government Code section 7299.4, and develop an implementation plan every year that documents compliance with the Act. You may access a copy of this law at the following url: http://www.spb.ca.gov/bilingual/dymallyact.htm

Course Faculty

Chair:

Jeffrey A. Tabas, MD, FACEP, FAAEM
Professor of Emergency Medicine; Director of Outcomes and Innovations; Office of Medical Education at UCSF
University of California, San Francisco School of Medicine

Co-Chair:

Michael Bresler, MD
Clinical Professor of Surgery, Division of Emergency Medicine, Stanford University, School of Medicine; Director, Mills-Peninsula Emergency Department

Rachel Chin, MD
Professor of Emergency Medicine

David Duong, MD
Assistant Professor of Emergency Medicine

Judith Klein, MD
Assistant Professor of Emergency Medicine

Ingrid Lim, MD, FAAEM
Kaiser Permanente, San Francisco; Assistant Professor, Emergency Medicine

Michelle Lin, MD, FAAEM
Associate Professor of Emergency Medicine

Amal Mattu, MD
Associate Professor of Surgery, Division of Emergency Medicine; Program Director, Emergency Medicine Residency; Co-Director, Emergency Medicine/Internal Medicine Combined Residency Program, University of Maryland School of Medicine, Baltimore, MD

Susan Promes MD
Program Director, UCSF-SFGH Emergency Medicine Residency Program; Professor of Emergency Medicine
Ghazala Q. Sharieff, MD, FACEP, FAAEM, FAAP
Medical Director/Associate Professor, Director, Pediatric Emergency Medicine, Palomar-Pomerado Health System

Craig Smollin, MD
Assistant Professor of Emergency Medicine, San Francisco Poison Control Center, Toxicology Fellowship Co-Director

Matthew Strehlow, MD
Assistant Professor of Surgery, Division of Emergency Medicine; Medical Director, Stanford University, Palo Alto, CA

Gary W. Tamkin, MD FACEP
Assistant Professor of Medicine; Vice President, Provider Development, Valley Emergency Physicians Walnut Creek, CA

Robert Vissers, MD
Adjunct Associate Professor, Oregon Health Sciences University; Director, Emergency Department, Legacy Emanuel Hospital, Portland, OR
Disclosures

The following faculty speakers, moderators and planning committee members have disclosed NO financial interest/arrangement or affiliation with any commercial companies who have provided products or services relating to their presentation(s) or commercial support for this continuing medical education activity:

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<th>Name</th>
<th>None</th>
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<tr>
<td>Bresler</td>
<td>Michael</td>
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<td>Chin</td>
<td>Rachel</td>
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<td>Duong</td>
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<td>Klein</td>
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<td>Vissers</td>
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This UCSF CME educational activity was planned and developed to:

This UCSF CME educational activity was planned and developed to: uphold academic standards to ensure balance, independence, objectivity, and scientific rigor; adhere to requirements to protect health information under the Health Insurance Portability and Accountability Act of 1996 (HIPAA); and, include a mechanism to inform learners when unapproved or unlabeled uses of therapeutic products or agents are discussed or referenced. This activity has been reviewed and approved by members of the UCSF CME Governing Board in accordance with UCSF CME accreditation policies. Office of CME staff, planners, reviewers, and all others in control of content have no relevant financial relationships to disclose.
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Step 4. Enter the redeem code UCSFHR11 in the box and click “Submit Redeem Code”.

Step 5. View or download your lectures from either the MY CME page or the UCSF High Risk EM course page under “Courses”.

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(415) 344-0644
www.agferrari.com

Boudin Bakery & Cafe
619 Market St. (near 2nd St.)
(415) 281-8200
www.boudinbakery.com

Boudin Bakery & Cafe
Macy's Union Square
(cellar food court)
251 Geary St.
(415) 296-4740 (Cellar)
www.boudinbakery.com

Caffe Museo (SF MOMA)
Categories: Coffee & Tea, American (New)
151 3rd Street (btw Masset Pl & Minna St)
(415) 357-4500

California Pizza Kitchen
Categories: Pizza, American (New)
53 3rd St
(415) 278-0443
www.cpk.com

Fang
Category: Chinese
660 Howard St (btw Hawthorne St & 3rd St)
(415) 777-8568
www.fangrestaurant.com

Ferry Building Marketplace
Categories: Specialty Food, Variety
1 Ferry Bldg (at Embarcadero)
(415) 693-0996
www.ferrybuildingmarketplace.com

Mixt Greens
Categories: Vegetarian, Fruits & Veggies, Sandwiches
560 Mission St (between Anthony St & Shaw Aly)
(415) 543-2505
www.mixtgreens.com

Paladar
Category: Cuban
329 Kearny St (between Bush St & Pine St)
(415) 398-4899
www.paladarcafeacubano.com

Perilla
Category: Vietnamese
510 Mission St (between 1st St & Ecker Pl)
(415) 777-1893
www.perillasf.com

Samovar Tea Lounge
730 Howard St
Yerba Buena Gardens - Upper Terrace
(415) 227-9400
www.samovarlife.com

Sellars Market
595 Market Street
(415) 227-9850
www.sellersmarkets.com

Soup Freaks
90 New Montgomery St. (at Mission)
(415) 369-9600
www.soupfreaks.com

Specialty's Cafe & Bakery
Categories: Bakeries, Caterers, Sandwiches
101 New Montgomery St
 betw Mission St & Minna St
(925) 299-2507
www.specialtys.com

Starbucks
Category: Coffee & Tea
7 3rd St. (between Kearny St & Market St)
(415) 979-9530
www.starbucks.com

Tropisueño
Category: Mexican
75 Yerba Buena Lane
(415) 243-0299
www.tropisueno.com

Vitrine
Category: New American
St Regis Hotel
125 3rd St
(415) 284-4000

Westfield San Francisco Centre Food Emporium
Category: Variety, Chinese, Mexican, Vietnamese
865 Market St (Sub-Level)
www.westfield.com/sanfrancisco
Subtle ECG Findings of Cardiac Ischemia
Amal Mattu, MD, FAAEM, FACEP
Professor and Vice Chair of Emergency Medicine
University of Maryland School of Medicine
amattu@smail.umaryland.edu

Case 1, ECG #1

Case 1, ECG #2 (4 days later)
Case 2, ECG #1

Case 2, ECG #2 (Baseline ECG)
Case 2, ECG #3 (one hour later)

Case 3
Case 4

References/Suggestions for Further Reading

Now available:
**ECGs for the Emergency Physician Volume 1.** Authors: Amal Mattu, William Brady. Blackwell Publishing, 2003. A collection of 200 high-quality ECGs with diagnoses and advanced teaching points. The first 100 ECGs focus on the intermediate level, and the second 100 ECGs focus on the advanced level emergency practitioner. Available through the ACEP bookstore, medical bookstores, Amazon.com, or similar sites.

**ECGs for the Emergency Physician Volume 2.** Authors: Amal Mattu, William Brady. Blackwell Publishing, 2008. A collection of 200 additional high-quality ECGs with diagnoses and advanced teaching points. Serves as a complement to Volume 2 with an added focus on dysrhythmias, misdiagnoses, and advanced topics. Available through the ACEP bookstore, medical bookstores, Amazon.com, or similar sites.

ACUTE HEART FAILURE
Matthew Strehlow, MD

Epidemiology

- #1 cause of admission to the hospital in people >65 yo
- 1 million admissions/year for acute heart failure (AHF)
- 80% of admissions originate in the ED
- Mortality rates ranges from 2% to over 20%

Pathophysiology

- Traditional triggers – fluid accumulation, ischemia, and arrhythmias
- Novel triggers – neurohormonal activation, increased vascular stiffness, and fluid redistribution
- Understanding of the pathophysiology of AHF syndromes is limited but based on existing data focus is shifting from traditional triggers to novel triggers

Diagnosis

Clinical Predictors

- Increased risk that the patient has AHF if the following are PRESENT
  - History of heart failure (LR = 5.8)
  - Paroxysmal nocturnal dyspnea (LR = 2.6)
  - S3 on examination (LR = 11)
  - Congestion of chest x-ray (LR = 12)
  - Atrial fibrillation (LR = 3.8)

- Decreased risk that the patient has AHF if the following are PRESENT
  - No history of heart failure (LR = 0.45)
  - No dyspnea on exertion (LR = 0.48)
  - No rales (LR = 0.51)
  - No cardiomegaly on chest x-ray (LR 0.51)
  - Normal ECG (LR = 0.64)

Brain Natriuretic Peptide (BNP and NT pro-BNP)

- BNP equal to NT pro-BNP as a diagnostic test
- The addition of BNP to clinical judgement may improve diagnostic accuracy
- Utility in ED patients without a clear diagnosis

- Conditions that elevate BNP levels
  - Age (primarily NT pro-BNP)
  - Renal failure (NT pro-BNP use cutoff <1200 pg/ml if GFR <60)
  - Severe sepsis (high elevations in BNP and NT pro-BNP)
  - Pulmonary embolus (moderate elevations)
  - Chronic heart failure (use baseline value if available)
ACUTE HEART FAILURE
Matthew Strehlow, MD

- Other conditions with high cardiac output or right heart strain

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<thead>
<tr>
<th></th>
<th>BNP</th>
<th>NT pro-B</th>
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<tr>
<td>Age</td>
<td>All</td>
<td>&lt;50</td>
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<tr>
<td>Rule Out</td>
<td>&lt;100⁺</td>
<td>&lt;300*</td>
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<td>Sens/Spec</td>
<td>90%/74%</td>
<td>99%/85%</td>
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<td>Rule In</td>
<td>&gt;400⁺</td>
<td>&gt;450*</td>
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<tr>
<td>Sens/Spec</td>
<td>81%/90%</td>
<td>93%/95%</td>
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**Directed Ultrasound**

**IVC evaluation**

- Marker of elevated filling pressures
- Measure just prior to connection with right atrium (within 2cm)
- IVC >2cm maximum diameter

  
  **AND/OR**
  
  IVC collapsibility index ((IVC maximum diameter – minimum diameter)/maximum diameter) < 0.45
  
  Are both signs of elevated right atrial pressure (≥10) and left ventricular filling pressure (PCWP ≥15)

**Pulmonary edema evaluation**

- Bedside US of anterior chest wall ribs 2-5 using 1.6 to 5 MHz probe
ACUTE HEART FAILURE
Matthew Strehlow, MD

- Lung rockets (aka comet tails) are shown below and are a sign of extravascular lung water (ELW)
- If lung rockets are present bilaterally in the proper clinical setting this ELW is likely cardiogenic pulmonary edema, however, it may be present in other conditions such as ARDS
- <3-5 total lung rockets may be normal but greater than 5 is abnormal
- The greater the number of lung rockets the greater the ELW present


Risk Stratification

- Factors portending an elevated mortality risk in AHF
  - Elevated BUN
  - Low systolic blood pressure
  - Elevated creatinine
  - Elevated troponin
  - Elevated BNP or NT pro-BNP
  - Others include age and tachycardia

Management

There is limited evidence to guide therapy in patients with AHF

Non-invasive Positive Pressure Ventilation (NIPPV)

- Continuous and Bilevel PPV (CPAP/BiPAP) equivalent efficacy
- Improves symptoms associated with acute cardiogenic pulmonary edema
- Unclear effect on mortality and intubation rates
**ACUTE HEART FAILURE**

Matthew Strehlow, MD

- Indications include patients with significant respiratory distress or low oxygen saturation (<90%)

**Nitrates**

- First-line therapy in AHF
- High doses are safe and effective
- IV administration preferred because of ease of titration and unreliable absorption with topical nitrates
- Caution in patients with SBP <90 or recent PDE-5 use

**Angiotensin Converting Enzyme Inhibitors (ACEI)**

- Second-line or adjunctive therapy in AHF
- Beneficial cardiovascular profile in acute setting
- Small trials and observational studies have suggested benefit
- Not associated with worsening renal failure during acute hospitalization
- Monitor for first dose hypotension (primarily with IV formulations and when high doses are used)

**Recombinant BNP (Nesiritide)**

- Beneficial cardiovascular effects and improves symptoms of AHF
- Little data comparing Nesiritide to high dose nitrates
- May increase mortality and worsen renal function in AHF patients (large trial ASCEND is pending)

**Loop Diuretics**

- Up to 50% of ED patients in AHF may be intravascularly volume depleted
- The onset of diuresis is delayed (45-120 minutes) in AHF patients
- Arterial constriction predominates (early <15 minutes) over venous dilation in AHF patients. This effect appears ameliorated if a vasodilator has been previously administered.
- Higher doses are associated with worsening renal failure during hospitalization and worsening renal failure is associated with a higher mortality in AHF patients. Direct causal relationship not established.
- Continuous infusions are more efficacious and lead to smaller cumulative doses than IV bolus administration

**Inotropes and Vasopressors**

- No clear beneficial and possibly detrimental effect on mortality rates in AHF
- No evidence to support a specific inotropic agent (common agents include dobutamine, milrinone, amrinone) or vasopressor
ECG Mimics of Acute Coronary Syndrome
Amal Mattu, MD, FAAEM, FACEP
Professor and Vice Chair of Emergency Medicine
University of Maryland School of Medicine
amattu@smail.umaryland.edu

1.

2.
ECG Mimics of Acute Coronary Syndromes
Amal Mattu, MD
References/Suggestions for Further Reading

Now available:
**ECGs for the Emergency Physician Volume 1.** Authors: Amal Mattu, William Brady. Blackwell Publishing, 2003. A collection of 200 high-quality ECGs with diagnoses and advanced teaching points. The first 100 ECGs focus on the intermediate level, and the second 100 ECGs focus on the advanced level emergency practitioner. Available through the ACEP bookstore, medical bookstores, Amazon.com, or similar sites.

**ECGs for the Emergency Physician Volume 2.** Authors: Amal Mattu, William Brady. Blackwell Publishing, 2008. A collection of 200 additional high-quality ECGs with diagnoses and advanced teaching points. Serves as a complement to Volume 2 with an added focus on dysrhythmias, misdiagnoses, and advanced topics. Available through the ACEP bookstore, medical bookstores, Amazon.com, or similar sites.

Acute Coronary Syndrome Therapies
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ACS Treatment: Non-STEMI ACS
ACC/AHA 2007 Guidelines for the Management of Patients With Unstable Angina/Non-ST-Elevation Myocardial Infarction: Executive Summary

Onset and Recognition of Symptoms

- One-third of all AMIs present with symptoms other than CP, and this is especially common in the elderly, in women, in patients with DM, and in patients with prior HF.
- The authors specifically bring up the fact unexplained dyspnea is common among AMI patients and is often misdiagnosed.
- The 5 most important factors on the initial history, in order of importance, are (1) nature of anginal symptoms, (2) prior history of CAD, (3) male gender, (4) older age, and (5) increasing number of traditional risk factors. [Note that the HPI is most important]
- ECGs: 1-6% of normal ECGs are associated with NSTEMI and 4% are associated with unstable angina. Approximately 4% of AMI patients have STE isolated to the posterior leads. Isolated posterior STEMI does qualify for emergent reperfusion therapy, therefore get those posterior leads on patients when the initial standard ECG is non-diagnostic!

Early Hospital Care — Anti-Ischemic and Analgesic Therapy

- Oral beta blockers should be initiated within the first 24 hours for patients who do not have 1 or more of the following; (1) signs of HF; (2) evidence of low-output state; (3) increased risk for cardiogenic shock (risk factors for cardiogenic shock in NSTE-ACS: age > 70 yo, SBP < 120, sinus tachycardia > 110 or HR < 60, and increased time since onset of symptoms of NSTE-ACS; the greater the number of risk factors, the greater the risk for developing cardiogenic shock), or (4) other relative contraindications to beta blockade (PR interval > 240 msec, 2nd or 3rd degree heart block, active asthma, or reactive airway disease).
  - Listed as Class III, level of evidence A are IV beta blockers [Class III means “risk ≥ benefit, treatment should not be performed since it is not helpful, may be harmful, no additional studies needed;” level of evidence A means the recommendation is based on the highest level of evidence]: “It may be harmful to administer IV beta blockers to UA/NSTEMI patients who have contraindications to beta blockade, signs of HF or low-output state, or other risk factors for cardiogenic shock.”

Antiplatelet Therapy

- ASA therapy should be initiated as soon as possible
- If the patient cannot tolerate ASA because of a severe allergy, give clopidogrel (300 mg loading dose followed by maintenance dose) instead.
- If the patient has a history of GI bleeding, add a proton pump inhibitor when giving ASA and/or clopidogrel.
For patients in whom **early invasive therapy is planned**, ASA should be supplemented with either clopidogrel (300 mg loading dose) or an IV glycoprotein IIb/IIIa receptor inhibitor (G2B3AI) before angiography. [There’s controversy in the EM literature regarding whether we truly need to be initiating these medications in the ED or whether we can just let the cardiologists do this in the cath lab.]

If a conservative (non-invasive) strategy is chosen, clopidogrel should be added to ASA and anticoagulant therapy “as soon as possible after admission.”

**Anticoagulant (AC) Therapy**

- AC therapy should be added to antiplatelet medications ASAP after presentation [remember again, we are talking about high risk patients with NSTE-ACS, not just the usual, low risk chest pain patients that comprise the majority of our admissions].
- If invasive therapy is planned, give either enoxaparin or unfractionated heparin (UFH). These have the highest class rating (I) and level of evidence (A). Alternatively, bivalirudin or fondaparinux can be used (Class I, level of evidence B).
- If conservative therapy is planned, give either enoxaparin or UFH. Fondaparinux is also reasonable. All three are listed as Class I medications.
- If conservative therapy is planned and the patient has an increased risk of bleeding [or heparin-induced thrombocytopenia], fondaparinux is preferred.

**Risk Stratification Before Discharge**

Noninvasive stress testing is recommended in low-risk patients who have been free of ischemia at rest or with low-level activity and HF for a minimum of 12-24 hours. This is listed as a Class I recommendation. [Note that the section heading is “Risk Stratification Before Discharge;” and that these Guidelines recommend stress-testing even the low-risk patients before discharge. This contradicts the earlier section of these Guidelines which said that some low-risk patients are reasonable for a 72-hour outpatient stress test. I think the important takeaway point here again is that even our low risk patients do need a stress test, and if a patient was concerning enough to be admitted, it’s surprising that so many are not getting the stress before discharge.]

- Characteristics of “low risk” patients with NSTE-ACS: Patients may have any of the following:
  - Increased angina frequency, severity, or duration
  - Angina provoked at a lower threshold
  - New onset angina with onset 2 weeks to 2 months prior to presentation
  - Normal or unchanged ECG
  - Normal cardiac biomarkers

**ACS Treatment: STEMI and PCI**


**Beta blockers:** Recommendations are similar to those listed above for non-STE-acute coronary syndromes

**Logistics of Care**

- STEMI patients presenting to a hospital which is unable to provide primary PCI or to transfer the patient for primary PCI within 90 minutes (time from first medical contact to balloon inflation) should be treated with **fibrinolysis within 30 minutes of hospital presentation** unless there are contraindications.
• If the patient presents to a hospital incapable of performing PCI, transfer to a PCI-capable hospital is appropriate if the time to balloon inflation will be < 90 minutes (as noted above), if there is a contraindication to fibrinolytics, or if fibrinolytics are administered but are unsuccessful (“rescue PCI”).

Facilitated PCI: Most commonly this refers to the planned combination strategy of administration of fibrinolytics followed by PCI. The term is, however, sometimes used also to refer to administration of glycoprotein (GP) IIb/IIIa receptor antagonists with or without fibrinolytics (full or half-dose) followed by PCI.

• A planned reperfusion strategy using full-dose fibrinolytics followed immediately by PCI is not recommended (Class III, i.e. considered harmful).
• However, the Guidelines do allow the possibility (Class IIb, i.e. possibly beneficial) of facilitated PCI using regimens other than full-dose fibrinolytics (e.g. GP IIb/IIIa receptor antagonists, especially abciximab, or even half-dose fibrinolytics) IF all of the following are present:
  o Patients are at high risk (large MI, hemodynamically unstable, or electrically unstable, e.g. runs of VTach)
  o PCI is not immediately available within 90 minutes; in other words, adding these meds might “buy some time” before PCI
  o Bleeding risk is low (younger age, absence of poorly controlled hypertension, normal body weight…okay, that might be a problem!)

• They do, however, admit that the amount of evidence for this recommendation is very small (Level of Evidence C)

Emergency Invasive Therapy After Failed Fibrinolysis (Rescue PCI): 90 minutes after administration of the fibrinolytic, you must assess the patient’s status and decide whether transfer for rescue PCI is indicated.

• Rescue PCI or emergency CABG (after failed fibrinolysis) is indicated for
  o patients in cardiogenic shock (Killip class IV).
  o patients with severe congestive heart failure and/or pulmonary edema (Killip class III).
  o patients with hemodynamically destabilizing ventricular dysrhythmias.
  o patients with persistent ischemic symptoms.
  o patients who fail to demonstrate ECG evidence of reperfusion (the lead with the greatest amount of STE fails to demonstrate at least a 50% reduction in the magnitude of the STE) by 90 minutes post-fibrinolysis.
    ▪ Interestingly, the Guidelines specifically state that simply using resolution of signs/symptoms as a marker of reperfusion is unreliable; you must follow the STE on the ECG.
• The authors point out that the presence of (1) anterior MI or (2) inferior MI with either RV extension or precordial ST depression [I assume this refers to posterior extension] predicts a higher likelihood of unsuccessful fibrinolysis and need for rescue PCI.

Anticoagulant Therapy (ACT):
• If patients receive fibrinolytics, they should receive ACT for a minimum of 48 hours, and preferably for the duration of the hospitalization, up to 8 days. Class I choices for ACT:
  o UFH (initial IV bolus 60 U/kg, maximum 4000 U bolus, followed by IV infusion of 12 U/kg, maximum 1000 U/hr infusion) can be used and titrated to achieve a PTT of 1.5-2.0 times control (approx. 50-70 secs). The authors state that there is
no benefit to using UFH > 48 hours in the absence of other ongoing indications for ACT, and also that more prolonged infusions increase the risk of HIT.

- **Enoxaparin** (provided the serum creatinine is < 2.5 mg/dL in men and 2.0 mg/dL in women): for patients < 75 years of age, give an initial 30 mg IV bolus followed in 15 minutes by SQ injections of 1.0 mg/kg every 12 hours. For patients ≥ 75 years of age, eliminate the initial IV bolus and reduce the SQ dose to 0.75 mg/kg every 12 hours. Regardless of age, if the creatinine clearance (using the Cockroft-Gault formula → just Google it!) is < 30 mL/min, the SQ regimen is 1.0 mg/kg every 24 hours. Maintenance dose of enoxaparin should be continued for the entire hospitalization, up to 8 days.

- **Fondaparinux** can be used instead, provided the serum creatinine is < 3.0 mg/dL. The initial dose is 2.5 mg IV, with subsequent SQ injections of 2.5 mg daily.

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**Antiplatelet therapy**

- Patients already taking daily long-term aspirin (ASA) should take 75-325 mg of ASA before PCI (Class I).
- Patients not already taking daily long-term ASA should be given 300-325 mg of ASA. Ideally, it should be given at least 2 hours before the PCI, so get this on-board ASAP (tell the EMS providers to give the ASA whenever possible) (Class I).
- A **loading dose of clopidogrel, generally 600 mg**, should be administered before or when PCI is performed. If patients are undergoing PCI within 12-24 hours of fibrinolytic administration, an oral loading dose of 300 mg “may be considered” (but still listed as Class I).

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**Unfractionated Heparin Dosing and Risk of Major Bleeding in Non-ST-Segment Elevation Acute Coronary Syndromes**


Emergency physicians should heed the following takeaway points: First, although UFH dosing is certainly more convenient for us when we use the **simple 5000/1000 dose, this common practice is dangerous to our patients**. We need to dose UFH based on the patient’s weight. Additionally, we all should be aware of the most recent ACC/AHA Guidelines for NSTE ACS, which now recommend dosing of UFH at **60 U/kg (max 4000 U) as an IV bolus and 12 U/kg/hr (max 1000 U/hr) as a maintenance infusion**.4 Secondly, be especially **meticulous about dosing with women and with elderly patients.** And finally, we should realize that the initial dose of UFH that we administer in the ED does have a significant bearing on the patient’s in-hospital prognosis. **We’ve got to get this dose correct right from the start.**

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**Cardiac Arrest, ACS, and Catheterization**

Regional Systems of Care for Out-of-Hospital Cardiac Arrest: A Policy Statement from the American Heart Association


- Increasing evidence (and new AHA policy) favors urgent cardiac catheterization for victims of primary cardiac arrest who regain pulses…regardless of ECG findings!
Take Home Messages

- Patients with scrotal pain< than the age of 16 have torsion until PROVEN otherwise.
- Patients > 18yo with testicular pain more commonly have epididymitis
- Testicular torsion tends to be acute in onset
- Scrotal pain accompanied by nausea & Vomiting is specific for torsion
- Patients with epididymitis tend to be gradual in onset and accompanied by fever
- DON’T rely on those “cute physical exam findings” (prehn’s sign, cremasteric reflex) to “rule out” testicular torsion
- Beware of the uncommon presentation of testicular torsion
  - Slow onset of pain
  - Abdominal pain (20-30%)
  - Fever (16%)
  - Urinary frequency (4%)
  - WBC in urine (30%)
  - Elevated CBC (60%)
- Patients with clinically suspected testicular torsion need to go DIRECTLY to the OR
- Don’t let your tired urologist talk you out of diagnosis
- Torsion of the testicular appendage is common and once diagnosed can be managed conservatively
- When the diagnosis is unclear, color doppler ultrasound is the diagnostic test of choice
- You either have a “normal” testicular ultrasound or you don’t
- “Time is testicle"
**Useful Tables**

**Evaluation of Acute Scrotal Pain**

- Perform history and physical examination.

- Consistent with torsion AND pain < 6 hours: immediate surgical exploration.
  - Normal or increased blood flow in symptomatic testis
  - Inflammation (orchitis, epididymitis) or torsion of the appendix testis
  - No further testing

- Questionable diagnosis OR pain > 6 hours: perform Doppler ultrasonography.
  - Absent or relatively decreased blood flow in symptomatic testis
  - Testicular torsion
  - Immediate surgery

**Diagnostic Criteria for Epididymitis**

- Gradual onset of pain
- Dysuria, discharge, or recent instrumentation
- History of genitourinary abnormality
  - UTI, neurogenic bladder, hypospadias, etc.
- Fever > 101°F (38.3°C)
- Tenderness and induration at epididymis
- Abnormal UA (10 WBC or RBC/HPF)
# Time is Testicle: The Emergency Department Evaluation of the Acute Scrotum

Gary W. Tamkin, MD, FACEP, Assistant Clinical Professor of Medicine, UCSF

## Take Home Messages

### Distinguishing Historical Features

<table>
<thead>
<tr>
<th></th>
<th>Testicular torsion</th>
<th>Torsion of appendage</th>
<th>Acute epididymitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Incidence</td>
<td>Perinatal &amp; puberty</td>
<td>Prepubertal</td>
<td>&lt; 2 years &amp; postpubertal</td>
</tr>
<tr>
<td>Onset of pain</td>
<td>Usually sudden</td>
<td>Usually sudden</td>
<td>Usually gradual</td>
</tr>
<tr>
<td>Duration of pain</td>
<td>Usually &lt; 12 hrs</td>
<td>Usually &gt; 12 hrs</td>
<td>Usually &gt; 24hrs</td>
</tr>
<tr>
<td>Previous episodes</td>
<td>Typical</td>
<td>Unusual</td>
<td>If previous episode</td>
</tr>
<tr>
<td>Nausea/Vomiting</td>
<td>Common</td>
<td>Uncommon</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Fever</td>
<td>Unusual</td>
<td>Unusual</td>
<td>Common</td>
</tr>
<tr>
<td>History of trauma</td>
<td>Occasional</td>
<td>Unusual</td>
<td>Unusual</td>
</tr>
<tr>
<td>Dysuria/Discharge</td>
<td>Rare</td>
<td>Rare</td>
<td>Common</td>
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</tbody>
</table>

### Distinguishing Physical Findings

<table>
<thead>
<tr>
<th></th>
<th>Testicular torsion</th>
<th>Torsion of appendage</th>
<th>Acute epididymitis</th>
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</thead>
<tbody>
<tr>
<td>Suggestive Findings</td>
<td>Bell-clapper</td>
<td>Palpable Blue Dot</td>
<td>None</td>
</tr>
<tr>
<td>Cremasteric reflex</td>
<td>Usually absent</td>
<td>Usually present</td>
<td>Usually present</td>
</tr>
<tr>
<td>Tenderness</td>
<td>Testicular then diffuse</td>
<td>Appendage then testis</td>
<td>Epididymitis then diffuse</td>
</tr>
<tr>
<td>Scrotal erythema/Edema</td>
<td>Common &gt; 12hrs</td>
<td>Common &gt; 12hrs</td>
<td>Common &gt; 12hrs</td>
</tr>
</tbody>
</table>

### Distinguishing Laboratory Tests

<table>
<thead>
<tr>
<th></th>
<th>Testicular torsion</th>
<th>Torsion of appendage</th>
<th>Acute epididymitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pyuria</td>
<td>Unusual</td>
<td>Unusual</td>
<td>Common</td>
</tr>
<tr>
<td>Positive smear/culture</td>
<td>No</td>
<td>No</td>
<td>Often</td>
</tr>
<tr>
<td>Leukocytosis</td>
<td>Common</td>
<td>Uncommon</td>
<td>Common</td>
</tr>
</tbody>
</table>
Differential diagnosis of painless scrotal mass in children

<table>
<thead>
<tr>
<th>Mass</th>
<th>Palpation</th>
<th>Transilluminate</th>
<th>Increased with Valsalva?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumor</td>
<td>Firm</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Varicocele</td>
<td>Fluid-filled</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Noncommunicating hydrocele</td>
<td>Fluid-filled</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Spermatocele</td>
<td>Fluid-filled</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Distinguishing Imaging Studies

<table>
<thead>
<tr>
<th></th>
<th>Testicular torsion</th>
<th>Torsion of appendage</th>
<th>Acute epididymitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color Doppler</td>
<td>Decreased</td>
<td>Normal or Increased</td>
<td>Normal or Increased</td>
</tr>
<tr>
<td>Radionuclide</td>
<td>Decreased</td>
<td>Normal or Increased</td>
<td>Normal or Increased</td>
</tr>
</tbody>
</table>

- **References**

Pacemakers & ICDs: Short Circuit to the Electronic Heart

Ingrid Lim, MD, FACEP

PACEMAKERS
Two basic functions of the device:
1. Pace or stimulate the heart when necessary – can be asynchronous (fixed) or demand pacing
2. Recognize intrinsic (“native”) electrical activity

Basic terminology:
Pacing = delivery of the signal to the heart
Capture = actual event of heart responding to electrical signal
Sensing = detection of intrinsic cardiac activity

Pacemaker Nomenclature:
Nowadays, the majority of implanted pacemakers (70%) are dual chambers. First three letters deal with anti-bradycardia functions (3 letter reference is most commonly used to refer to mode of pacer).

Approach to pacemaker EKG
- **Rate**: (if HR < 60 or > 120 → think of a possible malfunction); Rate is usually 60-100 bpm (varies depending on what rate was programmed)
- **Rhythm**: examine the pacemaker spikes – are they falling in the right place?
  - Are atrial pacemaker spikes followed by a P wave (may be absent occasionally) or ventricular spikes followed by a wide QRS and T wave (also usually wide)? Hatch marks at the top of the EKG indicating pacer spikes may not always be present.
- **Axis**: should be always be left-ward
- **Intervals**: QRS should be wide, resemble a LBBB pattern because the leads reside in the R atrium or R ventricle, causing the R side of the heart to depolarize first
- **ST segments**: rule of appropriate discordance (QRS and ST segments pointing in opposite directions), look for signs of ischemia (see below for Sgarbossa’s criteria)

Approach to CXR with pacemaker or ICD
- **CXR** can distinguish the pacer from ICD: the ICD pulse generator will be bigger; the leads of an ICD include thick coils of the shocking electrode
- **Look** for lead complications (fracture, breaks, migration by comparing to old films), insertion complications (hemothorax, pneumothorax, pleural effusion, pericardial effusion, perforation, arterial puncture)
- **Look** for signs of CHF.
- **PA CXR**: wires should always **cross the midline** (from R → L)
- **Lateral CXR**: wires should point anteriorly toward the lower portion of the sternum. If it’s facing toward the spine, the wire may be incorrectly placed in the coronary sinus → EKG clue of misplacement: a RBBB pattern.

Magnet Fun!
When should you consider getting the magnet?
1. **HR is too slow.** A patient with bradycardia (so slow that the pacer should have kicked in) or patient with symptoms suggestive of bradycardia but is now in normal sinus rhythm and asymptomatic. If applying the magnet causes the pacer to fire at its programmed rate (this is the expected outcome), the pacer is likely oversensing (see below) and inhibiting spikes inappropriately. If applying the magnet, there are no spikes, then there is likely component failure. If there are spikes, but slower than the programmed rate, it’s a battery failure.

2. **HR is too fast.** A patient (usually with DDD pacer) presents with tachycardia (near upper limit threshold of pacer) which might be due to pacemaker-mediated tachycardia (PMT) (see below). Applying the magnet will suppress atrial sensing of the retrograde p waves and interrupt the reentrant circuit between the atrial and ventricular chambers. Magnet application seems to resolve the tachycardia.

   - **ICD going wild!** A patient that presents with recurrent shocks from the AICD. The magnet disables the tachyarrhythmia detection/treatment, cardioversion and defibrillation functions, without altering its backup bradycardia sensing and pacing (but it does not cause the ICD to go into asynchronous pacing)

### PACEMAKER MALFUNCTION

**KEY POINT:** Pacemakers do not necessarily store ECG information (like ICDs). Interrogation may find underlying rhythm but may not record any ventricular dysrhythmias. If concerned about cardiac syncope, consider admission for tele monitoring.

**FAILURE TO CAPTURE** – the output is too low, resulting in failure to depolarize the ventricle or atrium → no mechanical contraction → no QRS or p wave.

- EKG will show either complete absence of pacemaker spikes or a pacer spike without any subsequent QRS. Or, a pacer spike without a subsequent p wave (failure to capture atrium)
- If constant (no capture at all) in a pacemaker-dependent patient, the patient can be pulseless (need to treat as asystolic patient with ACLS algorithms).
- If the patient’s HR is above the threshold for pacing, the EKG will not have any pacer spikes. In order for you to test the functioning of the pacemaker, there has to be spikes. Applying the magnet will allow the pacer to fire at its programmed rate to confirm that the pacemaker can pace.

- Causes
  - **Lead dislodgment** from endocardial surface (most common, usually within the 1st month of insertion)
  - Twiddler’s syndrome
  - Lead fracture
  - Cardiac perforation
  - Battery failure
  - Improperly programmed or inadequately programmed voltage
  - Increased threshold for capture from myocardial ischemia, fibrosis or scar tissue at contact site, metabolic (hyperkalemia, hypercarbia, hypoxemia, hypothyroidism), drugs (beta-blockers, class 1A antidysrhythmics, flecainide, verapamil), prolonged QT syndrome

**FAILURE TO PACE** (= failure to output) – pacemaker does not fire when expected.

**Causes of failure to pace:** lead fracture, loose connection, insulation defect, pulse generator defect, battery depletion, **oversensing** or “underpacing” (myopotential sensing, large T or U waves, MRI, electrocautery, extracorporeal shock wave lithotripsy, transcatheter electrical nerve stimulation, succinylcholine induced muscle fasciculations), cross talk (seen in dual chambers – the pacing stimulus in one chamber is sensed by the other chamber’s sensors as that chamber’s impulse and a spike is not generated)
FAILURE TO SENSE (also known as undersensing) – pacer does not detect patient’s own intrinsic rhythm and generates a pacer spike in the intrinsic rhythm, during an intrinsic QRS or during the refractory period of the T wave. Danger: R-on-T → VT/VF

EKG: pacemaker spike occurring earlier than expected

SUMMARY of pacemaker malfunction:
- Spikes without subsequent P or QRS → failure to capture
- No spikes + slow rate → failure to pace
- Inappropriate spikes → failure to sense

Pacemaker Mediated Tachycardia
- Develops in response to a premature ventricular complex (PVC) or premature atrial complex (PAC) that has retrograde conduction through the AV node → atria; leads to the atrial sensing component to sense it → ventricular component fires. Won’t fire at a rate faster than the upper programmed limit.
- EKG: tachycardia in which each ventricular beat is preceded by a pacing spike, may see retrograde P’s
- Diagnostic: magnet application will terminate the dysrhythmia (turns off the sensing)
- Treatment: reprogram the device (DDD → VVI) to prevent atrial sensing of the retrograde impulse.

How to diagnose AMI on a paced ECG using Sgarbossa criteria, GUSTO-1 trial, 1996
- Discordant ST elevation ≥ 5 mm in leads (sensitivity 53%, specificity 88%, positive likelihood ratio (LR= 4.4) [discordant = ST-T wave complex points in the opposite direction from the terminal portion of the QRS]
- Concordant ST elevation ≥ 1 mm (sens 18%, spec 94%)
- ST depression ≥ 1 mm V1-3 (sens 29%, spec 94%)

IMPLANTABLE CARDIOVERTER-DEFIBRILLATORS (ICD)
Modern ICD’s can perform all of the following functions:
1. **ECG storage** (unlike pacemakers which often have this function turned off to save battery)
2. **Antibradycardia pacing (dual chamber):** may kick in during the 1st 5 seconds after a shock because there is a brief asystolic period. Most modern ICDs have VVI pacing capability for this purpose.
3. **Tiered therapy for VT:** current devices are programmed for tiered therapy, in which the device will provide progressive anti-tachycardia pacing, cardioversion, and defibrillation, as required. Helps to reduce the need for high-energy defibrillation (which depletes the battery and causes discomfort to the patient).
   - **Antitachycardia pacing (ATP):** tries to short-circuit the rapid ventricular rhythms by sending brief bursts of impulses to the heart muscles at a pace faster than the already accelerated ventricular rate. The aim is to depolarize the heart muscle at the right moment, interrupting the abnormal rhythm and thereby avoiding an appropriate ICD shock. Benefit: less drain on the power source, ideal for patients with frequent ventricular tachycardias not controlled by medical therapy. Large-scale studies have shown this to be 90-96% effective in terminating VT.
   - **Low energy cardioversion:** little shock (0.5-2 J), usually more effective than anti-tachycardia pacing
   - **High energy cardioversion** if none of the above works.
4. **High energy defibrillation for VF** (low energy shock won’t stop VF): 10-15 J at minimum, but most devices deliver 35 J to allow a margin of safety. Devices can typically give up to 5 shocks with a pause to analyze the rhythm. If unsuccessful after 5 shocks, it will turn off to conserve battery life.

WHEN ICDS GO HAYWIRE!
Scenario #1: patient who presents after a single shock
- Most cardiologists tell their patients not to seek medical attention if they receive a single shock and are otherwise asymptomatic. Workup should be pursued if they have worrisome symptomatology: dyspnea, syncope or near syncope, chest pain, palpitations. Many patients have home transmission systems – they can upload information to a website for the cardiologist to interpret. Dispo: likely home if no other symptoms.

Scenario #2: patient who presents after multiple shocks (>2 shocks in 24 h)
- **Medical emergency and requires a cardiology consult for device interrogation** to decipher if shocks are appropriate (for true VF/VT) or inappropriate (device malfunction).
- Put the patient on cardiac monitor and have external defibrillation immediately available.

**Inappropriate shocks**: occurs in 20-25% of patients, can be caused by...
- Most commonly: supraventricular tachyarrhythmias, afib with rapid ventricular response, sinus tachycardia, as well as nonsustained VT.
- ICD malfunction (lead fracture, lead migration, insulation break, incorrect programming of the device)
- Inappropriate sensing – tall T waves or extracardiac (respiratory motion) sources.
- Electromagnetic interference from small appliances can also cause spurious shocks: electric razors, slot machines, antitheft detection devices, cell phones, TV remotes, large speakers, electrical current leaks
- **Clues in the history**: patients with multiple repetitive shocks (occurring within seconds or minutes of the previous shock) in the alert patient during intense physical activity, fever or pain prior to shock, may be getting inappropriate therapy for sinus tachycardia. Shock associated with repetitive movements may suggest an inappropriate therapy due to lead malfunction.
- If inappropriate shocks, **use the magnet** to turn off the device. Don’t forget to apply the external defib pads to the patient beforehand. Not all ICDs will resume function once the magnet is removed (unlike pacemakers)

**Appropriate shocks**: for VT/VF.
- Clues in the history: shocks that occur hours apart while the patient is at rest usually signify recurrent successfully treated ventricular arrhythmias – likely appropriate therapy; shock preceded by chest pain, shortness of breath, or syncope is more likely appropriate.
- Modern ICDs now have strategies to minimize the number of appropriate shocks without compromising patient safety: by increasing duration of the arrhythmia necessary to trigger therapy (e.g. from 16 → 20 beats), anti-tachycardia pacing (ATP) which should terminate at least 90% of persistent VT
- Other adjunctive therapies include antiarrhythmic drugs (amiodarone or sotalol) or catheter ablation.

**Scenario #3**: Patient is in VT/VF without any ICD therapy delivered
- Several possible causes: VT is slower than the device threshold for delivering therapy, the morphology may not meet recognition criteria, or the device is malfunctioning.
- Treatment: If the patient is stable, chemical or electrical cardioversion. If unconscious or unstable, follow ACLS guidelines as if the device is not there. If the ICD is working, let it shock, and deliver the ACLS meds.

**Cardiac resynchronization therapy (CRT) = biventricular pacing**
- Abnormal chamber mechanics, where there is an interventricular conduction delay, resulting in dyssynchronous contraction, contribute significantly to CHF.
- A third electrode is placed through the coronary sinus into a venous branch along the free wall of the left ventricle, or epicardially. It paces the LV restoring physiologic synchrony of the ventricles.
- CRT improves the cardiac output, ejection fraction, symptoms, quality of life, and lowers hospitalization rates.
- Current evidence shows that this CRT + ICD therapy is most beneficial in patients with severe CHF.

**KEY POINT**: External shocks near the ICD can damage the ICD circuitry – thus, after external cardioversion or defibrillation, the ICD must be interrogated to confirm that the parameters have not been reset by the shocking

**Non-electrical complications to think about in a patient with a cardiac device**:
- Complications from lead placement: hemothorax, pneumothorax, venous thrombosis, subclavian arterial puncture, chylothorax, brachial plexus injuries, cardiac perforation
- Lead problems: lead infection (technically a form of endocarditis with a very high mortality! An absolute indication for removal of leads), lead dislodgement, lead fracture
- Pocket complications: pocket hematoma (don’t aspirate or explore on your own), infection, wound dehiscence, migration within the pocket – Always check the pocket!
- Try to avoid doing a subclavian line in cardiac device patient – could dislodge a thrombus, cause an artifact that induces an inappropriate shock, dislodge a newly implanted lead (within first 2 months), cause entanglement, and it may be technically difficult because subclavian stenosis is common.
Trauma In Pregnancy
Susan B. Promes, M.D.

Incidence:

- 7% of pregnant women are victims of trauma
- 4.1 trauma related hospitalizations per 1,000 deliveries
- Leading cause of death during pregnancy in one series

Anatomic and Physiology Changes:

Must be aware of the anatomic and physiologic changes that occur during pregnancy and the impact these changes may have on the resuscitation of the pregnant woman and her unborn fetus.

- See Tables

Resuscitation:

- Early, aggressive resuscitation is key.
- Supine hypotension syndrome
  - Left lateral decubitus position or manually displace uterus off IVC
- Avoid vasopressors if at all possible
  - Decrease blood flow to uterus

Placenta Abruption:

- Incidence: 1-3% of minor trauma and 40-50% with major trauma
- Gold standard – cardiotocometric monitoring

Amniotic Fluid Embolism:

- High mortality - no great treatment unfortunately.
Procedures:

Modifications may be necessary in the gravid patient.

- **Intubation**
  - Increased risk of aspiration
  - Decreased oxygen reserves
- **Chest tube placement**
  - 1 or 2 rib spaces higher
- **DPL**
  - Supraumbilical approach
- **CPR**
  - Change hand position (higher)

Rh Status:

- Recommended dose RhoGAM: 300 micrograms
- Role of Kleihauer-Betke test

Radiographic Imaging:

- Do what you need to do!
- Greatest risk for radiation related malformation: 10 days to 10 weeks. After 20 weeks, no increased risk of malformation.

Ultrasound:

- eFAST
- May miss a placental abruption
  - Sensitivity only 24%

Perimortem C-section

- Delivery within 5 min of maternal arrest ideal
- If greater than 15 min, only 5% survival with fetal neurologic deficits
## Changes in Maternal Physiology During Pregnancy

<table>
<thead>
<tr>
<th>System</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Water Metabolism</td>
<td>↑ total body water</td>
</tr>
<tr>
<td>Cardiovascular System</td>
<td>↑ cardiac output</td>
</tr>
<tr>
<td></td>
<td>↑ pulse to 80–95 bpm</td>
</tr>
<tr>
<td></td>
<td>↓ BP in second trimester</td>
</tr>
<tr>
<td></td>
<td>↓ central venous pressure left axis deviation on electrocardiogram</td>
</tr>
<tr>
<td></td>
<td>↓ venous return when patient supine</td>
</tr>
<tr>
<td>Respiratory System</td>
<td>↑ respiratory rare</td>
</tr>
<tr>
<td></td>
<td>↑ tidal volume</td>
</tr>
<tr>
<td></td>
<td>↑ minute ventilation associated with a respiratory alkalosis</td>
</tr>
<tr>
<td></td>
<td>↓ functional residual capacity</td>
</tr>
<tr>
<td></td>
<td>↑ oxygen consumption</td>
</tr>
<tr>
<td>Hematologic System</td>
<td>↑ blood volume producing a dilutional anemia</td>
</tr>
<tr>
<td></td>
<td>↑ white blood cell count</td>
</tr>
<tr>
<td></td>
<td>↓ platelet count</td>
</tr>
<tr>
<td></td>
<td>↑ erythrocyte sedimentation rate</td>
</tr>
<tr>
<td></td>
<td>↑ fibrinogen, factors VII, VIII, IX and X</td>
</tr>
<tr>
<td>Urinary System</td>
<td>↓ BUN and creatinine levels / ↑ glomelular filtration rate</td>
</tr>
<tr>
<td>Gastrointestinal System</td>
<td>↓ motility</td>
</tr>
<tr>
<td></td>
<td>↓ tone in lower esophageal sphincter</td>
</tr>
<tr>
<td></td>
<td>↑ dilation of hemorrhoidal veins</td>
</tr>
<tr>
<td></td>
<td>↓ albumin &amp; total protein levels</td>
</tr>
<tr>
<td>Musculoskeletal System</td>
<td>↑ ligamentous laxity</td>
</tr>
<tr>
<td>Endocrine System</td>
<td>↑ aldosterone &amp; cortisol levels</td>
</tr>
<tr>
<td>Central Nervous System</td>
<td>↓ coordination in late gestation</td>
</tr>
<tr>
<td>Gestation (weeks)</td>
<td>Mean Hemoglobin (g/dL)</td>
</tr>
<tr>
<td>------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>12</td>
<td>12.2</td>
</tr>
<tr>
<td>16</td>
<td>11.8</td>
</tr>
<tr>
<td>20</td>
<td>11.6</td>
</tr>
<tr>
<td>24</td>
<td>11.6</td>
</tr>
<tr>
<td>28</td>
<td>11.8</td>
</tr>
<tr>
<td>32</td>
<td>12.1</td>
</tr>
<tr>
<td>36</td>
<td>12.5</td>
</tr>
<tr>
<td>40</td>
<td>12.9</td>
</tr>
</tbody>
</table>

Adapted from U.S. Department of Health and Human Services: *MMWR* 189;38:400–404.
DIAGNOSIS

Signs and Symptoms
- Courtney, AnnEM 10 – 7940 ED pts - 25 Signs/Sx’s
  - Signs and symptoms of PE in 7940 pts
  - Strongest predictors (OR > 2) were:
    - Hx of VTE, Unilateral Leg Swelling, O2 Sat < 95%, Estrogen Use, Surgery (GA) w/in 4 weeks
  - Weakest predictors (OR <1) were:
    - Inactive Ca, Sudden Onset, Pregnancy, Substernal CP, Smoker, Trauma w/in 4 weeks, Hemoptysis

Terminology in risk stratification
- Kline, JTH 08 - 8138 ED pts
  - 2/3 were clinically LOW SUSPICION (<15%) = 3% VTE rate
  - 27% were clinically MODERATE SUSPICION (15-40%) = 10% VTE rate
  - 7% were clinically HIGH SUSPICION (>40%) = 31% VTE rate

Risk Stratification - Gestalt vs prediction rule
- Runyon, Acad EM, 05
  - Gestalt yielded results that exactly mirrored those of a validated structured scoring system
  - Good interobserver reliability for gestalt (kappa > 0.60)

Prediction rules
- Wells, Ann IM, 98
- Wells, Thromb Haemost, 00
- Wicki, Arch IM, 01
- Kline, Ann EM, 02
- Miniati, AM J Med, 03

How well do we use them?
- Runyon et al., Acad EM, 2007
  - Half who are familiar with them use them > 50% of applicable cases.
  - Spontaneous recall of the specific elements was low to moderate.

The PERC rule
- Kline, JA et al JTH 08
  - 8138 ED pts, 5.9% had PE (6.9% any VTE) w/ 45 day f/u
  - Sens 97, spec 21 PERC Neg + Low Suspicion (20% of total) = 0.9% VTE
  1) Age < 50 years
  2) no unilateral leg swelling
  3) pulse < 100 bpm
  4) no hemoptysis
  5) SaO2= > 95%
  6) hospitalization for trauma/surgery w/in 4 wks
  7) No prior VTE
  8) no estrogen use.
D-dimers
- DiNisio JTH 07 meta-analysis
  - Sens=.97, Spec=.43
  - PLR = 1.7, NLR = 0.07
  "Cutoff value for D-Dimer by this method is 500ng/ml FEU (fibrinogen Equivalent Units). It has a high negative predictive value that a negative result rules out the diagnosis of DVT or PE. A positive result is not a definitive diagnosis but indicates further diagnostic testing may be warranted."

Table 5 Summary estimates of sensitivity and specificity of D-dimer methods

<table>
<thead>
<tr>
<th>Type of D-dimer</th>
<th>Deep vein thrombosis</th>
<th>Pulmonary embolism</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sensitivity (95% CI)</td>
<td>Specificity (95% CI)</td>
</tr>
<tr>
<td>ELISA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microplate</td>
<td>94 (86–97)</td>
<td>53 (38–68)</td>
</tr>
<tr>
<td>Membrane</td>
<td>89 (76–95)</td>
<td>53 (37–68)</td>
</tr>
<tr>
<td>ELFA</td>
<td>96 (89–98)</td>
<td>46 (31–61)</td>
</tr>
<tr>
<td>Latex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantitative</td>
<td>93 (89–95)</td>
<td>53 (46–61)</td>
</tr>
<tr>
<td>Semiquantitative</td>
<td>85 (68–93)</td>
<td>68 (53–81)</td>
</tr>
<tr>
<td>Qualitative</td>
<td>69 (27–93)</td>
<td>96 (94–100)</td>
</tr>
<tr>
<td>Whole-blood assay</td>
<td>83 (67–93)</td>
<td>71 (57–82)</td>
</tr>
</tbody>
</table>

Estimates derived from the bivariate multivariable model, adjusting for differences in study design. CI, confidence interval; ELFA, enzyme-linked fluorescent immunossay; ELISA, enzyme-linked immunosorbent assay.

Post test probability
- 4% pretest + neg d-dimer => 0 post test
- 10% pretest + neg d-dimer => 1% post test
- 30% pretest + neg d-dimer => 3% post test

Radiation
- Dose equivalents – sieverts and rems
- Absorbed dose – grays and rads
- Stein, Radiology, 2007

Table 2

<table>
<thead>
<tr>
<th>Radiation Exposure</th>
<th>Effective Whole-Body Dose (mSv)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postanterior and lateral chest radiography</td>
<td>0.07</td>
</tr>
<tr>
<td>Portrait scan</td>
<td>0.8</td>
</tr>
<tr>
<td>Ventilation-perfusion scan</td>
<td>1.2-2.0</td>
</tr>
<tr>
<td>Contrast-enhanced multi-detector CT angiography</td>
<td>1.6-3.3</td>
</tr>
<tr>
<td>Contrast-enhanced multi-detector CT venography</td>
<td>5.7</td>
</tr>
<tr>
<td>Pulmonary digital subtraction angiogram</td>
<td>3.2-30.1</td>
</tr>
<tr>
<td>Background radiation per year</td>
<td>2.5</td>
</tr>
</tbody>
</table>
PULMONARY EMBOLISM – Diagnosis and Treatment
Jeffrey Tabas MD

- Background radiation/year = 3 milliSv
- PA and Lat CXR = 0.07 mSv
- CTPA = 5 mSv (2-8)
- Abd/pelvis CT = 10 mSv

**Actual Doses!!! – Smith-Bindman, Arch IM 09**
- CTPA – 10 (7-14) mSv
- CT abdomen – 16 mSv

**1 CT begets another - Kline AnnEM 09**
- 73% had >=1 subsequent CT scans
- 5% had >= 5 repeat CTPAs.

**Breast exposure (Matthews, Br J Rad, 06)**
- V/Q – 280 microGy
- CTPA – 20,000-50,000 microGy
- Increased risk of Breast Ca begins > 200,000 microGy

**Diagnosis in Pregnancy**
**D-dimer in pregnancy (Kline Clin Chem 05)**
- Percentage of women with normal d-dimer (< 0.50 ng/L)
  - Preconception: 79%
  - 1st trimester: 50% (can use 0.50)
  - 2nd trimester: 22% (can use 0.75)
  - 3rd trimester: 0% (can use 1.0)
  - 4 weeks Postpartum: 69%

**Fetal Radiation (Matthews, BrJRad 06)**
- Background = 1000 microGy over 9 months
- 50,000 microGy (5 Rads) = teratogen
- 100 microGy = 1 in 300,000 cancer risk over next 15 years

**V/Q Scan in Pregnancy**
- Fetal radiation exposure
  - Ventilation = 40-200 microGy
  - Perfusion = 100-350 microGy
- Higher rate of diagnostic results (75% instead of 30%)
- Use half dose perfusion
- Place a foley

**CTPA in Pregnancy**
- 1st trimester = 3-20 microGy
- 2nd trimester = 8-80 microGy
- 3rd trimester = 50-130 microGy
TREATMENT

Enox vs fixed dose SQ UFH
- Kearon, et al. “Comparison of fixed-dose weight-adjusted UFH and LMWH for acute treatment of venous thromboembolism” Jama 06
  - No Difference!
- Vardi et al “SQ UFH vs (IV UFH or SQ LMWH) for VTE” Cochrane Library, 2009
  - 15 RCT’s, 3054 pts
  - No significant difference!
    - Recurrent DVT = O.R. 1.68 (.92 to 3.04)
    - Recurrent PE = O.R. 1.18 (.54 to 2.56)
    - Major Bleed = O.R. 0.9 (.6 to 1.36)
    - Death = O.R. 1.02
  - However, concluded SQ UFH was not non-inferior!
- ACCP Guidelines for Rx of VTE, CHEST 2008
  - DVT or PE: Fixed dose SQ UFH Grade 1A recommendation
    - 333/U/Kg initial dose then 250 units/Kg BID SQ
  - However, can’t get prefilled UFH syringes!

Fondaparinux vs IV UFH
- The MATISSE study, 2214 pts with PE
  - VTE at 3 mos. 3.8 vs 5.0 (NS)
  - Major Bleed 1.3 vs 1.1 (NS)
- Once daily dosing
- No HIT

HIT
(Morris, et al., Chest, 2007)
- 13 studies, 5,275 pts
- HAT 1.5% vs 1.2% (NS)
- HIT (2/1426 vs 3/1058)
- HITT (0/1000 vs 1/900)

Coumadin Dosing
- 5 to 10 mgs for 2 days and then adjust on 3rd day based on INR
- 10 mg for outpts

Thrombolysis
ACCP Guidelines for Rx of VTE, CHEST 2008
- For hemodynamic compromise – Grade 1B
- For Right Heart Strain AND Low Risk Bleeding – Grade 2B

IVC Filters - Use when anticoagulation contraindicated
- 400 pts with DVT compared Filter + Warfarin vs Warfarin alone – no difference!
Outpatient RX

ACCP guidelines 2008
- No published trials have randomized patients with acute PE to Rx in hospital or at home.
- Two randomized trials included patients with acute PE who were treated as outpatients.
  - (Wells, et al Arch Intern Med 2005) 90 of the pts had PE
  - (Kearon JAMA 06) = 52 pts with PE treated entirely as outpatients.
    ▪ VTE (3.5%) and major bleeding (1.4%) among all 142 VTE pts
- Three observational studies of LMWH with 158 patients (35% of total) with PE were treated entirely at home.
  - Good results
- Prediction rules have been developed to aid with selection of patients with acute PE who are suitable for treatment out of hospital.

EurSC guidelines 2008
- Outpatient Rx is “conceivable”

CAREFUL! Risk of recurrent PE was 25 percent if the activated partial thromboplastin time (aPTT) was not therapeutic within the first 24 hours after initiation of heparin in pooled analysis of 3 trials (Hull et al. Arch IM 1997)

APPENDIX – Wells Criteria

3 points
- S/S of DVT (swelling and pain w/ vein palpation)
- Alternative diagnosis less likely than PE

1.5 points
- HR > 100
- Immobilization > 3 d OR surgery < 4 wks
- Prior PE or DVT

1.0 points
- Hemoptysis
- Malignancy (receiving Rx within 6 mos or palliative)

Van Belle Jama 06
- 4 or less (“PE Not Likely”)
  - Safe for d-dimer testing
- 5 or more (“PE Likely”)
  - Not safe for d-dimer testing
REFERENCES

Risk Factors


Clinical Decision Rules


PERC Rule

D-Dimers

Radiation Exposure

PULMONARY EMBOLISM – Diagnosis and Treatment

Jeffrey Tabas MD


Evaluation in Pregnancy


Anticoagulation


Thrombolysis, IVC Filters, and Outpatient Treatment


There are several ways and several described protocols to evaluate and intervene with ED ultrasound in the hypotensive or critically ill patient. By utilizing focused ultrasound can reduce the number of diagnoses that need to be ruled out and reduce the time to diagnosis in patients with cardiac arrest,1 undifferentiated hypotension, 2 or shock.

**RUSH** protocol trying to evaluate -
1. The **PUMP - HEART** - ie the cardiac status (evaluated the pericardium, contractility, & heart strain)
2. The **TANK - IVC & IJ** - how ‘full’ or ‘empty’ is the system; a marker of CVP
3. The **PIPES - AAA & DVT** - evaluate for Abdominal Aortic Aneurysm or Dissection & Deep Venous Thrombosis

---

**Rapid Ultrasound in SHock (RUSH) protocol: ultrasonographic findings seen with classic shock states**

<table>
<thead>
<tr>
<th>RUSH eval</th>
<th>Hypovolemic Shock</th>
<th>Cardiogenic Shock</th>
<th>Obstructive Shock</th>
<th>Distributive Shock</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PUMP</strong></td>
<td>Hypercontractile heart</td>
<td>Hypocontractile heart</td>
<td>Hypercontractile heart</td>
<td>Hypercontractile heart (early sepsis)</td>
</tr>
<tr>
<td></td>
<td>Small chamber size</td>
<td>Dilated heart</td>
<td>Pericardial effusion</td>
<td>Hypercontractile heart (late sepsis)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cardiac tamponade</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>RV strain</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cardiac thrombus</td>
<td></td>
</tr>
<tr>
<td><strong>TANK</strong></td>
<td>Flat IVC</td>
<td>Distended IVC</td>
<td>Distended IVC</td>
<td>Normal or small IVC</td>
</tr>
<tr>
<td></td>
<td>Flat jugular veins</td>
<td>Distended jugular veins</td>
<td>Distended jugular veins</td>
<td>Peritoneal Fluid (sepsis source)</td>
</tr>
<tr>
<td></td>
<td>Peritoneal fluid (fluid loss)</td>
<td>Lung rockets (pulmonary edema)</td>
<td>Absent lung sliding (pneumothorax)</td>
<td>Pleural Fluid (sepsis source)</td>
</tr>
<tr>
<td></td>
<td>Pleural fluid (fluid loss)</td>
<td>Pleural Fluid</td>
<td>Peritoneal Fluid (ascites)</td>
<td></td>
</tr>
<tr>
<td><strong>PIPES</strong></td>
<td>Abdominal aneurysm</td>
<td>Normal</td>
<td>DVT</td>
<td>Normal</td>
</tr>
<tr>
<td></td>
<td>Aortic dissection</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: DVT - deep venous thrombosis; IVC - inferior vena cava; RV - right ventricle

reproduced from Perera et al. Table 1 The RUSH Exam: Rapid Ultrasound in SHock in the Evaluation of the Critically Ill 4
Limited Cardiac Echo to assess cardiac status - Cardiac Views

(A) Parasternal views (long/short axis)

(B) Subxiphoid view

(C) Apical view

The heart portion of the RUSH exam evaluates for -
- Pericardial effusion/tamponade
- Qualitative assessment of left ventricular function
- If effusion/tamponade is identified, can guide pericardiocentesis

Right Ventricular size as an indicator of -
- RV strain in acute PE or
- Right ventricular failure in RV infarction
- Rarely visible clot/thrombus

(C) Apical 4 chamber view demonstrating a thrombus in the right atrium.
The Tank

(A) Inferior vena cava (long axis)

(B) FAST (right upper quadrant, add pleural view)

(C) FAST (left upper quadrant, add pleural view)

(D) FAST = focused assessment of sonography in trauma (pelvis)

(E) Pneumothorax

(A) IVC evaluation under xiphoid, slide 1-2 cm to pt’s R & assess diameter and response to inspiration
- IVC < 1.5 cm complete collapse - low CVP
- IVC > 2.5 cm no collapse - high CVP
- also predicts responsiveness to fluid bolus and need to increase inotropy or decrease afterload

(B, C, D) Imaging for free fluid in the RUQ, LUQ, and pelvic area and including the lung base can provide a clue to many diagnoses including ectopic, ascites, ruptured viscus, ruptured AAA, hemothorax, pleural effusion, etc.

(E) Absence of pleural sliding and comet tail artifact on B mode, and absence of waves on a beach or “Seashore Sign” on M Mode - Indicates the presence of a pneumothorax when scanning in a rib innerspace in the supine patient
**The Pipes**

(A) Suprasternal aorta

(B) Parasternal aorta

(C) Epigastric aorta

(D) Supraumbilical aorta

(E) Femoral deep venous thrombosis

(F) Popliteal deep venous thrombosis

(A,B) Thoracic Aorta - Can be evaluated
- Suprasternal notch - may visualize dilation or flap at the level of the arch
- Parasternal views - can see dilated aortic root above aortic valve OR dilation or flap of descending thoracic aorta posterior to pericardium at level of posterior mitral valve leaflet

(A) Suprasternal aorta with aneurysm & dissection

(C,D) Abdominal Aorta
- Should be rapidly scanned for signs of AAA or dissection from xiphoid to bifurcation at level of umbilicus.
- If the patient is hypotensive and the aorta is > 5cm, assume dx AAA until proven otherwise
- Remember to include walls and thrombus in measurement

8.8 by 8.6 cm Aneurysm
Scott Weingart, et al simplify the approach with the pneumonic HI-MAP and eliminate the DVT scan -

1. **Heart**: Parasternal long and then 4 chamber cardiac views, with the general purpose or cardiac probe
2. **IVC** view with the same probe
3. **Morison’s** - If not already using it, switch to general purpose abdominal probe and scan Morison’s and splenorenal views with thorax images and then examine the bladder window.
4. **Aorta** - Increase your depth and find the aorta above and below the renal artery with four views.
5. **Pneumothorax** - Scan both sides of the chest for pneumothorax. It may be beneficial to switch to a small-parts, high frequency transducer, but the general purpose probe will often supply sufficient views of the pleural interface.

---


INDICATIONS:
• R/O DVT/PE, hypotension

TECHNIQUE:
FEMORAL VIEW
• Select the linear probe
• Position patient with leg externally rotated, knee bent
• Place probe in inguinal fossa in transverse
• Locate vessels – visualize vessels with crisp walls
• Identify femoral vein, femoral artery – maintain light touch
• Attempt to compress vein (without compressing artery)
• Record clip of compression

POPLITEAL VIEW
• Place probe in popliteal fossa
• Locate vessels – visualize vessels with crisp walls
• Identify popliteal vein, popliteal artery – maintain light touch
• Attempt to compress vein (without compressing artery)
• Record clip of compression

TROUBLESHOOTING
• Vascular setting
• Stay in the middle of the leg
• Position the pt prone

IMAGES TO SAVE
• Femoral artery and vein
• Compression of femoral vessels
• Popliteal artery and vein
• Compression of popliteal vessels
Focused Echo

A - PSLV – Parasternal Long
• Select phased array probe
• CARDIAC preset
• PSLV – at level of nipple, marker toward right shoulder, axis should approximate long axis of heart
• Obtain image in which all chambers, valves, are crisp
• Identify pericardium, myocardium, descending aorta behind LA
• Look for effusion – fan through in PSLV

B - PSSV – Parasternal Short
• Rotate probe 90 deg (marker toward right hip)
• Fan through – mediastinum – aorta – mitral valve – papillary muscle – apex
• Look for effusion, function

C - APICAL VIEW
• Identify PMI
• Place probe in transverse plane, indicator to right – 4 chamber apical
• Ventricles in near field, atria in far field
• Look for effusion
• Visualize relative chamber size
• Best for septum

IMAGE IMPROVEMENT:
• Have patient turn onto left lateral decubitus
• It is rare to be able to visualize the heart well through all three windows – however, all three windows should be attempted
• Increase depth, keep angle shallow on SX

PITFALLS:
• Free flowing effusion in supine pt should be dependent
• In parasternal views – dependent pericardium is in far field
• Subxiphoid view – fan posteriorly to obtain dependent view

SAVING IMAGES:
• Save images of heart with crisp chambers and pericardium as sharp as possible
• Try to save PSLV, PSSV, apical 4 chamber, subxiphoid
• Save at least 3 of the above views
• Video is excellent way to demonstrate cardiac views
• Include any additional views showing pathology
**Indications:**
Thoraco-abdominal trauma, hypotension

**Image acquisition:**

**RUQ view**
Curved/phased array probe in coronal plane (start parallel to ground) mid-axillary line, T11 scan through liver to visualize Morison’s pouch hepato-renal interface – is retroperitoneal, operator needs to point posteriorly look for free fluid in Morison’s pouch

**LUQ view**
Same as RUQ, except start more posterior – knuckles to the bed Spleen provides smaller acoustic window Fluid may be found in subdiaphragmatic recess, more dependent

**Pelvic view**
Bladder is usually most anterior structure Free fluid is deep to bladder

In women fluid may also be visible in the pouch of douglas Any free fluid on trans-abd view is pathologic Look in 2 planes

Cardiac – see emergency cardiac ultrasound

**Improving the view:**
When looking at the upper quadrants – turn the probe parallel to ribs to avoid rib shadows Decrease far gain in the pelvic view

**Note:**
In RUQ view, attempt to visualize 1/3 of the diaphragm, and the inferior pole of the kidney Free fluid in LUQ is perisplenic, not limited to spleno-renal space Increase sensitivity with Trendelenburg Repeat scan if patient has new or worrisome complaint, change in vitals

**Pitfalls:**
Each view must be obtained to call the FAST scan negative FAST sensitivity is imperfect – a negative FAST does not rule out free fluid
TROUBLESHOOTING

- If difficult subxiphoid use parasternal approach, left 4-6th parasternal space indicator right shoulder

SUBXIPHOID (OR PARASTERNAL)
- Curvilinear or phased array probe
- Subxiphoid space w/indicator to patient’s RIGHT side, beam to LEFT shoulder
- Look for free fluid in pericardial space

RUQ MORISON’S VIEW
- RIGHT flank mid-axillary line
- Indicator CEPHALAD in coronal plane
- Visualize diaphragm, liver, kidney and the potential spaces between, above, & below each

LUQ SPLENORENAL VIEW
- LEFT flank, posterior axillary line
- Indicator CEPHALAD in coronal plane
- Visualize diaphragm, spleen, kidney and sweep for all potential spaces

PELVIS VIEWS
SAGITTAL
- Transducer above pubic symphysis
- Indicator CEPHALAD in sagittal plane
- Sweep through bladder side-to-side

TRANSVERSE
- Rotate probe 90° to patient’s RIGHT
- Sweep through bladder from inferior to superior to visualize free fluid adjacent

TROUBLESHOOTING
- If difficult subxiphoid use parasternal approach, left 4-6th parasternal space indicator right shoulder
INDICATIONS
• Suspected pneumothorax
• Chest trauma, pleuritic chest pain, hypoxia

THORACIC SAGITTAL
• Linear Probe on Small Parts setting
• Probe on upper chest, mid-clavicular line, 2-3rd rib space, indicator to HEAD
• Center image between 2 ribs
• Identify pleural line and presence or absence of pleural sliding
  • Obvious sliding of pleural surfaces
  • Comet tail artifacts
• Scan in multiple rib spaces down chest
• Compare to opposite/normal side

COLOR POWER DOPPLER
• Select CPD mode & place box over pleural interface
• Color motion artifact should appear below the pleural line in normal lung

M-MODE
• Select M-Mode from the scan modes
• Drag cursor between ribs over pleural line
• Push Update or M-Mode again
• Near field should remain still/laminar & far field should appear like ‘sand on a beach’ straddling pleural line

IMAGES TO SAVE
• Video clip of lung sliding and comet tails if present
• Still or clip of Color Power Doppler slide if performed
• M-Mode image still showing ‘sand on a beach’ or absence thereof
• Any additional views demonstrating pathology
INDICATIONS
• Suspected AAA
• Presence of syncope, shock, hypotension, abdominal pain, abdominal mass, flank pain or back pain

IMPORTANT FACTS
• Aorta diameter >3cm or 1.5x proximal Ao diameter + study
• Consult surgery for stable AAA >4cm or >2x proximal aortic diameter
• Ultrasound Sensitivity 97-100%
• 90% AAA Infrarenal

ANATOMY
• Scan from diaphragmatic hiatus to bifurcation near umbilicus
• Celiac branches of as a Y anteriorly in the subxiphoid space = ‘seagull sign’
• SMA branches anteriorly 1cm below & runs caudal parallel to Aorta (Proximal Ao should be measured at this point)
• Renal arteries branch laterally 1cm below SMA

• 40% AAA’s extend to iliacs
• Fusiform AAA’s >> Saccular

DOCUMENTATION & INTERPRETATION
• Enter patient & operator data on Ultrasound Machine
• Perform exam and save appropriate images

• Document Indication for procedure (i.e. abd pain)
• AAA Yes or No? > or < 3cm?
• Evidence of Rupture?
• Document Limitations

If exam positive:
• Measure AAA
• Determine position with respect to SMA/renals
• Perform F.A.S.T.
TROUBLE SHOOTING

- Inability to visualize or partial view:
  - Adjust depth – the aorta becomes more superficial as it travels distally
  - Use vertebrae as marker
  - Gentle/firm pressure to displace bowel gas

- Rock the probe without sliding from the view you are able to obtain
- Use liver or spleen as an acoustic window in midaxillary line
- More accurate to measure in transverse view
- Patience!

TRANSVERSE VIEW

- Start in epigastrum in subxiphoid space
- Probe indicator to patient's RIGHT
- Identify vertebral shadow in far field
- Optimize depth setting
- Aorta is anterior and LEFT of spine
- IVC is RIGHT (patient’s left)
- Scan from Celiac through the bifurcation

SAGITTAL VIEW

- Probe indicator to patient’s HEAD
- Identify vertebral shadow posterior, SMA anterior to pulsatile Aorta
- Scan through length of Aorta

IMAGES TO SAVE

- Transverse view suprarenal - at or above SMA takeoff - with measurement of aortic diameter
- Measure Aortic diameter OUTSIDE wall to OUTSIDE wall
- Transverse view at or above the bifurcation with measurement of aortic diameter
- Transverse view with measurement at maximal Aortic diameter
- Sagittal/Longitudinal view(s) from celiac to bifurcation
- If AAA identified perform F.A.S.T.
- Any Additional views showing pathology
INDICATIONS:
• R/O DVT/PE, hypotension

TECHNIQUE:
FEMORAL VIEW
• Select the linear probe
• Position patient with leg externally rotated, knee bent
• Place probe in inguinal fossa in transverse
• Locate vessels – visualize vessels with crisp walls
• Identify femoral vein, femoral artery – maintain light touch
• Attempt to compress vein (without compressing artery)
• Record clip of compression

POPLITEAL VIEW
• Place probe in popliteal fossa
• Locate vessels – visualize vessels with crisp walls
• Identify popliteal vein, popliteal artery – maintain light touch
• Attempt to compress vein (without compressing artery)
• Record clip of compression

TROUBLESHOOTING
• Vascular setting
• Stay in the middle of the leg
• Position the pt prone

IMAGES TO SAVE
• Femoral artery and vein
• Compression of femoral vessels
• Popliteal artery and vein
• Compression of popliteal vessels
The High Risk Airway

Robert J. Vissers, MD  HREM Conference 2011

Objectives:
1. Develop an approach to high risk airway management
2. Introduce devices and techniques for high risk airways
3. Apply to specific challenging airway cases

Decision to Intubate
- Avoid the reflex intubation
- Assess the clinical context of the decision
- Modified by operator experience, setting and potential for a difficult airway
- Specific high-risk considerations – time, difficulty and physiologic challenges

Airway Algorithms
- On occasion surgical airway is the first step, and is always a potential endpoint
- Must assessment potential for difficult ventilation, intubation or rescue
- Awake look vs. RSI in difficult trauma airways (Preservation or loss of spontaneous respirations)
- Sometimes airway comes second – PTX, Cardiac Arrest, Shock
- Calling for help early when need anticipated
- Make a plan and share it with the team
- Use a checklist

**Plan for the worst-case scenario**
**Never take away what you cannot replace**

Assessment of Airway difficulty
- Consider potential difficulty of BVM ventilation, intubation and rescue before proceeding with RSI
- Five predictors found predictive of difficult BVM: facial hair, obesity, adentulous, elderly, snoring (MOANS mnemonic)
- LEMON assessment of intubation difficulty has been validated as predictive
- Need to consider what rescue device might be needed and assess if it may be difficult

What is the indication?
1. Airway maintenance
2. Oxygenation
3. Ventilation
4. Facilitate therapy
5. Expected course

M Mask seal
O Obesity
A Aged
N No teeth
S Snores or Stiff *
LEMON LAW to predict difficult laryngoscopy *

<table>
<thead>
<tr>
<th>Look externally</th>
<th>Look for external features predictive of airway difficulty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluate 3-3-2 (airway geometry)</td>
<td>The oral opening, the mentum to hyoid distance, and the mandible to thyroid cartilage distance are measured in fingerbreadths. Reduced distance may suggest difficulty aligning the oral, pharyngeal and laryngeal axes.</td>
</tr>
<tr>
<td>Mallampati score assessment</td>
<td>The degree of posterior pharynx visualized is associated with visualization of the vocal cords during laryngoscopy.</td>
</tr>
<tr>
<td>Obstruction and obesity assessment</td>
<td>Identification of where the obstruction is, and how quickly it is progressing will guide the management.</td>
</tr>
<tr>
<td>Neck mobility</td>
<td>Inability to flex or extend the neck could restrict visualization and the ability to reposition during bag mask ventilation or laryngoscopy.</td>
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</tbody>
</table>


High-Risk Airway: Making a Plan

- Assess, make a plan, prepare the rescue and the team

Two questions:
1. TIME: Is oxygenation adequate?
2. DIFFICULTY: Is the anatomy normal or disrupted?


Difficult Airway Techniques

I. Bag Mask Ventilation
   - Very technique dependent
   - Initial rescue of choice in most cases
   - Remember oral airways, positioning

TIP: The answer to difficult bagging – is almost always, better bagging

II. Laryngoscopy
   - Try something different between each attempt
   - Remember positioning, assistance, and BURP
   - Cricoid pressure can interfere with intubation

Remove the anterior c-collar during intubation, while maintaining immobilization of the c-spine
and BMV

III. **Awake look**
- Assess airway difficulty more accurately
- Can use with laryngoscope, video-laryngoscopy, fiberoptics
- May intubate without loss of respirations

IV. **Video laryngoscopy**
  a. Glidescope
  b. C-mac
  c. McGrath

V. **Extra-glottic Rescue Devices**
  a. Intubating LMA
  b. King-LT
  c. Combitube

VI. **Flexible fiberoptics**
- Requires time to set up
- Higher level of skill
- Can be obscured by blood

VII. **Surgical Airway**
- Cricothyrotomy, seldinger wire or open

**Awake Look Technique**
- Antisyalogogue – atropine or glycopyrrolate
- Anesthesia – lidocaine (2-4%), benzocaine
- Decongestant – oxymetazoline (afrin)
- Nebulize, atomize (MADgic®), viscous
- Sedation – ketamine, versed

**Clinical Issues**

- **Obstruction**
  - Where is the location of the obstruction?
  - Is the obstruction fixed (arterial hematoma) or mobile (tissue flap, mandibular fracture)?
  - How rapidly is the obstruction progressing?

- **Asthma**: Pre-oxygenation critical, don’t forget fluids
- Your first shot – your best shot!
- Post intubation management - permissive hypercapnia
- **Head Injury**: Shock should be avoided at all costs
- Pre-medication is **controversial**
- Etomidate drug of choice, ketamine if shock
- **Penetrating Neck Trauma**: Intubate early before the patient prominent symptoms
- Consider awake technique if a difficult airway is anticipated
- **Burns**: Pulse ox may overestimate oxygenation due to carboxyhemoglobin

Upper airway obstruction in burns progresses for 12 to 24 hours – intubate early!

- **Septic Shock**: NS boluses may be your best premedication
- Assess and optimize hemodynamics before intubation if possible
- Critical to ventilate appropriately – avoid exacerbation of acidosis

Brain Injury: Single episode of hypoxia or hypotension increases mortality 150%
Local infiltration
Less painful:
- Small needle
- Slow injection
- Inject on withdrawal
- Inject through wound edge, not skin
- Distraction
- Proximal first
- Buffer with 10% Na Bicarb

Flexor Tendon Sheath Digital Block
Advantages:
- Single injection
- Small amount
- Rapid onset
- High success rate

Technique:
- Hand supinated
- Flexor tendon is located
- Needle inserted at distal palmar crease
- Attach syringe, inject 2-4 ml of local anesthetic
- Resistance suggests needle tip is against the flexor tendon - careful withdrawal


Hand blocks

Ulnar Nerve Block:
- Under the tendon of the flexor carpi ulnaris
- Above the styloid process of the ulna
- Advance 5-10 mm
- Also inject above tendon

Median Nerve Block:
- Proximal volar crease of the wrist
- Between palmaris longus and flexor carpi radialis tendons
- Less than 1 cm deep, below flexor retinaculum
- About 5 cc

I'm allergic to that stuff…
Rare – usually Esters (procaine, tetracaine) or preservative
- Use single-use lido
- 1% diphenhydramine (Benadryl) is as effective as 1% lidocaine - Need to dilute!
Ultrasound guided regional blocks
- Most nerves can be seen, “honeycomb” appearance
- Short axis preferred – can confirm by following nerve
- Needle visibility determined by angle and gage
- See better with “test” injection
- Can place needle “Out-of-Plane” or “In-Plane”

- 22 blocks on 11 patients after 1 hour of training
- All successful, no rescue needed


Femoral nerve block/ 3-in-1
- 3-in-1 femoral nerve block
- Femoral nerve, obturator nerve, lateral cutaneous nerve
- Commonly used post hip surgery, proximal femur fractures
- Innervates the anterior thigh, the periosteum of the femur, hip joint capsule and the knee joint
- Use high volume, about 30 mL
- Apply pressure distally or 5 min
- 15 minutes to full effect

Femoral nerve block
- 50 patients with fractured neck of femur
- Randomized morphine IV vs. 3-in-1 block
- Performed by ED staff after training
- Pain improved twice as fast
- Required half the morphine
- No adverse events

Infraorbital block
- Identify the infraorbital foramen
- Palpated 1 cm inferior to the midpoint of the lower margin of the orbit
- Position finger over the infraorbital foramen
- Direct needle through the mucosa of the upper gum opposite, parallel to the long axis of the upper premolar tooth
- Advanced until palpated near the infraorbital foramen
- Aspirate, then instil 2 to 3 mLs of lidocaine 1%

Direct infiltration of the tongue is painful and ineffective
- Lingual nerve innervates anterior two-thirds of the tongue, floor of the mouth and gums
- Can be blocked with alveolar block
- Or, lingual nerve can be anesthetized by injecting 2 to 3 mLs into the lateral floor of the mouth adjacent to the premolar teeth.
**Lingual/Alveolar block**
- Intraorally identify the vertical ridge of anterior border of the ramus of the mandible by palpation
- Insert needle medial to ridge, 1 cm above the third molar tooth
- Advanced along the medial side of the ramus to 2 cm - bone must be felt with the needle
- Withdraw slightly and inject 1-2 cc

**Intraarticular shoulder anesthesia**
- 20 cc of 1% lidocaine using an 18 gauge needle
- 2 cm below the lateral edge of the acromion
- Directed towards the glenoid fossa
- Fifteen minutes to maximize the analgesic effect


**Hematoma block**
- For isolated closed fracture reduction
- Hematoma is aspirated
- Lidocaine 1% is infiltrated (3 to 10 mL) into fracture cavity and periosteum
- Effective within 5 to 10 min - several hours duration

**Hematoma vs. Biers Block**
- 142 colles' randomised to hematoma block or bier's block
- Bier's block less painful
- Less pain and better result with less manipulations under bier's block
- Same length of stay times

**Intravenous regional anesthesia**
- Intravenous local anesthetic distal to an inflated pneumatic tourniquet
- Useful for: fracture reductions, large laceration repairs, foreign body removal
- Duration of regional anesthesia 30 to 60 min
Low Back Pain
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Acute Low Back Pain (LBP):
- **Definition**: Back pain for < 6 weeks
- 70-90% have pain resolution within 6 weeks

“Red flag” conditions (Agency for Healthcare Research and Quality guidelines, 1999)
1. Fracture
2. Cauda equina syndrome
3. Spinal infection
4. Vertebral malignancy

Benign acute conditions
1. **Intervertebral disk herniation**
   - Herniation of the nucleus pulposus through the annulus fibrosis into the spinal canal, most frequently posterolaterally to compress a peripheral nerve root
   - **Age predominance**: 30-50’s
     ✓ 3rd decade: Disk starts to dessicate and degenerate— higher risk for herniation
     ✓ 6th decade: Disk shrinks—lower risk for herniation
   - **Symptoms**:
     ✓ Lower extremity pain severity often overshadows back pain
     ✓ Worse with sitting and Valsalva (sneezing, laughing, coughing)
   - **Lower Lumbar Disk Herniation (L4-L5, L5-S1)**:
     ✓ Accounts for 95% of all disk herniations
     ✓ Often associated with an L5 or S1 radiculopathy (sciatica)
   - **Complications**: Massive central disk herniation can cause cord compression or cauda equina syndrome
   - **Natural course of symptoms**: Self-resolution after 4-6 weeks with non-operative management usually

2. **Musculoskeletal back pain**
   - Back pain with possible radiation to buttocks (but no radiation beyond knee)
   - A diagnosis of exclusion, once more concerning causes of thoracolumbar pain ruled-out

The History

<table>
<thead>
<tr>
<th>Thoracolumbar Pathology</th>
<th>Historical Clues</th>
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<tbody>
<tr>
<td>Herniated disk</td>
<td>Back pain radiates down the legs, past the knees</td>
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<tr>
<td>Spinal stenosis</td>
<td>Pain worse with walking and better with bending forward</td>
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<tr>
<td>Ankylosing spondylitis</td>
<td>Morning back stiffness which improves with exercise</td>
</tr>
<tr>
<td>Fracture</td>
<td>History of blunt trauma</td>
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<td></td>
<td>Risk: age &gt; 50 yrs old, chronic steroid use</td>
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<tr>
<td>Spinal infection</td>
<td>FEVERS, CHILLS</td>
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<td></td>
<td>Back pain persistent at rest</td>
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<tr>
<td></td>
<td>Back pain worse at night</td>
</tr>
<tr>
<td></td>
<td>Risk: age &gt; 50 yrs old, chronic steroid use, immunocompromised, IVDU</td>
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<tr>
<td>Vertebral malignancy</td>
<td>Persistent back pain &gt; 6 weeks duration</td>
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<tr>
<td></td>
<td>Back pain worse at night</td>
</tr>
<tr>
<td></td>
<td>Unexplained weight loss</td>
</tr>
<tr>
<td></td>
<td>Risk: age &gt; 50 yrs old, history of malignancy</td>
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<tr>
<td>Cauda equina syndrome</td>
<td>Bilateral leg pain, numbness, or weakness</td>
</tr>
<tr>
<td></td>
<td>Bowel or bladder changes</td>
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</tbody>
</table>
The Physical Exam

Abdomen: Palpate for pulsatile mass and tenderness

Back:
- Palpate for tenderness midline and paraspinous
- Percussion-induced back pain suggests spinal infection or malignancy

Straight-Leg Raise (SLR) Manuevers:
- Stretches sciatic nerve when elevate supine patient’s extended leg
- Radiation of pain distal to knee suggests radiculopathy
- Sensitivity = 80%, specificity = 40%
- More specific test for L5-S1 radiculopathy (sciatica) is crossed-SLR test, where pain radiates down affected leg when contralateral leg is raised (sensitivity 25%, specificity 90%)
- An L5-S1 radiculopathy is 95% sensitive for lumbar disk herniation (thus, the absence of radiculopathy almost rules-out a herniated disk)
- Reverse SLR: Stretches L3 and L4 nerves by elevating PRONE patient’s extended leg

Neurologic:
- Sensory, motor, reflexes, gait

Rectal exam: For patients exhibiting severe back pain, bilateral leg symptoms, or bowel/bladder changes (to check for decreased tone, as found in cord compression and cauda equina syndrome)

Vascular:
- Check pedal pulses to help distinguish vascular claudication versus spinal stenosis pseudoclaudication
- A decreased pulse is worrisome for acute limb ischemia (thromboembolic disease, AAA, aortic dissection)

Imaging: Plain Radiograph

Plain radiographs should be obtained if concerned of one of the “red flag” diagnoses

RED FLAG #1: Thoracolumbar Fracture

- 90% of all thoracolumbar fractures occur in T12-L4 region, because of change of spinal curvature and more mobility than thoracic spine
- Incidence of spinal cord compression if fracture in T12-L2 region = 40%
- Incidence of non-contiguous fractures = 10.5% (Vaccaro et al, 1992)
- Incidence of concurrent intra-abdominal injury = 30%

Spine biomechanics: Three-column Denis model —— >
- Anterior Column: anterior 2/3 vertebral body, anterior longitudinal ligament
- Middle Column: posterior 1/3 vertebral body, posterior longitudinal ligament
- Posterior Column: posterior neural arch (pedicles, laminae, facets, transverse processes, spinous process), supraspinous/ interspinous ligaments, ligamentum flavum

Classic Fracture Patterns:
1. Wedge fracture
   - Mechanism: Spinal flexion and axial loading, yielding a compressive fracture of anterior column only
   - Radiograph:
     ✅ Described as % anterior height loss as compared to posterior vertebral body height
     ✅ Intact posterior vertebral line (otherwise a burst fracture)
   - Controversy: A plain film poorly differentiates a wedge fracture from a burst fracture.
14-22% of burst fractures appear as wedge fractures on x-ray (Ballock et al., 1992; Dai et al., 2004). Thus, have a low threshold to obtain a spinal CT to confirm an intact middle column.

2. Burst fracture
   - **Mechanism:** Spinal flexion and axial loading, yielding a compressive fracture of anterior and posterior vertebral body (compromised anterior and middle columns)
   - **Incidence of neurological deficit:** 65%

3. Chance fracture (“Seatbelt fracture”)
   - **Mechanism:** Distraction injury, yielding fractures through posterior → middle → anterior columns
   - **Incidence of concurrent intra-abdominal injury:** as high as 50% (pancreas, duodenum, mesentery)

4. Transverse process fracture
   - Comprises 15% of all thoracolumbar fractures
   - **Incidence of concurrent intra-abdominal injury:** 21%
   - **Incidence of concurrent pelvic fractures:** 29% (especially with L5 transverse process fracture)

**RED FLAG #2: Cauda Equina Syndrome**

A neurosurgical emergency from compression of multiple lumbar and sacral nerve roots in the cauda equina

**Etiology:** Massive central disk herniation >> epidural abscess, hematomata, trauma, malignancy, spinal surgery

**Importance of Timely Diagnosis:**
   - Equivocal literature, but likely greater chance of irreversible neurological damage if surgery occurs >48 hours after onset of symptoms. (Ahn et al., 2000; Shapiro, 2000)

**Presentation:** (Deyo et al., 1992)
   - Severe back pain
   - Bilateral lower extremity pain, radiculopathy, and diminished lower extremity reflexes
   - Saddle anesthesia (sensitivity 75%)
   - Decreased rectal tone (sensitivity 60-80%)
   - **Urinary retention**
     - Most consistent exam finding with sensitivity 90%, using post-void residual >100-200 cc
     - Rough bladder volume calculation using ultrasound:
       - **Volume (mL) = 0.52 x height x width x depth. Measurements in cm.**
   - Patients often do not notice urinary retention, but remark on urinary incontinence (from overflow)

**Plain radiographs:** Normal

**RED FLAG #3: Spinal Infection (Spinal Epidural Abscess)**

Classic triad of findings: Back pain, fever, and neurologic deficits

**Spinal epidural abscess (SEA):**
   - **Classic triad:** Back pain, fever, and neurological deficits found in only 15% patients (Davis et al., 2004)
   - **Difficult to diagnose:**
     - 75-89% have delayed diagnosis, defined as multiple ED visits prior, admission without a diagnosis of SEA, or >24 hrs to definitive study (Davis et al., 2004; Tang et al., 2002)
   - **Risk factors:** IV drug use, diabetes mellitus, trauma, alcoholism, immunocompromised status (HIV, chronic renal failure, chronic corticosteroid use), elderly, recent back trauma (includes iatrogenic epidural anesthesia needle puncture), indwelling catheter, recent bacterial infection
     - Reihaus et al., 2000: A meta-analysis review of 915 SEA patients showed that 3-20% of patients have zero risk factors
     - Davis et al., 2004: Need to obtain 49 negative MRI’s to pick up one positive MRI for patients with at least one risk factor PLUS back pain
   - **Exam:**
     - Fever in only 50-67% of patients
     - Neurologic exam can range from normal (grade 1), radiculopathy (grade 2), sensory or motor deficit (grade 3), or paralysis (grade 4)
Laboratory tests:
- Average ESR = 77-87 mm/hr
- Sensitivity of ESR >30 is 81% (Sidman et al., 2002)
- Sensitivity of ESR >20 is 98% (Davis et al., 2004)
- ESR is more sensitive and specific than serum WBC result
- Poor prognostic indicators: Thrombocytopenia<100K, ESR>110, abscess in cervical spine (Tang et al., 2002)
- Blood cultures: Organism is Staphylococcus aureus (90%) >> streptococcus, enteric GNR

Plain radiograph:
- Only 25% do have associated spondylitis—otherwise normal films

MRI: Definitive diagnostic imaging

RED FLAG #4: Vertebral Malignancy

Etiology:
- Metastatic disease 25x more likely than primary malignancy (eg. multiple myeloma)
- 60-70% of all vertebral metastases occur in the thoracic spine
- Most common metastatic malignancy: Prostate, Breast, Kidney, Thyroid, Lung, Lymphoma ("Lead kettle" mnemonic = PB KTLL)

Classic symptoms: Pain worse at night and at rest

Plain radiograph:
- Classic findings: Blastic or lytic lesions in vertebral body or pedicle ("winking owl" sign), sparing the intervertebral disk
- Note: Radiographic evidence of bony erosion requires >50% of vertebral bone loss. There is a false negative rate of 10-17% in detection of vertebral bony metastasis.

Laboratory:
- The ESR can help risk-stratify a patient with concerning risk factors for a malignancy, especially if very high (>100 mm/hr)

MRI:
- Expediency of ordering MRI based on risk of spinal cord compression

References

Tang HJ, Lin HJ, Liu YC, Li CM: Spinal epidural abscess—experience with 46 patients and evaluation of prognostic factors, J
Tricks of the Trade in Emergency Medicine

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Cases

• Wound care
• Tissue adhesives
• Pediatric pearls
• Can’t afford my meds
• Orthopedics
• Endotracheal intubation
• Ocular injury
• Peritonsillar abscess
• Vascular access
• Back pain
• Odors in the ED

Case 1: Scalp Laceration

6 y/o frightened boy presents with a scalp laceration after falling against a table corner edge.

How do you measure the length of the wound?

Trick: Use your “handy ruler” or stethoscope.

How do you minimize missing a 2nd laceration?

Trick: Good lighting is the key!
  1. LED flashlight
  2. Manual palpation of the scalp

How would you close the scalp laceration?

Trick #1. Pediatric scalp laceration: 2 staple guns
Trick #2: Hair Apposition Technique: Modified HAT trick

Case 2: Tissue Adhesives

How could you safely close the wound with a tissue adhesive?

Trick: Tegaderm with cut-out hole in center

What are other uses for tissue adhesives?

1. In combination with steristrip tapes, closure of wounds under slight tension.
2. In combination with absorbable sutures, closure of wounds under slight tension

What if the skin is really thin and fragile?

Trick: Use steristrips to “strengthen” wound edges in combination with sutures.

Case 3: Pediatric Pearls

A 5 y/o boy presents with a Salter-Harris I distal radius fracture after falling from the monkey bars.

What do you do for pain control?

Trick: Intranasal fentanyl 1.5 mcg/kg IN. May repeat 0.5-1.5 mcg/kg in 5 minutes

The patient’s mother mentions that his asthma has been acting up for the past 2 days.
You might hear wheezing. The patient is only partly cooperative with your exam.

How can you get a better exam?

Trick: Candle flame app

Case 4: I can’t afford my medications.

A homeless 35 y/o woman presents with a pyelonephritis, but can’t afford the ciprofloxacin prescription.

Trick: Generic Medication List www.genericmedlist.com
Case 5: Hand & Wrist Injury

30 y/o pedestrian vs auto presents with multiple abrasions and...
1. Gravel embedded in left palm
2. Right pinky finger laceration
3. Right 2nd metacarpal fracture
4. Left distal radius fracture

How would you anesthetize the left palm for copious irrigation and gravel removal?
**Trick:** Forearm Ultrasound-guided Nerve (FUN) block
* U/S-guided nerve block of radial, ulnar, and median N
* Inject at level of the mid-forearm
* Nerves = hyperechoic

How would you stop the constant oozing of the right pinky finger for suturing?
**Trick:** Hemostasis in finger lacerations: Make a glove “ring”.

How would you bandage the finger laceration?
**Trick:** “The Digi-Spec” • Wrap tubular gauze around finger using a pelvic speculum
* Be careful not to wrap too tightly because of digital necrosis.

How would you splint the 2nd metacarpal fracture?
**Trick:** Radial gutter splint

How would you splint the distal radius fracture?
**Trick:** Reverse sugar tong splint

Case 6: Endotracheal Intubation

45 y/o morbidly obese, edentulous woman arrives by ambulance for severe asthma requiring intubation.

Maximize oxygenation in your bag valve mask technique for someone with no teeth.
**Trick:** Lower lip mask repositioning technique

How can you maximize your chances for a successful intubation?
**Trick:** Hold laryngoscope handle as close to blade as possible to maximize lifting force
**Trick:** Use the bimanual laryngoscopy maneuver to optimize view of vocal cords

Case 7: Ocular Injury

50 y/o man s/p altercation presents with eye pain from pepper spray by the police. The patient is extremely sensitive to application of anesthetic eyedrops. How can you apply them more gently?
**Trick:** “Blink it in”
* Apply drops into medial canthus.
* Have patient then “blink” the drops in.

Now that he can open his eyes, let’s check his visual acuity.
**Trick:** Free iPhone app “EyeChart”

The patient had taken out his contacts because of eye pain. His visual acuity is 20/200 in both eyes. How can we determine if his blurred vision is the result of the pepper spray?
**Trick:** Pinhole correction using thick paper and holes made by needles

You try to apply Morgan lens for ocular irrigation, but the patient pulls them out. How can you irrigate the eyes?
**Trick:** Nasal cannula irrigation
**Trick:** Add 10 mL of 1% lidocaine into 1 liter of saline bag

After irrigation, soft tissue swelling of the eyelid makes it difficult to get an unobstructed view. You do not have an
eyelid retractor. How do you retract the eyelids?

- **Trick:** Paperclip eyelid retraction
- **Trick:** “Roll up” the upper eyelid with Q-tip
- **Trick:** Use benzoin to help retract the upper eyelid.

How can we check for pupillary constriction WITHOUT opening the eyelids?

- **Trick:** Ultrasound using a linear transducer

---

**Case 8: Peritonsillar Abscess**

23 y/o male presents with a sore throat and left-sided peritonsillar swelling.

How would you visualize the abscess during needle aspiration?

- **Trick:** Use a laryngoscope with a Macintosh (curved) blade. If cooperative, have patient retract inferiorly.

How would you perform the needle aspiration?

- **Trick:** Use a spinal needle with the sheath trimmed such that 1.5 cm of the needle is exposed.

---

**Case 9: Vascular Access**

80 y/o woman presents in PEA arrest and the nurses are unable to establish vascular access. You begin prepping for a femoral line.

With no palpable femoral artery pulse, how do you best locate the femoral vein for a central line?

- **Trick:** V-Technique - Use external landmarks where femoral vein is at “V” (1st webspace) of hand

Update: You successfully place the femoral central line! The patient is stabilized. You decide to change the line over to a subclavian central line. Fact: Most common malpositioning of subclavian catheter is into ipsilateral IJ vein (up to 10% of time)

How can you minimize the chances of your subclavian line tip ending up in the ipsilateral IJ vein?

- **Trick:** “Finger in Fossa” : Occlusion of IJ with finger during guidewire part of procedure.

You unfortunately forgot to occlude the IJ vein and now you have to re-wire the line. How can you easily re-feed the curved wire into the catheter hub?

- **Trick:** Stretch guidewire just proximal to curvature to straighten inner wire (which maintains the curvature)

---

**Case 10: Back Pain**

A 30 y/o woman BIBA for bizarre behavior at a storefront. She arrives agitated and yelling, requiring several officers to keep her on the gurney. She has dilated pupils (7 mm), a heart rate of 140 bpm, and a history of cocaine and IV heroin use. You decide to chemically sedate her for everyone’s safety.

What IM chemical agent(s) do you use?

- **Trick:** Midazolam: Most consistently IM-absorbed benzodiazepine - Quicker on / off than lorazepam IM or haloperidol IM

<table>
<thead>
<tr>
<th>Chemical Agent</th>
<th>Time to onset</th>
<th>Time to arousal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lorazepam (2 mg IM)</td>
<td>32.2 min</td>
<td>217.2 min</td>
</tr>
<tr>
<td>Haloperidol (5 mg IM)</td>
<td>28.3 min</td>
<td>126.5 min</td>
</tr>
<tr>
<td>Midazolam (5 mg IM)</td>
<td><strong>18.3 min</strong></td>
<td><strong>81.9 min</strong></td>
</tr>
</tbody>
</table>

Patient update: She awakes and wants her LBP x 2 wks evaluated. She has tenderness all along T and L spine. She then curls up into a fetal position and refuses to answer any further questions.

What maneuvers could reduce your suspicion for a red-flag back pain diagnosis? GREEN FLAGS.

- **Waddell sign #1**: Axial loading of scalp
  - With patient in an upright position, apply downwards pressure on top of head.
  - Patient should NOT experience LBP.

- **Waddell sign #2**: Distracted SLR Maneuver

- **Hoover Test**: Suboptimal effort in hip flexion strength test

- **Visual miscues in hand sensory exam**

What maneuvers could RAISE your suspicion for a red-flag back pain diagnosis -- spinal epidural abscess?

- **Spinal percussion tenderness**

### Case 11: Odors in the ED

A 40 y/o homeless man is BIBA for being “found down”. His feet exude a malodorous smell throughout the ED. You also notice a large thigh abscess.

“**Toxic Sock Syndrome**”: Trapped perspiration/bacteria within socks + poor foot hygiene. In a moist, warm environment, bacteria proliferate and produce foul-smelling isovaleric acid. How do you minimize the smell of “toxic sock syndrome”?

- **Trick**: Antacid booties:  
  - The alkaline antacid solution neutralizes the acidic environment and thus reduces the odor.

How do you minimize the smell of pus during the I&D?

- **Trick**: Suction the pus directly into closed canister.

Additional weekly “Tricks of the Trade” at: [http://AcademicLifeinEM.blogspot.com](http://AcademicLifeinEM.blogspot.com)
Communication is Crucial
Let the patient talk
Let the family talk
Best to use a medical translator
Be wary of family, especially in socially sensitive situations

Template Charts
Place check marks and circles carefully
Write or dictate your medical decision making if at all important
Explain WHY you sent that chest pain patient home

Electronic Charts
Beware of template phrasing which does not apply to your patient
Try to spend at least some time with your patient –
assuming the computer will permit such frivolous activity…

Prior Medical Records
Read them!
Quickly scan the relevant prior records

Paramedic and Nursing Notes
Read them! Even though they’re not written for you…
Beware of notes written after the patient has left
or after you’ve completed your note

Death Ray
Don’t forget your patient in Radiology
Send a nurse and a monitor if unstable

After-Care Instructions
Make sure the patient understands
Beware of language difficulties
Explain verbally – don’t rely on the nurse
Document in writing – both for the patient and in the chart
Leaving Against Medical Advice
The patient must be mentally competent
Potential consequences should be explained
Option of returning should be offered
Appropriate follow-up instructions should be given
Document all of this!

Temporary Admission Orders
Be sure you, the admitting doc, and the nurses all agree
Who’s in charge?
What is the lifespan of your orders?
When will the admitting doc see the patient?
Who should be called for any problems?

EMTALA (COBRA)
Screening exam can be done by a nurse per hospital protocol
Discharge counts, not just transfer
Stable patients may be transferred for economic reasons
Unstable patients may be transferred for medical reasons
Appropriate records must accompany the patient
A violation may be found without malpractice or a bad result
If you have to transfer against your will, document why (and who)

Follow-up of Lab & X-ray Results
Have a formal protocol
Document actions

Change of Shift
Both docs are responsible
Don’t rely on the other doc
Re-evaluate if conditions change

Return Visits
Reconsider all prior assumptions

Medical Clearance for Psych
Is there cognitive dysfunction?
Level of consciousness, orientation, attention, memory, fund of information
Sample wording:
“At this time there is no evidence of a non-behavioral medical emergency that would preclude transfer of care to the psychiatric service (or to another facility) for further psychiatric as well as medical evaluation.”
Chest Pain
Cardiac or non-cardiac?
Aortic dissection, esophageal spasm/esophagitis, pulmonary embolus, et al.
If cardiac, MI or UA?
Remember – cardiac pain can be burning, epigastric, or pleuritic
If pleuritic, is there pain between breaths as well?
Beware of GI cocktail
Beware of chest wall tenderness
Both patient and family must understand that we cannot absolutely rule out cardiac pain – Document

Abdominal Pain
Can always be early appy – or anything else!
If discharged, make sure patient and family understand that a serious condition may not be apparent now but may develop over time – Document
Appendicitis can cause pyuria
AAA can cause hematuria
Abdominal pain out of proportion to exam, especially in the elderly - Think mesenteric ischemia

Back Pain
Ask re bowel and bladder
Thoracic - epidural abscess?
Needle user – epidural abscess?
Elderly – AAA?

Headache
Sudden onset & worst headache of life – think SAH
CT can miss SAH. LP if possible SAH
?? CTA

Drug Users
May actually be sick too
May have need for higher analgesic dose
Beware of epidural abscess

Hostile Patients
Document their exact words in quotes

Endotracheal Intubation
Confirm and Document as much confirmatory evidence as possible
  - Symmetric breath sounds
  - No gastric sounds
  - Vapor in tube
  - Good compliance with bagging
  - Oxygen saturation
  - CO2 colorimeter or capnometry
Make sure the tube is secured – usually RT’s job, but best to confirm
Some Additional Points Regarding Charting

Be Truthful
Don’t claim you’ve done things you haven’t (eg. cranial nerves II-XII…)

The Most Important Goal of Charting - TELL THE STORY!

Anyone reading your chart years from now should be able to “see the movie” of what happened

Anything you would want your defense attorney – and jury! – to know, should be apparent in your chart.

This also applies to potential plaintiff’s attorney and prospective plaintiff’s expert witness. Most potential lawsuits are aborted based on the medical record – without the doctor ever knowing there was a possible suit

A Few Final Thoughts

The Best Way to Avoid Litigation
Good care
Good communication
Good documentation

If (When!) You are Sued – Remember:
You are not alone
Don’t let it ruin your life – or your marriage
Get counseling if appropriate
It doesn’t mean you’re a bad doc or a bad person
We all make mistakes
We all are treated unfairly at times

Life does go on!
**Some Suggested Readings**


ACEP website for medical-legal practice resources
http://acep.org/practres.aspx?LinkIdentifier=id&id=32132&fid=2196&Mo=No&taxid=124


Please note that the notes for this lecture are included in the file

“14BreslerHighRiskMedReview”

located immediately prior to this talk.
Objectives

- A short history of the kiddie fever business
- Vaccinations
- Rapid viral testing
- Biomarkers
- Month-by-month approach to fevers in these little folks
- A few thoughts on management

Some immutable facts

- Controversial topic
- Most infants with fever have viral infections
- Bacterial infections in young infants can have bad outcomes

What about vaccinations?

- Early 1990’s: *H. influenzae* type b (Hib)
- 2000: PCV-7 (included >80% of all invasive PC strains)
- 2010: PCV-13 approved (includes most common serotype 19a now involved in invasive pneumococcal disease)

Impact:
- Hib: Big. Significant reduction in meningitis/bacteremia
- PCV-7:
  - <3 months old: some but not much; herd immunity, but only 5-10% of positive cultures are pneumococcus
  - 3-36 months: huge impact; bacteremia rate now well under 1%; as low as 0.25%
- PCV-13: crystal ball??

Rapid viral testing

- Rapid testing available (DFA, EIA, PCR--variable sensitivities as low as 60 or 70% with first two techniques)
  - RSV
  - Influenza A/B
  - Parainfluenza

Kids with viral infections are less likely to have bacterial infections

Impact on <90 day group: potentially significant

Test all admitted patients for infection control reasons

Biomarkers: CRP and procalcitonin

- Thresholds: CRP >20, procalcitonin >0.5
- Sensitivity 60-80% individually for detection of SBI; up to 90’s% if combined
- In first two months of life when SBI rates high, sensitivity inadequate to limit work-up based on biomarkers.
- At 2-3 months of life and in under-immunized older kids, may be useful in limiting work-up (more detail below)
- RNA transcriptional signatures (blood assay) to distinguish between bacterial and viral infections) are wave of future (PECARN current research project)

Fever ground rules
• Fever: >38.0 rectal for <3 months; >39.0 for 3-36 months
• Temporal or tympanic measurements most unreliable in kids with fever: not acceptable in young infants
• Fevers at home count!
• Higher fevers, ill contacts, underlying medical conditions, prematurity count more
• Fever length (if <5 days) and response to antipyretics don’t count
• Kids who look sick are sick! No risk guidelines apply. Just work them up and admit.

• **What does sick look like?**
  • Difficult to arouse
  • Respiratory distress
  • Pale or cyanotic/CRT>2 sec
  • Poor suck/tone
  • Rash: petechiae, vesicles

• **What is a serious bacterial infection (SBI)?**
  • Bacteremia
  • Meningitis
  • Pyelonephritis
  • Pneumonia
  • Bacterial gastroenteritis
  • Osteomyelitis/Septic Joint

• **CASE 1:**
  • 2 week old term female 1 day fever to 38.5
  • Maternal GBS+ -->got ampicillin peri-partum
  • Physical: T 37.9 o/w WNL

• **Neonatal (<30 days) Fever**
  • 12-28% who present to Pediatric ED have an SBI: lots of meningitis
  • Bad bugs: Group B strep (GBS), *E. coli, Enterococcus, Listeria*
  • Even viruses are bad (Herpes)
  • Can’t tell which are sick (In various studies, neonates categorized as “low risk” had a 6-10% rate of SBI)

• **Approach to Neonates (<30 days old)**
  • BCx, UA/UCx (catheter or suprapubic aspiration <SPA> specimen only), CSF for all; WBC count not helpful
  • UCx for all <90 days because UA unreliable predictor of infection
  • CXR (lower respiratory symptoms), stool studies (diarrhea) as indicated
  • Indications for CXR in infants:
    • Hypoxia, tachypnea
    • Signs of respiratory distress: grunting, flaring, retraction
    • Abnormal lung exam
  • Delay LP if toxic appearing due to respiratory depression risk; consider upright LP
  • Viral studies not helpful: RSV+ neonates still have high (~10%) rate of SBI

• **Management of Neonates**
  • ADMIT THEM ALL AND GIVE ANTIBIOTICS
  • Increasing ampicillin resistance (GBS); consider vancomycin if toxic appearing or if mother given ampicillin
• Antibiotics of choice: ampicillin or vancomycin and 3rd generation cephalosporin like cefotaxime (preferred over gentamicin because better with meningitis)
• Add acyclovir if risks for herpes simplex virus (HSV)

• **Neonatal HSV**
  • May not have fever
  • Usually ≤ 2 weeks old
  • Empiric acyclovir if high risk:
    • primary maternal infection
    • prolonged rupture of membranes
    • skin/eye/mouth lesions
    • seizure at presentation
    • CSF pleocytosis

• **CASE 2:**
  • 6 week old term male with 2 days fever to 38.5
  • Physical: T 39, RR 70, smiles, o/w WNL

• **Approach to 30-60 day old**
  • Clinical exam helpful, but still misses SBI, particularly meningitis
  • Older pre-PCV-7 risk-stratifying criteria useful in this age
  • Rochester criteria: 0-60 day olds, previously healthy, appear well, no focal infection; CBC, bands, UA, stool (prn); 98.9% NPV for SBI
  • Philadelphia Criteria: 31-60 day old, appear well, CBC, UA, CSF, CXR, Stool (prn); 100% NPV for SBI
  • Approach:
    • CBC/BCX, UA/UCx (cath or SPA), LP for all
    • CXR, stool as needed
    • **Multiple sites of infection common in this age-group so don’t stop if one site found**
  • Social: reliable caretaker? transportation? willing parent?

• **Role of Viral Studies**
  • Levine 2002: SBI in <60d with and without RSV
    • SBI rate decreased from 12.5% to 7% if RSV+
    • Most SBI were UTI
  • Krief 2009: SBI in <60d with and without influenza
    • SBI rate decreased from 13.3% to 2.5% if flu +
    • Most SBI were UTI
  • Large studies but still underpowered to detect meningitis/bacteremia
  • Be conservative with this age and do a full work-up until larger study with enough power rolls around

• **Management of 30-60 day old:**
  • **Admit if:**
    • WBC<5K >15K, band/neutrophil >0.2
    • UA >5 wbc/hpf
    • CSF ≥8 wbc
    • stool ≥5 wbc/hpf
    • CXR with infiltrate **OR IF**
• **High risk**: preemie, long hospitalization, immunocompromised, on antibiotics, fever >5 days, poor social situation
  - May discharge if lab tests/XR normal and social situation adequate
  - Antibiotics? Your call
  - If yes, then ceftriaxone

• **CASE 3**:
  - 11 week old female NSVD 2 days of T 39. PCV-7 first round 2 wks ago.
  - Physical: T 38.9, smiling, o/w NL.
  - A few weeks make a big difference
    - PE for “sick” becoming more reliable
    - Decreasing rate of meningitis and occult bacteremia:
      - 4.1% (<1 mo), 1.9% (1-2 mo), 0.7% (2-3 mo), no meningitis in 2-3 mo in one study of 3000 infants (Pantell et al. 2004)
    - Some studies consider fever to be T>39 in this age group
    - Predominant bugs: *E. coli* but increasing pneumococcus, so vaccination/herd immunity of some value

**Approach to 60-90 day old**

- Management of 60-90 day old
  - Strongly consider admit/antibiotics if:
    - UA positive (high rate of bacteremia)
    - CXR positive (ditto, plus deterioration risk higher at this age vs older)
  - If CBC obtained, consider antibiotics prior to discharge if:

---

![Diagram: Full workup if toxic or high risk history](image-url)
• WBC: >15K <5K
• Band/PMN: >0.2
• May discharge without antibiotics if all tests normal
• Do LP if antibiotics are to be given**

• **Case 4:**
  • 6 month old with 2 days T>39; 2 sets of vaccinations
  • Physical: T 39.2, O2 96%, otherwise normal.
  • History and physical work at this age. Temp threshold ≥39
  • SBI rate very low: ≤ 0.7% so test based on symptoms or high risk status. No need for routine blood work.

• **Approach to high risk 3-36 months:**
  • **Full workup/antibiotics if:**
    • Immunocompromised
    • Indwelling medical devices (CVL, VP shunt, etc)
    • Toxic or unwell appearance
  • **Consider BCx in addition to lower risk workup noted below if:**
    • Petechiae below clavicles or progressive over few hours observation
    • Prolonged gastroenteritis or bloody stool
    • T>40 (+/-)
    • Underimmunized: <2 PCV

• **Approach to lower risk 3-36 months:**
  • Most SBI are UTI and pneumonia
  • Bugs: S pneumoniae=E coli>Salmonella>N meningitidis
  • **UTI:** up to 16% in some risk groups (white girls under 2 years with no other clear source of fever)
    • Urine gathering: cath specimen best; can consider bag if UA negative; must cath if UA positive or dirty or if UCx returns positive with potential contaminant
  • UA/UCX if:
    • <6 months
    • Boys uncircumcised <12 months
    • Girls <2 years and
      • Fever>2 days or
      • White race or
      • No clear source
  • UTI/pyelo: first dose of antibiotics parenteral (ceftriaxone) then oral (keflex)

• **Pneumonia:** CXR if symptoms of pneumonia
  • Tachypnea
  • Hypoxia (O2 sat <97%)
  • Respiratory distress
  • If CXR positive, treat (amoxicillin or azithromycin) because can’t distinguish viral from bacterial on XR

• **Febrile seizure:** 6 mo to 5 years.
  • If simple and neurologically normal post event than no increased risk of SBI except if <2 PCV/Hib
  • Consider BCx and LP if <12 months and/or <2 PCV/Hib
• **Summary**
  
  - **< 30 days:** Full work-up and admit/antibiotics
  
  - **30-60 days:** Full work-up -->discharge if all normal. Consider antibiotics
  
  - **60-90 days:** Urine only or urine/CBC/BCx; consider viral testing to figure out which way to go. Discharge if normal. Consider antibiotics if WBC abnormal. LP if you decide to give antibiotics.
  
  - **3mo-3yrs:** History and physical work! WBC useless. No blood culture unless high risk/under-immunized. High UTI risk in some groups so get UA/UCx if meet criteria. CXR if symptomatic. Discharge if well appearing. Antibiotics for focal infection only. Avoid antibiotics for risk factors alone.

• **References:**


WHY WE GET SUED & AVOIDING ERRORS IN CHILDREN

Ghazala Q. Sharieff  MD, FACEP, FAAEM

• 2/3 of pediatric cases are related to errors in diagnosis
• Most dangerous time for lawsuits in the ED are:
  • Nights
  • Weekends
  • Holidays

• Frequency of Claims
  • 10% of all ED malpractice suits involve pediatric patients
  • Only 10% of pediatric cases will ever see a jury
  • Meningitis and appendicitis are the two most commonly missed diagnoses in pediatrics

• Cost of Claims
  • Settlements and judgments are often higher
  • Young lives are affected
  • Long statute of limitations
  • Long term morbidity

• The standard of care is often hard to define
  • Simple diseases often have complex presentations
  • Disease processes change rapidly
  • Children are hard to evaluate
  • You have to depend upon the caregiver’s history
  • Medication errors are more common
  • High risk diagnoses: meningitis, appendicitis, sepsis, wounds
  • Poor follow-up arranged
  • Miscommunication with caregivers

• Documentation Pearls
  • Do not use inappropriate terms such as FLK, obese
  • Do not alter chart later
  • Do not block out or erase
  • Document consultant times
  • Document patient improvement and reassessments
• **Documentation Pearls**
  - Words to avoid: lethargic, irritable, nausea
  - Encourage triage nurses not to use them either
  - Words to include: attention, well-hydrated, cooing, alert, attentive
  - Documentation of exam should start with a general description: “this is an awake, alert 9 month old who is well-hydrated and is in no acute distress”

• **Interesting notes….**
  - “Patient wrestled to place IV”
  - “Pt with petechial, no pustular rash”
  - HR 210, sats 88% but crying…
  - Pt with nuchal rigidity
  - Child is running around ED, playing

• **High Risk Peds Diagnoses**
  - Meningitis
  - Appendicitis
  - Missed fractures
  - Testicular torsion
  - Medication errors
  - Wound complications
  - Myocarditis

• **Discharge instructions**
  - Be specific on when to see PCP
  - When should the patient immediately return?

• **Explain potential misses**
  - Ie “I may have missed a subtle fracture, but I am treating you as though you have one.”
  - “We will call you if the radiologists sees something”
PEDIATRIC PROCEDURAL SEDATION
Ghazala Q. Sharieff, MD

PEDIATRIC SEDATION AND PAIN MANAGEMENT
• Underused
  — Concern about respiratory depression
  — Easy to overlook expression of pain in infants and small children
  — Length of stay and nursing time is increased if sedation is used

Newborn Pain Management
- New Emphasis on pain in this population
- Neonates often undergo painful procedures such as lumbar puncture, intravenous catheter placement, intubation, circumcision, and heelsticks for blood draws, without analgesia.
  - While medical personnel often base administration of pain medications to neonates on their own perceptions, newborns have been proven to have the neuroendocrine mechanisms that permit the transmission of pain.
  - Studies have shown that neonates, between 28 and 32 weeks gestational age, who were exposed to multiple painful stimuli had increased distress during future painful procedures when compared with neonates who did not experience these earlier painful stimuli.

Non-Pharmacologic Interventions
- Several studies have shown that suckling and breastfeeding is analgesic in neonates. A prospective, randomized trial of neonates undergoing heel lances for blood tests, revealed that infants who were held and breastfed by their mothers during the procedure had a reduction in crying and grimacing of 91% and 84% respectively when compared to infants who were swaddled in their bassinet.

- Another method under investigation is the use of kangaroo care (KC) - maternal skin –to- skin contact (31). KC was recently shown to significantly lower the PIPP scores in preterm neonates (32-36 weeks gestational age) undergoing heel lancing procedures. Patients are held in kangaroo care for 30 minutes prior to the procedure and remain in this position throughout the heel lancing.

- The use of a 12-50% oral sucrose solution has also been shown to control pain effectively in neonates (33,34). Typically the newborn is given up to 2 ml of the sucrose solution approximately 2 minutes prior to a painful procedure via a dropper, syringe or pacifier. Smaller volumes of under 1ml should be used in preterm infants.

DRUG CATEGORIES
• Analgesics
  — Topical
– Infiltrative
– Systemic

• Sedatives
• Combination drugs

ANALGESICS

• NARCOTICS
  – Tylenol with codeine
  – Morphine
  – Meperidine
  – Fentanyl/Remifentanil

• NON-NARCOTIC AGENTS

  – Acetaminophen
  – Ketamine
  – Nitrous oxide
  – NSAID’s
    - Ibuprofen: 10mg/kg, not recommended in infants less than 6 months of age

SEDATIVES

• Midazolam
• Diazepam
• Pentobarbital
• Methohexital
• Dexmedetomidine
• Ketamine
• Propofol
• Etomidate
• Chloral hydrate

NPO STATUS

For non-emergent procedures-AAP/ASA guidelines
<-6 months of age: clear liquids 2 hours, solids and nonclear liquids 4-6 hours
-6-36 months: clear liquids 2 hours, solids and nonclear liquids 6 hours
->36 months: clear liquids 2 hours, solids and nonclear liquids 6-8 hours

For emergency purposes:
  – Solids: 3-4 hours, liquids 2 hours
Scope of the Problem:
Leading cause of morbidity and mortality ages 1-24
50% of all pediatric deaths in kids < 15 years due to trauma
Per year:
1.5 million injuries
500,000 hospitalizations
20,000 deaths
Why are kids so vulnerable?
Smaller body-->greater distribution of trauma around body-->more injuries
Improper use of carseat/seatbelt
ABCDE’s: How are kids different? How do differences change management?
A=Airway: stridor key to detect
large tongue
floppy epiglottis
more cephalad and anterior airway
airway narrowest at cricoid ring until age 8 (conical vs. adult cylindrical airway)
large occiput
oblige nasal breathing until age 6-12 months
Implications and Management:
suction liberally
no NP airway under 1 year
BVM: fit from nasal bridge to cleft of chin
Straight blade easiest to pick up floppy epiglottis
< 8 years old: uncuffed tube usually because narrowest point of airway low down
RSI: consider atropine <6-12 months to avoid reflex bradycardia
B=Breathing:
Immature intercostals-->diaphragm dependent breathing
Pliable chest wall-->retractions when distressed-->poor respiratory dynamics
Mobile mediastinum
Implications and Management:
Tire more easily: consider early aggressive intervention
Close observation: don’t walk away from respiratory distress because can deteriorate rapidly
Decompress stomach early with positive pressure breathing: distended stomach impedes diaphragm excursion
Relieve HTX/PTX quickly: mobile mediastinum means tension physiology can develop more quickly
C=Circulation:
Smaller volume
Cardiac output very heart rate dependent
High metabolic rate-->high cardiac output at baseline-->little reserve
Can maintain blood pressure despite dramatic (30-40%) blood volume loss
Potentially difficult IV access
Implications and Management:
Bradycardia-->can lead to marked blood pressure drop (hence recommendation for atropine during RSI in infants)
Increased metabolic demands poorly tolerated (e.g. hypothermia)
Beware of pitfall of waiting for hypotension to diagnose shock; once kids become hypotensive they are extremely hypovolemic
Signs of shock:
CRT>2-3 seconds
cool skin
low urine output
altered mental status
elevated HR
narrowed pulse pressure
elevated lactate (>4)

**D=Disability (Brain and Cervical Spine):**
Brain differences:
- High glucose needs/low glycogen stores
- Less myelination
- Thin skull/fontanelle
- Larger head/body size ratio
- Mental status assessment more difficult

**Implications and Management:**
- Skull fractures more common-->high correlation with TBI
- More intracranial injuries: 80% of all trauma deaths in kids are from TBI
- Mental status assessment: consider AVPU system vs. GCS (A alert/V responds to verbal stimulus/ P responds to painful stimulus/ U unresponsive)
- Hypoglycemia common-check FSBG early

**Cervical spine differences:**
- Large head
- High fulcrum: C2-3
- More cartilage in cervical spine/growth plates
- More pre-vertebral soft tissue
- Horizontal facets: more slippage

**Implications and Management:**
- High cord lesions more common <8 years old
- Ligament injuries more common
- C2/C3 pseudo-subluxation: 40% of all kids <8 years; distinguish from true subluxation by looking for alignment of spino-laminar line
- SCIWORA: injuries visible on MRI; so continue imaging if patient with pain/tenderness but negative CT

**E=Exposure:**
- Higher surface area to body weight ratio

**Implications:** get cold more easily, so cover up early

**Organ Differences:**
- Pliable rib cage-->rib fractures less common but thorax more vulnerable
- Liver and spleen more anterior and less protected by musculature
- Kidney more mobile/less protected

**Hot Topics in Imaging:**
**The Background: Downsides of diagnostic imaging**
- 4 million CT’s per year done on kids in 2007 (more now)
- 700% increase in CT use in last 10 years
- Kids are 10-15 times more radiation sensitive than adults
- Bone marrow, thyroid, breast and lung are most radiosensitive organs
- Best models based on atomic bomb data/retrospective studies suggest:
  - 1 extra cancer per 2000 head CT’s in infants
  - 1 extra cancer per 5000 head CT’s in older kids

**The Trauma Series: Do all kids with trauma need CXR and pelvis xray?**
Holmes, *Annals EM* 2002:
- 986 kids <16 years old
- Derived decision rule for who needs CXR: 98% NPV
- Low BP
- Increased respiratory rate
Abnormal chest exam (inspection, palpation, auscultation)
GCS<15
Femur fracture
Needs validation
Kevill, Ped Em Care 2002:
91 kids > 2 years with GCS 15, retrospective study
Localizing findings on chest and abdomen/pelvis exam:
pain/tenderness
abrasions/ecchymosis
SOB/respiratory distress
Hematuria/urinary retention
abdominal distension
If no localizing findings-->100% NPV for normal CXR and pelvis XR
**Bottom line:** If AMS, ill appearing/poor VS, or signs/symptoms of chest or abdominal trauma then do CXR and pelvis. Otherwise, reconsider.

**Head CT and mild TBI (GCS≥14): Who needs imaging?**
Who gets imaged now?
40-50% of kids who go to an ED with traumatic brain injury (TBI)
Higher CT rates if:
White, older
General vs. pediatric hospital
More emergent triage status
Treated by attending
<10% of head CT’s have any TBI/0.5% have a clinically important TBI
GCS<14 have >20% risk of TBI. No controversy, just image.
What are we trying to pick up on CT?
All TBI
Clinically important(CI) TBI:
Neurosurgical intervention
Hospitalization >2 nights/intubation >24 hours
Death or long term neurological sequelae
Kuppermann, Lancet 2009: PECARN minor head trauma decision rule
Derivation and validation
42,000 kids with GCS≥14; >10,000 kids under 2 years
< 2 years: 100% NPV for CI TBI and all TBI
>2 years: 99.9% NPV for CI TBI and 98.4% NPV for all TBI
If criteria used, CT use would have declined by 20-25%.
Severe mechanism:
- MVA with ejection, rollover or death of occupant
- Pedestrian or bike without helmet vs. car
- Fall > 3 feet if under 2 years or > 5 feet if over 2 years old
- High impact object to head

**Cervical Spine Imaging: Who needs it?**

Cervical spine injuries are uncommon < 8 years old

Leading causes:
- MVA (under 8 years)
- Sports (over 8 years)
- PVA

Viccellio, *Pediatrics* 2001: NEXUS in kids

NEXUS subset of 3065 kids
30 cervical spine injuries: only 4 in kids 2-8 yrs, none in kids < 2 yrs

Criteria (100% sensitive) --> OK to clinically clear
- No neck tenderness
- No focal neurological symptoms
- No distracting injuries

Garton, *Neurosurgery* 2008: Problems with NEXUS

187 kids with known cervical spine injury: NEXUS applied retrospectively
32 kids under 8 years: 94% sensitivity (missed injuries were high in cervical spine and ligamentous)
155 kids over 8 years: 100% sensitivity (NEXUS works in this older age group)
Recomendations for clearing pediatric c-spines:

**CT** better for detecting bony injuries; **MRI** better for ligamentous injuries (MRI not as good as CT for detecting fractures of posterior elements of spine and injuries of cranio-cervical junction)

**Role of FAST ultrasound in pediatric trauma?**  
*Holmes, J Ped Surg 2007*: meta-analysis  
FAST and hemoperitoneum: sensitivity 66-80%, specificity 95%  
Role of US in trauma:  
HD unstable: to identify general source of bleeding (abdomen, pericardial vs. other (e.g. pelvic fracture))  
HD stable: determine if immediate need for laparotomy in multi-trauma patient requiring urgent other procedure (e.g. craniotomy for head injury)

**When is an abdominal CT necessary?**  
*Fenton, J Ped Surg 2004:*  
897 kids post trauma undergoing abdominal CT  
2% of these CT’s were abnormal-->only 5% of these go to OR (1 kid out of 897-->lots of collateral damage)  
CT scan can lead to unnecessary laparotomy if unexplained free fluid and concern for bowel injury. This finding is not as predictive of bowel injury in kids as in adults.  
Head CT: 2 mSV vs. Abdominal CT: 10-15mSV  
*Holmes, Annals EM 2009*: Decision rule for who needs an abdominal CT  
1119 kids under 18 years  
Decision rule: validation study  
Low SBP (even transient if no other clear source)
Abdominal tenderness
Femur fracture (weakest element)
Abnormal labs: initial HCT<30, AST>200, ALT>125, UA>5RBC/hpf
Sensitivity: 94.9%, Specificity: 37%
Missed injuries:
Low GCS (<15)
Low thoracic tenderness
Seatbelt sign

PECARN (Pediatric Emergency Care Applied Research Network) study in progress to refine rule
What do we know about seatbelt signs (SBS)?
Poorly located lap belt-->bruising of abdominal wall-->correlates with bowel injury
Studies give a mixed picture. Bottom line: if SBS and pain/tender then image. If SBS and no pain or tenderness, consider prolonged observation/admission to follow exam.

**Bottom line:** Consider CT if low SBP, abdominal or low thoracic tenderness, abnormal labs or femur fracture and CT or prolonged observation if AMS or SBS.

What to look for on abdominal CT (IV contrast only, no oral needed: significant delays and increased risk of vomiting/aspiration with oral)
Solid organ injury: liver, spleen, kidney, pancreas
Bowel injury: unexplained free fluid, wall thickening, mesenteric infiltration, contrast extravasation from bowel if no contrast given (very RARE)

Hom, Acad EM 2010: If abdominal CT negative, can I discharge?
Meta-analysis of 2596 kids
NPV of CT: 99.8%
If negative CT:
Consider 6 hour observation
May discharge if physical exam normal and no seat belt sign. If SBS higher risk for bowel injury and should have more prolonged observation/admission.

**References:**


Body Modification Gone Wrong

Rachel Chin MD

Introduction

- Body modification popularity has skyrocketed in the last 10 years.
- 20% of college students have 1 or more tattoos and or piercing of a body part, other than the earlobes.
- Regulation is only at the state or county level. Most tattoo or piercing artists are unlicensed and have learned via an informal apprenticeship and do not have formal training in anatomy, infection control or universal precautions.
- 18 states have laws ending to regulate piercing; several others already have specific regulations.

The Risks: Infection

- Greatest risk: those with artificial heart valves, prostheses, DM

The Risks: Keloid Formation

- May be associated with any body modification procedure
- Surgical removal of keloid often results in another overgrowth of scar tissue

Tattooing:

- The permanent marking of small amounts of colored pigment directly into the skin.
- Although there are professional artists who use aseptic techniques and materials, tattoos may also be made by any dye and needle-like device.
- Possible to have an allergic reaction to red and yellow dyes, anytime after the inking.
- Can result in burns during MRI because tattoo pigments may contain heavy metals and iron. Burning sensation and intense pain are due to oscillations of the gradients or radiofrequency induced electrical currents. Heating raises intracellular water temperature in the skin, resulting in a burn.
- Increased photosensitivity in the areas of inking is also common.

Piercing

- Can be on earlobe, eyebrow, nasal septum, nasal ala, tongue, nipple, navel
- Genital piercings: clitoris, head of penis, underside of penile shaft, scrotum
- A wide variety of body piercing jewelry is worn:
  - Barbells, j-bars, captive bead rings
- The ear is the most frequent area of infection. Piercings in largely avascular cartilage – poor healing and more serious infection.
- Superficial infection - warm compress, topical antibx ointment, oral antibx
Ciprofloxacin is the drug of choice for auricular perichondritis because of effectiveness against *Pseudomonas*.

Infection can lead to abscess requiring a surgical incision and drainage.

Allergic reaction: ornaments made of nickel are often the cause
  - Replace with ornament made of titanium or niobium

Acute reaction: SQ epinephrine 1:1000, benedryl, H2 blocker

**Tongue Piercings:**
- **Trigeminal neuralgia:** extreme facial pain related to repeated firing of the 5th cranial nerve.
  - Pain may stop when the piercing stud is removed.
- **Bacterial endocarditis:**
  - Even after the site has healed, the area may be colonized with bacteria which may evolve into endocarditis.
  - Have a high index of suspicion for any patient with oral jewelry who presents with signs and symptoms of systemic infection.
  - Increased potential with tongue slitting related to the increased surface area of open healing tissue.
- **Ludwig’s Angina:** rapidly spreading cellulitis
  - Requires rapid airway protection, IV antibx, surgical management of any abscesses.
- **Excessive bleeding:** as the tongue is a muscle, cutting and piercing can lead to excessive bleeding and edema.
- **Other complications include:** salivary flow, gingival injury or recession, speech difficulties, cracked or broken teeth, aspiration of oral jewelry.
- Piercings can be torn. Earlobe is most common.
  - Lacerations may be sutured as any laceration. Check tetanus status.

**Genital Piercing:**
- **Male piercings:**
  - **Prince Albert (PA):** one of the most common male genital piercings
  - **Ampallang:** Derived from the Dyaks in Borneo. A male rite of passage is celebrated with the placement of the Palang (“cross bar”) horizontally through the head of the penis above the urethra.
  - **Apadravya:** from the Kama Sutra. Vertical placement of a bar through the penis and the urethra.
  - **Frenum:** underside of the penis, through the surface tissue, not through the shaft itself. It is placed so that a large ring or frenum loop could be worn through the piercing around the head.
  - **Hafada/Scrotum:** a surface piercing located anywhere on the skin of the scrotum.
  - **Dydoe:** piercing througthe rim of the glans.
- **Problems with Male piercing:**
  - **Paraphimosis:** urological emergency of the foreskin, once pulled back behind the glans penis, cannot be brought down to its original position.
• Occurs only in uncircumcised or partly circumcised males.
• Results from piercing with a penile ring into the glans.
• Delayed treatment can result in tissue ischemia and may eventually cause gangrene or autoamputation of the distal penis.
• May require a nerve block before reduction and injection of Hyaluronidase to dissipate edematous fluid.
  o Urethral tears: do not place a Foley catheter because it may complete a tear, until urology evaluation is completed. May require a suprapubic catheter.

• Female Piercings
  o Horizontal & Vertical Hood
  o Triangle Piercing: a horizontal piercing behind the nerve bundle of the clitoris, at the base of the hood tissue.
  o Keloid scarring has been seen in clitoral piercings.
  o Increased risk for STD’s

Scarification
• Originated in Africa and New Guinea as part of rituals that involve scarring the body with intricate designs.
• Common techniques:
  o Branding: burning a pattern into the skin, using an electrocautery knife
  o Scarring: using a scalpel to remove the outer layer of tissue
  o May also be done via a chemical burn, tattoo gun (without ink),
• The outcome of the design is based solely on how well the body scars.
• The practice is legal in California, but regulations for shops vary by county or city.
• Resultant wound will likely be a combination of a 2nd and 3rd degree burn.
• Burn Treatment:
  o For circumferential burns: check neurovascular status
  o Consider transfer to a specialty burn center. Check tetanus status.
  o For mild burns: cold compresses, Silvadene cream, covered dressing

Pearling:
• The practice seems to have been fairly common across world cultures; pearling is seen as a form of body modification.
• Also known by its technical term, genital beading, is usually done by professional body piercers.
• Procedures are relatively safe with risks and healing much like a subdermal implant in any other part of the body.
• Migration is very common, during and after healing. Rejection is rare, but can occur. A wide variety of inert implant materials can be used for these implants: Teflon, silicon, surgical steel or titanium are commonly used.
• Genital ribs are a form of genital beading whereby rods, rather than beads, are implanted, giving the appearance of a ribbed penis.
Patient Education for Body Modification

- Pregnancy: avoid new piercing as body changes may alter the fit of jewelry and piercing size
  - Nipple rings: may cause mastitis, galactorrhea and damaged milk ducts. Jewelry may also obstruct breast feeding.
  - Genital piercing: increase the risks of severe lacerations during labor and delivery.

- Genital Piercing: remind patient of need for condom use with any sexual contact, but be aware that condoms may be torn by body jewelry.

Considering Body Modification?

- Select a reputable practitioner, who carries a certification from either the Association of Professional Piercers (APP) or the Alliance of Professional Tattooist (APT).
- Ensure that all tools are steriley packaged and new bottles of ink are used.
- Don’t get a modification when drunk!
- Carefully consider your design choice.


High Risk Ophthalmology

David Duong, MD MS

Eye Trauma

First, rule-out life and limb threatening conditions.

Key history
- vision changes (including diplopia)
- ocular pain (including photophobia)
- potential penetrating trauma or foreign body
- screen for abuse/DV

Physical exam
- visual acuity
- extraocular movements
- pupillary response/RAPD
- slit lamp exam (if possible)
- fluorescein exam (consider Seidel test)
- IOP (but not in globe rupture)

CORNEAL FOREIGN BODY
- evert eyelid to r/o foreign body
- removal with 18G needle or cotton-tipped swab
- refer to ophtho non-urgently if rust ring is not completely removed

RETROBULBAR HEMATOMA
- consider in eye trauma with:
  - ↓ Va  ↑ IOP  ↓ EOM
  - RAPD  proptosis
- obtain ophtho consult
- lateral canthotomy within 60-90 minutes
- orbital CT (should not delay treatment)

CORNEAL ABRASION
- evert eyelid to r/o foreign body
- consider corneal violation and Seidel test
- consider cycloplegia, topical Abx, artificial tears, & pain management

TRAUMATIC HYPHHEMA
- think about concurrent globe rupture or intraocular FB (consider CT orbit)
- perform Seidel test if corneal perforation is suspected
- obtain ophtho consult if:
  - >50% hyphema
  - ↑ IOP
  - sickle cell trait or disease
  - bleeding diathesis
- needs outpt follow-up for IOP monitoring
  - eye shield
  - HOB >30° at rest
  - cycloplegia (if IOP wnl)
  - NO NSAIDs

EYE LID LACERATIONS
- Referral if involvement of:
  - lid margin
  - nasolacrimal system (region around medial eyelids)
  - canaliculus
  - lacrimal sac
  - nasolacrimal duct

GLOBE RUPTURE
- consider in eye trauma with:
  - ↓ Va  RAPD
  - deformed iris or globe
  - 360° subconjunctival hemorrhage
  - + Seidel test  hyphema
- obtain ophtho consult
- CT scan (though not sensitive)
- avoid pressure to the eye
  - eye shield
  - antiemetics, analgesia
- prophylactic Abx
- tetanus prophylaxis
<table>
<thead>
<tr>
<th>Condition</th>
<th>Key Actions</th>
<th>Pearls</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conjunctivitis</strong></td>
<td>Look for red flags that suggest another diagnosis: ↓ Va, ciliary flush, corneal defects or opacity, headache with nausea, photophobia</td>
<td>Abx ointments may work better for kids. Topical abx ointments for gonorrhea are the same for bacterial conjunctivitis (but also treat genital infection).</td>
</tr>
<tr>
<td><strong>Herpes Keratitis</strong></td>
<td>Slit lamp exam with fluorescein staining. Ophthalmology referral. Consider admission for immunocompromised patients.</td>
<td>Oral antivirals are just as effective as topical antivirals in HSV keratitis.³</td>
</tr>
<tr>
<td><strong>Zoster Ophthalmicus</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Episcleritis</strong></td>
<td>Rule out scleritis, which may be sight-threatening. Episcleritis is self-limiting.</td>
<td>Blanches with vasoconstrictors (phenylephrine drops) Consider NSAIDs drops (diclofenac QID)</td>
</tr>
<tr>
<td><strong>Scleritis</strong></td>
<td>Ophthalmology consult for NSAIDs +/- steroids.</td>
<td>Won’t blanch with vasoconstrictors. The pain is usually intense (unlike episcleritis, which is more like irritation).</td>
</tr>
<tr>
<td><strong>Acute Angle Glaucoma</strong></td>
<td>Obtain IOP. Goal reduction of IOP to &lt;35 mmHg or &gt;25% of presenting IOP.⁴ Ophthalmology consult.</td>
<td>Give acetazolamide early. Give separate eye drops 1 minute apart from each other (timolol, apraconidine, pilocarpine, prednisolone are acceptable). Repeat drops once before starting mannitol IV. If mannitol IV is ordered, call ophthalmology again if they are not present.</td>
</tr>
<tr>
<td><strong>Preseptal cellulitis</strong></td>
<td>Look for red flags that suggest orbital cellulitis: proptosis, limitation of eye movement, diplopia, ↓ Va.</td>
<td>If preseptal cellulitis does not improve in 1-2 days with PO Abx, pt should get a CT scan and consider admission for IV Abx.</td>
</tr>
</tbody>
</table>
DDx for ocular causes: PVD, retinal tear/detachment, posterior uveitis, vitreous hemorrhage, oculodigital stimulation, rapid eye movements, macular degeneration

**Floaters and Flashes**

- In the history:
  - consider ocular causes
  - consider non-ocular causes
    - migraine/aura
    - occipital lobe disorder
    - postural hypotension

- Physical exam:
  - Va (corrected)
  - visual field testing
  - RAPD
  - funduscopic exam
  - slit lamp exam
  - neurologic exam

- Stable sx (weeks/months)
  - not bothersome to pt
  - nl visual acuity
  - nl ocular exam
  - elective referral to ophthalmologist

- no subjective visual acuity reduction
  - nl visual acuity
  - nl ocular exam
  - elective referral to ophthalmologist

- Subjective visual acuity reduction
  - Decreased visual acuity
  - Visual field defect
  - vitreous pigmentation or hemorrhage
  - same day referral to ophthalmologist (increased risk for retinal tear or detachment)

- new floaters
  - visual acuity reduction
  - elective referral to ophthalmologist
# High Risk Ophthalmology

## Acute Monocular Vision Loss

<table>
<thead>
<tr>
<th>History</th>
<th>Physical</th>
</tr>
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<tbody>
<tr>
<td>Amaurosis fugax, diplopia Systemic sx (F/C, malaise, anorexia, wt loss) Jaw claudication New-onset temporal HA Age ≥ 50</td>
<td>Firm, tender temporal artery +/- overlying erythema papilledema</td>
</tr>
<tr>
<td>Red perception desaturation Eye pain, central scotoma Typically age 20-40</td>
<td>Red described as pink or “washed-out” pain with EOM +/- papilledema</td>
</tr>
<tr>
<td>Painless Dramatic, abrupt onset Older age, HTN, DM, AFib, carotid artery disease</td>
<td>Retinal pallor with “cherry red spot”</td>
</tr>
<tr>
<td>Similar presentation to CRAO +/- amaurosis fugax</td>
<td>Retinal hemorrhages (if severe, “blood and thunder”) Dilated, tortuous retinal veins</td>
</tr>
<tr>
<td>floaters</td>
<td>Visual field defects Vitreous hemorrhage Billowing retinal separation</td>
</tr>
</tbody>
</table>

**Key actions**

**Temporal Arteritis**
- send ESR (≥50)
- rheumatology c/s
- ophthalmology c/s
- systemic steroids

**Optic Neuritis**
- neurology consult and MS work up
- consider MRI with gadolinium
- ophthalmology c/s
- consider IV steroids

**CRAO**
- r/o temporal arteritis in those ≥50
- ECG (look for AFib)
- consider ocular massage
- consider admission for carotid artery imaging and stroke risk stratification
- ophthalmology c/s: consider lytics, ant chamber paracentesis

**CRVO**
- ophthalmology consult
- consider anticoagulation

**Retinal Detachment**
- ophthalmology consult (direct fundoscopy is inadequate to exclude dx)

For all pts, evaluate: visual acuity RAPD funduscopic exam
Pearls:

Corneal abrasions

in suspected corneal abrasions a drop of anesthetic will help with the exam
discharge with an ointment (longer lubricating effects and much less sting than drops)
cycloplegia can be helpful. try 1 drop of 2.5-5% homatropine in the ED after diagnosis.
   It lasts for about 2 days. It lasts longer and has less sting than cyclopentolate.
   codeine elixir can also be helpful
If there is persistent pain or unwillingness to open the eye after 1 day, refer to
ophthalmology (? retained foreign body, keratitis, ulcer). If there is a haze or any
kind of opacity in the cornea, it may be an infiltrate so refer to ophthalmology.

Consider sedation to fully evaluate the eye. If possible, have the ophthalmologist present during
the sedation. Total ketamine doses less than 3 mg/kg does not raise the IOP, but can still
cause vomiting.⁹ Consider other medications when you suspect globe rupture.

Testing vision – if the child cannot see the eye chart, move on to testing “fix and follow”
   (analogous to hand motion perception) and “blink to light” (analogous to light
   perception) for each eye. Suspect a vision problem if, upon covering an infant or young
child’s eye, there is crying that resolves when you uncover the eye.

References

7. Fraser et al. Cochrane Database of systematic reviews. 2009.
Antidotes
Craig Smollin MD

BACKGROUND:

The most common interventions in acute poisoning are (1):

- Decontamination
- Intravenous Fluids
- Supplemental oxygen

First and foremost the acutely poisoned patient needs GOOD SUPPORTIVE CARE.

Certain circumstances however, require prompt administration of a specific antidote.

Keys to success:

- Recognition
- Rapid Response
- Familiarity with treatment options

This lecture aims to describe select antidotes, and to discuss their indications and potential pitfalls in their use. Refer to Table 1, summarizing the indications for each antidote along with dosages.

I. High-Dose Insulin Euglycemic Therapy (HIET) for the treatment of calcium channel blocker (CBB) overdose:

Acute CCB overdose associated with significant morbidity and mortality (2)

Recognition: Metabolic acidosis, refractory hypotension and shock in the patient with appropriate history.

Pitfalls:

- Patients may initially appear well, followed by rapid hemodynamic decompensation. (3)
- Conventional therapies produce variable responses. These include IV fluids, Calcium salts, Atropine, Vasopressors, and Glucagon.

Pearl:

- Consider HIET early in the management of the sick CCB overdose patient

Proposed Mechanism: CCB overdose induces insulin deficient state. Inhibition of glucose uptake by heart may be cause of toxicity. HIET may reverse these metabolic derangements.
Evidence:
- Animal studies show HIET more effective than conventional therapies in verapamil-poisoned dogs (4)
- No randomized controlled trials in humans but many successful case reports

II. Crotalidae Polyvalent Immune FAB

About 8,000 venomous snakebites yearly in the U.S., most of which are caused by the Crotlidae (pit viper) family. (5)

Crotalidae polyvalent immune fab is derived from sheep immunized with the venom of one of four species of rattlesnake (Western Diamondback, Eastern Diamondback, Mojave, and Cottonmouth)

Recognition:
- Local: stinging, burning, progressive swelling and erythema. Petechiae, ecchymosis and hemorrhagic blebs may develop over hours.
- Systemic: Hypovolemic shock.
- Neurotoxic: weakness, muscle fasciculations, metallic taste in mouth, perioral and peripheral paresthesias.

Pitfall:
- Lack of recognition of delayed coagulopathy after cessation of therapy

Pearl:
- Experience with Crofab compared to the older Wyeth antivenom indicates a substantially reduced incidence of allergic reactions and serum sickness with apparently equal efficacy (6)

III. Hydroxocobalamin

Inhalation of smoke accounts for more fire-related morbidity and mortality than burns. (7)
Among the components of fire smoke is included both carbon monoxide and hydrogen cyanide gas.

Recognition: Cardiovascular collapse, and cellular hypoxia resulting in severe lactic acidosis and death in the right clinical setting (ie. the smoke inhalation victim)

Pitfall:
- Use of the conventional cyanide antidote kit (amyl nitrite, sodium nitrite) in the undifferentiated smoke inhalation victim may exacerbate CO poisoning and hypotension.
Pearl:
- Hydroxocobalamin likely safe to administer in setting of CO poisoning

Evidence:
- Multiple animal studies demonstrating efficacy compared with placebo (8,9)
- Prospective noncomparative trial in fire-smoke inhalation victims demonstrated survival of 72% in patients receiving Hydroxocobalamin (7).
- No head to head trials of Hydroxocobalamin compared to sodium thiosulfate.

IV. Intravenous NAC

Acetaminophen is one of the most common causes of poisoning worldwide.

Recognition: Acetaminophen associated with delayed onset of hepatotoxicity (24-36 hours after ingestion). Patient will present with minimal to no symptoms early on.

Pitfalls:
- Failure to recognize and thus treat.
- Intravenous NAC associated with anaphylactoid reactions especially in patients with history of allergy, asthma, or low acetaminophen concentrations.
- Dosing error in children have led to deaths (10,11)
- Use of 20-hour regimen in the setting of delayed presentations, large or chronic ingestions.
- Premature discontinuation of therapy

Pearl:
- Oral and Intravenous formulations equally efficacious.
- IV NAC advantageous in patients with ALOC or significant nausea and vomiting

Mechanism: Restores hepatic glutathione, which binds to and detoxifies the toxic metabolites of acetaminophen.

V. Intravenous Lipid Emulsion (ILE)

This is a cutting edge therapy that is currently receiving a lot of attention in the toxicology literature.

Recognition: ILE has been suggested for a variety of poisonings from many different classes of drugs. Consider using it in the overdose patient who is very sick or who has coded.

Pitfalls:
- Not too much to say here. This is likely a last ditch effort to resuscitate the patient.

Pearls:
- Not too much downside to throwing this in with the kitchen sink.

**Evidence:**
- Animal studies suggest effectiveness in resuscitation from cardiotoxic effects of bupivacaine (12,13), chlorpromazine (14), clomipramine (15), propranolol (16), and verapamil (19).
- Numerous case reports in humans including buproprion, questiapine, verapamil and others.

**Table 1.**

<table>
<thead>
<tr>
<th>Antidote</th>
<th>Primary Indication by Substance</th>
<th>Dose and Administration</th>
</tr>
</thead>
<tbody>
<tr>
<td>High dose insulin euglycemic therapy (HIE)</td>
<td>Severe calcium channel blocker poisoning</td>
<td>Bolus of Regular Insulin 1U/kg followed by infusion at 0.5-1.0 U/kg/h. Give 25 grams (50cc of D50W) initially and monitor glucose frequently to prevent hypoglycemia. Monitor serum K and replace as needed</td>
</tr>
<tr>
<td>Intravenous lipid emulsion (intralipid)</td>
<td>Lipophilic cardiotoxic agents</td>
<td>1.5 mL/kg of 20% intralipid as an initial bolus followed by 0.25 mL/kg/min for 30-60 min. Depending upon response, bolus could be repeated 1-2 times and infusion rate increased</td>
</tr>
<tr>
<td>Hydroxocobalamin</td>
<td>Cyanide</td>
<td>5 grams as intravenous infusion over 15 min. Depending on severity of poisoning, a second dose of 5 grams may be administered.</td>
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<tr>
<td>Oral N-Acetylcysteine (NAC)</td>
<td>Acetaminophen</td>
<td>Loading dose: 140 mg/kg, diluted in juice or soda to produce a 5% solution Maintenance dose: 70 mg/kg every 4 hours for 4 doses (uncomplicated cases)</td>
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<tr>
<td>Intravenous N-Acetylcysteine (NAC)</td>
<td>Acetaminophen</td>
<td>Loading dose: 150 mg/kg in 200 mL of 5% dextrose in water (D5W) over one hour Maintenance dose: 50 mg/kg in 500 Ml fo D5@ over four hours then 100 mg/kg in 1000 mL of D5W over 16 hours Note: dosing is based on ideal body weight, and use smaller diluent doses of D5W in children</td>
</tr>
<tr>
<td>Crotalid Antivenom CroFab</td>
<td>Rattlesnake envenomation</td>
<td>Depending on severity fo bite, initial dose ranges from 4-8 vials Repeat until there is a halt in progression of symptoms Additional 2 vial doses every 6 hours for up to 18 hours if needed</td>
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</tbody>
</table>
REFERENCES


(2) Smollin CG, Toxicology: Pearls and Pitfalls in the Use of Antidotes, Emerg Med Clin N Am 2010;28(10) 149-161


## Registrant List

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**Total Number of Attendees for MEM11002: 275**