Abdominal Compartment Syndrome

Barbara A. Latenser, MD

University of Iowa Hospitals and Clinics

Michael D. Peck, MD

North Carolina Jaycee Burn Center

Is Abdominal Compartment Syndrome (ACS) in Burns a New Problem?

- 1940-1980 resuscitation formulas included colloid
- 1980-2000 resuscitation formulas excluded colloid
- From ~1990 on we have become more aware of complications of excessive crystalloid resuscitation

How Do We Define Abdominal Compartment Syndrome?

- IAP ≥ 25 mm Hg **AND**
  new onset single/multiple organ failure

- There is no grading system

Primary ACS

- Injury or disease in the abdomen or pelvis
  - Non-operative management solid organ injury
  - Develops after abdominal surgery
    - damage control
    - pelvic fractures
    - liver transplant

Secondary ACS

- Non-abdominal conditions
  - Major burns
  - Sepsis
  - Conditions requiring massive fluid resuscitation

Tertiary ACS

- Also known as recurrent ACS
- Develops after treatment of 1° or 2° ACS
- Recurrent or new episode after definitive abdominal wall closure

Secondary ACS

- Non-abdominal conditions
  - Major burns
  - Sepsis
  - Conditions requiring massive fluid resuscitation

Predisposing Conditions for Intra-Abdominal Hypertension (IAH)

- Hypothermia
- Massive transfusions
- Sepsis
- Mechanical ventilation
- Pneumonia
- Acidosis
- Excessive fluid resuscitation

Excessive Fluid Resuscitation

- Post-resuscitation pulmonary edema
- Conversion of superficial → deep burns
- Need for unburned limb fasciotomies
- Abdominal compartment syndrome

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Cardiovascular Effects of ACS

- ↑ Intra-thoracic pressure transmitted through diaphragm
  - Compression IVC
- ↑ CVP
- ↓ Preload
- ↑ Afterload with ↑ PVR

Pulmonary Effects of ACS

- ↑ Peak airway pressure
- Poor compliance
- ↑ End-inspiratory pressure
- Mechanical impairment of diaphragm
- Decreased pulmonary blood flow
- V/Q mismatch

All lead to…

- Decreased PaO_2
- Intractable hypercarbia

Renal Effects of ACS

- Renal vein compression
- Renal parenchymal compression
- Shunting blood away from cortex and functioning glomeruli
- ↑ Anti-Diuretic Hormone release
- Oliguria/Anuria

Measuring Methods

- Direct
  - Direct needle puncture and transducer
- Intermittent Indirect
  - Bladder pressure transducer
- Continuous Indirect
  - Continuous bladder irrigation method

Treatment of ACS*

Bladder Pressure	Treatment
10-15 mmHg	Monitor
16-25 mmHg	Monitor
26-35 mmHg	Decompression
> 35 mmHg	Decompression & re-exploration

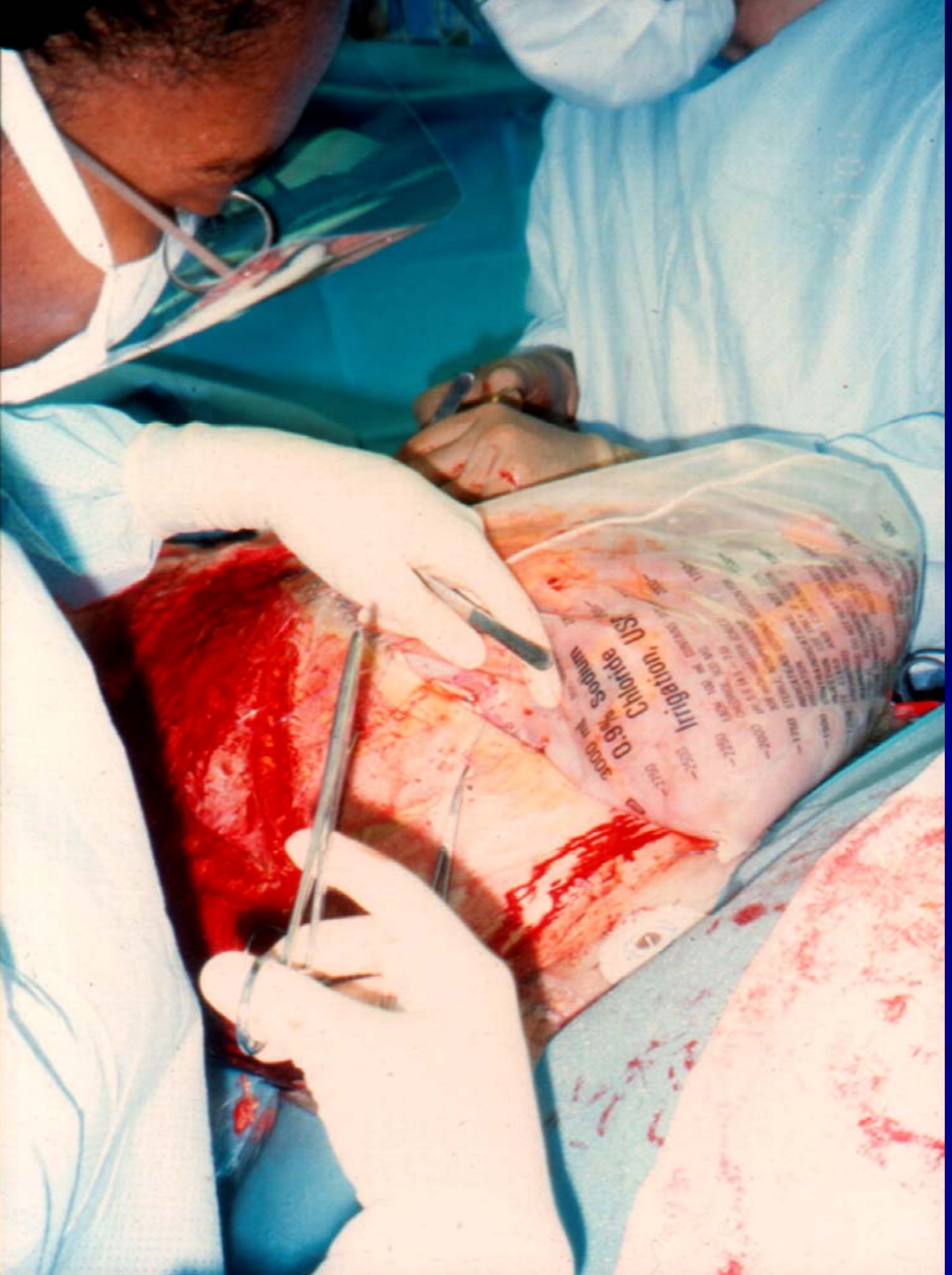
*Meldrum et al, *Am J Surg* 1997

The Problems

- The “Standard of Care” for ACS is decompressive laparotomy
- Additional morbidity of laparotomy
- Operating Room vs. Bedside Surgery
- Temporary closures are temporary

Temporary Closure Goals

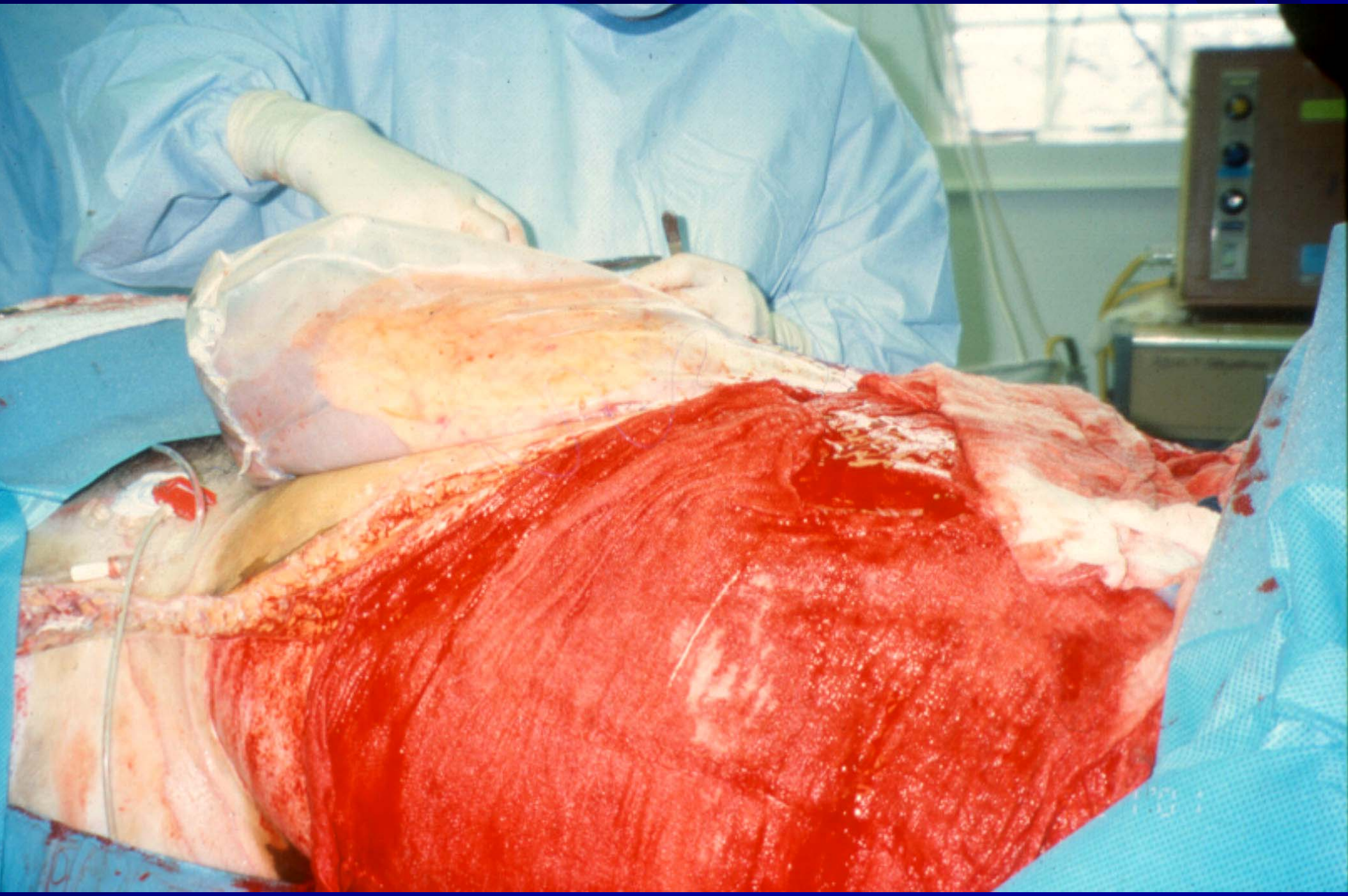
- Expeditious closure
- Minimize heat and fluid loss
- Minimize loss of abdominal domain



Bogota Bag

- + Inexpensive
- + Readily available
- + Minimize fluid losses

- - Loss of abdominal domain
- - Ease of tearing
- - Subsequent procedure mandatory



Other Techniques for Temporary Closure

- Running nylon and/or towel clips
- Absorbable (Dexon/Vicryl) mesh
- Plastic sheet (Ioban)
- Wound VAC

Vacuum-Assisted Closure

- Decreased incidence ACS
- Prevent loss abdominal domain
- ↓ Need for chemical paralysis

Predisposition for ACS in Burns

- Large volume fluid resuscitation
- Circumferential torso burns
- Inhalation Injury

Research Questions Asked at the University of Iowa

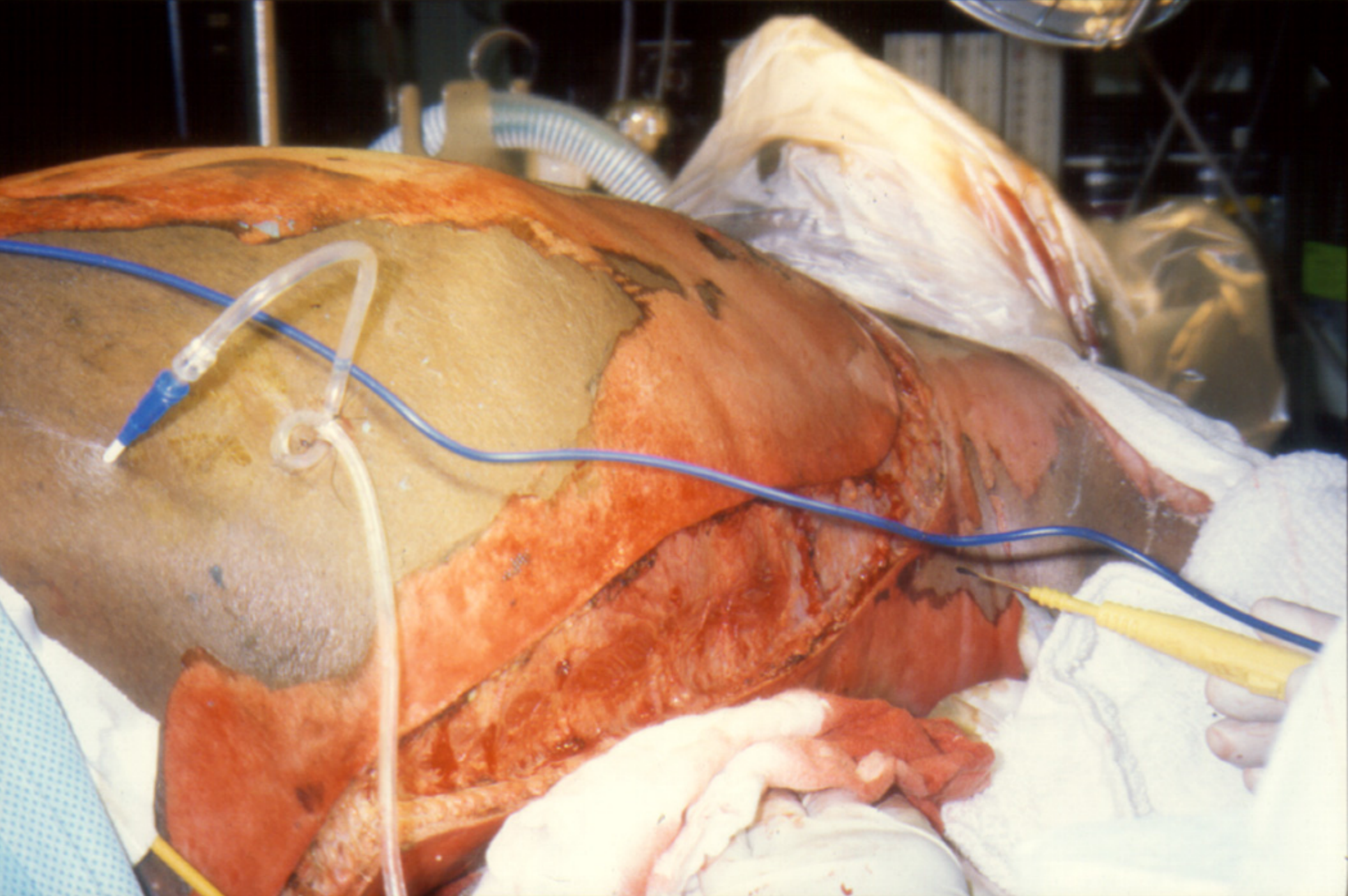
- What is the etiology of the ACS in acute thermal injury ?
- Is decompressive laparotomy the only method of treatment?

Sample Population

- March 1999 - November 2003
  22/1,454 admissions (1.5%) ACS

Materials & Methods

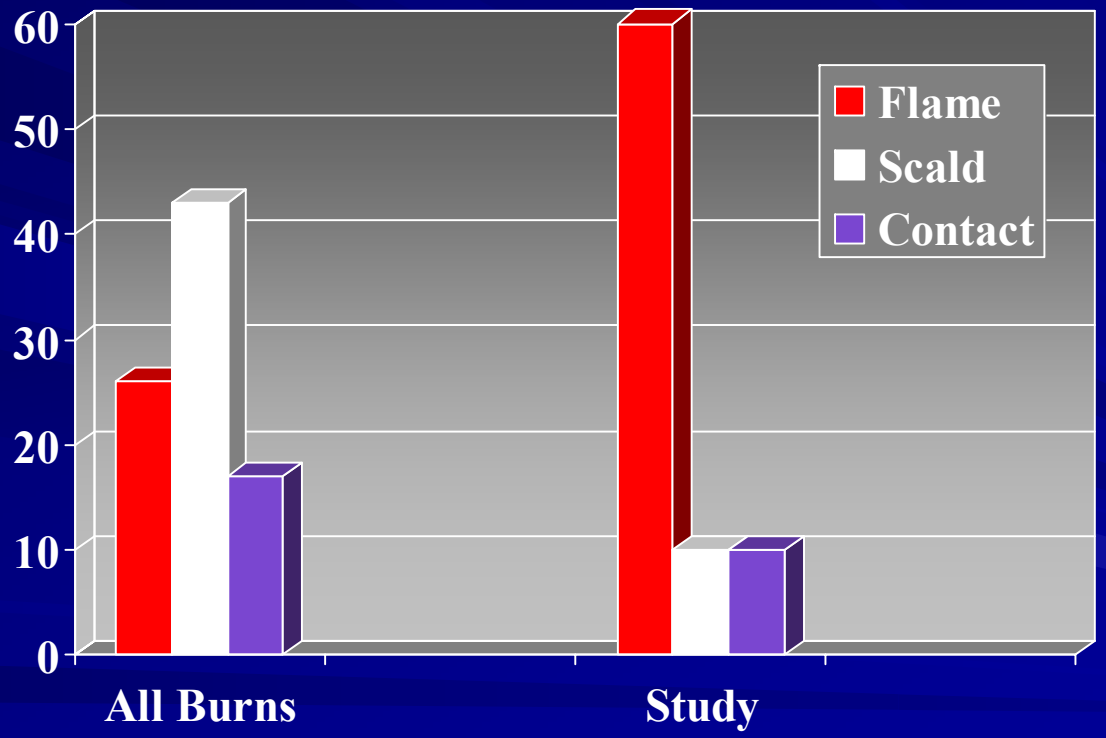
- Intra-abdominal pressure measurement (bladder transducer) for >40% TBSA burns
- Percutaneous peritoneal lavage catheter placement if pressure >25 mmHg
- Decompressive laparotomy if PD failed



Resuscitation Fluid

- Standard: Modified Parkland Formula
  - 4ml/kg/%TBSA
  - 6ml/kg/%TBSA if Inhalation injury also
- Study Patients
  - 3.7 cc/kg/%TBSA
  - (range =2-5 cc/kg/%TBSA)

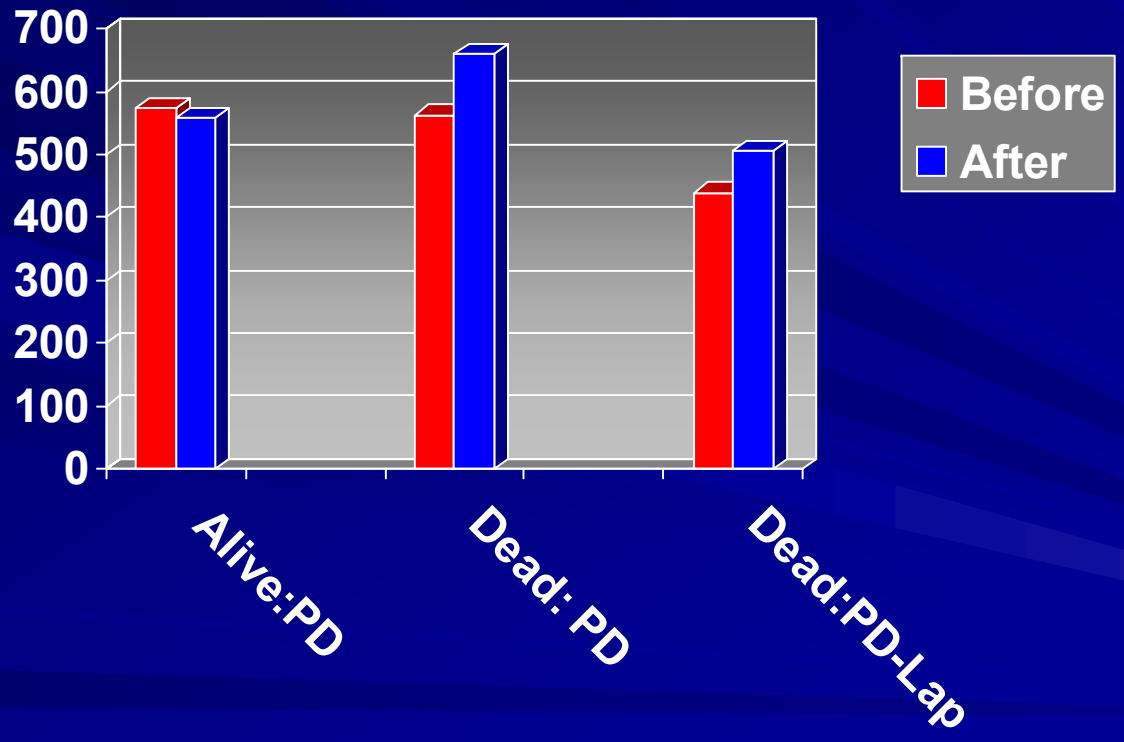
Mechanism of Injury



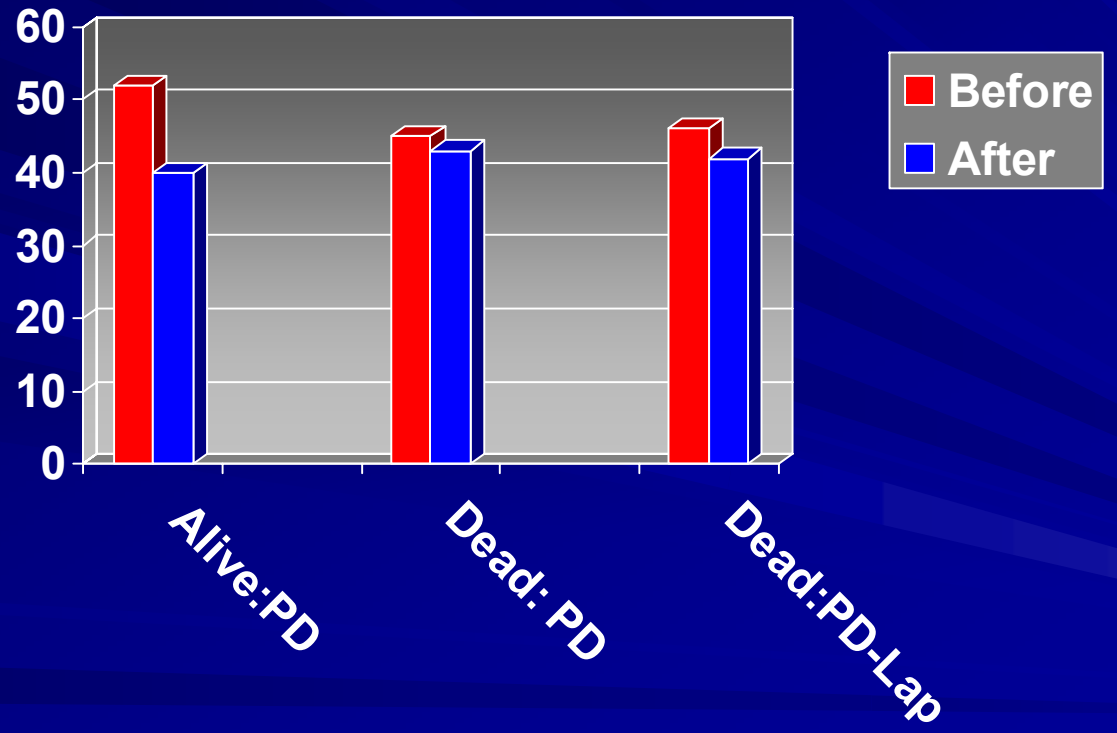
PD vs PD+Laparotomy

Group	Alive: PD N=6	Dead: PD n=10	Dead:PD+Lap n=6
Age (yrs)	40	54	37
%TBSA	46	30	80
Vent/LOS	0.7	0.9	1.0
Bladder Pressure	29	29	37

Tidal Volume Before & After PD



Peak Inspiratory Pressure Before & After PD



Nonsurvivors had:

- ↑ ventilator/LOS days
- ↑ bladder pressure
- ↓ peritoneal drainage
- ↑ fluid intake
- Lower PaO_2/FiO_2 ratios, $p<0.02$

Findings

- Patients with < 80%TBSA & inhalation injury responded to PD
- Patients with >80%TBSA & inhalation injury failed PD
- Autopsy: no intra-abdominal sepsis or bowel complications seen

Conclusions

- Percutaneous decompression is an option to prevent progression to decompressive laparotomy
- Peritoneum is a third kidney
- High risk patients should be monitored for abdominal hypertension

75% TBSA (all FT), inhalation injury, multiple fractures

PD cath on admit

LOS 58 days

Back in school and riding horses again

Contact Information

- Dr. Barbara Latenser
- barbara-latenser@uiowa.edu