Ode to the Diaphragm

Management of Penetrating Thoracoabdominal Injuries

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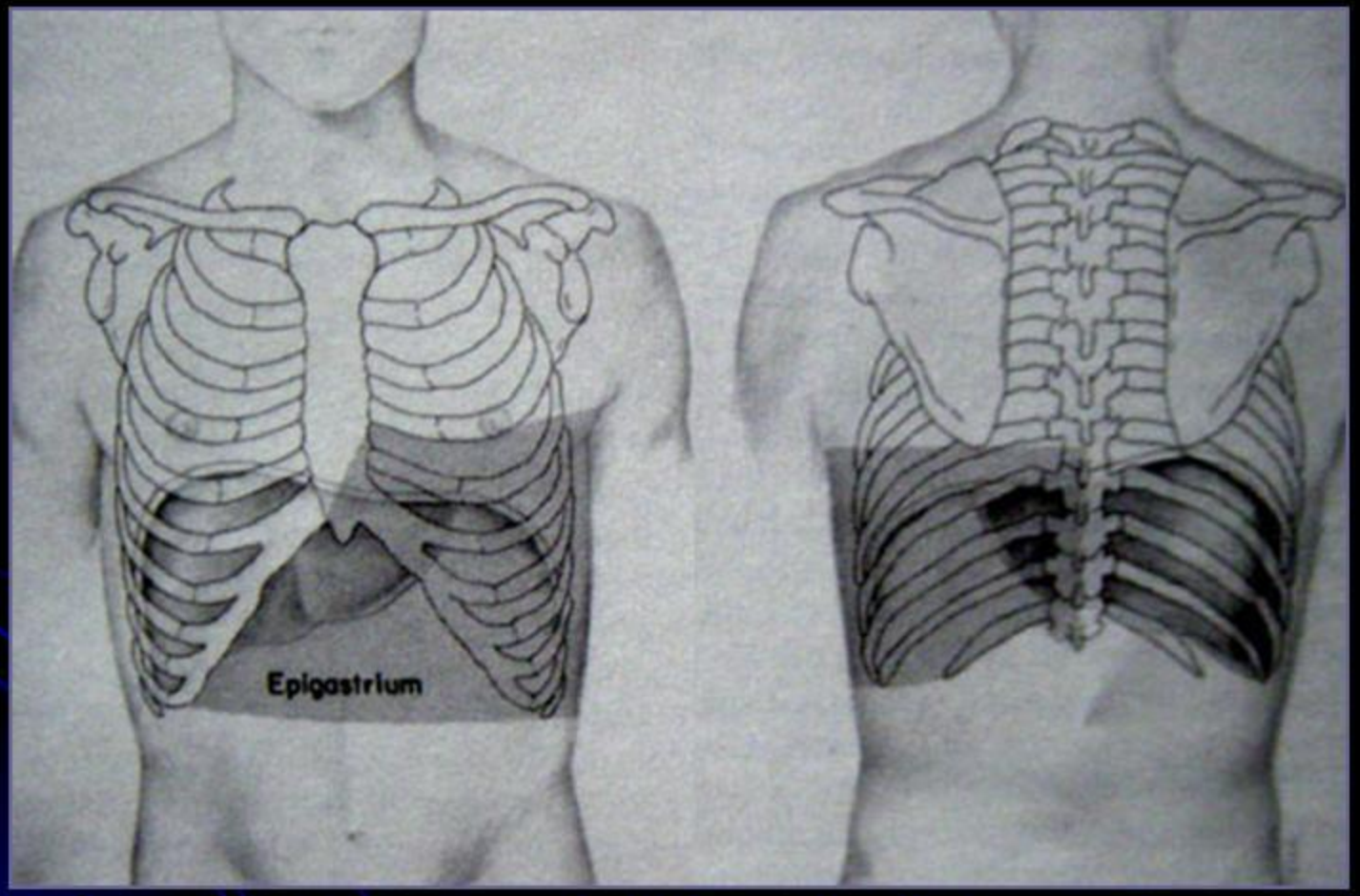
Penetrating Injury of the Diaphragm

Suspicion of Injury



Occult Diaphragmatic Injury from Stab Wounds to the Lower Chest and Abdomen

Madden, et al. J Trauma, 1989

Physiology

- Unsung workhorse of the body
- Creates (-) intrathoracic pressure
- Pleuroperitoneal gradient
  - supine position: +7 to +20 cm H_2O
  - peak inspiration: > 100 cm H_2O

Penetrating Injury of the Diaphragm

Natural History if Untreated

- Atrophy and retraction of diaphragm
- Progressive herniation of abdominal viscera
  - Cardiorespiratory compromise
  - Obstruction, strangulation

Marchand, et al. Thorax, 1957
Hood, et al. Ann Thor Surg, 1971
Ali, et al. J Trauma, 1992
Bernatz, et al. JAMA, 1958
Bark, et al. Resp Dis, 1988
Stylianos et al. Am Surg 1992

Penetrating Injury of the Diaphragm
Incidence in Thoracoabdominal Wounds

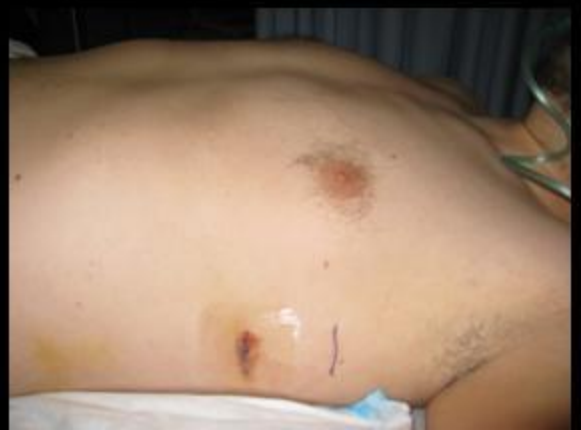
All patients

- 50%: (n=100) *Ivatury, et al. J Trauma, 1992*
- 42%: (n=119) *Murray, et al. J Trauma, 1993*
  - 31% non-tender abdomen
  - 40% normal CXR; 49% hemo-ptx

Penetrating Injury of the Diaphragm
Incidence in Thoracoabdominal Wounds

Stable patients without peritonitis

- 25% (n=110) *Murray, et al. JACS, 1998*
  - incidence similar for anterior, lateral, and posterior injuries
- 28% (n=80) *McQuay & Britt, Ann Surg, 2003*
  - 27% were R-sided



Penetrating Injury of the Diaphragm

Diagnosis

- **CXR**: diagnostic in only 30%
- **CT scan**: typically unhelpful
- **DPL**: 34% false (-), including 3 reported cases with RBC count = 0
- ***The only way to see the diaphragm is to see the diaphragm***

Estera, et al. Chest, 1979
Weincek, et al. J CT Surg, 1986
Toombs, et al. Radiology, 1981
Madden, et al. J Trauma, 1989
Moore, et al. Am J Surg, 1980
Demetriades, et al. Br J Surg, 1988
Miller, et al. J Trauma, 1984
Spann, et al. Am J of Surg, 1995
Degiannis, et al. Br J Surg, 1996
Alyono, et al. Surgery, 1992

Penetrating Injury of the Diaphragm

Surgical Repair

- Acute phase: abdominal approach
  - 60-80% associated injury
- Chronic phase: thoracic approach or combined thoracotomy / laparotomy
- Interrupted horizontal mattress sutures
  - non-absorbable

Penetrating Injury of the Diaphragm

Sequelae of Missed Injury

Tension fecopneumothorax due to colonic perforation in a diaphragmatic hernia

Chest. 115: 288-91, Jan, 1999

- 2 years after stab wound to left chest
- patient survived

- 11 total cases reported

Penetrating injury of the diaphragm

Sequelae of Missed Injury

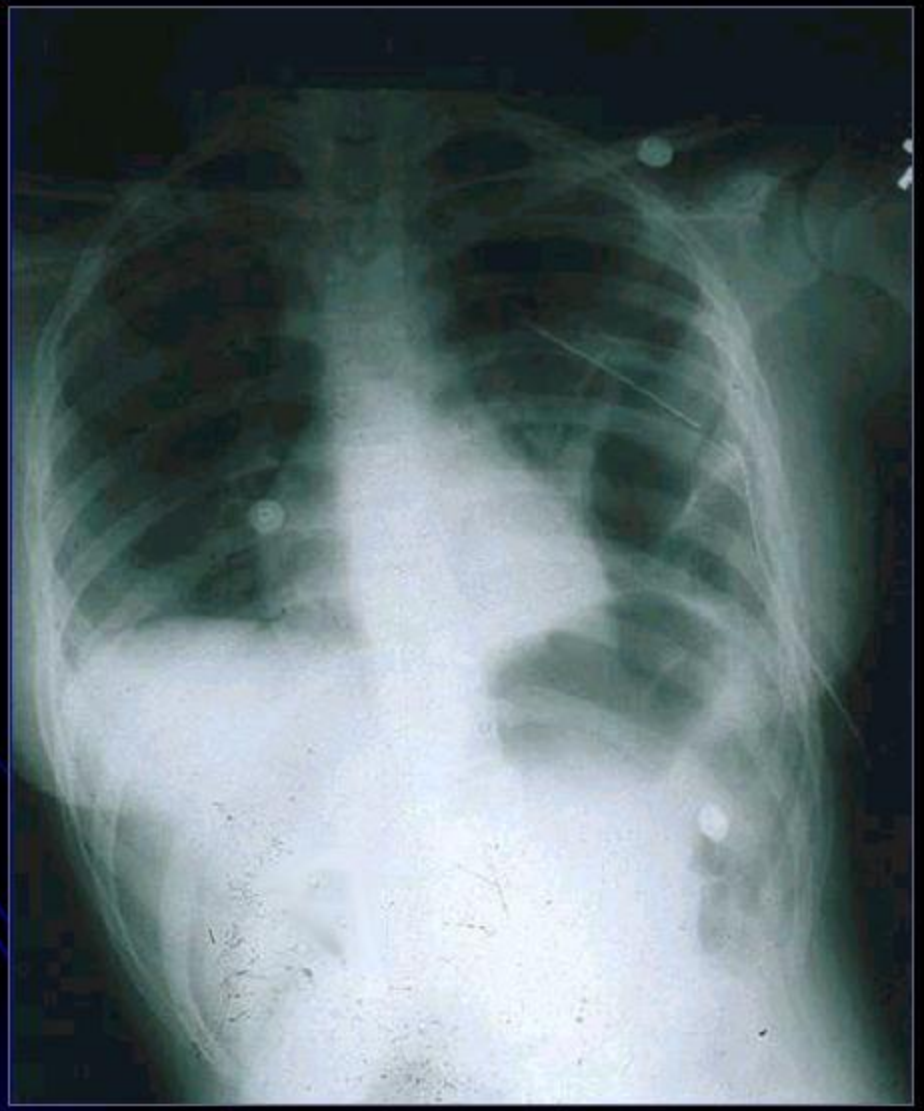
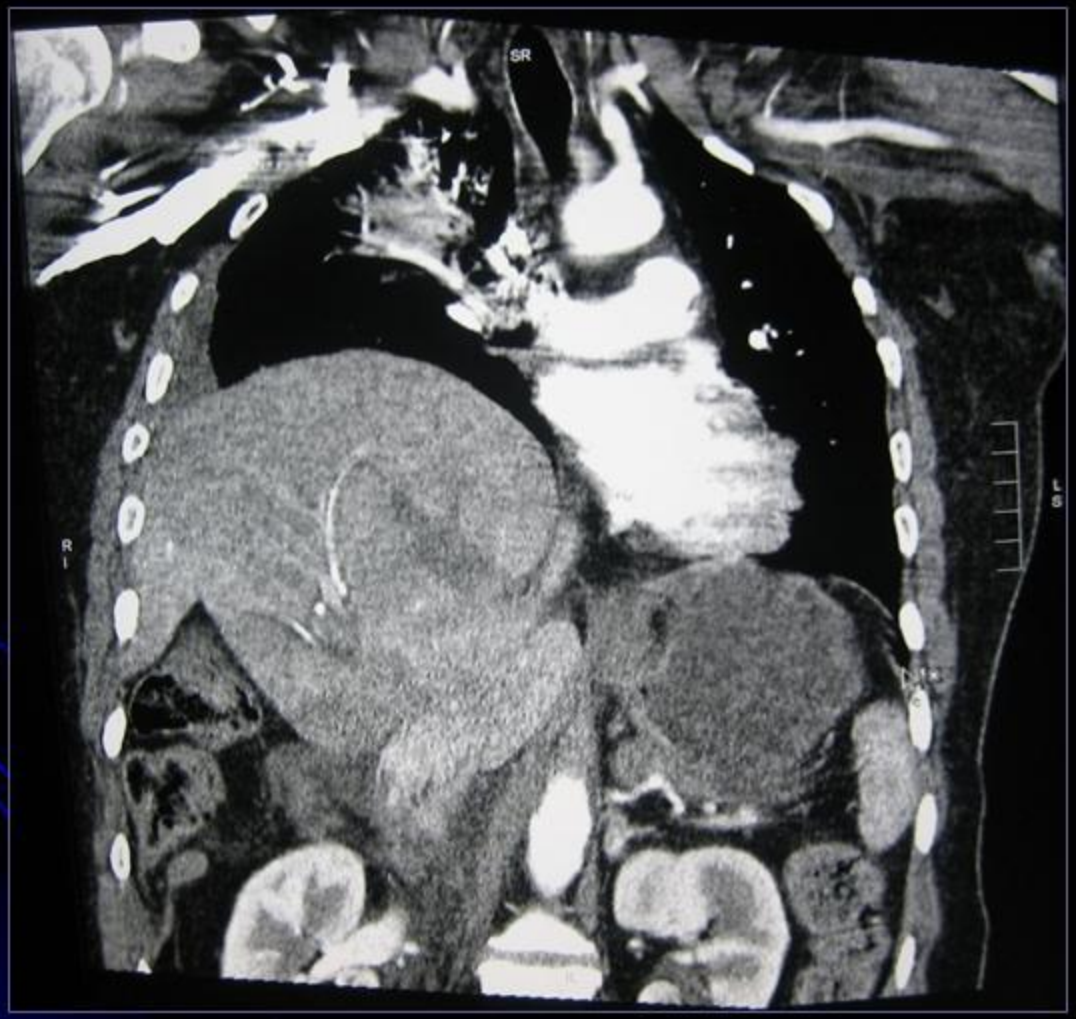


Photo courtesy of LD Britt
Professor of Surgery
Eastern Virginia Medical School

Penetrating injury of the diaphragm

Sequelae of Missed Injury



“Lesson of the week” BMJ 2008 15yo boy

- Stabbed L posterior chest, 9th interspace
- HD stable
- L haemopneumothorax drained
- CT scan – no visceral injury
- Discharged home day 7

Penetrating injury of the diaphragm

Sequelae of Missed Injury

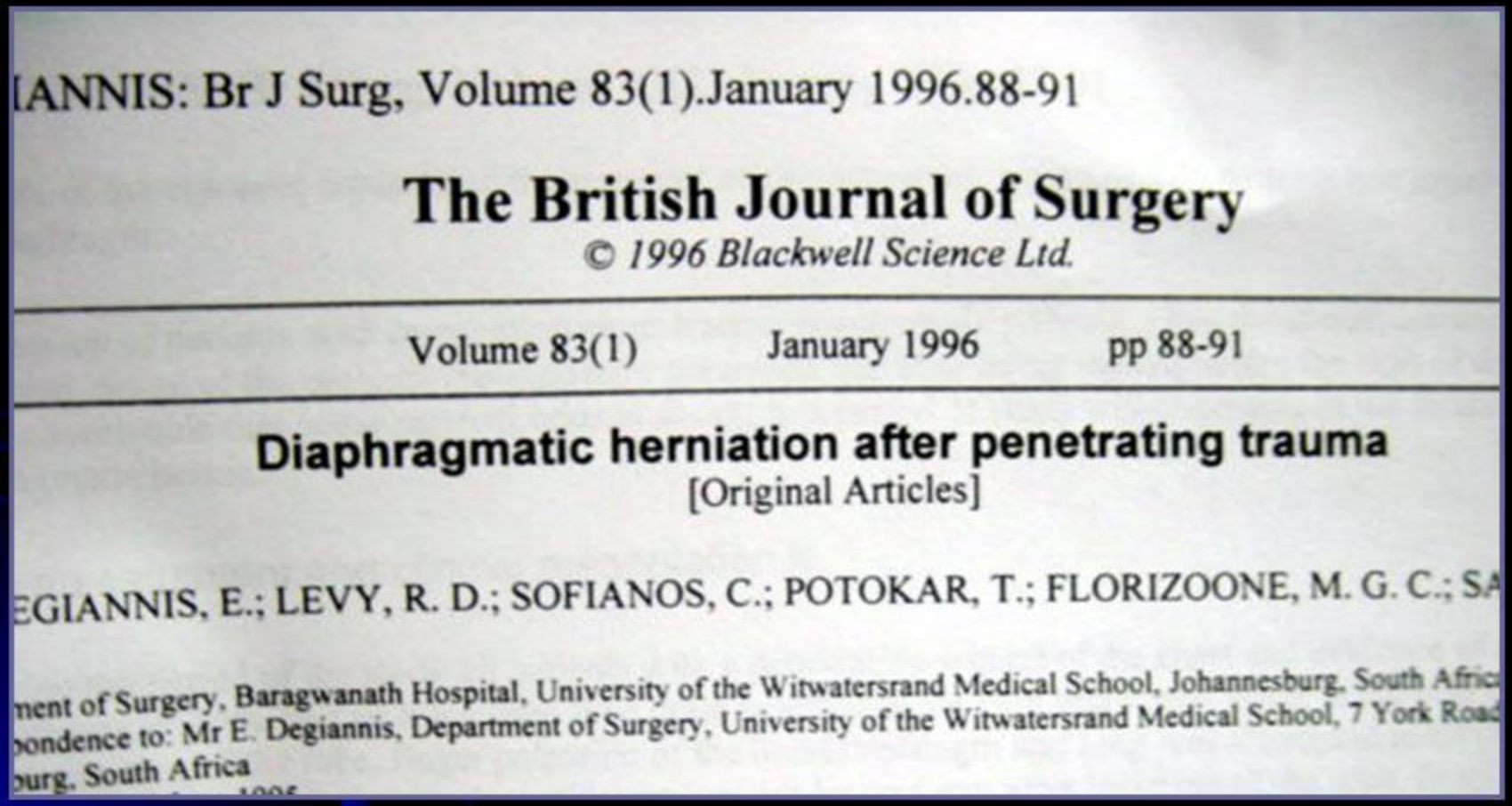
Obstruction-strangulation of post-traumatic diaphragmatic hernia - delayed diagnosis and fatal outcome

South African Medical Journal. 68:39-44, July, 1985

- Series of 9 cases
- history of penetrating trauma (6 mos-18 yrs)
- 4 / 9 (44%) died

Penetrating injury of the diaphragm

Sequelae of Missed Injury



IANNIS: Br J Surg, Volume 83(1).January 1996.88-91

The British Journal of Surgery

Volume 83(1) January 1996 pp 88-91

Diaphragmatic herniation after penetrating trauma

[Original Articles]

EGIANNIS, E.; LEVY, R. D.; SOFIANOS, C.; POTOKAR, T.; FLORIZOONE, M. G. C.; SA

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Penetrating injury of the diaphragm

Sequelae of Missed Injury

- case series of 45 penetrating injuries

	dx	n	died	LOS
early	0-72hr	29	**3%**	9d
late	5m-9y	16	**25%**	19d

Diaphragmatic herniation after penetrating trauma

British Journal of Surgery. 83:88-91, Jan, 1996

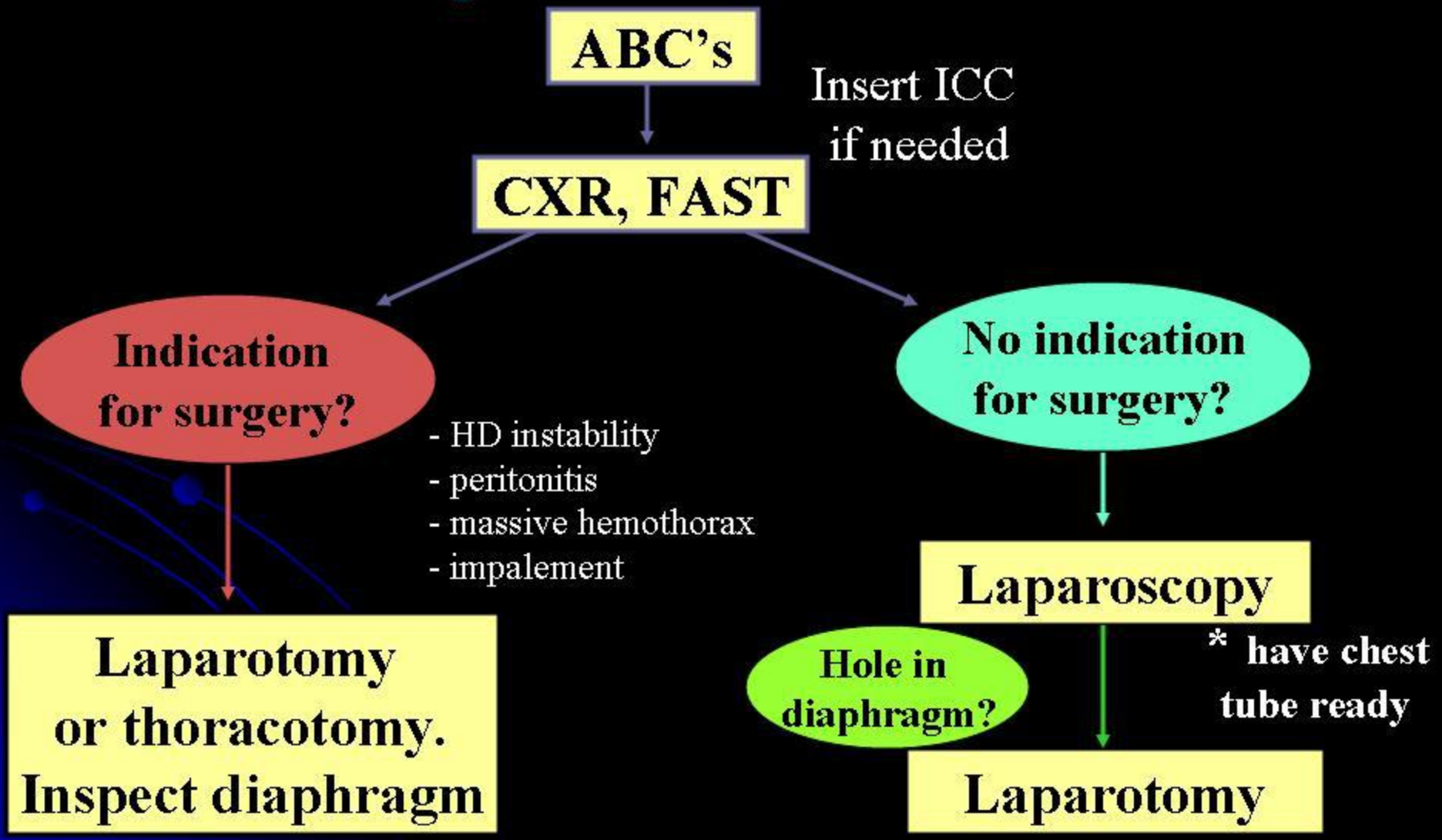
Penetrating Injury of the Diaphragm

Summary

- The incidence of diaphragmatic injuries after penetrating thoracoabdominal trauma is high
- Failure to diagnose diaphragmatic injury leads to increased morbidity and mortality
- Clinical, radiologic, and lavage findings are unreliable

Penetrating Thoracoabdominal Injury

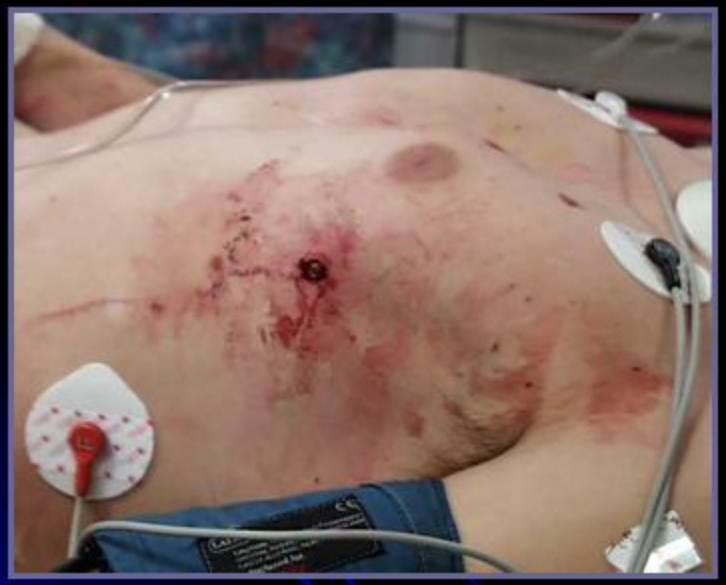
Management Guidelines



Penetrating Injury of the Diaphragm

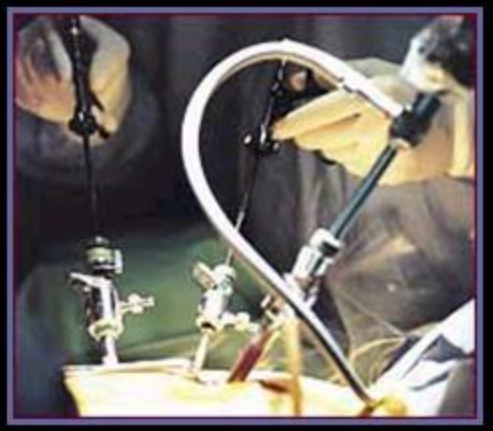
Conclusion

Patients with this:



Who don't need this

Need this:

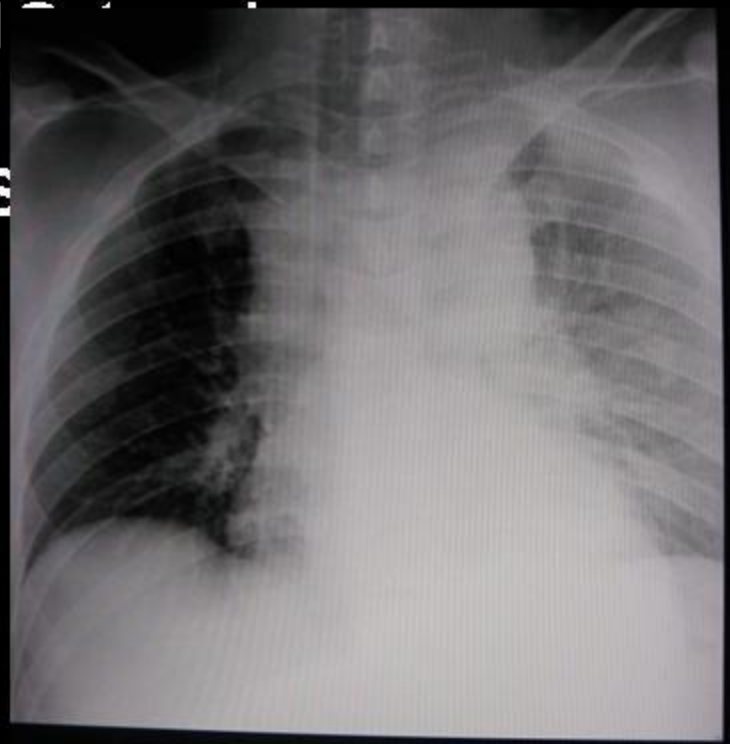


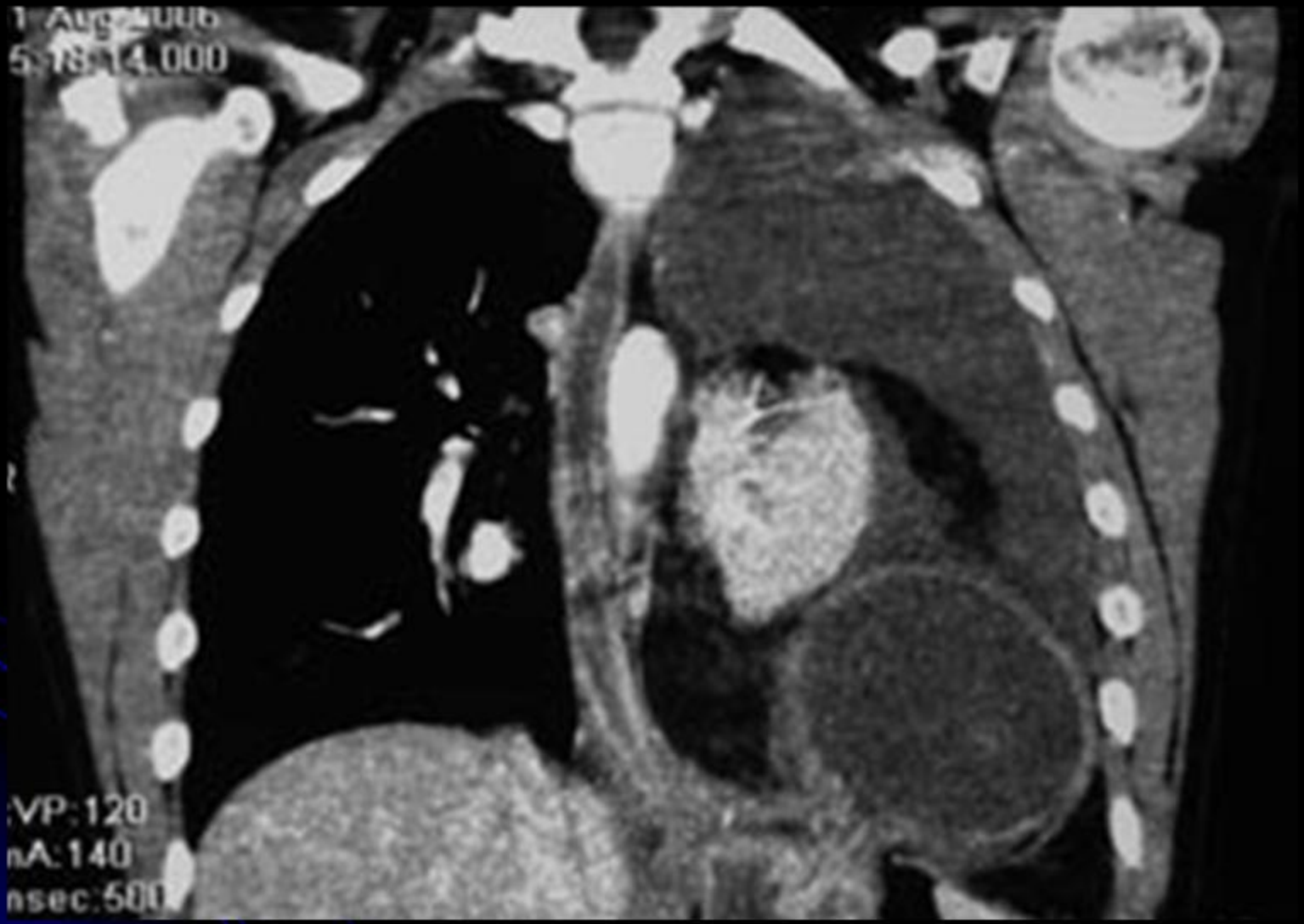
3m followup

- Clinically well
- CXR normal
- discharged

One year later

- Sudden severe epigastric pain
- Dysphagia, blood-stained vomit
- Constitutionally unwell, LU
- Decreased air entry L ches




VP:120
nA:140
nsec:500

Laparotomy

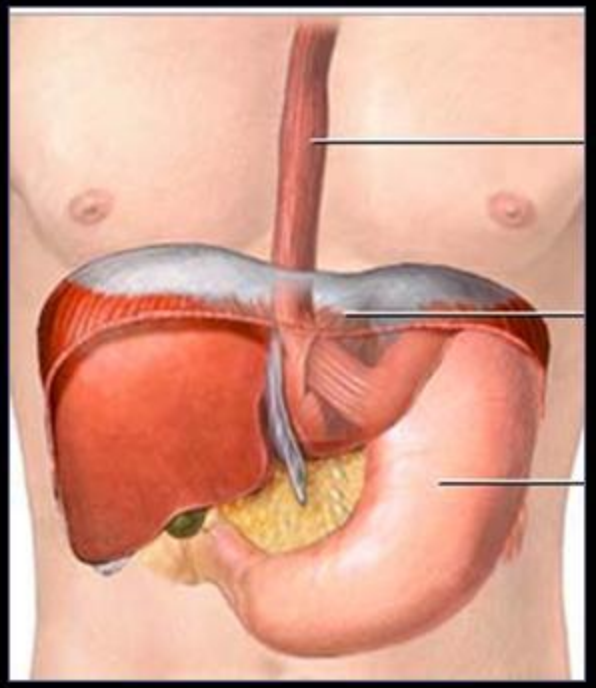
- Entire stomach strangulated through 4cm defect in diaphragm
- Irreversible ischaemia
- Total gastrectomy, roux-en-y

Ambrose Paré, 1579

- Case report: French artillery captain
- Died of colonic obstruction & sepsis 8 months after GSW left chest
- Autopsy: colon strangulated and gangrenous within diaphragmatic rent
- "a hole only large enough to admit the tip of the little finger…."

Anatomy

- Dome - shaped
- The diaphragm rises to
  - T4 on the right
  - T5 on the left



- ∴ any missile at or below nipple (T4) has a potential intra-abdominal course

Definition:
"Thoracoabdominal"

- Anteriorly: nipple to costal margin
- Posteriorly: scapular tips to costal margin