

Case Conference

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2010. 7. 14

Discussion

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Trauma Protocol In SKH

Trauma Blue

VS.

Trauma Red

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Indications of Trauma Blue

- Severe trauma mechanism :
 - Trauma to multiple sites
 - Penetration or gunshots to head, neck or trunk
 - Severe chest, abdomen or pelvis blunt injury
 - Severe trauma patients >3 in one time
 - Fall : >6 m or 20 ft or >2 floor high
 - Other clinical judgment

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新光醫院 Trauma Blue 啟動流程

到院前緊急醫療通報
病患符合下列受傷機轉

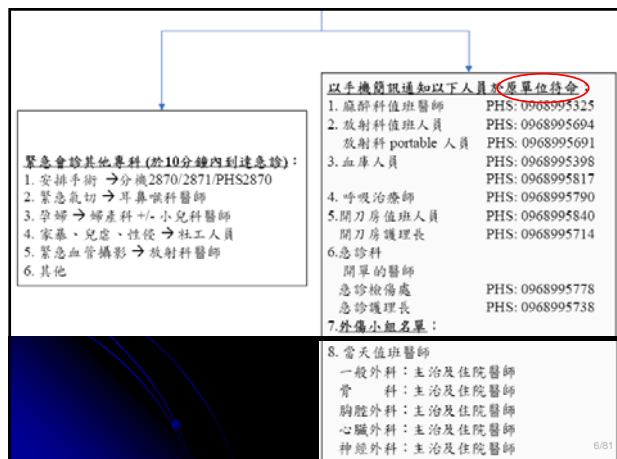
嚴重之受傷機轉：

- 多重部位創傷
- 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：> 6 m 或 20 ft 或 2 層樓
- 其他臨床判斷

急診專科醫師立即啟動 Trauma Blue

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Indications of Trauma Red

- **Trauma blue** indication plus :
 1. Shock (adult SBP <90 mmHg or children SBP < age x 2 +70)
 2. Respiratory distress :
RR < 10/min or > 29/min
 3. Cardiac arrest or PEA after arriving ER

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新光醫院 Trauma Red 啟動流程

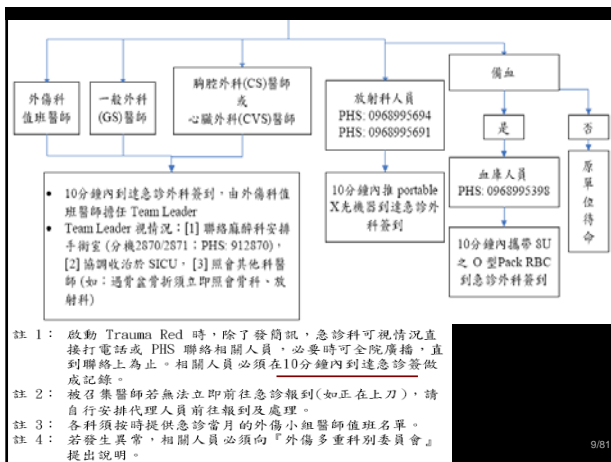
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119病人到達急診時
病患符合下列受傷機轉時
由急診專科醫師直接已大電腦系統
啟動Trauma Red

嚴重之受傷機轉：

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

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Spleen Injury Grading Scale

- Buntain et al
- Splenic grading system was revised in 1994
- **Grade I**
 1. Capsular tear < 1 cm in depth
 2. Subcapsular hematoma < 10% of surface area

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● **Grade II**

1. Laceration of 1-3 cm in depth and not involving trabecular vessels
2. Subcapsular hematoma of 10-50% of surface area
3. Intraparenchymal hematoma < 5 cm in diameter

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● **Grade III**

1. Laceration > 3 cm in depth or involving trabecular vessels
2. Subcapsular hematoma > 50% of surface area or expanding and ruptured subcapsular or parenchymal hematoma
3. Intraparenchymal hematoma > 5 cm or expanding

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- **Grade IV**
Laceration involving segmental or hilar vessels with devascularization > 25% of the spleen
- **Grade V**
Shattered spleen or hilar vascular injury

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Journal reading

CEUS in abdominal trauma: multi-center study

Abdominal Imaging (2009)34:225-234

Orlando Catalano et al

Introduction

- For abdominal blunt trauma
European and Asian → US
Americans → contrast enhanced CT
- CT has high rate of true negative and radiobiological and pharmacological invasiveness.
- Could Contrast enhanced US (CEUS) replace CT or US ?

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Materials and Methods

- Study design :
arrange conventional US, CEUS and CT for each patient of post-traumatic abdominal injuries
- Patients :
156 patients, all > 14 y/o
US, CEUS and CT performed within 1 hr

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Materials and Methods

- CEUS technique :
contrast medium : *SonoVue* 4.8 ml in 2 doses
Right side organ scan for 1-3 min, then
Left side organ scan for 3-4 min
- Standard of reference :
CT or surgery

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Results

- Among 156 p't :
91 had one or more abnormalities at CT
n=107, 26 renal, 38 liver, 43 spleen

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Table 1. Presence/absence of parenchymal lesion in liver using US, CEUS, and reference methods

	Reference methods	US	CEUS
Total number of patients	156	156	156
Patients with lesion	38	29	33
Patients without lesions	117	127	123
Indeterminate	1	0	0

Table 2. Presence/absence of parenchymal lesion in spleen using US, CEUS, and reference methods

	Reference methods	US	CEUS
Total number of patients	156	156	156
Patients with lesion	43	37	40
Patients without lesions	112	118	115
Indeterminate	1	0	1

Table 3. Presence/absence of parenchymal lesions in kidneys using US, CEUS, and reference methods

	Reference methods	US	CEUS
Total number of patients	156	156	156
Patients with lesion	26	12	19
Patients without lesions	130	144	137
Indeterminate	0	0	0

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Liver Trauma

Table 4. Accuracy for liver trauma detection

	US	CEUS
True negative	115	117
True positive	26	32
False negative	12	6
False positive	3	1
Total	156	156
Sensitivity	68%	84%
Specificity	97%	99%
Accuracy	90%	96%
Positive predictive value	90%	97%
Negative predictive value	91%	95%

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Spleen Trauma

Table 5. Accuracy for spleen trauma detection

	US	CEUS
True negative	109	112
True positive	33	40
False negative	10	3
False positive	4	1
Total	156	156
Sensitivity	77%	93%
Specificity	96%	99%
Accuracy	91%	97%
Positive predictive value	89%	98%
Negative predictive value	92%	97%

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Kidney Trauma

Table 6. Accuracy for kidney trauma detection

	US	CEUS
True negative	128	129
True positive	9	18
False negative	16	8
False positive	3	1
Total	156	156
Sensitivity	36%	69%
Specificity	98%	99%
Accuracy	88%	94%
Positive predictive value	75%	95%
Negative predictive value	89%	94%

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Per Patient Evaluation

	US	CEUS
● Sensitivity	79 %	94 %
● Specificity	82 %	89 %
● Accuracy	80 %	92 %

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Liver Trauma

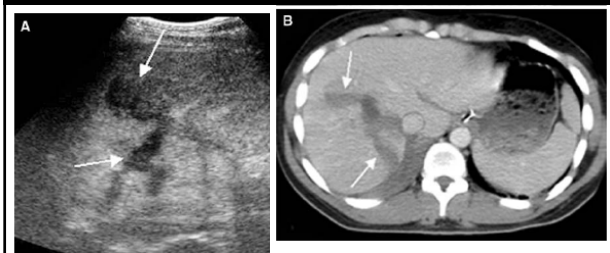
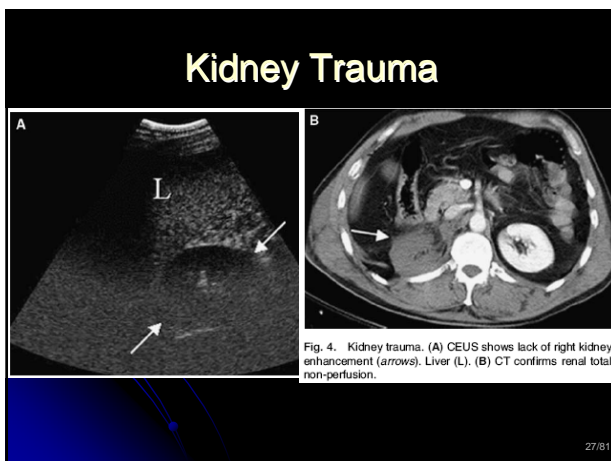
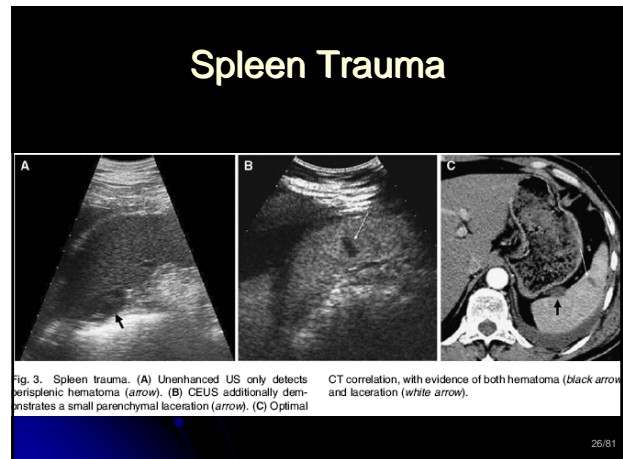
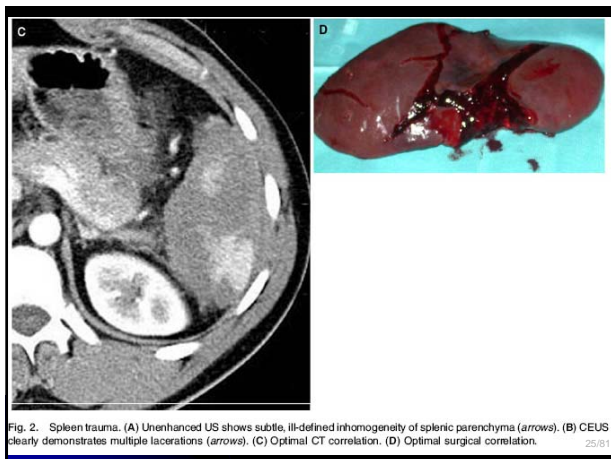


Fig. 1. Liver trauma. (A) CEUS detects a complex hepatic laceration (arrows). (B) CT demonstrates a very similar morphology of injury (arrows).

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Discussion

- The limitation of US or FAST :
low sensitivity for detecting **organ injury**, especially without free fluid.
- Peritoneal fluid is an **indirect sign** of trauma
- To increase US sensitivity :
 1. High resolution transducer
 2. Catheter bladder distension
 3. Contrast medium injection ...

CEUS

- Directly demonstrate parenchymal injury
- Contusion → hypoechogenicity
- Laceration → clear hypoechoic linear deficiencies
- Hematoma → non-enhancing area
- Contrast extravasation



CEUS applications

- 1. When CT is not available
- 2. CT is contra-indicated
- 3. Unstable patients
- 4. CT is inconclusive or with artifacts
- 5. US detected fluid but failed to identify organ injury
- 6. A negative US, but clinically highly suspicion

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The Advantages of CEUS

- Reduce the observation time for patients negative at baseline US
- Reduce follow-up CT exposure for non-operative patients

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Limitations of CEUS

- Obesity
- Difficulty in exploring deeply located areas (ex. Right liver lobe)

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CEUS Currently

- A limited number of CEUS for blunt abd trauma was published
- Most of the published studies agree on the relevant opportunities offered by CEUS for blunt abd trauma

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The limitations of this study

- 1. The number of positive cases for each organ is limited
- 2. "learning curve bias", due to unfamiliarity with contrast medium and technique
- 3. The CEUS performer is not blinded to US findings

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Conclusion

- CEUS is more **sensitive** than US and is almost as sensitive as CT
- CEUS allows more accurate assessment of solid organ lesions in comparison with baseline US.
- False negative from CEUS are due to minor injury → self-limited

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Conclusion

- Contrast enhancement may allow to overcome some intrinsic limitations of US
- The number of CT studies, with their cost, contrast medium-related risk, and radiation exposure can be decreased

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TABLE 251-4 Estimated Fluid and Blood Losses Based on Patient's Initial Presentation

	Class I	Class II	Class III	Class IV
Blood loss (mL)*	Up to 750	750-1500	1500-2000	>2000
Blood loss (percent blood volume)	Up to 15	15-30	30-40	40
Pulse rate	<100	100-120	120-140	>140
Blood pressure	Normal	Normal	Decreased	Decreased
Pulse pressure (mm Hg)	Normal or increased	Decreased	Decreased	Decreased

* Assumes a 70-kg patient with a preinjury circulating blood volume of 5 L.

TABLE 260-4 American Association for the Surgery of Trauma (AAST) Spleen Injury Scale (1994 Revision)

Grade*	Injury Description
I. Hematoma Laceration	Subcapsular, nonexpanding, <10 percent surface area Capsular tear, nonbleeding, <1 cm parenchymal depth
II. Hematoma Laceration	Subcapsular, nonexpanding, 10-50 percent surface area; intraparenchymal, nonexpanding, <5 cm in diameter Capsular tear, active bleeding; 1-3 cm parenchymal depth, which does not involve a trabecular vessel
III. Hematoma Laceration	Subcapsular, >50 percent surface area or expanding; ruptured subcapsular hematoma with active bleeding; intraparenchymal hematoma, >5 cm or expanding >3 cm parenchymal depth or involving trabecular vessels
IV. Hematoma Laceration	Ruptured intraparenchymal hematoma with active bleeding Laceration involving segmental or hilar vessels producing major devascularization (>25 percent of spleen)
V. Laceration Vascular	Completely shattered spleen Hilar vascular injury that devascularizes spleen

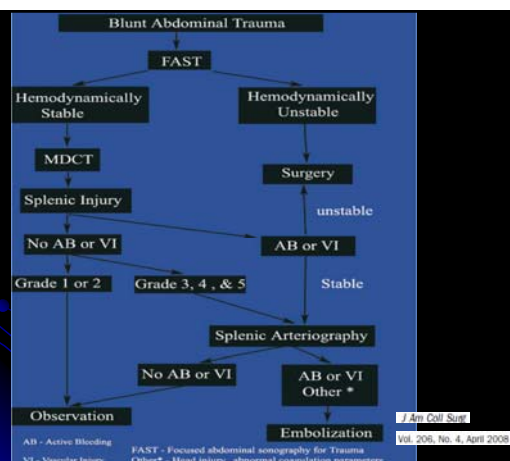
* Advance one grade for multiple injuries up to grade III.

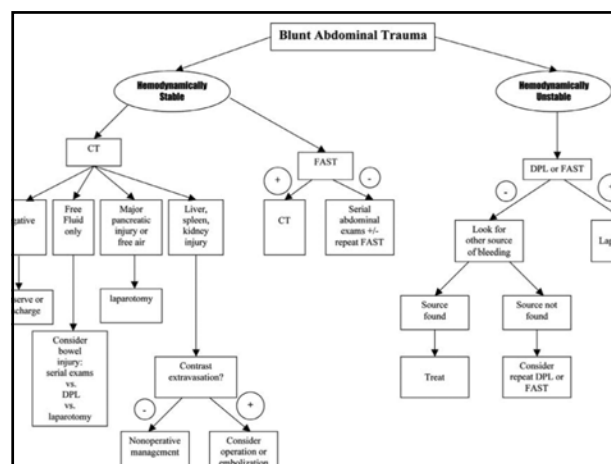
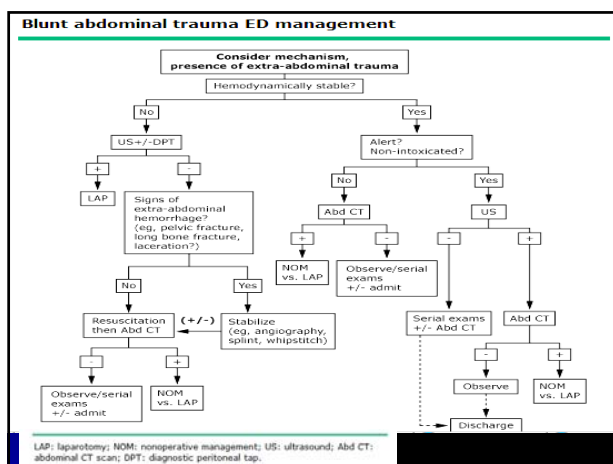
TABLE 260-3 American Association for the Surgery of Trauma (AAST) Liver Injury Scale

Grade*	Injury Description
I. Hematoma Laceration	Subcapsular, nonexpanding, <10 cm surface area Capsular tear, nonbleeding, <1 cm parenchymal depth
II. Hematoma Laceration	Subcapsular, nonexpanding, 10-50 percent surface area; intraparenchymal, nonexpanding, <10 cm in diameter Capsular tear, active bleeding; 1-3 cm parenchymal depth, <10 cm in length
III. Hematoma Laceration	Subcapsular, >50 percent surface area or expanding; ruptured subcapsular hematoma with active bleeding; intraparenchymal hematoma, >10 cm or expanding >3 cm parenchymal depth
IV. Hematoma Laceration	Ruptured intraparenchymal hematoma with active bleeding Parenchymal disruption involving 25-75 percent of hepatic lobe or 1-3 Couinaud's segments within a single lobe
V. Laceration Vascular	Parenchymal disruption involving >75 percent of hepatic lobe or >3 Couinaud's segments within a single lobe Juxtahepatic venous injuries, i.e., retrohepatic vena cava/central major hepatic veins
VI. Vascular	Hepatic avulsion

* Advance one grade for multiple injuries, up to grade III.

- nonoperative management
 - to patients
 - under 55 years of age
 - and CT injury grade no higher than 3
- Initial CT scan
 - may miss a splenic pseudoaneurysm
 - in 75 percent
 - Thus, follow-up CT is important
 - even asymptomatic





Tintinalli's Emergency Medicine > Section 22: Trauma > Chapter 260. Abdominal Injuries > Nonoperative Management of Blunt Trauma > Nonoperative Management of Splenic Injuries

Table 260-4 American Association for the Surgery of Trauma (AAST) Splenic Injury Scale (1994 Revision)

Grade*	Injury Description
I. Hematoma	Subcapsular, nonexpanding, <10 percent surface area
Laceration	Capsular tear, nonbleeding, <1 cm parenchymal depth
II. Hematoma	Subcapsular, nonexpanding, 10–50 percent surface area; intraparenchymal, nonexpanding, <5 cm in diameter
Laceration	Capsular tear, active bleeding; 1–3 cm parenchymal depth, which does not involve a trabecular vessel
III. Hematoma	Subcapsular, >50 percent surface area or expanding; ruptured subcapsular hematoma with active bleeding; intraparenchymal hematoma, >5 cm or expanding
Laceration	>3 cm parenchymal depth or involving trabecular vessels
IV. Hematoma	Ruptured intraparenchymal hematoma with active bleeding
Laceration	Laceration involving segmental or hilar vessels producing major devascularization (>25 percent of spleen)
V. Laceration	Completely shattered spleen
Vascular	Hilar vascular injury that devascularizes spleen

*Advance one grade for multiple injuries up to grade III.

Liver injury scale (1994 revision)

Grade*	Type of Injury	Description of injury
I	Hematoma	Subcapsular, <10% surface area
	Laceration	Capsular tear, <1 cm parenchymal depth
II	Hematoma	Subcapsular, 10% to 50% surface area; intraparenchymal <10 cm in diameter
	Laceration	Capsular tear 1–3 parenchymal depth, <10 cm in length
III	Hematoma	Subcapsular, >50% surface area of ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma > 10 cm or expanding
	Laceration	>3 cm parenchymal depth
IV	Laceration	Parenchymal disruption involving 25% to 75% hepatic lobe or 1–3 Couinaud's segments
V	Laceration	Parenchymal disruption involving >75% of hepatic lobe or >3 Couinaud's segments within a single lobe
	Vascular	Juxtahepatic venous injuries; ie, retrohepatic vena cava/central major hepatic veins
VI	Vascular	Hepatic avulsion

*Advance one grade for multiple injuries up to grade III.

- a negative splenic arteriogram
- predicted successful nonoperative management

Thanks for your attention and advices !

