La valutazione del cuore e dei grossi vasi nel paziente traumatizzato

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A position statement: echocardiography in the critically ill

On behalf of a Collaborative Working Group of the British Society of Echocardiography (BSE)

Focused echocardiography in the critically ill

	FEEL Focused Echo Evaluation in Life Support	FATE Focused Assessed Transthoracic Echocardiography	FAST Focused Assessed Sonography in Trauma
Views	PLAX PSAX A4Ch Subcostal	PLAX PSAX A4Ch Subcostal *Pleural*	Subcostal *RUQ* *LUQ* *Pelvic*
Pathology	Pericardial collection Cardiac activity Gross ventricular function	Pericardial collection Measurement of ventricular dimensions Pleural collection	Free intra-peritoneal or pericardial fluid
Training	One-day course Supervised practice (eg 50 cases)	Two-day course Practical/theory exam	25-50 documented and outcome reviewed scans

Table 1 Focused ultrasound protocols devised for the critically ill. FEEL (previously FEER) incorporates only echocardiography, whereas FATE and FAST include additional views to image other organs (shown in italics). PLAX; parasternal long axis view, PSAX; parasternal short axis view, A4CH; apical four chamber view, RUQ right upper quadrant view; LUQ; left upper quadrant view.

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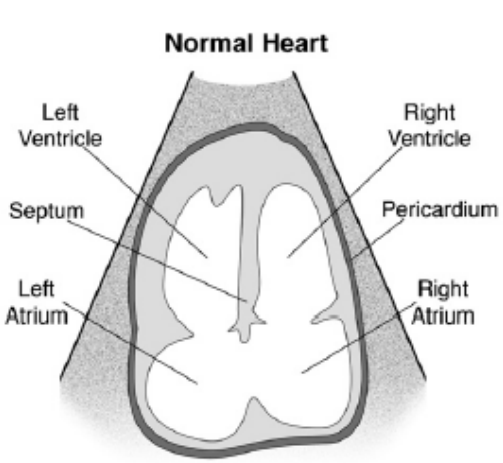
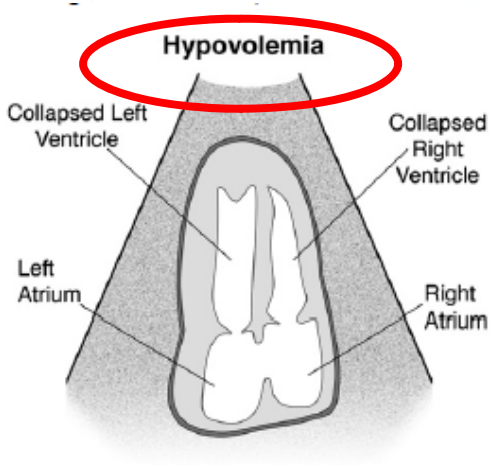
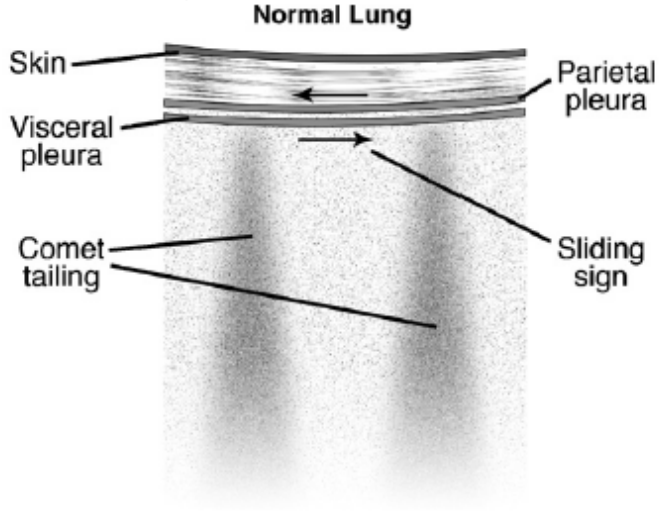
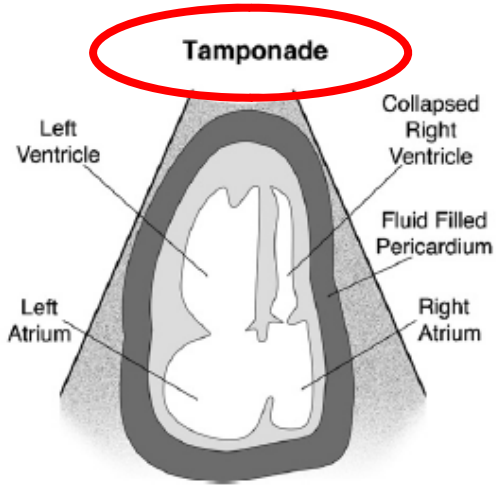
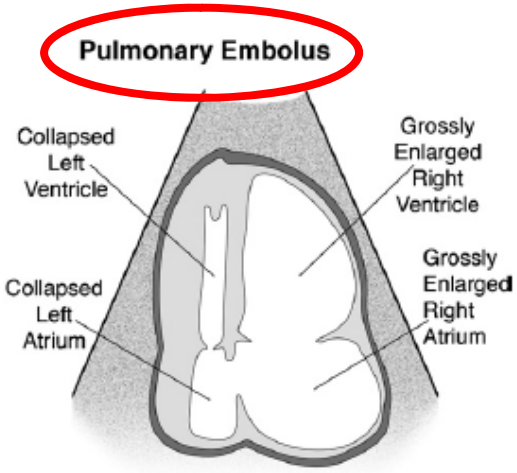
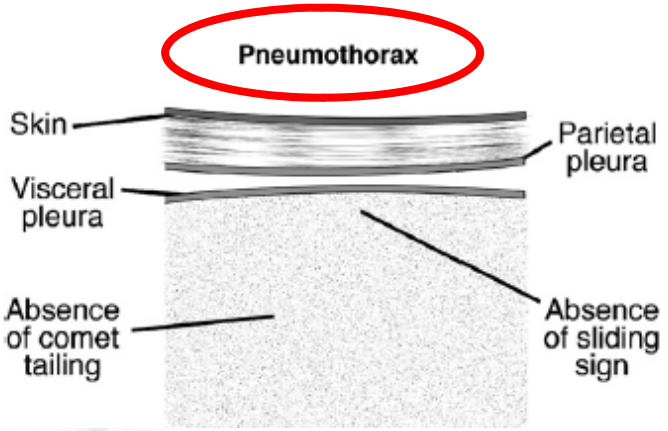

Normal Heart
Left Ventricle
Right Ventricle
Septum
Pericardium
Left Atrium
Right Atrium


Hypovolemia
Collapsed Left Ventricle
Collapsed Right Ventricle
Left Atrium
Right Atrium


Normal Lung
Skin
Parietal pleura
Visceral pleura
Comet tailing
Sliding sign


Tamponade
Left Ventricle
Collapsed Right Ventricle
Fluid Filled Pericardium
Left Atrium
Right Atrium


Pulmonary Embolus
Collapsed Left Ventricle
Grossly Enlarged Right Ventricle
Collapsed Left Atrium
Grossly Enlarged Right Atrium


Pneumothorax
Skin
Parietal pleura
Visceral pleura
Absence of comet tailing
Absence of sliding sign

ECHOCARDIOGRAPHY FOLLOWING CHEST TRAUMA

- Hemopericardium
- Pleural collection
- Aortic disruption
- Myocardial contusion
- Mitral valve disruption
- Aortic valve disruption
- VSD
- Coronary artery disruption
- PNX

✓Is there pericardial fluid?

✓Is the heart hypokinetic?

✓Is the heart hyperkinetic?

✓How well filled is the heart?

INSTABILITA' EMODINAMICA

- VERSAMENTO PERICARDICO
- COMPRESSIONE CAMERE CARDIACHE

- TAMPONAMENTO CARDIACO
- PAT. ACUTA AORTA

IPOCINESIA

- V.SX e/o V.DX (GRADING)
- PRESS.RIEMPIMENTO ELEVATE?
- FUNZIONE DIASTOLICA

- ANOMALIE CINETICA SEGMENTALE
- IMA

COMPLICANZE IMA
-INS. MITRALICA ACUTA
- ROTTURA SIV
- ROTTURA MIOCARDIO (VERS.PERIC.)

- CARDIOPATIA CRONICA
- MIOCARDIOPATIE

DISFUNZIONI VALVOLARI

IPERCINESIA

- IPOVOLEMIA
- "FLUID RESPONSIVENESS"
- VALUTARE ANCHE V.DX

- OSTRUZIONE DINAMICA LVOT
- BASSE RESISTENZE SISTEMICHE (SIRS?, SEPSI?)

- PATOLOGIE VALVOLARI
- PATOLOGIE POLMONARI

"NORMOCINESIA"

- "ADEGUATA" vs STATO CLINICO
- "relatively hypokinetic"

MYOCARDIAL CONTUSION

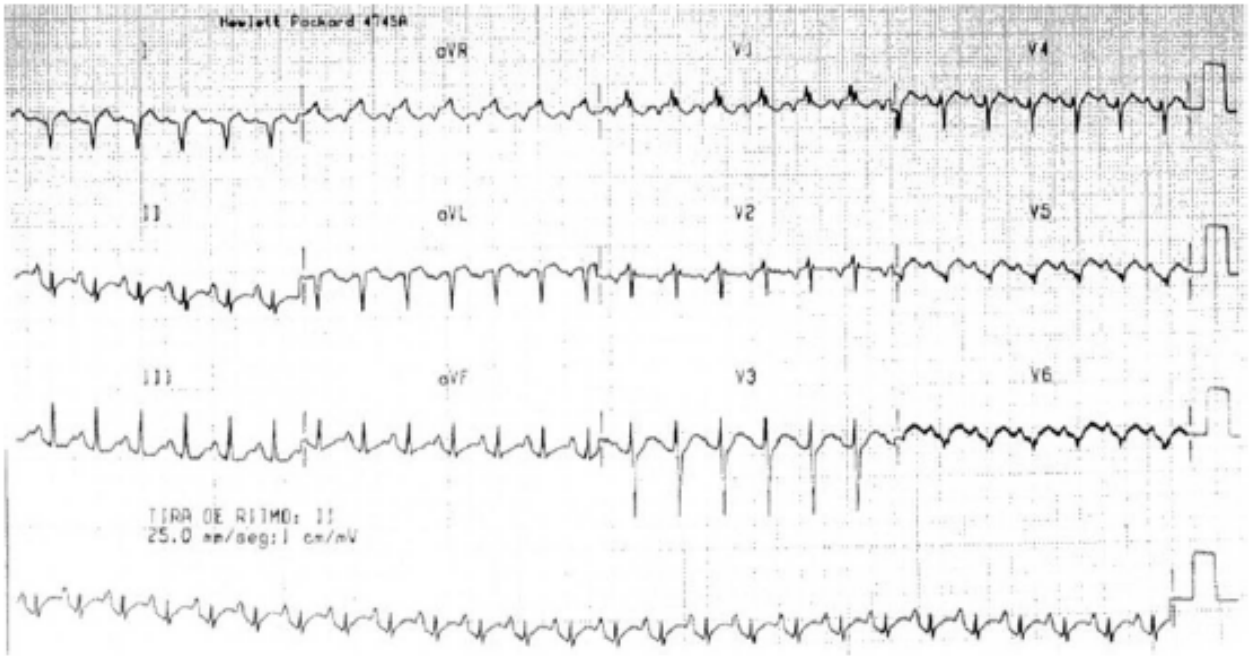
➢A 30-year-old man was re
head injury and loss of cons

➢severe dyspnoea and left

Echocardiogram : severe lef
and an ejection fraction of 2

➢tachycardia, tachypnea ar
Auscultation of the chest sh

Chest radiograph :a large cc
hemithorax



ECG :sinus rhythm and a supepicardial lesion in the anteroseptal aspect

> Troponin I

Swan-Ganz :Wedge12mmHg ,CVP 4 mmHg.

- Five days after ICU admission :**ventricular tachycardia** and lost consciousness

- **new echocardiogram:** no relevant changes compared with the previous one

- **Coronariography:** a complete proximal occlusion of the anterior descending coronary artery, and the ventriculography a dilated left ventricle with highly reduced systolic function owing to diffuse hypokinesis, secondary to an extensive apical and anterolateral aneurysm

- **Contrapulsation** balloon was inserted

- Six hours after the coronariography, he developed a **sudden cardiac arrest**

  the pulse was recovered after 10 min of advanced cardiopulmonary resuscitation

- After 4 days, the contrapulsation balloon was removed.

The **neurological** examination showed severe cerebral damage, which was associated with marked decrease in bioelectrical activity in the electroencephalogram.

- The patient died 20 days after admission because of **multiorgan failure**

THE HEART IN BLUNT TRAUMA

- direct transfer of energy during the impact on the thorax;
- rapid deceleration of the heart;
- compression of the heart between the sternum and the spine

Blunt Cardiac Trauma

❖ **MYOCARDIAL COMMOTION** (commotio cordis)

- low-energy impact to the precordium leading to cardiac arrest (athletic activity:baseball, hockey puck, karate kicks, etc)

- an impact *30–15 ms* before the peak of the T wave, leading to ventricular fibrillation, or from an impact during the QRS complex, leading to complete heart block (no can be evidenced by any imaging method, including histology)

❖ **MYOCARDIAL CONTUSION**

- high energy impact and is associated with myocardial lesions (hemorrhage, increase in edema formation, necrosis, polymorphonuclear infiltrates) that increase extravascular resistance and may result in decreased coronary blood flow and cardiac function

COMPLICATION

- Arrhythmias
- Hemopericardium can be caused by myocardial contusion but is rarely responsible for cardiac tamponade
- Severe myocardial contusion may induce a decrease in cardiac function, but frank cardiogenic shock is rarely observed
- Cardiac rupture is a rarely observed
- Right ventricle is more often involved than the left ventricle …*

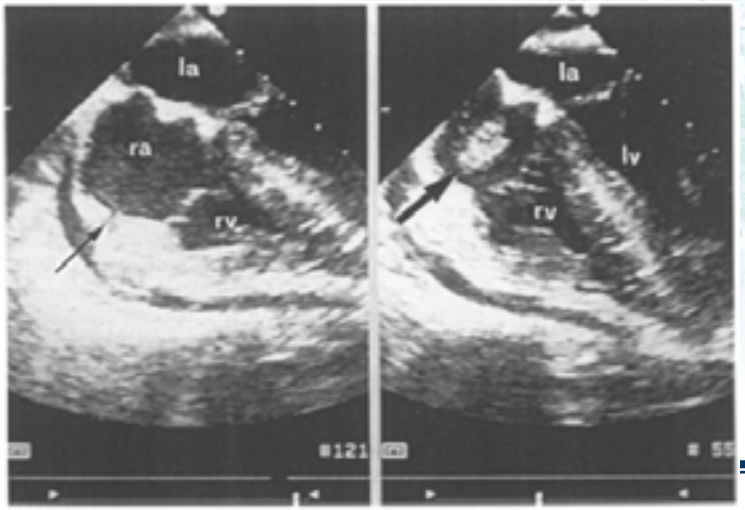


Figure 1 Transoesophageal basal four chamber view taken in a patient with cardiac tamponade following a horse kick. (Left) The arrow indicates a small fissuring on the right atrial wall. There is pericardial effusion and the right ventricle looks compressed. (Right) A portion of the torn right atrial wall (arrow) is seen floating within the right atrium just above the tricuspid valve (la, left atrium; lv, left ventricle; ra, right atrium; rv, right ventricle).

Table 1. Comparison of Diagnostic Performance of Transthoracic (TTE) and Transesophageal (TEE) Echocardiography Performed in the Same Blunt Chest Trauma Patients (n = 134)

	TTE	TEE
Feasibility	51 (38%)	131 (98%)
Hemopericardium	28 (21%)	40 (30%)
Myocardial contusion	**15 (11%)**	**45 (34%)**
Aortic rupture	3 (2%)	14 (10%)
Hemomediastinum	5 (4%)	34 (25%)
Valvar lesions	0	2 (1%)

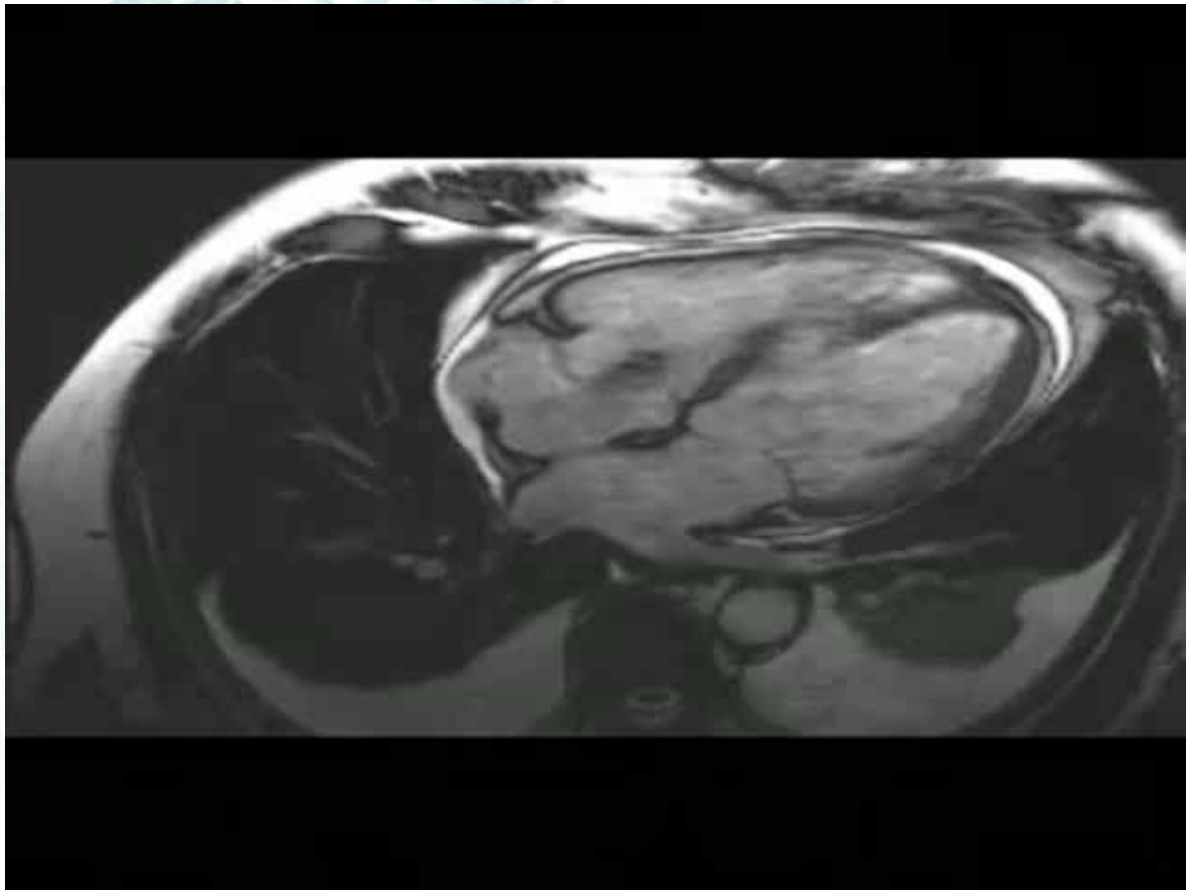
From Chirillo *et al.*[8]

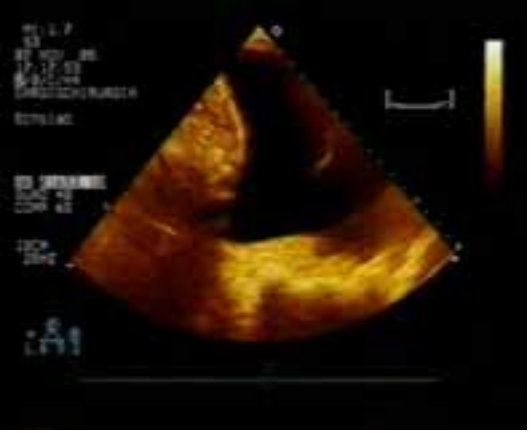
INDIRECT LESIONS

- Head trauma, subarachnoid hemorrhage, and increases in intracranial pressure *
- Hemorrhagic shock can be associated with a decrease in cardiac function

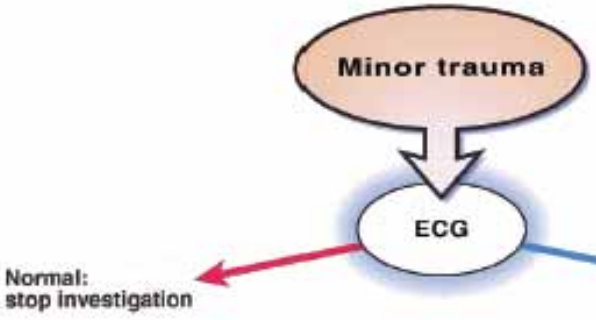
ASSESSMENT OF THE HEART

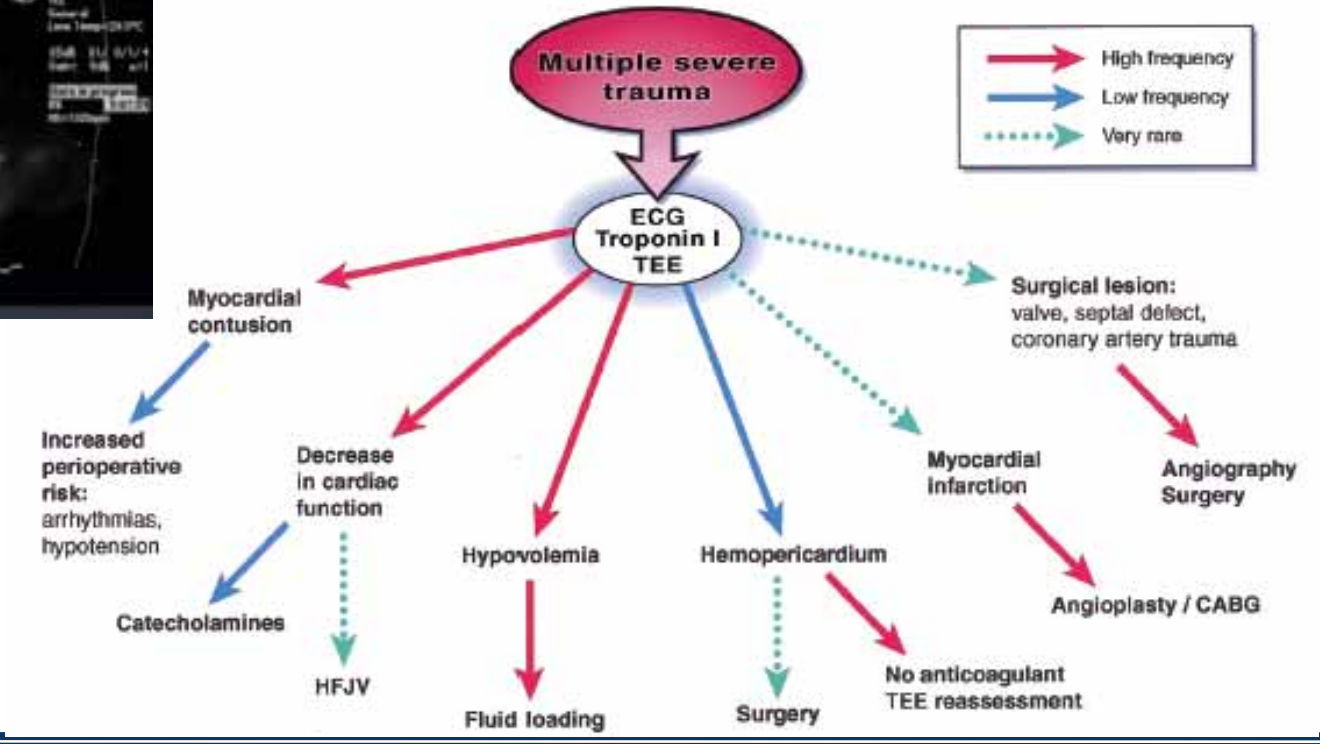
- Electrocardiography (tachycardia and extrasystoles)
- Troponin I concentration measurement,
- Echocardiography
- Coronary angiography (coronary lesion or a cardiac rupture is suspected)





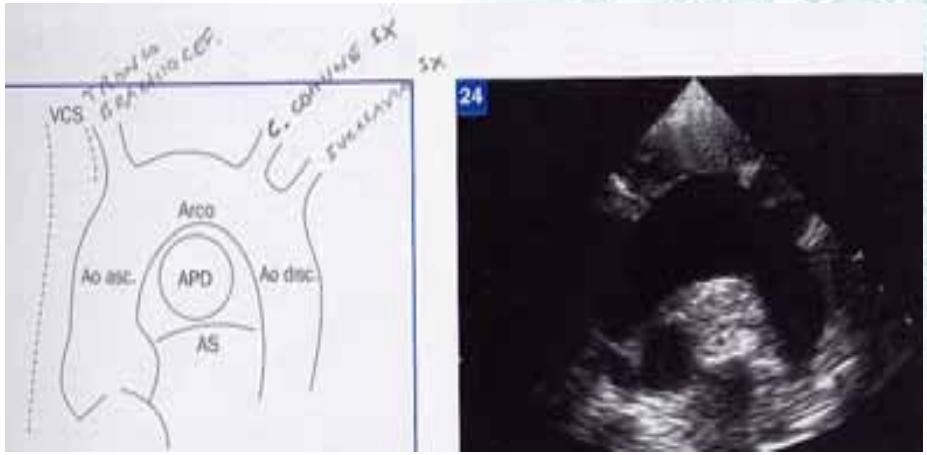

Tamponamento
cardiaco

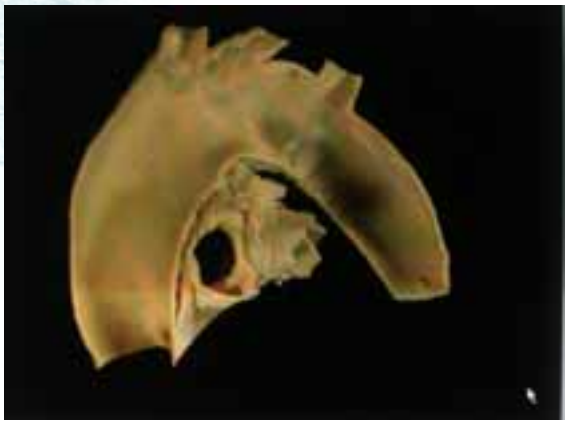

Minor trauma
ECG
Normal:
stop investigation
Abnormal,
ICU monitoring


Multiple severe trauma
High frequency
Low frequency
Very rare
ECG
Troponin I
TEE
Myocardial contusion
Surgical lesion:
valve, septal defect,
coronary artery trauma
Increased perioperative risk:
arrhythmias, hypotension
Decrease in cardiac function
Hypovolemia
Hemopericardium
Myocardial infarction
Angiography
Surgery
Catecholamines
HFJV
Fluid loading
Surgery
No anticoagulant
TEE reassessment
Angioplasty / CABG

TRAUMATIC RUPTURE OF THE AORTA

- ✓ life-threatening lesion
  about 80% of affected patients do not survive to reach the hospital
- ✓ **10% to 30%** of fatalities from blunt thoracic trauma
- ✓ second most common cause of death after head injury.
- ✓ in-hospital mortality remains high, ranging from 15% to 28%.





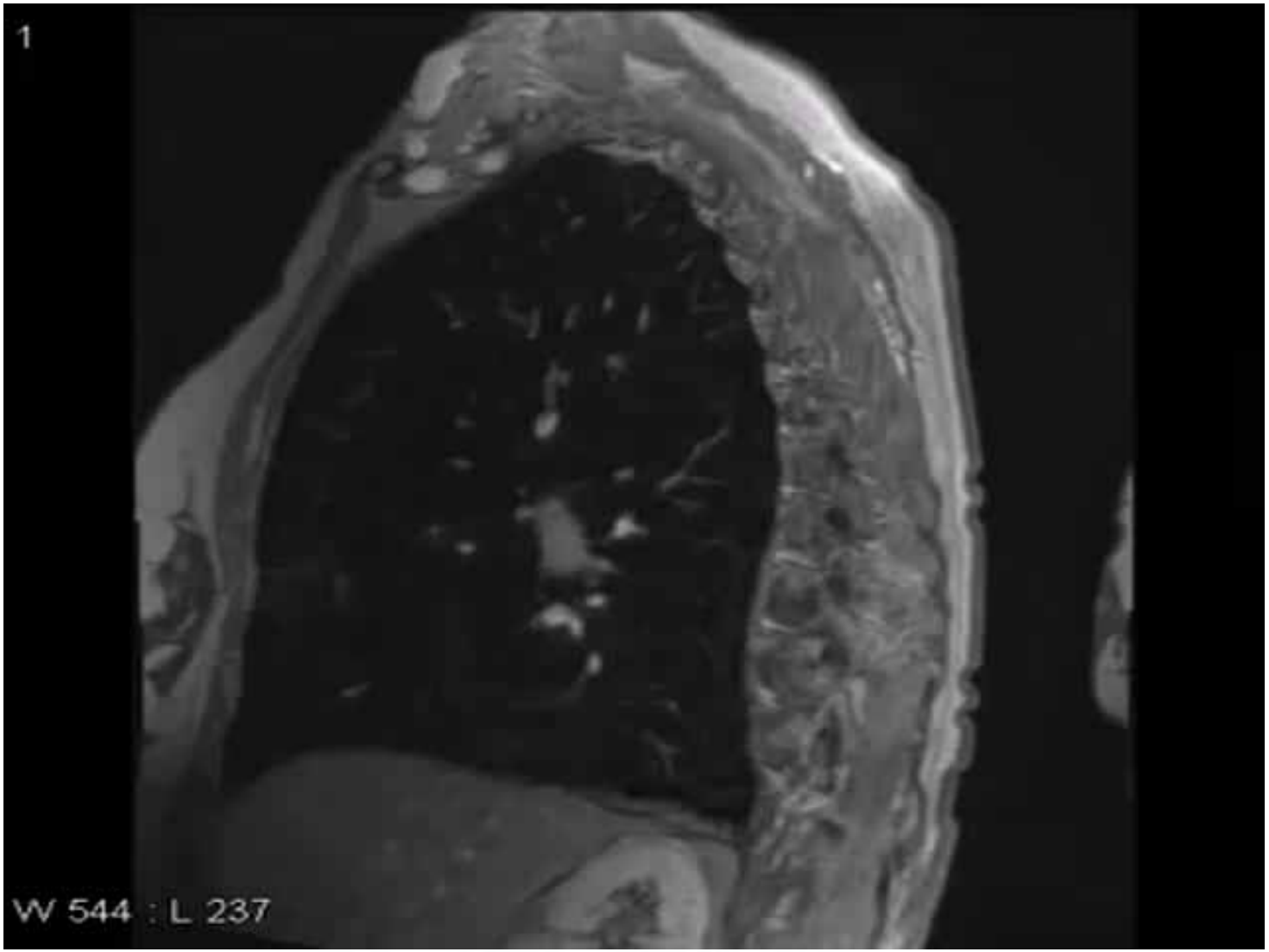
THE DIAGNOSIS OF TRAUMATIC RUPTURE OF THE AORTA

❖**MECHANISM OF INJURY**

- falls from .10 feet,
- motor vehicle crashes at speeds .30 mph,
- Unrestrained drivers, ejected passengers, and pedestrians struck by motor vehicles
- severe crush

❖ Blunt trauma can damage the thoracic aorta by several mechanisms

- ***deceleration*** ;descending aorta remains fixed to the posterior chest wall while the heart and ascending aorta swing forward and tear free at the ***isthmus.***
- A displaced thoracic vertebral fracture can cause direct shearing injury to the aorta.
- Bony intrusion by the first rib and clavicle can cause ‘‘osseous pinch’’ or bony compression of the aortic isthmus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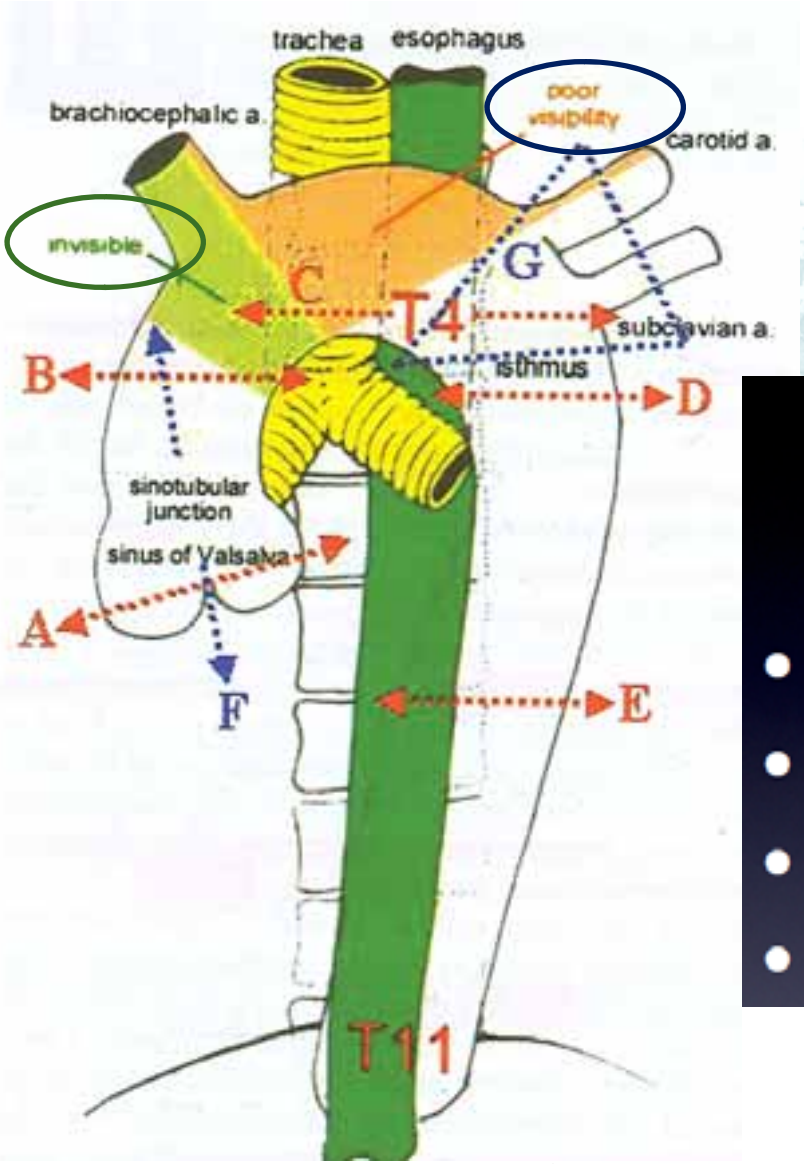
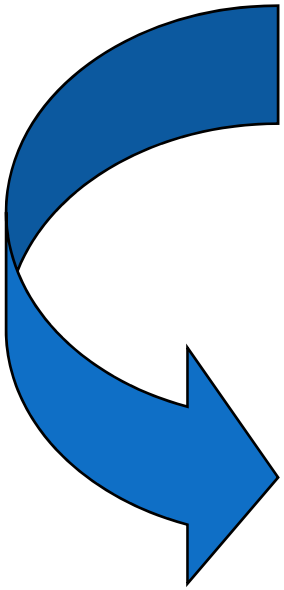
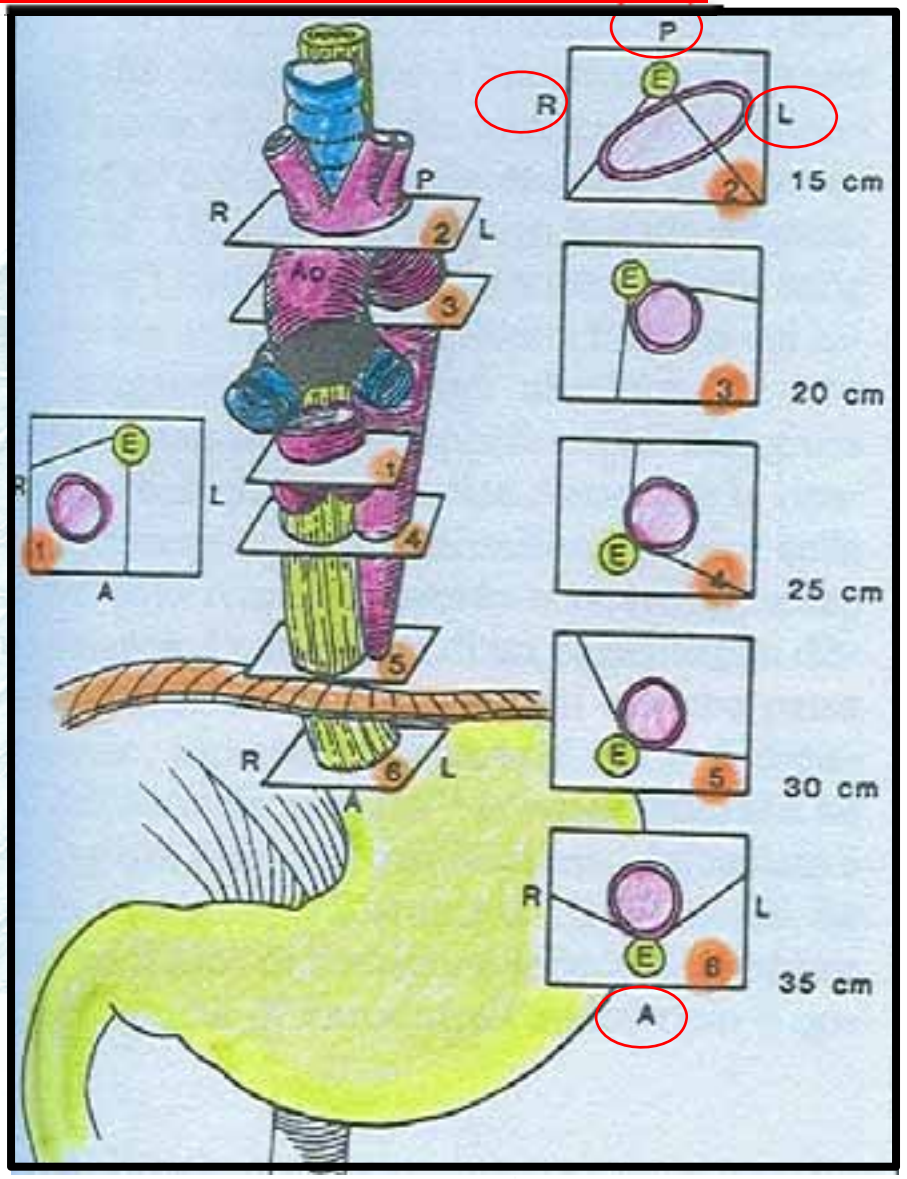


TOE in aortic trauma

- Sensitivity 91-100%
- Specificity 95-100%
- Blindspot in distal ascending aorta
- For the emergent or unstable patient

ANATOMIC COURSE OF THE THORACIC AORTA





CLINICAL FEATURES

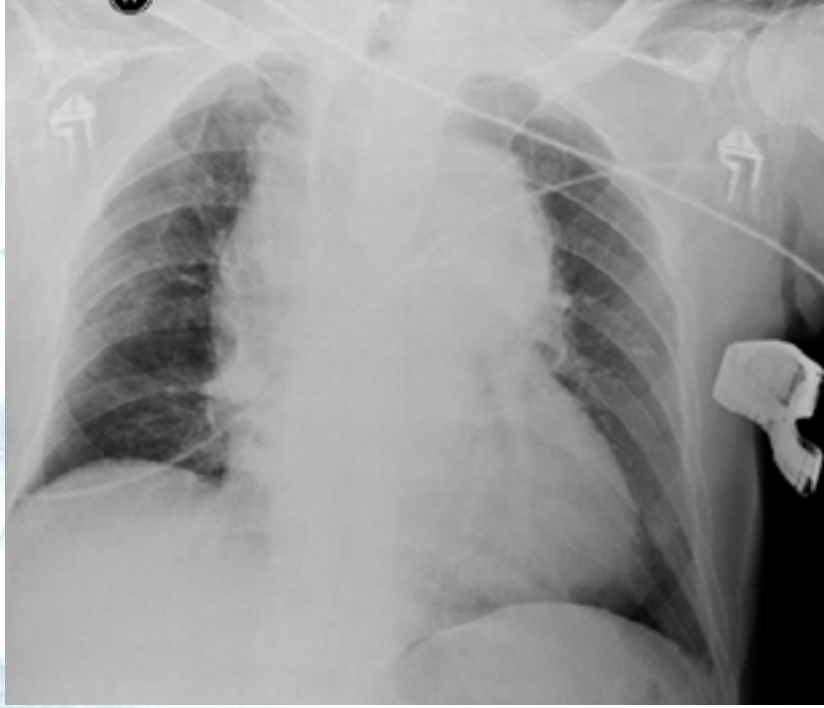
✓chest pain
✓dyspnoea, back pain,
✓hoarseness, dysphagia, and cough.

❖SIGNS

-anterior chest wall contusion,
- unexplained hypotension,
- upper limb hypertension,
-acute coarctation syndrome (decreased lower limb pulses with normal upper limb pulses),
- differences in pulse amplitude,
-systolic murmur audible over the base of the heart or between the scapulae

TRIAD
- Increased blood pressure in the upper limbs.
- Decreased blood pressure in the lower limbs.
- Widened mediastinum on radiography

❖Chest Radiography



- ✓ Mediastinal widening,(M/C ratio)
- ✓ a blurred aortic knob,
- ✓ apical capping of the lung,
- ✓ a depressed left bronchus,
- ✓ a displaced nasogastric or endotracheal tube,
- ✓ mediastinal emphysema,
- ✓ fractured first or second ribs
- ✓hemothorax or pneumothorax

❖<u>Findings on Transesophageal Echocardiography</u>

✓a mobile 2-3 cm echogenic flap or intraluminal mass located just distal to the isthmus

✓echocardiographic appearance similar to that of aortic dissection, with a flap completely traversing the lumen

✓protruding echogenic mass, resembling a thrombus

✓a thin, highly mobile, linear flap

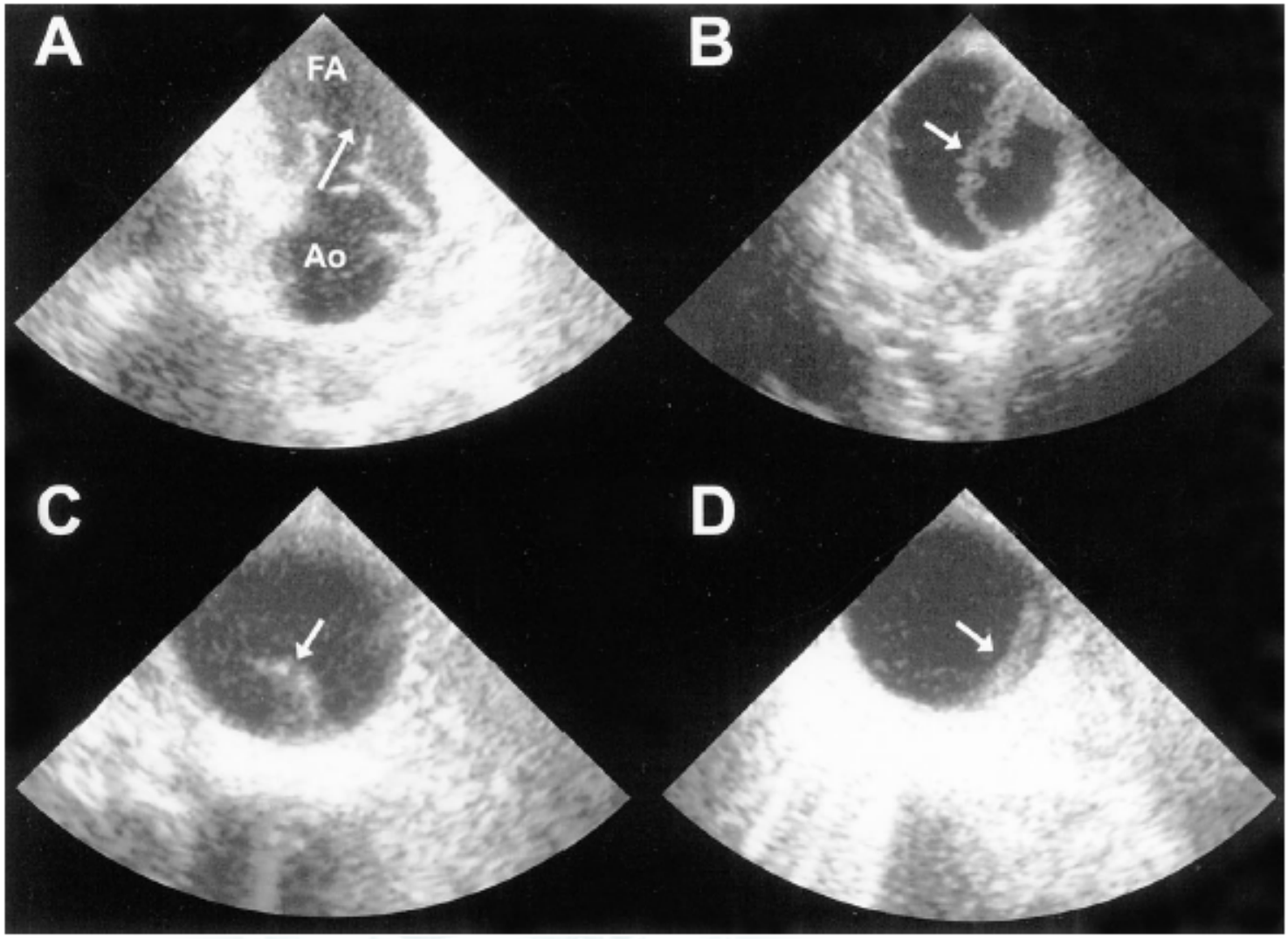
Anesthesiology 2000; 93:1373–7

A) TAR with False Aneurism

B) Wit a Large medial Flap

C) Intimal Flap without Hemom. or modif. Ao. Geometry

D) Intramural Hematoma without Hemom.



❑ **Transesophageal echographic aspect of main categories of traumatic aortic injury(TAR)**

BLUNT AORTIC INJURIES (BAI)

Minor BAIs: *grade 1*, intramural hematoma or limited intimal flap

Major BAIs: *grade 2*, subadventitial rupture or modification of the geometric shape of the aorta; *grade 3*, aortic transsection with active bleeding or aortic obstruction with ischemia

❖ acute management of **grade 2 BAIs** *remains controversial*,especially because major BAIs are rarely isolated and associated injuries can be worsened by the use of heparin or aortic clamping during aortic repair.

Major BAIs and

- *severe head trauma,*
- *extensive pulmonary contusion,*
- *intra- abdominal bleeding*
- *unstable patients with severe hemodynamic or respiratory failure*.

Table 2 Transesophageal Echocardiographic Findings Obtained in the Three Groups of Patients Sustaining Blunt Aortic Injuries*

Variable	Major BAI, Rapid Surgery (n = 13)	Major BAI, Late Surgery (n = 11)	Minor BAI, Conservative Management (n = 7)
Maximal diameter of the disrupted aorta	33.0 ± 9.0 (20.7–49.0)	28.3 ± 5.5 (19.3–36.5)	23.8 ± 4.2** (18.6–31.3)
Maximal diameter of the disrupted aorta/ diameter of the adjacent descending thoracic aorta	1.8 ± 0.4 (1.1–2.5)	1.3 ± 0.2** (1.0–1.7)	—
Depth of the false aneurysm	13.0 ± 5.7 (5.8–25.4)	7.6 ± 2.5** (2.9–11.6)	—
Width of the neck of the false aneurysm	16.9 ± 3.0 (12.3–23.0)	17.4 ± 5.0 (11.9–28.7)	—
Thickness of the medial flap	3.6 ± 1.0 (2.5–5.6)	2.6 ± 1.0 (1.5–4.1)	—
Hemomediastinum			
Distance, esophagus-aortic isthmus	9.3 ± 5.4 (2.5–23.0)	3.7 ± 2.2** (0–7.2)	3.7 ± 1.0** (1.9–5.2)
Distance, aortic isthmus-left visceral pleura	9.1 ± 5.6 (2.9–22.2)	2.3 ± 2.2** (0–6.2)	0.7 ± 1.9** (0–5.2)
Left hemothorax	17.5 ± 19.9 (0–51.3)	7.5 ± 10.8 (0–36.2)	7.1 ± 7.9 (0–17.5)
Coarctation syndrome	2 (15)	0	0

J Trauma. 2005;58:1150 –1158.

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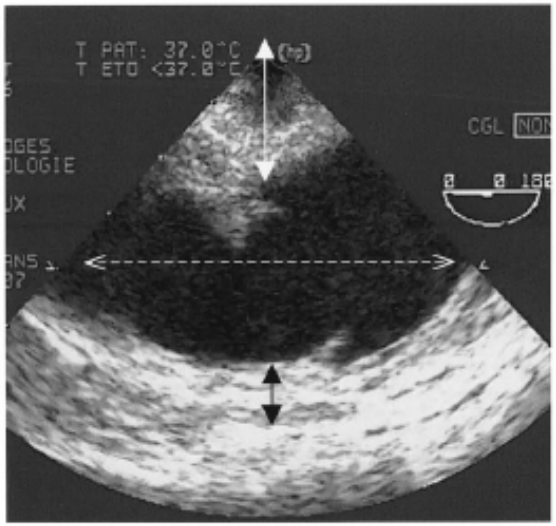
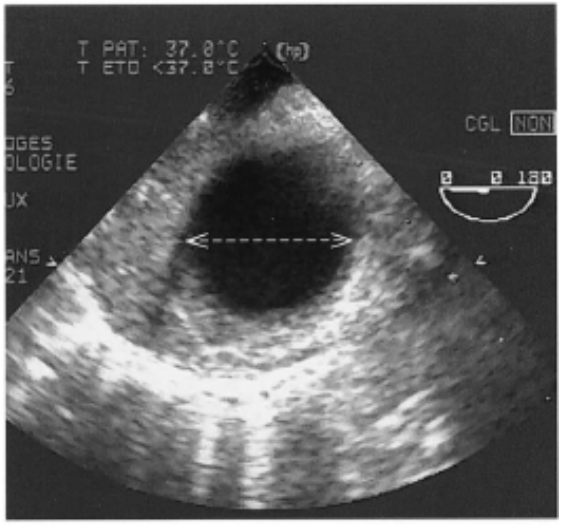
Aortic isthmus | Descending aorta

Group I

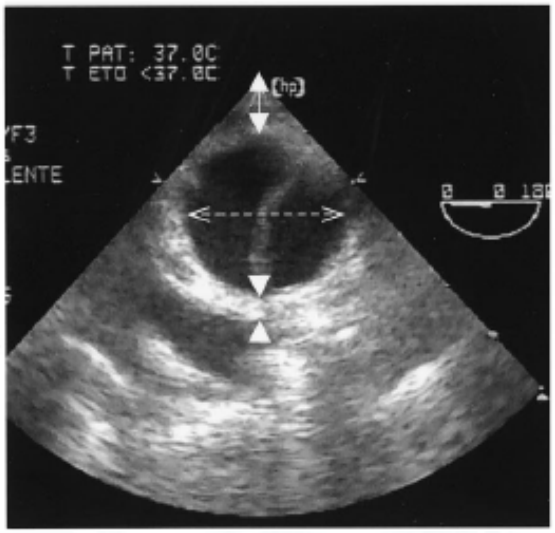
The size of the traumatic false aneurysm *was more than <u>twice</u> the diameter of the adjacent normal descending thoracic aorta.*

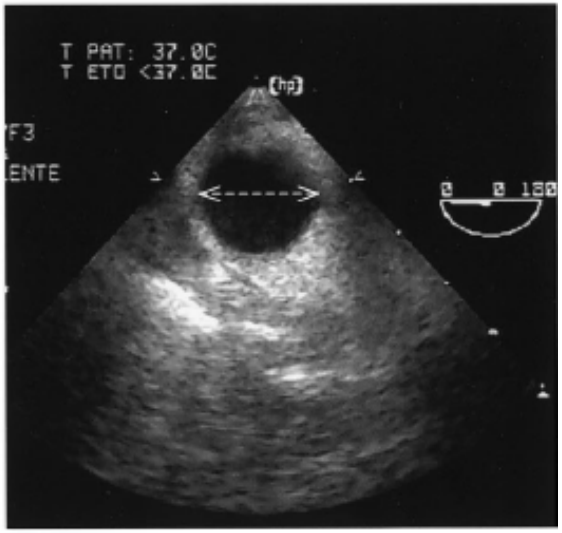




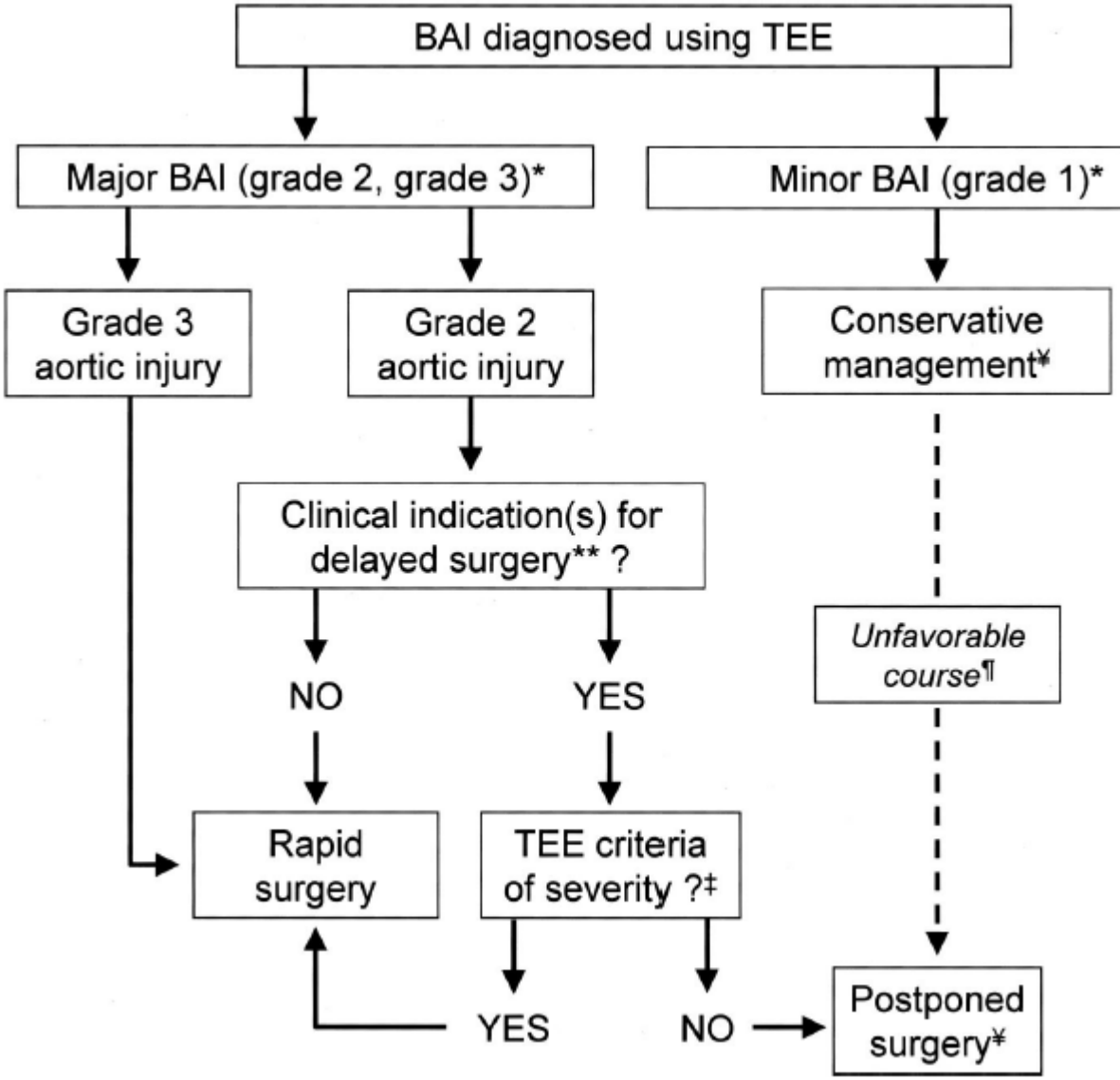
Group II

The <u>ratio diameter</u> of the aorta at the level of false aneurysm formation/diameter of the normal adjacent descending aorta ***was < 1.4***





J Trauma. 2005;58:1150 –1158.



- Pain relief
- B-blockers
- Ca-channel blockers
- Vasodilatator (SNP)

close follow-up is required

J Trauma. 2005;58:1150 –1158.

D.Penzo

The Journal of Thoracic and Cardiovascular Surgery ● April 2005-*Pacini et al*

Traumatic rupture of the thoracic aorta: Ten years of delayed management

Objective: Traumatic rupture of the thoracic aorta is a highly fatal condition in which patient outcome is strongly conditioned by other associated injuries. Delayed aortic treatment has been proposed to improve results.

Methods: The charts of 69 patients with traumatic rupture of the thoracic aorta observed between 1980 and 2003 were reviewed. Patients were grouped according the timing of repair: group I, immediate repair (21 patients); and group II, delayed repair (48 patients). In group II, 45 patients were treated surgically or by endovascular procedure.

Results: In-hospital mortalities were 4 of 21 patients (19%) in group I and 2 of 48 patients (4.2%) in group II. There were 3 cases of paraplegia in group I and none in group II.

Conclusion: Improvement of patient outcome with traumatic rupture of the thoracic aorta can be achieved by delaying surgical repair until after management of major associated injuries if there are no signs of impending rupture. Endovascular treatment is feasible and safe and may represent a valid alternative to open surgery in selected cases.


Site of Dissection
www.bassam-akasheh.com

Conclusion

❖*In patients without severe associated lesions, delaying the treatment of TRTA does not provide any advantage, and it should be performed as soon as possible.*

❖*The correct timing of aortic repair in a polytraumatized patient should be considered and balanced along with other severe injuries, without a fixed priority.*


Grazie per l'attenzione.
Venezia – Laguna Ghiacciata
1926

	AORTOGRAFIA	TAC	RMN	TEE
Sensibilità	++	++	+++	+++
Specificità	+++	+++	+++	++/+++
Breccia di entrata	++	+	+++	++
Trombosi aortica	++	+++	+++	++
Insufficienza aortica	+++	-	++	+++
Versamento pericardico	-	++	+++	+++
Ematoma mediastinico	-	+++	+++	++
Dissezione dei collaterali	+++	++	+++	+
Dissezione coronarica	++	+	+	++
Rapidità di esecuzione	+	++	+	+++
Eseguibile al letto del paziente	-	-	-	+
Noninvasività	-	+++	+++	++
Uso di mezzi di contrasto	+++	++	+	-
Disponibilità perioperatoria	-	-	-	+++
Ripetibilità (Follow-up)	-	+++	+++	++
Basso costo	+	++	+	+++

	Sensibilità (%)	Specificità (%)	Accuratezza (%)	Valore predittivo positivo (%)	Valore predittivo negativo (%)
Dissezione tipo A					
TTE	78.1	86.7	84.1	71.4	90.3
TEE	96.4	85.7	90.0	81.8	97.3
TAC	82.6	100	94.9	100	93.3
RMN	100	98.6	99.0	96.8	100
Dissezione tipo B					
TTE	10.0	100	80.4	100	80
TEE	100	96.4	97.1	88.2	100
TAC	96.0	88.9	91.1	80.0	98.0
RMN	96.5	100	99.0	100	98.7
Breccia di entrata					
TTE	26.2	100	71.0	100	67.7
TEE	72.7	100	86.8	100	79.5
TAC	-	-	-	-	-
RMN	88.0	100	95.2	100	92.6
Trombosi aortica					
TTE	11.8	100	72.7	100	71.7
TEE	68.4	100	91.3	100	89.3
TAC	92.0	95.6	94.4	92.0	95.6
RMN	96.2	96.5	95.2	97.0	94.4
Insufficienza aortica					
TTE	96.9	94.7	95.4	88.6	98.6
TEE	100	95.3	97.1	92.9	100
TAC	-	-	-	-	-
RMN	83.2	100	96.6	100	96.8

Classificazione di DeBakey

Tipo I Dissezione di tutta l'aorta

Tipo II Dissezione dell'aorta ascendente

Tipo III Dissezione dell'aorta discendente

Classificazione di Stanford

Tipo A Dissezione dell'aorta ascendente (associata o meno all'aorta discendente)

Tipo B Dissezione della sola aorta discendente

Classificazione della Società Europea di Cardiologia

Tipo I Dissezione classica con flap e divisione dell'aorta in vero e falso lume (Tipo A: Comunicante; Tipo B: Non comunicante)

Tipo II Ematoma intramurale (Tipo A: Aorta non aterosclerotica; Tipo B: Aorta aterosclerotica)

Tipo III Dissezione circoscritta senza ematoma, con estroflessione della parete circoscritta a livello della breccia

Tipo IV Rottura od ulcerazione di placca

Tipo V Dissezione traumatica o jatrogena

I tipi I-V rappresentano sottogruppi dei tipi identificati dalla classificazione DeBakey o Stanford