



Eastern Association for the Surgery of Trauma

Masters Course Part III: This is How I Do It

**January 12, 2012
Disney's Contemporary Resort
Lake Buena Vista, Florida**

Course Faculty:

L.D. Britt, MD, MPH, FACS

David Ciraulo, DO

Stephen Cohn, MD

Christian Minshall, MD

Course Directors:

William Chiu, MD

Carl Valenziano, MD

Panel Discussion Moderator:

Jennifer C. Knight, MD



EAST Masters Course Part III: This is How I Do It
Thursday, January 12, 2012
3:00 PM – 5:30 PM

Presented by the EAST Careers in Trauma Committee and EAST Seniors Committee

Course Overview:

This course is an exciting didactic and interactive discussion forum with distinguished experts, focusing on clinical and technical strategies and approaches to complex patient presentations. It will represent the third part of a multi-year curriculum on mastery of difficult problems in trauma. The Masters faculty will present their own personal perspective and expertise on a clinical scenario and discuss their management style at their own institutions. At the conclusion of the course, a pre-selected complex case will be presented to the Masters panel for discussion.

Learner Objectives:

At the conclusion of this course, the participant should be better able to:

1. Explain the management of trauma patients with combined liver and retrohepatic inferior vena caval injuries.
2. Discuss the management of penetrating trauma patients with mediastinal and esophageal injuries.
3. Describe the approach to reconstructive strategies for devastating chest wall injuries.
4. Describe the exposure of the anterior spine in trauma patients with thoracic and lumbar spine injuries requiring operative fixation.

Course Directors: William Chiu, MD and Carl Valenziano, MD

Credit:

The Wake Forest School of Medicine designates this live activity for a maximum of 2.5 *AMA PRA Category I Credits*[™]. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Course Faculty:

L.D. Britt, MD	Stephen Cohn, MD
William Chiu, MD	Jennifer Knight, MD
David Ciraulo, DO	Christian Minshall, MD

Course Schedule:

3:00 pm	Introduction - William Chiu, MD
3:10 pm	This is How I Manage Combined Liver and Retrohepatic Inferior Vena Caval Injuries in San Antonio - Stephen Cohn, MD
3:40 pm	This is How I Manage the Penetrating Trauma Patient with Mediastinal and Esophageal Injuries in Norfolk - L.D. Britt, MD
4:10 pm	This is How I Approach Reconstructive Strategies for Devastating Chest Wall Injuries in Portland - David Ciraulo, DO
4:40 pm	This is How I Expose the Anterior Spine for Trauma Patients with Thoracic and Lumbar Spine Injuries Requiring Operative Fixation in Dallas - Christian Minshall, MD
5:10 pm	Masters Panel Discussion on a Pre-Selected Complex Case - Jennifer Knight, MD, Moderator
5:30 pm	Adjourn

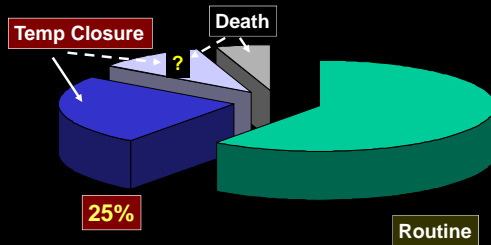
Operative Strategies For Liver and Caval Injuries



Stephen M. Cohn MD FACS

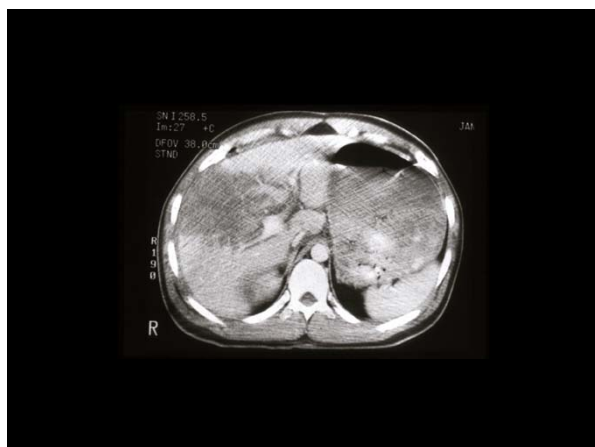
*Witten B. Russ Professor
Department of Surgery
The University of Texas Health Science Center
San Antonio, Texas*

Abdominal Trauma Operations

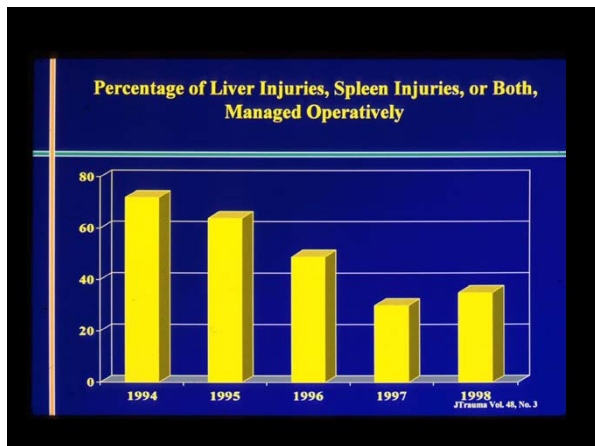












Minimizing death and complications in those with high risk for adverse outcomes

1. Understanding premorbid conditions
2. "Doing the most conservative thing"
 - Temporary Abdominal Closure
 - Second look operations



Operative Pitfalls in Abdominal Trauma

- Preparation
- Resuscitation
- Operation, technique
 - Inadequate retraction
 - Inadequate exposure
 - Inadequate exploration
 - Failure to recognize the need for abbreviated laparotomy.

Preparation

- Vascular access
- Monitoring
- Blood Products
 - Cell Saver
- Hemostatic aids
- Antibiotics



Resuscitation

- Type of Fluid
 - Whole blood or packed cells
 - Platelets
 - Clotting factors
 - Crystalloid or Colloid
- Endpoints
 - Hypotensive anesthesia
 - Low CVP
 - Aortic compression

Operation, technique

- Inadequate retraction
 - Bookwalter
- Inadequate Operative Team management
 1. Packing
 2. Aortic palpation
 3. Communication with Anesthesiology
- Inadequate exposure
 - Right and Left Visceral Rotations
- Inadequate surgical hemostasis
- Inadequate exploration

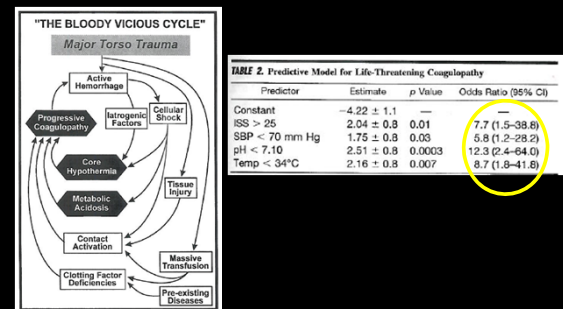
Operation, technique

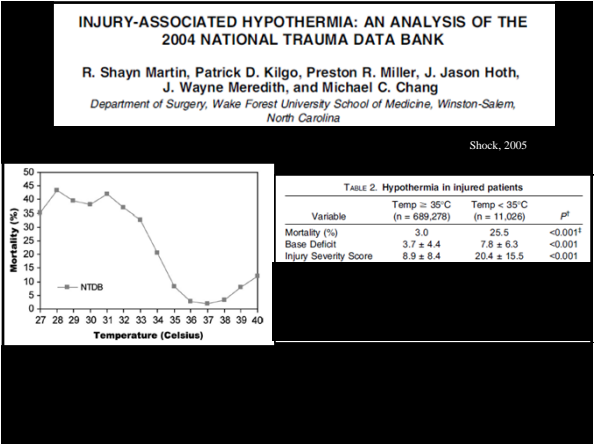
Failure to recognize the need for abbreviated laparotomy:

1. Hypotension: SBP < 80 despite fluids
2. Hypothermia: < 35C
3. Acidosis: BD > 6 and worsening
4. Coagulopathy: medical bleeding

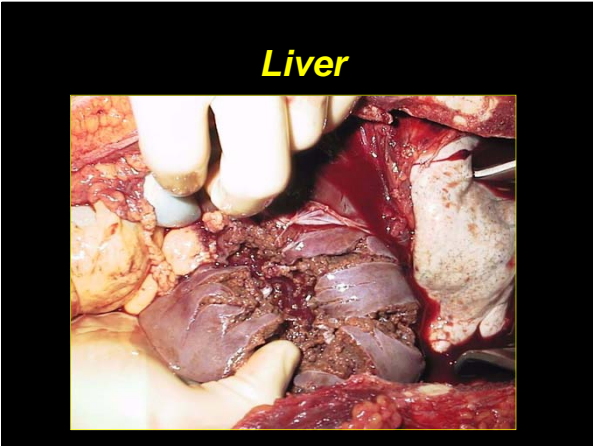
Predicting Life-Threatening Coagulopathy in the Massively Transfused Trauma Patient: Hypothermia and Acidosis Revisited

Ned Cosgriff, MD, Ernest E. Moore, MD, Angela Sauaia, MD, Mary Kenny-Meynhan, MD, Jon M. Burch, MD, and Ben Galloway, MD
J Trauma, 1997









Mortality in Rupture of Liver

Author	Year	No.	Mortality
Mayer	1872	135	88%
Thöle	1912	260	64%
Castren	1946	245	56%
Hellström	1961	300	37%

Contemporary Management

Demetriades et al – 2003

181 Grade III, IV, V pts; 18 DOA/DIE
71% treated operatively
116 pts op – 38 deaths (33%)

Br J Surg. 2003 Nov;90(11):1398-400

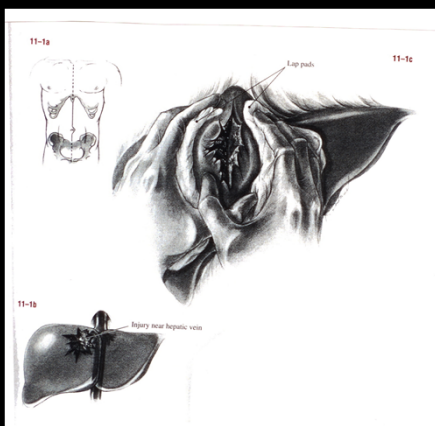
Contemporary Operative Management

- Temporary hepatic compression with aortic compression and low CVP
- Consider wider exposure
 - Pringle Maneuver
 - Tractotomy/suture ligation
 - Topical Hemostatic Agents
 - Definitive procedure?
 - Resectional debridement
 - Omentum after definitive surgery/hemostasis
- Temporary packing
-Embolization

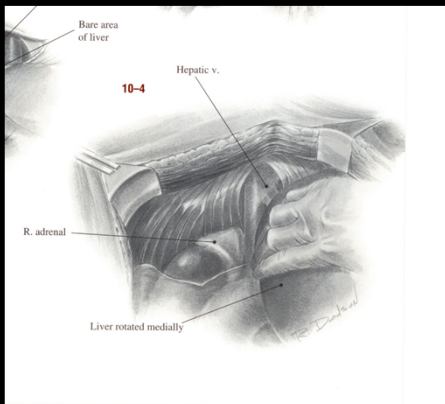
Hemostatic Agents

- Dry Fibrin sealant
- Quickclot
- Traumadex
- Chitosan
- Rapid deployment hemostat
- Surgicel
- Gelfoam (thrombin)
- Tisseel
- Tachocomb
- Bolheal



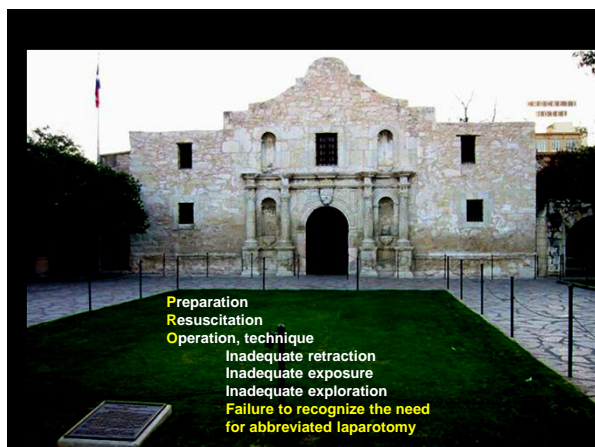


Carico, Thal and Weigelt, *Operative Trauma Management*, 1998



Carico, Thal and Weigelt, *Operative Trauma Management*, 1998





... a long and productive journey



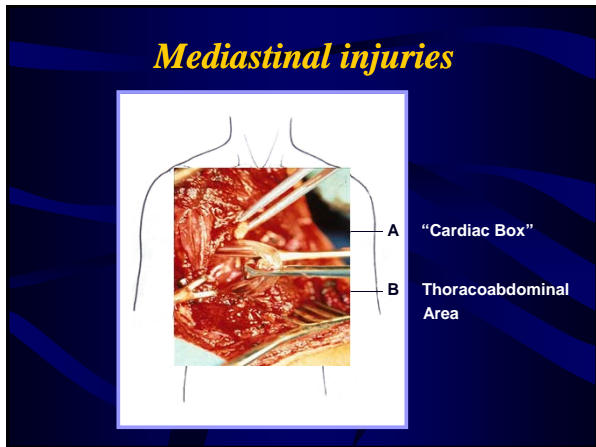
surgical management of the acutely ill & injured

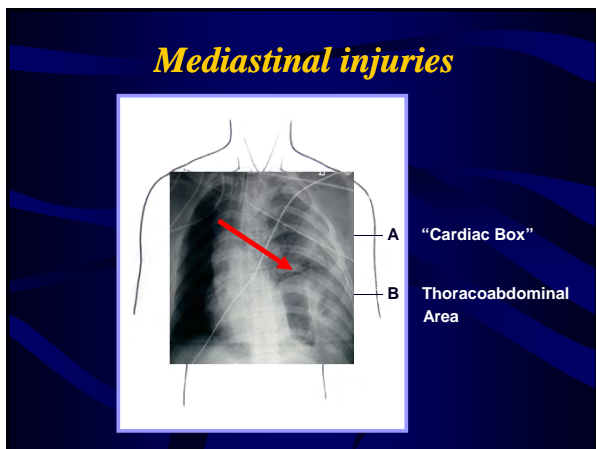


Civilian penetrating (gunshot) injuries

- a significant socioeconomic burden
- 238,647 fatalities (1998-2000)
- estimated hospital costs:13-15K
- annual total management cost:
\$20-\$100 billion
(which includes
loss of productivity and QOL)







Focus

Esophageal Injuries: Uncommon and Technically Challenging



Esophageal Injuries

- relatively uncommon
- penetrating cervical wounds – ~ 10%
(violating the platysma)
- penetrating intrathoracic wounds – < 1%
- associated morbidity/mortality remain high

Etiology of Penetrating Esophageal Perforation in Recent Large Series

	Goldstein, 1982	Richardson, 1985	Nesbitt 1987	Flynn 1989
Iatrogenic				
Endoscopy	5	6	29	7
Celestin's/Souttar tube	0	5	1	0
Sengstaken's tube	1	3	3	1
Intubation	1	2	1	0
Operative injury	5	2	13	1
Foreign body extraction	0	6	0	0
Intraoperative temperature probe	0	0	1	0
External trauma				
	5	19	23	23
Foreign body				
	1	0	5	3

Esophageal Injuries – signs/symptoms

- subcutaneous emphysema
- pneumomediastinum
- odynophagia
- dysphagia
- dyspnea
- hematemesis
- oropharyngeal blood
- tenderness (neck/chest/abdomen)
- mediastinal “crunching” sounds (Hamman sign)

Common presenting symptoms

- pain (71%)
- fever (51%)
- dyspnea (24%)
- crepitus (22%)

Evaluation process

- surgically –
 - direct inspection
 - assessment of tract trajectory
- diagnostic imaging –
 - plain radiography
 - computed tomography
 - contrast studies
- endoscopy

Enhanced Diagnostic Imaging

Esophageal injuries: Evidence – based?

- Cervical
- Thoracic
- Abdominal

Esophageal injuries:
Evidence – based?

- Cervical
- ***Thoracic***
- Abdominal

ANATOMY

Cardiovascular
Respiratory
Digestive
Endocrine
CNS

ANATOMY

Cardiovascular
Respiratory
Digestive
Endocrine
CNS

*Esophageal injury -
Achilles Heel?*




The slide features a blue background with a yellow horizontal line. On the left, there is a black and white illustration of a female runner in a tank top and shorts. To the right of the runner, the text "Esophageal injury - Achilles Heel?" is written in a yellow, italicized font. Below the text is a small, square, color photograph showing a surgical procedure on a reddish, fleshy tissue, likely the esophagus, with surgical instruments visible.

mechanism of injury



The slide has a blue background with a yellow horizontal line. The text "mechanism of injury" is written in a yellow, italicized font. Below the text are two images. On the left is a black and white photograph of a hand holding a handgun. On the right is a diagram of a human torso with a pinkish, fleshy area representing the chest. Two white lines, representing stab wounds, are shown entering the chest area. The text "Stabbing Injury" is written in white over the diagram.

Warning
high velocity injuries



The slide has a blue background with a yellow horizontal line. The text "Warning" is written in a yellow, italicized font and underlined. Below it, the text "high velocity injuries" is written in a white, bold font. At the bottom center is a small, square, color photograph of a bullet fragment, which is dark and irregular in shape, resting on a light blue surface.

Surgical management



Accuracy of diagnostic tests

- Computed tomography $\geq 95\%$
- Contrast esophagography 50% - 95%
- Endoscopy $\geq 95\%$

Esophageal injuries: Evidence – based?

- Cervical
- Thoracic
- Abdominal

Esophageal injuries: *Evidence – based?*

- Cervical
- ***Thoracic***
- Abdominal

mechanism of injury



including iatrogenic injuries (e.g., endoscopy, other instrumentation)

increased intraluminal pressure (e.g. retching)

DEBATE



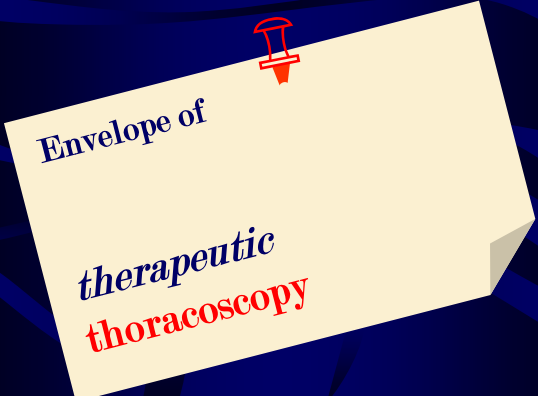
Minimally invasive approach

- Minimal-access (e.g. laparoscopy, thoracoscopy)
- Endoluminal access

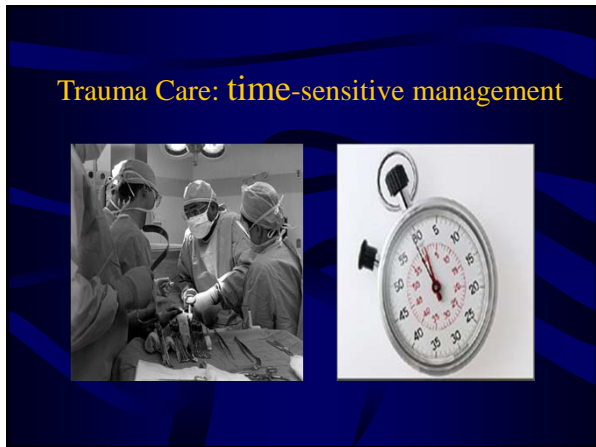


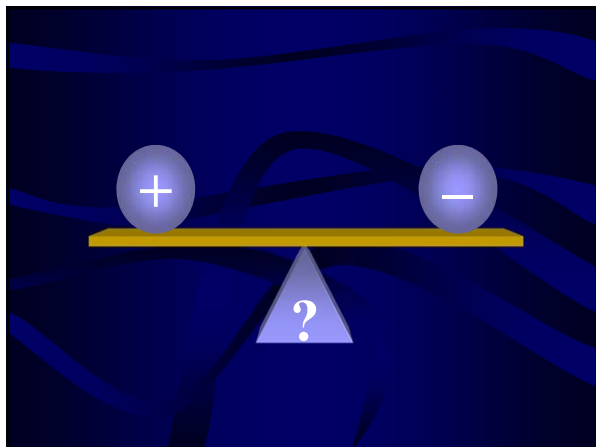
Envelope of

therapeutic thoracoscopy







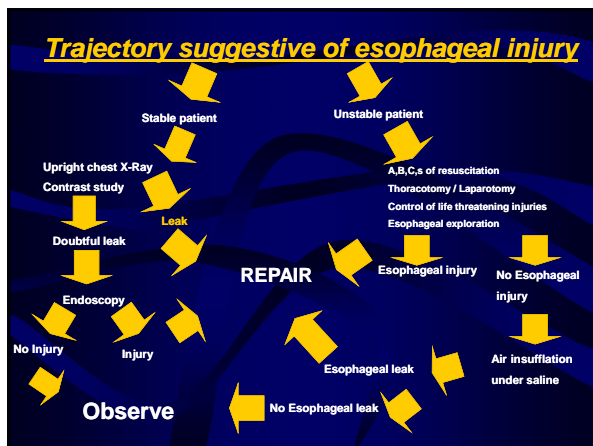


Operative Management

- **surgical approaches**
 - neck
 - thoracic
- (proximal, mid, and distal esophageal injuries)

Operative Management

- **surgical repair**
 - **local debridement**
 - **primary repair**
 - **buttressing of the repair with viable tissue**
 - **wide drainage**



Operative Management

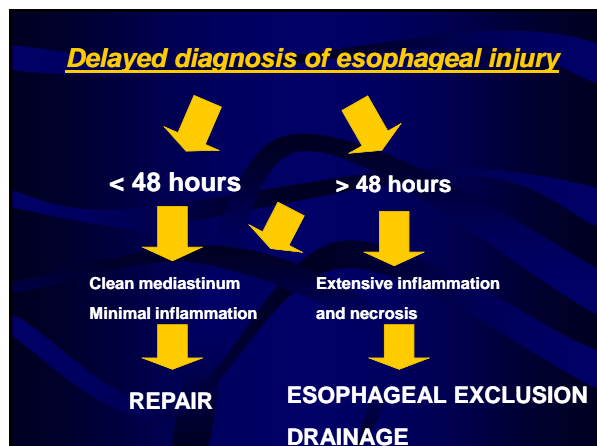
the role of gastrostomy tube
placement and the establishment
enteral feeding access

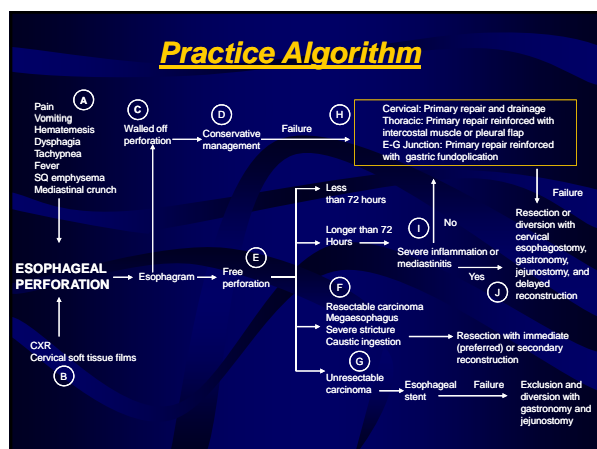
Operative Management

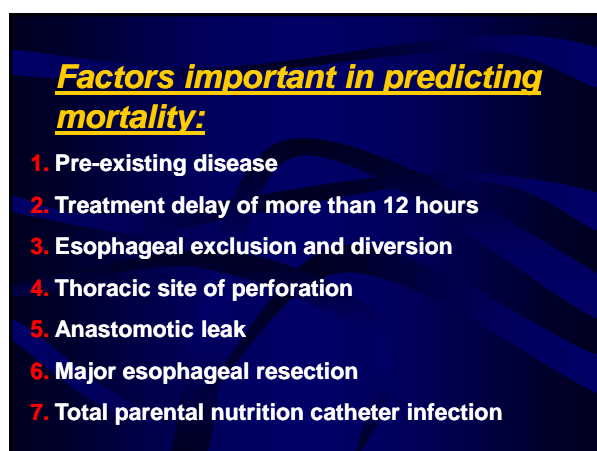
Is there a role for exclusion,
diversion, and resective
management?

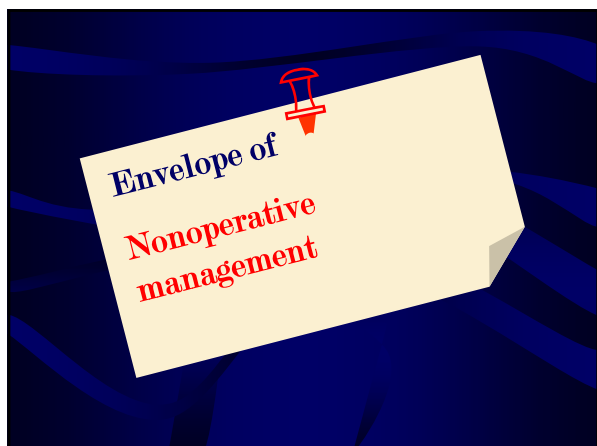
Operative Management

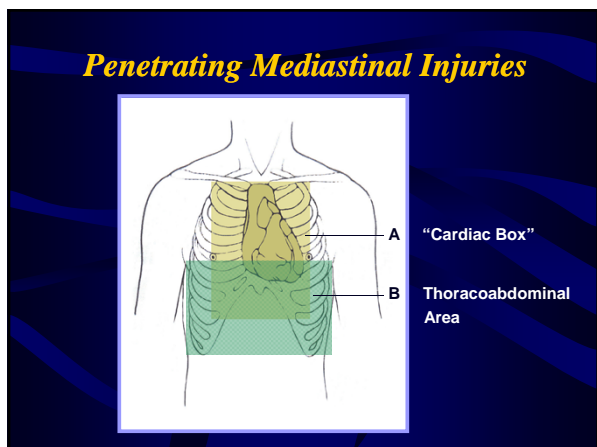
? timeline

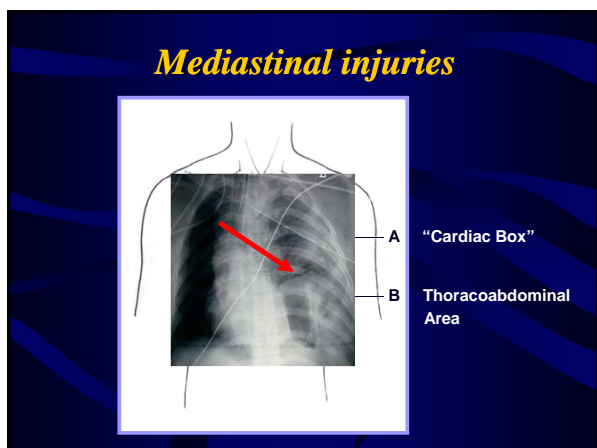




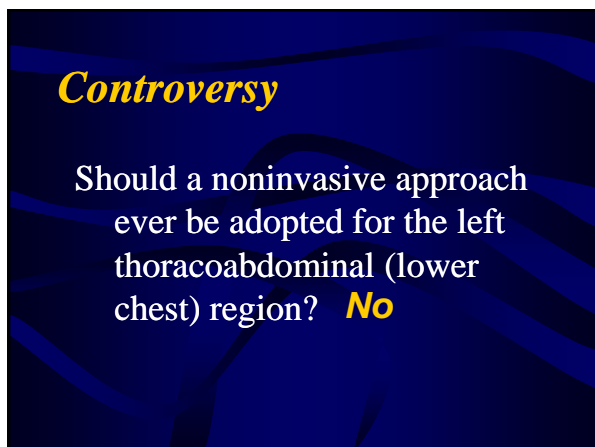


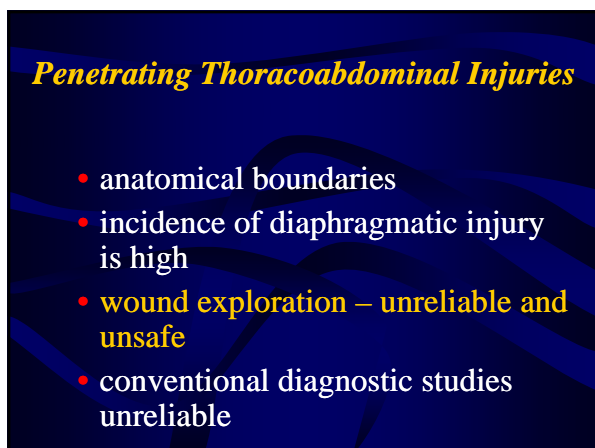












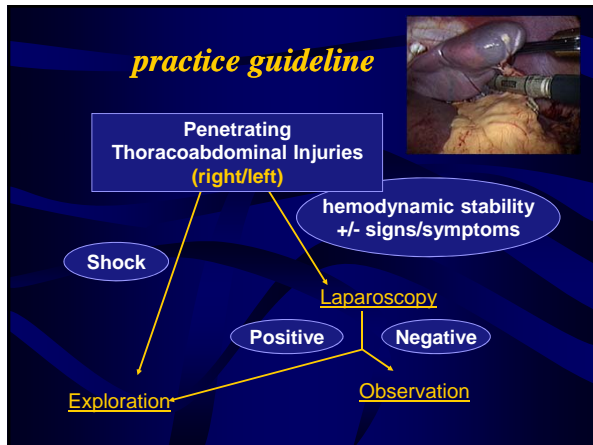
... introduction of laparoscopy in trauma

40 patients(34 SW,6 GSW) with penetrating wounds

- 20 normal(15/5) = no lap
- 10 hemoperitoneum = nontherapeutic
- 10 visceral = 10 therapeutic

Ivatury R: J Trauma 33:101,1992

practice guideline





Surgical Approach

THE “OPERATIVE PLAN”

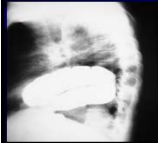
- Control hemorrhage
- Control gross spillage
- Thorough exploration
 - **Mobilization techniques**
 - **Adequate assessment of all holes/hematomas**
- Closure of diaphragmatic rent(s)

Laparoscopy as a diagnostic tool (identifying injuries)

Missed injury rate: 41% to 77% !

Villaricencio and Aucar: Analysis of laparoscopy
in trauma

J Am Coll Surgery 189, 1999



How reliable is laparoscopy?

Therapeutic laparoscopy (n=25):

colonic, gastric, and diaphragmatic repairs
liver & intra-abdominal bleeding
control

1 missed small bowel injury
No mortality

Saribevoğlu K et al , *Surg Laparosc Endosc Percutan Tech.* 2007 Oct;17(5):396-401

How reliable is laparoscopy?

“Missed” bowel injuries

- Livingston, 1992 : 5 of 10
 - Ivatury, 1993 : 7 of 12
 - Smith, 1994 : 3 patients

Frequency of laparoscopy use at two busy trauma centers

2007

<u>Trauma Center</u>	<u>Trauma Admits</u>	<u># laparoscopic procedures</u>
RACSTC	6464	4
VCUMC	3109	34
Combined	9573	38

0.37% of patients overall underwent trauma laparoscopy

Sources: RACSTC: B.K., Trauma registrar
VCUMC: The NSA*

LAPAROSCOPY FOR BLADDER RUPTURE

6 cases with laparoscopic technique
3 ports : (5 mm, 10 mm, and 12 mm)
intracorporeal single layer suturing
Jackson-Pratt drain

mean OR time : 43 (31-75) minutes,
mean length of bladder tear was 6.37 cm (5.3-7.7 cm)

Kim FJ et al, 2008

Laparoscopy: the next generation

- microinstruments
- microcameras
- advanced staplers
- suction-irrigation-dissection systems
- injectable hemostatic agent
- fibrin glue products

...how should this case be managed?





Chest Wall Stabilization

David L. Ciraulo, DO, FACS, MPH
Associate Professor of Surgery
Tufts University
University of New England

Blunt Chest Trauma Considerations

- Underlying pulmonary contusions
- Blunt cardiac injury
- Aortic injury
- Mediastinal hematoma unknown origin
- Flail chest

Introduction

- Flail Chest
 - Definition
 - 3 or more consecutive ribs fractured in two or more locations

Introduction

- Flail chest injury
 - Pain
 - Paradoxical Motion
 - Rib displacement / non-union

Introduction

- Management
 - Pain control
 - Epidural
 - PCA
 - Ventilator
 - Internal stabilization

Patient Selection for Stabilization

- 48hr failure to wean from ventilator
- Severe displacement of fracture segments
- Severe pain not improved by epidural
- Other indications resulting in thoracotomy

Risk / Benefit of Fixation

- Risk
 - Surgical incision
 - Pain
 - Infection
 - Iatrogenic injury
 - Anesthetic risk
 - Placement of hardware

Risk / Benefit of Fixation

- Benefit
 - Shorter ventilator course
 - Shorter length of stay
 - Decreased risk VAP
 - Decreased long-term disability secondary to pain and non-union

Studies

- Internal stabilization (Kyobu et al 2006)
 - Reduces period of pneumatic stabilization
 - Reduces risk of pneumonia

Studies

- Internal stabilization (Vu et al 2008)
 - 3 – 6 months internal stabilization resulted in no non – union and statistically stronger callus formation at fracture site compared to non stabilization

Studies

- U – plate stabilization verses anterior plate stabilization results is more stable in cadaver model of stressed ribs

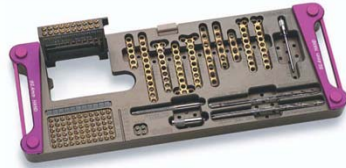
Where did all start?

Plating System Synthes Hand Modular Set



2.4 mm Titanium Hand Module Set

For use in the metacarpals and carpal



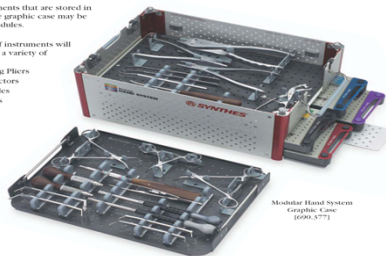
Plating System Synthes Hand Modular Set

Universal Instruments for the Modular Hand System

The universal instruments that are stored in the upper level of the graphic case may be used with all four modules.

The wide selection of instruments will meet the demands of a variety of surgical indications:

- Bending and Cutting Pliers
- Elevators and Retractors
- Universal Drill Guides
- Double Drill Sleeves
- Depth Gauges
- Screwdrivers
- Forceps



Modular Hand System
Graphic Case
(600,377)

Plating System Synthes Hand Modular Set

Color-coded instruments in each module

Drill bits, countersinks, and screwdriver blades are color-coded for easy recognition to correspond to the screw size.

1.0 mm / 1.3 mm Module

- 0.75 mm Drill Bit
- 1.0 mm Drill Bit
- 1.3 mm Drill Bit
- 1.3 mm/1.5 mm Countersink
- Screwdriver Blade with Holding Sleeve for 1.0 mm screws
- Screwdriver Blade with Holding Sleeve for 1.3 mm screws

1.5 mm Module

- 1.1 mm Drill Bit
- 1.5 mm Drill Bit
- 1.5 mm/1.5 mm Countersink
- Screwdriver Blade with Holding Sleeve for 1.5 mm and 2.0 mm screws

2.0 mm Module

- 1.5 mm Drill Bit
- 2.0 mm Drill Bit
- 2.0 mm/2.4 mm Countersink
- Screwdriver Blade with Holding Sleeve for 1.5 mm and 2.0 mm screws

2.4 mm Module

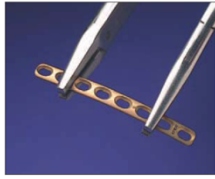
- 1.8 mm Drill Bit
- 2.4 mm Drill Bit
- 2.0 mm/2.4 mm Countersink
- Screwdriver with Holding Sleeve for 2.4 mm screws (see instrument set)



Plating System Synthes Hand Modular Set



Bending/Cutting Pliers
[391.962.96]



Universal Bending Pliers
[391.963.96]

Plating System Synthes Hand Modular Set

Screws in the Titanium Modular Hand System

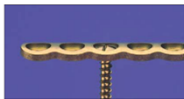
- Self-tapping design for easy insertion
- Low-profile head to reduce soft tissue irritation
- Thread design provides optimal purchase in bone
- Commercially pure titanium for biocompatibility
- Screw lengths available up to 38 mm for 2.0 mm and 2.4 mm



Plates for self-tapping



Low-profile screw head



Low plate profile

Dawn of the U plate !

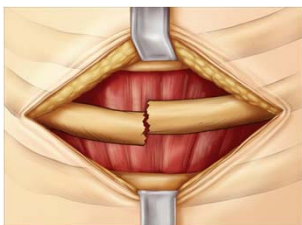
Plating System Acute Innovations, LLC



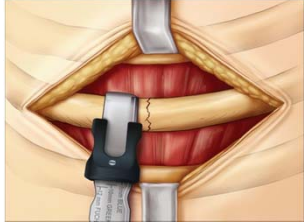
Plating System



Plating system



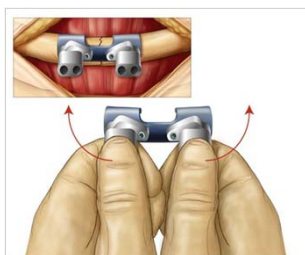
Plating system



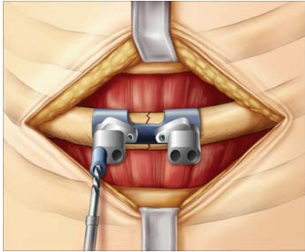
Plating system



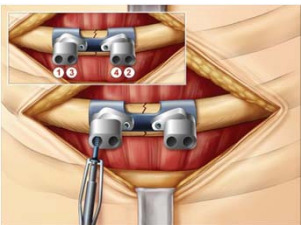
Plating system



Plating system



Plating system



Plating system



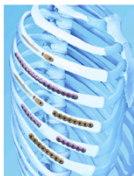
Synthes emerges with
standardization system.....

Rib Matrix System



Synthes MatrixRIB

Synthes MatrixRIB
fixation system



- Third alternative
 - Preformed
 - Locking system
 - Addition of inter-medullary nail

Synthes MatrixRIB

2 Types of Fixation

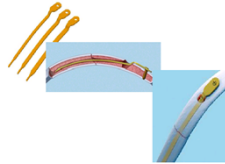
• Pre-contoured plates with locking screws

- Ideal for large-scale trauma (ie flail ribs)
- Ideal for complex fractures (ie comminuted, oblique)

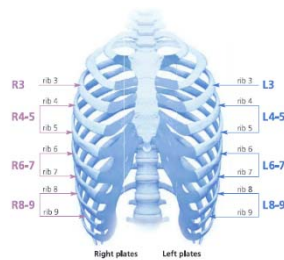


• Intermedullary splints

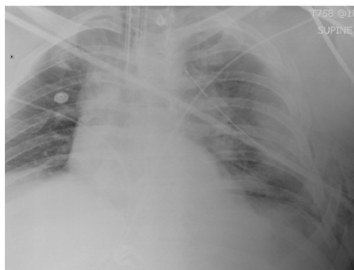
- Minimally invasive
- Ideal for single, displaced rib fractures
- Ideal for posterior fractures



Plates



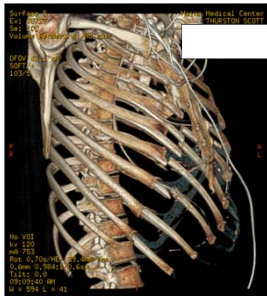
Rib Fractures



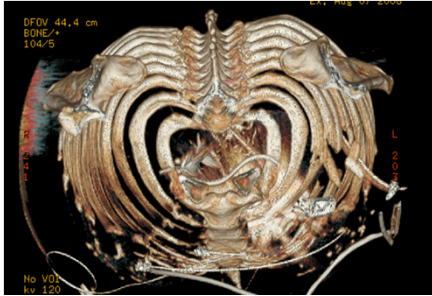
Chest CT Lung Herniation



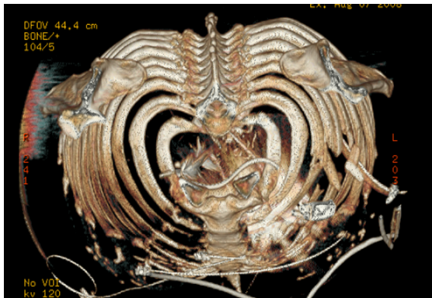
Chest CT 3D Reconstruction



Chest CT 3D Reconstruction



Chest CT 3D Reconstruction



Patient Positioning

Position the patient to gain access to the rib to be repaired.

For pure lateral chest injuries, a lateral thoracotomy may be used, with the patient in a lateral decubitus position, and the arms abducted 90° on a rest and carefully padded.



Anterolateral chest injuries may be approached with an anterolateral thoracotomy with the patient in a supine position, with both arms abducted 90°.



OR Incision



1 Expose fracture Rib

Expose the rib to allow a minimum of three screws on each side of the fracture

Remove nonviable bone

Removal of the periosteum is not required



Caution: Avoid significant muscle division, to preserve Respiratory function.

2 Measure rib thickness

Insert the caliper tip through a small incision at the superior border of the rib and measure rib thickness

Add 2mm to the measurement to determine appropriate screw length and drill bit with stop



Caution: Avoid damage to the nerve and vessel bundle along the inferior border of the rib.

3a Approximate rib segment and select plate
Approximate broken rib
segments using forceps



3b Optional

Cut and contour the plate
Template to the rib.



3c Optional

Use the plate template to
Select the plate.



4a optional Cut plate

If necessary, cut the plate to length to match the template



Caution: Use a minimum of three screws on each side of the fracture

4b optional

Bend the plate to match the template, using the bending pliers.



Caution: Avoid sharp bends, reverse bends, bending the plate at a screw hole, and notching or scratching the plate

5 Position plate

Use the plate holding forceps to hold the plate over the fracture, allowing a minimum of three screws on each side of the fracture



Caution: Insert the forceps from the superior border of the rib, to avoid the nerve and vessel bundle located along the inferior border of the rib.

6 Drill

Thread the drill guide into the plate. Drill, using the 2.2 mm drill bit with stop determined in Step 2.

Irrigate during drilling, to avoid thermal damage to the bone

Remove the drill guide



Caution: Do not drill deeper than necessary, to avoid the risk of pneumothorax.

7a Insert locking screws

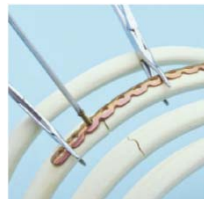
Use the depth gauge through the plate to confirm screw length



Caution: Do not extend the tip of the depth gauge too far beyond the posterior cortex of the rib.

7b

Insert the locking screw through the plate. Tighten until secure.

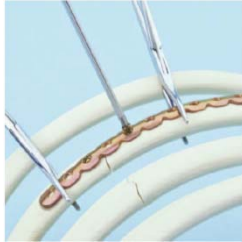


Caution: The tip of the screw should not extend more than 1 mm beyond the posterior cortex.

8a Drill and place remaining screws

Verify proper reduction of the fracture.

Insert a second screw on the opposite side of the fracture, as in Steps 6 and 7.



8b

Insert remaining screws in the same manner.



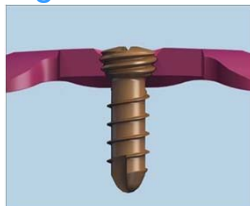
Titanium Locking Screws

Matrix design:
One screw diameter for use with
all plates and splints

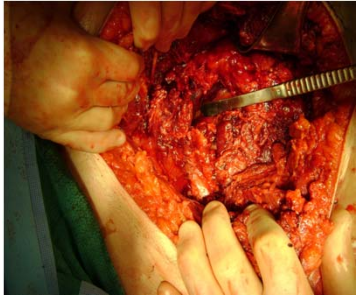
- Self-tapping
- Diameter = 2.9 mm

Lengths:

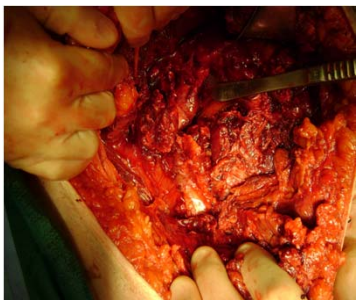
- 6 – 14 mm Locking
(2mm increments)
- 6 mm Non-Locking



Lung Herniation



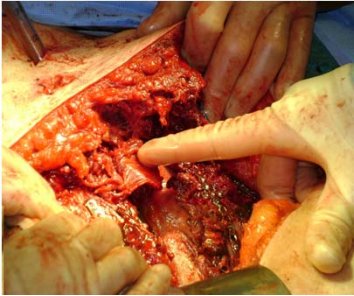
Chest Wall Defect



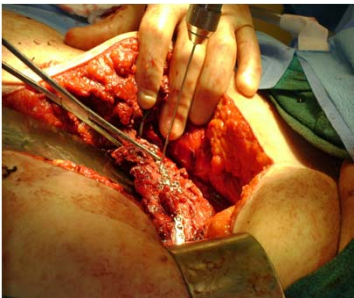
Lung



Floating Segment



Plating



Plating



Completion



Difficult Access

- Rib Fractures behind scapula
 - Muscle splitting of infra- spinatus and subscapularis
 - Elevation of scapula

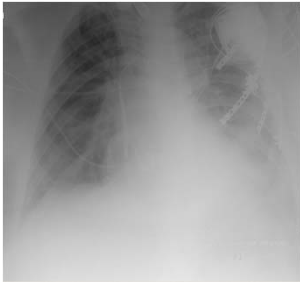


Difficult Access

- Right angle instruments
 - Right angle drill and screw driver essential



Post op CXR



Future

- Defining Indication
 - Who
 - Number fx
 - Ventilator days
 - Displacement
 - When
 - Day 1 -2 - 3- ????
 - Why
 - Pain
 - Mechanics
 - Failure to wean

Questions



EAST Masters Course Part III

This is How I Expose the Anterior
Spine for Trauma Patients with
Thoracic and Lumbar Spine Injuries
Requiring Operative Fixation

Christian Minshall, MD

