重症脑损伤患者的机械通气撤离

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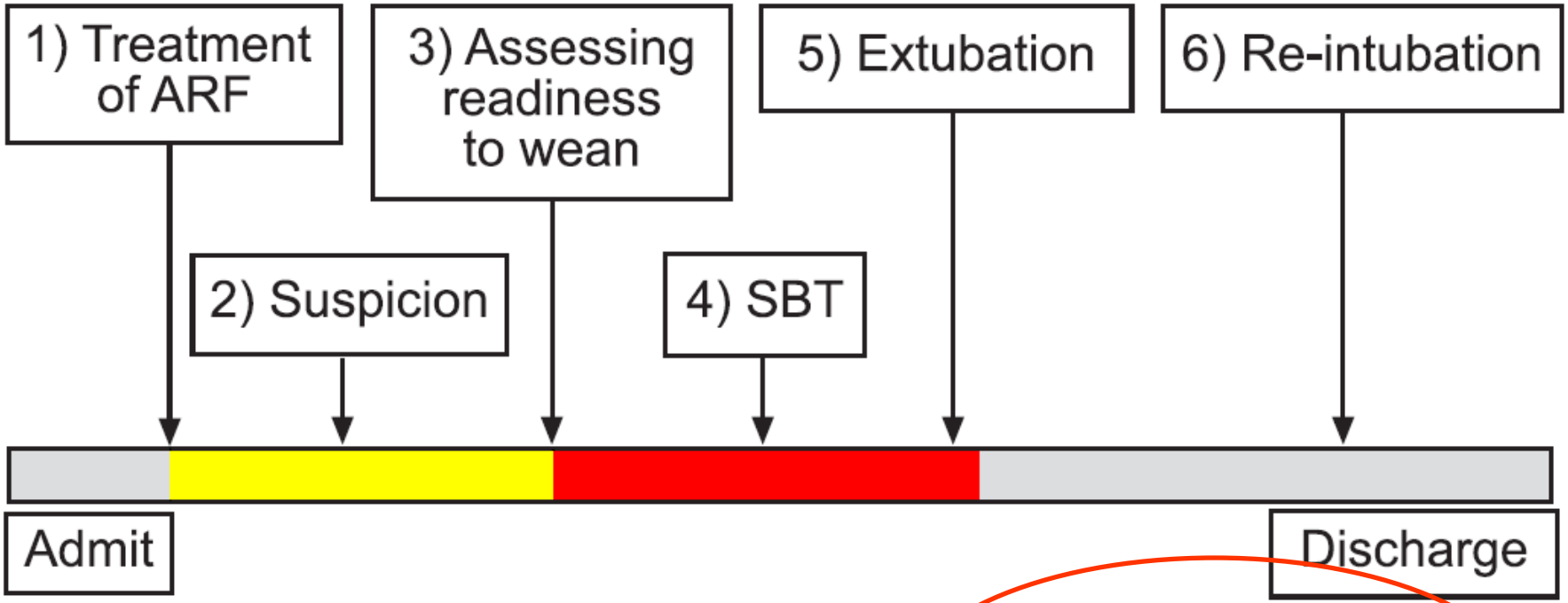
神经危重患者机械通气的流行病学

- ICU中接受MV支持的患者中，约20%为神经源性病因
- 与非神经源性病因相比，这些患者的MV时间长、转归差

Esteban A, et al. 2000, 2002; Kelly BJ, et al. 1993

撤机是一个过程



- 脱离呼吸机
  - 考虑开始撤机 – 判断1
  - 试验性撤机 – 实施SBT和判断2
    - 失败 – 处理困难撤机
    - 成功 – 是否拔管

- 人工气道的解除—判断3
  - 失败—如何处理
  - 成功—转出患者

Tobin MJ. Role and interpretation of weaning predictors. Presented at the 5th International Consensus Conference in Intensive Care Medicine. 2005

SBT

- T管
- PSV：PS=5-10；PEEP=5
- CPAP：=5

- 综合重症患者，一般SBT 30min

SBT成功后的再插管率平均为13%

Incidence of weaning success and failure

First author	Yr	Subjects	Failed initial SBT	Passed Initial SBT	Re-intubated	Total failed weaning	Successful weaning
FARIAS	2001	257	56 (22)	201	28 (14)	84 (32.7)	173
ESTEBAN	1999	526	73 (14)	453	61 (13)	134 (25.5)	392
VALLVERDU	1998	217	69 (32)	148	23 (16)	92 (42.4)	125
ESTEBAN	1997	484	87 (18)	397	74 (19)	161 (33.3)	323
ESTEBAN	1995	546	130 (24)	416	58 (14)	188 (34.4)	358
BROCHARD	1994	456	109 (24)	347	8 (3)	117 (25.6)	339
Total		2486	524/2486 (21%)	1962/2486 (79%)	252/1962 (13%)	776 (31.2%)	1710/2486 (68.8%)

Data are presented as n or n (%), unless otherwise stated. SBT: spontaneous breathing trial

Boles JM, et al. Eur Respir J 2007

再插管的危险因素

- 内科、儿科患者(25%)的发生率高于外科患者(5%)
- 神经科患者最危险 – 最高的报道达36%

- 高龄>70yr
- MV时间
- 贫血: Hb<10g/dl
- 拔管当日APACHE评分
- 拔管前日液体正平衡
- 拔管前f/Vt
- 应用镇静剂
- 拔管后立即转出ICU
- ICU医师和护士与床位的比例

对脑损伤患者拔除气管导管的顾虑

意识障碍

气道保护性反射损害

Epstein SK. Intensive care medicine 2002

预测神经外科患者拔管成功率

- 100例接受MV的神经外科危重患者，每日筛查，通过后进行2h SBT
- 评价GCS，测定f/V_T、P/F、V_E
- 拔管的决定权在主管医师
- 通过SBT但当日未拔管：75%（84%的情况是医师担心意识水平）

Namen AM, et al. AJRCCM 2001

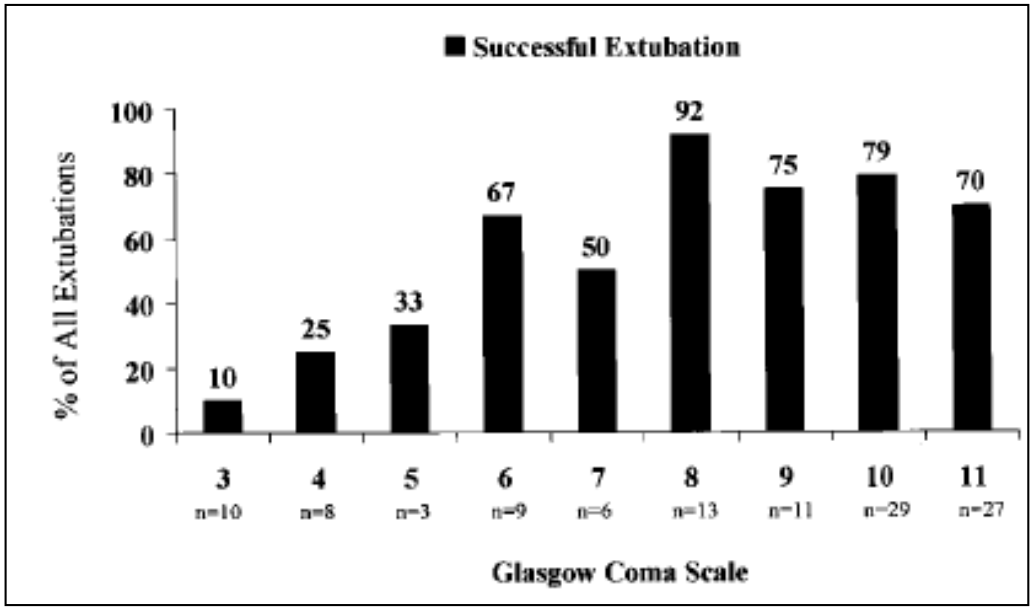
成功拔管的决定因素

TABLE 3. FACTORS ASSOCIATED WITH SUCCESSFUL EXTUBATION IN NEUROSURGICAL PATIENTS AFTER FIRST EXTUBATION ATTEMPT

	Univariate Analysis			Multivariate Analysis		
Parameter	OR	95% CI	p Value	OR	95% CI	p Value
GCS score	1.35	(1.2–1.5)	< 0.0001	1.24	(1.1–1.4)	0.0006
f/V_T ratio	0.99	(0.98–0.99)	< 0.0001	0.99	(0.985–0.997)	0.0050
P/F ratio	1.01	(1.00–1.01)	0.0001	1.01	(1.002–1.007)	< 0.0001
$\dot{V}_E$	0.89	(0.85–0.94)	< 0.0001	0.92	(0.845–0.981)	< 0.0116

Definition of abbreviations: CI = confidence interval; F = flow; *f* = frequency of respiration; GCS = Glasgow Coma Scale; OR = odds ratio; P = pressure; $\dot{V}_E$ = minute volume; V_T = tidal volume.

GCS与拔管成功率的关系



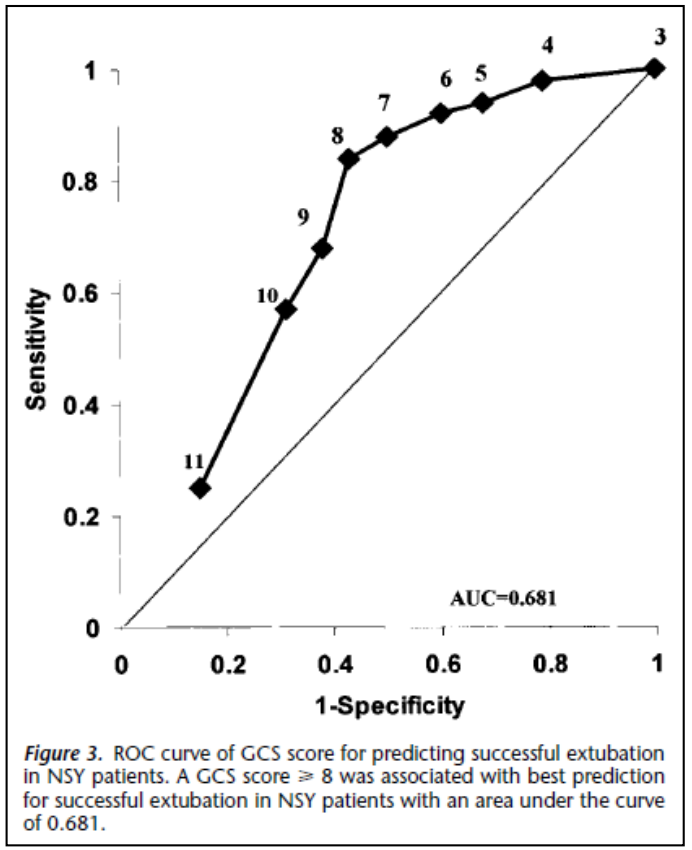


Figure 3. ROC curve of GCS score for predicting successful extubation in NSY patients. A GCS score ⩾ 8 was associated with best prediction for successful extubation in NSY patients with an area under the curve of 0.681.

f/V_T的预测价值

- 平诊神经外科术后MV时间超过6h患者：92例
- 排除标准
  - 脱机前气管切开或死亡
  - 意外拔管
  - 术前已经建立人工气道

Vidotto, MC, et al. Neurocrit Care 2008

每日筛查和SBT

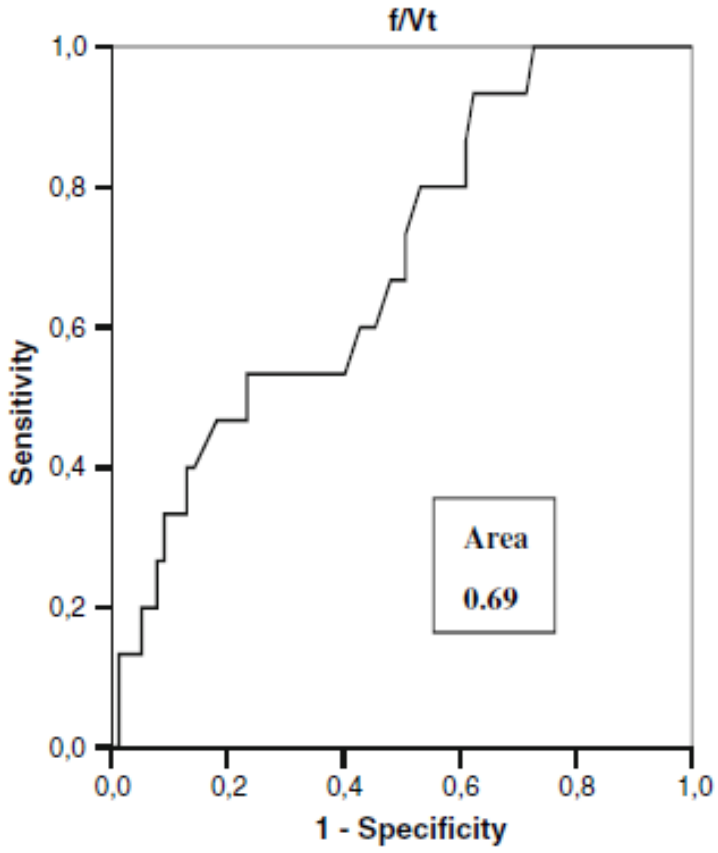
- 每日筛查
  - GCS≥8
  - 体温<38℃
  - 无血管活性药（允许多巴胺或多巴酚丁胺<5μg/kg/min）
  - 呼吸：PaO2>60mmHg(FiO2<40%) ;PEEP<5cmH2O
- SBT：120minT管 或 PS<8cmH2O/PEEP<5cmH2O
  - SaO2<90%
  - RR>35rpm>10min
  - SBP变化>20%
  - 呼吸做功增加的表现>15min
  - 呼吸窘迫或躁动
- 通过SBT的患者测量V_E、f、V_T；评价GCS

拔管失败的原因

- 92例患者中15例（16%）48小时内再插管
  - 意识水平降低 53%
  - 呼吸窘迫 20%
  - 气道保护障碍（误吸或气道梗阻） 13.5%
  - 癫痫 13.5%

f/V_T的预测价值

- 90例患者在拔管前f/V_T<105
- 预测界值62
  - 敏感度：0.75
  - 特异度：0.53



神经危重患者拔管延迟

- 136例气管插管的脑损伤患者
  - TBI、SAH、缺血性卒中、癫痫、脑膜炎
- 研究人员与主管医师双盲，研究过程中未实施干预措施
  - 研究人员，判断患者是否可拔除气管插管
  - 主管医师决定是否拔除气管插管

Coplin WM, et al. AJRCCM 2000

拔管判断1

TABLE 2

CRITERIA USED TO DETERMINE READINESS FOR DISCONTINUATION OF VENTILATORY SUPPORT*

Category	Criteria
Neurologic status	Physical examination not deteriorating ICP < 20 mm Hg (when ICP measured) CPP ≥ 60 mm Hg (when ICP measured)
Cardiovascular status	Systolic BP > 90 and < 160 mm Hg HR > 60 and < 125 beats/min No acute dysrhythmia
Arterial oxygenation	$Pa_{O_2}/F_{I_{O_2}}$ ≥ 200 mm Hg Pa_{O_2} ≥ 80 mm Hg on $F_{I_{O_2}}$ ≤ 0.50 (on ≤ 5 cm H_2O PEEP)
Spontaneous ventilatory mechanics	MIP > 20 cm H_2O RSBI (f/V_T) < 105 Spontaneous $\dot{V}_E$ ≤ 12 L/min Spontaneous $\dot{V}_E$ ≥ 80% of ventilator spontaneous $\dot{V}_E$
Absence of specific indication for mechanical ventilation	Surgery requiring general anesthesia not planned within 72 h No deliberate hyperventilation Cervical-spine status cleared

拔管判断2

TABLE 3

SEMIQUANTITATIVE ASSESSMENT OF NEED FOR AIRWAY CARE

Spontaneous Cough		Gag		Sputum Quantity	
0	Vigorous	0	Vigorous	0	None
1	Moderate	1	Moderate	1	1 pass
2	Weak	2	Weak	2	2 passes
3	None	3	None	3	⩾ 3 passes

Sputum Viscosity		Suctioning Frequency (*per last 8 h*)		Sputum Character	
0	Watery	0	> 3 h	0	Clear
1	Frothy	1	q2–3 h	1	Tan
2	Thick	2	q1–2 h	2	Yellow
3	Tenacious	3	< q1 h	3	Green

27%患者延迟拔管

	未延迟组 （达到标准后48h内拔管） 99 (73%)	延迟组 （达到标准后超过48h拔管） 37 (27%)	*P*
GCS	8 (3-11)	7 (3-11)	0.02
GCS≤8	31 (31%)	29 (78%)	>0.001
Airway care	7.5 (1-12)	9.0 (2-16)	0.01
Pneumonia	21 (21.2%)	14 (37.8%)	0.048
ICU LOS	3 (1-15)	8 (3-22)	<0.001
Hosp. LOS	11 (1-39)	17 (3-61)	0.009
Cost $	41824	70881	<0.001
Mortality	12 (12.1%)	10 (27.0%)	0.04
Reintubation	17 (17.2%)	7 (18.9%)	0.8

神经危重患者的拔管问题

- 早期研究显示，神经危重患者有较高的拔管失败率
- 临床医师普遍担心意识问题
- 出于伦理学的考虑，很难实施RCT研究
- 延迟拔管的情况普遍存在
- 现有研究中多数未包括对气道反应性的仔细评估

- 主要问题：存在意识障碍或气道保护性反射损害的患者如何处理

Case

- CPA术后15小时，经口气管插管、T管吸氧2小时（3L/min）
  - 循环和氧合指标良好
  - 遵嘱运动
  - 主动咳嗽良好
  - 被动咳嗽稍弱
- 充分吸引后拔除气管导管
- 2min后SpO2急剧降低 90%-73%，立即面罩给氧，手动呼吸囊通气，效果不佳
- 喉镜下紧急气管插管，困难气道，SpO2升高至93%
- 面罩面罩给氧，手动呼吸囊通气，效果不佳，SpO2降低
- 喉镜支撑下吸氧，SpO2升至95%，直视下发现会厌张力低，紧急气管切开

对于幕下病变的患者

顺序	操作方法	判断目标
1	观察患者是否流涎	吞咽功能
2	嘱患者做吞咽动作	吞咽功能
3	嘱患者张口、伸舌	咽喉部肌肉张力
4	嘱患者做咳嗽动作	自主咳嗽能力
5	吸引气道	咳嗽反射，观察分泌物性状

幕下损伤患者的拔管成功率

- 69例幕下病变接受MV患者，回顾性调查
- 尝试拔除气管导管的标准
  - GCS>7
  - 无脑干损伤表现
- 23 (33%) 成功拔管

Qureshi AI, et al. Crit Care Med 2000.

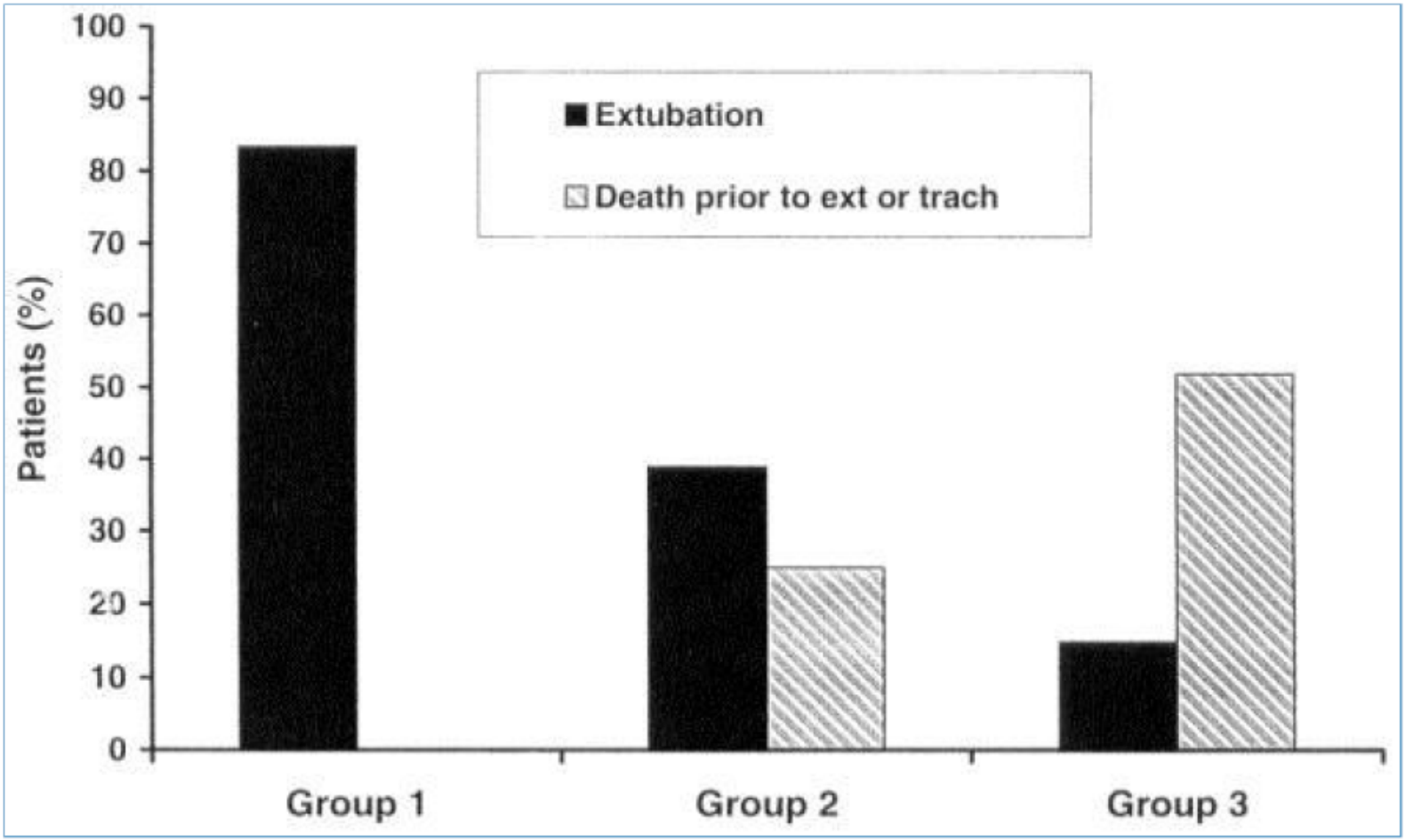


Figure 1. Frequency of successful extubations and in-hospital deaths before extubation (*ext*) or tracheostomy (*trach*) according to strata defined by presence or absence of GCS score > 7 at intubation and brainstem deficits. *Group 1* represents patients with intubation GCS score > 7 and no brainstem deficits. *Group 2* represents patients with either intubation GCS score > 7 or absence of brainstem deficits. *Group 3* represents patients with both intubation GCS score <= 7 and brainstem deficits.

神经危重患者的早期气管切开

- 保留气管插管超过14天，增加气道并发症危险
- 缩短ICU滞留时间
- 降低肺部感染发生率

Koh WY et al. Anaesth Intensive Care 1997
Kluger Y, et al. Eur J Emerg Med 1996
Nowak P, et al. Am J Otolaryngol 1987

The Journal of TRAUMA® Injury, Infection, and Critical Care

Early Tracheostomy versus Prolonged Endotracheal Intubation in Severe Head Injury

Moulay Ahmed Bouderka, Bouchra Fakhir, Abderrahmane Bouaggad, Badreddine Hmamouchi, Driss Hamoudi, and Abdeslam Harti

Background: To see if early tracheostomy (fifth day) reduces duration of mechanical ventilation, ICU stay, incidence of pneumonia and mortality in comparison with prolonged intubation (PI) in patients with head injury.

Methods: Patients were prospectively included in this study if they met the following criteria: isolated head injury, Glasgow coma scale (GCS) score ≤8 on first and fifth day, with cerebral contusion on CT scan. On the fifth day, randomization was done in two groups: early tracheostomy group (T group, n = 31) and prolonged endotracheal intubation group (I group, n = 31). We evaluated total time of mechanical ventilation, ICU stay, pneumonia incidence and mortality. Complications related to each technique were noted. Analysis of data were performed using Yates and Kruskall Walis tests. $p < 0.05$ was considered significant.

Results: The two groups were comparable in term of age, sex, and Simplified Acute Physiologic Score (SAPS). The mean time of mechanical ventilatory support was shorter in T group (14.5 ± 7.3) versus I group (17.5 ± 10.6) ($p = 0.02$). After pneumonia was diagnosed, mechanical ventilatory time was 6 ± 4.7 days for ET group versus 11.7 ± 6.7 days for PEI group ($p = 0.01$). There was no difference in frequency of pneumonia or mortality between the two groups.

Conclusion: In severe head injury early tracheostomy decreases total days of mechanical ventilation or mechanical ventilation time after development of pneumonia.

Key words: Tracheostomy, Head injury, Intubation, Nosocomial pneumonia, Intensive care unit.

J Trauma. 2004;57:251–254.

研究设计

- 纳入标准
  - 重度TBI (入室GCS≤ 8).
  - CT显示脑挫伤
  - 入室第5天GCS≤8（非镇静）
- 入室第5天随机分组
  - 早期气管切开 (T)
  - 保留气管插管 (I)

GCS≤8: 第5天行气管切开缩短MV时间

Table 1 Demographic Data

	T Group (n = 31)	I Group (n = 31)	*p*
Age (years)	41.1 ± 17.5	40 ± 19	0.53
Sex: M/F	18/9	20/11	
SAPS	5.4 ± 1.5	6 ± 3.8	0.52

F, female; M, male; SAPS, simplified acute physiological score.

Table 2 Ventilatory Data

	T Group (n = 31)	I Group (n = 31)	*p*
Number of weaning attempts	1.6 ± 0.7	1.5 ± 0.9	0.6
Total ventilation days	14.5 ± 7.3	17.5 ± 10.6	0.02
Day of extubation or tracheostomy off	26.3 ± 13.7	19.4 ± 10.4	0.03

Table 3 Frequency of Nosocomial Pneumonia and Sinusitis

	T Group (n = 31)	I Group (n = 31)	*p*
Nosocomial pneumonia n (%)	18 (58)	19 (61.3)	0.79
Day NP diagnosed	6.7 ± 1.8	9.2 ± 2.3	0.95
Mechanically ventilated days after pneumonia diagnosed	6 ± 4.7	11.7 ± 6.7	0.01
Bacteria			
NGB/PGC	13/5	15/4	0.92
Sinusitis n (%)	3 (9.6)	5 (16.1)	0.7

NP, nosocomial pneumonia; NGB, negatives gram bacilli; PGB, positives gram bacilli.

Table 4 Outcome and Mortality

	T Group (n = 31)	I Group (n = 31)	*p*
Recovery n (%)	19 (61.3)	23 (74.2)	0.41
Bleeding n (%)	2 (6.4)	0 (0)	0.47
Death n (%)	12 (38.7)	7 (22.5)	0.27
Day of death	30.6 ± 20.1	27.7 ± 14.6	0.72

小结

- 神经危重患者是拔管失败的高危群体
- 延迟拔管情况普遍存在
- 临床决定气管切开的时间受到多种因素影响
- 尚需要设计合理的进一步研究

- GCS-M 5~6，气道5项评价通过，常规气道处理
- GCS-M 5~6，气道5项评价未通过，延迟至7天
- GCS-M≤4，3~5天，气管切开