

Journal reading

指導老師:曾理銘醫師

報告:pgy張寬頡

101.12.24

第一篇

Original article

Resuscitative emergency thoracotomy in a Swiss trauma centre

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前言

- **Emergency thoracotomy (ET)** 緊急開胸對非常危急的病患到底有沒有幫助
 - no indications and associated risks
 - low survival rates → blunt trauma
- 胸部創傷大多數是鈍傷會造成:
 - Tension pneumothorax
 - cardiac tamponade
 - haemorrhagic shock

- **Emergency thoracotomy (ET)** 可以做什麼:
 - release cardiac tamponade
 - 直接止血,修補
 - 心臟按摩
 - 直接夾血管
- 在美國和南非多是穿刺傷,與歐洲多是鈍傷不同且討論的文章較少

方法

- 迴溯分析1996-2008 在此創傷中心的急診室或刀房接受ET的病患
- 做 **ET Indications:**
 - 在運送途中或現場量不到血壓但還有生命跡象的胸部穿刺傷病患
 - 剛到院才沒有生命跡象的胸部鈍傷病患
 - 嚴重失血(對輸液無反應)
 - 在現場就沒有生命跡象的不做

結果

Table 1 Demographic and clinical injury characteristics in patients undergoing emergency thoracotomy

	All thoracotomies (n = 121)	EDT (n = 49)	ET in OR (n = 72)	P†
Age (years)*	38 (16–84)	39 (16–80)	38 (16–84)	0.940†
Sex ratio (M: F)	92: 29	38: 11	54: 18	0.747
Penetrating mechanism of injury	38 (31)	10 (20)	28 (39)	0.032
Gunshot wound	12 (10)	4 (8)	8 (11)	0.760
Stab wound	23 (19)	5 (10)	18 (25)	0.042
Impalement	3 (3)	1 (2)	2 (3)	1.000
Systolic BP on admission (mmHg)*	90 (0–135)	60 (0–105)	110 (98–135)	< 0.001†
Haemorrhagic shock class III–IV	91 (75)	45 (94)	45 (63)	< 0.001
GCS score*	3 (3–15)	3 (3–15)	3 (3–15)	0.071
ISS	41 (16–70)	43 (16–70)	36 (16–66)	0.257†
Head AIS ≥ 3	50 (41)	26 (53)	24 (33)	0.031
Chest AIS ≥ 3	118 (98)	48 (98)	70 (97)	1.000
Abdominal AIS ≥ 3	61 (50)	30 (61)	31 (43)	0.050
Extremity AIS ≥ 3	39 (32)	17 (35)	22 (31)	0.633

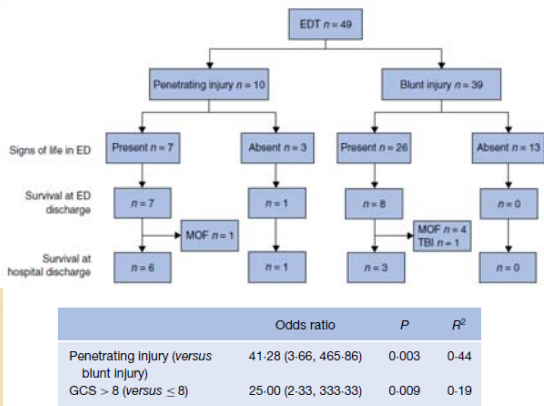


Table 2 Demographic and clinical injury characteristics in surviving and non-surviving patients who underwent emergency department thoracotomy

	All EDTs (n = 49)	Survivors (n = 10)	Non-survivors (n = 39)	P†
Age (years)*	39 (16–80)	32 (16–55)	39 (16–80)	0.8901
Sex ratio (M:F)	38:11	9:1	29:10	0.419
CPR en route	19 (39)	1 (10)	18 (46)	0.066
Signs of life				
At scene	46 (94)	10 (100)	36 (92)	1.000
En route	40 (82)	9 (90)	31 (80)	0.663
On admission	33 (67)	9 (90)	24 (62)	0.135
Penetrating mechanism of injury	19 (20)	7 (70)	12 (31)	<0.001
Gunshot wound	4 (8)	4 (40)	0 (0)	0.001
Stab wound	5 (10)	3 (30)	2 (5)	0.051
Impalement	1 (2)	0 (0)	1 (3)	1.000
Systolic BP on admission (mmHg)*	60 (0–105)	100 (80–105)	48 (0–90)	0.006
Haemorrhagic shock class III–IV	46 (94)	9 (90)	38 (97)	0.102
GCS score*	3 (3–15)	11 (3–15)	3 (3–15)	<0.001‡
ISS*	43 (16–70)	38 (25–59)	45 (16–70)	0.119‡
Head AIS ≥ 3	26 (53)	1 (10)	25 (64)	0.003
Chest AIS ≥ 3	43 (88)	10 (100)	33 (87)	1.000
Abdominal AIS ≥ 3	30 (61)	5 (50)	25 (64)	0.480
Extremity AIS ≥ 3	17 (35)	3 (30)	14 (36)	1.000



	All EDTs (n = 49)	Survivors (n = 10)	Non-survivors (n = 39)
Intrathoracic injuries			
Cardiac injury	10 (20)	2 (20)	8 (21)
Intrathoracic vascular injury	9 (18)	3 (30)	6 (15)
Lung parenchymal injury	38 (78)	8 (80)	30 (77)
Intra-abdominal injuries			
Severe liver rupture	11 (22)	2 (20)	9 (23)
Splenic rupture	13 (27)	1 (10)	12 (31)
Kidney rupture	4 (8)	0 (0)	4 (10)
Intra-abdominal aortic laceration	3 (6)	1 (10)	2 (5)
Pelvic fracture with ongoing bleeding	9 (18)	0 (0)	9 (23)



討論

- 穿刺傷 + 有生命跡象 Outcome 最好(6/7)
- 鈍傷 + 無生命跡象=無人生還
- 鈍傷 + 有生命跡象 = 12%(3/26)
- 爭論: American College of Surgeons Committee on Trauma 7035 meta-analysis
 - 穿刺 11.2% VS. 鈍傷 1.6%
 - 建議: 心胸穿刺傷, 嚴重失血腹部穿刺要ET
 - 鈍傷要有生命跡象或cardiopulmonary arrest



- 到院前緊急開胸
- London Helicopter Emergency Medical Service (HEMS)
 - 胸部穿刺傷且心搏停止
 - 急救人員到場小於10分鐘
 - 到最近的急診大於5分鐘
 - 18%(13/71)
 - 鈍傷的outcome很差
- OR outcome 比較好: patient selection



limitations

- 個案少
- 沒有長期結果
- 腦死但EDT保留器官
- 長期→醫學進步影響

第二篇



Short communication

Emergent pediatric thoracotomy following traumatic arrest^{☆,☆☆,★}

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目標

- 評估兒童做緊急開胸術後存活率
- 分辨不同特性對存活率的影響

前言

- 成人證實有幫助
 - Meta-analysis 24篇 4620 人
 - 整體存活率:7.4% 神經學功能正常:92.4%
- 兒童尚缺乏實證
 - 舊Paper:比成人存活率低

方法

- 回溯性世代研究
- 1995 ~ 2009 Denver Health Medical Center
- 由於沒有indication→由醫師自行決定
- 標準左前胸;經胸骨開胸
- Include:
 - (1)軀幹穿刺傷,或明顯鈍傷
 - (2)到急診時沒有脈搏,或運送途中脈搏消失
 - (3)在急診做緊急開胸。
- 在刀房做的排除

Characteristics of children undergoing emergent thoracotomy following trauma.

	Age	Gender	Mechanism	SIX	ROSC	Injury	Outcome
Blunt trauma	2	M	Fall	Y	Y	Brain	Death
	5	F	Auto-ped	Y	Y	Abdominal organs	Death
	5	F	Auto-ped	N	N	Brain	Death
	10	M	Auto-bike	Y	N	Lung, brain	Death
	11	M	MVC	Y	N	No autopsy	Death
	13	M	Auto-ped	N	N	Lung, brain	Death
	13	F	MVC	N	Y	Brain, face	Death
	14	M	MVC	Y	N	Lung, brain, liver	Death
	14	M	Fall	Y	N	Brain, cervical spine, abdominal organs	Death
	15	F	MVC	N	N	No autopsy	Death
	15	M	MVC	Y	N	Aorta, brain, cervical spine	Death
	15	M	MVC	Y	Y	No autopsy	Death
	16	M	MVC	Y	Y	Brain	Death

- 沒生命跡象 31% (4/13) underwent ET
- 1(8%)心臟大血管受傷

Penetrating trauma	11	F	GSW	Y	N	No autopsy	Death
	15	M	GSW	N	N	Aorta, heart, abdominal organs	Death
	15	M	CSW	N	N	Heart	Death
	15	M	SW	N	N	No autopsy	Death
	16	M	GSW x 2	N	N	Subclavian artery, jugular vein	Death
	16	M	GSW x 4	N	N	Heart, lungs, abdominal organs	Death
	16	M	GSW	N	N	No autopsy	Death
	16	M	SW	N	N	Aorta	Death
	17	M	GSW x 2	N	N	Aorta	Death
	17	M	SW x 2	N	N	Heart	Death
	17	M	GSW x 2	N	N	No autopsy	Death
	17	M	SW	N	N	Lung	Death
	17	M	SW	N	N	Heart	Death
	17	M	SW	Y	Y	Heart	Survive
	17	M	SW	Y	Y	Heart	Survive
	17	M	SW	Y	Y	Heart	Survive

- 沒生命跡象 12 (75%) underwent ET
- 11 (69%) 心臟大血管受傷
- 有生命跡象 且是穿刺傷 75%(3/4)存活

討論

- 20年來只有兩篇 共34個兒童 2人存活
- 緊急開胸對兒童外傷性心搏停止有助益特別是穿刺傷
- 舊的paper 0~4% VS. 10% 這篇paper
 - 原因: prehospital care, more rapid transport, pediatric trauma centers.
- 與成人相同: 穿刺傷且到院時還有生命跡象有較好存活率
- 兒童緊急開胸量很少
 - 原因: 兒童創傷後少心搏停止
 - 之前沒有數據顯示對兒童有幫助
 - 不會開

Limitation

- Case太罕見, 需要multi-center研究
- 沒有完整記錄運送時間及脈搏停止時間
 - 在成人少於10分鐘才建議開胸
- 個案沒包含幼童是心胸創傷
- Selection bias → 醫師決定要不要開

結論

- 有可能對存活有幫助
- 急診醫師要能執行兒童緊急開胸
- 兒童創傷後心搏停止要送到能兒童緊急開胸醫院

第三篇

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www.ictvs.org

Case report - Cardiac general

'Scoop and run' strategy for a resuscitative sternotomy following unstable penetrating chest injury

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Case report

- 31y/o 男性 來地區醫院急診
- 左第二肋間離胸骨三公分處有穿刺傷
- 2 X 7.5公分小刀
- 有意識, 但休克 BP:60/45
- CXR: 左側大量血胸, drain 1.5L
- 持續輸血 → SBP:80 出血持續, 需要立即開胸探查
- 插管送35公里外心胸中心

- 到達時已輸血20U
- 此時Hb:9.3
- CVP:50 mmHg 臉充血, 頸靜脈怒張
- 體溫33.1°C
- 緊急中央胸骨切開術 → 心包膜切開 → 大量血塊及鮮血 → 使用自體血液回收儀器
 - 左內乳動脈斷
 - 左上肺葉撕裂傷
 - 心包膜破裂
 - 主肺動脈破裂
 - 6.5小時後拔管 7天後出院

討論

- 到達心胸中心時的休克原因
 - bleeding LIMA and lacerated lung
 - Cardiac tamponade
 - 應該要做 Pericardiocentesis
- 早期paper
 - 胸腹部外傷導致心搏停止要急診緊急開胸處理 cardiac tamponade和做 open cardiac massage
 - 不管鈍傷或是穿刺傷→沒有受益
- 可在刀房開→狀況比較好→修正之後還是刀房好

- 在地區醫院:留下來 VS. 快送走
 - 這篇是後者的成功例子
 - 有經驗的專家好的設備
 - autologous cell saver
 - perform sternotomy
 - cardiopulmonary bypass.
- Median sternotomy比thoracotomy好
 - 手術視野包含縱膈腔和兩側胸腔
 - Overlooked main pulmonary artery
- 要仔細評估
 - 左 或 右胸
 - 高位前胸 或 外側胸
 - 年紀大已及合併症多不適合長途的轉院

結論

- 留下來 一般外科開
 - 病人狀況不適合轉院
 - 右側或外側 心血管外傷機率較低
- 其他馬上轉 有心胸外專科以及設備 開
 - 穿刺傷
 - 路程以及交通狀況許可 (少於25分鐘)

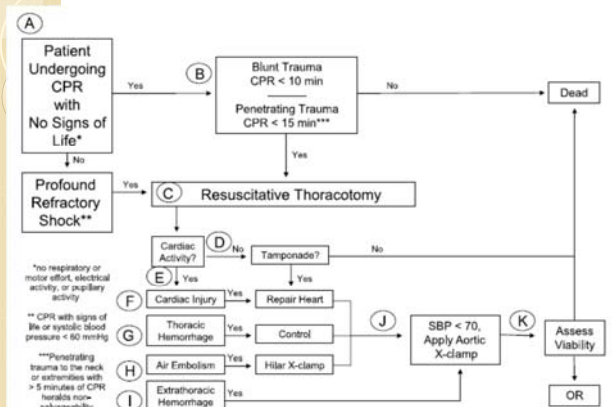
第四篇

WTA 2012 ALGORITHM

Western Trauma Association Critical Decisions in Trauma:
Resuscitative thoracotomy

Clay Cothren Burlew, MD, Ernest E. Moore, MD, Frederick A. Moore, MD, Raul Coimbra, MD,
Robert C. McIntyre, Jr., MD, James W. Davis, MD, Jason Sperry, MD,
and Walter L. Biff, MD, Denver, Colorado

- 穿刺傷+心臟受傷=35%
- 穿刺傷=15%
- 鈍傷休克=2%
- 鈍傷沒生命跡象=1%



第五篇

Endovascular balloon occlusion of the aorta is superior to resuscitative thoracotomy with aortic clamping in a porcine model of hemorrhagic shock

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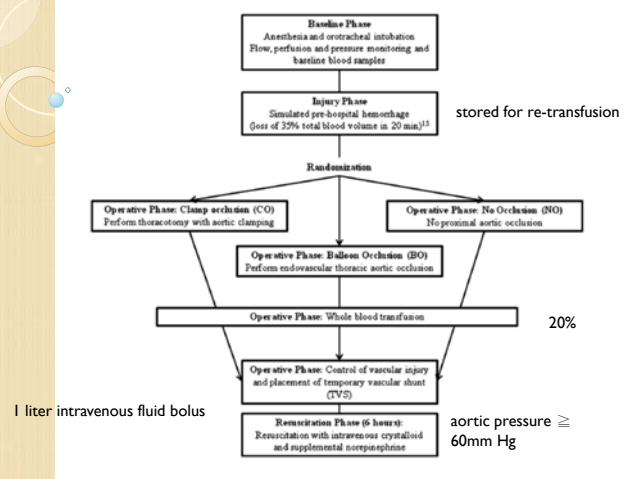
(Surgery 2011;150:400-9.)

前言

- 戰場上最常見死因
 - 無法壓迫止血的軀幹出血
- 1976年Ledgerwood:緊急開胸夾動脈
 - 有效保持血壓控制出血
 - 非常侵入,沒幾個活
 - 沒其他替代方案
- Aortic balloons
 - 暫時阻塞動脈以及撐開支架用來治療動脈瘤破裂
 - 想法一樣但未有比較實驗資料

方法

- 豬 5-6個月大 70-95 kg
- 18隻 分CO,BO,NO各六隻
- 四個phase



手術細節

- exposure of
 - right carotid artery → carotid flow probe
 - jugular vein → CVP
 - right brachial artery → aortic arch → central aortic pressure
- Clamp distal to the left subclavian artery
- 放TVS → extremity reperfusion

結果

Table 1. Comparison of perfusion measurements

	Clamp occlusion	Balloon occlusion	No aortic occlusion
Central aortic pressure (mmHg)			
Baseline	57 ± 4	59 ± 4	62 ± 4
End of injury phase (t ₀)	35 ± 3	37 ± 3	30 ± 2
Operative phase: pre-TVS	138 ± 12*	146 ± 13*	45 ± 41,‡
Operative phase: post-TVS	50 ± 4	66 ± 5	48 ± 4
Resuscitation phase (t ₆₀)	48 ± 3	62 ± 3	53 ± 3
Resuscitation phase (t ₃₀₀)	57 ± 2	59 ± 3	59 ± 3
Carotid flow (mL/min)			
Baseline	320 ± 29	259 ± 24	258 ± 27
End of injury phase (t ₀)	187 ± 22	174 ± 20	149 ± 17
Operative phase: pre-TVS	1,085 ± 110*	862 ± 87*	262 ± 271,‡
Operative phase: post-TVS	283 ± 34	333 ± 42	274 ± 33
Resuscitation baseline (t ₆₀)	321 ± 30	302 ± 28	300 ± 27
Resuscitation phase (t ₃₀₀)	351 ± 26	313 ± 24	332 ± 27
PbtO ₂ (mmHg)			
Baseline	34 ± 25	31 ± 23	30 ± 22
End of injury phase (t ₀)	27 ± 42*	26 ± 39*	12 ± 18*,1,‡
Operative phase: pre-TVS	37 ± 64*	49 ± 45*	21 ± 23*,1,‡
Operative phase: post-TVS	37 ± 26	32 ± 23	21 ± 131,‡
Resuscitation baseline (t ₆₀)	35 ± 20	32 ± 18	24 ± 131,‡
Resuscitation phase (t ₃₀₀)	30 ± 10	23 ± 7	25 ± 8

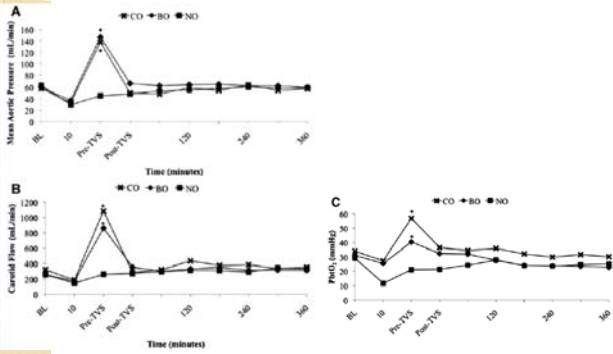


Table II. Laboratory assessment of global ischemia

	Clamp occlusion	Balloon occlusion	No aortic occlusion
Serum lactate (mmol/L)			
Baseline	1.1 ± 0.3	0.9 ± 0.2	1.0 ± 0.2
End of injury phase (t ₁₀)	1.7 ± 0.5	1.2 ± 0.4	1.6 ± 0.5
Resuscitation baseline (t ₂₀)	6.6 ± 1.1* [‡]	4.5 ± 0.7* [‡]	2.0 ± 0.5 [‡]
Resuscitation baseline (t ₃₀₀)	1.4 ± 0.3	1.4 ± 0.3	1.2 ± 0.3
Arterial pH			
Baseline	7.46 ± 0.01	7.49 ± 0.01	7.46 ± 0.01
End of injury phase (t ₁₀)	7.38 ± 0.02	7.43 ± 0.02	7.40 ± 0.02
Resuscitation baseline (t ₂₀)	7.24 ± 0.03* [‡]	7.35 ± 0.03* [‡]	7.39 ± 0.03 [‡]
Resuscitation baseline (t ₃₀₀)	7.36 ± 0.01*	7.45 ± 0.01	7.37 ± 0.02*
Base excess			
Baseline	4.9 ± 1.2	8.0 ± 1.2	6.0 ± 1.2
End of injury phase (t ₁₀)	5.5 ± 1.0	5.5 ± 1.0	4.1 ± 1.0
Resuscitation baseline (t ₂₀)	-3 ± 1.1* [‡]	0.7 ± 1.1* [‡]	3.9 ± 1.1* [‡]
Resuscitation baseline (t ₃₀₀)	2.6 ± 1.2* [‡]	5.5 ± 1.2 [‡]	1.5 ± 1.3* [‡]

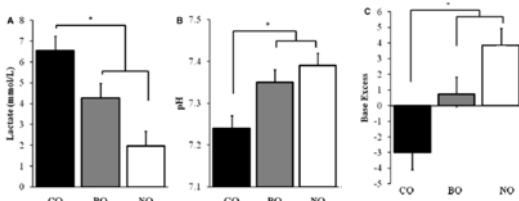
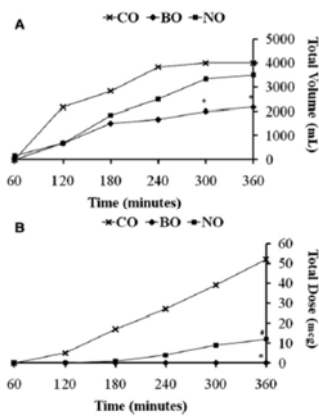


Table III. Comparison of cumulative resuscitation requirements

	Clamp occlusion	Balloon occlusion	No aortic occlusion
Cumulative IV fluid volume (mL)			
Resuscitation phase (t ₂₀)	0	0	167 ± 408
Resuscitation phase (t ₃₀₀)	2,167 ± 1,329*	667 ± 816	667 ± 516
Resuscitation phase (t ₂₀)	3,833 ± 1,835*	1,667 ± 1,870	2,229 ± 1,643*
Resuscitation phase (t ₃₀₀)	4,000 ± 1,789* [‡]	2,167 ± 1,643*	3,422 ± 1,761* [‡]
Cumulative norepinephrine (mcg)			
Resuscitation phase (t ₂₀)	0	0	0
Resuscitation phase (t ₃₀₀)	5 ± 7	0	0 ± 1
Resuscitation phase (t ₂₀)	27 ± 20* [‡]	0	4 ± 7 [‡]
Resuscitation phase (t ₃₀₀)	52 ± 28* [‡]	0	12 ± 14* [‡]



討論

- 藉由這篇動物實驗顯示在第四級出血性休克時
- BO與CO一樣好：
 - 增加中央動脈壓
 - 頸動脈壓
 - 腦氧分壓
- BO比CO好：
 - less acidosis
 - 更少輸液及昇壓劑需求

- Spence: BO與open cardiac massage併用
 - 增加130%中央動脈壓
 - 增加100%腦灌流
- Sesma: BO與胸外按壓併用
- 增加150%冠狀動脈灌流
- 增加200%腦灌流
- BO 尚未被廣泛臨床應用
 - 原設計用來堵擴大的動脈瘤 直徑大
 - 在手術室有影像儀器輔助
 - 改良後可能成為下一個tourniquets般成功

Limitations

- reperfusion 時間太短,看不出死亡率差異
- 個案數太少
- 存活率很高 可能出血量定得不夠
- 出血太少,人工造成出血點 無法代表實際情況
- 要開發小尺寸,適合外傷場景的OB system

結論

- 動脈氣球栓塞
 - 可有效增加中央動脈壓及腦灌流
 - 與緊急開胸相比,較不影響生理數值
- 改良後的外傷專用動脈氣球栓塞系統
 - 適用無法壓迫的外傷出血
 - 也適用心搏停止後的處置