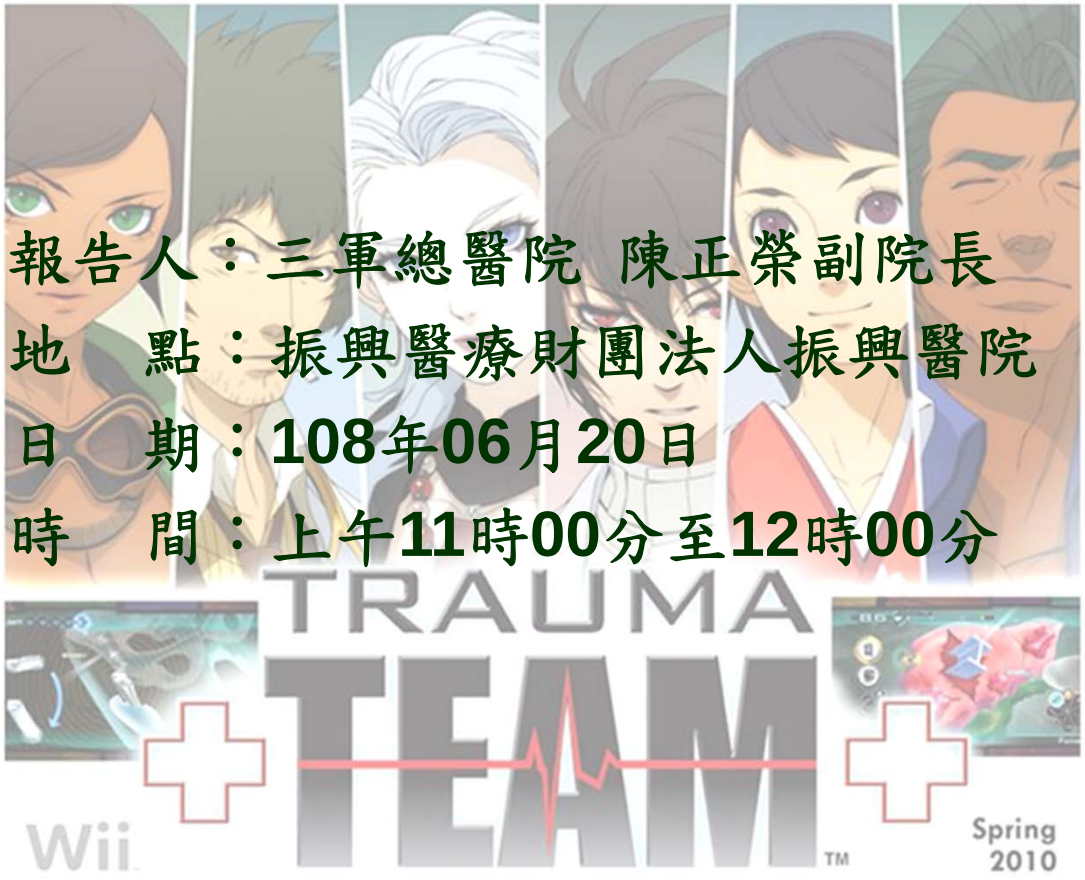
108年振興醫院外傷教育研討會

報告主題：

外傷病人的重症照護要點



報告人：三軍總醫院 陳正榮副院長

地　點：振興醫療財團法人振興醫院

日　期：108年06月20日

時　間：上午11時00分至12時00分

A clinician attacks the three heads of sepsis (hypotension, hypoperfusion, and organ dysfunction). Inspired by Hercules Kills Cerberus, *Renato Pettinato, 2001, in Zuccaro Palace, Agira, Sicily, Italy. Printed with the permission of the artist and the Rubulotta family.*

SURVIVING SEPSIS CAMPAIGN:

International guidelines for management of severe sepsis and septic shock

Crit Care Med. 2004 Mar;32(3):858-73

Crit Care Med. 2008 Jan;36(1):296-327

Crit Care Med. 2013 Feb;41(2):580-637

Crit Care Med. 2017 Mar;45(3):486-552

Outlines

Guidelines for Shock Resuscitation

J Trauma. 2006;61:82– 89

Guidelines for Transfusion in the Trauma Patient

J Trauma. 2006;61:436–439

Guidelines for Mechanical Ventilation of the Trauma Patient

J Trauma. 2005;59:764–769

Guidelines for Prevention, Diagnosis and Treatment of Ventilator-Associated Pneumonia (VAP) in the Trauma Patient

J Trauma. 2006;60:1106 –1113

Guidelines for Sedation and Analgesia During Mechanical Ventilation General Overview

J Trauma. 2007;63:945–950

Blood Glucose Control in the Critically Ill Trauma Patient

J Trauma. 2007;63:703–708

Guidelines for Antibiotic Administration in Severely Injured Patients

J Trauma. 2008;65:1511–1519

Nutritional Support of the Trauma Patient

J Trauma. 2008;65:1520 –1528

Definitions for Complications of Clinical Care of Critically Injured Patients

J Trauma. 2009;67:384–388

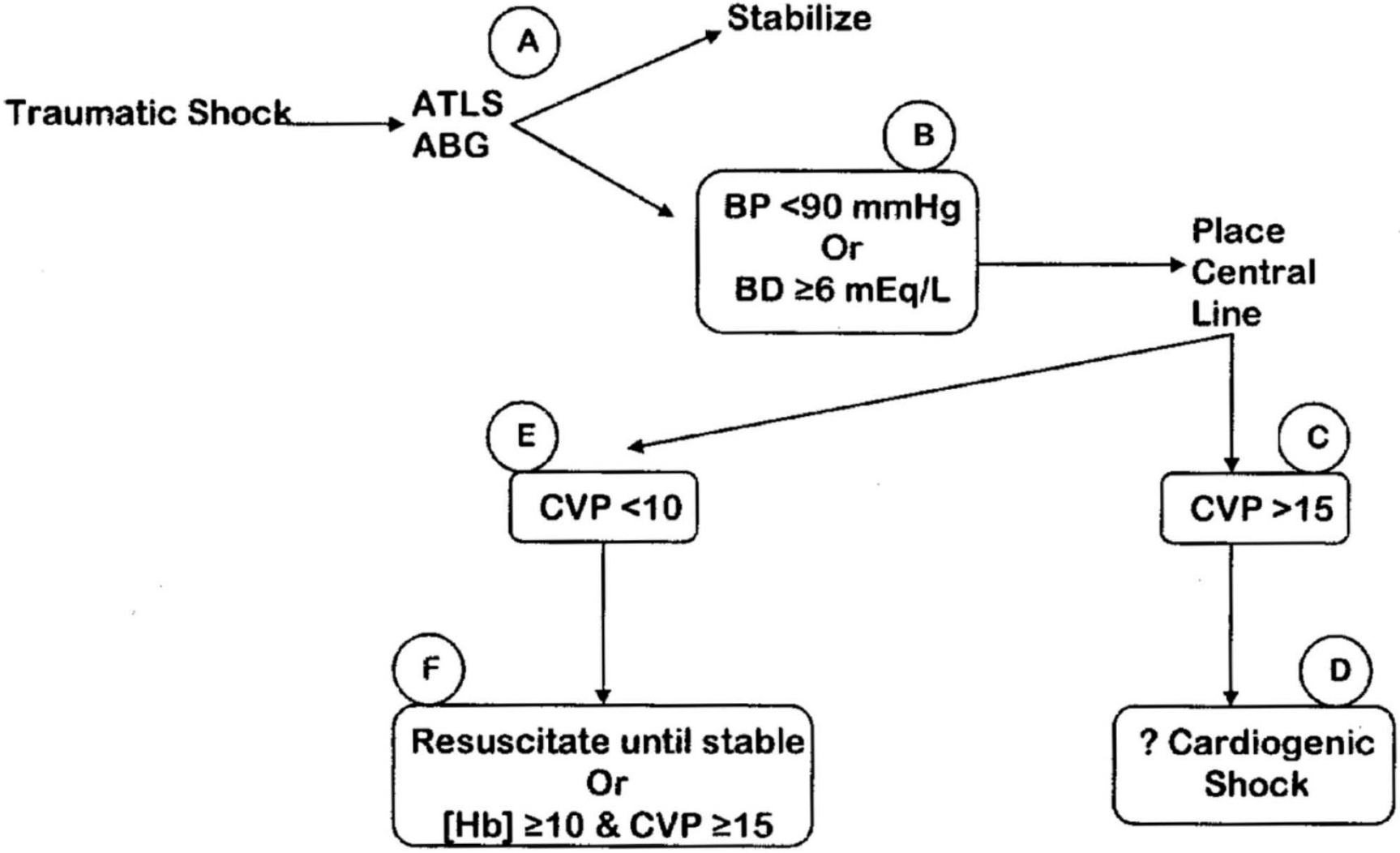
Guidelines for Venous Thromboembolism Prophylaxis in the Trauma Patient

J Trauma. 2008;65:944–950

Guidelines for Shock Resuscitation

J Trauma. 2006;61:82– 89

INITIAL RESUSCITATION



Initial Resuscitation

A. 外傷+休克 (SPB < 90 mmHg, HR > 130 bpm): ATLS, vital signs (q15min), ECG and pulse oximetry (SpO_2), core BT, and data flow sheet

B. 嚴重軀幹外傷+休克 (early SBP < 90 mmHg and/or BD ≥ 6 mEq/L): ongoing resuscitation, central venous line placed (via subclavian or internal jugular vein), CVP measurements

C. CVP > 15 cm mmHg: 需排除 **cardiogenic shock**

鈍傷後心因性休克的鑑別診斷：

1) tension pneumothorax

2) myocardial contusion/infarction

3) pericardial tamponade

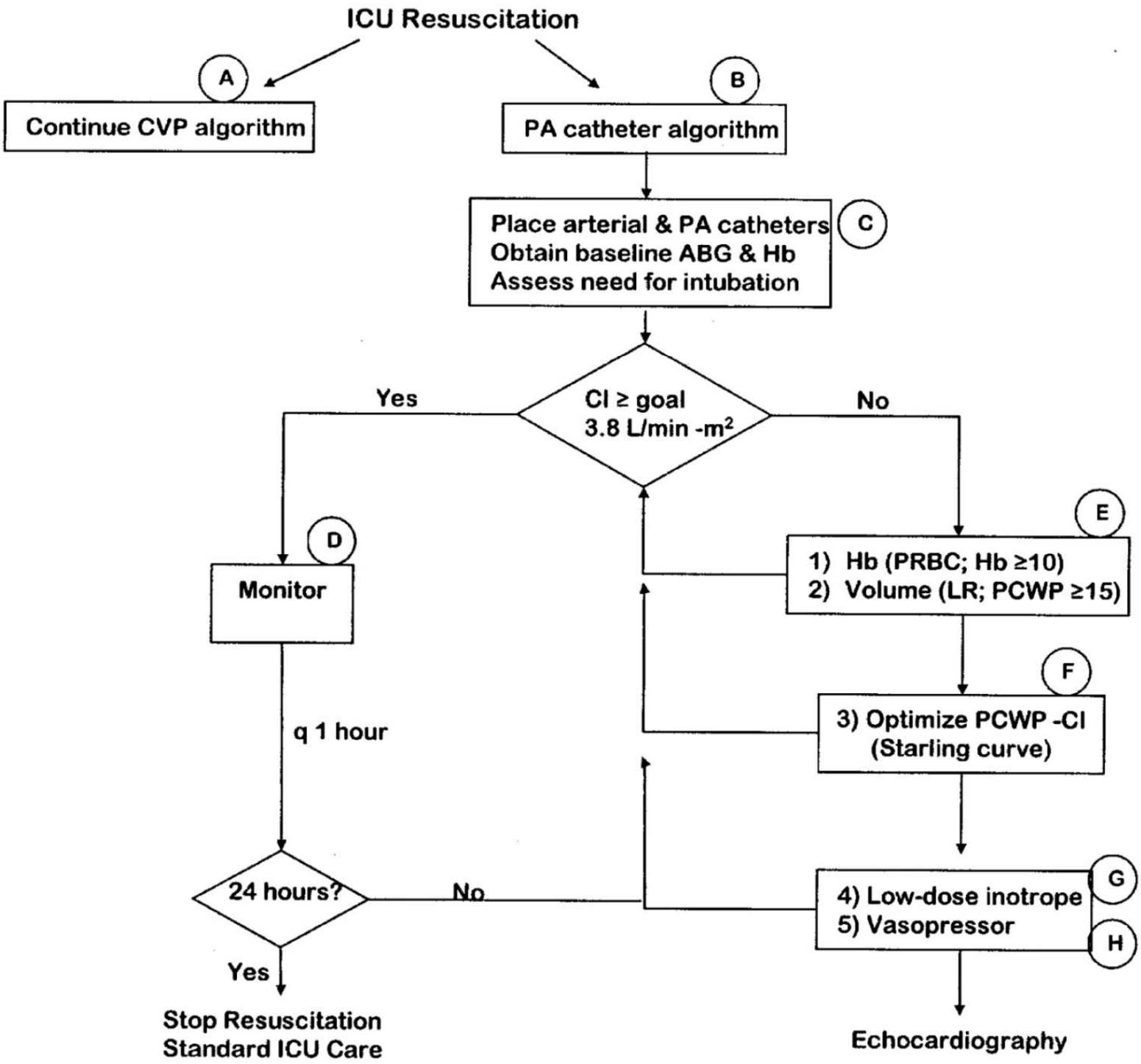
4) air embolus

Initial Resuscitation

D. CVP < 10 mmHg: **hypotensive resuscitation** (SBP > 90 mm Hg and HR < 130 bpm) with moderate volume loading until hemorrhage control (except concomitant brain injuries)

E. LR infusion > 30 mL/kg

F. blood transfusion (especially elderly, severe shock or injuries with significant bleeding


ICU Resuscitation
A
Continue CVP algorithm
B
PA catheter algorithm
Place arterial & PA catheters
Obtain baseline ABG & Hb
Assess need for intubation
C
CI ≥ goal
3.8 L/min -m2
Yes
No
D
Monitor
q 1 hour
E
1) Hb (PRBC; Hb ≥10)
2) Volume (LR; PCWP ≥15)
F
3) Optimize PCWP -CI
(Starling curve)
G
4) Low-dose inotrope
5) Vasopressor
H
24 hours?
No
Yes
Stop Resuscitation
Standard ICU Care
Echocardiography

ICU Resuscitation

A. continue resuscitation: serial vital signs, CVP, Hb and BD, bedside close observation

B. not responding volume loading/blood transfusion (**low MAP or persistently high BD**): secondary organ dysfunctions (worsening oxygenation or decreased urine output)

   pulmonary artery catheterization warranted

C. considered impending **abdominal compartment syndrome** (if fluid loading > 10 L or PRBC transfusion > 10 units): urinary bladder pressure ≥ **25 mmHg**

ICU Resuscitation

D. if CI (cardiac index) $<$ 3.8 L/min/m^2

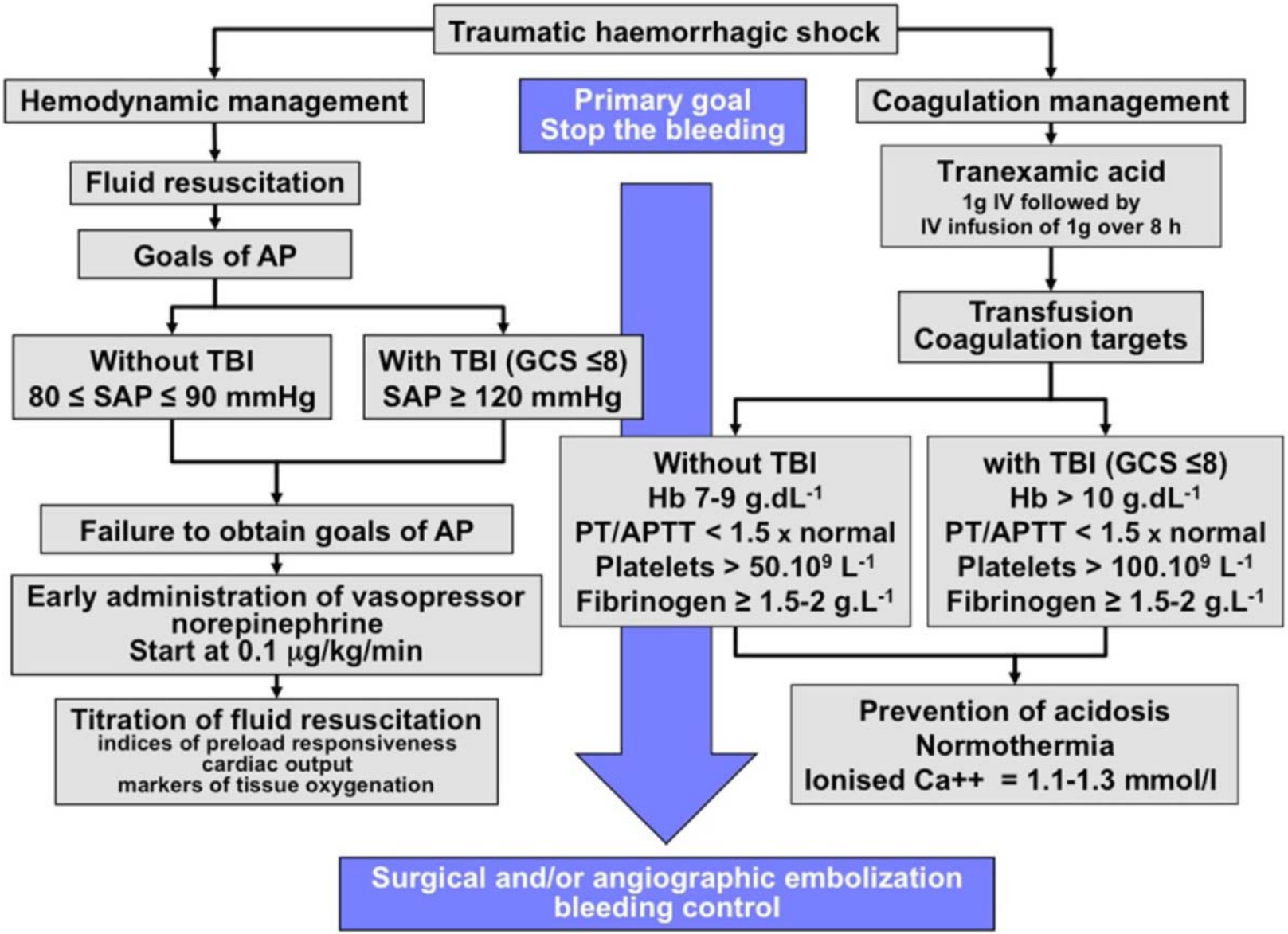
vasodilating inotropic agent, **dobutamine** (5.0 μg/kg/min, maximum 20 μg/kg/min)

not tolerate vasodilation, use **dopamine** (monitoring tachycardia)

E. vasoconstrictive inotropic agent to maintain MAP $\geq$ 60 mm Hg, started **norepinephrine** (0.05 μg/kg/min, maximum 0.2 μg/kg/min)

Resuscitative strategies in traumatic hemorrhagic Shock

Ann Intensive Care. 2013 Jan 12;3(1):1

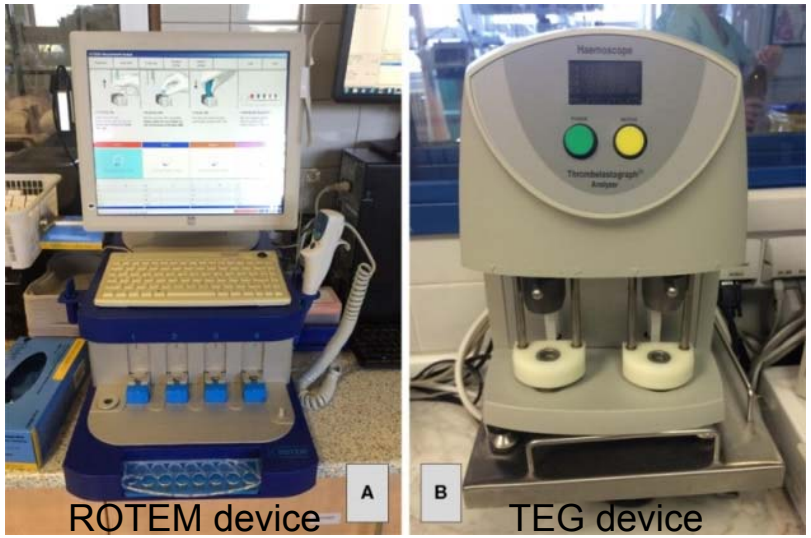


Bundles of care for resuscitation from hemorrhagic shock and severe brain injury in trauma patients—Translating knowledge into practice

J Trauma Acute Care Surg
2016 Volume 81, Number 4

TABLE 5. Recommended Bundles for Resuscitation from Hemorrhagic Shock and Early Management of Severe TBI

Resuscitation from Hemorrhagic Shock	Traumatic Brain Injury
Activate massive transfusion protocol	Avoid and treat hypoxia
Measure lactate or base deficit upon arrival	Avoid and treat hypotension
Transfuse packed red blood cells, plasma, and platelets in a 1:1:1 ratio	
Measure coagulopathy using viscoelastic methods upon arrival	
Do not use large volume crystalloid resuscitation (no more than 3 L over 6 hours)	



ROTEM device TEG device

Guidelines for Transfusion in the Trauma Patient

J Trauma. 2006;61:436–439

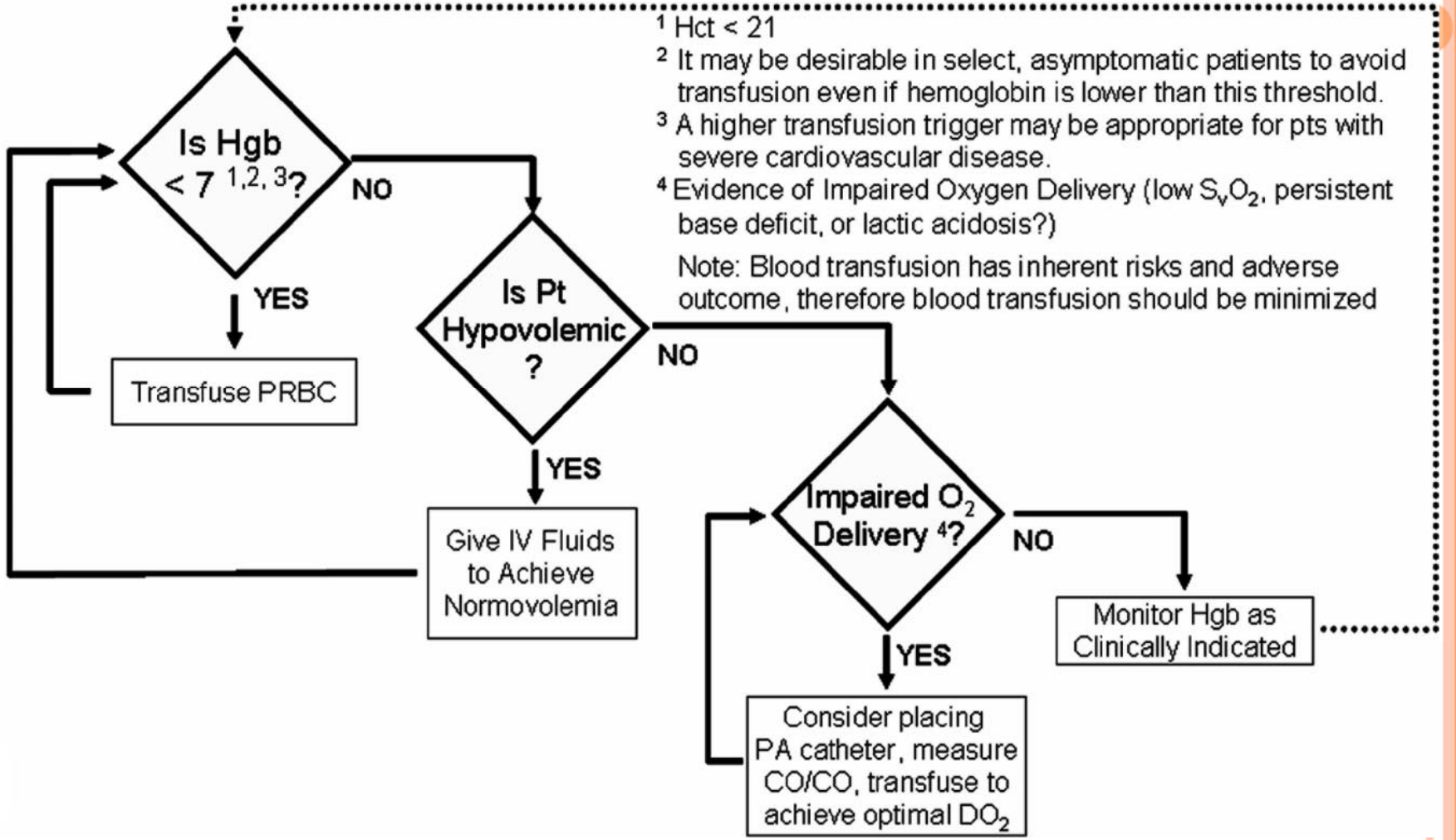
A Transfusion Guideline for Trauma Patient*

Inflammation and the Host Response to Injury

1. Identify critically ill patient with hemoglobin < 7 gm/dL (or Hct < 21%).
2. If hemoglobin < 7 gm/dL transfusion of PRBCs is appropriate.
    a. For patients with severe cardiovascular disease, a higher transfusion trigger may be appropriate.
3. If hemoglobin > 7 gm/dL assess the patient for hypovolemia.
    a. If the patient is hypovolemic, administer IV fluids to achieve normovolemia.
    b. If the patient is not hypovolemic, determine whether there is evidence of impaired oxygen delivery (low S_vO_2, persistent/ worsening base deficit, presence/ worsening of lactic acidosis).
4. If impaired O_2 delivery present, consider pulmonary artery catheter placement, measure cardiac output, and optimize O_2 delivery.
5. If impaired O_2 delivery not present, monitor hemoglobin as clinically indicated.

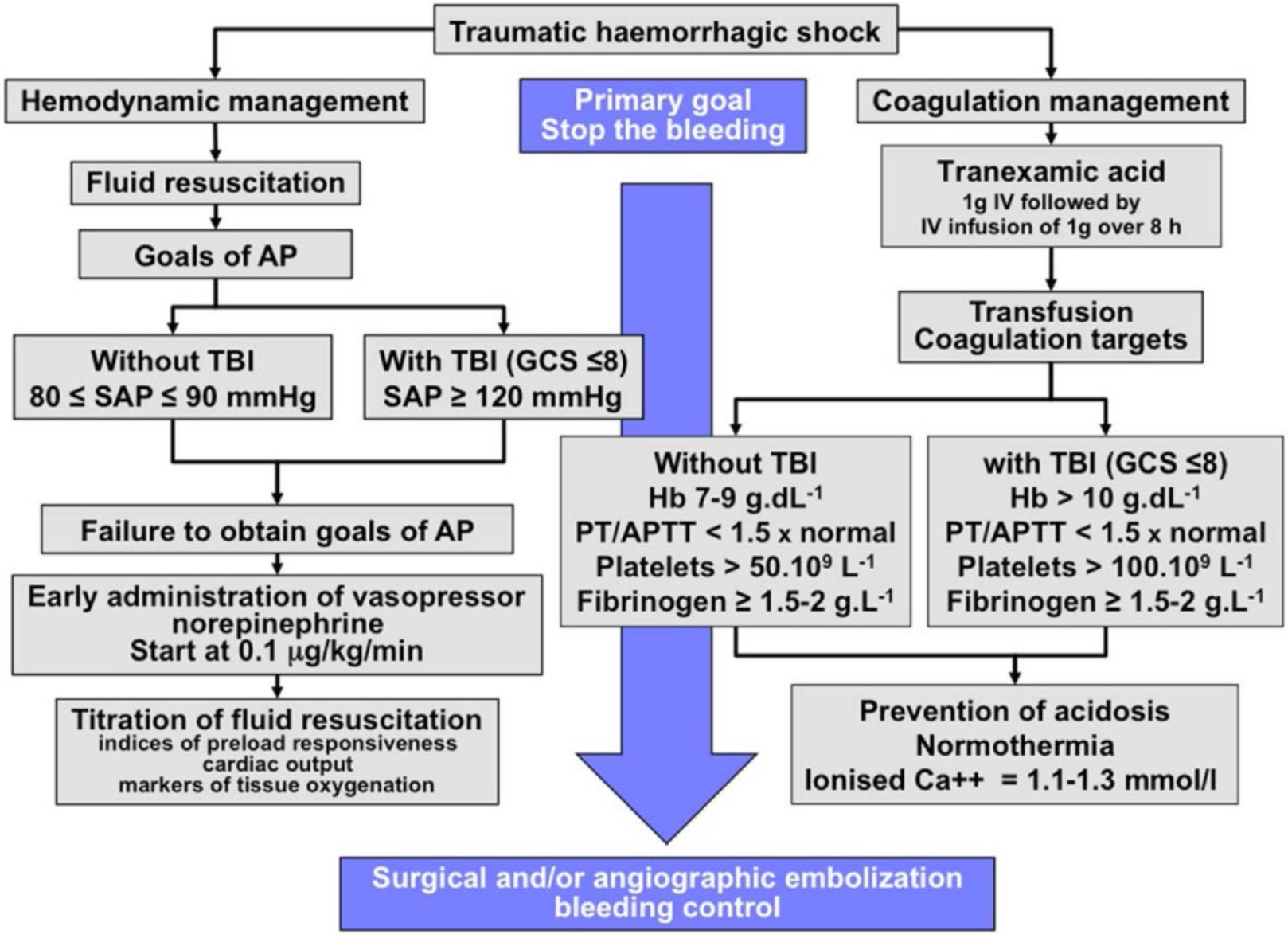
** This protocol assumes that acute hemorrhage has been controlled, the initial resuscitation has been completed, and the patient is stable in the ICU without ongoing hemorrhage.*

B Transfusion Guidelines for Trauma Patient (excludes immediate resuscitation)



Resuscitative strategies in traumatic hemorrhagic Shock

Ann Intensive Care. 2013 Jan 12;3(1):1



Criteria to trigger the activation of an MTP should include one or more of the following:

- ABC score of two or more
- Persistent hemodynamic instability
- Active bleeding requiring operation or angioembolization
- Blood transfusion in the trauma bay

Assessment of Blood Consumption (ABC) score:

pulse>120, **SBP<90**, **+ FAST**, and **penetrating torso injury**

Guidelines for Mechanical Ventilation of the Trauma Patient

J Trauma. 2005;59:764–769

急性呼吸窘迫症候群（ARDS）診斷定義

表三：AECC急性肺損傷(ALI)/急性呼吸窘迫症候群(ARDS)診斷準則(criteria)[4]

	發生時間	氧合能力	胸部X光表現	肺動脈楔壓
ALI準則	急性	PaO2/FiO2 ≤ 300 mmHg	雙側肺浸潤	≤ 18mmHg，或無左心房高壓
ARDS準則	急性	PaO2/FiO2 ≤ 200 mmHg	雙側肺浸潤	≤ 18mmHg，或無左心房高壓

Bernard GR, Artigas A, Brigham KL, et al. The American-European consensus conference on ARDS: definitions, mechanisms, relevant outcomes, and clinical trial coordination. *Am J Respir Crit Care Med.* 1994;149:818–824.

表五：ARDS的柏林定義(Berlin definition)[20]

	急性呼吸窘迫症候群ARDS
發生時間	一周內發生的臨床事件或新的/惡化的呼吸症狀
胸部影像	無法完全以積液、肺塌陷或肺結節就可以解釋的雙側肺陰影(opacity)
肺水腫的來源	無法完全以心衰竭或積液過多解釋的呼吸衰竭 假如沒有ARDS危險因子的存在，就必須藉由其它的客觀方式，例如心臟超音波，來排除靜水性肺水腫(hydrostatic edema)
氧合能力	
輕度	200 mmHg < PaO2/FiO2 ≤ 300 mmHg + PEEP或CPAP ≧ 5 cm H2O
中度	100 mmHg < PaO2/FiO2 ≤ 200 mmHg + PEEP ≧ 5 cm H2O
重度	PaO2/FiO2 ≤ 100 mmHg + PEEP ≧ 5 cm H2O

註：CPAP: Continuous Positive Airway Pressure 連續式正壓呼吸。

Ranieri VM, Rubenfeld GD, Thompson BT, et al. Acute respiratory distress syndrome: the Berlin Definition. JAMA 2012; 307: 2526-33.

呼吸器臨床使用指引

1. 呼吸器設定：
   a. 通氣模式： volume-control mode
   b. 潮氣容積（Tidal volume, Vt）：
      8 mL/kg（初期）
      6 mL/kg（理想）

Men: PBW (kg) = 50 + 0.91 (height [cm] – 152.4)

Women: PBW (kg) = 45.5 + 0.91 (height [cm] – 152.4)

predicted body weight (PBW)

   c. 呼吸速率：
      12~20 breaths/min（最高35）

呼吸器臨床使用指引

2. 理想目標：

a. 動脈血酸鹼值（Arterial pH）：7.25~7.45

(i) 鹼血症（pH > 7.45）

↓rate by two breaths/min

(ii) 輕微酸血症（7.15 ≥ pH < 7.25）

↑rate until pH > 7.25 or $PaCO_2$ < 25 mmHg（最高 35 breaths/min）

若rate ≥ 35 or $PaCO_2$ < 25, 給 bicarbonate

(iii) 嚴重酸血症（pH < 7.15）

↑rate（最高 35 breaths/min）

若rate ≥ 35, 也給了 bicarbonate但pH < 7.15

↑Vt by 1mL/kg until pH ≥ 7.15

b. 氣道高原壓（plateau pressure Pplat）：< 30 cm H_2O

(i) ↓Vt 1 mL/kg/2 hrs → Pplat ≤ 30 cm H_2O

呼吸器臨床使用指引

c. 氧和能力（Oxygenation）：55 mmHg ≤ PaO_2 ≤ 80 mmHg or SaO_2 ≥ 88%, FiO_2/PEEP ratio should be ≤ 5, particularly for FiO_2 ≥ 0.45

(i) If PaO_2 < 55 mmHg or SaO_2 < 88%

↑FiO_2 until PaO_2 = 55~80 mmHg or SaO_2 ≥ 88%

(ii) If PaO_2 < 55 mmHg or SaO_2 < 88% and FiO_2 = 1.0

↑PEEP to achieve adequate oxygenation

FIO2 %	30	40	40	50	50	60	70	70	70	80	90	90	90	100
PEEP cmH_2O	5	5	8	8	10	10	10	12	14	14	14	16	18	20–24

自主呼吸評估（Trial of Spontaneous Breathing, SBT）

1. 病況已平穩並獲得緩解
2. 具自發性呼吸能力
3. 未使用肌肉神經阻斷劑
4. 使用低劑量或無升壓劑，血液動力學穩定
5. $FiO_2 \leq 0.5$ and PEEP ≤ 8 cm H_2O
6. $PaO_2 \geq 70$ mm Hg
7. 每分鐘通氣量 < 15 L/min
8. pH of 7.30~7.50
9. 顱內壓 < 20 cm H_2O

自主呼吸測試

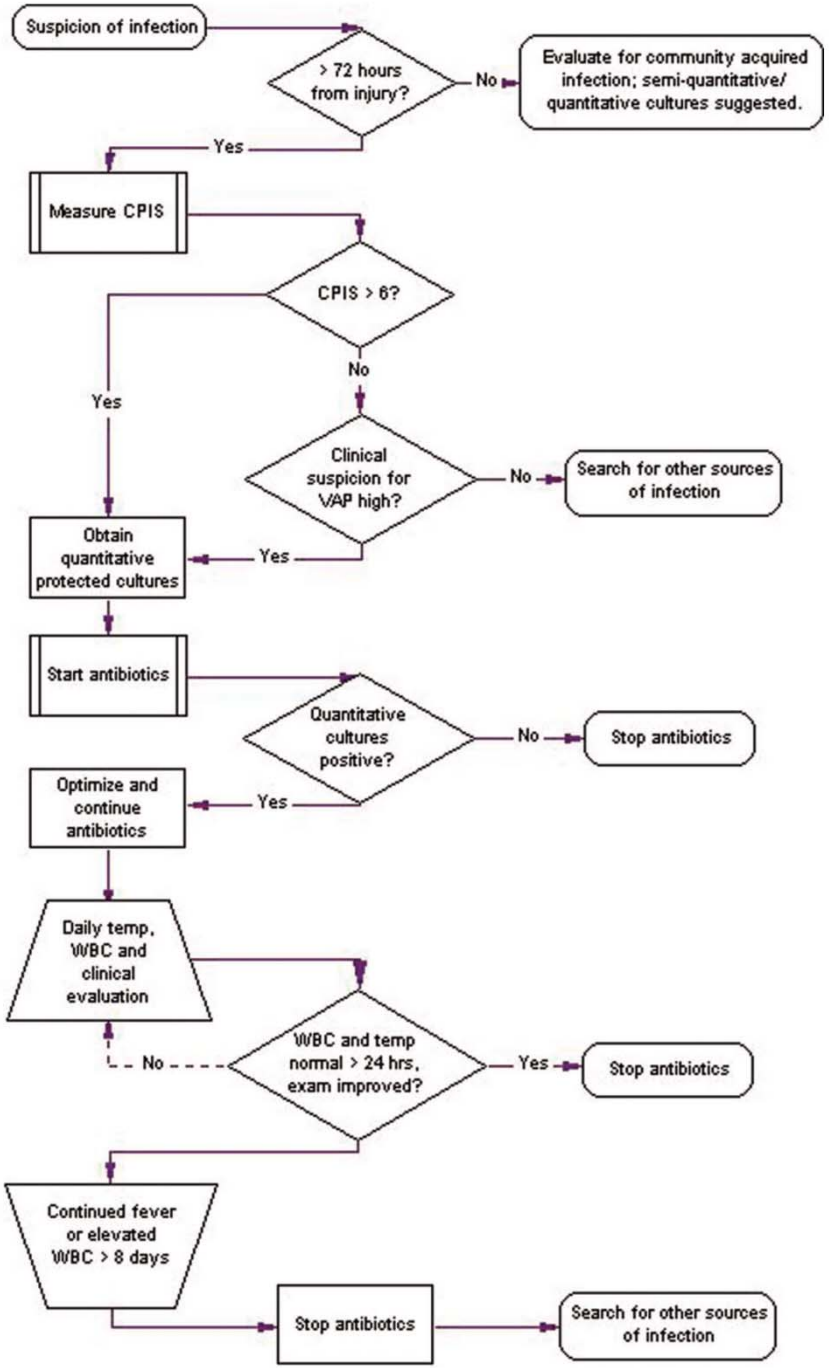
1. 進行30~90 min持續氣道正壓（CPAP）
2. 停止測試條件：
   a. 呼吸速率 > 35 (超過 5 min)
   b. SaO_2 < 90% (超過 30 seconds)
   c. HR > 140 bpm, ↓or↑HR 20% from baseline; new onset hypertension (SBP > 180 mm Hg) or hypotension (SBP < 90 mm Hg)
   d. 出現焦躁、出汗、顏面潮紅、或呼吸窘迫
   e. 心律不整
   f. pH ≤ 7.32
   g. 顱內壓≥ 20 cm H_2O

氣管內管移除前的評估

1. 每天超過4 hrs不需要suctioning
2. 具良好的咳嗽反射及呼吸道保護能力
3. 氣管內管氣囊漏氣 (cuff leak) < 30 cm H_2O of positive pressure
4. 無上呼吸阻塞的過去病史
5. 48 hrs之內無喘鳴（stridor）
6. 48 hrs之內沒有因分泌物濃稠阻塞人工氣道重新插管的紀錄

Guidelines for Prevention, Diagnosis and Treatment of Ventilator-Associated Pneumonia (VAP) in the Trauma Patient

J Trauma. 2006;60:1106 –1113



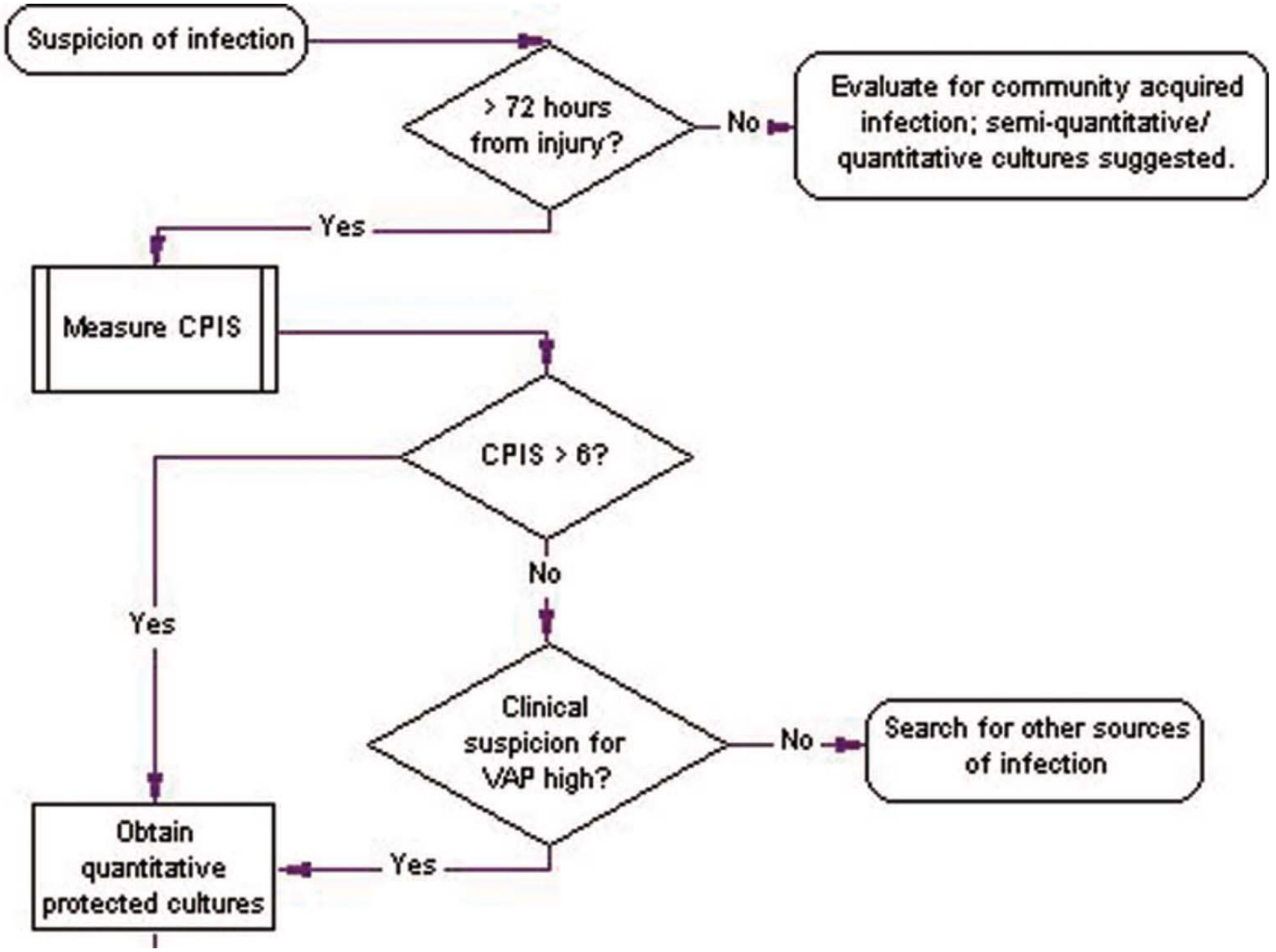
Algorithm for the Diagnosis and Treatment of VAP

Table 1 Clinical Pulmonary Infection Score

	Points
Temperature (°C)	
≥ 36.5 and ≤ 38.4	0
≥ 38.5 and ≤ 38.9	1
≥ 39 or ≤ 36.5	2
Blood leukocytes, mm^3	
≥ 4,000 and ≤ 11,000	0
≤ 4,000 or ≥ 11,000	1
≤ 4,000 or ≥ 11,000 and band forms ≥ 50%	2
Tracheal secretions	
None or scant	0
Presence of non-purulent secretions	1
Presence of purulent secretions	2
Oxygenation: PaO_2/FiO_2	
≥ 240, ARDS or Pulmonary contusion	0
≤ 240 and no ARDS (ARDS defined as Pa_{O2}/Fi_{O2} ≤ 200, PAWP ≤ 18 mm Hg and acute bilateral infiltrates)	2
Pulmonary radiography	
No infiltrate	0
Diffuse (or patchy) infiltrate	1
Localized infiltrate	2

呼吸器相關肺炎的預防

1. 標準化呼吸器脫離計畫
2. 口腔衛生照護 q8h, 0.12% chlorhexidene
3. 降低吸入感染性分泌物的機會
   a. 床頭搖高30-60度
   b. 徹底抽吸口咽部積存的分泌物
   c. 儘早使用胃管或經皮內視鏡胃造口術（PEG），避免胃脹
   d. 時常清潔呼吸器管路蒸發凝聚水氣
   e. 使用sulcralfate or H_2-blockers（避免使用制酸劑）控制胃酸，使用 PPI減少上腸胃道出血機會
4. 接觸病人前勤洗手及戴手套
5. 定期衛教、稽核


Suspicion of infection
> 72 hours from injury?
No
Evaluate for community acquired infection; semi-quantitative/ quantitative cultures suggested.
Yes
Measure CPIS
CPIS > 6?
Yes
No
Clinical suspicion for VAP high?
No
Search for other sources of infection
Obtain quantitative protected cultures
Yes

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	Points
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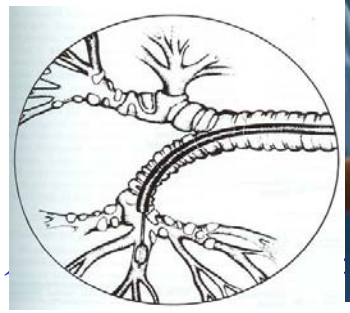
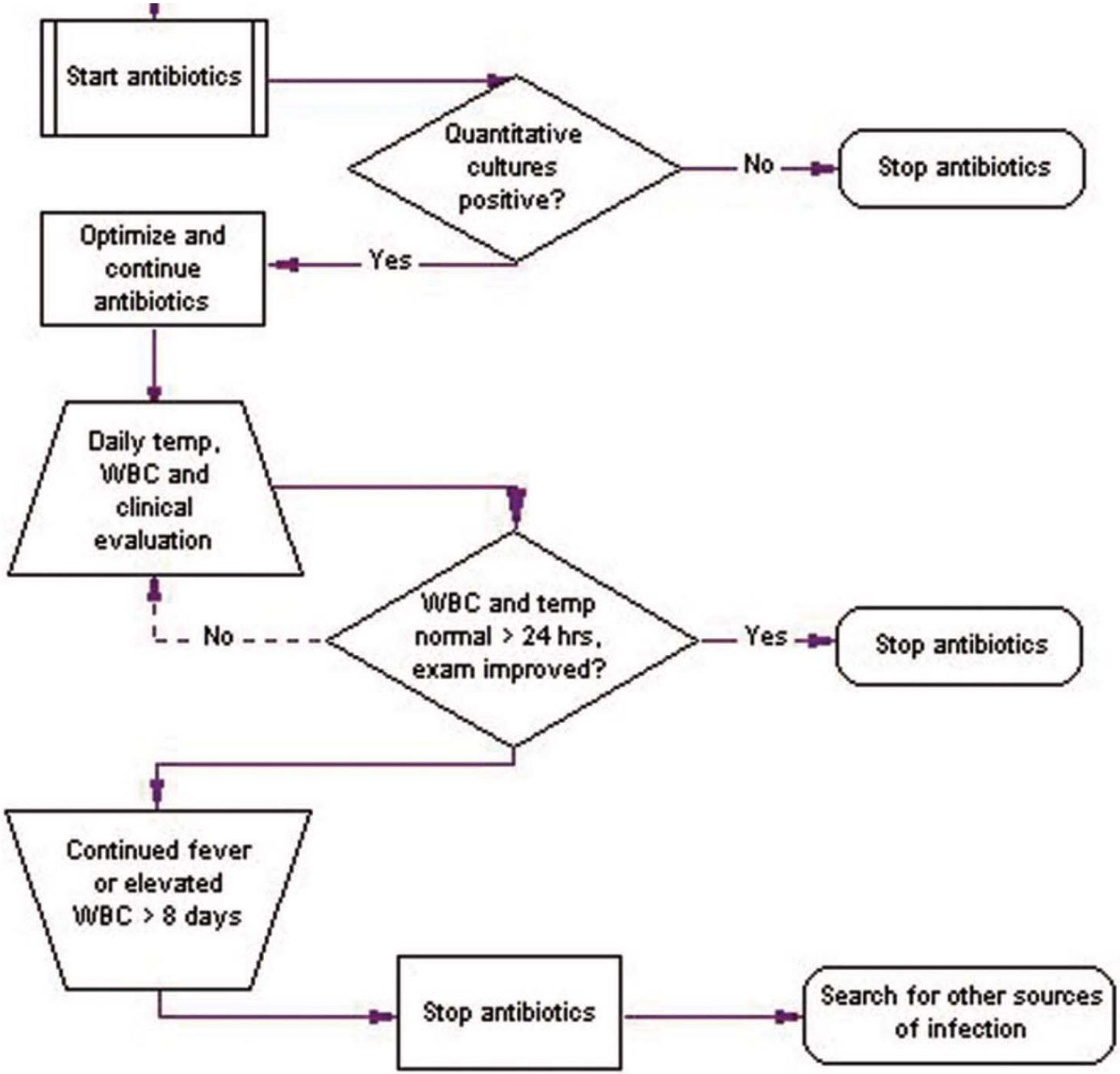



1. 支氣管鏡保護性檢體刷拭術(bronchoscopic protected specimen brush)或肺泡灌洗術(bronchoscopic bronchoalveolar larvage)
2. “blind BAL” techniques (BAL-CATH; Kimberly-Clark, Draper, UT)
3. positive quantitative culture results (美國疾病防制中心訂定標準)

   a. Bronchoscopic or non-bronchoscopic (blind) BAL: 10^4 colony forming units/mL

   b. Bronchoscopic protected specimen brush: 10^3 colony forming units/mL



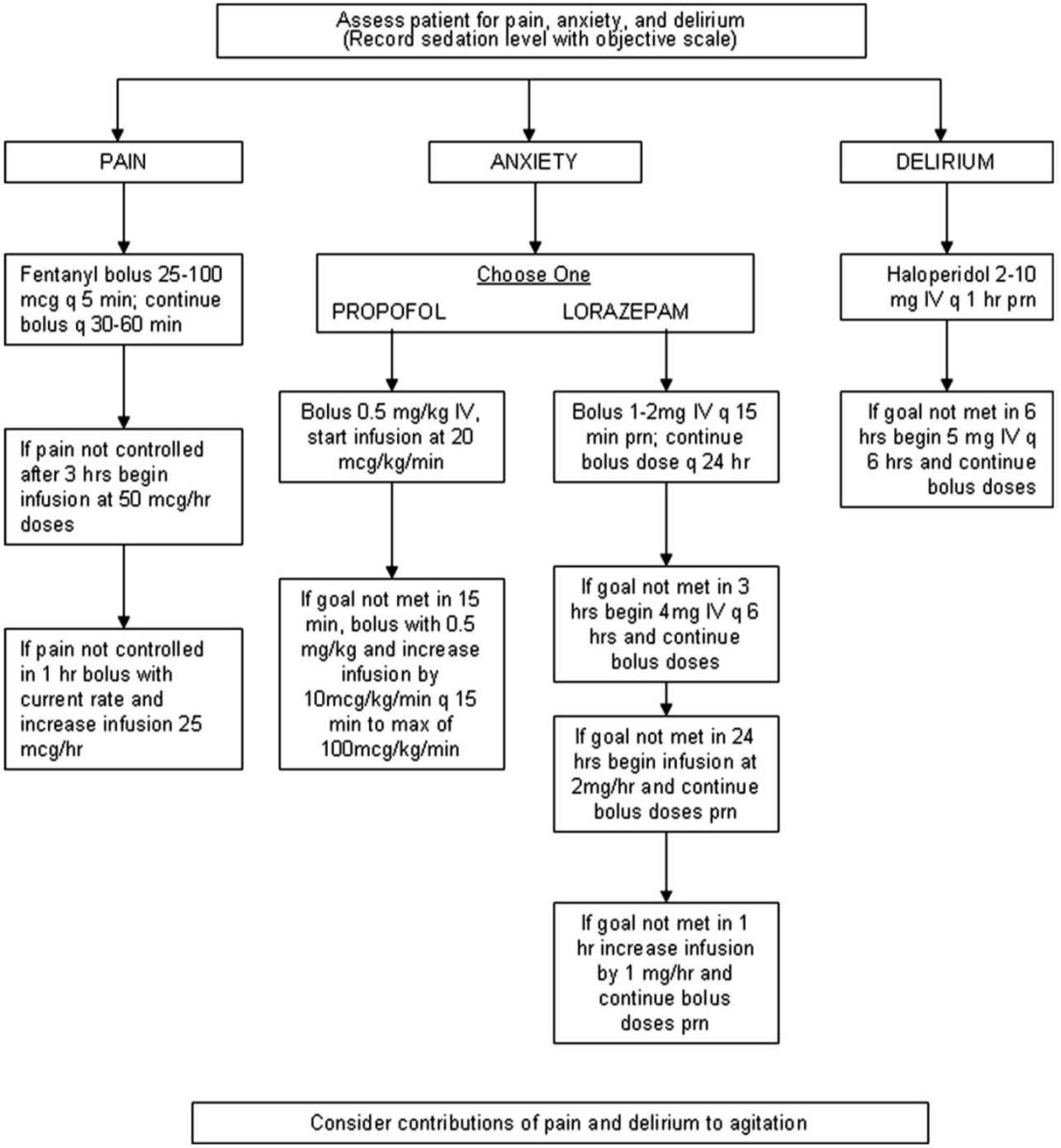
Algorithm for the Diagnosis and Treatment of VAP

呼吸器相關肺炎的治療

1. 經驗性抗生素：在取得培養結果報告前，先針對G^+ MRSA及*P. aeruginosa*用藥
2. 確認培養結果及敏感性後：選擇適當的抗生素（de-escalation），若在**48 -72 hrs**後定量細菌培養低於CDC訂定 VAP的閾值，建議可以停藥
3. 抗生素使用期間：達到適當的臨床效果（沒有發燒、白血球值正常、痰分泌量減少、呼吸狀況改善達**24 hrs**以上）

Guidelines for Sedation and Analgesia During Mechanical Ventilation General Overview

J Trauma. 2007;63:945–950



Sedation or analgesia protocol for mechanical ventilation.

Richmond Agitation Sedation Scale (RASS)

Clinical Status	RASS
Combative	4
Very agitated	3
Agitated	2
Anxious	1
Alert, calm	0
Maintain eye contact $\geq$ 10 sec.	-1
Maintain eye contact $<$ 10 sec.	-2
Eye opening, no contact	-3
Eye opening with stimuli only	-4
Unresponsive	-5

RASS鎮靜程度評估表(Richmond Agitation-Sedation Scale)

+4	有攻擊性	有暴力行為
+3	非常躁動	試著拔除呼吸管、鼻胃管或靜脈點滴
+2	躁動焦慮	身體激烈移動，無法配合呼吸器
+1	不安焦慮	焦慮緊張、但身體只有輕微移動
0	清醒平靜	清醒，自然狀態
-1	昏昏欲睡	沒有完全清醒，但可維持清醒超過十秒
-2	輕度鎮靜	無法維持清醒超過十秒
-3	中度鎮靜	對聲音有反應
-4	重度鎮靜	對身體刺激有反應
-5	昏迷	對聲音及身體刺激都沒有反應

ABCDE Bundle

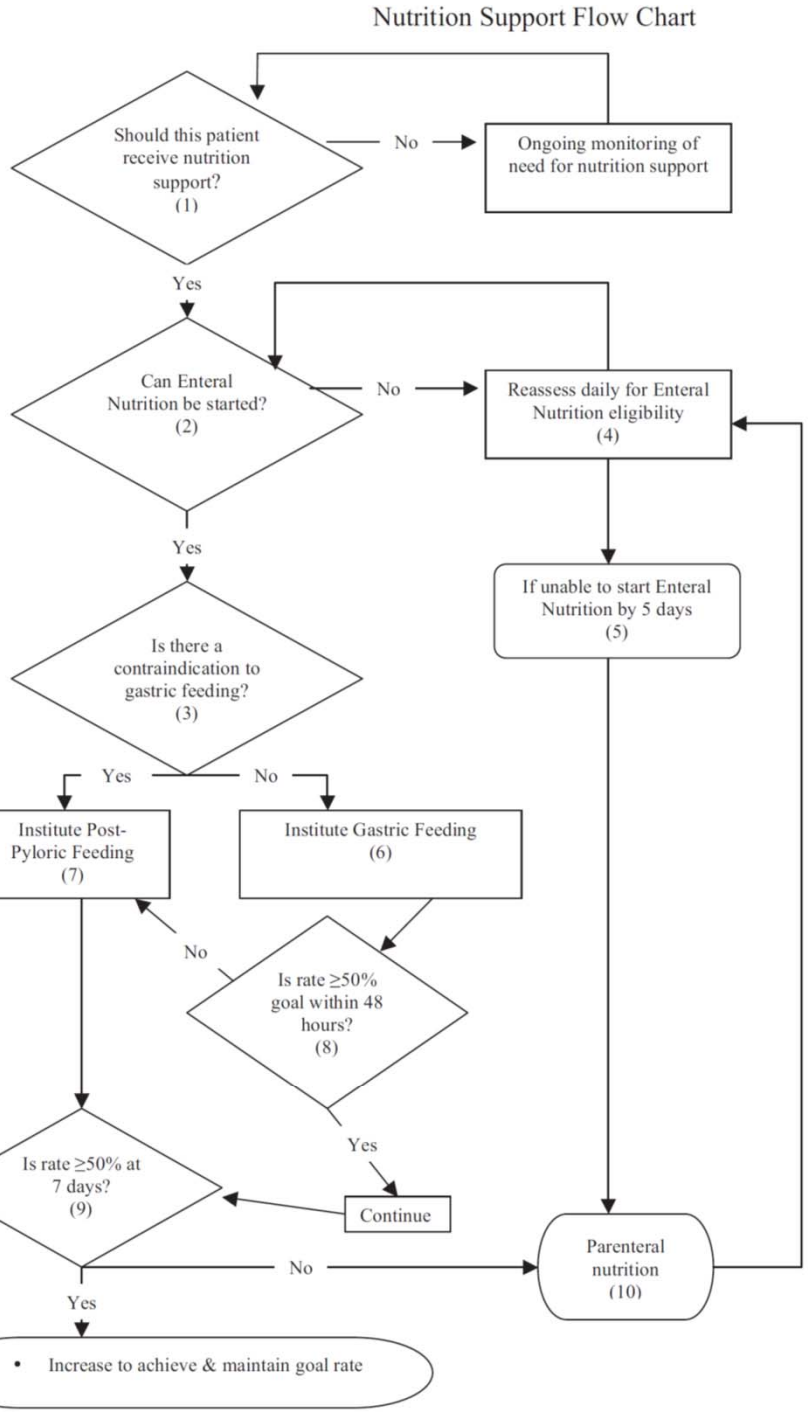
Society of Critical Care Medicine (SCCM) 2013 42nd Critical Care Congress

Crit Care Med. 2013 JAN;41(1).263-306

- **A**wakening：中斷給鎮靜劑讓病人嘗試每天醒來一次(Daily Interruption of Sedatives, DIS)
- **B**reathing：讓病人中斷機械式換氣嘗試自己呼吸(SBT)
- **C**oordination：由護理師及呼吸治療師每天協調實踐A + B
- **D**elirium：使用ICDSC或CAM-ICU兩種診斷工具監測(Monitor)病人精神狀況並做治療(Management)
- **E**xercise或**E**arly rehabilitation：幫病人早期做復健

Nutritional Support of the Trauma Patient

J Trauma. 2008;65:1520 –1528



Nutrition support flow chart.

Nutritional Flow Chart Legend

外傷重症照護的前**72 hrs**先不考量腸道營養

- frequent interruptions for operative procedures
- shock
- ongoing massive resuscitation
- intestinal discontinuity

Nutritional Flow Chart Legend

1. after **5 days**, if enteral support not started or unsuccessful, parenteral nutritional support started
2. gastric feeding started at 25 mL/hr and residual volume measured q4h, rate advanced by 25 mL/hr q8h until goal rate reached, in absence of intolerance
3. nasojejunal tube or jejunostomy feeding indicated when gastric feeding contraindicated or intolerance (50% of goal rate not been achieved by 48 hrs)

Glycemic control and intensive insulin therapy in critical illness

UpToDate: May 29, 2018

Glycemic control in critical trauma patients

compared to normoglycemic patients, hyperglycemic patients had a significantly increased mortality rate (26% vs 12%) and incidence of nosocomial infection (52% vs 32%)

Admission hyperglycemia is predictive of outcome in critically ill trauma patients.

J Trauma. 2005 Jul;59(1):80-3

Glycemic control in critical illness

Leuven surgical trial: 1548 surgical ICU patients

IIT (intensive insulin treatment): 血糖值 80~110 mg/dL

conventional glucose control: 血糖值 180~200 mg/dL

- ICU mortality lower in IIT (4.6% vs 8%)
- Hospital mortality lower in IIT (7.2% vs 10.9%)
- Hypoglycemia (血糖值 <40 mg/dL) frequent in IIT (5.1% vs 0.8%)

Intensive insulin therapy in critically ill patients.

N Engl J Med. 2001;345(19):1359-67

Glycemic control in critical illness

NICE-SUGAR trial: 6104 medical and surgical ICU patients

IIT: 血糖值 81~108 mg/dL

conventional glucose control: 血糖值 <180 mg/dL

- lower blood glucose in IIT (115 vs 144 mg/dL)
- higher 90 day mortality in IIT (27.5% vs 24.9%, OR 1.14, 95% CI 1.02-1.28)
- higher incidence of severe hypoglycemia (血糖值 <40 mg/dL) in IIT (6.8% vs 0.5%)

Intensive versus conventional glucose control in critically ill patients.

N Engl J Med. 2009;360(13):1283-97

Glycemic control in critical illness

NICE-SUGAR trial: subgroups

- 2232 operative patients

  higher mortality in IIT (24.4% versus 19.8%, OR 1.31, 95% CI 1.07-1.61)

- 315 traumatic brain injury (TBI) patients

  no differences in long term (24 month) neurologic outcome (ITT vs conventional therapy: 60% vs 53%)

  mortality (21% vs 23%)

Intensive versus conventional glucose control in critically ill patients with traumatic brain injury: long-term follow-up of a subgroup of patients from the NICE-SUGAR study.

Intensive Care Med. 2015 Jun;41(6):1037-47

Intensive insulin therapy in critical illness

- recommended blood glucose target of 140 to 180 mg/dL in most critically ill adult patients, rather than a more stringent target (80 to 110 mg/dL) or a more liberal target (180 to 200 mg/dL)
- avoid use of intravenous fluids that contain glucose and administer insulin (except young children)
- using insulin infusions and intermittent short-acting insulin to avoiding prolonged hypoglycemia
- careful monitoring of blood glucose is mandatory
- once acute illness resolved, transitioning to longer-acting insulin in the ICU patients (enterally fed)

Why is sepsis resuscitation not more like trauma resuscitation? Should it be?

J Trauma Acute Care Surg. 2015;79(4):669–677.

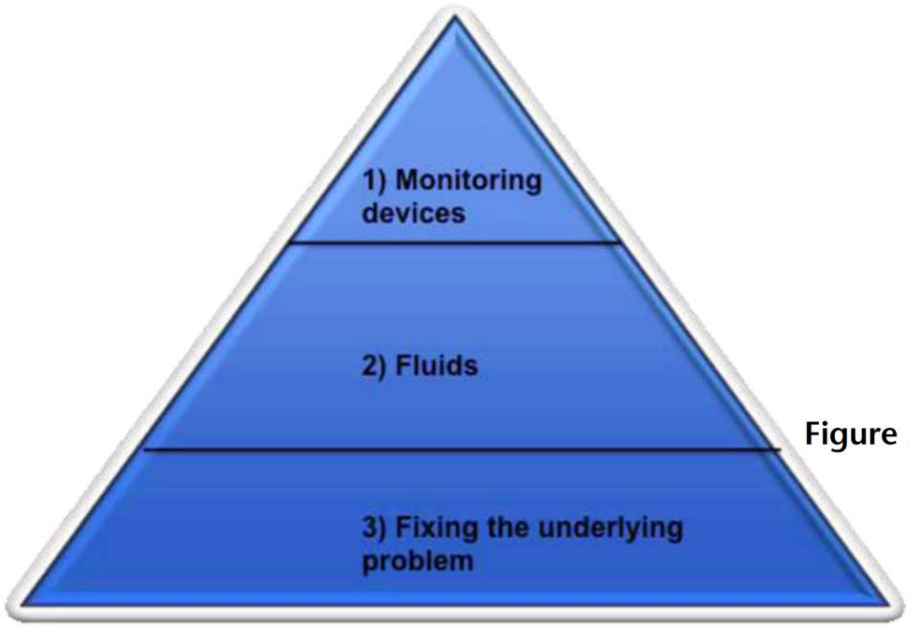


Figure 1. Resuscitation priorities in sepsis.

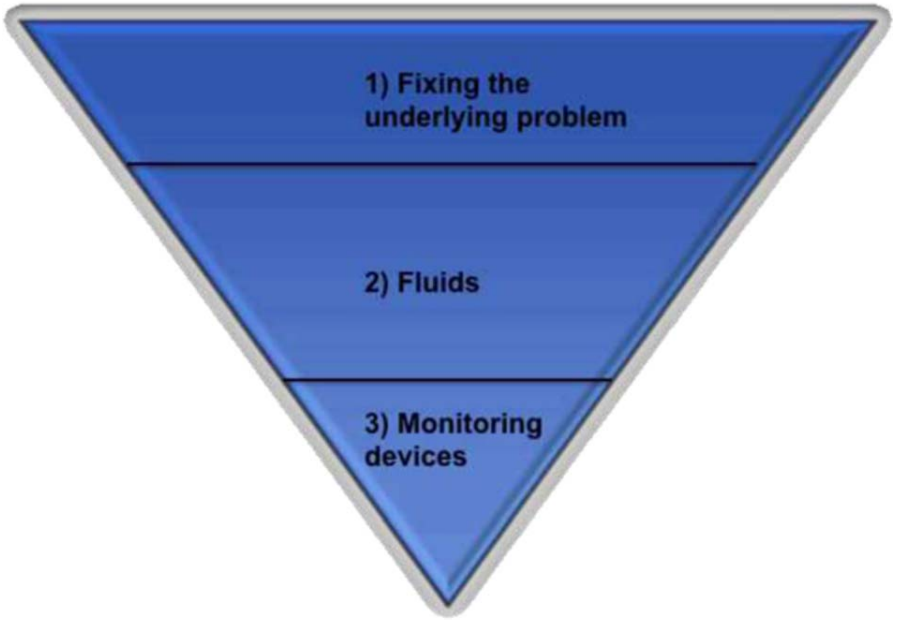
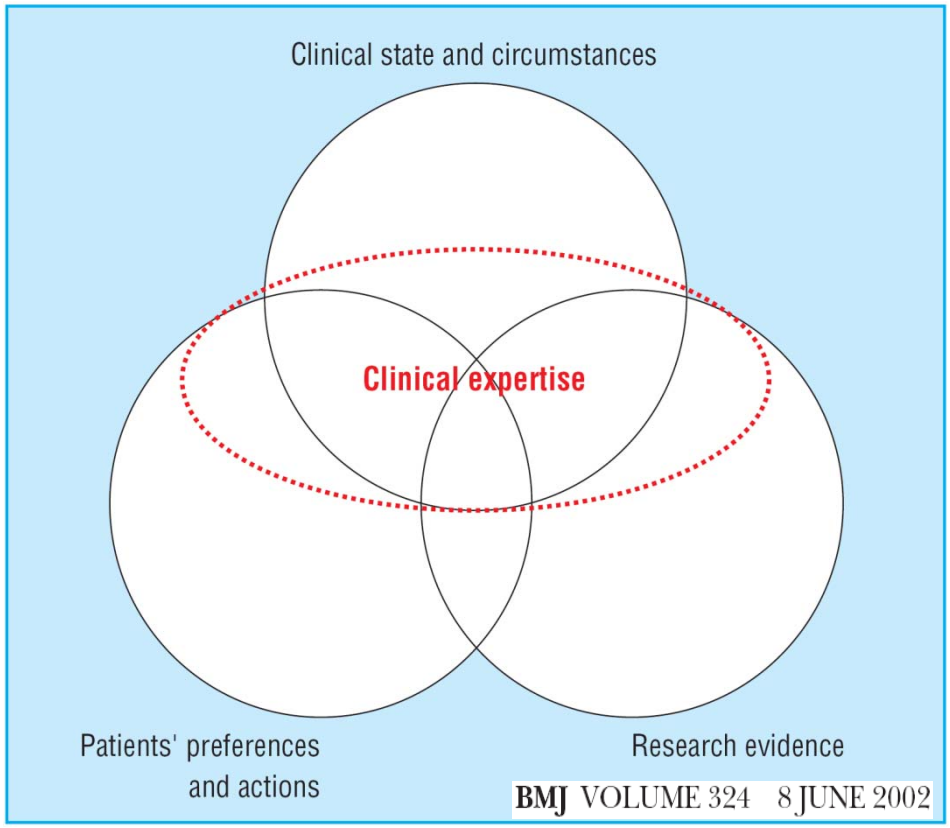


Figure 2. Resuscitation priorities in trauma.



Evidence does not make decisions, people do

We supply evidence, you make the decisions.

The experience of the clinical practice guideline movement has shown that it is nearly impossible to make recommendations that are appropriate in every situation.

Clinical Evidence- BMJ Publishing Group

Thanks for Attention!