Eastern Association for the Surgery of Trauma

Advanced Practitioners in Trauma Workshop
Hospital Complications in Trauma and Acute Care Surgery

January 15, 2015
Disney's Contemporary Resort
Lake Buena Vista, Florida

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**This workshop qualifies for Self-Assessment Credit.

American College of Surgeons
Division of Education

DVT/PE
Case Based

Paula Ferrada MD
Associate Director for the Surgical Critical Care Fellowship
Associate Director for the Surgical Residency
Assistant Professor
Trauma, Critical Care and Emergency Surgery
Virginia Commonwealth University
Richmond, VA

PE SXS/ Signs

- Dyspnea (79%)
- Tachypnea (57%)
- Pleuritic pain (47%)
- Leg edema, erythema, tenderness, palpable cord (47%)
- Cough/ hemoptysis (43%)

Incidence

900,000 PEs/ DVTs in USA in 2002.
Estimated 296,000 PE deaths:
7% treated, 34% sudden and fatal, and 59% undetected.
Heit J. ASH Abstract 2005

762,000 PEs/ DVTs in EU in 2004
Thromb Haemostas 2007; 98: 756

- The high death rate from PE (exceeding acute MI!) and the high frequency of undiagnosed PE causing "sudden cardiac death" emphasize the need for improved preventive efforts.
- Failure to institute prophylaxis is a much bigger problem with Medical Service patients than Surgical Service patients.

Annual # At-Risk for VTE: US Hospitals

- 7.7 million Medical Service inpatients
- 3.4 million Surgical Service inpatients
- Based upon ACCP guidelines for VTE prophylaxis

Anderson FA Jr, et al. Am J Hematol 2007; 82: 777-782

Case 1

- 21 yo F s/p MVC on 10/12 with pelvic fx and below-listed injuries
  - R distal radius fx
  - R ulnar styloid process fx
  - R displaced fxs of third-fifth metacarpal shafts w/soft tissue swelling
  - R acetabulum fx
  - L iliac wing fx
  - L pubic body sagittal fx
  - R superior and inferior pubic rami fxs
  - L inferior pubic ramus fx
  - L open femoral shaft fx

Case 1

- ICU protocol: DVT screen every Wednesday found to have a **Soleal DVT day 4**. What is the best course of action
  - Lovenox therapeutic
  - Lovenox treatment
  - Heparin drip
  - IVC filter
  - fondaparinux

Case 2

- 55 yo male prolonged ICU stay after multiple injuries. Has left leg swelling . Doppler shows an acute DVT right common femoral
  - Lovenox therapeutic
  - Lovenox treatment
  - Heparin drip
  - IVC filter
  - fondaparinux

Case 2

- Heparin drip started; with 6 hours massive melena BP 80/palp HR 140
  - Then what?

Diagnostic investigations

If a patient presents with signs or symptoms of DVT, carry out the following to exclude other causes:

- an assessment of their general medical history **and**
- a physical examination.

If DVT is suspected, use the two-level DVT Wells score.

Diagnostic investigations

Wells score = DVT likely

Offer **either**:

- proximal leg vein ultrasound scan (within 4 hours of request), if negative, a D-dimer test **or**
- if proximal leg vein scan not available within 4 hours, D-dimer test and an interim 24-hour dose of a parenteral followed by proximal leg vein ultrasound within 24 hours of request

Repeat proximal leg vein ultrasound scan 6–8 days later for all patients with positive D-dimer test and negative proximal leg vein ultrasound scan.

Thromboembolism after trauma

AN ANALYSIS OF 1602 EPISODES FROM THE ACS NATIONAL TRAUMA DATA BANK

Annals of Surgery 2004

M. Margaret Knudson MD
Danagra G. Ikossi MD
Linda Khaw BA
Diane Morabito RN, MPH
Larisa S. Speetzen BA

The University of California, San Francisco

VTE Risk Factor Analysis

Hypotheses:

- Clinical incidence of VTE - relatively low
- Patients who would benefit from VTE prophylaxis could be clearly identified

Methods

Data source: NTDB (1994-2001)

Data analysis:

- Demographics
- Nature/severity of injuries
- Complications/outcomes

Survey: participating trauma centers

- VTE risk factors/protocols

Results

- 450,375 patients included
- 84% blunt injuries
- 31% ISS>10
- 998 pts: DVT (0.36%)
- 522 pts: PE (0.13%)
- 82 pts: both DVT/PE
- PE mortality: 18.7%

Risk Factor Analysis

Risk Factor *	Odds Ratio
Shock on admission (BP < 90 mHg)	1.95
Age ≥ 40 yrs.	2.29
Head injury (AIS ≥ 3)	2.59
Pelvic fracture	2.93
Lower extremity fracture	3.16
Spinal cord injury with paralysis	3.39

* Greenfield 1997, 2000; Knudson 1994, 1996

p < .0001 for all factors

Risk Factor Analysis

Risk Factor	Odds Ratio
Major surgical procedure	4.32
Venous injury	7.93
Ventilator days > 3	10.62

p < .0001 for all factors

Multivariate Analysis

Risk Factor	Odds Ratio
Head injury (AIS ≥ 3)	1.24
Major operative procedure	1.53
Lower extremity fracture (AIS ≥ 3)	1.92
Age ≥ 40 years	2.01
Venous injury	3.56
Ventilator days > 3	8.08

p ≤ 0.0125 for all factors

Conclusions

- Clinically significant VTE rates: low
- 90% VTE pts. have at least 1 risk factor
- VTE risk- varies with each factor
- Role of IVC filters: re-examined

IVC Filters: Is the long-term risk justified by the immediate benefit?

Indication

1. Contraindication to anticoagulation with DVT / PE
   GI bleed / Intracranial Hemorrhage
2. Failed anticoagulation with DVT / PE
3. Trauma patient at High risk for DVT / PE
4. High risk procedure for thromboembolism with history of venous thromboembolism
5. Patient with VTE at high risk secondary to location
   Free floating clot

Why?

1979	2000
2007	167000
2012	259000

http://www.fda.gov/Safety/MedWatch/SafetyInformation/SafetyAlertsforHumanMedicalProducts/ucm221707.htm

Since 2005, the FDA has received 921 device adverse event reports involving IVC filters, of which 328 involved device migration, 146 involved embolizations (detachment of device components), 70 involved perforation of the IVC, and 56 involved filter fracture.

Short term Complications

- Insertion or deployment- related complication
  - Pneumothorax / Hemothorax
  - Wound hematoma / bleeding: 2.4 -4.2%
  - Arterial injury
  - A-V fistula
  - Ulceration
- Placement
  - Vessel wall perforation / cardiac tamponade
  - Pulmonary embolus
  - Misplacement：
    - Incidence of 0.7-4.6 %
    - 2.5% with cavography

Short term Complications

- Migration
  - Overall Incidence (>9mm) 2.9 to 12 %
  - 1990's: high incidence 48 -76%
  - 30% with old stainless steel Greenfield filters
  - 11% titanium GF filters with modified hooks

Greenfield LJ, Proctor MC.. J Vasc Surg 2001;33:510-4.
Greenfield LJ, et al. J Vasc Surg 2000;32:490-5.
Rogers FB et al. Arch Surg 1998;133:406-11.

Long-term Complications

- Thrombosis at Insertion Site : 1.8% -24.7 %
- Distal Deep Venous Thrombosis: 18% – 35.7%
- Filter
  - Thrombus: 3.1 to 11.4%
  - Angulation: 0.6%
  - Endothelialization: 1.9%

Greenfield LJ, Proctor MC.. J Vasc Surg 2001;33:510-4.
Greenfield LJ, et al. J Vasc Surg 2000;32:490-5.
Rogers FB et al. Arch Surg 1998;133:406-11.

Longterm Complications

- IVC occlusion/thrombosis
  - Filter dependent:
    - GF 1 - 9% (currently 3.6%)
    - Vena Teck 4.5-24%
    - Simon Nitinol 3.5%
  - 2 % in General Population
  - 2.3 to 3.5% in Trauma Population

Greenfield LJ, Proctor MC.. J Vasc Surg 2001;33:510-4.
Greenfield LJ, et al. J Vasc Surg 2000;32:490-5.
Rogers FB et al. Arch Surg 1998;133:406-11.

Long-term Complications

- Filter erosion or perforation of the IVC
  - GF 30%
  - Bird's Nest 85-100%
  - Simon Nitinol 95%)
- Filter migration
- Recurrent PE :
  - 2.5 to 7.7 % reported incidence
  - Fatal Recurrent PE: 0-4.4 %

Greenfield LJ, Proctor MC., J Vasc Surg 2001;33:510-4.
Greenfield LJ, et al. J Vasc Surg 2000;32:490-5.
Rogers FB et al. Arch Surg 1998;133:406-11.

Breakthrough PE
permanent filters-
Nonrandomized Case series

Permanent Filters
- 0 to 4.6% incidence

Removable Filters
- 0 to 1.9%

PE Prophylaxis

Greenfield LJ, Proctor MC. Recurrent thromboembolism in patients with vena cava filters. J Vasc Surg 2001;33:510-4.

Among 1191 patients receiving filters for a variety of indications
- 2% developed PE

Greenfield LJ, Proctor MC, Michaels AJ, et al. Prophylactic vena caval filters in trauma: the rest of the story. J Vasc Surg 2000;32:490-5

In 385 trauma populations receiving IVC filters
- 249 (65%) Prophylaxis purposes
  - PE in 1.5% of pts
- 136 (35%) after a diagnosis of VTE
  - PE in 2.3% of pts

Breakthrough PE

permanent filters – randomized trials

Randomized Controlled Trials: PREPIC STUDY

PREPIC Study Group. Eight-year follow-up of patients with permanent vena cava filters in the prevention of pulmonary embolism: the PREPIC (Prevention du Risque d'Embolie Pulmonaire par Interruption Cave) randomized study. Circulation 2005;112:416-22.

- 400 pts
  - DVT with and without PE
  - Anticoagulation therapy (>3mon) +/- filter
  - 8 year Follow up

TABLE 2. Cumulative Rate of Clinical Outcomes at 8 Years*

Characteristic	Filter (n = 200)	No Filter (n = 200)	Hazard Ratio (95% CI)	P
Symptomatic pulmonary embolism	9 (6.2)	24 (15.1)	0.37 (0.17–0.79)	0.008
Nonfatal	7	19		
Fatal	2	5		
Symptomatic recurrent deep-vein thrombosis	57 (35.7)	41 (27.5)	1.52 (1.02–2.27)	0.042
Deep-vein thrombosis of the lower limb	55	41		
Thrombosis of filter	26	21		
Symptomatic venous thromboembolism	58 (36.4)	55 (35.4)	1.12 (0.78–1.62)	0.54
Pulmonary embolism only	1	14		
Deep-vein thrombosis only	49	31		
Pulmonary embolism and deep-vein thrombosis	8	10		
Postthrombotic syndrome	109 (70.3)	107 (69.7)	0.87 (0.66–1.13)	0.30
Edema	92	80		
Varicose veins	48	52		
Trophic disorders	32	39		
Ulcers	5	15		
Death	98 (48.1)	103 (51.0)	0.97 (0.74–1.28)	0.83
Major bleeding	26 (15.4)	31 (18.5)	0.84 (0.50–1.42)	0.52

*Values are number of patients (cumulative rate in percent) or number of patients.
†Overall, 19 patients among 200 allocated to the no-filter group subsequently received a filter during the study period.

Prospective Randomized study comparing the clinical outcomes between inferior vena cava Greenfield and TrapEase filters. Usoh et al. J Vasc Surg 2010; 52 (2), 394-9

- Prospective Randomized study - July 2006- Nov. 2008
- 156 patients
  - 84 Greenfield Filter (12 Fr. Introducer)
  - 72 TrapEase (6 Fr. Introducer)
- FU duplex : 12 month FU : Day 1, Week 1, q 3 mon x4, q6mon x2

- Indication:
  - GI bleed 37
  - ICH 12
  - Free floating Clot 19
  - Failure of AC 29
  - PE 27
  - Prophylactic 4
  - Others : 32

Outcome
- IVC thrombosis 5/72 (6.9 %)
- Recurrent PE 1/72 (1.4 %)
  - Mortality 66/156 (42.3 %)
  - 2° to PE 1/156 (0.6 %)
- No filter migration
- No access site Thrombosis
- No misplacement
- No IVC perforation

Prospective Randomized study comparing the clinical outcomes between inferior vena cava Greenfield and TrapEase filters. Usoh et al. J Vasc Surg 2010; 52 (2), 394-9

Table III. Patients with inferior vena cava thrombus[a]

Pt	Age	Sex	Medical history	Indication for VCF	Time to occurrence	VCF-related complication	Outcome
1	97	M	CHF, BPH, cholecystectomy PNA, GIB	AC contraindicated	2 days	IVT	Died (unrelated)
2	77	M	HTN, rec DVT, prostatectomy meningioma-craniotomy	AC contraindicated	42 days	IVCT/IVT	Alive
3	66	M	APKD/ESRD, HTN, CAC, rec DVT	Failure of AC	7 days	IVCT	Alive
4	53	M	Breast cancer, cholecystectomy, rec DVT	Failure of AC	9 days	IVCT	Alive
5	83	M	CVA, CAD, COPD, PHTN, GIB, CKD, HR, PE	Recurrent PE	14 days	IVT	Died (rec PE)[b]

AC, Anticoagulation; *APKD*, adult polycystic kidney disease; *BPH*, benign prostate hyperrophy; *CAC*, cerebral aneurysm clipping; *CAD*, coronary artery disease; *CHF*, congestive heart failure; *CKD*, chronic kidney disease; *COPD*, chronic obstructive pulmonary disease; *CVA*, cerebrovascular accident; *DVT*, deep veinous thrombosis; *ESRD*, end-stage renal disease; *GIB*, gastrointestinal bleeding; *HR*, hip replacement; *HTN*, hypertension; *IVCT*, inferior vena cava thrombosis; *IVT*, iliac vein thrombosis; *PE*, pulmonary embolism; *PHTN*, pulmonary hypertension; *PNA*, pneumonia; *VCF*, vena cava filter.
[a]All five patients were diagnosed with duplex imaging and treated symptomatically.
[b]Suspected recurrent PE as the cause of death.

Retrievable IVC filters

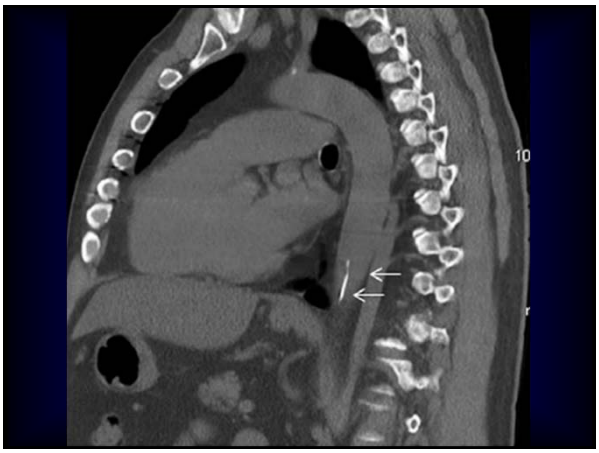
Kim HS, Young MJ, Narayan AK, et al. A comparison of clinical outcomes with retrievable and permanent inferior vena cava filters. J Vasc Interv Radiol 2008;19:393-99.

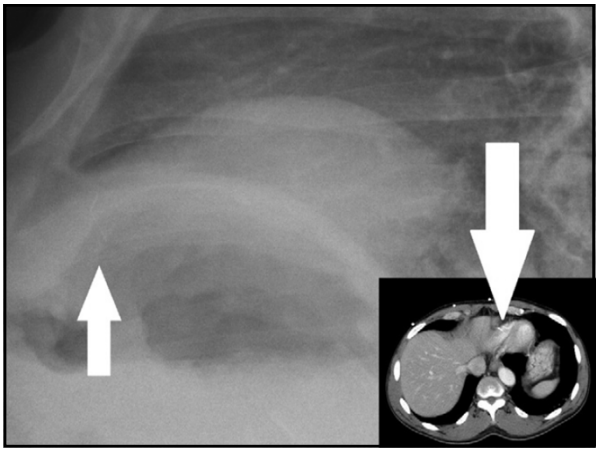
- 427 patients with retrievable filters
- 275 patients with permanent filters
- FU : 11.5 months
- PE occurred
  - 4.0% of retrievable filters
  - 4.7% of permanent filters
- 70% of retrievable filters were successfully removed
- 12 month FU : no PE post retrieval

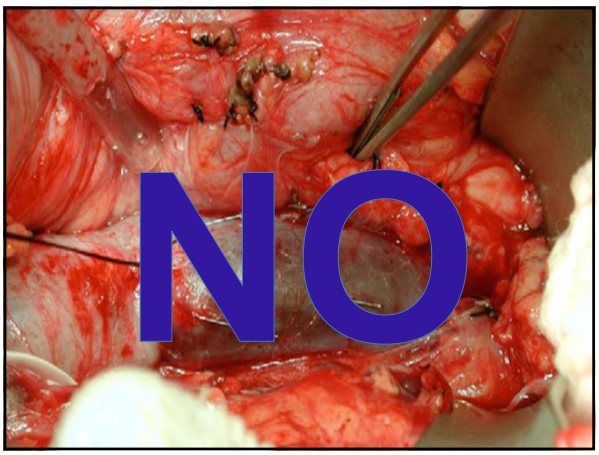
Retrievable IVC filters

Johnson ON III, Gillespie DL, Aidinian G, et al. The use of retrievable inferior vena cava filters in severely injured military trauma patients. J Vasc Surg 2009;49:425-21.

- 72 trauma patients with retrievable filters
  - Contraindications to retrieval 62.5%
  - Lost to FU 15.2%
  - Technical failure 2.8%
  - Died before retrieval 1.3%



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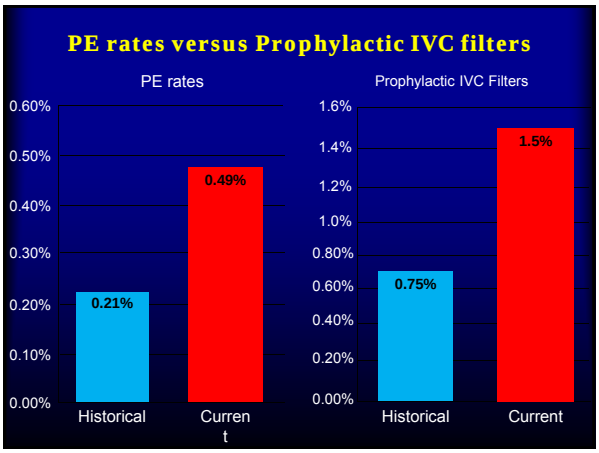

Recurrent symptomatic venous thromboembolism (VTE), major bleeding and mortality at 3 months – summary of two meta-analyses in deep vein thrombosis and pulmonary embolism

	Low molecular weight heparin (%)	Unfractionated heparin (%)	OR (95% CI)
Deep vein thrombosis			
Recurrent VTE	86/1998 (4.3)	113/2021 (5.6)	0.75 (0.55–1.01)
Major bleeding	30/2353 (1.3)	51/2401 (2.1)	0.60 (0.39–0.93)
Mortality	135/2108 (6.4)	172/2137 (8.0)	0.78 (0.62–0.99)
Pulmonary embolism			
Recurrent VTE	30/988 (3.0)	39/895 (4.4)	0.68 (0.42–1.09)
Major bleeding	14/1023 (1.4)	21/928 (2.3)	0.67 (0.36–1.27)
Mortality	46/988 (4.7)	55/895 (6.1)	0.77 (0.52–1.15)

Which of the following statement is false regarding DVTs

- Clinical diagnosis is very obvious
- Obese patients at higher risk
- Hip and knee replacement are high risk for developing DVT
- Optimal hydration is essential to prevent it

Case 3

- 66 yo male initially presenting for a crush and degloving injury to his left hand at work, no other trauma
- PMH: Hypercholesterolemia
- PSH: None
- Meds: Simvastatin
- All: NKDA
- Soc Hx: Denies EtOH, smoking

- HD 1 to OR for complex laceration repair, ORIF, and integra placement
- Initially on Lovenox for 2 days, then this was discontinued. Pt on ASA 325, statin, ancef
- Pt intermittently ambulatory but left hand in stockinette suspended from IV pole while in bed
- returned to OR Hd4 for debridement, Integra placement
- Kept in hospital for complex wound care

- HD 5 while walking had syncopal episode
- Apneic, cyanotic, unresponsive for 3 min
- BVM initiated, pulse ox 91%
- Awoke spontaneously and became appropriate
- c/o some pain in left lower chest
- SBP 100, HR 130s, RR 30s, sats 93% on 4L NC
- EKG sinus tach
- Troponin 0.4->1.22


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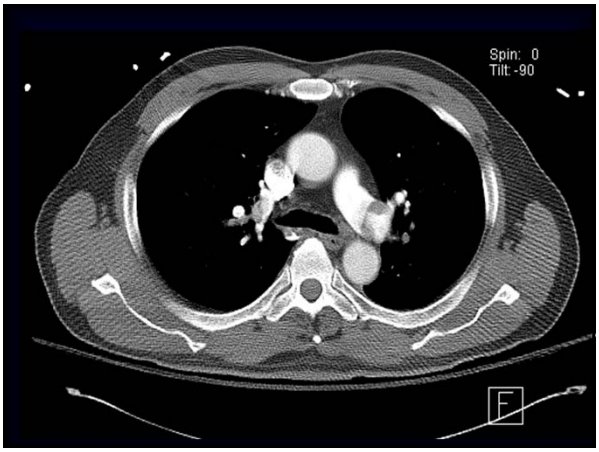
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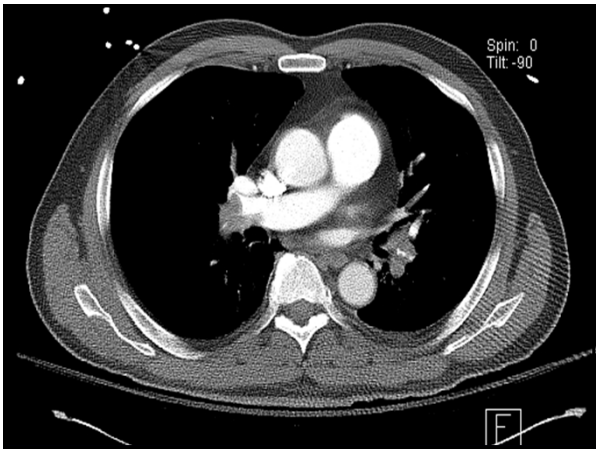
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Management of PE

- UFH gradually replaced by LMWH
- Similar efficacy and safety in sub- massive PE
- No difference in mortality between altepase and LMWH compared to LMWH alone (NEJM 2002)
- Thrombolytic therapy essential in massive PE (better identification of patients needed).

Thrombolytic Therapy in PE

Subgroup analysis of trials that included major (hemodynamically unstable) pulmonary embolism compared with those that excluded patients with major pulmonary embolism

Outcome	Trials that included patients with major PE			Trials that excluded patients with major PE		
	Lysis, *n/N* (%)	Heparin, *n/N* (%)	OR (95% CI)	Lysis, *n/N* (%)	Heparin, *n/N* (%)	OR (95% CI)
Recurrent PE or death	12/128 (9.4)	24/126 (19.0)	0.45 (0.22–0.92)	13/246 (5.3)	12/248 (4.8)	1.07 (0.50–2.30)
Recurrent PE	5/128 (3.9)	9/126 (7.1)	0.61 (0.23–1.62)	5/246 (2.0)	7/248 (2.8)	0.76 (0.28–2.08)
Death	8/128 (6.2)	16/126 (12.7)	0.47 (0.20–1.10)	8/246 (3.3)	6/248 (2.4)	1.16 (0.44–3.05)
Major bleeding	28/128 (21.9)	15/126 (11.9)	1.98 (1.00–3.92)	6/246 (2.4)	8/248 (3.2)	0.67 (0.24–1.86)

Wan et al, Circulation 2004.

Incidence of Occult PE after Trauma

- 90 consecutive patients; ISS≥ 9
- Asymptomatic; no DVT
- Chest CT: between 3-7 days
- 22 had clot on CT; 4 were major!
- 30% were receiving prophylaxis

Schultz et al J Trauma 2004


pferrada@mcvh-vcu.edu

Clostridium Difficile Infection
Early Identification and Treatment Strategies

Cassandra Winter, MPAS, PA-C
Trauma and Acute Care Surgery
UPMC Presbyterian
Pittsburgh, PA

Epidemiology

- Clostridium difficile (C diff) was identified as the causative organism in most cases of antibiotic-associated diarrhea in 1978

-*Clostridium difficile:* anaerobic, gram positive, spore forming, bacillus

Epidemiology

- The incidence of c diff is rising
- Death from CDI or CDI complications was about 4% in 2010
- An estimated $3.2 billion was spent on healthcare related to CDI in the US from 2000-2002.

Pathophysiology

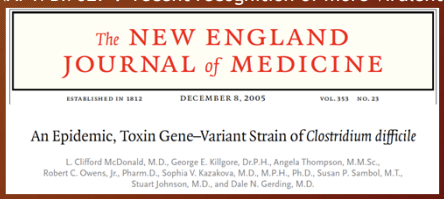
- C diff infection develops when intestinal flora is disrupted
- C diff produces exotoxins, Toxin A & B
- Patients with known carriage to c diff have higher levels of IgG antibodies to toxin A, decreasing their risk of infection

Epidemiology

- C diff is easily transmitted via the fecal-oral route
- C diff carriers are a significant source of environmental contamination, including in hospitals and long term care facilities

Epidemiology

- C diff, NAP1/BI/027-: recent recognition of more virulent strain


The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 DECEMBER 8, 2005 VOL. 353 NO. 23

An Epidemic, Toxin Gene–Variant Strain of *Clostridium difficile*

L. Clifford McDonald, M.D., George E. Killgore, Dr.P.H., Angela Thompson, M.M.Sc., Robert C. Owens, Jr., Pharm.D., Sophia V. Kazakova, M.D., M.P.H., Ph.D., Susan P. Sambol, M.T., Stuart Johnson, M.D., and Dale N. Gerding, M.D.

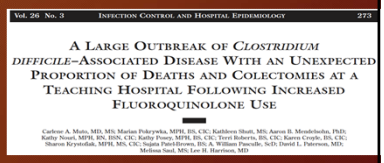
-More than 60% of isolates at UPMC

Epidemiology

- Healthy population colonization is ~3-6%
- Hospitalization increases colonization rate up to 20-50%
- Colonization and new exposure put patients at risk for CDAD, more so than patients who present as known carriers
- Community acquired infections are also on the rise

Risk Factors

- Antibiotics
  - All antibiotics carry the risk of CDAD
  - Clindamyin, fluoroquinolones, penicillins, cephalosporins
  - Risk of CDAD highest during treatment and one month after
    - CDAD can develop as long as 3 months after therapy
  - Perioperative antibiotics


Vol. 26 No. 3 INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY 273

A LARGE OUTBREAK OF *CLOSTRIDIUM DIFFICILE*–ASSOCIATED DISEASE WITH AN UNEXPECTED PROPORTION OF DEATHS AND COLECTOMIES AT A TEACHING HOSPITAL FOLLOWING INCREASED FLUOROQUINOLONE USE

Risk Factors

- Advancing Age
- H2 Blockers/PPIs
- Cancer/chemotherapy
- NPO/Tube feeding/elemental diets


Use of Gastric Acid–Suppressive Agents and the Risk of Community-Acquired *Clostridium difficile*–Associated Disease

Sandra Dial, MD, MSc
J. A. C. Delaney, MSc
Alan N. Barkun, MD, MSc
Samy Suissa, PhD

Context Recent reports suggest an increasing occurrence and severity of *Clostridium difficile*–associated disease. We assessed whether the use of gastric acid–suppressive agents is associated with an increased risk in the community.

Objective To determine whether the use of gastric acid–suppressive agents increases the risk of *C difficile*–associated disease in a community population.

Early Identification

- Symptoms
  - Watery diarrhea
  - Abdominal pain, lower, crampy
  - Nausea/vomiting
  - Fever
- Signs
  - Lower abdominal tenderness
  - Leukocytosis
  - Low grade fever
  - Unexplained WBC >15k, with risk factors, rule out c diff

Mild diarrhea → Sepsis/ Extremis

Early Identification: Fulminant C diff

- Symptoms
  - Severe abdominal pain
  - Watery diarrhea
    - Prolonged ileus can cause decreased diarrhea
- Signs
  - Diffuse abdominal tenderness
  - Abdominal distention
  - Tmax >38.5 °C
  - Hypovolemia
  - Lactic acidosis
  - Hypoalbuminemia
  - Marked elevation in WBC
    - Up to 40K
  - Guarding, rigidity, absent BS, rebound tenderness= concern for perforation

Diagnosis: Lab Testing

Test	Advantages	Disadvantages
C. difficile cytotoxin assay	• Excellent specificity (99%–100%) • Sensitivity 76-90%.	• Test results not available until after 48 h • Requires tissue culture capacity
Immunoassay for detection of toxin A or toxins A and B	• Good specificity (95%–100%) • Test results available within 4 h • Technically simple	• Reduced sensitivity (65%–85%) compared with cytotoxin assay
Stool culture to isolate *C. difficile* with subsequent toxin assay of isolate	• Research gold standard • Enables typing of strain for outbreak investigation	• Results not available for at least 72–96 h • Labor-intensive • Non-specific (carriers result in false positives if non-diarrheal stools processed)
PCR for toxin genes	**• Sensitivity on par with cytotoxin assay • Same-day turn-around time • Empiric therapy does not hinder detection**	**• Specificity hindered by carrier state • Test cost ($26-60/test) • Skill on par with performing cytotoxin assay required**

Prevention of CDI

- Single use, disposable instruments
- Patient isolation
- Contact precautions
- Hand hygiene

Prevention

- Decrease environmental contamination
- Restriction of antimicrobials

Early Identification

- Imaging
  - KUB- normal, small bowel dilation, “thumb printing”- submucosal colonic edema, air fluid levels, free air
  - CT scan- pronounced colonic wall thickening
- Endoscopy = pseudomembranes
  - White-yellowish plaques, up to 2cm
  - Pathognomonic

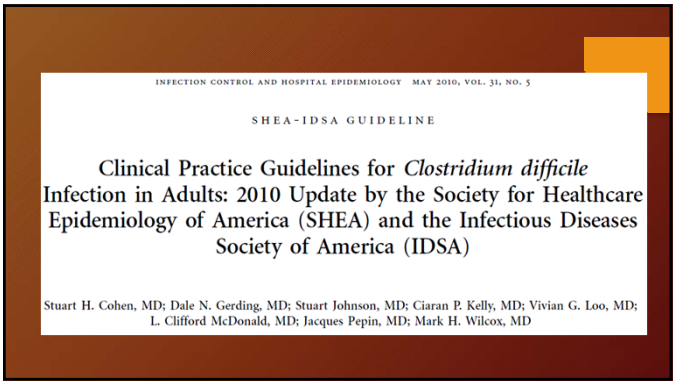
Colonic wall thickening

"Thumb printing"- Submucosal edema

Toxic Megacolon

Clinical Practice Guidelines for Clostridium Difficile Infection in Adults

- 2010 Update by the Society for Healthcare Epidemiology of American (SHEA) and Infectious Disease Society of America (IDSA)
- Cohen et al.
- Posted on the CDC website for c diff
  - http://www.cdc.gov/HAI/pdfs/cdiff/Cohen-IDSA-SHEA-CDI-guidelines-2010.pdf



INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY MAY 2010, VOL. 31, NO. 5

SHEA-IDSA GUIDELINE

Clinical Practice Guidelines for *Clostridium difficile* Infection in Adults: 2010 Update by the Society for Healthcare Epidemiology of America (SHEA) and the Infectious Diseases Society of America (IDSA)

Stuart H. Cohen, MD; Dale N. Gerding, MD; Stuart Johnson, MD; Ciaran P. Kelly, MD; Vivian G. Loo, MD; L. Clifford McDonald, MD; Jacques Pepin, MD; Mark H. Wilcox, MD

SHEA-IDSA Severity Scoring System

Severity	Criteria
Mild or moderate	WBC of 15K or lower *&* Serum creatinine <1.5 times pre-morbid level
Severe	WBC of 15K or higher *or* Serum creatinine >1.5 times the premorbid level
Severe, complicated	Hypotension or shock, ileus, megacolon

Practice Guidelines

The American Journal of Gastroenterology , (26 February 2013) | doi:10.1038/ajg.2013.4

Guidelines for Diagnosis, Treatment, and Prevention of Clostridium difficile Infections

Christina M Surawicz, Lawrence J Brandt, David G Binion, Ashwin N Ananthakrishnan, Scott R Curry, Peter H Gilligan, Lynne V McFarland, Mark Mellow and Brian S Zuckerbraun

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- Published in 2013 in the American Journal of Gastroenterology
- Supplements previously published Update by the SHEA/IDSA
- Evidence based review

ACG Scoring System

Severity	Criteria
Mild	Diarrhea
Moderate	Diarrhea plus any additional signs or symptoms not meeting severe or complicated criteria
Severe	Any two of the following: -WBC≥ 15000cells/mm^3 -Serum albumin <3 g/dL -Abdominal tenderness

ACG Scoring System

Severity	Criteria
Complicated	Any one of the following: -Admission to ICU for CDI -Hypotension with or without required use of vasopressors -Fever ≥38.5° -Ileus or significant abdominal distention -Mental status changes -WBC≥ 35,000 cells/mm^3 -Serum lactate levels greater than 2.2 mmol/Liter -End organ failure (Mechanical ventilation, Renal failure, etc)

Treatment Strategies

- Supportive Care
  - IV fluid resuscitation
  - Management of electrolyte disturbances
  - Pharmacologic DVT prophylaxis
  - Continue oral or enteral feeding if no concern for ileus
- Operative intervention
  - Monitor patients closely for deterioration
  - Serum lactate >5 and wbc >50,000 associated with increased mortality

Metronidazole vs Vancomycin

- Metronidazole
  - Effective as intravenous or enteral form
  - Does not reach colon at effective MIC unless diarrhea
  - Both dosing regimens dependent upon GI motility
- Vancomycin
  - Intravenous not effective
  - Enteral (oral, tube, rectal) reaches colon effectively
  - MIC in both diarrheal and non-diarrheal stool

ACG Severity Scoring and Treatment

Severity	Criteria	*Treatment*
Mild	Diarrhea	*Metronidazole 500mg PO TID*
Moderate	Diarrhea plus any additional signs or symptoms not meeting severe or complicated criteria	
Severe	Any two of the following: -WBC≥ 15000cells/mm^3 -Serum albumin <3 g/dL -Abdominal tenderness	*Vancomycin 125mg PO QID*

ACG Severity Scoring and Treatment

Severity	Criteria	*Treatment*
Complicated	Any one of the following: -Admission to ICU for CDI -Hypotension with or without required use of vasopressors -Fever ≥38.5° -Ileus or significant abdominal distention -Mental status changes -WBC≥ 35,000 cells/mm³ -Serum lactate levels greater than 2.2 mmol/Liter -End organ failure (Mech. ventilation, Renal failure, etc)	*Metronidazole 500 mg IV TID* + *Vancomycin 125 mg PO QID* + *Vancomycin 500 mg in 500 mL saline as enema QID (if ileus or distended)* + *SURGICAL CONSULTATION*

Clinical Practice Guidelines for Clostridium Difficile Infection in Adults

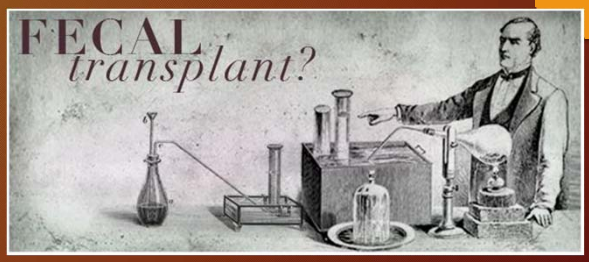
- Probiotics
- Avoid antidiarrheal or antiperistaltic meds acutely
- No evidence to suggest treating asymptomatic carriers
- No test of cure warranted

Treatment Strategies

- Recurrent CDI
  - 25% rate of reoccurrence in treated patients
    - Increased rate after first reoccurrence
  - Symptoms similar or worse than 1st episode
  - Risk factors: >65 y.o., ongoing antibiotic tx for primary infection, multiple comorbidities, immunosuppression

Treatment strategies- Recurrent CDI

- 1st Recurrence: Vancomycin
- 2nd Recurrence: Vancomycin 7 week taper
- 3rd Recurrence: Fecal Microbiota Therapy



Fecal Microbiota Transplant (FMT)

- Recommended treatment option for patients with multiple episodes of RCDI
- First documented case in 1958, 4 patients with pseudomembranous colitis
  - Sx resolved in hours
- Methods of administration: Nasogastric tube, colonoscopy, enemas

ORIGINAL ARTICLE

Duodenal Infusion of Donor Feces for Recurrent *Clostridium difficile*

Els van Nood, M.D., Anne Vrieze, M.D., Max Nieuwdorp, M.D., Ph.D., Susana Fuentes, Ph.D., Erwin G. Zoetendal, Ph.D., Willem M. de Vos, Ph.D., Caroline E. Visser, M.D., Ph.D., Ed J. Kuijper, M.D., Ph.D., Joep F.W.M. Bartelsman, M.D., Jan G.P. Tijssen, Ph.D., Peter Speelman, M.D., Ph.D., Marcel G.W. Dijkgraaf, Ph.D., and Josbert J. Keller, M.D., Ph.D.

N Engl J Med 2013; 368:407-415 | January 31, 2013 | DOI: 10.1056/NEJMoa1205037

Fecal Microbiota Transplant (FMT)

- Since 2011, ~325 case reports with an average cure rate of 91%
- Universal donors or patient-identified donors- rigorous stool testing
- Restores healthy intestinal flora similar to donor
- More RCTs are needed to confirm its safety and efficacy


Hot Topics: Health Data Connected Care

U.S.'s first stool bank supplies hospitals with fecal transplants for C. difficile treatment

February 22, 2014 8:00 am by Deanna Pogorelc | 1 Comments

Fidaxomicin

- Approved in 2011
- macrocyclic antibiotic, bactericidal
- Dose- 200mg po BID x 10 days
- Activity against c diff, most staphylococci and enterococci
  - Does not cover gram negatives or fungi
- Drawback= $$$

Fidaxomicin vs Vancomycin


The NEW ENGLAND JOURNAL of MEDICINE

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ORIGINAL ARTICLE

Fidaxomicin versus Vancomycin for *Clostridium difficile* Infection

Thomas J. Louie, M.D., Mark A. Miller, M.D., Kathleen M. Mullane, D.O., Karl Weiss, M.D., Arnold Lentnek, M.D., Yoav Golan, M.D., Sherwood Gorbach, M.D., Pamela Sears, Ph.D., and Youe-Kong Shue, Ph.D. for the OPT-80-003 Clinical Study Group

N Engl J Med 2011; 364:422-431 | February 3, 2011 | DOI: 10.1056/NEJMoa0910812

- Non-inferior to Vancomycin for cure rate
- Lower reoccurrence rate

"Guidelines for Diagnosis, Treatment, and Prevention of Clostridium Difficile Infections"

- Conclusions
  - If a patient has a strong pre-test suspicion for CDI, begin appropriate therapy
  - Inciting antibiotic should be stopped if possible
  - CT scan of the abdomen is recommended for patients with complicated disease

Management of comorbidities with CDI

- Inflammatory bowel disease (IBD) patients
  - Any patient admitted with IBD flare should be tested for CDI
  - Risk factors: ongoing immunosuppression, colonic inflammation, severe underlying dx
    - Steroid use increases risk of CDI 3-fold, and also increases mortality
  - Patients with ileostomy or ileoanal pouch can also develop CDI
  - If sx severe, begin CDI treatment prior to test results

Management of comorbidities with CDI

- Immunosuppressed patients
  - Cancer, chemotherapy, steroid use, organ transplant, cirrhosis
  - Increased risk for CDI- new diarrhea= testing
- Pregnant/peripartum women
  - Any new diarrhea= testing
  - One series noted high fetal and maternal mortality, with 5/10 patients developed toxic megacolon
  - Vancomycin= drug of choice

Treatment Strategies: Surgery

- EAST Guidelines, 2014, review of 32 studies

Journal of Trauma and Acute Care Surgery:
June 2014 - Volume 76 - Issue 6 - p 1484-1493
doi: 10.1097/TA.0000000000000232
Guidelines

Timing and type of surgical treatment of Clostridium difficile–associated disease: A practice management guideline from the Eastern Association for the Surgery of Trauma

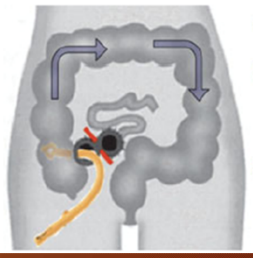
Ferrada, Paula MD; Velopulos, Catherine G. MD, MHS; Sultan, Shahnaz MD; Haut, Elliott R. MD; Johnson, Emily MLIS; Praba-Egge, Anita MD, PhD; Enniss, Toby MD; Dorion, Heath MD; Martin, Niels D. MD; Bosarge, Patrick MD; Rushing, Amy MD; Duane, Therese M. MD

EAST Guidelines

- 1. Timing of surgical intervention
  - Early surgery, prior to shock or organ failure, is associated with decreased mortality
  - Typically between 3-5 days after presentation
  - Observe patients for early signs of hemodynamic instability- decreased arterial pressures, decreasing urine output
  - Peritonitis and bowel perforation is associated with increased post op mortality

EAST Guidelines

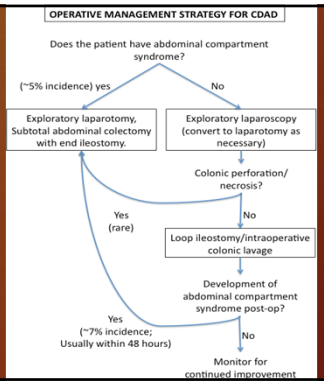
- 2. Type of operation
  - Total abdominal colectomy (TAC) or subtotal colectomy
  - Partial colectomy
  - TAC is associated with decreased mortality and recommended for treatment of fulminant CDI
  - Loop ileostomy with colonic lavage is likely to lead to decreased risk of mortality compared to TAC
    - Directly lavage the colon with vancomycin
    - Post op vancomycin enemas



1. Creation of diverting loop ileostomy.
2. Intraoperative antegrade colonic lavage with 8 liters of warmed PEG3350/electrolyte solution via ileostomy.
3. Postoperative antegrade colonic enemas with vancomycin (500 mg in 500 mL X 10 days) via ileostomy.

Surgery and CDI

- High mortality rate associated with colectomy
- Consult surgery early with severe and worsening disease
- Loop ileostomy- treat underlying infection without colon removal
  - Decreased mortality



Summary

- Classify the severity of disease and begin appropriate treatment
- Consult surgery early
- Escalate treatment if clinically worsening
- High rate of reoccurrence
- Prevention and infection control

Case presentation

- 76 year old male h/o ESRD on HD, CAD s/p CABG, A-fib, OSA, and prior episode of c diff infection 1 month ago, presented to local ED c/o abdominal pain and diarrhea from a rehab facility.
  - Hypotensive on arrival, responded to IVF
  - Mild LLQ tenderness on exam
  - Labs- Albumin 2.4, lactate 3.4, WBC 17
  - Initial CT a/p - pan colitis
  - Started on metronidazole IV and oral Vancomycin
  - Surgery consulted

Case presentation

- HD #2: Hypotensive, WBC increased to 24k.
  - Transferred to tertiary care center
- Upon arrival- hypotensive, peritonitic on exam- Taken emergently to the OR: Laparoscopic lysis of adhesions, creation of loop ileostomy with colonic lavage
  - ICU post op
  - Metronidazole IV, Vancomycin enemas
  - Required ongoing vent support and vasopressors
- Post op course complicated by evisceration on POD #11- revision of loop ileostomy
- Ongoing ICU management for acute respiratory failure and CHF.

References

- Ferrada MD, Paula, et al. "Timing and type of surgical treatment of Clostridium difficile-associated disease: A practice management guideline from the Eastern Association for the Surgery of Trauma". *Journal of Trauma and Acute Care Surgery.* 76. 2014: 1484-1493.
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Postoperative Delirium in the Elderly

Gary T. Marshall, MD FACS
New York University School of Medicine
Bellevue Hospital Center

Advanced Practitioners Workshop
EAST Annual Scientific Assembly
Orlando, Florida
January 15, 2015

Disclosure Statement

- I, Gary T. Marshall, MD, have no financial or commercial interests in the material presented.

Learning Objectives

- Learn to recognize and diagnose delirium
- Understand the incidence and impact of delirium
- Identify risk factors for delirium
- Learn to employ preventative and non-pharmacologic interventions for delirium
- Discuss pharmacologic strategies for the treatment of delirium and its symptoms

What is delirium?

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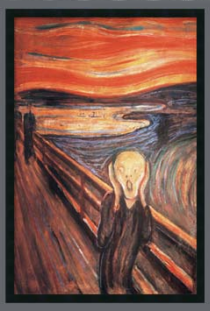
Definition

- Delirium is a transient, reversible syndrome of impairment of consciousness, attention, and perception in the setting of a medical condition that is acute and fluctuating.



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Key Features of Delirium

- Disturbance of consciousness; reduced clarity of awareness of the environment, with reduced ability to focus, sustain, or shift attention
- Change in cognition such as impairment in memory or problem-solving or a perceptual disturbance, such as hallucinations
- Onset of hours to days, and tendency to fluctuate.
- Behavior may be either overactive or underactive, and sleep is often disturbed
- Thinking is slow and muddled but the content is often complex.

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Differences between Delirium and Dementia

Feature	Delirium	Dementia
Onset	Sudden	Slow and gradual
Duration	Days to weeks	permanent
Cause	Almost always another condition	Usually a chronic brain disorder
Course	Reversible	Progressive
Attention	Greatly impaired	Unimpaired until severe
Level of Consciousness	Variably impaired	Unimpaired until severe
Orientation	Varies	Impaired
Use of Language	Slow, incoherent, and inappropriate	Occasional difficulty in word finding
Memory	Varies	Lost, especially short-term

What is the impact of delirium?

Incidence of Postoperative Delirium

- Reported rates range from 5 to >50%
- Rates vary by surgical procedure
  - <5% following cataract surgery
  - 4-15% for elective hip surgery
  - 19-44% for emergency hip surgery
  - 30-50% for aortic surgery

Effects on postoperative outcomes

- Higher complication rates
- Higher probability of discharge to a nursing home
- Poorer functional outcome with a decline in basic activities of daily living at 1 and 12 months
- Increased mortality at 6 and 12 months
- Reduced cognitive function

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Financial Burden

- $164 billion annually
- Significant increase in cost of hospitalization
  - $50,100 for patients with delirium
  - $31,600 in patients without
- Doubled length of stay in a study of patients undergoing non-orthopedic operations

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What are the risk factors and causes?

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Etiology

- Thought to be due to under-activity of cholinergic system coupled with excessive dopaminergic activity
- Delirium is the end result of a complex interaction between predisposing factors and precipitating factors

Predisposing Factors

- Advanced age
- Underlying cognitive impairment
- Functional impairment
- Coexisting medical comorbidities
- Psychotropic medications
- Alcohol abuse
- Sensory impairment
- Immobility

Precipitating Factors

- Infection
- Medications
- Hypoxemia
- Dehydration
- Sensory deprivation
- Electrolyte abnormalities
- Unfamiliar environment
- Malnutrition
- Surgery
- Neurologic events
- Sleep deprivation or disruption
- Use of physical restraints
- Use of a bladder catheter

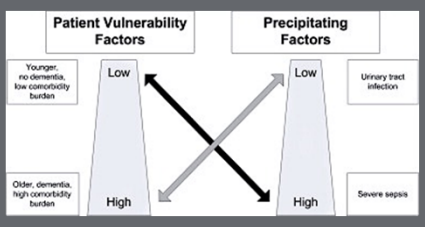
Medications Associated with Delirium

Drug Class	Drug Types	Example
Anticholinergic	H_1 Blocker Antiparkinson Phenothiazine	diphenhydramine, meclizine benztropine promethazine
Antidepressant	Tricyclics SSRIs	amitriptyline, nortriptyline fluoxetine, sertraline
Sedative	Benzodiazepines	alprazolam, diazepam
Analgesics	Opioids	codeine, morphine
Antiinflammatory	NSAIDs Corticosteroids	aspirin, ibuprofen hydrocortisone, prednisone
Antihypertensives & antiarrhythmics	Betablockers ACE inhibitors Ca channel blockers other	propranolol, metoprolol lisinopril, captopril amlodipine, nifedipine digoxin
Antibiotics	Quinolones Macrolides	levofloxacin, ciprofloxacin azithromycin, clarithromycin
Anticonvulsants	Barbiturates	phenobarbital

Medications Associated with Delirium

Preoperative	Intraoperative	Postoperative
Antipsychotics	Anticholinergics	Opioids (dose dependent)
SSRIs	Fentanyl (dose dependent)	Sedatives (dose dependent)
Antidepressants	Benzodiazepines (dose dependent)	Inotropes
Benzodiazepines	Inotropes	
Statins		

Interplay of Predisposing and Precipitating Events



Knowing this, how can we prevent delirium in the postoperative patient?

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Prevention Strategy

- Up to 40% of cases are preventable
- Identify risk factors in the preoperative period
- National Institute for Health and Care Excellence (NICE) defines at risk individuals as patients with any one of the following:
  - Age 65 and older
  - Any cognitive impairment, past or present
  - Dementia
  - Severe illness
  - Current hip fracture

Predisposing Factors

- Baseline cognitive impairment has the strongest correlation with acute postoperative delirium
- Many risk factors cannot be modified
- Reduction in the severity of risk factors can reduce the incidence of delirium
  - Correct visual and hearing impairment
  - Reduce immobility

Prevention Strategy – Precipitating Factors

- Extent of the operation is the main determinant of the precipitating insult
  - Blood loss
  - Length of operation
  - Extent of dissection
  - Anesthetic agent
  - Type of anesthesia
  - Medications

- Actively monitor, treat and avoid precipitating factors

Prevention Strategy – Precipitating Factors

- Each precipitating factor is a marker for a risk factor, has the potential to increase the severity of risk factors, or lead to the development of complications for which delirium may be a sign
  - Use of catheters may lead to immobility or urinary tract infection, both of which may cause delirium
  - Medications
  - Sleep deprivation and altered sleep/wake cycle
  - Neurologic events may precipitate delirium

Delirium Prevention Strategies

- Orientation
- Avoidance of restraints
- Family presence
- Eyeglasses
- Hearing aids
- Bladder and bowel regimen
- Maintain normal sleep/wake cycle
- Adequate pain management
- Early mobilization
- Adaptive equipment
- Adequate hydration
- Adequate oxygenation
- Medication review and avoidance of causative medications

Multicomponent Intervention Results

- Study intervention using standard protocols for 6 risk factors for delirium (cognitive impairment, sleep deprivation, immobility, visual impairment, hearing impairment and dehydration) versus routine care
- Delirium 9.9% vs. 15%
- Decreased total days with delirium and number of episodes
- Concluded that primary prevention of delirium is the most effective treatment strategy

Inouye SK, NEJM, 1999

Reducing Delirium After Hip Fracture

- 126 patients 65 and older (mean 79±8)
- Randomized to proactive geriatrics consultation before or within 24 hours of surgery vs. usual care
  - Mean of 10 recommendations made with 77% compliance
  - Delirium 32% with intervention, 50% in usual care
  - Severe delirium in 12% with intervention vs. 29%
- Concluded that proactive geriatrics consultation reduced delirium by over one-third and severe delirium by one-half

Marcantonio ER, J Am Geriar Soc, 2001

Optimize Pain Control

- Increased levels of postoperative pain are associated with higher incidence of delirium
- Non-opioid medications may have benefit
  - Gabapentin
  - Acetaminophen
  - Celecoxib and other NSAIDs

Regional Anesthesia

- May be beneficial based on two small studies
- Mouzopoulos *et al* randomized hip fracture patients to regional anesthesia or placebo. Lower rates of delirium with fascia iliaca block (RR 0.13, 95% CI 0.03-0.53)
- Kinjo *et al* randomized total knee replacement patients to either femoral nerve block with PCA or PCA alone. Delirium in 25% of nerve block group compared with 61% in control group

Opioid Analgesics and Delirium

- Study of 541 hip fracture patients
- Patients who received < 10 mg morphine sulfate equivalents daily were *more* likely to develop delirium than patients given more analgesia (RR 5.4, 2.4-12.3)
- Patients given meperidine were more likely to develop delirium that those given other opioids (RR 2.4, 1.3-4.5)
- Severe pain significantly increased the risk of delirium (RR 9.0, 1.8-45.2)

Morrison RS, J Geront, 2003

Avoid Inappropriate Medication

- The most strongly associated medications:
  - Anticholinergic drugs
  - Diphenhydramine
  - Meperidine
  - Benzodiazepines
- The use of multiple medications (≥5) is associated with increased delirium risk

Early Mobilization

- Time to mobilization after hip fracture is an independent risk factor for delirium
- Multi-component intervention strategies that include early mobility have been shown to reduce the incidence of delirium

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Anemia and Transfusion Strategy

- Results are conflicting with regard to transfusion threshold
- Two recent trials in orthopedic surgery have shown no reduction in delirium using a liberal transfusion trigger
- Transfusion has been a part of successful multi-component interventions

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How is the diagnosis made?

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Diagnosis – Clinical Features

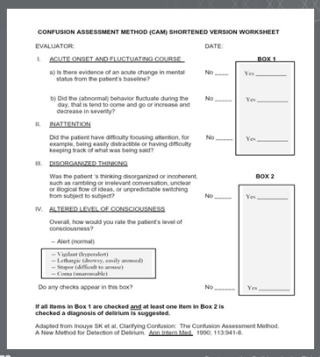
- Inattention with the inability to focus
- Disorganized thinking
- Altered level of consciousness
- May be agitated or hyperactive
- Up to half may be hypoactive, presenting as somnolence, leading to poor recognition and under-diagnosis

Clinical Presentation

Confusion Assessment Method (CAM)

- Requires the presence of acute onset with a fluctuating course
  - Direct observation
  - History from family or providers
- Requires inattention
  - Counting backwards by 3's or 7's
  - Saying months in reverse order
- Either disorganized thinking or altered level of consciousness must also be present
  - Rambling speech or illogical flow of ideas
  - Lethargy/somnolence or hyperactivity/mania

Confusion Assessment Method Worksheet



CONFUSION ASSESSMENT METHOD (CAM) SHORTENED VERSION WORKSHEET

EVALUATOR: DATE:

I. ACUTE ONSET AND FLUCTUATING COURSE

a) Is there evidence of an acute change in mental status from the patient's baseline? No _____ Yes _____

b) Did the (abnormal) behavior fluctuate during the day, that is tend to come and go or increase and decrease in severity? No _____ Yes _____

II. INATTENTION

Did the patient have difficulty focusing attention, for example, being easily distractible or having difficulty keeping track of what was being said? No _____ Yes _____

III. DISORGANIZED THINKING

Was the patient 's thinking disorganized or incoherent, such as rambling or irrelevant conversation, unclear or illogical flow of ideas, or unpredictable switching from subject to subject? No _____ Yes _____

IV. ALTERED LEVEL OF CONSCIOUSNESS

Overall, how would you rate the patient's level of consciousness?

– Alert (normal)

– Vigilant (hyperalert)
– Lethargic (drowsy, easily aroused)
– Stupor (difficult to arouse)
– Coma (unarousable)

Do any checks appear in this box? No _____ Yes _____

BOX 1

BOX 2

If all items in Box 1 are checked and at least one item in Box 2 is checked a diagnosis of delirium is suggested.

Adapted from Inouye SK et al, Clarifying Confusion: The Confusion Assessment Method. A New Method for Detection of Delirium. Ann Intern Med. 1990; 113:941-8.

Confusion Assessment Method for ICU (CAM-ICU)

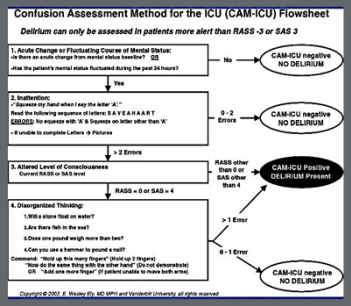
- Delirium may be present in up to 80% of ICU patients
- The CAM-ICU is a useful adaptation for ICU patients
- Can be completed in an average of 2 minutes
- Sensitivity of 73% and specificity of 100% when compared to CAM

McNicoll L, J Am Geriatr Soc, 2005

CAM-ICU Video

- CAM-ICU Video Link

CAM ICU Flowsheet



How do I evaluate and treat a delirious patient?

Initial Evaluation of Delirious Patient

- Review history, functional assessment and medications
- Identify potential causes (IMCONFUSED)
- Other postoperative complications may present initially with delirium
  - Occult infection
  - Anastomotic leak
  - Hypoxia
  - Fluid and electrolyte imbalances
- Thorough evaluation to identify and treat these precipitating factors when present

Initial Approach to Delirium

Initial Approach to Delirium

Initial Approach to Delirium

Etiology of Acute Confusion in Surgical Patients

I	Infection
M	Metabolic
C	Cognitive, sensory
O	Oxygenation
N	Nutrition, swallowing
F	Function, pharmacy, Foley catheter
U	Unfamiliar environment
S	Stress, pain
E	Electrolytes/fluids
D	Dysfunction lung, liver, kidney, brain

Treatment – Supportive Care

- Treatment is directed at identifying the underlying cause, providing supportive care, and controlling symptoms
- Supportive care uses many of the delirium prevention strategies
- Ensure airway protection
- Maintain oxygenation
- Maintain fluid and electrolyte balance
- Provide nutritional support

Treatment of Severe Agitation

- Antipsychotics may be used for severe agitation, distress, or when behavior threatens harm to the patient or others
- Use antipsychotics only after non-pharmacologic means have failed
- The need for antipsychotics should be reassessed with daily exams

Haloperidol for Severe Agitation

- Load with a 2 mg dose i.v. then repeat every 15-20 minutes, doubling dose, until agitation resolves
- Scheduled doses given every 4-6 hours for several days then tapered over several more
- QT prolongation may occur, leading to ventricular dysrhythmias such as torsades de pointes
- Extrapyramidal symptoms such as akathisia, dystonia and tardive dyskinesia may occur

Atypical Antipsychotics

- Risperidone, ziprasidone and quetiapine have been studied
- No recommendation have been made due to the lack of significant results and the heterogeneity of the studies
- Two small trials found quetiapine at doses of either 40 mg/day or 100 mg/day to be beneficial
  - Decreased time to resolution of delirium
  - Decreased time spent delirious
  - Less agitation
  - Increased rate of resolution of non-cognitive symptoms

Treatment of Hypoactive Delirium

- Antipsychotic medications and benzodiazepines should not be used to treat older adults with postoperative delirium who are not agitated or threatening harm to themselves or others
- No studies have shown a clinical benefit from treatment with these medications
- Significant potential harm from these medications exists in the setting of no clinical benefit

Benzodiazepines

- Should *not* be used as a first line treatment of severe agitation in a patient with postoperative delirium
- Only exception is treatment of benzodiazepine or alcohol withdrawal
  - Lowest dose
  - Shortest time
  - May promote delirium

Cholinesterase Inhibitors

- In older adults not taking cholinesterase inhibitors, these medications should *not* be prescribed to prevent or treat delirium
- Four trials have found no benefit in prophylactic use of cholinesterase inhibitors such as rivastigmine and donepezil
- Treatment groups in two studies showed trends toward increased adverse events, serious adverse events and mortality

Summary

- Postoperative delirium is a frequent and significant complication in the elderly
- Prevention is the best treatment
- Recognize delirium promptly
- Rapidly diagnose and treat the underlying factors
- Use medications only in cases of severe agitation

Questions?

NYU School of Medicine
NYU LANGONE MEDICAL CENTER

Postoperative and Post-trauma Pulmonary Complications

Brian Van Ness, MS, PA-C
Surgical and Trauma ICU
Hackensack University Medical Center
Hackensack, NJ

Conflict of Interest Disclosure

The Eastern Association for the Surgery of Trauma partners with the American College of Surgeons to provide continuing medical education credit. The American College of Surgeons is an accredited provider with the Accreditation Council for Continuing Medical Education.

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Conflict of Interest Disclosure

Author	*Disclosure*
Brian Van Ness, MS, PA-C	NONE

Objectives

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- Why postoperative pulmonary complications (PPC) matter?
- Categories of post-trauma and PPC
- Risk factors for PPC and post trauma pulmonary complications
- Prevention strategies
- Postoperative and post-trauma treatment strategies

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Postoperative Pulmonary Complications

Pulmonary abnormality that produces identifiable disease or physiologic dysfunction that is clinically significant and adversely affects the normal clinical course, within 48-72 hours postoperatively

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Scope of Pulmonary Complications

1° • Transient Hypoxemia • Atelectasis

2° • Acute lung injury • Pulmonary Infections

3° • ARDS • Death

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Why Does All of This Matter?

Quality and Outcomes

- PPCs occur **twice as often** as post op cardiac events (9.6% vs. 5.7%)
- Ventilator associated pneumonia (VAP)
  - 5.2 cases/1000 ventilator days in Surgical ICUs
  - 10.2 cases/1000 ventilator days in Trauma ICUs
- Healthcare associated pneumonia (HCAP)
  - Prolongs hospital stays for an average of 7-9 days

*McAllister FA, Bertsch K, Man J, et al. Am J Respir Crit Care Med 2005;171:514-7

8

Quality and Outcomes

- Post-op pneumonia = #2 reason for unplanned readmission postoperatively
- Any PPC increases lengthy of stay (LOS) by 8 days on average
- 2008 review
  - More than 1 million patients experienced a PPC
  - 46,200 deaths
  - 2.9 million additional days on the floor
  - 1.9 million additional days in the ICU

Shander A, et al. Crit Care Med. 2011 Sep;39(9):2163-72
McAllister FA, Bertsch K, Man J, et al. Am J Respir Crit Care Med 2005;171:514-7

Cost

- VAP
  - Estimated cost of treatment per patient $11,000 to $57,000
- Medicare study, 2004 cost of all unplanned rehospitalizations→$17.4 BILLION
  - 22% of these = postoperative readmissions
- Annually
  - PPCs = $3.4 billion in health care costs

Shander A, et al. Crit Care Med. 2011 Sep;39(9):2163-72
Sigl JC, Bloom JD, Hansell DM, et al. Annual meeting of the American Society of Anesthesiologists, October 2010, Abstract A859

10

Defining and Categorizing the Problem

Postoperative Pulmonary Complications

- Incidence 5-80%
- 5-10% of all post-surgical patients
- 25% of deaths within 7 days

O'Donohue WJ Jr. Postgrad Med 1992; 91: 167

12

Postoperative Pulmonary Complications

- Most common post surgical complication
  - Major surgical procedures
  - Critically ill
- Increase LOS
- Decrease short and long term survival

Categories

- Atelectasis
- Aspiration
- Pulmonary vascular congestion
- Pneumonia
- Acute respiratory failure
- Other

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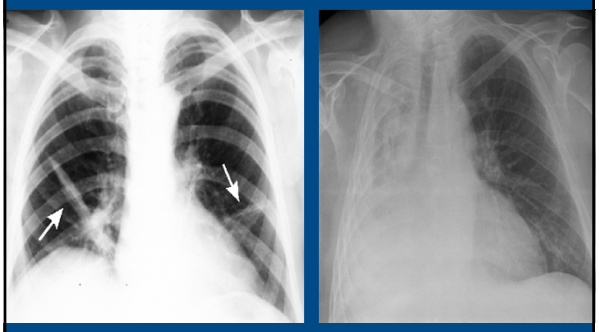
Atelectasis



Atelectasis

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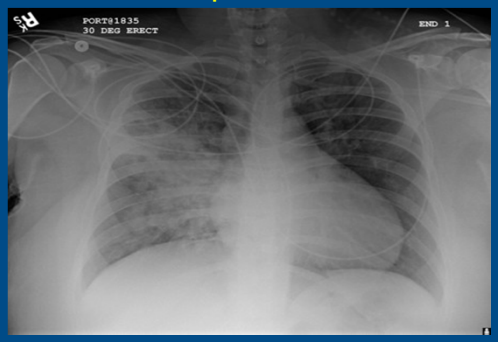
- Majority of all PPCs
  - Abdominal and thoracoabdominal cases
  - Primary mechanism in acute lung injury (ALI)
- Physiologic Mechanisms
  - Obstruction of the tracheobronchial tree
    - Secretions, inability to cough
  - Hypoventilation
    - Anesthetics, narcotics, under-treated pain

Lawrence VA, Hilsenbeck SG, Mulrow CD, et al. J Gen Intern Med 1995; 10:671 16

Aspiration

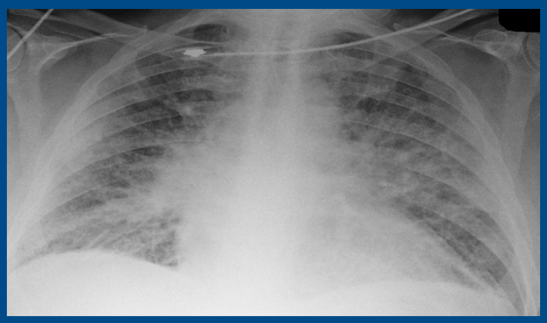


Aspiration

- Absence of normal protective mechanisms
- Consequence of surgical procedure
- Consequence of pre-existing condition
- Prevention
  - NPO 6-8 hours prior to OR
  - Gastric decompression prior to anesthetic induction

Squadrone V, Coha M, Cerutti E, et al. JAMA 2005; 293: 589 18

Pulmonary Vascular Congestion



Pulmonary Vascular Congestion

- Non-cardiogenic
  - Volume overload (most common)
    - Excessive crystalloid/colloid infusion
- Cardiogenic
  - Decreased contractility due to:
    - Cardiac disease
    - Anesthetic/narcotic/hypnotic agent effects
    - Acute ischemic cardiac events

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Other PPC

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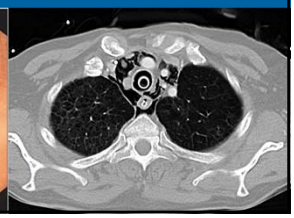
- Exacerbation of underlying lung disease
  - COPD, asthma
- Pulmonary complications related to inadequately treated pain
- Tracheal injury secondary to intubation



What Puts Patients at Risk for Pulmonary Complications?

Medical History Risk Factors

- Major Risks
  - COPD
  - CHF
  - Total functional dependence
  - ASA Physical score >2
- Minor Risks
  - NIDDM/IDDM
  - Protein calorie malnutrition
  - Liver failure
  - CKD
  - Altered mental status

Smetana GW, Lawrence VA, Cornell JE. Ann Intern Med 2006; 144(8):581-595
Qaseem A, Snow V, Fitterman N, et al. Ann Intern Med 2006;144(8):575-80

23

Social History Risk Factors

- Weight loss > 10% in previous 6 months
- Smoking pre-op goals
  - 6-8 weeks of abstinence = most beneficial
  - Peak flow >80%
  - Absence of wheezing

Stein M, Cassara EI. JAMA 1970; 211:787

24

Procedure-Related Risk Factors

- Highest risk procedures
  - Abdominal aortic aneurysm repair
  - Thoracic surgery
  - Upper abdominal surgery
  - Operative procedures > 3hr
  - Vascular surgery
  - Emergency surgery

Qaseem A, Snow V, Fitterman N, et al. Ann Intern Med 2006;144(8):575-80.

25

Surgical Site/Technique Risk Factors

- Distance of the incision from the diaphragm
- Aortic/esophageal = 20-25%
- Upper abdominal = 20-25%
- Lower abdominal = 5-10%
- Laparoscopic vs. open procedures

Qaseem A, Snow V, Fitterman N, et al. Ann Intern Med 2006;144(8):575-80.

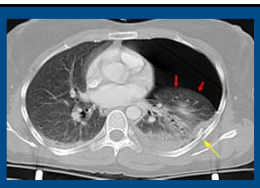
26

Other Risk Factors for PPC

- Perioperative transfusion of > 4 units PRBC
  - TRALI
- Low albumin (< 3.5 g/dL)
  - Preoperative nutrition does not afford a protective benefit against PPCs
    - Questionable benefit in small sub-group
  - Consider pre op nutrition supplements if time allows

Arozullah AM, Kuri SF, Henderson WG. Ann Intern Med 2001;135: 853
Lawrence V, Cornell J, Smetana G. Ann Intern Med. 2006;144:596-608.

27



Trauma Specific Risk Factors for Pneumonia and Respiratory Failure

Pneumonia in Trauma

National Trauma Data Bank 2013

#1 post-trauma hospital complication?

Pneumonia

Committee on Trauma. American College of Surgeons. NTDB. 2013

29

Pneumonia Risk Factors

- Intubation in the field + any of these risk factors
  - Intubation alone **does not** increase risk
- One or > rib fractures
- High ISS (>15)
- Documented aspiration
- Presence of parenchymal lung injury or hemothorax
- Administration of blood products
- Severe TBI (GCS <8 and/or hemiplegia/hemiparesis) or severe neck trauma

Critical Care research and practice, Vol 2012 (2012), Article ID 207247
Kuo-Wei MD, Han JC, Kang L, et al. J of Neurosurg 2013; (118): 358-63
Michelet P, Couret D, Bregeon F, et al. J Trauma. 2010 Feb;68(2):395-400

30

Acute Respiratory Failure in Trauma

National Trauma Data Bank 2013

#3 in-hospital complication?

ALI/ARDS

Respiratory Failure Risk Factors

- Risk Factors
  - Age >65
  - Male gender
  - ISS >20
  - Any rib fracture or parenchymal injury on CXR
  - Rib fracture in >1 anatomic location on CT scan

Committee on Trauma. American College of Surgeons. NTDB, 2013
Livingston D, et al. Trauma. 2008 Apr;64(4): 905-11.
Sharpe JP, Magnotti LJ, Weinberg JA. J Trauma Acute Care Surg. 2014 Jul;77(1):161-5
Gannon CJ, Pasquale M, Tracy JK, et al. Shock 2004;21(5): 410-4

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Acute Postoperative and Post-Trauma Respiratory Failure

Acute Postoperative Respiratory Failure

- Definitions
  - Failure to extubate within 48 hours of surgery
- More Common
  - Multi-system organ failure
  - Multi-system trauma
- In-hospital mortality rate ≈ 40% vs. 6% in those without acute postoperative respiratory failure

O'Donohue WJ Jr. Postgrad Med 1992; 91: 167

34

Acute Postoperative Respiratory Failure

- Etiologies
  - Sepsis
  - Massive transfusion
  - Pulmonary emboli
  - Pancreatitis
  - Aspiration
  - Anesthetic effects
  - Intravascular volume overload

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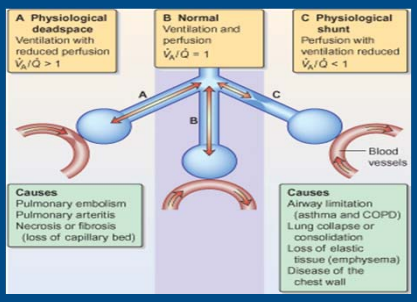
Hypoxemic Respiratory Failure

- PaO2 < 60 mmHg on room air
  - 1° Diffusion defects/VQ mismatch
    - Alveolar dead space (PE)
    - Physiologic shunt (ARDS, PNA, plug)
  - 2° Metabolic/cellular abnormalities
    - Adequate delivery and alveolar VQ, inability to extract O_2 at cellular level (sepsis)

Sachdev G, Napolitano L. Surg Clin N Am 92(2012):141 37



Hypercarbic Respiratory Failure

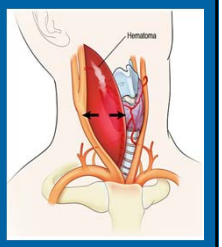
- $PaCO_2$ > 50 mmHg
  - CNS
  - Thoracic trauma
  - Obesity
  - Endotracheal tube obstruction/displacement
  - Alveolar level → VQ mismatch

Sachdev G, Napolitano L. Surg Clin N Am 92(2012):141 39

Acute Respiratory Failure Due to Loss of Airway

- Bronchospasm
- Airway edema
- Extrinsic airway compression
- Neurologic impairment
- Absence of gag/cough reflexes

When in doubt, INTUBATE/REINTUBATE



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Postoperative and Post-trauma Pneumonia

Non-infectious Causes of Fever and Infiltrates Masquerading as Pneumonia

- Aspiration pneumonitis
- Atelectasis
- Pulmonary embolus
- Pulmonary hemorrhage
- Lung contusion
- Infiltrative mass
- Medication reactions

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Healthcare Associated Pneumonia (HCAP)

- Positive sputum bacterial culture > 48hr after admission
- Second most common nosocomial infection
- **Most common** cause of death in ICU setting
- Accounts for 25% of all ICU infections
- Leading cause of mortality attributed to nosocomial infections at 33-50%
- 5-10 cases per 1,000 hospital admissions

Fagon JY, Chastre J, Hance AJ, et al. Am J Med 1993;94:281-288
Tablan OC, Anderson LJ, Besser R, et al. 2003: recommendations of CDD and Healthcare Infection Control Practices Advisory Committee. MMWR Recomm Rep 2004;53:1-36

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Ventilator Associated Pneumonia (VAP)

- Positive sputum culture
  - Mechanically ventilated
  - > 48hr after admission or tracheal intubation
- **Most common** hospital acquired ICU infection
- 10-20% mechanically ventilated patients
- Risk of pneumonia, mechanically ventilated patient
  - 3% per day first 5 days
  - 2% per day on days 5-10
  - 1% per day thereafter

Ventilator Associated Pneumonia (VAP) event, CDC January 2014, http://www.cdc.gov/pdfs/pscmanual/opscvapcurrent.pdf

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VAP Diagnostic Criteria

- CXR: new infiltrate/cavitation/consolidation
- At least one:
  - Temperature (>38° C or >100.4° F)
  - WBC (<4,000) or >12,000)
  - Altered mental status (>70 y/o)
- At least two:
  - New or worsening sputum production
  - New or worsening cough/dyspnea/tachypnea or worsening P:F ratio

Ventilator Associated Pneumonia (VAP) event, CDC January 2014, http://www.cdc.gov/pdfs/pscmanual/opscvapcurrent.pdf

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Postoperative Pneumonia

- HCAP or VAP in a postoperative patient
- Bacterial, onset within 5 days of surgery
- Significant risk factors
  - Duration in the healthcare environment
  - Recent exposure to antibiotics
- Rule out other likely causes of fever
  - Wound infection
  - UTI
  - Atelectasis

Markowicz P, Wolff M, Djedaini K, et al. Multicenter prospective study of ventilator-associated pneumonia during acute respiratory distress syndrome. Incidence, prognosis and other risk factors. ARDS Study Group. Am J Respir Crit Care Med 2000; 161:1942-8

46

Postoperative Pneumonia Pathogens

- Initial/early onset
  - Staph aureus (post op neurologic surgery, coma/TBI)
  - Strep pneumo & H. Influenzae (traumatic injury)
- Late Onset
  - Aerobic gram negative bacilli
    - Pseudomonas, Klebsiella sp, Acinetobacter sp, E. Coli, Enterobacter sp, Serratia sp
- MRSA
  - Predominant gram + pathogen in the ICU setting
  - Diabetes, traumatic brain injury, critical care setting

George DL, Falk PS, Wunderink Rg, et al. Am J Respir Crit Care Med 1998;158:1839-47

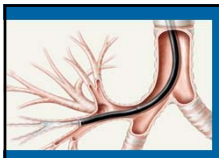
47

Postoperative Pneumonia Pathogens

- Pseudomonas
  - Mechanical ventilation >8d, antibiotic therapy for >48hrs in the 10 days preceding the PNA
- Acinetobacter species
  - Mechanical ventilation
  - But NO specific surgery or traumatic injury related pattern
- Anaerobic
  - Rare
  - Except aspiration pneumonia in non-intubated patients (BiPAP)

Singh N, Falestiny MN, Rogers P, et al. Chest 1998;1114:1129
Rello J, Ausina V, Ricart M, et al. Intensive Care Med 1994;20: 193
Garnacho-Montero J, Ortiz-Leyba C, Fernandez-Hinojosa E, et al. Intensive Care Med 2005;31:649

48



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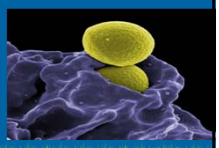
Strategies for the Prevention of Postoperative Pulmonary Complications



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Gastric Decompression

- Targeted/selective usage of nasogastric tube decompression vs. routine placement
- Direct path for oropharyngeal bacteria→lungs
- Nasal vs. oral tubes

Lawrence VA, Cornell JE, Smetana GW. Ann Inter Med 2006;144(8):596-608

50

Anesthetic Options

- No strong evidence to recommend one anesthetic technique over another
- Intermediate duration NMBs (Atracurium) vs. long duration NMBs (Pancuronium)
- Neuraxial blockade (spinal or epidural)

Sachdev G, Napolitano L. Surg Clin N Am 92(2012):141
Major CP Jr, Greer MS, Russell WL, et al. Am J Surg 1996; 62:45

51

Intra-op Lung Protective Ventilation?

- PROVHILO STUDY (n = 900), 2011-2013, RCT
  - Two groups
    - Lung protective: V_T < 8mL/kg predicted body wt, PEEP +12, recruitment maneuvers
    - Conventional: V_T < 8mL/kg predicted body wt, PEEP 0-2, no recruitment maneuvers
  - Results
    - NO significant difference in PPC between the two groups
    - Higher PEEP group = ↑ intra-op hypotension & vasopressors
  - Recommendations
    - Low V_T, low/conventional PEEP levels, no recruitment maneuvers

The PROVE Network Investigators for the Clinical Trial Network of the European Society of Anaesthesiology. *The Lancet*. 2014; 384: 495-50

52

Lung Expansion and Lung Capacity Restoration Techniques

- Prevention
  - Control pre-existing pulmonary disease pre-op
  - Cessation of smoking 8 weeks preoperatively
- Incentive spirometry
- Cough/deep breath exercise
- Chest PT
- Early mobilization
- No single modality better than another
- Combination therapies do NOT improve risk reduction

ANY type of lung expansive technique is better than NONE AT ALL

Lawrence VA, Cornell JE, Smetana GW. Ann Inter Med 2006;144(8):596-608

Postoperative Analgesia

- Most important postoperative intervention
- Epidural
  - Vs. PCA
    - Equal in terms of PPC reduction
  - Vs. on demand opioids
    - Epidural superior in terms of PPC reduction
  - Vs. systemic parenteral opioids
    - Reduction in atelectasis, not pneumonia

Walder B, Schafer M, Henzi I, Tramer MR. Acta Anaesthesiol Scand 2001;45(7):795–804
Ballantyne JC, Carr DB, deFerranti S, et al. Anesth Analg. 1998;86(3):598-612

54

Case Study

70M, POD #3 s/p extensive lysis of adhesions and small bowel resection secondary to prolonged SBO with minimal PO intake x 7 days. Admitted to SICU, mechanically ventilated.

-HOB is 15 degrees
-Versed infusion at 8 mg/hr
-NPO
-Blood glucose ranges 190-240
-2 units of PRBC for Hgb 8.6 overnight
-Antibiotics: Linezolid and Piperacillin/ Tazobactam, with no positive cultures, fever or leukocytosis

Which of these treatment modalities put this patient at risk of healthcare-ventilator associated pneumonia?

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2005 ATS/IDSA Non-pharmacologic Strategies to Prevent Nosocomial Pneumonia

Strategy	Evidence Grade
Hand washing/decontamination	Level I
Non-invasive positive pressure ventilation/avoid intubation	Level I
Avoid reintubation	Level I
Utilize subglottic suctioning	Level I
Semi-erect positioning	Level I
Enteral/small bowel nutrition	Level I
Use orogastric/orotracheal tubes	Level II

Adapted from Kollef, M. Hosp Physician 2007: 54

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Subglottic Suctioning

- ETT cuff pressure @ 20cm H2O
  - Dual lumen tubes
    - Do reduce risk of VAP/HAP
    - Do not improve mortality, ICU LOS, duration of mechanical ventilation

Kollef MH, Skubas NJ, Sundt TM. Chest 1999;116:1339-46

57

Prevention Strategies

- Short duration mechanical ventilation
  - Develop standardized weaning protocols
- Enteral nutrition better than parenteral
  - Fewer episodes of pneumonia
  - No difference in mortality gastric vs. post-pyloric feeds

Heyland DK, Drover JW, Dhaliwal R, et al. J Parenter Enteral Nutr 2002;26(6 suppl)LS51-7
Kollef, MH. N Engl J Med 1999;340:627-34

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2005 ATS/IDSA Pharmacologic Strategies to Prevent Nosocomial Pneumonia

Strategy	Evidence grade
Avoid antibiotic prophylaxis	Grade I
Avoid unnecessary RBC transfusion	Grade I
Blood glucose control with insulin	Grade I
Oral decontamination	Grade I
Short duration antibiotic therapy	Grade I
Avoid unnecessary GI prophylaxis	Grade I

Adapted from Kollef, M. Prevention of postoperative pneumonia. Hosp Physician 2007: 54

59

Prevention Strategies

- Oropharyngeal decontamination
  - Mixed study results
  - Definitely better than placebo at reduction of VAP/HAP
  - Low cost, minimal/no side effects and lack of resistance

Houston S, Hougland P, Anderson JJ, et al. Am J Crit Care 2002;11:567-70
Koeman M, van der Ven AJ, Hak E, et al. Am J Respir Crit Care Med 2006; 173: 1348-55

60

Case Study

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Recall, current treatments:
-HOB is 15 degrees
-Versed infusion at 8 mg/hr
-NPO
-Blood glucose ranges 190-240
-2 units of PRBC for Hgb 8.6 overnight
-Antibiotics: Linezolid and Piperacillin/ Tazobactam, with no positive cultures, fever or leukocytosis

Which put patient at risk for VAP/HAP?
THEY ALL DO!

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¶Treatment Strategies for Pulmonary Complications

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Case

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32M, post trauma day #2, s/p MVC: L flail chest, L pulmonary contusion, L pneumothorax s/p chest tube, mechanically ventilated with persistent high plateau pressures and refractory hypoxemia.
Vent: PRVC 20/400/+18/100%
ABG: 7.36/40/52/24/-4
Hgb 7.6, Creatinine 3.2

-What adjunctive therapies are available for this patient to improve oxygenation?
-Is nitric oxide an option? Or high frequency oscillatory ventilation? Steroids? PRBC transfusion?

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Mechanically Ventilated Patients

ARDSnet Protocol

- Maximize alveolar recruitment
- Prevent cycles of recruitment/derecruitment
- Minimize FiO2, “optimal” PEEP
- Minimize alveolar over distention and lung injury
  - Plateau pressure = ***most predictive of ALI***
  - Measures static compliance in the ABSENCE of gas flow = tidal volume/compliance
  - Goal < 30 cmH_2O
  - Adjust TV to achieve
- Adjust tidal volume and respiratory rate to pH 7.30-7.45

The Acute Respiratory Distress Syndrome Network. N Engl J Med 2000; 342:1301-1308

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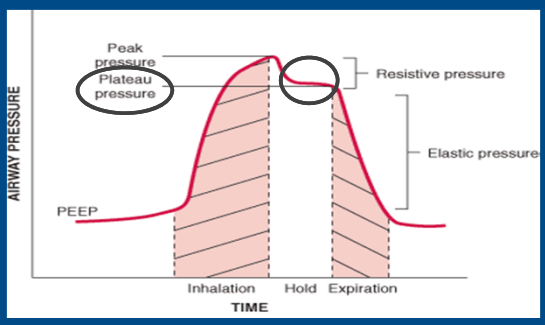
Plateau Pressure



Neuromuscular Blockade (NMB)

- Multicenter, double blind study, n = 340
  - Cisatracurium x 48 hr. or placebo infusion in severe ARDS of < 48 hr. duration
  - Mixed medical/surgical
  - Early administration of NMB agents improved 90 day survival
  - Increased time off mechanical ventilator
  - No residual muscle weakness

Papazian, L, et al. N Engl J Med 2010; 363:1107-1116

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High Frequency Oscillatory Ventilation

- OSCAR trial
  - 795 patients, multicenter randomized trial
  - HFOV vs. conventional ventilation
  - No significant difference in 30 day mortality
- OSCILLATE trial
  - Intended 1,200 patients, stopped after 548 patients
  - Increased use of dose benzodiazepines, neuromuscular blockade, vasopressors
  - Early initiation of HFOV in moderate to severe ARDS does not reduce and may increase hospital mortality (47% vs. 35%)

NEJM 2013; 368: 795-805
NEJM 2010; 363: 1107-1116

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Corticosteroids

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- 2014 meta-analysis
  - Effects of corticosteroids inconsistent due to:
    - Differing outcome measures
    - Heterogeneity of population and disease state studies
  - Conclusions:
    - **Do not** improve long term (>60 day) mortality
    - **Might** improve short term mortality
    - **Might** have some benefit in a subgroup of patients with persistent lung inflammation and ARDS with initiation <14 days after inciting event
    - **Definitely** increase mortality when used late in ARDS, >14 days
    - Side effects negate short term gains
      - Hyperglycemia, infection, immunosuppression
    - **Can not** be routinely supported for use in ARDS

Sheng-Yuan R, Hsien-Ho L, Chung-To H. Critical Care 2014, 18:R63

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Fluid Balance

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FACTT trial (n = 1000)

•Restrictive vs. liberal IV fluid in ALI
- CVP or PCWP and CI parameters
- Restrictive strategy:
  - **Did not improve** 60 day mortality (1° endpoint)
  - Improved lung function
  - Shortened mechanical ventilation times/ICU days
  - No increase non-pulmonary organ failure

Wiedemann, HP, et al. N Engl J Med. 2006 Jun 15;354(24):2564-75.

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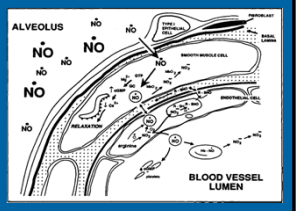
Nitric Oxide

2014 meta-analysis
- **Transiently** improves oxygenation
- Expensive
- Dose & titration questions
- Potentially harmful
  - Acute kidney injury
- Has not been shown to:
  - Increase ventilator free days
  - Improve mortality



Adhikari N, Dellinger R, Lundin S. Crit Care Med 2014;42(2):404-412

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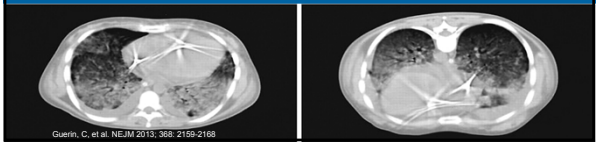
Prone Ventilation

- Early, severe ARDS, prospective, randomized study
  - n = 66
  - 16 hours prone vs. supine mechanical ventilation
  - No difference in complications except cardiac arrest higher in supine group
- Prone group:
  - 16% vs. 33% mortality at 28 days
  - 24% vs. 41% mortality at 90 days



Guerin, C, et al. NEJM 2013; 368: 2159-2168

Acute Anemia

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- Conservative PRBC approach
  - Transfusion threshold Hgb < 7 gm/dL
  - Exceptions
    - Active cardiac ischemia
    - Active hemorrhage

Grocott MP, Mythen MG, Gan TJ. Anesth Analg 2005;100:1093-106

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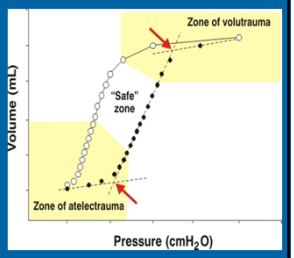
Summary

Minimize ventilator induced lung injury by:

- Avoid volutrauma
  - Alveolar distention
- Avoid atelectrauma
  - Repetitive opening/closing
- Avoid biotrauma
  - Lung inflammation
- Avoid oxygen toxicity



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Case Study

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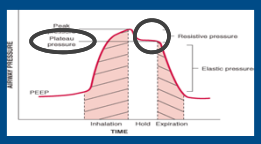
Recall:
32M, post trauma day #2, s/p MVC: L flail chest, L pulmonary contusion, L pneumothorax s/p chest tube, persistent high plateau pressures and refractory hypoxemia.
Vent: PRVC 20/400/+18/100%
ABG: 7.36/40/52/24/-4 Hgb 7.6, Creatinine 3.2

-Nitric oxide not indicated
-HFOV not indicated
-Transfusion not indicated
-Too early for steroids
-Consider NMB
-Consider prone ventilation
-Control plateau pressure
Utilize ARDSnet protocol



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Antibiotic Therapy Principles

- Initially broad spectrum, adequately dosed regimen
- Geographic variability of bacteriology
- Short duration antibiotic therapy
  - Reduces risk of infection with resistant bacteria
  - 7 days uncomplicated non-bacteremic infections with appropriate clinical response
    - Except Pseudomonas
  - De-escalate or discontinue all empiric antibiotics after **48-72 hours**
    - Cultures negative or signs of infection have resolved

ATS/IDSA 2005. Am J Respir Crit Care Med. 2005 Feb 15;171(4):388-416

Case Study

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42M post trauma day #10, severe TBI. Not mechanically ventilated, in the surgical step down unit. Day #3 of Piperacillin/Tazobactam and Vancomycin due to fevers, leukocytosis and cough. Deep bronchial culture, UA and blood cultures all negative. Currently afebrile, normal WBC count, negative CXR

SHOULD HIS ANTIBIOTIC REGIMEN BE STOPPED OR DE-ESCALATED?

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Other Treatment Strategies for Pulmonary Complications

Avoid Unnecessary GI Prophylaxis

- 0.5-5% incidence stress-related mucosal bleeding in critically ill patients
- Independent Risk Factors:
  - Mechanical ventilation >48 hours
  - Coagulopathy (Platelet count <50,000, INR > 1.5 or PTT > 2x control)
- Other Risk Factors:
  - Shock/hypoperfusion with associated organ dysfunction (AKI)
  - Burns >35% TBSA
  - Severe TBI (GCS <8), severe spinal cord injury
  - Concomitant use of NSAIDs
  - Glucocorticoid therapy (>250 mg Hydorcortisone or equivalent)
- Negative Risk Factor:
  - Enteral nutrition

Miano et al. Chest 2009; 136:440-447

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Avoid Unnecessary GI Prophylaxis

- H2 receptor antagonists vs. proton pump inhibitors
  - Equal efficacy
  - PPI: GERD or recent GI bleeding
  - Why not PPI's for all
  - Risk of nosocomial pneumonia (9.3% vs. 1.5%)
  - Association in multiple trials with C. Difficile infection

Miano et al. Chest 2009; 136:440-447

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Hyperglycemia

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- Trauma
  - Increase mortality rate, LOS, ventilator days
  - Worse neurologic outcomes in TBI
- Surgical
  - Higher mortality & nosocomial infection rates
- Intensive insulin therapy (80-120 mg/dL)
  - Increased rate of hypoglycemia, adverse events
- Conventional therapy (140-180 mg/dL)
  - Less hypoglycemic events
  - No increase in mortality and improved outcomes

J Diabetes Sci Technol. Nov 2009; 3(6): 1373–1376
NICE-SUGAR investigators, Finfer S, Chittock DR, et al. N Engl J Med 2009; 360: 1283
Griesdale DE, de Souza RJ, van Dam RM, et al. CMAJ 2009, 180: 821

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Pain Control/Sedation

- 2013 SCCM Pain, Analgesia, Delirium guidelines
- **Maximize** narcotic usage in trauma/surgical patients
- **Minimize** benzodiazepine sedation
  - Prolongs mechanical ventilator weaning
  - Increases risk of delirium
- **Utilize** non-benzodiazepine sedation, if indicated
  - Propofol and Dexmedetomidine
- **Utilize** non-narcotic alternatives
  - Parenteral/oral NSAIDS, parenteral/oral Acetaminophen
- Selective use of neuraxial blockade may facilitate faster ventilator weaning and improve pain control
  - AAA repair, rib fractures

Barr J, Fraser G, Puntillo K, et al. Crit Care Med. 2013 Jan;41(1):263-306.

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"In the mindset of the data-driven, cost conscious, nonclinical performance examiner, any postoperative complication may be viewed as iatrogenic in nature and therefore a non-reimbursable service"

David M. Wheeler, BA, RRT-NPS, RCP, Postoperative Pulmonary Complications: Panel discussion. Clinical Foundations 2012;669:p10

Summary

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Where medicine meets innovation

- Early recognition of modifiable risk factors
- Pre-op strategy to combat post-op complications
- Employ any lung expansion therapy
- Utilize post-op risk reduction strategies that work
- Know local microbiologic flora and tailor antibiotics
- Recognize post trauma risk factors
- Employ proven ventilator strategies for lung protection and prevention of PNA

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