

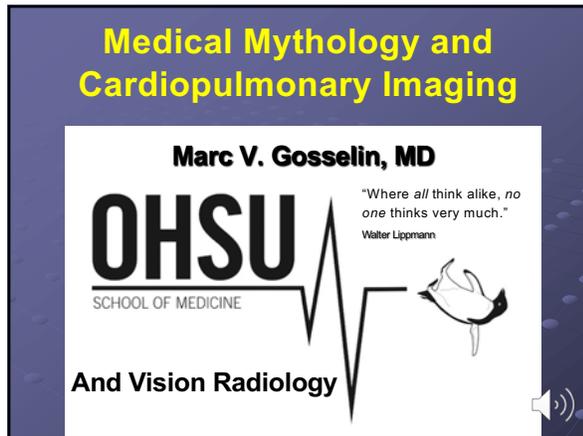
Medical Mythology and Cardiopulmonary Imaging

Marc V. Gosselin, MD

OHSU
SCHOOL OF MEDICINE

And Vision Radiology

"Where all think alike, no one thinks very much."
Walter Lippmann



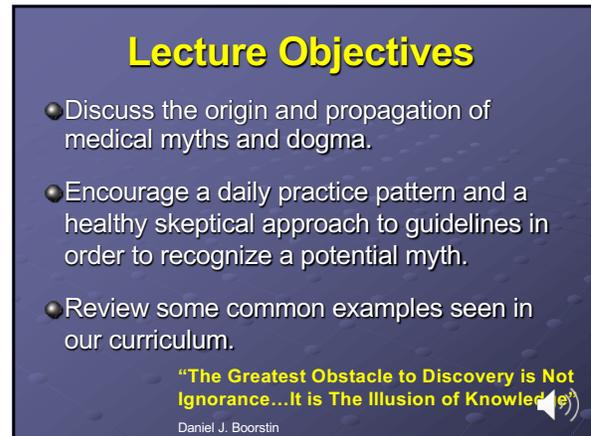
1

Lecture Objectives

- Discuss the origin and propagation of medical myths and dogma.
- Encourage a daily practice pattern and a healthy skeptical approach to guidelines in order to recognize a potential myth.
- Review some common examples seen in our curriculum.

"The Greatest Obstacle to Discovery is Not Ignorance...It is The Illusion of Knowledge"

Daniel J. Boorstin

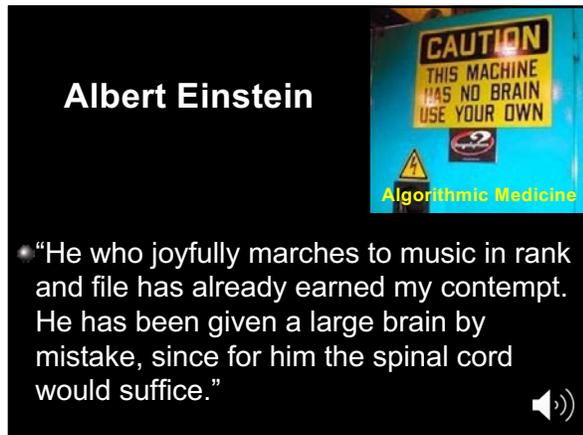


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Albert Einstein

Algorithmic Medicine

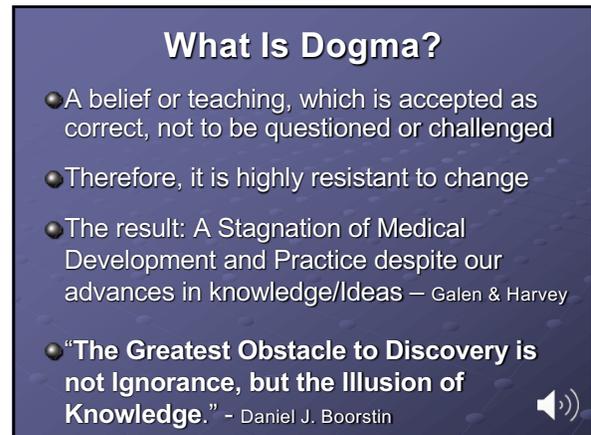
“He who joyfully marches to music in rank and file has already earned my contempt. He has been given a large brain by mistake, since for him the spinal cord would suffice.”



3

What Is Dogma?

- A belief or teaching, which is accepted as correct, not to be questioned or challenged
- Therefore, it is highly resistant to change
- The result: A Stagnation of Medical Development and Practice despite our advances in knowledge/Ideas – Galen & Harvey
- **"The Greatest Obstacle to Discovery is not Ignorance, but the Illusion of Knowledge."** - Daniel J. Boorstin



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"Eminence Based" Medicine

CAUTION

THIS SIGN HAS SHARP EDGES

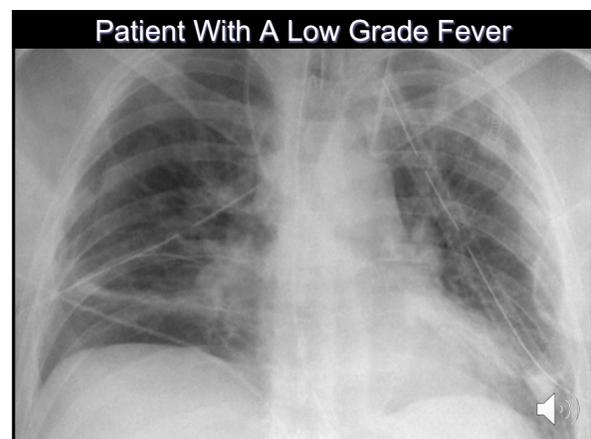
DO NOT TOUCH THE EDGES OF THIS SIGN

ALSO, THE BRIDGE IS OUT AHEAD



5

Patient With A Low Grade Fever



6

Does Atelectasis Cause Fever?

- According to "**Eminence-based**" medicine, of Course! This a well known cause, especially for surgical patients.
- According to **Evidence-based** medicine and physiological mechanisms (or lack thereof), the answer is NO.



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Mild Hypoxia: **No Fever** Obstructive Atelectasis – Mucus Plug of The Right Middle Lobe



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How Did This Myth Start?

- Early work (1900 –1950's) did not distinguish between pneumonia and atelectasis.
- Lansing and Jamieson. Arch Surg 1963; 87:184.
- Placed **non-sterile** cotton plugs in left-main bronchus in 30 dogs.
- Most developed fever in 12 hours. However...
- Inflammation and obstructive pneumonia on microscopic exam. (6 even became septic!)
- Antibiotics improved the fever, **not the atelectasis.**



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What Else? Well...

- Rats were given one atelectatic lung and the contralateral normal (control) lung.
- Atelectatic lung: 3 X increase in cytokines & TNF-1. (Theory: Hypoxic-induced activated the alveolar macrophages)
- Therefore, this is the likely mechanism of "atelectasis-induced" fever.
- Problem: **None of the rats became febrile!**

● *Kisala et al. Am J Physiol Regul Integr Comp Physiol 264:610-614, 1993



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Atelectasis Does **NOT** Cause Fever

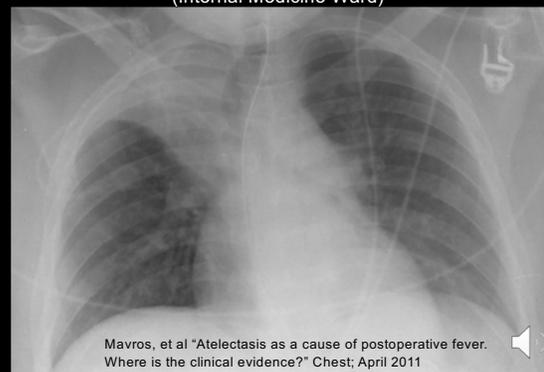
- Chest: Volume 107 (1), Jan 1995 81-84
- Prospective evaluation of 100 post cardiac patients over first three days.
- Demonstrated an **Inverse relationship** with post-operative fever and atelectasis!
- Atelectasis: 43% → 79% over 3 days.
- Fever (>38.0): 37% → 17% over 3 days.



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Hypoxia...No Fever

(Internal Medicine Ward)



Mavros, et al "Atelectasis as a cause of postoperative fever. Where is the clinical evidence?" Chest; April 2011



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“Belief in myth allows for the comfort of opinion without the discomfort of thought”

John F. Kennedy



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What Is A Myth?

- **A myth is a like a virus**, which infects the culture of medicine.
- *The vectors*: Faculty, fellows, residents, students & the media!
- *Horizontal spread* – throughout the medical education curriculum.
- *Vertical spread* – down through the generations of health professionals.
- It can survive **many** generations.



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How Do You Suspect a Myth?

- The teaching does not match what you are seeing, *especially over time*
- **RED ALERT WORDS**: “They say...”, “Everyone knows...”, “Standard of Care”, “It’s a no brainer”
- These phrases have a tendency to put you on the defense, since a sense of certainty is implied...*which is an illusion*



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Myth Or “Conventional Wisdom”

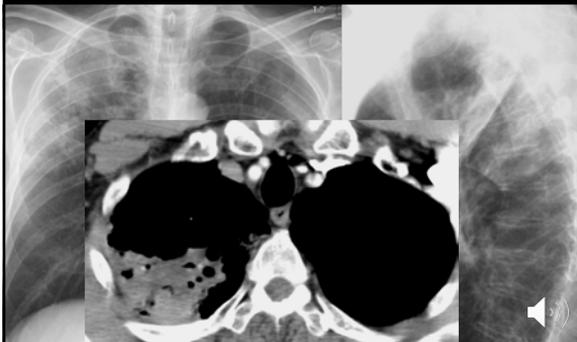
- “Must be simple, convenient, comfortable and comforting – although not necessarily true.”*
- Most “*Pearls of Punditry*” have either a ring of truth or aura of wisdom. (i.e. -“Running is bad for the knees”)
- Experts can be biased to the point of deceit, *not appreciating the contrary observations*.* (*The Brain* → *Eyes*. *Not vice versa*)
- *Freakonomics. Levitt S, and Dubner S. 2005



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Typical Cavitory TB Localization:

Upper Apical/Posterior Lobes or Superior Segment Lower Lobes



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Cavitory Tuberculosis Distribution

- Almost always occurs in the upper lobes apical/posterior segments or the lower lobe superior segment.
- Why?
- Physicians and textbooks teach us it is **all about the higher oxygen tensions** in the upper lobes.
- Well, the story is **not** that clear...



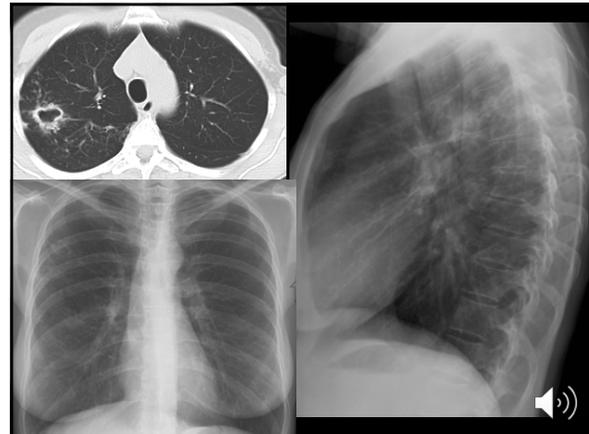
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Tuberculosis: Immune System

- **Normal immune system:** A reproducible distribution and imaging appearance.
- **Compromised immune system:** The distribution is *significantly changed*.
- **Therefore:** *Systemic* factors affect imaging presentation and likely *overshadow* the local factors.

*Geng et al. JAMA, June 2005

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Local Differences In The Upper Lobes Versus The Lower Lobes

- Reduced pulmonary flow **relative** to ventilation.
- Decreased CO₂ and increased O₂ levels.
- Increased pH (Alkaline environment).
- Reduced lymph production and flow.
- How do these “micro-environmental” differences affect pulmonary diseases?

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Goodwin & Des Prez Chest, 83(5) May 1983

- High oxygen is **not** the major determinate.
- The **decreased lymph production & flow** has a *very strong* correlation to TB's characteristic localization.
- Histoplasmosis, silicosis and chronic hypersensitivity pneumonitis also correlate.
- Most likely related to **antigenic induced inflammation**. (“Positive PPD”)

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CHF Septal Lines Reflect Lymphatic Drainage

How Does the Lymphatic Clearance Change as We Ascend in The Lungs?

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Lymphatic Drainage Much Higher Anteriorly Compared to Posteriorly

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Chronic Histoplasmosis



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Previously On The "Up to Date" Website

- Reactivation TB is "felt to occur in the upper lobes secondary to high oxygen tension". (Revised 2006)
- **1 Reference given:** Goodwin and Des Perez 1983 CHEST article!
- **This reference was *not* actually read by the author**

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"Still, a man hears what he wants to hear and disregards the rest."

Simon & Garfunkle, The Boxer

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How Do Medical Myths Develop?

- **"Plausible Theory" model:** It makes pathophysiologic sense, so it must be true.
- **"Dogma or Eminence-based" model:** If the experts say so, it must be true. "Blood is sonoluculent (simple fluid) on ultrasound or "FAST" exam."
- **"Bad Research" model:** Poor early research suggest myth. Later more rigorous research refutes the myth, but often does not make it into conventional teaching.

● *Flaherty R. Medical Mythology www.montana.edu

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Cephalization: Is There Pulmonary Edema?



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"Cephalization" as an Indication of Acute Left Sided Heart Failure

- **Eminence-based** medicine: Early acute hydrostatic edema is reflected by flow inversion or "cephalization".
- This is based on numerous articles from the 1950's and 60's in patient's with **longstanding mitral stenosis**.
- The early 1970's saw scattered articles in reference to **acute MI**.

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McHugh TJ, Forrester JS, Adler L, Zion D, Swan HJC. Pulmonary Vascular Congestion in Acute Myocardial Infarction: Hemodynamic and Radiologic Correlations. *Ann Intern Med* 76: 29, 1972

- The Swan-Ganz Catheter entered clinical use in 1970
- This study found a 90% correlation with PVH (Cephalization) and PCW pressures. The other 10% had serious discrepancies. (Supine & Semi-upright films)
- Set foundation for teaching that still occurs today. **This study is still referenced.**

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Acute MI and Cephalization

- Lasser et al (1970): PCW pressures had a correlation with edema (*not* cephalization), but there was a great deal of overlap
- Harrison et al (1971): found that flow inversion was not a reliable indicator due to the difficulty seeing it on the radiograph. ("Hand-waving")
- Kostuk et al (1973): found only 1 of 86 patients with acute MI had some flow inversion. They found no useful correlation with this sign in the acute setting.

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Acute Edema Studies: Problems

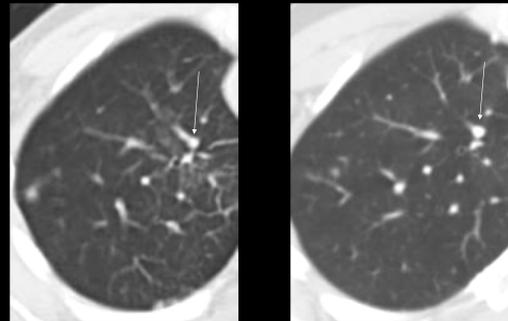
- Supine or Semi-upright portable exams
- Quality of narrow Latitude films were poor
- Pulmonary capillary wedge pressures are not completely reliable. (33% incorrect)*
- Hydrostatic edema and capillary leak were incompletely separated.

* Morris et al. *Crit Care Med* 13:705, 1985.

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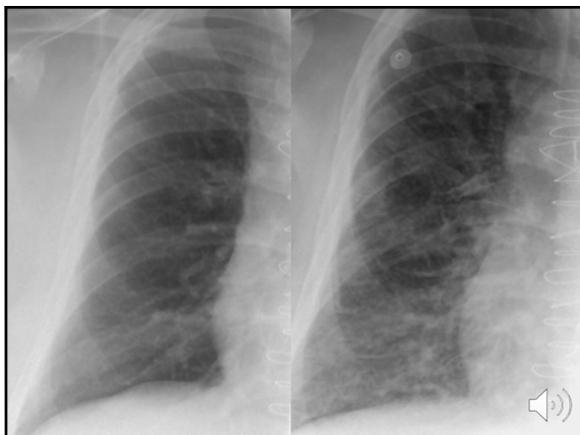
Acute Edema

No Edema



CT in Patient with Hydrostatic edema: Before and After Therapy

34



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Cephalization: What Does It Mean?

- Milne and Pistolesi found that cephalization **closely correlated with duration** of PVH/PVR rather than **severity of edema.** (1988)
- Goodman & Morgan found cephalization **rarely** occurred in *acute* LVF. (*Rad Clin North Am*: 1991; 29:943-63)

36

Ketai and Godwin. J of Thoracic Imaging
13:147-171 1998

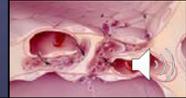
- Review of the evidence and daily observation supports flow inversion from **chronically** elevated venous pressures. (mitral stenosis or **chronic** LVF)
- Even with correction, it **often persists** on the radiograph. (organic microvascular changes)
- Vessel compliance likely a factor.



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Cephalization: Practical Points

- The presence of flow inversion indicates a **long standing history of PVH/PVR**. (Not common with *acute* LVF)
- **Predisposition** for hydrostatic edema.
- *Exact mechanism is not clear*, but likely relates to vessel compliance, neural (reversible) and microvascular organic changes (permanent).



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Truth pass through 3 stages:
First, It is ridiculed. *Second*, It is violently opposed. *Third*, It is eventually accepted as being Self Evident.

Arthur Schopenhauer



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Myth Evolution

Original work may have been accurate but, *things do change over time...*

- Disease presentations.
- The understanding of disease pathology.
- The treatments are different.
- The imaging technology has changed.
- Example: "BPD *often* has a cystic/bubbly appearance on the radiograph."



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The 'Wide Mediastinum'

- **Dogma**: A wide mediastinum with trauma indicates a *possible* hematoma, which *may* be secondary to great vessel injury.
- In other words... a widened mediastinum is an **indirect sign** of a hematoma, which then is a **possible sign** of great vessel injury!
- When this term is used... *Clinicians get anxious*
- What about this? A 'wide mediastinum' in a trauma patient may represent a **GOOD prognosis**.



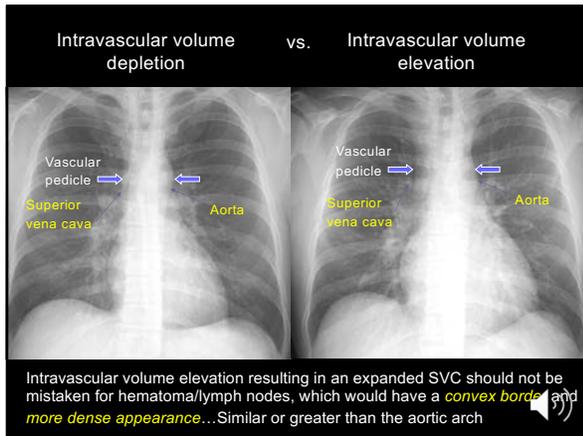
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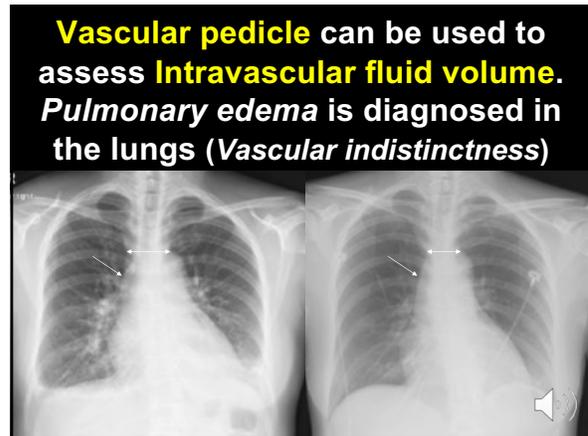
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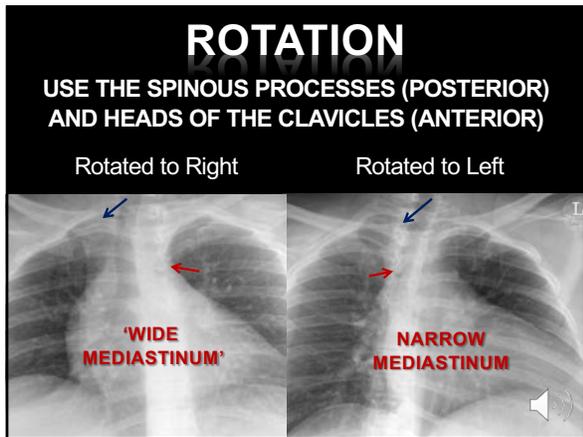
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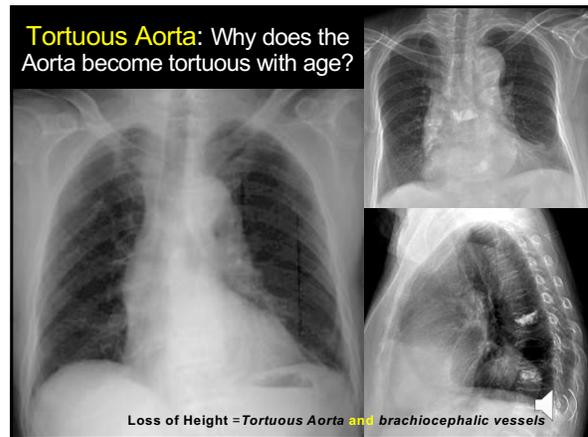
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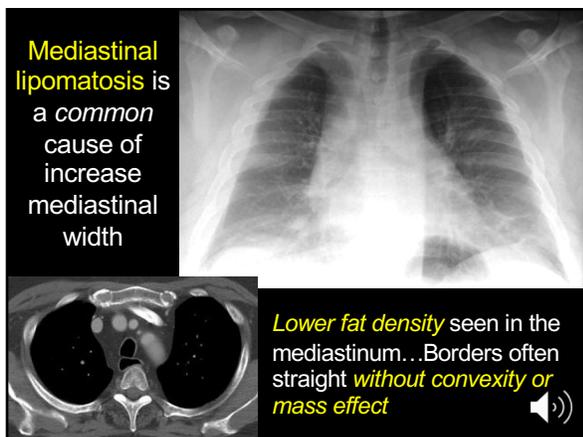
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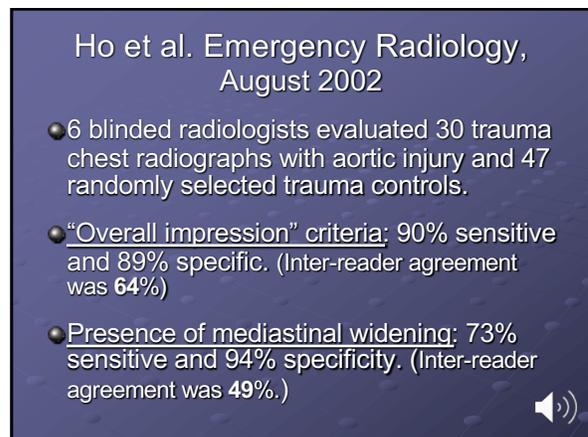
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Ho et al. Emergency Radiology, August 2002: Conclusions

- “Medical education has ingrained the widely promoted concept of mediastinal widening, which may be misleading.”
- “We believe that the use of this term causes confusion and *should be discontinued.*”



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‘Wide Mediastinum’: Definition

- **1976:** Marsh et al concluded that > 8 cm or $> 25\%$ of the thoracic cavity is abnormal.
- How has the *imaging technology*, *Generalized body habitus* and *trauma protocol* changed over the last 30 years since this study?



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Older Film Screen radiographs had a *Narrow Latitude*. The mediastinum was *often uniformly white*, so contour and width were the 2 imaging features to use. With the *Wide Latitude* used today, *the mediastinum has varying densities that can be used.*



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Trauma Imaging: Changes

- Current trauma protocol places the cassette under the trauma board or in the table; not *directly under* the patient.
- This increases the patient to screen distance...
- The result: **A magnification of 17 – 25%!**
- *Phantom measurements in OHSU trauma bay



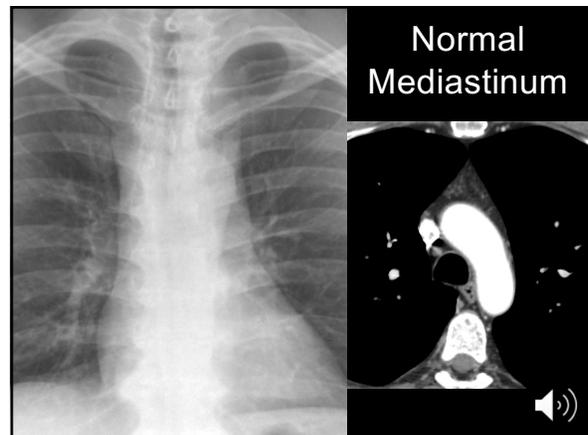
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Avoid term: ‘Wide Mediastinum’ *Approach from a different perspective*

- The Aortic Arch is **horizontal** and the SVC is **vertical** in orientation.
- Therefore, the **aortic arch** should be **more dense** than the right paratracheal region.
- Use the Arch as a *standard of reference*
- A hematoma or enlarged lymph nodes/mass will give a **similar/greater density** of the SVC side compared to the arch.



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Using **density and contour** of the mediastinum is a practical perceptual method to identify pathology.
Aortic Arch is the standard of reference for density.

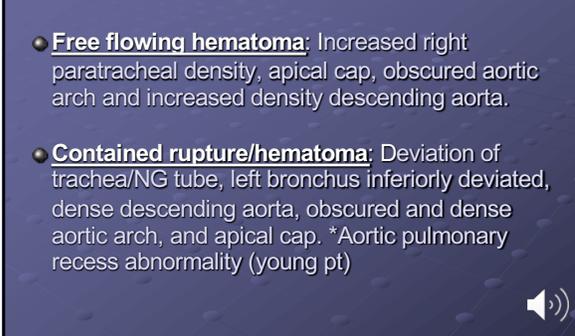


A frontal chest radiograph showing the mediastinum. The aortic arch is clearly visible and serves as a reference point for density. A small white arrow points to the aortic arch. A speaker icon is in the bottom right corner.

55

2 Common Manifestations Of **Hematoma** On Chest Radiograph

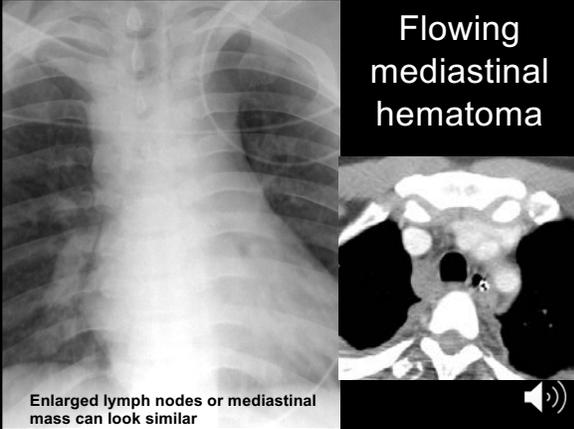
- **Free flowing hematoma:** Increased right paratracheal density, apical cap, obscured aortic arch and increased density descending aorta.
- **Contained rupture/hematoma:** Deviation of trachea/NG tube, left bronchus inferiorly deviated, dense descending aorta, obscured and dense aortic arch, and apical cap. *Aortic pulmonary recess abnormality (young pt)



A frontal chest radiograph showing a contained rupture/hematoma. The mediastinum is widened, and there is a dense area in the right paratracheal region. A speaker icon is in the bottom right corner.

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Flowing mediastinal hematoma

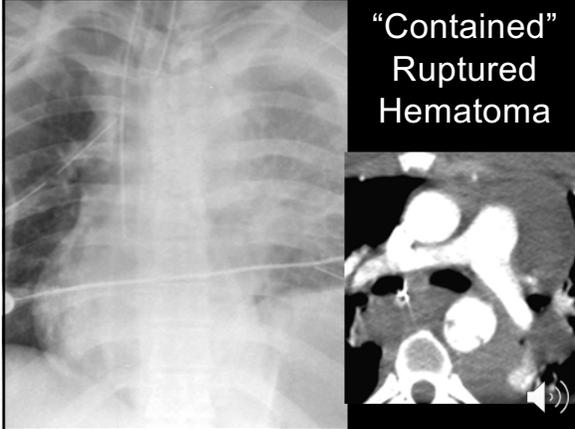


A frontal chest radiograph and an axial CT scan. The radiograph shows a widened mediastinum. The CT scan shows a hyperdense, flowing hematoma in the mediastinum. A speaker icon is in the bottom right corner.

Enlarged lymph nodes or mediastinal mass can look similar

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"Contained" Ruptured Hematoma



A frontal chest radiograph and an axial CT scan. The radiograph shows a widened mediastinum. The CT scan shows a hyperdense, contained hematoma in the mediastinum. A speaker icon is in the bottom right corner.

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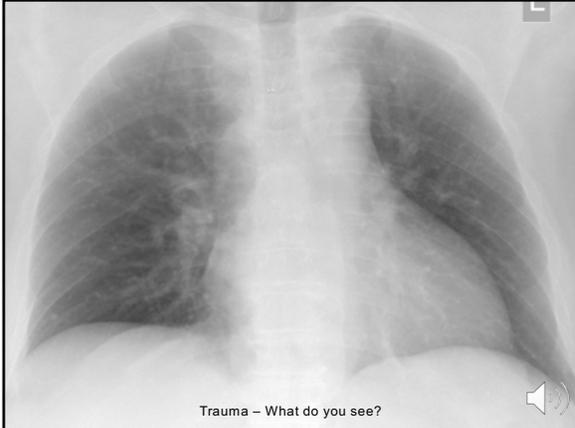
MVA: What do you see?



A frontal chest radiograph showing findings after a motor vehicle accident. There is a widened mediastinum and a hazy area in the right lung. A speaker icon is in the bottom right corner.

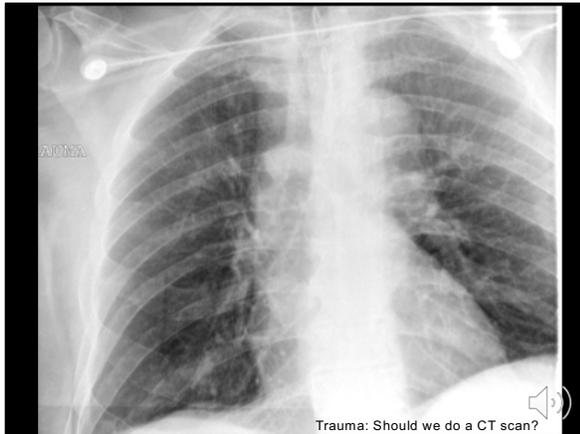
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Trauma – What do you see?



A frontal chest radiograph showing findings after trauma. There is a widened mediastinum and a hazy area in the right lung. A speaker icon is in the bottom right corner.

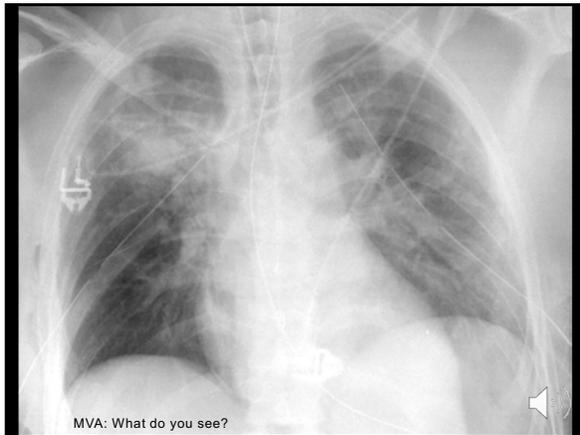
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Summary: Mediastinum

- Increased intravascular volume, fat deposition, tortuous aorta and/or rotation to the right *most common* for 'wide mediastinum'/Vascular Pedicle.
- Compare the **DENSITY** of the right paratracheal region to the aortic arch
- Mass effect, poorly seen Arch and convex AP recess.
- **Avoid the term 'Wide Mediastinum'**

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"Where *all* think alike, *no* one thinks very much."

Walter Lippmann

"People are like Snowflakes"

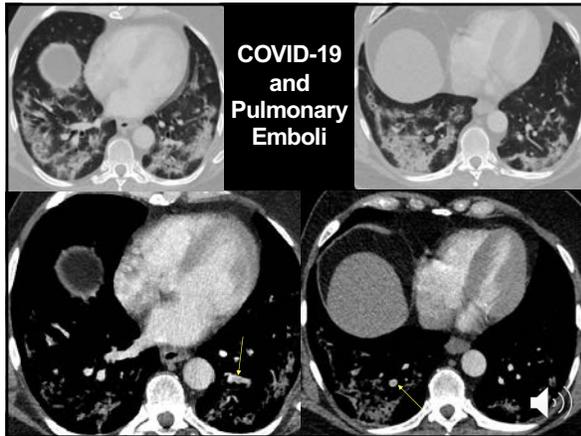
Lewis Black (Comedian)

65

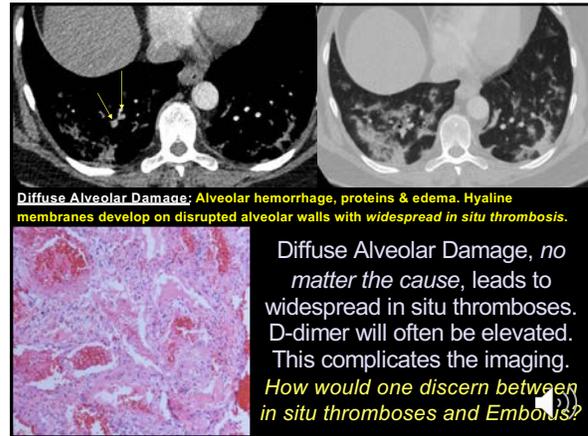
Myth Propagation: *Bias Models*

- **Bias** influences the literature *and* our clinical observations *towards* the currently held belief.
- 1. "**We've shown something here**" – interpretation tainted by researchers' enthusiasm for a positive result. i.e...Jupiter Study & Statins. COVID associated PE's...*But most are likely in situ thrombus*
- 2. "**If enough people say it, it becomes true**" – i.e. A pneumonia will "bloom" on a radiograph with hydration
- 3. "**Just keep taking the tablets**" – tendency to overestimate benefits & underestimate the harms of drug therapy,

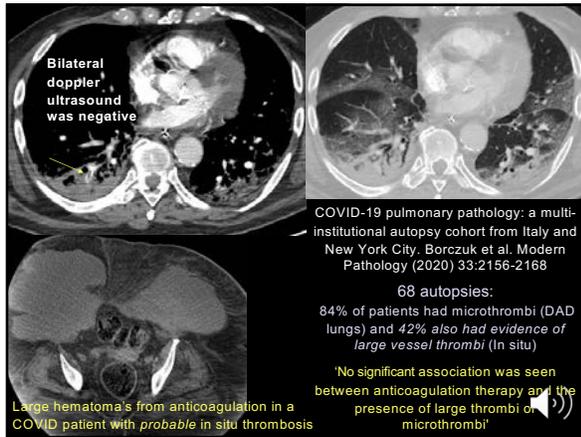
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‘Education is a progression from a cocky ignorance to a miserable uncertainty.’

Albert Einstein*

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Myth Propagation: **Knowledge Inertia** and **Review Articles**

- **Knowledge Inertia:** We teach and practice what we have learned in medical school & residency.
- Review articles and the numerous medical web sites *very often* propagate medical myths! (Extensive cross referencing)
- “Standard of Care” often used. For example: **All PE should be treated with anticoagulation...**

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How Else Myths Affect Medical Studies

- **Leads to Surrogate Outcome Measurements**
- **Examples:**
 - Weight loss vs. Health
 - Cancer stage detection (screening) vs. mortality reduction
 - Reduction in DVT rate with anticoagulation vs. morbidity/mortality
 - Pregnancy induced specific coagulation factor changes vs. Overall coagulation function

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How We Deal with Uncertainty is Central to Myth Propagation

- Find a healthy way to be Secure with your own Insecurity
- Be Skeptical and humble... Observe and Constantly generate questions
- The book of what we **DO NOT KNOW** in Medicine is Substantially Larger than the book of what we DO KNOW!

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Breaking Down the Myth: **Observation** and "**Learning to See**" (Sir William Osler)

- Observation is the *hallmark of science*.
- Discovery of new ideas depends on observing something that is **discordant** with our current understanding.
- Detecting *patterns* over time leads to a hypothesis creation & further investigation.
- "Why is this my first PE seen in a post partum patient over 9 years?" (Note: Patient is post C-section, 2 blood transfusions, lupus anticoagulate positive and intubated in the ICU)

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Medical Knowledge and Therapy Are Always Evolving: **Observation is the Cornerstone.**



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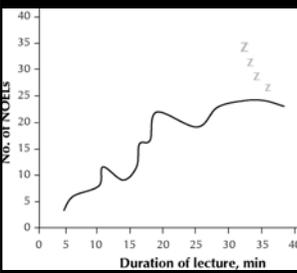
Thank you!

mgosselin@visionradiology.com or gosselin@ohsu.edu



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Number of nodding-off events per lecture (NOELs) per 100 attendees over length of time of presentation



Factor	Odds ratio (and 95% CI)
Environmental	
Dim lighting	1.6 (0.8-2.5)
Warm room temperature	1.4 (0.9-1.6)
Comfortable seating	1.0 (0.7-1.3)
Audiovisual	
Poor slides	1.8 (1.3-2.0)
Failure to speak into microphone	1.7 (1.3-2.1)
Circadian	
Early morning	1.3 (0.9-1.8)
Post prandial	1.7 (0.9-2.3)
Speaker-related	
Monotonous tone	6.8 (5.4-8.0)
Tweed jacket	2.1 (1.7-3.0)
Losing place in lecture	2.0 (1.5-2.6)

Rockwood, K. et al. CMAJ 2004;171:1443-1445

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Uncertainty

- Association does NOT equal Causation
- Add in elements of Moral Hazard & Ego
- Leads to Pluralistic Ignorance
- Results in "Eminence-Based" Medical Teaching and possible BS-style teaching
- Certainty is an illusion that leads to false confidence and develops into Dogma... Which then leads to Certainty

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'Bullshit'

- A method to *Improve the Perception* of Knowledge
- It is Commonly Used in circumstances where we do not really understand, but the information is given with a sense of confidence

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INVISIBLE TO THE EYE RICHARD B. GUNDERMAN, MD, PhD

Bullshit

Amid the industrial and agricultural chemicals leaching into our drinking water, the automobile emissions fouling the air, and the herbicides and hormones with which much of our food supply is laced, one pollutant poses a far greater threat. It permeates not our

Bullshit is different. Although it too is a form of deliberate misrepresentation, bullshitters do not really care whether what they are saying is true or not. Bullshitters merely do not want to be revealed as unknowing. They want everyone to think they know what they are talking

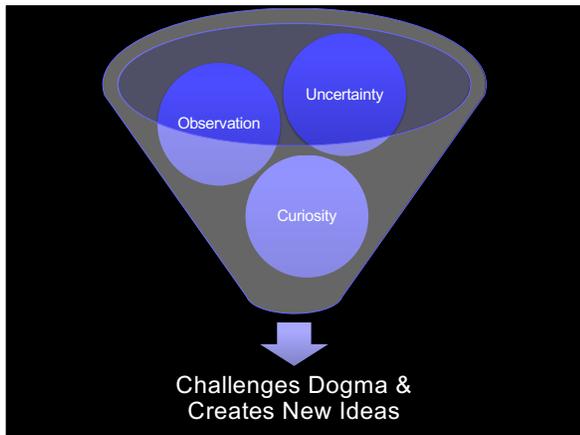
with excitement, he had flown like a comet at the speaker, out his way in, dashed right and left, saw the other had passed both and he had fallen exhausted, and so on. And so he told them all that.

Of course, bullshit is the nameable of excitement. Frankfurt describes excitement as the "escape" of

"BS is inevitable in situations that require us to talk or write about something we do not understand. This is one of the dangers in perpetuating the myth of the perfect physician."

"Bullshit is different (from lying). Although it too is a form of deliberate misrepresentation, BS'ers do not really care whether what they are saying is true or not. BS'ers merely do not want to be revealed as unknowing... To tell a lie, it is necessary to know the truth, but to BS it is only necessary not to care about it."

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Wisdom:

It is *not* the same as Knowledge

- Wisdom is hard to find, since no one knows where to look for it
- Open mind, curiosity and most importantly...Observe (*Learn to See*)
- Often it is *insignificant events* that allow a discovery. I.e. Penicillin and mold
- "*The Eyes are useless when the mind is closed*" – Graffiti Vancouver, BC Bus Station

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"Your time is limited, so don't waste it living someone else's life. Don't be trapped by dogma-which is living with the results of other peoples thinking. Don't let the noise of others opinions draw out your own inner voice. Most important, Have the courage to follow your heart & intuition. They already somehow know, what you truly want. Everything else is secondary."

Steve Jobs

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'It is a miracle that curiosity survives formal education.'

Albert Einstein

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Beware of Lysenkoism!

- Russia – Trofim Lysenko Began 1920 until finally Ending in 1964
- Lysenkoism is used metaphorically to describe the manipulation or distortion of the scientific process as a way to reach a *predetermined conclusion* as dictated by an *ideological bias*, often related to social or political objectives

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“The Chest Radiograph Can Not Diagnose a Pericardial Effusion”

- The Echocardiogram is commonly used and is good for transudates, not so much for the exudative effusions
- The chest radiograph can “only” identify a large global cardiac “silhouette”
- However, there are at least **six signs** that can help distinguish cardiomegaly from a pericardial effusion

89

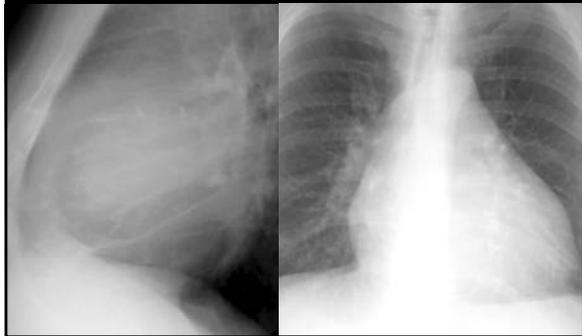
Cardiomegaly Versus Pericardial Effusion

- Rapid onset of silhouette enlargement
- “Oreo” sign (lateral projection >4 mm)
- Wide vascular pedicle without edema.
- No “cephalization” or flow inversion.
- Pacemaker/ICD leads or Swan catheter.
- Superior pericardial border visualization.



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"Oreo" Sign and Superior Pericardial Border



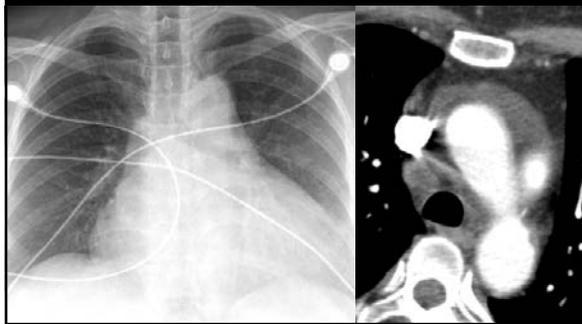
91

Pericardial Effusion



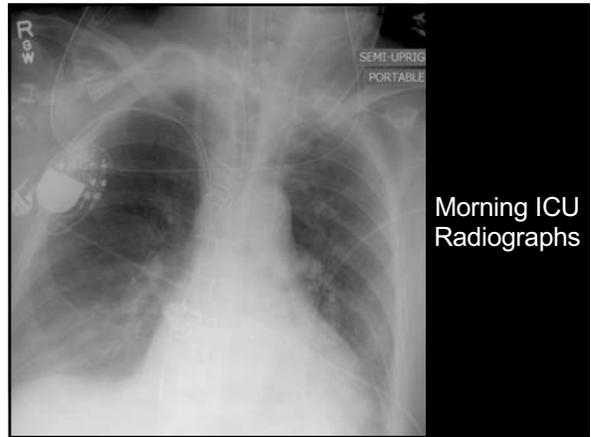
92

Superior Pericardial Border



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Morning ICU Radiographs



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Post Op Day 1



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97

Ilivitzki, A: Deep sedation during pneumatic reduction of intussusception

Pediatr Radiol Feb 2 2012.

- 119 Children – 121 reduced (92%), 10 (8%) Failed Avg floro Time 1.5 minutes
- 2 perforations (1.5%) Baseline with air estimated at (1.1% - 1991)
- No complications of Sedation
- Smooth muscle relaxation hypothesized.

98

Collins, I et al. Hydrostatic reduction of ileocolic intussusception: A 2nd Attempt in the operating room with general anesthesia. Journal of Pediatrics 1989

- 31 of 62 patients failed reduction
- 2/3 (21) of these patients were successfully reduced without surgery
- 10 required surgery – These were quite difficult and some needed resection
- Smooth muscle relaxation hypothesized as the reason for reduction
- Confounding: May be related to 2nd attempt, not the anesthesia

99

Shiels w, Colonic perforation by air & liquid: comparisons in young pigs.

J Roentgenol, 1993; 160 931-5

- General anesthesia had a slightly higher perforation rate than light anesthesia.
- Enemas were done *until a perforation occurred*. It occurred on average of 108 mm Hg without Valsalva and 145 mm Hg with Valsalva.
- Straining is hypothesized as the reason (Valsalva maneuver)

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The Value of Valsalva?

- Increase intra abdominal pressures make it more difficult to reduce the intussusception, requiring higher pressures.
- The Value of pre medication with short acting fentanyl was found with Touloukian's study in 1987
- Touloukian RJ, et al. Analgesic premedication in the management of ileocolic intussusception. Pediatrics 1987;79:432-434.

101

“Wide Mediastinum”: Practical Points

- Compare the DENSITY of the right paratracheal region to the aortic arch (flowing hematoma).
- Mass effect and increased arch density.
- Important: Radiograph is only a screening study...ANY HIGH RISK individual should undergo further evaluation.
- Upright exam (low risk) or CT

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20% Reduction in Cardiac Death Found on Mediterranean Diet

- How Information is presented to Physicians & the Public
- *How about this one?* 1 in 9 Women will get Breast Cancer during their Lifetime
- Or... There is an 80% Reduction in Death from Breast Cancer in HIGH RISK women who undergo bilateral mastectomies

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Medical Studies: OUTCOMES

- **What is a Surrogate Outcome Measurement**
- Examples:
 - Weight loss vs. Health
 - Cancer stage detection (screening) vs. mortality reduction
 - Reduction in DVT rate with anticoagulation vs. morbidity/mortality
 - Pregnancy induced specific coagulation factor changes vs. Overall coagulation function
 - Etc...

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Who Funded The Study?

- A Strong Bias is Often Present
- Positive Results Should be viewed with Skepticism
- Harms are Often Minimized Compared to Apparent Benefits
- Statins and Elevated C-Reactive Protein
- Chocolate Milk after Exercise

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What is The Gold Standard

- An Investigative Test that is compared and superior than the Gold Standard will still always fare less well
- CTA and Conventional Angiography for PE
- Colonoscopy and Barium Enema for Polyps
- Radiograph & H&P compared to Swan Cath for CHF in Chronic Left Vent. Dysfunction

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Conclusions...

- When you hear alert phrases...*Be Skeptical*
- Beware of data presented in **Relative Risk**
- Ask for **Absolute Risk Frequencies** or NNT
- Understand that there is **often uncertainty** with each doctor
- The medical information available is often misleading, and may cause confusion ('Fox News')

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“The Greatest Obstacle to Discovery is Not Ignorance...It is The Illusion of Knowledge”

Daniel J. Boorstin



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Innumeracy

- Inability to reason about uncertainties and risk*
 - Illusion of certainty
 - Ignorance of risk
 - Miscommunication of risk
 - Clouded thinking/drawing inference

Calculated Risks. Gerd Gigerenzer. Simon&schuster. 2002

109

Physicians And Innumeracy

Annals of Internal Medicine
ESTABLISHED IN 1937 BY THE AMERICAN COLLEGE OF PHYSICIANS

Home Current Issue All Issues Online First Collections In the Clinic Journal Club CME

8 March 2012, Vol 156, No. 5

Email Share Get Citation Slideset (.ppt) PDF

Original Research 8 March 2012

Do Physicians Understand Cancer Screening Statistics? A National Survey of Primary Care Physicians in the United States

Odette Wegwarth, PhD; Lisa M. Schwartz, MD, MS; Steven Woloshin, MD, MS; Wolfgang Gaismaier, PhD; and Gerd Gigerenzer, PhD

[-] Article and Author Information

See Also:
What We Don't Know Can Hurt Our Patients: Physician Innumeracy and Oupuse of Screening Tests

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Case Example:

41 year old female “Ms. Odds’ with history of hypertension, otherwise healthy comes into clinic for follow up. She has a friend whose mother died from breast cancer and is wondering if she should get a screening mammogram...

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Choices:

- She returns a month later, stating she went ahead and got a mammogram from a screening fair-- *its come back positive*, what is her chance she has breast cancer?

- A. 90%
- B. 70%
- C. 50%
- D. 30%
- E. 10%
- F. 1%

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Background Data:

- Age 40-50 yo women
- **Incidence** of breast cancer in 10 years= 1.4%
- **Sensitivity** of mammogram test (If B+ then M+) = 75%
- **False positive rate** of mammogram (If B- then M+) =10%
- If Ms. Odds has a positive mammogram, what is her chance of breast cancer?

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Choices:

- A. 90%
- B. 70%
- C. 50%
- D. 30%
- E. 10%
- F. 1%

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Answer:

- A. 90%
- B. 70%
- C. 50%
- D. 30%
- **E. 10%**
- F. 1%

Out of 100 women in age 40 group with a positive screening mammogram, 10 will have diagnosis of breast cancer

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Uncertainty versus Risk

Risk is the *quantification* of uncertainty into a probability or frequency based on empiric data

How do we quantify risk...

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Risk “Mis”Communication “Innumeracy”

- A. Single event probabilities
 - “you have 30% chance of side effect”
 - Lack of reference causes confusion
- B. Comparing treatment effects
 - RR - largest effect, drug companies
 - AR - how patients like to hear risks from MD
 - NNT - how we communicate to peers
- C. Conditional probabilities
 - sensitivity is not the same as PPV of a test

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Overcoming Innumeracy

- 1. Defeat illusion of certainty
- 2. Learn about the actual risks of relevant events and actions
- 3. Communicate/Ask about the risks in an understandable way as well as other options
- This may be a good “I-Thou” moment

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Use Natural Frequencies

Representing Bayes Theorem through Frequencies

```

            graph TD
            A[1,000 people] --> B[14 disease]
            A --> C[986 no disease]
            B --> D[12 positive]
            B --> E[2 negative]
            C --> F[99 positive]
            C --> G[887 negative]
            
```

$P(B+|M+) = 12 / (12 + 99) = 10\%$ (Bayes Theorem)

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Improving Numeracy: Change the Context

Data type:	Example:	Potential Solution:
Single Event Probabilities	“30% risk of side effect”	Use frequency statement: “3 out of 10 patients have side effects”
Conditional probabilities	Sensitivity, specificity, positive predictive value	Use natural frequencies to represent Bayes Theorem & PPV
Relative Risk	15 of 1000 mortality in group A; 12 of 1000 mortality in group B; Relative risk reduction is 20%	Use absolute risks (3/1000) or Number needed to treat (with peers): 333 patients need to be screened/treated to prevent 1 death

Adapted from gigerenzer, edwards, “simple tools for understanding risks: from innumeracy to insight.” BMJ 2003

120

Albert Einstein

● “He who joyfully marches to music in rank and file has already earned my contempt. He has been given a large brain by mistake, since for him the spinal cord would suffice.”