

General principles for trauma patients

新光急診 楊毓錚醫師
1030904

Knowing is not enough,
we must apply.
Willing is not enough,
we must do.

~ [Goethe]

Minor trauma vs Major trauma

- Life threaten, limb threaten
- Management
- Disposition

Trauma blue? Trauma red ?

- 嚴重之受傷機轉：
- 休克現象 (成人收縮壓 < 90 mmHg 或兒童血壓 < 70 + 年齡 * 2)
- 呼吸困難 RR <= 10 或 RR > 29/min
- 到院後心跳停止或 PEA
- 重部位創傷
- 頭、頸或軀幹的穿刺傷或槍傷
- 嚴重之胸、腹或骨盆鈍傷害
- 同時送來 > 3 個嚴重外傷病患
- 高處跌落 : > 6m 或 20ft 或 2 層樓
- 其他臨床判斷

Trauma blue? Trauma red ?

- 是否需非常緊急輸血 PRBC 8u
- ? 是 ? 否
-
- 啟動地點
- ? 急救室 ? 急診外科

破傷風類毒素的施打

Tetanus Toxoid 施打時機

- 病人右手表淺性撕裂傷長約2公分，伸0.5公分；以下何者須打T.T？或施打immunogloblin？
 - 5 m/o
 - 5 y/o
 - 15 y/o
 - 50 y/o

Where do tetanus bacteria grow in the body?

- Contaminated wounds
- Deep wounds or those with devitalized (dead) tissue
- Puncture wounds : nails, splinters, or **insect bites**
- Bacteria can also be introduced through burns, any break in the skin, and injection-drug sites.
- Tetanus can also be a hazard to both the mother and newborn child (by means of the uterus after delivery and through the umbilical cord stump).
- The potent toxin which is produced when the tetanus bacteria multiply is the cause of the harm in this disease.

History & Occurance

- 台灣地區該病之發生以民國四十五年1,004例最高，其後實施類毒素接種
- 民國六十一年：100例以下
- 民國七十年起：20例以下
- 破傷風病例通常會發生在農業區或低度開發地區，因為該等地區較易與動物之排泄物接觸或免疫情形較不完全。

潛伏期 (Incubation period)

- 3到21天
- 大部分病例在14天內發生。
- 通常潛伏期越短、傷口污染情形越嚴重者，其病況越嚴重而癒後情形越差
- 不會直接以人傳人之方式傳染

主動免疫疫苗 Active immunization ("tetanus shots")

- DPT：白喉、百日咳、破傷風三合一疫苗
- DT：白喉、破傷風混合疫苗
- Td：破傷風、減量白喉混合疫苗
- Toxoid：單一破傷風類毒素
- 小於7歲之小孩，使用DPT（如百日咳疫苗為禁忌時則用DT）較使用單一Toxoid為佳，而大於7歲者，則使用Td較使用單一Toxoid為佳。
- **Pregnancy is not a contraindication for use**

被動免疫血清

- TAT：破傷風抗毒素
- TIG：破傷風免疫球蛋白 Antitetanic Gamma Globulin
- 被動免疫血清之使用原則：
 - TAT：1,500~5,000 I.U. 靜脈注射，先注射0.1 ml（應準備一針adrenaline以備過敏反應發生時急救），等15分鐘後再注射0.25 ml，等30分鐘後如無過敏反應發生則才將剩餘之劑量注射完。
 - TIG：至少250 I.U. 肌肉注射，child：4 units/kg。
- 必要時擴創術清理傷口，並使用penicillin等抗生素

Wound Evaluation

Table 1. Wound Evaluation

Clinical Features	Non-Tetanus-Prone Wounds	Tetanus-Prone Wounds
Age of wound	< 8 hours	> 8 hours
Depth	Superficial, linear	Deep, irregular
Mechanism of injury	Cuts from sharp edges	Burn, crush, puncture
Signs of infection (eg, cellulitis)	No	Yes
Dirty wound (contaminated)	No	Yes
Purulent, necrotic tissue	No	Yes

受傷後傷口之預防破傷風處理措施原則

破傷風類 毒素之主動 免疫情形 (包括 DPT · DT · Td · Toxoid)	小而乾淨之傷口		所有其他之傷口	
	Td* (或 Toxoid)	TIG (或 TAT)	Td* (或 Toxoid)	TIG (或 TAT)
*不確定或少於 3 次	需要	不需要	需要	需要
3 次或 3 次以上	不需要(但最後一劑已 超過 10 年者需要追加)	不需要	不需要(但最後一劑已 超過 5 年者需要追加)	不需要

Case I

- 20 y/o, male
- Rode the motorcycle and hit into telegraph pole (3000萬是撞路樹)
- Unconsciousness, smells of alcohol
- Pale face
- Sent by EMT

Learning Objectives

- Identify the priorities in multiple injured patient
- Outline the primary & secondary evaluation surveys
- Guidelines and techniques in resuscitative
- Mechanism and History
- Pitfalls

Advanced Trauma Life Support. 2009

Principles

- Team approach for multiple injured patient
- Rapid assessment; life-preserving therapy; treatment before diagnosis
- Thorough examination (*don't be happy when one injury was found*)
- Repeated and frequent reassessment for dynamic change

Trauma score

- **RTS:** reversed trauma score, 0-4
- **AIS:** Abbreviated Injury Scale
- **ISS** is the sum of the squared AIS (three most severe injured body regions)
- **PTS:** Pediatric trauma score

Universal Precautions

- Gloves
- Goggles
- Facemask
- Water-impervious apron
- Leggings

Primary Survey

Primary Survey

- A : Airway + C-spine immobilization
- B : Breathing + Ventilation
- C : Circulation + hemorrhage control
- D : Disability (AVPU + pupils)
- E : Exposure + Environment control
- F : Films of C-spine, chest, and pelvis(whole body CT)
- G : Gastric tube and Foley

ABCDE

- 大小通吃
- 老少咸宜
- 男女不分

注意量的不同

注意老人脆弱

注意懷孕生理

Airway

- Jaw thrust + in-line immobilization
- Patent if patient can talk
- Artificial airway if tongue drop
- Suction prn
- Nasopharyngeal airway and oral airway
- Check trachea for deviation, hematoma, crepitations, disruption

Airway

- Timing of definitive airway management and watch for difficult airway
 - severe head-injury with GCS score of 8 or less
 - any doubt about the patient's ability to maintain airway integrity

Assume a C-spinal injury

- Multisystem trauma
- Altered level of consciousness
- Blunt injury above the clavicle

Pitfalls-A

- Equipment fail; difficult airway after paralysis
- Intubation in unknown laryngeal fracture or incomplete upper airway transection
 - *Triad of laryngeal fracture:*
 - *Hoarseness*
 - *Subcutaneous emphysema*
 - *Palpable fracture*
- Incomplete C-spine control

Breathing and Ventilation

- Airway patency doesn't assure ventilation
- Pulse oximeter is valuable
- Give O₂, high flow > 85%
- Immediately diagnose:
 - *Tension pneumothorax*
 - *Flail chest with pulmonary contusion*
 - *Massive hemothorax*
 - *Open pneumothorax*

Pitfalls-B

- Ventilation problems or airway compromise?
- Deterioration after intubation
- CXR asap after intubation

Circulation with hemorrhage control

- Consciousness, skin color, temperature, capillary refill
- Pulse (central artery: quality, rate, regularity, assessed bilaterally)
- Vital signs, hemorrhage is leading reason of shock
- *External hemorrhage is identified and controlled in the primary survey*
- Control bleeding by direct pressure or operative intervention.

Circulation with hemorrhage control

- Two large-caliber IV catheters and type crossmatch
- Warm Ringer's lactate: 2-3 liters, Hypothermia?
- bolus therapy-->type-specific B/T or type O
- Hypovolemic shock should not be treated by *vasopressors, steroids, or sodium bicarbonate.*
- Bleeders: *chest, abdomen, pelvis, vessels, retroperitoneum, external (scalp), or multiple fracture*

Pitfalls-C

- Healthy elderly patients (inability)
- Children (sudden collapse)
- Well-trained athlete (relatively bradycardia)
- Medication for hypertension (β -block)

Disability: Neurologic status

- Pupils - *Anisocoric? Sluggish? Dilated? Pinpoint?*
- AVPU
 - **A**lert
 - Responsible to **V**erbal stimuli
 - Responsible to **P**ainful stimuli
 - **U**nconscious
- Limb movements - *Symmetric?*
- GCS
- Correct hypoxia, hypovolemia

GCS昏迷指數:

眼睛睜開	自動睜開	4
	對言語指揮	3
	對痛刺激	2
	無反應	1
最佳言辭反應	清晰	5
	模糊	4
	不適當	3
	辭不達意	2
	無反應	1
最佳運動反應	聽從指揮	6
	痛覺定位	5
	收縮反應	4
	去大腦皮質收縮	3
	去大腦伸張	2
	無反應	1

Pitfalls-D

- Alcohol induced altered consciousness
- Reevaluation
- Lucid interval: talk and die
- Sedation
- Hypoxia
- Hypovolemia

Exposure/Environment control

- Exposure
 - Completely undress the patient
- Environment
 - Avoid hypothermia
- Quick check and log-roll
- Safety of patient and rescuers

Adjuncts to primary survey

- Monitoring
 - Urine output
 - ABG
 - ECG
 - Pulse oximetry
 - End-tidal Co2
- Foley
- Gastric catheters
- X-rays

Pitfalls

- Contraindications in urethral injury: (**SPPPP**)
 - *blood in the scrotum*
 - *perineal ecchymosis*
 - *blood at the penile meatus*
 - *a high-riding or nonpalpable prostate*
 - *pelvic fracture*
- Cribriform plate fracture is suspected.

Films (portable)

- C-spine lateral
- Chest AP
- Pelvis AP
- Should not delay patient resuscitation
- Diagnostic peritoneal lavage
- FAST



Secondary Survey

Secondary survey

- History
- Physical examination
- Adjuncts
- Reevaluation
- Definitive care

「AMPLE」病史

- **A:**過敏史(Allergies)
- **M:**詢問長期使用或目前使用之藥物(Medications currently used)
- **P:**過去病史及懷孕(Past illness/Pregnancy)
- **L:**上一餐何時進食(Last meal)
- **E:**之前發生何事或處於何環境
(Events/Environments related to the injury)

More information

- Blunt trauma: seat belt or helmet usage, wheel deformation, direction of impact (front, side, rear), ejection.....
- Penetrating trauma: firearms, stabbing, impaling objects, injured regions.....
- Burns and cold injuries: circumstances (inhalation injury, CO intoxication), temperatures.....
- Hazardous environment

HEAD TO TOE, FINGER TO HOLE

- Head: EOM? Deform? Bleeding (耳鼻喉)?
- Maxillofacial: airway
- Cervical spine and neck: Neck veins, trachea, hematoma
- Chest: BS, paradoxical movements, bruises
- Abdomen: Soft? Distend? Pelvis stability? DPL?

HEAD TO TOE, FINGER TO HOLE

- Musculoskeletal: Deform? Pulse? Motor? Sensory?
- Back: C-, T-, L-spine deformity, tenderness
- Perineum/rectum/vagina
- Neurologic

Adjuncts to secondary survey

- CT
- TEE
- Bronchoscopy
- Esophagoscopy
- Reevaluation
- Definitive care

Summary

- Primary survey assessment of ABCDEs
- Resuscitation
- Adjuncts to primary survey and resuscitation
- Secondary survey
- Adjuncts to the secondary survey
- Definitive care
- Transfer

Consultation and transfer

- Consultation
 - CVS : Emergent thoracotomy, vascular emergency
 - GS : Exploratory laparotomy
 - Ortho : External fixation
 - PS : Fasciotomy, escharotomy
- Transfer
 - Physician-to-physician communication
 - Equipment and personnel

Records and Legal considerations

- Records
- Consent
- Forensic evidence

Question?

頭部創傷概論

新光急診科
楊毓錚醫師



- 20男性由119送入急診，主述機車車禍，現場有失去意識。醒來時已經在救護車上了。
- 急診：血壓 110/ 60 mmHg, 呼吸 14 次/分, 脈搏 72 次/分, GCS 14→15；有nausea, dizziness, amnesia等現象。
- 請問患者屬於Minor, moderate, severe head injury?

學習目標

- 基本神經解剖與生理
- 快速神經學檢查
- 常見之顱內傷害
- 頭部外傷之嚴重度分類與處置
- 頭部外傷之藥物治療
- 神經外科會診與轉診

顱內壓

- 10 mmHg = 正常
- > 20 mmHg = 異常
- > 40 mmHg = 嚴重
- 許多病理性過程會影響結果
- 增加顱內壓 降低腦功能 降低癒後

大腦灌注壓 (Cerebral Perfusion Pressure)

- 平均動脈壓 - 顱內壓 = 大腦灌注壓
- $MBP - ICP = CPP$
- 正常 : $90 - 10 = 80$
- 庫欣式反應(Cushing's Response) :
 $100 - 20 = 80$
- 低血壓 : $50 - 20 = 30$
- 大腦灌注壓不等於大腦血流量
- 大腦血流量是主要關鍵

如何快速評估腦外傷？

- Glasgow Coma Scale 昏迷指數
- 瞳孔大小與對光反射
- 一側肢体乏力或偏癱
- 其他定位神經徵象

GCS

眼睛睜開	自動睜開	4
	對言語指揮	3
	對痛刺激	2
	無反應	1
最佳言辭反應	清晰	5
	模糊	4
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	辭不達意	2
	無反應	1
最佳運動反應	聽從指揮	6
	痛覺定位	5
	收縮反應	4
	去大腦皮質收縮	3
	去大腦伸張	2
	無反應	1

頭部外傷之分類

機轉	□ 鈍傷	<ul style="list-style-type: none"> • 高速(自動車撞擊) • 低速(墜落, 受處)
	□ 穿刺傷	<ul style="list-style-type: none"> • 槍傷 • 其他穿刺傷
嚴重度	□ 輕度	• GCS指數 14 - 15
	□ 中度	• GCS指數 9 - 13
	□ 重度	• GCS指數 3 - 8
型態	□ 顱骨骨折	• 頭頂骨 <ul style="list-style-type: none"> • 線性 對 星形 • 凹陷/非凹陷 • 開放性/閉閉性
		• 顱底 <ul style="list-style-type: none"> • 合併/不合併 大腦脊髓液漏出 • 合併/不合併 神經麻痺
	□ 顱內病灶	• 局部 <ul style="list-style-type: none"> • 硬腦膜外 • 硬腦膜下 • 大腦內
		• 廣泛性 <ul style="list-style-type: none"> • 輕度腦震盪 • 典型腦震盪 • 瀰漫性神經軸損傷

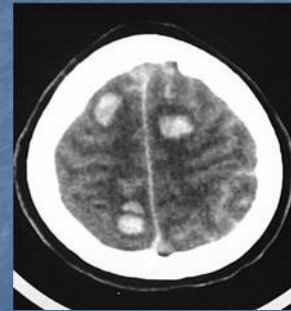
腦震盪-Classic cerebral concussion

- 短暫喪失意識
- 正常頭部電腦斷層
- 噁心、嘔吐
- 頭痛：如果嚴重，重複電腦斷層
- 在病情改善前症狀可能加劇
- 常見後遺症

廣泛性腦傷害-Diffuse brain injuries

- 加減速傷害
- 廣泛性軸突傷害 (Diffuse axonal injury)
 - 延長深度昏迷 (非由於質塊病灶)
 - 運動姿勢改變 (Decortication or decerebration posturing)
 - 經常出現自主神經失調
- 斷層：
 - 可能一開始正常，之後嚴重水腫
 - 多處斑點狀出血

嚴重之廣泛性腦傷害



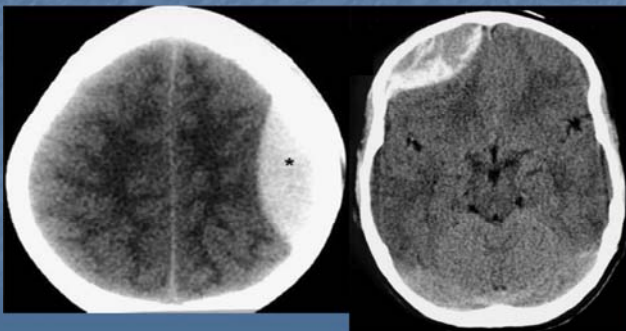
頭顱骨折-Skull fracture

- 顱頂
 - 線性 (linear); 壓迫性 (Depressed)
 - 開放性 (Open); 封閉性 (Closed)
 - 下壓深度大於頭骨厚度則需開刀
- 顱底
 - Raccoon eyes, Battle's sign, rhinorrhea, otorrhea, VII nerve palsy

硬腦膜上出血-Epidural hematoma

- 典型病史有清明期 (Lucid interval); 病程常急速惡化; 可快速致命
- 發生率不高: 0.5%
- X光常常可見顱骨骨折
- CT表現為雙凸狀 (豆狀形) 血塊: 由於硬腦膜附著於顱骨
- 典型: 中硬腦膜動脈撕裂
- 及早手術預後最佳
- 增加靜脈撕裂引起之硬腦膜外血腫: 可能以非外科手術處理

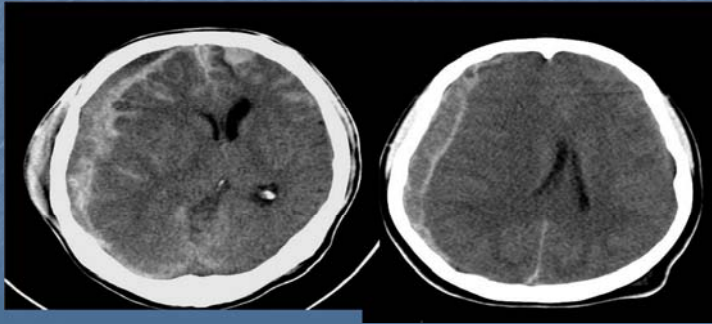
硬腦膜上出血 (EDH)



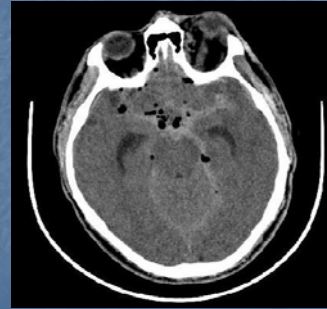
硬腦膜下出血-Subdural hematoma

- 腦皮質裂傷或靜脈出血
- 常合併嚴重之腦實質傷害
- 約佔30%
- 為預後較差之腦傷: 由於潛在之腦傷害
- 靜脈撕裂/腦撕裂傷
- 覆蓋整個大腦表面
- 建議快速外科手術清除血腫, 特別中線偏移 > 5mm

硬腦膜下出血 (SDH)



蛛網下出血-Subarachnoid hemorrhage

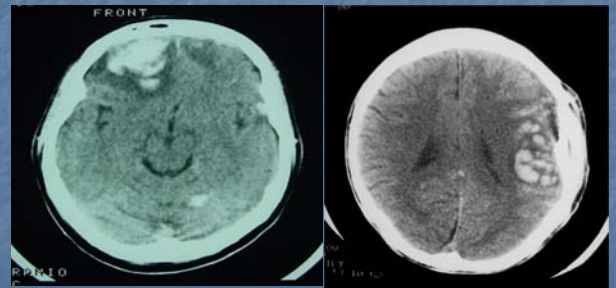


- 嚴重頭痛，頸部僵硬
- 和自發性區分

腦挫傷出血-Brain contusion

- 挫傷為常見之腦傷，約佔20-30%
- 通常位於額葉與顳葉底部
- 同側/對側傷害(Coup/contrecoup injuries)
- 追蹤之CT可見漸進惡化
- 挫傷約有20%，常於12至24小時演變成腦出血
- 大部分常見：額葉/顳葉在電腦斷層顯現出“鹽巴與胡椒”狀“(Salt and pepper)”
- 大部分有意識的病患：不需手術

腦挫傷出血



Head and Neck Trauma

Case 01

劇情

37歲女性，機車事故撞到頭(有戴安全帽)。病患，就醫時意識清晰、頭部無明顯外傷，主訴頭暈。ILOC(-)，vomiting(-)，headache(-)。

身體檢查

呼吸道：暢通
呼吸：16次/分；SaO₂：99%
呼吸音：正常
循環：血壓110/70mmHg
意識：E4M6V5

下一步？
CT、回家或留觀？

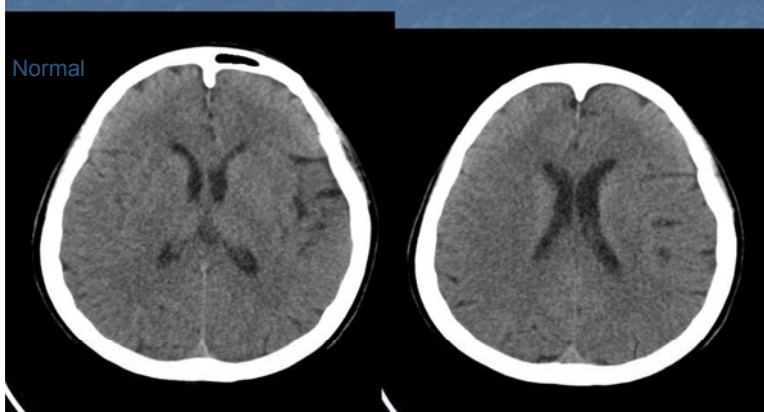
急診室



- 瞳孔：3mm / 3mm
- Light reflex：+ / +
- MP：5 / 5
- FAST掃瞄：無異常

Head and Neck Trauma

Case 01



頭部外傷如何處置？

-輕度頭部外傷之處置

- GCS 14-15，約佔所有腦外傷的80%；3%病人會惡化
- 排除系統性傷害
- 除了完全無症狀者外，考慮CT
- 入院或留觀
 - 沒有CT
 - 不正常之CT
 - 可疑之病史或神經學檢查
 - 家中無可靠之人照顧
 - GCS 14
- 返家患者應給予家屬頭部外傷須知

Brain CT

- 失去意識，持續惡化的頭痛
- 創傷後抽搐或失憶
- 多處創傷
- 大於兩次的嘔吐
- 嚴重的顏面傷害
- 嚴重的皮下血腫
- 壓迫性骨折
- 大於兩個小時的 GCS < 15

做電腦斷層的特殊考量

- 懷疑兒童虐待
- 小於兩歲
- 大於65歲
- 高危險的機轉
- 凝血功能異常
- 酒癮患者
- 吃抗凝血劑：Aspirin, Coumadin

頭部外傷藥物治療有何選擇？

- 注射靜脈輸液
 - 等張溶液
 - 避免含葡萄糖之輸液
 - 維持血容積正常
- 適中過度換氣治療
 - PaCO₂ 35 mmHg
 - 手術前或急救時短暫使用

頭部外傷之藥物治療

- Mannitol
 - 可以控制顱內壓增高
 - 急速惡化、瀕臨腦疝時最適宜
 - 0.25-1g/Kg 快速注射
- 其他藥物 (抗抽搐劑、鎮靜劑、麻醉劑)
 - Lasix
 - Anti-convulsant
 - Propofol
 - Barbiturate

會診與轉診要注意哪些重點？

- 會診應提供資訊
 - 年齡、過去病史、外傷機轉
 - 生命徵象
 - 昏迷指數、瞳孔光反射、肌力
 - 酒精或藥物使用
 - 相關外傷
 - 腦部電腦斷層發現

轉診注意事項

- 確保呼吸道
- 頸椎有適當保護
- 無低血壓、低血氧等問題
- 其他相關外傷已獲得適當診斷處置
- 無神經外科時須儘早與轉診醫院聯絡
- 有神經外科時須會診同意後再安排

Chest trauma

楊毓錚 醫師

Learning objectives

- Identify and initiate treatment in primary survey:
 - Airway obstruction
 - Tension pneumothorax
 - Open pneumothorax
 - Flail chest
 - Massive hemothorax
 - Cardiac tamponade

Learning objectives

- Identify and initiate treatment in secondary survey:
 - Simple pneumothorax
 - Hemothorax
 - Pulmonary contusion
 - Tracheobronchial disruption
 - Blunt cardiac injury
 - Traumatic aortic disruption
 - Traumatic diaphragmatic injury
 - Mediastinal traversing wounds

Introduction

- Significant cause of mortality
- Blunt: < 10% require operation
- Penetrating: 15-30% require operation
- Majority: Require simple procedures
- Most life-threatening injuries identified in primary survey

Major Pathophysiologic Changes

- Hypoxia
- Hypoventilation
- Acidosis
 - Respiratory
 - Metabolic
- Inadequate tissue perfusion

!! Identify and Correct the problems in the primary survey !!



Laryngeal Injury

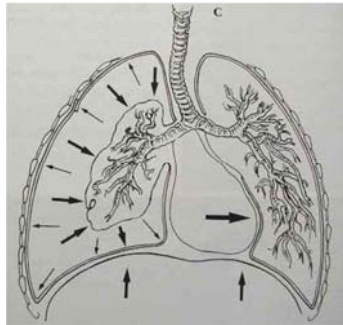
Causing **A**irway Obstruction

- Rare
- Hoarseness
- Subcutaneous emphysema
- Treatment
 - Intubate cautiously
 - Tracheostomy
 - Surgical cricothyroidotomy



Tension Pneumothorax

- Respiratory distress
- Distended neck veins
- Tracheal deviation
Unilateral ↓ in breath sounds
- Hyperresonance
- Cyanosis (late)
- Crepitations



Tension pneumothorax

- The most common cause is mechanical ventilation in patient with a visceral pleural injury.
- Clinical diagnosis
- Be careful to confuse with cardiac tamponade



Tension pneumothorax

- Needle decompression
 - 14 cath; 2nd ICS on midclavicular line
- Tube thoracostomy
 - 32 chest tube; 5th ICS on anterior axillary



Open pneumothorax

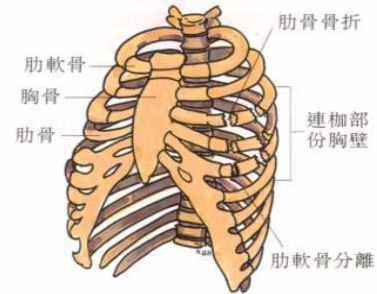


Open Pneumothorax

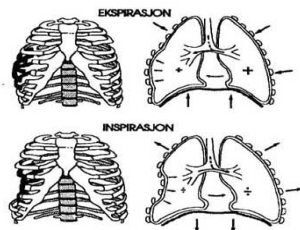
- 3-side cover over defect
- Tube thoracostomy
- Definitive operation



Flail chest



Flail Chest



Flail chest

- In one third of major trauma
- Associated with multiple rib fractures, ie, > 2 ribs in two or more places
- Paradoxical motion is the hallmark
- Clinical diagnosis
- Pulmonary contusion is the major problem

Flail chest

- Oxygen
- Aggressive pulmonary physiotherapy
- **Definitive treatment: reexpand the lung**
- Effective analgesia, intercostal nerve blocks, high segmental epidural analgesia
- CPAP
- Intubation
- Internal fixation

Intubation for Flail chest

- RR > 35/min or < 8/min
- PaO₂ < 60 mm Hg at FiO₂ ≥ 0.5
- PaCO₂ > 55 mm Hg at FiO₂ ≥ 0.5
- Alveolar-arterial oxygen gradient > 450
- Severe shock
- Severe head injury
- Requiring surgery

Massive Hemothorax

- Systemic / pulmonary vessel disruption
- ≥ 1500 mL BL; 1/3 blood volume
- Flat vs distended neck veins
- Shock with no breath sounds and / or percussion dullness



Massive Hemothorax

- Rapid volume restoration
- Chest decompression and x-ray
- Blunting the CP angles in upright position: 200-300 ml
- Autotransfusion
- Operative intervention

Massive hemothorax

- Thoracotomy
 - Immediate drainage > 1500 ml (20 ml/kg)
 - Continued output > 200 ml/hr for 2-4 hours (7 ml/kg/hr)
 - Hypotension despite adequate blood supplied
 - Persistent blood transfusion
 - Color of blood?
 - Medial to nipple line or scapula: possible thoracotomy

Cardiac tamponade

- Most common from penetrating injury
- Beck's triad
 - Venous pressure elevation
 - Decline arterial pressure
 - Muffled heart sounds
- Pulsus paradoxus



Cardiac tamponade

- 15-20 ml pericardiocentesis improve hemodynamic immediately
- Pericardiocentesis may not be diagnostic or therapeutic
- Open pericardiotomy



Secondary survey

- Simple pneumothorax
- Hemothorax
- Pulmonary contusion
- Tracheobronchial disruption
- Blunt cardiac injury
- Traumatic aortic disruption
- Traumatic diaphragmatic injury

Simple pneumothorax

- Most caused by a fractured rib
- CT for small pneumothorax
- Penetrating trauma: asymptomatic, negative in initial X-ray: observation for 6 hr (3 hr)



Simple pneumothorax

- Indication for tube thoracostomy
 - Traumatic cause
 - Moderated to large
 - Respiratory symptoms
 - Increasing size
 - Requires ventilator support
 - Bilateral pneumothorax, tension
 - Associated hemothorax

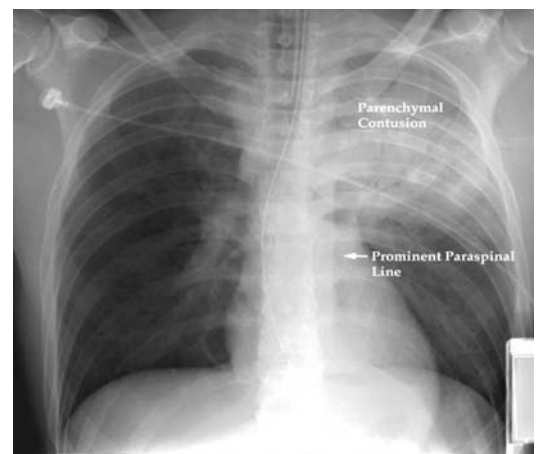
Hemothorax

- Chest wall injury
- Lung / vessel laceration
 - Intercostal vessel
 - Internal mammary artery
- Tx: Tube thoracostomy



Pulmonary contusion

- Most common significant chest injury in children
- Radiographic findings: within minutes, patchy, irregular, alveolar, consolidation
- Intubation: significant hypoxia, chronic d'z
- Dual-lumen endotracheal tube with two ventilators
- ABG



Tracheobronchial disruption

- Within 1 inch of the carina
- Most die at the scene
- Large air leak after tube thoracostomy, massive subcutaneous emphysema: more than one chest tube; hemoptysis
- Bronchoscopy
- Opposite main stem bronchial intubation
- Stable patients may receive delayed operation



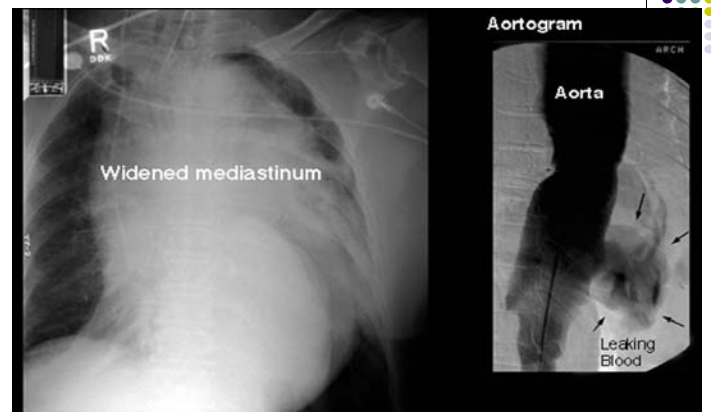
Blunt cardiac injury

- Sternum fracture
- True diagnosis is direct inspection of the injured myocardium
- Enzymes: low sen-70%, ineffective, costly
- Abnormality of ECG (multiple VPCs, Af, BBB, sinus tachycardia), Echo
- Hypotension
- Monitor for 24 hours



Traumatic aortic disruption

- Sudden death
- High index of suspicion by history and radiologic findings
 - Widened mediastinum
 - Deviation of trachea
 - Depression of left main bronchus
 - Apical cap
 - Deviation of the NG
- Early consultant
- CT, angiography, TEE



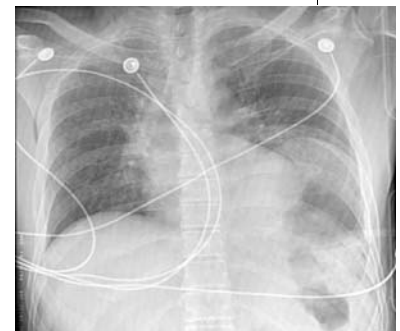
Mediastinal Traversing Wound

- | | |
|---|---|
| <p>Hemodynamically Abnormal</p> <ul style="list-style-type: none"> ➢ Multiple mediastinal injuries ➢ Bilateral tube thoracostomy ➢ Emergent surgical consult | <p>Hemodynamically Normal</p> <ul style="list-style-type: none"> ➢ Diagnostic studies ➢ Surgical consult mandatory ➢ Frequent reevaluation |
|---|---|



Traumatic diaphragmatic injury

- Common left side
- On NG
- Blunt trauma-herniation; penetrating-years later
- UGI



Fracture



Sternum, Scapular, and Rib

- Pain
- Associated injuries
- Complications
 - Atelectasis
 - Pneumonia

Associated Injuries of Fractures



- Ribs 1-3
 - Severe force
 - Associated injuries: High mortality risk
- Ribs 4-9: Pulmonary contusion and pneumothorax
- Ribs 10-12: Suspect abdominal injury

Indications for rib view



- Fractures suspected rib 1 to 3
- Fractures suspected rib 9 to 12
- Multiple rib fractures
- Elderly patient
- Preexisting pulmonary disease
- Suspected pathologic fracture

Other manifestations



- Traumatic asphyxia
 - subconjunctival hemorrhage
 - petechiae
 - cyanosis
 - edema
 - face discoloration
 - epistaxis
 - hemotympanum
- Rib sternum scapular fracture
- Blunt esophageal rupture

What pitfalls should I avoid?



- Simple pneumothorax → Tension pneumothorax
- Retained hemothorax → empyema
- Diaphragmatic injury
- Severity of rib fracture / pulmonary contusion
- Elderly

Abdominal trauma

楊毓錚 醫師

Learning objectives

- Anatomic regions
- Blunt and penetrating injury patterns
- Clinical signs about intraperitoneal, retroperitoneal, and pelvic injuries
- Diagnostic procedures
- Therapeutic modalities in abdominal and pelvic trauma

Introduction

- Early recognition of occult hemorrhage.
- Preventable death
- Assessment is often compromised by alcohol intoxication, illicit drugs, brain or spinal cord injury.

Anatomy

- Anterior abdomen
- Flank
- Back
- Peritoneal cavity
- Pelvic cavity
- Retroperitoneal space



Anatomy

- Anterior abdomen: trans-nipple line, inguinal ligaments and symphysis pubis, anterior axillary lines.
- Flank: anterior and posterior axillary line; sixth intercostal to iliac crest
- Back: posterior axillary line; tip of scapula to iliac crest

Anatomy

- Peritoneal cavity: upper-diaphragm, liver, spleen, stomach, and transverse colon; lower-small bowel, sigmoid colon
- Retroperitoneal space: aorta, inferior vena cava, duodenum, pancreas, kidneys, ureters, ascending and descending colons
- Pelvic cavity: rectum, bladder, iliac vessels, and internal genitalia

Mechanism

- Blunt trauma
 - ☞ Direct compression: solid organ
 - ☞ Lap belt injury-hollow organ
 - ☞ Deceleration: fixed and nonfixed parts
 - ☞ Shearing: vascular pedicles
- Penetrating trauma



Blunt trauma

- Greater mortality due to delayed diagnosis and associated injuries
- Spleen (40-55%), Liver (35-45%), small bowel (5-10%)
- Retroperitoneal hematoma: 15%



Penetrating trauma

- Liver (40%), small bowel (30%), diaphragm (20%), and colon (15%)
- GSW: small bowel (50%), colon (40%), liver (30%), vascular structures (25%)



Other mechanisms

- Shoulder belt injury
 - ☞ tear or thrombosis in innominate /carotid/subclavian/vertebral arteries
 - ☞ Rib fx, pulmonary contusion
- Lap belt injury
 - ☞ Mesentery avulsion
 - ☞ Small bowel or colon rupture
 - ☞ Chance fx
- Air bag
 - ☞ Cardiac rupture
 - ☞ C-spine fracture
 - ☞ Corneal abrasion



PE

- Inspection, auscultation, percussion, palpation
- Local exploration of stab wounds
- Pelvic stability
- Penile, perineal and rectal examination
- Vaginal examination

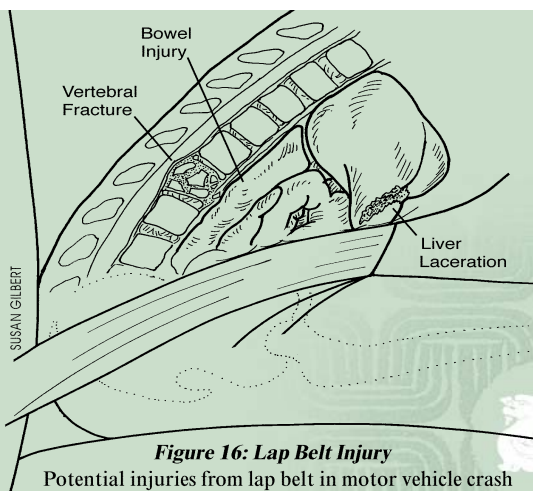


Figure 16: Lap Belt Injury
Potential injuries from lap belt in motor vehicle crash



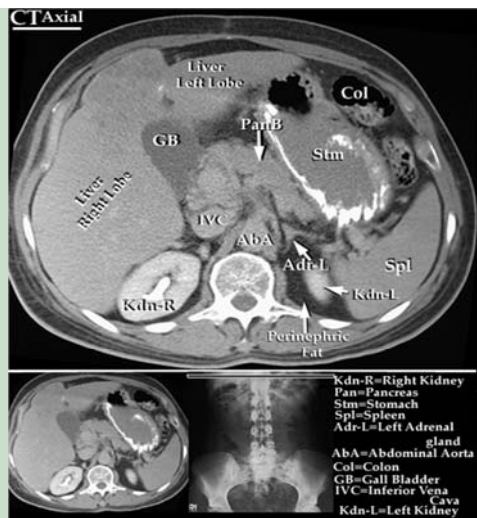
Adjuncts

- Gastric tube
- Urinary catheter
- Blood and urine sampling
- X-ray studies



Special diagnostic studies

- Diagnostic peritoneal lavage
- Diagnostic ultrasound
- Urethrography
- Cystography
- Screening IVP
- CT/CTA
- Gastrointestinal series



Diagnostic Peritoneal Lavage

- Indications:
 - ☞ Change in sensorium: SCI, HI
 - ☞ Injury to adjacent structures
 - ☞ Equivocal PE
 - ☞ Prolonged loss of contact with patient
 - ☞ Lap-belt sign: suspect bowel injury
 - ☞ No other choice



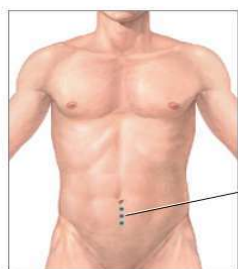
DPL

- Contraindication
 - ☞ Absolute: indication for celiotomy
 - ☞ Relative: previous abdominal operations, morbid obesity, advanced cirrhosis, preexisting coagulopathy
- Infraumbilical technique: semiopen, full open, closed
- Supraumbilical technique: pelvic fracture, advanced pregnancy

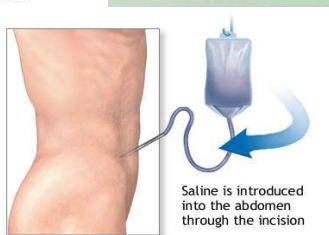


DPL

- Foley and NG first
- One-third of distance from umbilicus to symphysis pubis
- Vertical incise
- Insert PD catheter
- 10 ml/kg (up to 1 L) warm NS or LR
- 5-10 min retain



Incision



Saline is introduced into the abdomen through the incision

adam.com

DPL

Positive:

- Aspiration of blood
- GI contents
- Bile
- Gram's stain with bacteria
- $\geq 5,000$ in GSW
- $\geq 100,000$ RBC/mm³, ≥ 500 WBC/mm³

Table 39-2. Diagnostic Peritoneal Lavage Red Blood Cell Criteria (per mm³)

	Positive	Indeterminate
Blunt trauma	100,000*	20-100,000
Stab wound		
Anterior abdomen	100,000	20,000-100,000
Flank	100,000	20,000-100,000
Back	100,000	20,000-100,000
Low chest	5,000	1000-5000
Gunshot wound	5,000	1000-5000

Criterion of DPL for Detection of Hollow Organ Perforation

- 320 patients suffered from blunt abdominal trauma over an 18-month period
- A cell count ratio of greater than or equal to 1 predicted hollow organ perforation with a specificity of 97% and a sensitivity of 100%.

Fang, Jen-Feng et al. *The Journal of Trauma, Injury, Infection, and Critical Care*. Volume 45(3), September 1998, pp 540-544

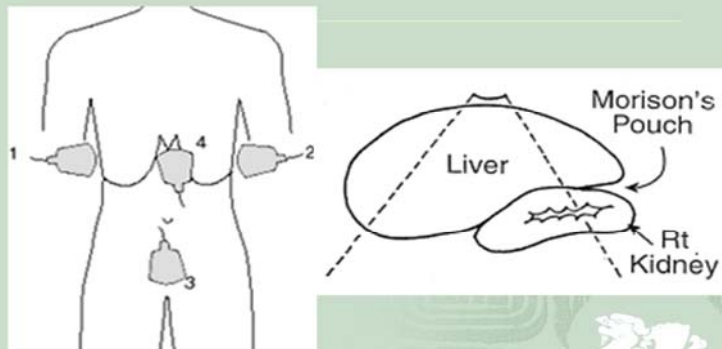
“FAST” should be “SLOH”

- FAST
 - ↳ Focused Abdominal Sonography in Trauma
- SLOH
 - ↳ Systematic Look for Occult Hemorrhage
- Pericardial sac, hepatorenal fossa, splenorenal fossa, and pelvis
- 30 min interval



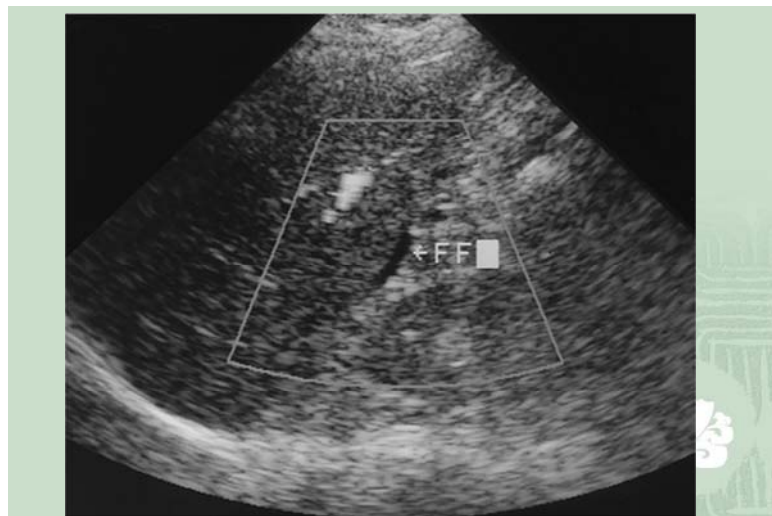
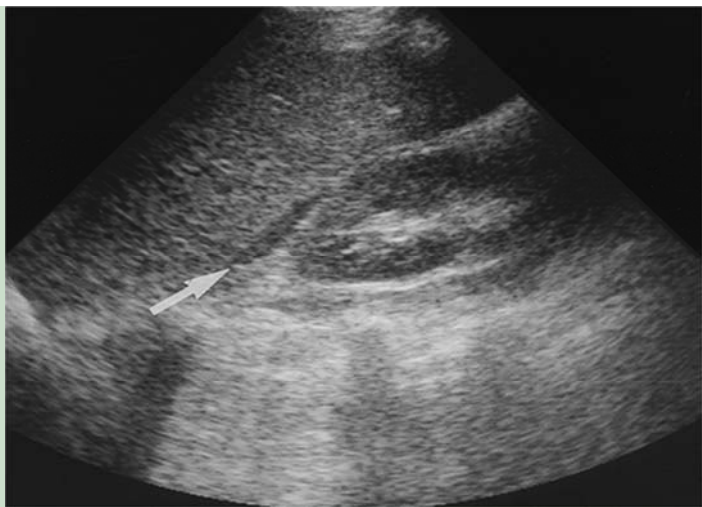
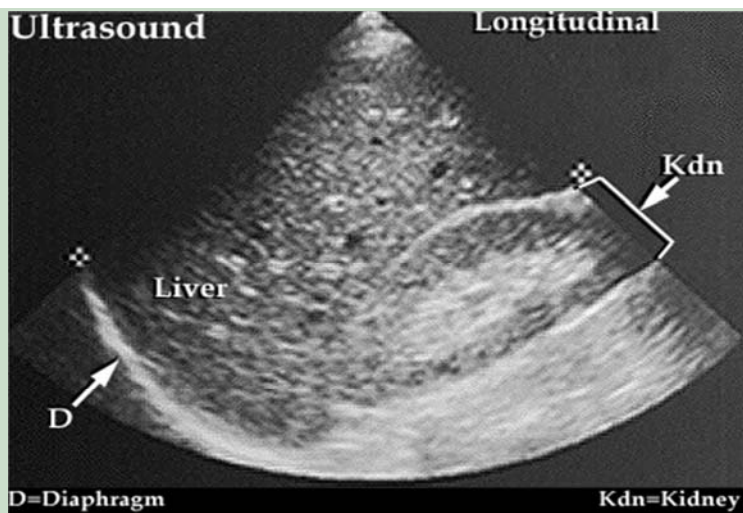
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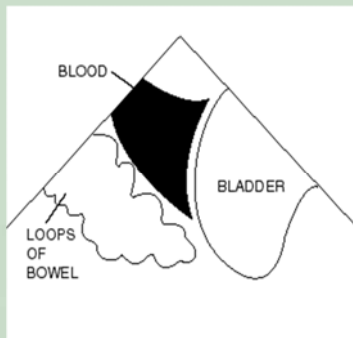
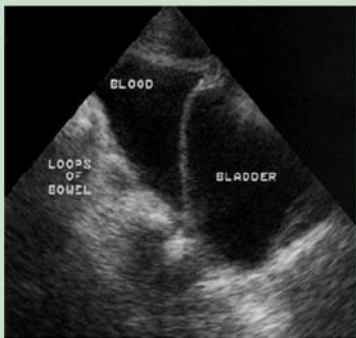
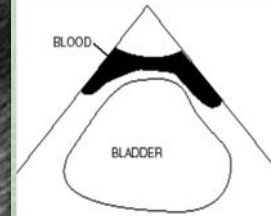
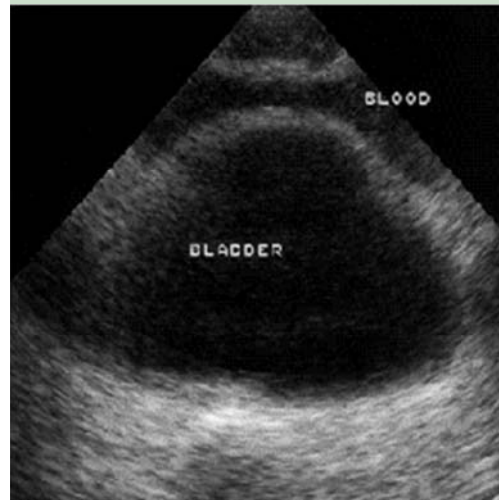
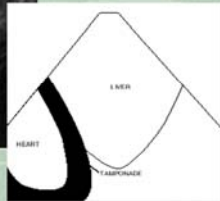
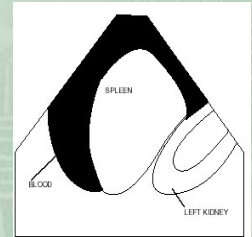
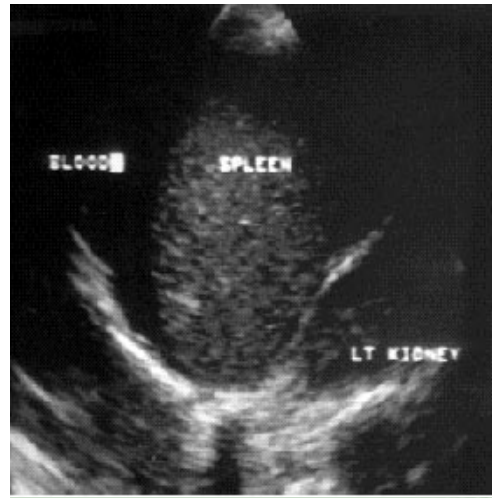
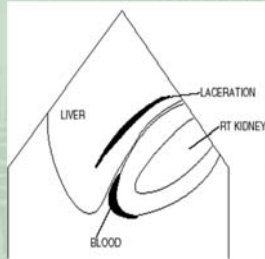
腹部會山傷



投影片 146

2 僅：不顯開、noninvasive, cheap, no radiation, repeat (30 mins), 看其他地方傷害
 缺：obvious dependent, obesity, abdominal air, scar, obesity, (non-FAST)



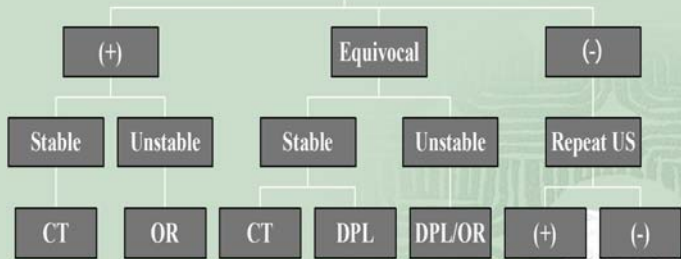


Indications for celiotomy

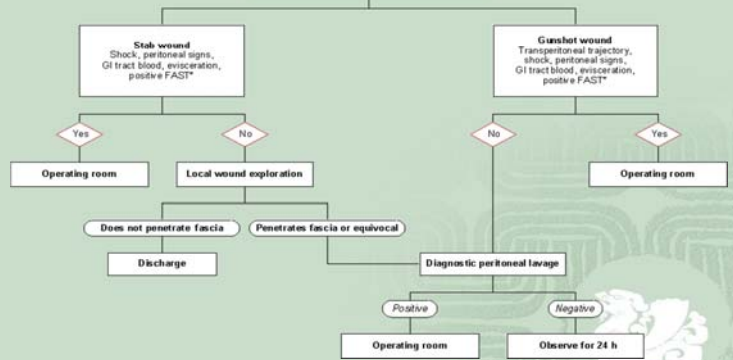
- BAT + DPL or ultrasound
- BAT + recurrent hypotension
- Early peritonitis
- Hypotension with penetrating abdominal wound
- GSW
- Evisceration



Blunt Abdominal Trauma FAST



Penetrating anterior abdominal trauma FAST performed on all patients*



Penetrating back or flank abdominal trauma FAST performed on all patients* Look for transperitoneal trajectory, peritoneal signs, shock, GI blood tract, positive FAST*

