



Eastern Association for the Surgery of Trauma

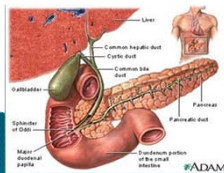
Maintenance of Certification (MOC) Acute Care Surgery Workshop

**January 10, 2012
Disney's Contemporary Resort
Lake Buena Vista, Florida**

Workshop Faculty:
Jose Diaz, MD, FACS
Rao Ivatury, MD, FACS
Patrick Reilly, MD, FACS

Therese Duane, MD, FACS – Workshop Director

A Review of Acute Cholecystitis for the Acute Care Surgeon



Jose J. Diaz, MD, CNS, FACS, FCCM
Professor of Surgery
Chief of Acute Care Surgery
R Adams Cowley Shock Trauma Center
University of Maryland Medical Center
Baltimore, Maryland

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Outline

- ▶ History
- ▶ Incidence of gallstone disease
- ▶ Presentation
- ▶ Workup
- ▶ Indications

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History– 1st Cholecystectomy

- ▶ Carl Johann August Langenbuch–performed the first gallbladder removal (July 15, 1882)
- ▶ At the time, medical management of acute cholecystitis consisted of hot local compresses, belladonna, hanging patients by their feet and shaking them (in hope of dislodging stones), and narcotics in increasing amounts that often resulted in addiction.
- ▶ As the outcome was seldom satisfactory, need for an alternative method of intervention was blatantly apparent.



Aust N Z J Surg 1993;63:56–64.
JAMA 1993;270:1429–32.
Surgical Rounds 1982; 68 –75.
J La State Med Soc 1991;143:22–5.

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History

- ▶ 1743, Jean Louis Petit, a surgeon in Paris, recognized the benefit of biliary procedures.
- ▶ Petit limited such operations to instances where pericholecystic abscesses ruptured transcutaneously, or for the cutaneous removal of stones through cholecystocutaneous fistulas.



Aust N Z J Surg 1993;63:56–64.
JAMA 1993;270:1429–32.
Surgical Rounds 1982; 68 –75.
J La State Med Soc 1991;143:22–5.

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Incidence of Gallstone Disease

- ▶ More than 25 million Americans have gallstones, and a million are diagnosed each year.
- ▶ 14.2 million are in women
- ▶ 600K–750K cholecystectomies / year are performed in the United States
 - most are for symptomatic gallstone disease
- ▶ Only 1 – 3% of the population complains of symptoms during the course of a year, and fewer than half of these people have symptoms that return

Everhart et al, *Gastroenterology*. 1999, 117: 632–639.

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Gallstone Disease: Women

- ▶ Women more likely than men to develop gallstones.
- ▶ 25% of women in the US by age 60, and 50% by age 75.
- ▶ Most cases are asymptomatic.
- ▶ Women at increased risk due to estrogen stimulation of the liver to remove more cholesterol from blood and divert it into the bile.
- ▶ Pregnancy increases the risk for gallstones, and pregnant women with stones are more likely to have symptoms than non-pregnant women.
- ▶ Several large studies have shown that the use of hormone replacement therapy (HRT) 2X –3X the risk for gallstones, hospitalization for gallbladder disease, or gallbladder surgery.
- ▶ Estrogen raises triglycerides, a fatty acid that increases the risk for cholesterol stones.

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Gallstone Disease: MEN

- ▶ 20% of men have gallstones by age 75.
- ▶ A study of nursing home residents reported that 66% of the women and 51% of the men had gallstones.
- ▶ Men are more likely to have severe disease and surgical complications than women.

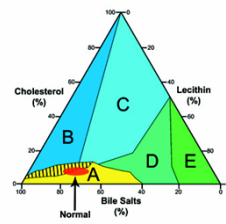
Other Risk Factors

- ▶ Spinal injury
 - ▶ History of abdominal surgery
 - ▶ Sickle-cell anemia
 - ▶ Impaired immune system
 - ▶ TPN
- Ethnicity**
- ▶ Hispanics & Northern Europeans higher risk for gallstones than Asian and African descent
 - ▶ Native North & South Americans
 - ▶ Pima Indians in US & native populations in Chile and Peru.
 - ▶ Pima women 80% chance of developing gallstones during their lives & virtually all native Indian females in Chile and Peru develop gallstones

Other Risk Factors

- ▶ Mutation gene ABCG8 significantly increases a person's risk of gallstones.
 - Gene controls a cholesterol pump that transports cholesterol from the liver to the bile duct. It appears this mutation may cause the pump to continuously work at a high rate.
- ▶ Obesity and Weight Changes, Metabolic Syndrome, Crohn's Disease, Organ transplant, Blood disorders, Medications (octreotide), Heme Iron

Cholesterol, lecithin, bile salts triangle

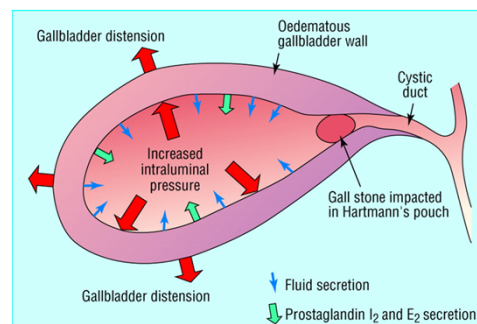


- ▶ Cholesterol gallstones: bile contains too much cholesterol and not enough bile salts.
- ▶ 2 other factors are important in causing gallstones.
 - 1st – how often & how well the gallbladder contracts, incomplete and infrequent emptying of the gallbladder may cause bile to become over concentrated and contribute to gallstone formation.
 - 2nd – presence of proteins in the liver & bile that either promote or inhibit cholesterol crystallization into gallstones.

Molecular pathophysiology and physical chemistry of cholesterol gallstones



Pathophysiology: Acute Cholecystitis



Clinical Presentation: Acute Cholecystitis

- | | |
|-----------------------------------|---|
| A. Local signs of inflammation | A. Murphy's sign, RUQ mass/pain/tenderness |
| B. Systemic signs of inflammation | B. Fever, elevated CRP, elevated WBC count |
| C. Imaging findings | C. Imaging findings characteristic of acute cholecystitis |

Definite diagnosis

- (1) One item in A and one item in B are positive
- (2) C confirms the diagnosis when acute cholecystitis is suspected clinically

Note: acute hepatitis, other causes of acute abdomen, and chronic cholecystitis should be excluded

T. Mayumi et al.: Results of the Tokyo Consensus Meeting

Clinical Presentation

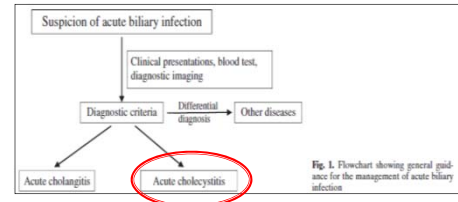


Fig. 1. Flowchart showing general guidance for the management of acute biliary infection

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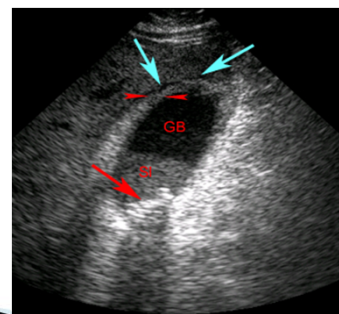
Imaging findings of acute cholecystitis: Ultrasonography

- ▶ Sonographic Murphy sign (tenderness elicited by pressing the gallbladder with the ultrasound probe)
- ▶ Thickened gallbladder wall (>4 mm, if the patient does not have chronic liver disease and/or ascites or right heart failure)
- ▶ Enlarged gallbladder (long axis diameter >8 cm, short axis diameter >4 cm)
- ▶ Incarcerated gallstone, debris echo, pericholecystic fluid collection
- ▶ Sonolucent layer in the gallbladder wall, striated intramural lucencies, and Doppler signals

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Ultrasound – Acute Cholecystitis



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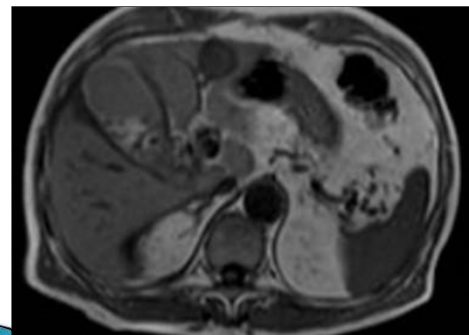
Imaging findings of acute cholecystitis: MRI

- ▶ Pericholecystic high signal
- ▶ Enlarged gallbladder
- ▶ Thickened gallbladder wall

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MRI



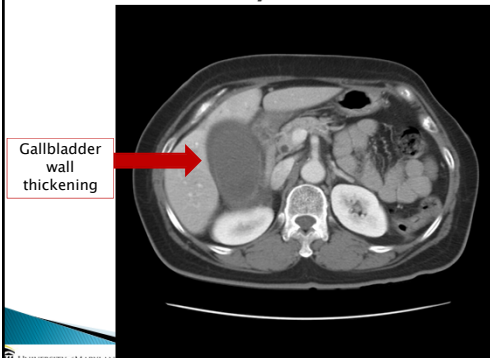
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Imaging findings of acute cholecystitis: CT scan

- ▶ Thickened gallbladder wall
- ▶ Pericholecystic fluid collection
- ▶ Enlarged gallbladder
- ▶ Linear high-density areas in the pericholecystic fat tissue

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Acute Cholecystitis



CT Scan Cholelithiasis



Acute Cholecystitis in the elderly: use of CT and correlation with ultrasonography.

- ▶ 475 patients (age, >64 y) with AC
- ▶ Groups: US alone (n = 240), CT alone (n = 60), and CT + US (n = 168).
- ▶ 60 (35.7%) US + CT group had inflammation in both studies
- ▶ 34 (20.2%) inflammation only on US
- ▶ 32 (19.0%) inflammation only on CT.
- ▶ US + CT detection of cholelithiasis was not different
- ▶ Peritonitis, leukocytosis, and acidosis were more frequent in the 2 groups undergoing CT.
- ▶ cholecystectomy rate was lowest (and the complication rate was highest) in the CT + US group.

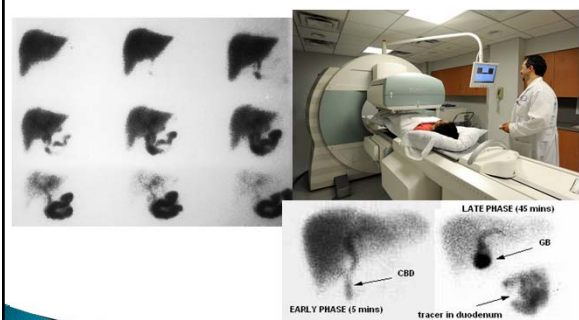
McGillicuddy et al, Am J Surg. 2011 Nov;202(5):524-7

Imaging findings of acute cholecystitis: Tc-HIDA scan (technetium hepatobiliary iminodiacetic acid scan)

- ▶ Non-visualized gallbladder with normal uptake and excretion of radioactivity
- ▶ Rim sign (augmentation of radioactivity around the gallbladder fossa)

T. Mayumi et al.: Results of the Tokyo Consensus Meeting

HIDA Scan



Acute Cholecystitis – Tokyo Classification 2007

Mild (grade I) acute cholecystitis: early laparoscopic cholecystectomy is the preferred procedure.

Moderate (grade II) acute cholecystitis: early cholecystectomy is performed. However, if patients have severe local inflammation, early gallbladder drainage (percutaneous or surgical) is indicated. Because early cholecystectomy may be difficult, medical treatment and delayed cholecystectomy are necessary.

Severe (grade III) acute cholecystitis: urgent management of organ dysfunction and management of severe local inflammation by gallbladder drainage and/or cholecystectomy should be carried out. Delayed elective cholecystectomy should be performed later, when cholecystectomy is indicated.

Acute Cholecystitis – Tokyo Classification 2007

Mild (grade I) acute cholecystitis

- ▶ “Mild (grade I)” acute cholecystitis does not meet the criteria of “severe (grade III)” or “moderate (grade II)” acute cholecystitis.
- ▶ It can also be defined as acute cholecystitis in a healthy patient with no organ dysfunction and mild inflammatory changes in the gallbladder, making cholecystectomy a safe and low-risk operative procedure.

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Acute Cholecystitis – Tokyo Classification 2007

Moderate (grade II) acute cholecystitis

- ▶ “Moderate” acute cholecystitis is associated with any one of the following conditions:

- 1. Elevated WBC count ($>18,000/\text{mm}^3$)
- 2. Palpable tender mass in the right upper abdominal quadrant
- 3. Duration of complaints >72 h ♦
- 4. Marked local inflammation (biliary peritonitis, pericholecystic abscess, hepatic abscess, gangrenous cholecystitis, emphysematous cholecystitis)

- ♦ Laparoscopic surgery should be performed within 96 h of the onset of acute cholecystitis

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Acute Cholecystitis – Tokyo Classification 2007

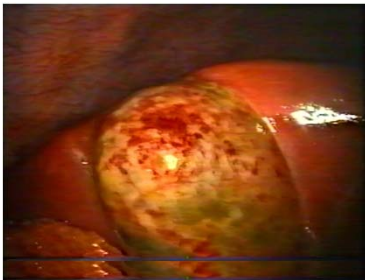
Severe (grade III) acute cholecystitis

- ▶ “Severe” acute cholecystitis is associated with dysfunction of any one of the following organs/systems

- 1. Cardiovascular dysfunction (hypotension requiring treatment with dopamine $5 \mu\text{g}/\text{kg}$ per min, or any dose of dobutamine)
- 2. Neurological dysfunction (decreased level of consciousness)
- 3. Respiratory dysfunction ($\text{PaO}_2/\text{FiO}_2$ ratio <300)
- 4. Renal dysfunction (oliguria, creatinine $>2.0 \text{ mg/dl}$)
- 5. Hepatic dysfunction ($\text{PT-INR} >1.5$)
- 6. Hematological dysfunction (platelet count $<100,000/\text{mm}^3$)

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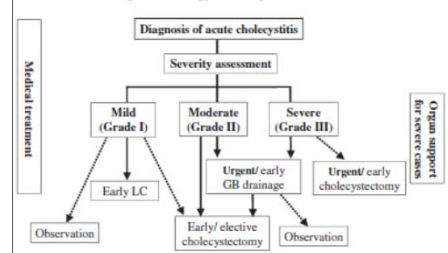
Acute Gangrenous Cholecystitis



Flowcharts for the diagnosis and treatment of acute cholangitis and cholecystitis: Tokyo Guidelines

FUMIHIRO MIURA¹, TADAHITO TAKADA¹, YOSHIFUMI KAWARADA², YUI NIMURA³, KEITA WADA⁴, MASAHITO HIROTA⁵, MASATO NAGINO⁶, TOSHIO TSUTSUMI⁷, TOSHIHIRO MAYUMI⁸, MASAHITO YOSHIDA⁹, STEVEN M. STRASBERG¹⁰, HENRY A. PIPP¹¹, JACQUES BELCHET¹², EDUARDO DE SANTIBANAN¹³, THOMAS R. GADAGU¹⁴, DERE J. GORMAN¹⁵, SHEUNG-TAT FAN¹⁶, MIN-FU CHEN¹⁷, ROBERT T. PABRIER¹⁸, PHILIPPUS C. BORNHANN¹⁹, SUN-WHE KIM²⁰, KUN-HUN LAM²¹, GIULIO BELLI²², and CHRISTOPH DEPPERT²³

F. Miura et al.: Management strategy for biliary inflammation/infection



Survey of General Surgeons

- ▶ At least two published surveys show that 40 to 80% of surgeons do not offer CCK at the index admission.

Schuerer, Plenary Session EAST PMG "08,09,11

EAST Acute Cholecystitis PMG

- ▶ Grade 1A
 - Laparoscopic cholecystectomy should be attempted first over open cholecystectomy for acute cholecystitis.
- ▶ Grade 1B
 - This applies for patients over age 60 as well.

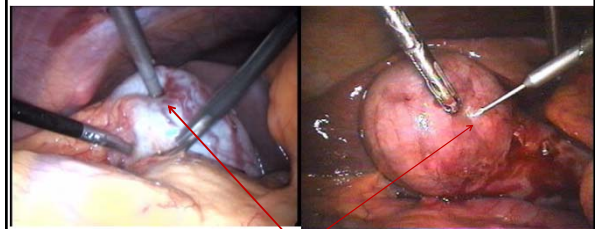
Schuerer, Plenary Session EAST PMG "08,09,11

EAST Acute Cholecystitis PMG: Early vs. Late

- ▶ Grade 1A
 - Laparoscopic cholecystectomy should be done during the index admission versus a delay of 6 or more weeks.
- ▶ Grade 1B
 - Laparoscopic cholecystectomy should be done within 72 hours of symptoms when possible.
- ▶ 3 RCTs show that early laparoscopic CCK vs 6 or greater week delay leads to decreased LOS and costs. LOS difference was 3–5 days.
- ▶ Between 15–26% in the delayed group had to have surgery early due to continued symptoms.

Schuerer, Plenary Session EAST PMG "08,09,11

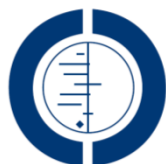
Laparoscopic Cholecystectomy



Laparoscopic Needle Decompression

Early versus delayed laparoscopic cholecystectomy for acute cholecystitis (Review)

Gurusamy KS, Samraj K



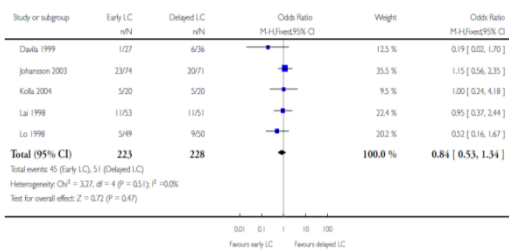
THE COCHRANE
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Analysis 1.6. Comparison 1 Early versus delayed LC (number of people randomised). Outcome 6 Conversion to open cholecystectomy.

Review: Early versus delayed laparoscopic cholecystectomy for acute cholecystitis

Comparison: 1 Early versus delayed LC (number of people randomised)

Outcome: 6 Conversion to open cholecystectomy



Early versus delayed laparoscopic cholecystectomy for acute cholecystitis (Review)
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Early vs. Delayed?

- Overall conversion rate higher in the delayed intervention group (23.6%) vs. early intervention group (20.3%). N.S.
- Reports of increased conversion rate if surgery is delayed more than 48 – 96 hours after the onset of symptoms
 - (Eldar 1997; Madan 2002; Liguori 2003; Peng 2005)
- Other studies do not confirm this
 - (Knight 2004).
 - 2 trials included <4 days of onset of symptoms.
 - 3 trials included <7 days of onset of symptoms.
- Subgroup analysis (N.S.) conversion rate or complication rate in the early group (<4 days of onset of symptoms or <7 days of onset of symptoms) vs. delayed laparoscopic cholecystectomy
- Laparoscopic cholecystectomy up to 7 days after onset of symptoms safe.
 - Time for dealing with CBD stones before operation

Operating time and hospital stay

- In all trials but 1 (Johansson 2003), operating times were longer for early compared with the delayed group
- Total LOS ~ 4 days shorter for the early vs. delayed group in all the trials

Table 7. Operating time and hospital stay

Study	Early-operating time	Delay-operating time	Early -hospital stay	Delay-hospital stay
	Minutes (Median)	Minutes (Median)	Days (Median)	Days (Median)
Davila 1999	71	50	1.6	2.7
Johansson 2003	98	100	5	8
Kolla 2004	104 (Mean)	93 (Mean)	4.1 (Mean)	10.1 (Mean)
Lai 1998	122.8 (Mean)	106.6 (Mean)	7.6 (Mean)	11.6 (Mean)
Lo 1998	135	105	6	11

Bile duct injury

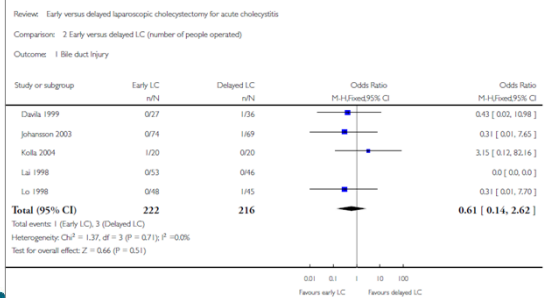
- Bile duct injury rate 0.5% early group vs 1.4% in the delayed group
- N.S. between the two groups for this most feared complication (OR 0.63, 95% CI 0.15 to 2.70).

Study	Conversion ELC	Conversion DLC	Conversion-conversion	Bile duct injury-ELC	Bile duct injury-DLC
Davila 1999	1/27 (3.7%)	6/36 (16.7%)	4/5 (80%)	0/27 (0%)	1/36 (2.8%)
Johansson 2003	23/74 (31.1%)	20/69 (29%)	10/18 (55.5%)	0/74 (0%)	1/69 (1.4%)
Kolla 2004	5/20 (25%)	5/20 (25%)	Not applicable	1/20 (5%)	0/20 (0%)
Lai 1998	11/53 (20.8%)	11/46 (23.9%)	2/8 (25%)	0/53 (0%)	0/46 (0%)
Lo 1998	5/48 (10.4%)	9/45 (20%)	2/9 (22.2%)	0/48 (0%)	1/45 (2.2%)
All studies	45/222 (20.3%)	51/216 (23.6%)	18/40 (45%)	1/222 (0.5%)	3/216 (1.4%)

ELC = early laparoscopic cholecystectomy
DLC = delayed laparoscopic cholecystectomy

Early versus delayed laparoscopic cholecystectomy for acute cholecystitis (Review)
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Analysis 2.1. Comparison 2 Early versus delayed LC (number of people operated), Outcome 1 Bile duct injury.



Non-resolving or recurrent cholecystitis

- 17.5% in the delayed group had either non-resolution of symptoms or recurrence of symptoms prior to planned operation
- Leading to emergent lap cholecystectomy.
- Proportion with conversion to open cholecystectomy 45%
- 2 pts developed cholangitis awaiting cholecystectomy

Study	Delayed laparoscopic cholecystectomy	Emergency surgery in delayed group	Emergency surgery in delayed group (%)	Conversion to open cholecystectomy in the emergency surgery in delayed group
Davila 1999	36	5	13.9	4
Johansson 2003	71	18	25	10
Kolla 2004	20	0	0	0
Lai 1998	51	8	15.7	2
Lo 1998	50	9	18	2
Total	228	40	17.5	18

Early versus delayed laparoscopic cholecystectomy for acute cholecystitis (Review)
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Cochrane Analysis:

- No significant differences in the complication rate or the conversion rate whether the laparoscopic cholecystectomy is performed during acute cholecystitis or performed 6 to 12 weeks after the symptoms settle.
- Early laparoscopic cholecystectomy has the advantage of decreased LOS & these patients do not run the risk of non-solved symptoms or risk of emergency operation.
- The latter leads to a high proportion of patients undergoing open cholecystectomy.

When to convert to *Open Cholecystectomy*



Risk factors resulting in conversion of laparoscopic cholecystectomy to open surgery

- 1,000 laparoscopic cholecystectomies
 - (March 1992 to July 1999) prospectively analyzed
- 804 women (80.4%) & 196 men (19.6%) with a mean age of 43.8 years (range, 30–80 years).
- 48/1,000 (4.8%) patients attempt laparoscopic cholecystectomy required conversion to open surgery.
- most common reason for conversion: inability to define anatomy –inflamed contracted gallbladder (n = 34).
- Significantly independent predictive factors for conversion
 - male gender, previous abdominal surgery, acute cholecystitis, thickened gallbladder wall on preoperative ultrasonography, and suspicion of common bile duct stones.

Risk factors resulting in conversion of laparoscopic cholecystectomy to open surgery

Table 1. Reasons for conversion to open cholecystectomy

	No. of patients	%
Inability to define anatomy	34	3.4
Suspicion of common bile duct injury	1	0.1
Common bile duct stone	1	0.1
Duodenal injury	3	0.3
Common bile duct injury	2	0.2
Common bile duct and duodenum injury	1	0.1
Cystic artery bleeding	2	0.2
Cystic duct injury	2	0.2
Major abdominal vessel injury	2	0.2
Total	48	4.8

Nationwide study of conversion from laparoscopic to open cholecystectomy

- National Hospital Discharge database 1998 – 2001 (CDC Data)
- All gallbladder disease related admissions, and the cholecystectomies (ICD-9-CM codes 51.2X)
- ~25% of all cholecystectomies are performed by the open technique.
- Remaining 75%, ~ 5% to 10% conversion rate.
- Major risk factors for conversion:
 - male sex, obesity, and cholecystitis.
- Concurrent choledocholithiasis, cholelithiasis, and cholecystitis associated with a conversion rate of 25%.
- LOS reduced for laparoscopic operations and conversion added 2 – 3 days to LOS, for most cases the LOS was still less than for primary open operations.

Nationwide study of conversion from laparoscopic to open cholecystectomy

Diagnosis	Regression parameter estimate	Odds ratio	95% Confidence limits
Acquired immune deficiency syndrome	1.34	3.82	(3.38–4.32)
Any acute cholecystitis	1.29	3.64	(3.59–3.70)
Any chronic cholecystitis	0.83	2.29	(2.25–2.32)
Psychoses	0.76	2.15	(2.03–2.27)
Male sex	0.50	1.65	(1.62–1.67)
Obesity	0.48	1.62	(1.57–1.66)
Rheumatoid arthritis/ collagen vascular disease	0.35	1.42	(1.33–1.52)
Solid tumor without metastasis	0.32	1.38	(1.33–1.42)
Hypertension	0.08	1.08	(1.07–1.10)
Intercept	–5.01		

Laparoscopic cholecystectomy after a quarter century: why do we still convert?

- NSQIP database: retrospectively reviewed 1,193 cholecystectomies performed at their institution from 2002 – 2009 and identified 70 conversions.
- 91% of conversion cases: conversion was elective.
- 49% of these conversions: number of ports was fewer than four.
- Most conversions were performed after minimal or no attempt at dissection.
- There were no differences in LOS, complications, operating room charges, or hospital charges between categories.
- Of the 6 emergent conversions (9%), bleeding and concern about common bile duct (CBD) injury were the main reasons.
- 1 CBD injury occurred

Laparoscopic cholecystectomy after a quarter century: why do we still convert?

Table 1 Extent of dissection before conversion of the case (Effort score)

	No. of cases (n = 66)	%
Minimal	32	48
Some dissection	26	39
Extensive dissection	8	13

Table 2 Number of trocars placed before conversion

	No. of cases (n = 66)	%
1	22	33
2	3	5
3	7	11
4-5	34	51

Table 3 Reasons for conversion

	No. of cases (n = 66)	%
Elective		
Inflammatory process	37	56
Nonsurgical adhesions	20	30
Unusual anatomy/Intraop findings	3	5
Emergent (bleeding, concern for CBD injury)	6	9

Table 4 New conversion categories taking into account Effort score and number of ports

Category code	Definition
1	Inability to access peritoneal space
2A	Lack of effort to dissect to achieve appropriate exposure
2B	Lack of exposure despite the effort to dissect
3	Emergent conversion

Lengyel et al, Surg Endosc. 2011 Sep 23

Gallbladder Bacteriology

- Most commonly cultured organisms: *Escherichia coli*, *Klebsiella-Enterobacter*, *enterococci*, *Clostridium perfringens*, and *staphylococci*
- Gallstones did not influence the prevalence of positive cultures
- Wound infections: 11% of the men and 2% of the women.

AMA Arch Surg. 1973;106(2):169-171

Diagnosis and Management of Complicated Intra-abdominal Infection in Adults and Children: Guidelines by the Surgical Infection Society and the Infectious Diseases Society of America

Joseph S. Solomkin, John E. Mazuski, John S. Bradley, Keith A. Reddy, Elie J. C. Gidycz, Ellen J. Baron, Patrick J. O'Neill, Anthony W. Chow, E. Patricia Dellinger, Soumya R. Exchamps, Sherwood Gorbach, Mary Kellum, Anthony S. May, Avery B. Nathens, Robert S. Stevens, and John G. Bartlett

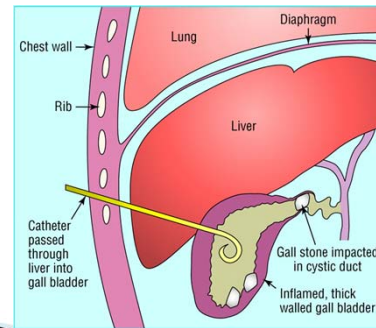
Table 4. Agents and Regimens that May Be Used for the Initial Empiric Treatment of Biliary Infection in Adults

Infection	Regimen
Community-acquired acute cholecystitis of mild-to-moderate severity	Cefazolin, cefuroxime, or ceftriaxone
Community-acquired acute cholecystitis of severe physiologic disturbance, advanced age, or immunocompromised state	Imipenem-clazixan, meropenem, doripenem, piperacillin-tazobactam, ciprofloxacin, levofloxacin, or cefepime, each in combination with metronidazole
Acute cholangitis following biliary-enteric anastomosis of any severity	Imipenem-clazixan, meropenem, doripenem, piperacillin-tazobactam, ciprofloxacin, levofloxacin, or cefepime, each in combination with metronidazole
Health care-associated biliary infection of any severity	Imipenem-clazixan, meropenem, doripenem, piperacillin-tazobactam, ciprofloxacin, levofloxacin, or cefepime, each in combination with metronidazole, vancomycin added to each regimen

* Because of increasing resistance of *Escherichia coli* to fluoroquinolones, local population susceptibility profiles and, if available, isolate susceptibility should be reviewed.

CID 2010;50(15 January)

Cholecystostomy tube

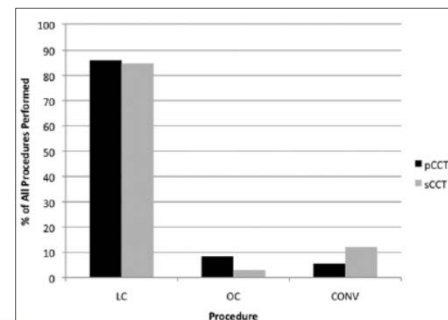


Use of Cholecystostomy Tubes in the Management of Patients with Primary Diagnosis of Acute Cholecystitis

- Management of patients with severe acute cholecystitis (AC) remains controversial.
- Options LC conversion to open cholecystectomy or surgical cholecystostomy tube (CCT) placement, or initial percutaneous CCT.
- 185 PTS with AC and who received CCT.
- Age 71 years and 80% had 1 comorbidity (mean 2.6).
- 78 % CCTs percutaneous CCT and 22% surgical CCT.
- Median LOS from CCT insertion to discharge 4 days.
- Majority (57%) of patients – cholecystectomy at a median of 63 days post-CCT (range 3 to 1,055 days)
 - 86% underwent LC and 13% underwent open conversion or open cholecystectomy.
- In the radiology and surgical group, 50% and 80% underwent subsequent cholecystectomy, respectively, at a median of 63 and 60 days post-CCT.
- Whether surgical or percutaneous CCT placement, approximately the same proportion of patients (85% to 86%) underwent LC as definitive treatment.

Cherng et al, J Am Coll Surg 2012

Percentage of procedures performed for removal of gallbladder after placement of percutaneous or surgical cholecystostomy tube.



Cherng et al, J Am Coll Surg 2012

Percutaneous drainage versus emergency cholecystectomy for the treatment of acute cholecystitis in critically ill patients

- ▶ Percutaneous drainage (PD) of the gallbladder to emergency cholecystectomy (EC) in PTS with sepsis related to acute calculous/acalculous cholecystitis (ACC/AAC).
- ▶ 42 PTS with age 65.5 years
- ▶ 45% EC (10 laparoscopic, 9 open) and 55% PD (n = 23).
- ▶ 91% Percutaneous drainage and 100% EC successful
- ▶ Organ dysfunctions 3rd postoperative/postdrainage days.
- ▶ Despite undergoing PD, 2 pts required EC due to gangrenous cholecystitis.
- ▶ Conversion rate after laparoscopy was 20%.
- ▶ Overall morbidity: 8.7% after PD and 47% after EC
- ▶ Major morbidity: 0% after PD and 21% EC
- ▶ Mortality rate was not different (13% after PD and 16% after EC, P = 1.0)
- ▶ deaths related to the patients' preexisting disease.
- ▶ Hospital and ICU stays were not different.
- ▶ Recurrent symptoms (17%) occurred only after ACC in the PD group.
- ▶ Secondary cholecystectomy is mandatory in cases of acute calculous cholecystitis.

Percutaneous cholecystostomy in critically ill patients with a cholecystitis: a safe option.

- ▶ Retrospectively analyzed 35 patients (2003–2009)
- ▶ Perc. cholecystostomy – technically successful in all patients.
- ▶ Symptoms resolved within 3 days in 33/35 patients.
- ▶ 2 patients needed emergency laparotomy.
- ▶ Catheter dislodged 5 patients and was replaced in 2/5.
- ▶ 30-day mortality rate was 3/35 (8.7%) due to gallbladder necrosis, myocardial infarction and multiorgan failure.
- ▶ LOS 17 days and median drainage time was 28 days
- ▶ 23 patients (66%) underwent open or laparoscopic cholecystectomy after a median interval of 44 days.

Percutaneous Cholecystostomy Without Interval Cholecystectomy as Definitive Treatment of Acute Cholecystitis in Elderly and Critically Ill Patients

- ▶ 24 elderly/critically ill pts unfit for surgery with acute cholecystitis underwent percutaneous cholecystostomy as an emergency procedure
 - Tokyo Guidelines, ASA physical status used for the perioperative risk
- ▶ 4 male:10 female with a median age of 79 years
- ▶ Acute cholecystitis was classified as grade 2 –20, grade 3 – 4
- ▶ ASA score III–17 patients & 7 as ASA score IV
- ▶ 23 Gallstones & 1 acalculous cholecystitis.
- ▶ Perc. cholecystostomy technically feasible in all patients
- ▶ Clinical improvement: 14 patients within 24 hours and in all patients within 72 hours.
- ▶ Reduction in WBC, C-reactive protein, temperature in 72 hours.
- ▶ Procedure-related mortality 4%
- ▶ Median follow-up 17.5 months: definitive and effective control of symptoms was achieved in 90.5%

Gallbladder Perforation

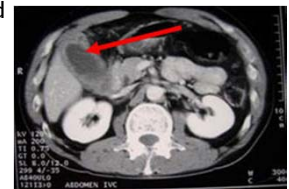
- ▶ 10% of acute cholecystitis cases – perforated gallbladder
 - life-threatening condition.
- ▶ Perforation of the gallbladder is most common in diabetics.
- ▶ Risk for perforation increases in *emphysematous cholecystitis*
- ▶ Once the gallbladder has been perforated, pain may temporarily decrease.
- ▶ This is a dangerous and misleading event as peritonitis develops afterward.

Gallbladder Perforation: Duncan 1844

- ▶ **Neimeier's Classification**
 - In 1934 Neimeier proposed a classification of gallbladder perforation
- ▶ **Type I** Acute free perforation into the peritoneal cavity
- ▶ **Type II** Subacute perforation with pericholecystic abscess
- ▶ **Type III** Chronic perforation with cholecystoenteric fistula

Gallbladder Perforation

- ▶ During a 20-year period (1961 – 1980) 3,260 admissions acute & chronic cholecystitis.
- ▶ 115 perforations of the gallbladder
 - incidence of 3.5 percent.



Emphysematous Cholecystitis



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Gallbladder Perforation: type 2



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Conclusion

- ▶ Gallbladder disease is a common surgical problem
- ▶ Women > Men
- ▶ Imaging: US + CT maybe helpful
- ▶ Laparoscopic Cholecystectomy should be considered as the initial modality in most cases
- ▶ Predictors of for conversion: male, obese, acute cholecystitis

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Conclusion

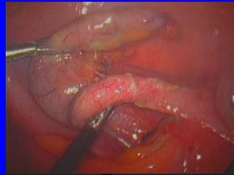
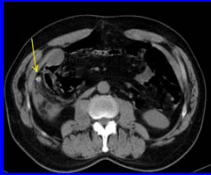
- ▶ Strongly consider early LC during the index admission
- ▶ Antibiotic Regimen
- ▶ If patient is too sick consider cholecystostomy tube
- ▶ Surgical Emergency > perforated Cholecystitis

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Questions?

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MOC - Appendicitis



Patrick M Reilly MD FACS
Professor of Surgery
Perelman School of Medicine at
The University of Pennsylvania



Outline

- Introduction
- Diagnosis / Imaging
- Technique
- Operative Findings
- Medical Therapy
- Complicated Appendicitis
- Special Groups
- Future



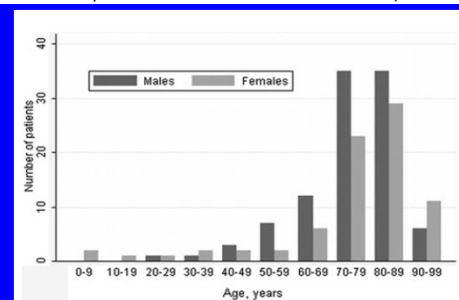
Appendicitis

- Most Common Surgical Emergency
- Pathophysiology: Luminal Obstruction
 - Children: Lymphoid Hyperplasia
 - Adults: Fecolith
 - Elderly: Neoplasm on Occasion
- Mortality : 1%



Causes of Short-Term Mortality After Appendectomy

A Population-Based Case-Controlled Study

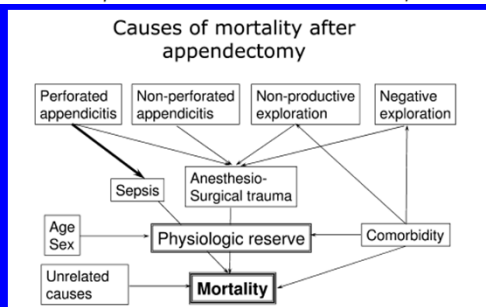


Annals Surg 2011



Causes of Short-Term Mortality After Appendectomy

A Population-Based Case-Controlled Study



Annals Surg 2011



Diagnosis

- Presentation
 - Mid abdominal pain that localizes to RLQ
- Physical Exam
 - Localized Tenderness
- Lab Studies
 - Leukocytosis
 - Negative UA
 - C Reactive Protein?



Diagnosis

- Clinical Signs
 - Rovsing's Sign
 - RLQ Pain caused by LLQ palpation
 - Psoas Sign (Retrocecal Appendix)
 - Pain on extension of right thigh
 - Obturator Sign (Pelvic Appendix)
 - Pain on medial rotation of the thigh

...what does it all mean...



Pitfalls in Appendicitis

Robert J. Vissers, MD^{a,b,*}, William B. Lennarz, MD^{c,d}

- What our EM Docs are Reading

LR of 5–10, presence moderately increases probability of disease.
LR of 2–5, may increase probability of the disease.
LR of <2, not likely to change the probability of the disease.

EM Clinics of NA 2010



Pitfalls in Appendicitis

Table 1
LRs for specific symptoms in appendicitis

Historical Symptom	Positive LR	Increase in Posttest Probability	Negative LR
RLQ pain	7.31–8.46	Moderate probability	0–0.28
Migration	3.18	Small increase	0.50
Pain before vomiting	2.76	Small increase	—
No past similar pain	1.50	Not helpful	0.323
Anorexia	1.27	Not helpful	0.64
Nausea	0.69–1.20	Not helpful	0.70–0.84
Vomiting	0.92	Not helpful	1.12

EM Clinics of NA 2010



Pitfalls in Appendicitis

Table 2
LRs for specific signs in appendicitis

Physical Sign	Positive LR	Increase in Posttest Probability	Negative LR
Rigidity	3.76	Small increase	0.82
Tender RLQ	2.30	Small increase	0.0–0.1
Psoas sign	2.38	Small increase	0.90
Rebound tenderness	3.70	Small increase	0.43
Fever	1.94	Not helpful	0.58
Guarding	1.65–1.78	Not helpful	0.27
Rectal tenderness	0.83–5.34	Not helpful	0.76

EM Clinics of NA 2010



Clinical Policy: Critical Issues in the Evaluation and Management of Emergency Department Patients With Suspected Appendicitis

Table 1. Alvarado score in acute appendicitis.

	Value
Symptoms	
Migration	1
Anorexia-acetone (in the urine)	1
Nausea-vomiting	1
Signs	
Tenderness in right lower quadrant	2
Rebound pain	1
Elevation of temperature (>37.3°C measured orally)	1
Laboratory	
Leukocytosis (>10,000/mm ³)	2
Shift to the left (>75% neutrophils)	1
Total score	10
Score	
1–4	Appendicitis unlikely
5–6	Appendicitis possible
7–8	Appendicitis probable
9–10	Appendicitis very probable

Annals EM 2010



Alvarado Score

- ≤ 3 5 % Appendicitis
- 4 – 6 36 % Appendicitis
- ≥ 7 78 % Appendicitis

...guide to ordering a CT Scan...

Am J Em Med 2007



Imaging in Appendicitis

- Ultrasound
- CT Scan
- MRI

...goal to improve accuracy
of diagnosis...



Imaging in Appendicitis

- PROs
 - Improved Accuracy
 - Decreased Negative Appendectomy Rate
- CONs
 - Costs
 - Delays to Surgery
 - Radiation Exposure



Graded Compression Ultrasound

- Noncompressible Appendix
- Diameter > 6 mm
- Sensitivity 86%
- Specificity 81%
- Accuracy at Night?

Annals Int Med 2004



Graded Compression Ultrasound



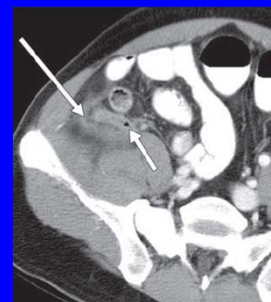
Multidetector CT Scan

- Diameter > 6mm
- Wall Thickening
- RLQ Inflammation
- Appendicolith
- Sensitivity 98.5% / Specificity 98%
- Benefits of Contrast?

Annals Int Med 2011



Multidetector CT Scan



AJR 2011



The Negative Appendectomy Rate: Who Benefits From Preoperative CT?

TABLE 4: Negative Appendectomy Rates for Patients Who Did and Did Not Undergo Preoperative Imaging

Patient Group	Appendicitis or Necessary Appendectomy	No Appendicitis	Total	Negative Appendectomy Rate, % (95% CI)	p
All patients					0.07
Preoperative CT	433	32	465	6.9 (0.90–0.95)	
No CT	40	7	47	14.9 (0.77–0.96)	
Men					0.004
Preoperative CT	231	6	237	2.5 (0.95–0.99)	
No CT	36	6	42	14.3 (0.72–0.94)	
Women					0.46
Preoperative CT	202	26	228	11.4 (0.83–0.92)	
No CT	4	1	5	20.0 (0.36–0.98)	

AJR 2011



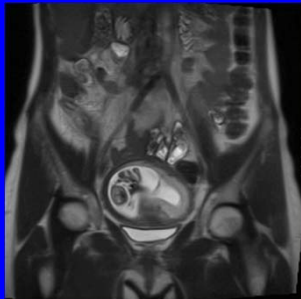
MRI Scan

- Similar Findings to CT
- Option During Pregnancy
- Sensitivity 91% / Specificity 98%
- Availability?

AJR 2011



MRI Scan



Rad Rounds 2009



Diagnosis : Simple Appendicitis Now What?

- Surgery
 - Timing / Delay
 - Technique
- Medical Therapy



Appendicitis, Is It an Emergency?

NAVALKISHOR UDGIRI, M.D., ERNESTO CURRAS, M.D., VENKATA K. KELLA, M.D., KAMAL NAGPAL, M.D., JOHN COSGROVE, M.D.

TABLE 4. Outcomes

	Group A < 10 Hours	Group B > 10 Hours	P value
Laparoscopic to open conversions	2 (2.6%)	5 (4.1%)	0.58
Deep surgical site infection	1 (1.3%)	10 (8%)	0.04
Superficial surgical site infection	0	2 (1.6%)	0.26
Pneumonia	0	2 (1.6%)	0.26
Readmissions	0	6 (4.8%)	0.05
Length of stay (hrs)	75.5	89.1	0.04

American Surgeon 2011



In-hospital Delay Increases the Risk of Perforation in Adults with Appendicitis

Table 1 Operated appendicitis patients according to time interval

Time interval (hours)	No. of operated patients		% Perforated
	Nonperforated	Perforated	
≤6	622	179	22.3
>6–9	266	92	25.7
>9–12	160	36	18.4
>12–18	105	37	26.1
>18–24	47	20	29.9
>24	73	38	34.2

World J Surg 2011



Perforated Appendicitis Among Rural and Urban Patients: Implications of Access to Care

TABLE 4. Multivariate Logistic Regression Analysis for Perforation

	OR	95% CI
Age, y		
40-64	1.92	1.87-1.98
>65	3.87	3.70-4.06
Transferred	1.94	1.76-2.14
Female	0.87	0.85-0.89
Uninsured	1.01	0.97-1.06
Poorest 25th percentile	1.21	1.17-1.25
Black race	1.21	1.14-1.28
Charlson 0	0.65	0.56-0.74
Charlson ≥ 2	1.42	1.23-1.63
Rural patient (All rural patients)	1.11	1.02-1.22
Rural patient treated at rural hospital	1.0	(Reference)
Rural patient treated at urban hospital	1.23	1.12-1.34

Ann Surg 2011



An Acute Care Surgery Model Improves Outcomes in Patients With Appendicitis

Angela S. Earley, MD, John P. Pryor, MD, Patrick K. Kim, MD, Joseph H. Hedrick, MD,
Jibby E. Kurichi, MPH, Amy C. Minogue, BS, Seema S. Sonnad, PhD,
Patrick M. Reilly, MD, and C. W. Schwab, MD

Ann Surg 2006

The Impact of an Acute Care Emergency Surgical Service on Timely Surgical Decision-Making and Emergency Department Overcrowding

Adnan Qureshi, MD, MSc, Andy Smith, MD, FRCSC, Frances Wright, MD, MEd, FRCSC,
Fred Brenneman, MD, FRCSC, FACS, Sandro Rizoli, MD, PhD, FRCSC, Taulee Hsieh, MD,
COL Homer C.Tien, MD, MSc, FRCSC, FACS

JACS 2011



Laparoscopic vs Open Surgery

- 67 Studies and 6000 Patients
- Better with Laparoscopic Approach
 - Lower Wound Infection Rate
 - Less POD # 1 Pain
 - Shorter Hospital Stay
 - Quicker Return Bowel Function

Cochrane Review 2010



Laparoscopic vs Open Surgery

- 67 Studies and 6000 Patients
- Worse with Laparoscopic Approach
 - Higher Rate of Intra-abdominal Abscess
 - Longer Operative Time
 - Higher Operative and Hospital Costs

Cochrane Review 2010



Comparison of Outcomes of Laparoscopic and Open Appendectomy in Management of Uncomplicated and Complicated Appendicitis

- Retrospective, Observational Study
- 40,000 Appendectomies
 - 2006 - 2008
- Complicated and Uncomplicated
- Overall Favored Lap Appendectomy

Annals Surg 2011



Operative Findings

- Normal Appendix
 - Look for other pathology
 - IBD / PUD
 - Diverticulitis / TOA
- Remove Appendix
 - Microscopic Findings
 - Future RLQ pain
 - Cecal Inflammation?



Appendiceal Neoplasms

- Very Rare: < 1% of Appendectomies
 - Often Found on microscopic review
- Carcinoid
 - Right Hemicolectomy for >2 cm
- Primary Adenocarcinoma
 - Right Hemicolectomy
- Cystic / Pseudomyxoma
 - Avoid spillage as able



Medical Therapy for Appendicitis

- First Described in 1959
- Recent Studies – New Life
- Prospective Randomized Studies
 - Few
 - Poorly Described
- Cochrane Review 2011
 - Inconclusive



Amoxicillin plus clavulanic acid versus appendectomy for treatment of acute uncomplicated appendicitis: an open-label, non-inferiority, randomised controlled trial

- Randomized Trial
- Antibx Group
 - 12% appendectomy within one month
 - 29% appendectomy within one year
 - Fecolith as risk factor
- Conclusion - Noninferior?

Lancet 2011



Appendicitis: is surgery the best option?

	Eriksson (1995) ^a	Styrdal (2006) ^b	Hansson (2009) ^c	Malik (2009) ^d	Vons (2011) ^e
Number of patients in antibiotic group	20	128	202	40	120
Antibiotic failure needing appendectomy	1	15	105	2	14
Normal appendix	0	1	3	0	1
Recurrence requiring appendectomy	7	16	11	4	30
Normal appendix with recurrence	0	0	0	0	4
Did not need appendectomy	13/20 (65%)	98/128 (77%)	89/202 (44%)	34/40 (85%)	81/120 (68%)

Table: Summary of randomised trials comparing antibiotics with appendectomy

Lancet 2011



Postoperative Antibiotics Correlate with Worse Outcomes after Appendectomy for Nonperforated Appendicitis

- Retrospective Study
- Postop Antibx
 - No change in SSIs
 - Increased UTI / *c. diff* / diarrhea
 - Increased hospital LOS

JACS 2011



Complicated Appendicitis

- Phlegmon
- Abscess
- Surgery depends on presentation
 - Sepsis / Peritonitis – Surgery
 - Indolent – Antibx +/- IR drain
 - Interval appendectomy?



Complicated Appendicitis Meta-Analysis

- Conservative Therapy
 - Fewer Complications
 - No Difference LOS or Antibiotic Course
- Results valid
 - Recent Studies
 - Pediatric Patients

Surgery 2010



Interval Appendectomy?

- Adults (mean age 54)
 - 25.5% Recurrence Rate
 - 83% within six months
 - 3% Colon Cancer (not at cecum)
 - 8% New Bowel Diagnoses
 - 84% Specimens with Inflammation

World J Surg 2006
J Surg Research 2010



Interval Appendectomy?

- Children
 - Different Pathophysiology?
 - Risk of colon cancer minimal
 - Recurrence Rate ~ 8%
 - 7.5 year follow-up
 - Procedure itself is safe

J Ped Surg 2007



Interval Appendectomy?

- What to do?
 - Children – Weigh risk of lifetime
 - Women of Child Bearing Age
 - Risk of Appendicitis during pregnancy
 - Older patients
 - Colonoscopy – then personalized care

J Ped Surg 2007



Appendicitis in Pregnancy

- Most common GS problem in pregnancy
 - Incidence about 0.1%
 - More common in 2nd trimester
- Presentation may be atypical
- Imaging often called for

JACS 2006



Imaging in Pregnancy

- Ultrasound - No Radiation
 - Decreased ability to visualize appendix
- CT Scan - Radiation
 - Reasonable Results
- MRI Scan – No Radiation
 - 91% Sensitivity / 98% Specificity

AJR 2011



Pregnancy Considerations

- Technique
 - Laparoscopy largely acceptable
 - Studies equivalent results
 - Fetal loss rate may be slightly higher
 - ~ 5% – 6 %
- Complicated Appendicitis
 - VERY limited data

WJS 2009 / J Soc Lap Surgeons 2009



Outcomes in Pregnancy

- Delay in Dx > 24 hours
 - Increases perforation rate
 - Increases fetal loss (36% v 1.5%)
 - Increased peritonitis
 - Increased early delivery
- Spontaneous abortion / Premature labor
 - Even in uneventful procedure

JACS 2006



Appendectomy During Pregnancy: Follow-Up of Progeny

- 3 year follow-up
- 52 patients
- 2% fetal loss rate
- No developmental delays
 - Trimester of surgery – no effect

JACS 2011



Appendicitis in Elderly

- More likely to have gangrene / perforation
 - Biology of peritonitis
 - Delays to presentation
 - Diagnostic difficulties
- Laparoscopy safe
- Concern for cancer

Can J Surg 1996 / WJS 2009



Acute appendicitis—not just for the young

Brian G. Harbrecht, M.D.*, Glen A. Franklin, M.D., Frank B. Miller, M.D., Jason W. Smith, M.D., J. David Richardson, M.D.

Table 2 Age stratification for acute appendicitis

Age group (y)	n	Men	Age (y)	Complicated appendicitis	% of total patients	LOS (d)	Charges (>\$1,000)	% of total charges
≤29	1582	58.2	17.0 ± 6.9	25.2%	45.2%	2.6 ± 2.6	16.3 ± 12.4	37.6%
30-64	1592	53.5	45.3 ± 9.7	38.0%	45.5%	3.6 ± 3.7*	20.8 ± 18.0*	48.2%
65-79	271	56.5	70.6 ± 4.0	53.9%	7.7%	6.0 ± 6.1*	28.3 ± 25.3*	11.2%
≥80	57	36.8	84.6 ± 4.4	64.9%	1.6%	7.8 ± 6.4*	37.0 ± 34.0	3.1%

Table 5 Discharge disposition

Age group (y)	Home	Home with home health	Skilled nursing	Rehabilitation/long-term acute care facility	Mortality
≤29	98.0%	1.6%	.1%	.0%	.1% (n=1)
30-64	95.3%	3.4%	.5%	.2%	.3% (n=4)
65-79	81.2%	8.5%	4.1%	1.8%	2.2% (n=6)
≥80	50.9%*	10.5%*	28.1%*	7.0%*	3.5% (n=2)*

Am J Surg 2011



Single Incision Versus Standard 3-Port Laparoscopic Appendectomy

A Prospective Randomized Trial

TABLE 2. Operative Data

	Single Incision (N = 180)	3-Port (N = 180)	P
Operative time (min)	35.2 ± 14.5	29.8 ± 11.6	<0.001
Surgical difficulty (1 – Easy to 5 – Difficult)	2.3 ± 1.4	1.7 ± 1.0	<0.001

Annals Surg 2011



Single Incision Versus Standard 3-Port Laparoscopic Appendectomy

A Prospective Randomized Trial

TABLE 4. Convalescence After Hospital Discharge

	Single Incision (104)	3-Port (101)	<i>P</i>
Days of prescribed analgesics	3.8 ± 3.6	4.0 ± 5.1	0.85
Doses of prescribed analgesics	6.4 ± 9.3	5.1 ± 6.6	0.37
Days to full activity	7.5 ± 5.8	8.5 ± 6.2	0.33
Days to return to school	4.7 ± 2.9	4.9 ± 3.7	0.77

Annals Surg 2011



Pure Transvaginal Appendectomy Versus Traditional Laparoscopic Appendectomy for Acute Appendicitis

A Prospective Cohort Study

TABLE 1. Patient Characteristics

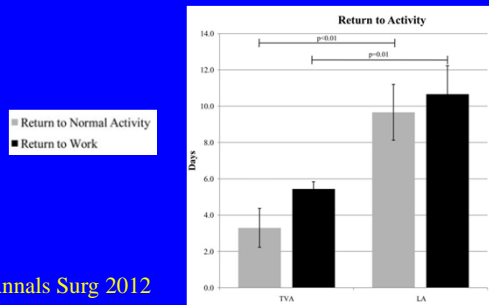
	Transvaginal Appendectomy	3 Port Laparoscopic Appendectomy	<i>P</i>
n	18	22	
Age (years)	31.3 ± 2.5	28.2 ± 2.3	0.36
BMI (kg/m ²)	23.7 ± 1.2	23.6 ± 0.7	0.96
Operative time (min)	44.4 ± 4.5	39.8 ± 2.6	0.38
Length of stay (days)	1.1 ± 0.1	1.2 ± 0.1	0.53

Annals Surg 2012



Pure Transvaginal Appendectomy Versus Traditional Laparoscopic Appendectomy for Acute Appendicitis

A Prospective Cohort Study



Annals Surg 2012



JAMA PATIENT PAGE

Appendectomy

Tests usually include a complete blood cell count (looking for an increase in white blood cells as evidence of an infection), blood chemistries, an abdominal ultrasound, or a computed tomography (CT) scan of the abdomen. Regular x-rays or other tests may be ordered to look for other causes of the symptoms. Electrocardiogram (ECG), chest x-ray, and further testing may be needed, depending on your medical condition.

Some cases of appendicitis may be handled in a nonemergency manner if antibiotics are given while waiting. Operations may safely be delayed for certain individuals. Surgeons make that decision on a case-by-case basis.

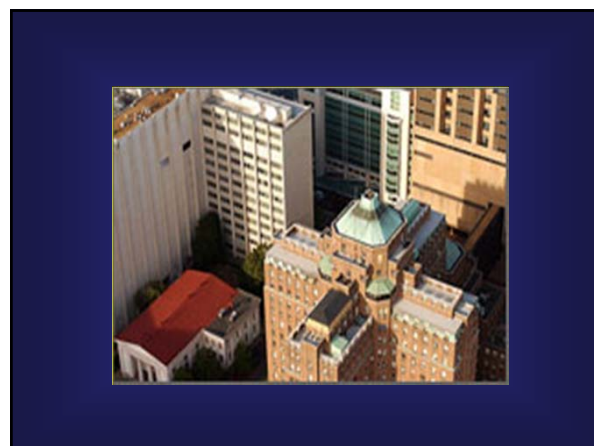
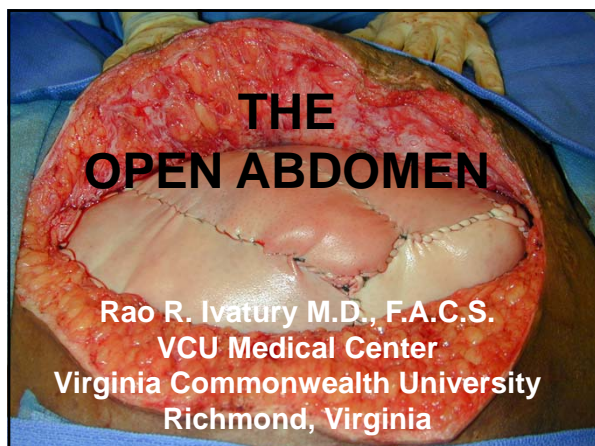
JAMA 2011



Summary

- Ongoing Research
- New Approaches
- Great Opportunities for Acute Care Surgery





“THE OPEN ABDOMEN”

1. Review history
2. Outline indications, benefits and risks
3. Discuss the patho-physiology of the open abdomen (Open abdomen as a motor for SIRS)
4. Discuss delayed primary & definitive repair
5. Outline long term outcomes

“THE OPEN ABDOMEN”

1. Review history
2. Outline indications, benefits and risks
3. Discuss the patho-physiology of the open abdomen (Open abdomen as a motor for SIRS)
4. Discuss delayed primary & definitive repair
5. Outline long term outcomes

“THE OPEN ABDOMEN” : History and Evolution

On leaving the peritoneal cavity open in generalized suppurative peritonitis
Steinberg D, 1979

Open peritoneal drainage as effective treatment of advanced peritonitis
Maetani S and Tobe T, 1981

Zipper closure of the abdominal wall in the treatment of recurrent IAA
Doody DP et al, 1986

The septic abdomen : open management with Marlex mesh with a zipper
Hedderich GS et al, 1986

Open management of the septic abdomen

Ivatury RR et al, Crit Care Med 1989 17:511-7

30 patients with abdominal sepsis

Groups I (Trauma) : 11

2 (Pancreatic abscess) : 5

3: (acute GI path) : 14

27 patients had MODS

16 (53%) of the 30 survived

73% in Group 1, 60% in Group 2, 36% in Group 3

Survival correlated well with :

age < 50

Absence of MODS

Open management of the post-traumatic septic abdomen

Ivatury R et al, Am Surg. 1990

13 patients with abdominal trauma and sepsis resistant to conventional methods

11 had MODS

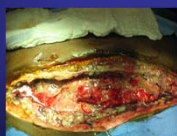
10/13 patients (76.9%) survived, significantly better than predicted by APACHE (50%)



Necrotizing infections

Uncontrolled sepsis

Recalcitrant abscess



“for he who fights and runs away
will live to fight another day:
But he who is in battle slain
will never rise and fight again”

Oliver Goldsmith, 1761

Damage-control surgery
Abbreviated laparotomy
Staged laparotomy
“bail-out surgery”

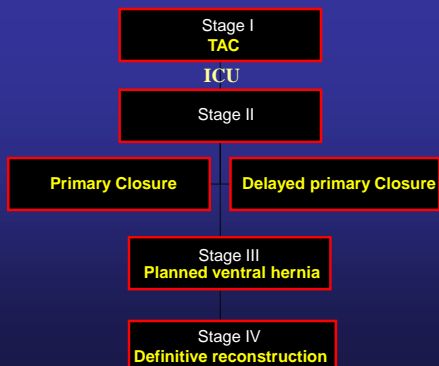
Termination of the initial operation
Return for completion



Temporary
Abdominal Closure
(TAC)



Open abdomen :Staged Management

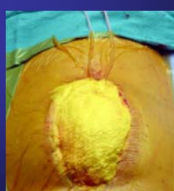


Skin-grafting and Planned ventral hernia



Barker's Vac-Pac "Poor man's VAC"

Separation of bowel from fascia J-Ps to suction



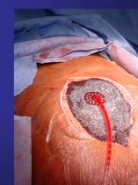
loban

Negative Pressure therapy V.A.C

Polyurethane foam dressing



-175 mm Hg suction



Vacuum Assisted Fascial Closure

Garner et al , 2001 : 13 of 14, **92%**

Miller et al, 2002 : 59 of 83, **71%**

Suliburk et al, 2003 : 25 of 29, **86%**

Clothren et al, 2006 : 14 of 14, **100%**

"THE OPEN ABDOMEN"

1. Review history
2. Outline indications, benefits and risks
3. Discuss the patho-physiology of the open abdomen (Open abdomen as a motor for SIRS)
4. Discuss delayed primary & definitive repair
5. Outline long term outcomes

“THE OPEN ABDOMEN”

Indications

“Damage-control” procedures
Intra-abdominal hypertension &
ACS
Severe suppurative peritonitis
Proposed “second-look”
Necrotic abdominal wall

“THE OPEN ABDOMEN”

Benefits

Reduce:

Intra-abdominal hypertension &
Abdominal Compartment Syndrome
MODS

Facilitate :

Irrigation
confirm bowel viability

INTRAABDOMINAL HYPERTENSION

Incidence of IAH (23 of 70, 32.8%)

Group I (mesh closure):

10 of 45, 22.2%

Group II (fascial suture)

13 of 25, 52%

p=0.012 (Fisher's)

Ivatury et al, 1998

INTRAABDOMINAL HYPERTENSION

	No IAH (n=47)	IAH (n=23)	p
Mortality	4 (8.5%)	10 (43.5%)	0.006
MODS	0.8 ± 1.9	4.3 ± 3.7	0.0001

Ivatury et al, 1998

ACS, MOF and Mortality

	NO ACS (n=49)	ACS (n=28)	p
Mortality	12%	43%	0.01
MOF	8%	32%	0.01

Raeburn et al, 2001

ACS & MOF

**ACS an independent risk
factor for
MOF (OR 9.2, CI 3.8-22.8, p<0001)**

Mortality (OR 8.4, CI 3.5-20.6, p<0.001)

Balogh et al, 2003

“THE OPEN ABDOMEN”

Risks

Fluid losses
Nursing problems
“Tertiary peritonitis”
“EA” fistulas
Hernial defect

“THE OPEN ABDOMEN”



Serositis



Fistulas

“Entero-atmospheric fistula”

Principles of Management

1. Prevention
2. Attempt to seal the fistula
3. Control fistula effluent
4. Cover fistula with vascularized soft tissue
5. Nutritional support
6. Resect chronic fistula when timely

Prevention

Protect bowel with omentum
Avoid serosal injury
Avoid edematous bowel
Vacuum-suction devices
Re-close abdomen ASAP

Nutritional support

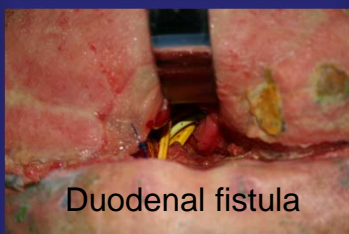
TPN
Rarely enteral feeding
Monitor :
wound status
Prealbumin

Control sepsis

Attempt to seal the fistula



Control fistula effluent



Duodenal fistula

“retroperitoneal laparostomy”

Attempt to seal the fistula



Fibrin glue
Human dermis
Skin graft

20%-25% chance of success

Resect chronic fistula



All wounds healed
Optimal nutritional state
6 months to a year

Entero-Atmospheric fistulas

Prevent !!

Protect bowel with omentum
Avoid serosal injury
Avoid edematous bowel
Vacuum-suction devices
Re-close abdomen ASAP

Classification of open abdomen

GRADE	Description
I A	Clean, no adhesion between bowel and abdominal wall
IB	Contaminated without adhesion / fixity
2A	Clean , developing adhesion / fixity
2B	Contaminated , developing adhesion / fixity
3	Complicated by fistula
4	Frozen, adhered bowel unable to close

Bjorck M et al, 2009

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Toxic lymph (Deitch)

Ligate mesenteric lymph duct

↓ Lung Injury

↓ Neutrophil Activation

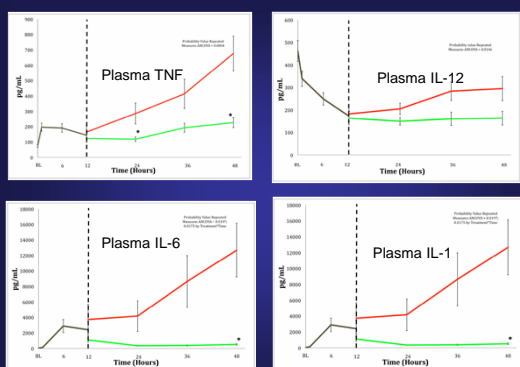
↓ Mortality

Mesenteric lymph

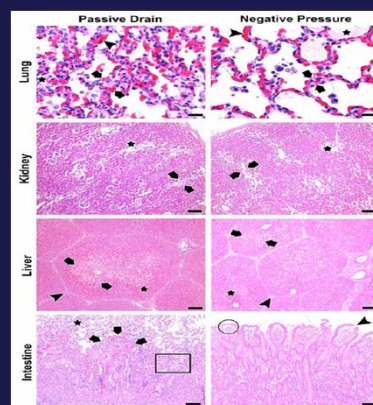
↑ EN Apoptosis & Permeability

Two-Hit Injury Swine Model

- **First Hit** - Superior mesenteric artery (SMA) was isolated and clamped for 30 minutes to induce intestinal ischemia/reperfusion
- **Second Hit** - Enterotomy made in cecum and fecal clot created and placed in the abdomen to induce severe sepsis
- **Two Groups**: 1) NPT and 2) Passive Drain



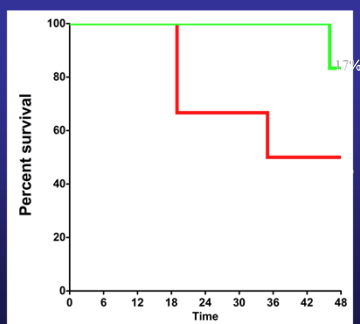
Kubiak et al Critical Care, 2011



Histopathology

Kubiak et al Crit. Care.med, 2011

NPT vs. PD Data



“THE OPEN ABDOMEN”

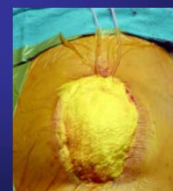
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Temporary Abdominal Closure EAST PMG : Diaz J et al, 2010

- A. There are no **level I** recommendations
- B. Any TAC technique must provide for easy re-exploration, a high rate of definitive closure, and be cost effective (**level II**)
- C. Multiple techniques of TAC are safe including Bogota bag, Wittman Patch, and Vacuum pack (VP) (**level II**)
- D. Permanent mesh (i.e., polypropylene [PPE]) should not be used for TAC, as it is associated with high fistula rates (**level III**)
- E. The 3-layer VP is considered the current standard by which to measure other devices (**level III**)

Barker's Vac-Pac "Poor man's VAC"

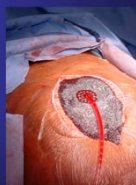
Separation of bowel from fascia J-Ps to suction



loban

Negative Pressure therapy V.A.C

Polyurethane foam dressing -175 mm Hg suction

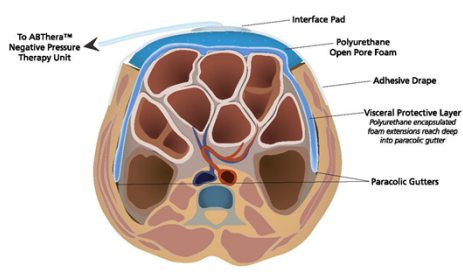


AbThera™



AbThera™

Cross-sectional view: AbThera™ Open Abdomen Negative Pressure Therapy System



AbThera™

Mechanism of Action of Protective Layer

- ❖ Provides medial tension, helps minimize fascial retraction and loss of domain
- ❖ Actively removes fluid and reduces edema
- ❖ Enhances fluid removal from paracolic gutters

Ab Thera vs VAC-PAC

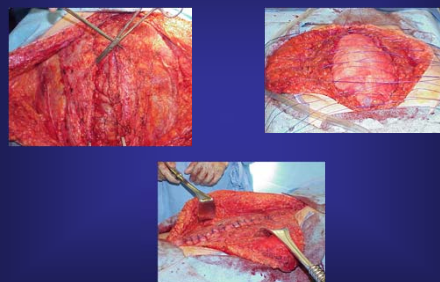
280 patients enrolled from 20 study sites
138 : at least 48 hours of consistent TAC therapy
(94 ABThera, 44 VP)

PFC rate : 76% vs. 57% ($p=0.03$)
30-day all-cause mortality : 15% vs 34% ($p=0.01$)

Logistic regression : patients with an
ABThera were 2.8 times more likely to achieve PFC
($p=0.01$)
4.0 times more likely to survive compared to VP
($p<0.01$)

Cheatham M et al , 2012

"Component Separation"



Results of MCS +/- Prosthesis

	n	Months Follow-up	Recurrence
De Vries Reilingh 2003	43	15.6	28%
Lowe 2003	30	9.5	10%
Jernigan 2003	73	24	6%
De Vries Reilingh 2007	37	36	57%
Rodriguez 2007	23	7	9%
De Moya 2008	6	12	100%
Diaz 2009	165	10.4	25%
Ko 2009	200	10.3	22%
Total	577	13.9	23%
Current Study	114	63.6	14%

DiCocco JM et al, 2010

•Female gender, BMI

Weighted closure rates

VAC	8	251	60%(54 – 66)
Vacuum pack	15	1186	52%(49 – 54)
Artificial burr	4	180	90%(86 – 95)
Silo	3	109	29% (20 – 37)
Mesh/sheet	16	1176	23% (20 – 25)
Loose packing	1	18	11%
Skin only	2	101	43% (34 – 53)
Zipper	7	135	39% (31 – 47)

Boele van Hensbroek P et al, 2008

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Long term outcomes

?

Physical health
Mental well being
Quality of life
employment

Long term outcomes of OA (Cheatham et al, 2008)

324 consecutive patients in 6 years

EAF more with STSG patients
Primary fascial closure best with
Prophylactic decompression or
Damage control groups

ACS, fascial dehiscence, sepsis:
More skin only closure

Resource use of OA (Cheatham et al, 2008)

Primary closure :

Least resource utilization
Lowest mechanical ventilation days
Lowest ICU days
Lowest hospital stay
Lowest hospital charges

Long term outcomes SF-36 (Cheatham M et al, 2008)

Prospective study of 44 patients,
2-years after open abdomen

6 months: physical and social functions
significantly down in those with hernia
but not with fascial closure

18 months: patients with hernias
comparable to general population
QALY comparable to those with
fascial closure, similar employability

Secrets to success with open abdomen

Choose open abdomen wisely

Resuscitate complete & fast
DO NOT OVER-RESUSCITATE
Avoid “fluid-creep”!
Avoid edematous bowel

Secrets to success with open abdomen

Pay attention to IAP
Optimize IAP
Aggressively fight IAH

Never see ACS!

Re-close abdomen ASAP

Long term outcome: What have I done to this patient?

I resuscitated him
I controlled his IAP
I supported his organ function
I managed his open abdomen well
I closed his fascia
I sent him back to his family!

He is back at work, mentally ok

Temporary and permanent closure
of the open abdomen

Conclusion

Recent innovations have provided
a variety of techniques to achieve
temporary and permanent closure,
accrue all the benefits and minimize
the potential complications
of the open abdomen approach

