

# The Open Abdomen

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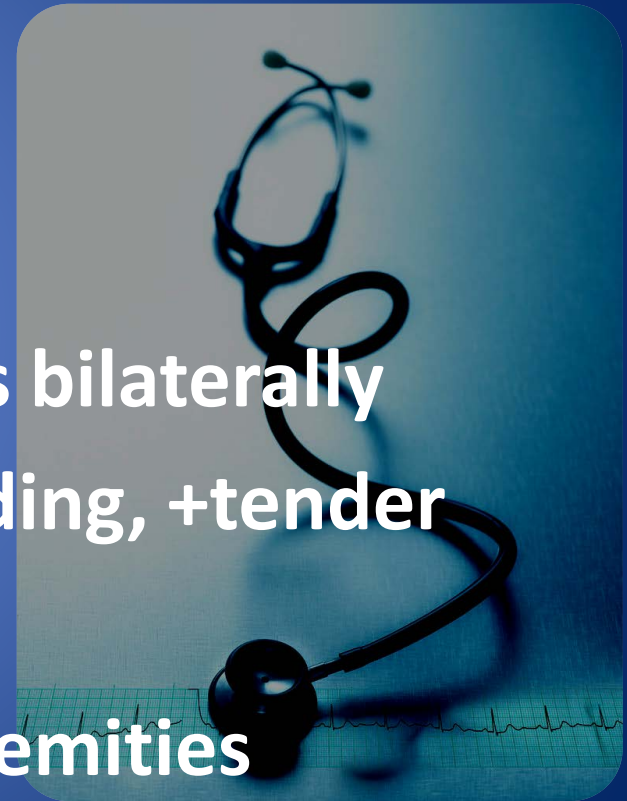
Richmond University Medical Center  
Department of Surgery  
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# Case Presentation

- **21M brought in by EMS s/p GSW to LUQ**
- **No significant blood loss at scene**
- **Complaining of pain in abdomen, speech sluggish**
- **PMHx: asthma**
- **PSHx: exploratory laparotomy, SBR 2011**

# Physical Examination

- Afebrile, 103/53, HR 112
- Awake, arousable to voice
- HEENT: PERRLA, EOMI
- S1/S2 RR, equal breath sounds bilaterally
- Abd: GSW in LUQ, active guarding, +tender
- No gross blood on rectal exam
- Full range of motion in all extremities



# Clinical Course

- IV access established, intubated in ED
- Primary survey completed, no other injuries
- CXR: no traumatic injury, ETT in place
- Foley placed draining amber-colored urine
- Taken to OR urgently for exploration

# Operative Findings

- Through & through injury to stomach
- Zone I hematoma
- Hematoma within Gerota's fascia
- Ex-lap, repair of gastrotomy & aortic lac, SBR
- IV pyelogram by GU, no extravasation

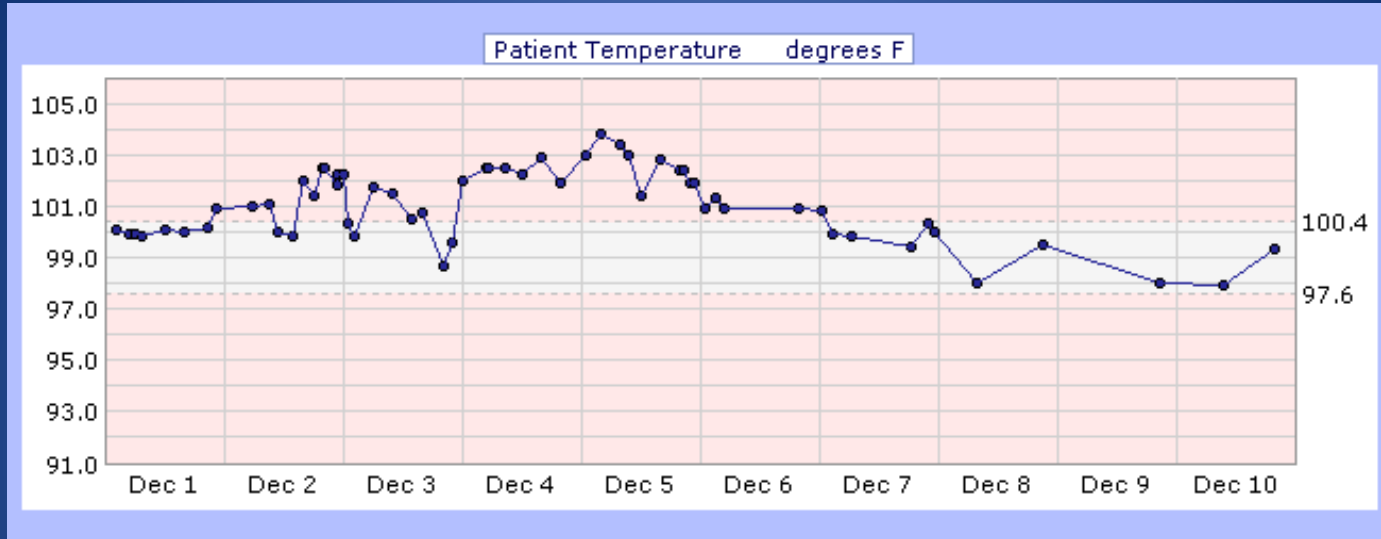
# OR

- **Bowel markedly distended at end of case**
- **Total operative time: 4 hours**
- **EBL: 500mL**
- **Crystalloid: 6 liters**
- **Replacement: 2U pRBCs, 3U FFP**
- **Decision made to keep abdomen open**
- **ABThera dressing applied**

# Postoperative Period

- Kept intubated, sedated, no paralytics
- Initial vascular exam improved with fluids
- ABThera dressing with good seal
- On Cipro/Flagyl, febrile POD#0-1, 1-4
- Blood/sputum/peritoneal cultures neg

# Hospital Course



- Returned to OR POD#3 for washout & closure
- No active bleeding from retroperitoneum
- Fascia closed with PDS & retention sutures



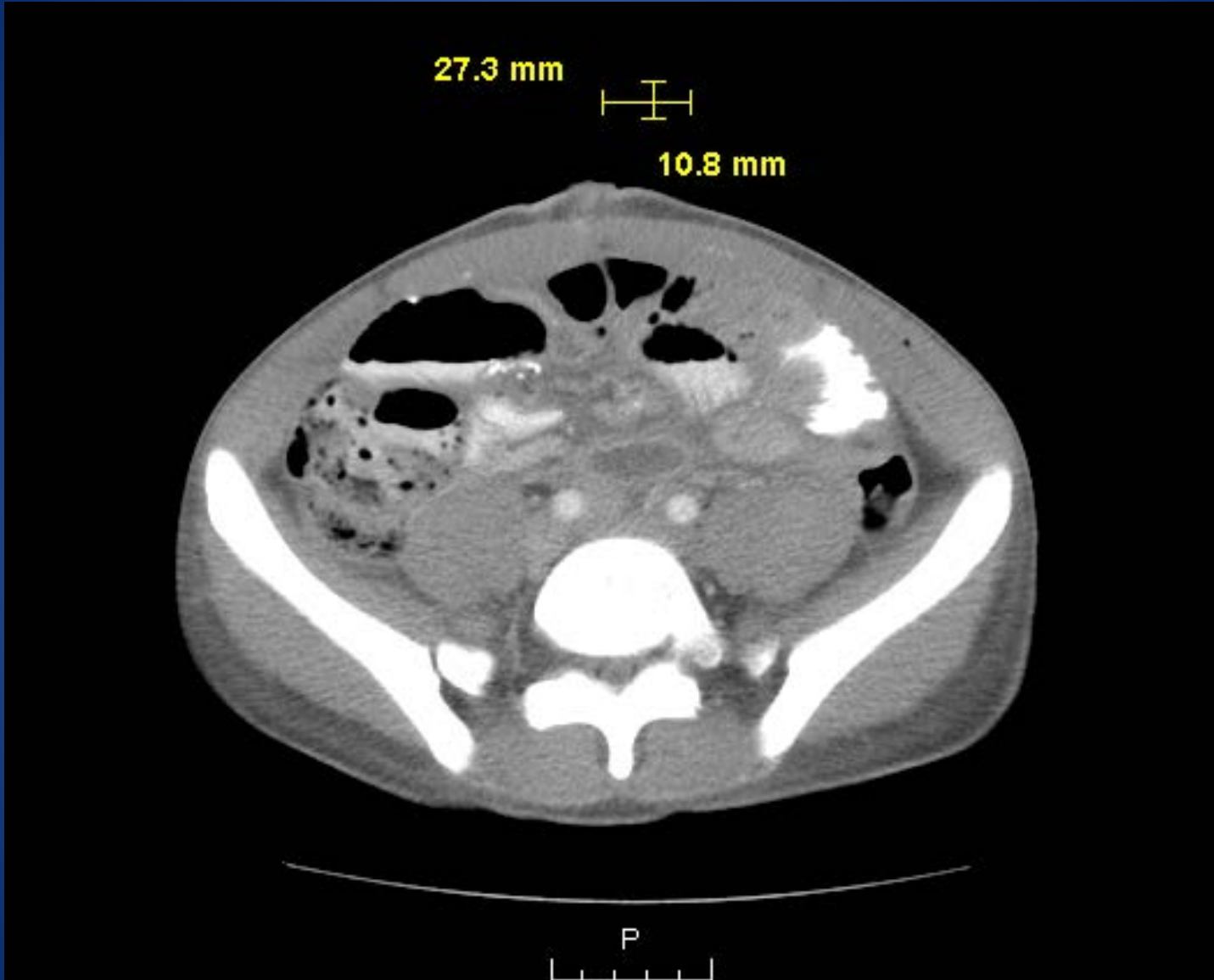
# Hospital Course #2

- **POD #5/2: self-extubated**
- **POD #6/3: passed flatus, +BM; diet advanced**
- **WBC 22.3K, contaminated case → CT scan**
- **Antibiotics changed to Vancomycin/Zosyn**
- **POD 9/6: Pelvic abscess drained by IR**



# Hospital Course #3

- **POD #13/10: repeat CT ↓ed collection size**
- **Cx: E.coli sensitive to cefepime**
- **Signed out AMA, drain removed by IR**
- **Pt returned with pain, signed out next day**
- **POD# 23/20: discharged home with oral ABx**



# Questions?



11/18/81

# Background

- Prior to 1980, pts treated in one definitive surgery
- Leaving OR early thought to increase infection rates
- Diagnoses such as ‘failure to resuscitate’ were common
- Pathophysiology of ACS not well understood
- Stone 80s, Rotondo 90s: ‘Damage-control’ surgery

# Definition

- Fascial edges intentionally unapproximated
- Temporizing measure allows planned escape
  - Correct electrolytes, medical bleeding
  - ICU resuscitation
- Facilitates repeat exploration, intervention



# Indications for Open Abdomen

- Damage control laparotomy for trauma
- Severe abdominal infection
- Acute mesenteric ischemia
- Necrotizing infection of the abdominal wall
- Intra-abdominal hypertension

# Risk Factors

- Preoperative
  - Blunt trauma c hemoperitoneum & hypotension
  - pH < 7.2; SBP < 60 mm Hg; pre-hospital intubation
  - Severe multicavitary trauma
- Intraoperative
  - Transfusion > 10 pRBCs, EBL > 4L, T < 34° C
  - Base deficit greater than -6 (≥55 yrs); -15 (< 55yrs)
  - Absence of clot formation, bleeding s source

# Damage-Control Surgery

- Phase I: ex-lap, control of bleeding/spillage, packing
- Phase II: ICU resuscitation, correction of lethal triad
- Phase III: Re-exploration, definitive fascial closure
- Phase IV: planned ventral hernia
- Phase V: Abdominal wall reconstruction

# Abdominal Compartment Syndrome

- Not an end-stage process, but a continuum
- Intra-abdominal hypertension (>12 mm Hg)
- IAP  $\geq$  20 mm Hg + organ dysfunction
- Subtypes:
  - Primary
  - Secondary
  - Recurrent

# Abdominal Compartment Syndrome

- Lethal effects on cardiac, pulmonary, renal fxn
  - Impaired oxygenation & increased peak pressures
  - Oliguria
- Increased intracranial pressure
- GI ischemia due to decreased splanchnic flow
- Abd wall ischemia, wound complications

# Diagnosis

- Clinical suspicion is paramount
- IAP measurement via bladder pressures
  - Instill 25-50mL of saline into empty bladder
  - Record pressure using arterial line transducer
  - Greater than 20 mm Hg require close monitoring
  - $\geq 25$  mm Hg may benefit from decompressive lap
- No definitive IAP at which ACS occurs

# WSACS Grades of IAH

Grade	IAP (mm Hg)
I	12-15
II	16-20
III	21-25
IV	>25

# Management of IAH

- Medical
  - Sedation/paralysis
  - Diuretics/fluid restriction
  - Evacuation of intraluminal contents (NGT, enemas)
- Maintain Abdominal Perfusion Pressure



# Management of ACS

- ~~Medical~~
  - ~~Sedation/paralysis~~
  - ~~Diuretics/fluid restriction~~
  - ~~Evacuation of intraluminal contents (NGT, enemas)~~
- ~~Maintain Abdominal Perfusion Pressure~~
- **Decompressive laparotomy**



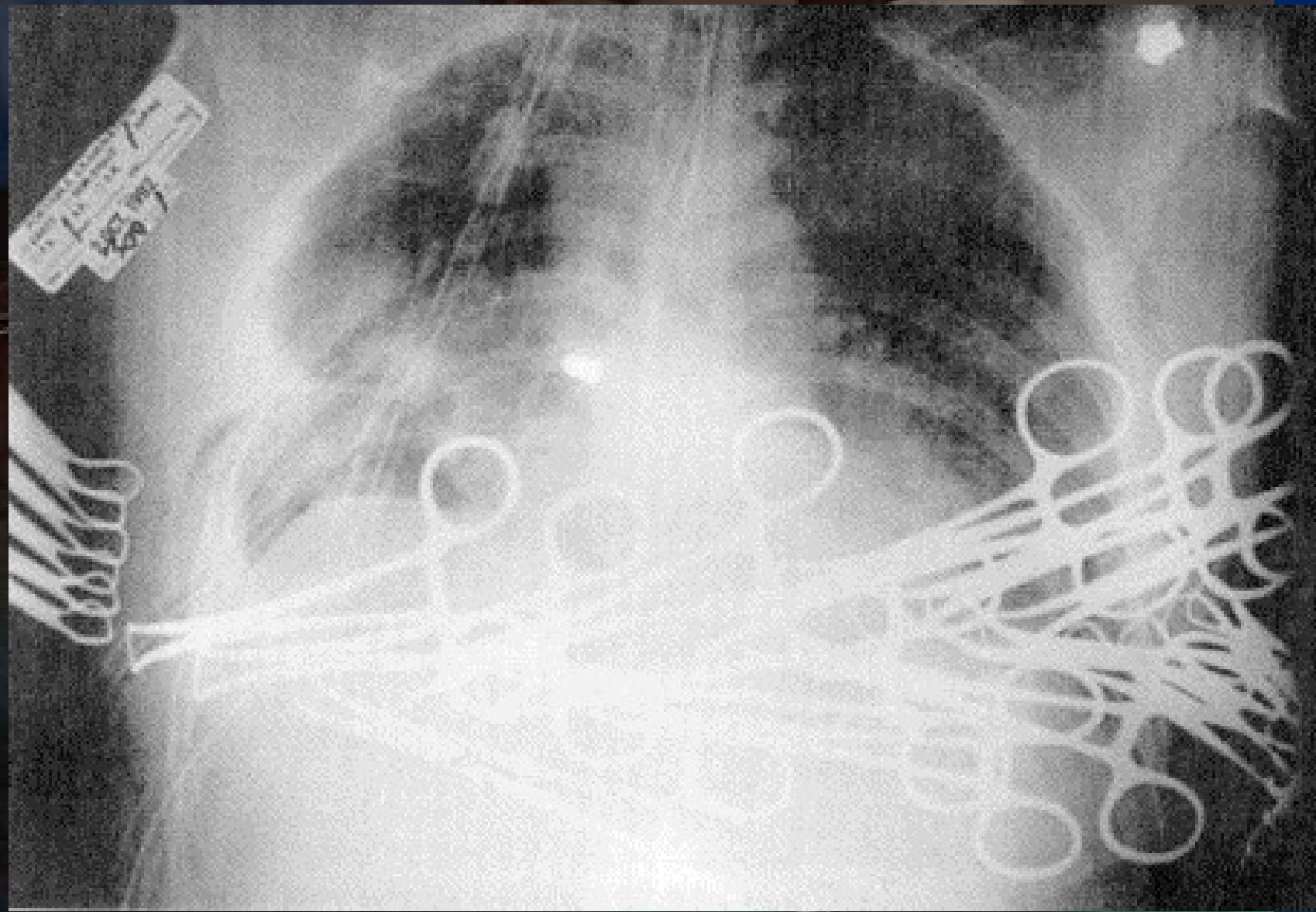
11/18/81

# Temporary Abdominal Closure

- Easy to apply, inexpensive
- Contains abdominal viscera during transport
- Decreases bowel edema
- Assists with evacuation of abdominal fluid
- Prevents adhesions and abd wall retraction
- Allows for expansion of abdominal contents

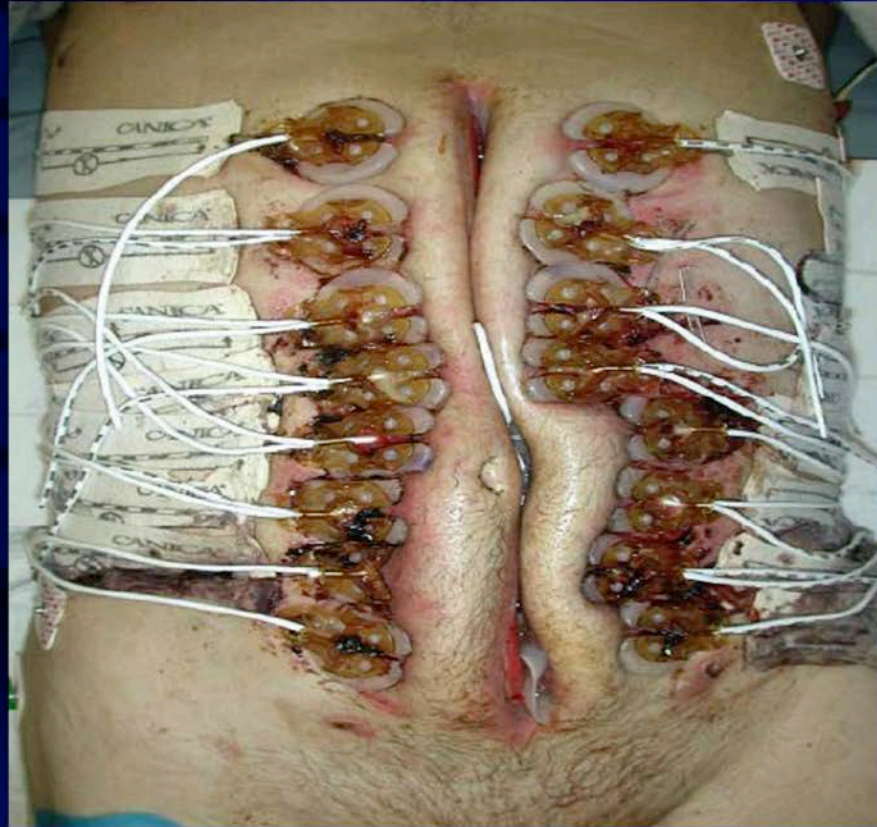
# Options for Temporary Coverage

- Skin-only closure
- Artificial burr (Wittman Patch)
- Absorbable mesh
- Non-absorbable mesh c visceral protection
- Vacuum pack
- Vacuum-assisted closure (VAC) wound mgmt



# Bogotá Bag





# Mesh closure

- Absorbable
  - Cheaper, readily available
  - Low primary fascial closure rates (18-38%)
  - Used in cases of planned ventral hernia
- Non-absorbable
  - Expensive
  - Improved fascial closure rates (33-89%)
  - High enterocutaneous fistula rate (6-18%)



[www.downstatesurgery.org](http://www.downstatesurgery.org)

# Wittmann Patch



# Negative Pressure Dressings

- Barker et al., coined 'vacuum pack' in 1995
- 3-layered technique:
  - Inner layer: fenestrated inert sheet
  - Middle layer: Kerlex/lap pads/blue towels + drains
  - Outer layer: bio-occlusive adhesive sheet (Ioban™)
- Known here in Brooklyn as 'ghetto vac'

# ABThera



# TAC Preference

TAC 2012 PLENARY PAPER

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## Negative-pressure wound therapy for critically ill adults with open abdominal wounds: A systematic review

Derek J. Roberts, MD, David A. Zygun, MD, MSc, FRCPC, Jan Grendar, MD, Chad G. Ball, MD, MSc, Helen Lee Robertson, MLIS, Jean-Francois Ouellet, MD, Michael L. Cheatham, MD, *and Andrew W. Kirkpatrick, MD, MHSc, Calgary, Canada*

# Study

- 2,715 citations were identified
- 2 RCTs & 9 cohort (3 prospective) met criteria
  - RCT: ↑ closure with VAC + retention sutures
  - RCT: trend toward ↑ closure with VAC vs Barker
  - Prospective cohort: variable results
- Low quality methodology
- Risk of bias is at least moderate

**TABLE 5.** Summary of Effect of Negative-Pressure Wound Therapy Versus Alternate Temporary Abdominal Closure Techniques on Outcomes

Source, Year	Therapy (n)	1° Outcome, n (%)		2° Outcomes, Mean (SD) or n (%)	
		Hospital Mortality	Length of Hospital Stay, d	Fascial Closure	ACS Rate or Effect on IAP, mm Hg
Randomized controlled trials					
Pliakos et al., <sup>17</sup> 2010	KCI VAC + RSSFC (26)	5 (19)	11.9 (2.1)	14 (54)	IAP was 12 vs. 16 for VAC after the first dressing change ( $p < 0.001$ )
	KCI VAC (27)	6 (22) ( $p = 1.0$ ) <sup>#</sup>	17.5 (4.6) ( $p < 0.001$ )	6 (22) ( $p = 0.02$ ) <sup>#</sup>	
Bee et al., <sup>18</sup> 2008†	KCI VAC (5)	NA	NA	3 (60)	NA
	Barker's vacuum pack (26)	NA		6 (23)	
	NPWT (KCI VAC/vacuum pack) (31)	8 (26)		15 (31)	
	Polyglactin mesh (20)	5 (25) ( $p = 1.0$ )		5 (26) (KCI VAC vs. vacuum pack, $p = 0.13$ ) <sup>#</sup> (NPWT vs. vacuum pack, $p = 0.10$ ) <sup>#</sup>	

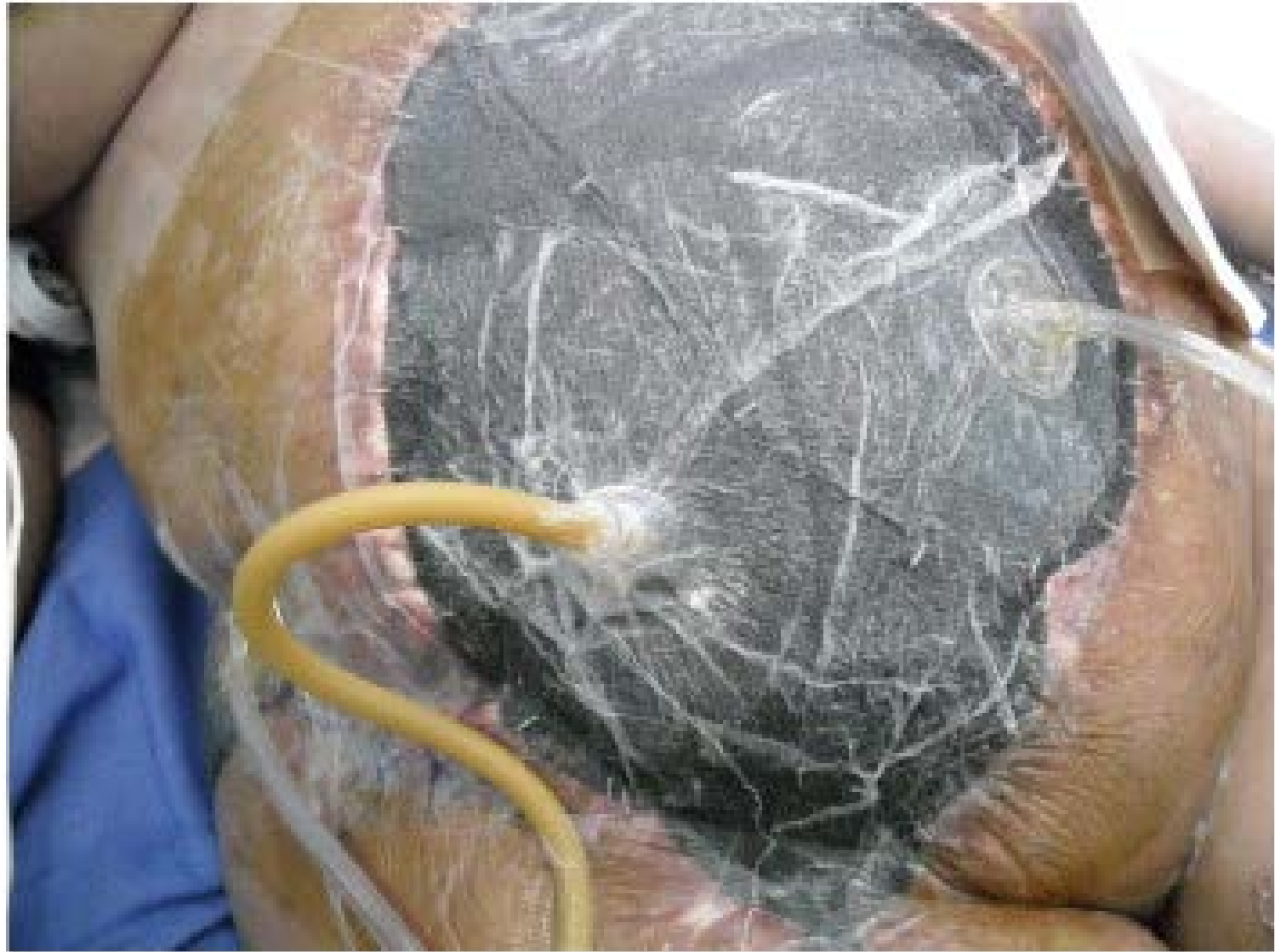
# Complications of TAC/OA

- Recurrent abdominal compartment syndrome
- Hypoalbuminemia, malnutrition
- Ventilator associated pneumonia
- Enteroatmospheric fistulae
  - High mortality rates
  - Significant nursing/wound care burden

# Management of Fistulae

- Prevention
- Attempt to seal fistula
- Control effluent
- Cover with well-vascularized soft tissue
- Resect chronic fistula





# When to Close?

- Adequately resuscitated
- Control of contamination/sepsis
- Warning signs of high fascial tension:
  - Sustained IAH (15-20 mmHg)
  - Rise in peak inspiratory pressure of 10+ cm H<sub>2</sub>O
- Failure to close: planned ventral hernia repair
- Component separation for non-acute setting

# Summary

- Use open abdomen early to prevent ACS
- ACS is a continuum, not a fixed state
- TAC: negative pressure & fascial approx best
- Primary closure possible in 50-90% ( $\leq$  7-10 d)
- If not closed, expected VH repair in 6-12 mos
- Component separation in non-acute setting

# Questions

- An 18-year-old man is admitted to the ICU after undergoing emergency laparotomy and splenectomy. He received 12 units of red blood cells and 8 units of fresh frozen plasma. Over the course of the next 12 hours, his abdomen becomes increasingly distended and firm, and urine output decreases significantly. Which of the following statements is true regarding abdominal compartment syndrome?
  - **A** Pulmonary capillary wedge pressure is typically low.
  - **B** Functional residual capacity is increased.
  - **C** There is increased central venous return.
  - **D** Central venous pressure is increased.
  - **E** Cardiac output increases.

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A 35-year-old man is admitted to the surgical ICU with a diagnosis of acute alcoholic pancreatitis.

**Systemic inflammatory response syndrome**

(SIRS) develops and the patient requires 8 L of fluid resuscitation to keep his central venous pressure higher than 10 mm Hg. You have a high index of suspicion for the development of abdominal compartment syndrome (ACS). This clinical entity:

- A Requires immediate decompressive laparotomy for IAP greater than 20 mm Hg
- B Results in hypocapnia
- C Is associated with decreased systemic vascular resistance
- D Will not affect cerebral perfusion
- E Should be suspected in any patient taking vasopressors who requires more than 6 L of resuscitative fluid over a short period

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- A 59-year-old woman with a long-standing history of GERD underwent a Nissen fundoplication that was complicated by 2 L of blood loss and hypotension in the OR. Her vital signs are an HR of 103 beats/min, BP of 100/70 mm Hg, RR of 16 breaths/min, and  $\text{Sao}_2$  of 96%. Her urine output was 15 mL of urine per hour over the last 4 hours. Laboratory results include a urine osmolality of 600 mOsm/kg, urine sodium of 15 mEq/L, plasma sodium of 140 mEq/L, urine creatinine of 20 mg/dL, and plasma creatinine of 1.5 mg/dL. What is the next step in management?
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