



北京协和医院

PEKING UNION MEDICAL
COLLEGE HOSPITAL

组织氧分压监测如何应用于休克？

北京协和医院重症医学科 何怀武

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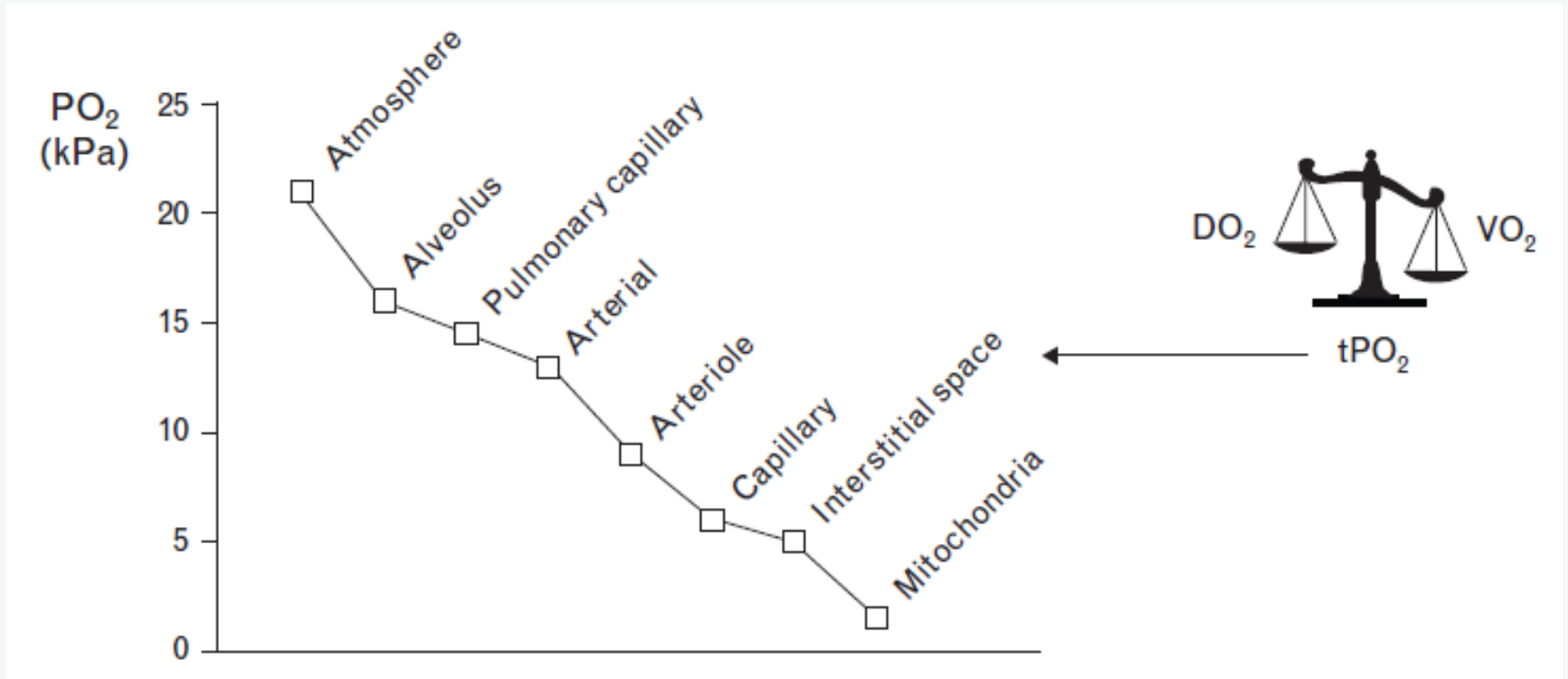
全身和局部



休克复苏的监测

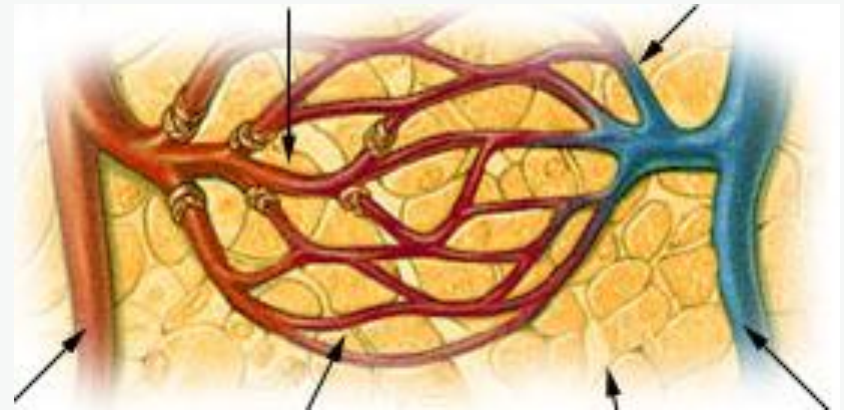
- 血流动力学：HR、CVP、CO、MBP、SVRI
- 全身代谢：Lac、ScvO₂、CO₂gap
CO₂gap / CaO₂-CvO₂
- 局部灌注：OPS、PI、CRT
- 局部代谢：tPO₂、tPCO₂、stO₂

氧的运输



组织氧分压

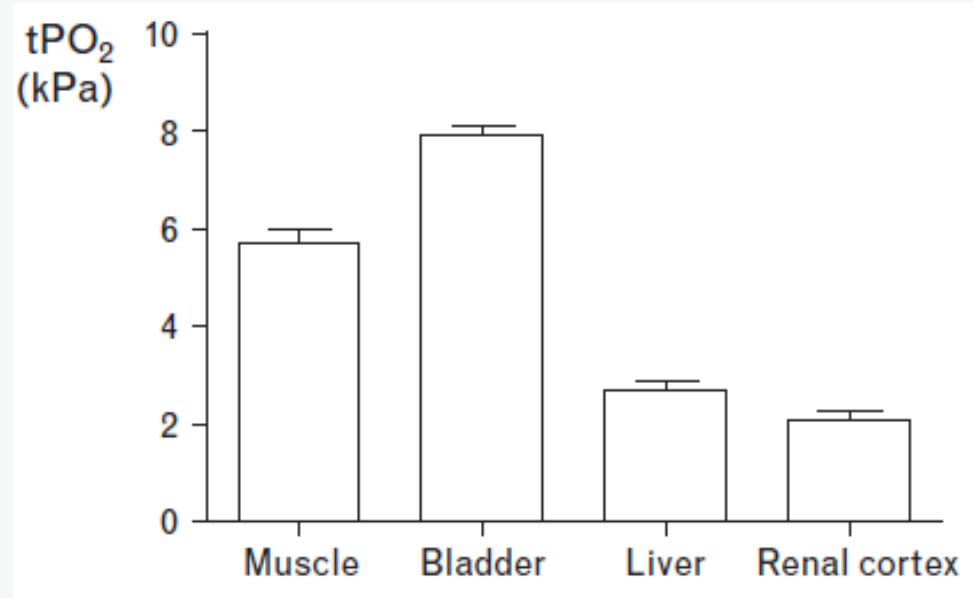
- 线粒体氧代谢
- 氧化磷酸化
- 局部 DO_2 和 VO_2 的平衡



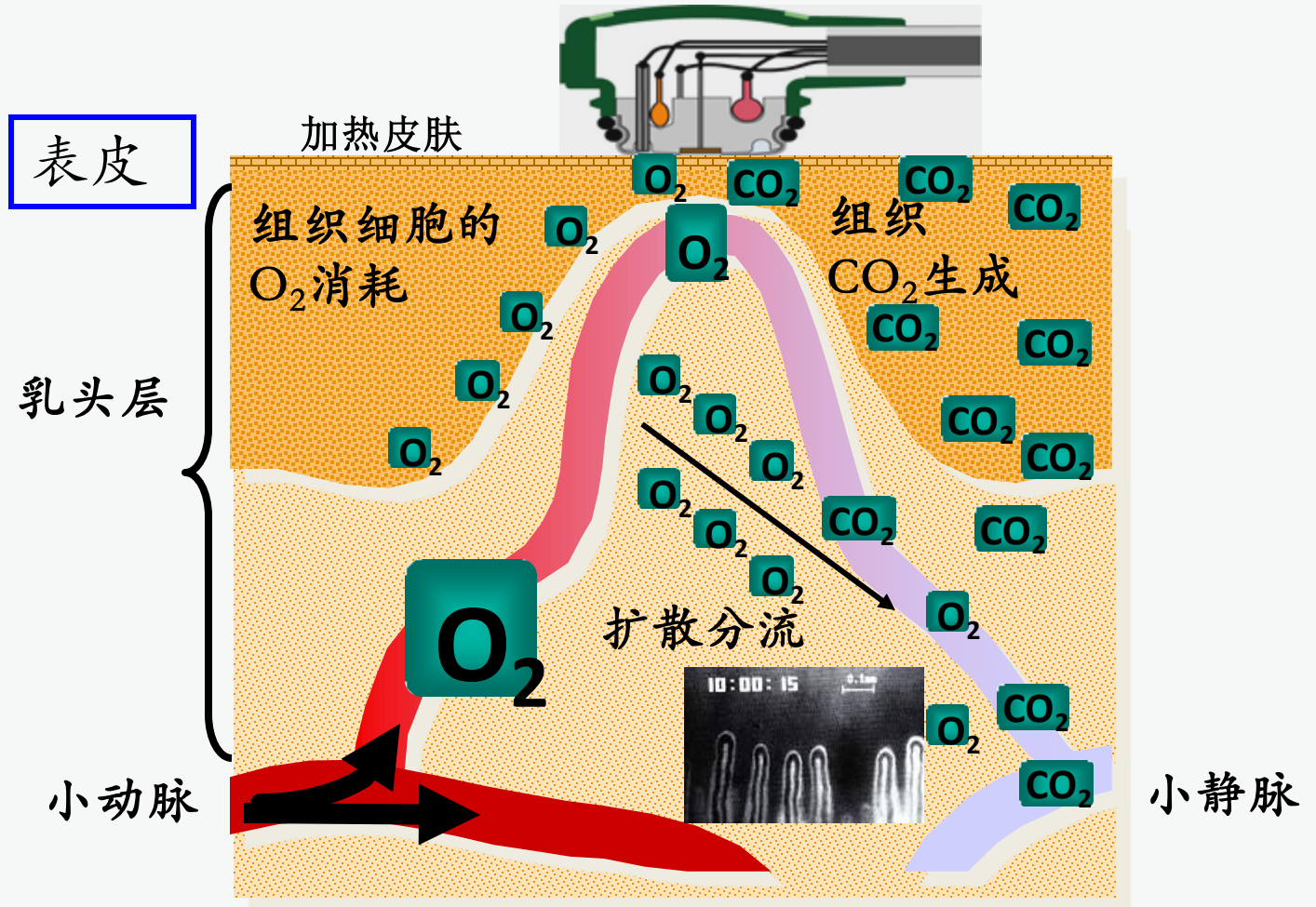
组织

组织氧分压

- 不同组织存在差异
- 反映器官代谢率
- 浅表低于深部



经皮O₂/CO₂电极测量



tPO₂在其它疾病的应用

- 预测伤口溃疡愈合的可能
- 选择截肢平面
- 筛选高压氧治疗的患者
- 评估高压氧治疗的反应
- 评血管再通的效果

tPO₂在其它疾病的应用

TISSUE OXYGEN TENSION VALUES FOR PROGRESSIVELY INCREASED INSPIRED PO₂

Ambient pressure (atm abs)/ Breathing media	1.0 AIR	1.0 O ₂	2.0 O ₂	2.4 O ₂	3.0 O ₂
REPRESENTATIVE TISSUE OXYGEN TENSION VALUES, mmHg					
Ambient PO ₂ , mmHg	159	760	1,520	1,824	2,280
Transcutaneous PO ₂ (1)	69 ± 6	440 ± 95		1,350 ± 220	
Transcutaneous PO ₂ - chest (2)	67 ± 12	450 ± 54		1,312 ± 112	
Transcutaneous PO ₂ - calf, male (2)	49 ± 14	281 ± 78		1,027 ± 164	
Transcutaneous PO ₂ - calf, female (2)	59 ± 12	367 ± 59		1,174 ± 127	
Transcutaneous PO ₂ - midfoot (2)	63 ± 13	280 ± 82		919 ± 214	
Transcutaneous PO ₂ - limb (3)	49	325	696		

1 - TRANSCUTANEOUS O₂ DATA FROM SHEFFIELD (1998)

2 - TRANSCUTANEOUS O₂ DATA FROM DOOLEY (1997)

3 - TRANSCUTANEOUS O₂ DATA FROM HART (1990)

(CHART FROM PJ SHEFFIELD, 1998)

tPO₂在其它疾病的应用

Table 5: Protocol for PtcO₂ Assessment^a

Question	Test
Is wound healing complicated by severe hypoxia?	<ol style="list-style-type: none">1. Baseline air value at 1 atm abs; hypoxia exists if PtcO₂ <40 mmHg for diabetics, < 30 mmHg for non-diabetics.2. O₂ challenge at 1 atm abs; value should be at least double the baseline value.3. O₂ challenge 2–2.5 atm abs; value should be well above normobaric O₂ value.4. Repeat PtcO₂ evaluations at 1 atm abs in 2- to 4-wk intervals; normalization of baseline values would indicate that the healing process is in place.
Does the wound site respond to O ₂ breathing?	
Does the wound site respond to HBO ₂ ?	
Is the patient's wound at the point where it will heal without further treatment?	

^aValues are from experience at the Jefferson C. Davis Wound Care & Hyperbaric Medicine Center (Heimbach RD, 1998, personal communication).

tPO₂在其它疾病的应用

- Is wound healing complicated by hypoxia?
- When present, is hypoxia reversible?
- Is the patients responding to hyperbaric oxygen therapy?
- Has the patients reached a therapeutic end point?

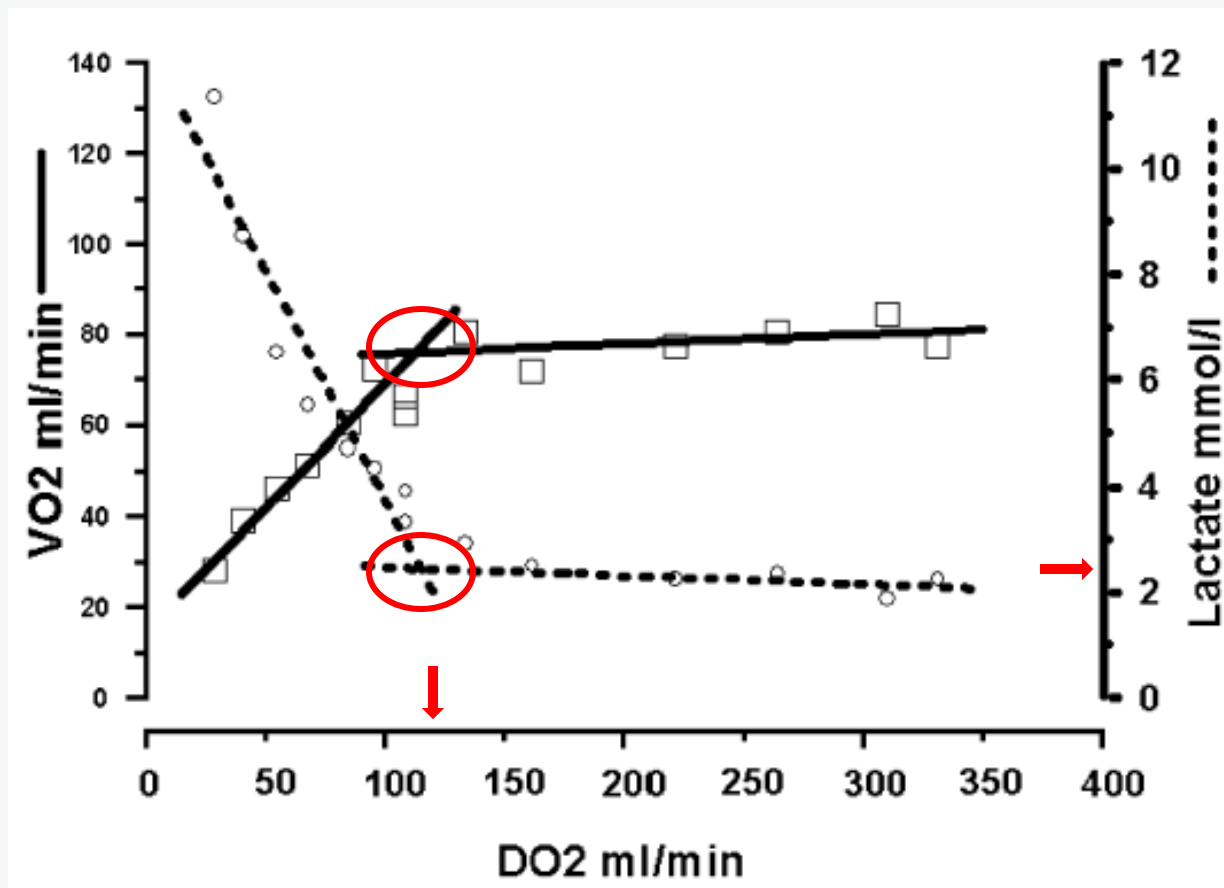
氧负荷试验

- 增加氧输送来观察机体的反应
- 评价提高氧输送有效性和安全性
- 方法：扩容、强心、输血、吸氧？

氧负荷试验

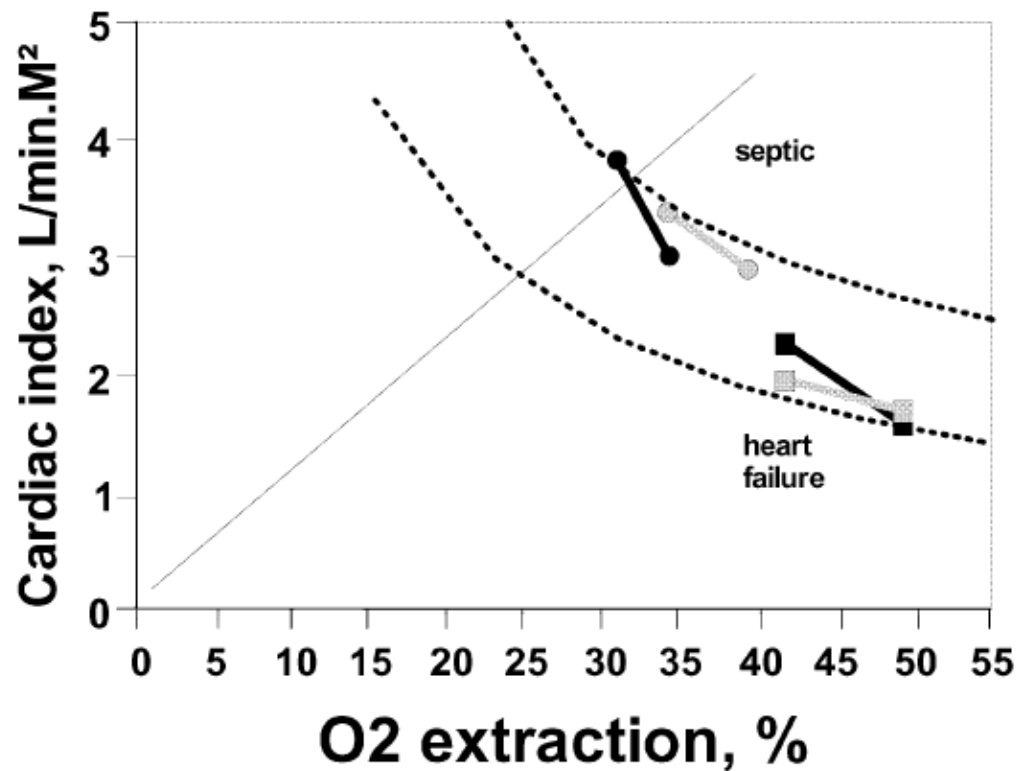
- DO_2 增加 > 80 , VO_2 相应增加 >15
- 氧供氧耗曲线斜率至少增加10%
- VO_2 增加 $>15\%$

氧输送理论的临床争议



氧输送理论的临床争议

- 非生理性依赖
- 数学偶联



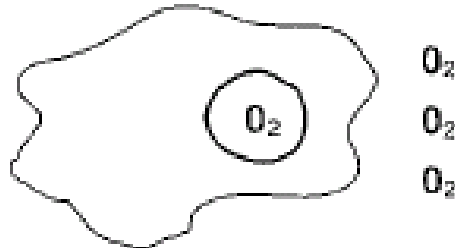
氧输送理论的临床争议

- VO_2/DO_2 依赖 **不存在** 稳定的重症患者
- VO_2/DO_2 依赖 **存在** 严重循环衰竭
- VO_2/DO_2 依赖 **可能存在** 感染性休克
- 局部的 VO_2/DO_2 : 肝静脉血氧饱和度、 tPO_2 ?

tPO₂ 氧负荷试验

Adequate Resuscitation

Adequate Cellular Oxygenation

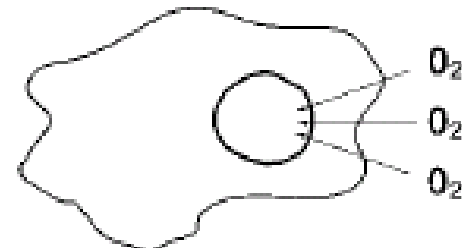


Flow-dependent oxygen consumption not present

Hypothesis:
Tissue PO₂ ↑ with ↑ PaO₂

Inadequate Resuscitation

Inadequate Cellular Oxygenation



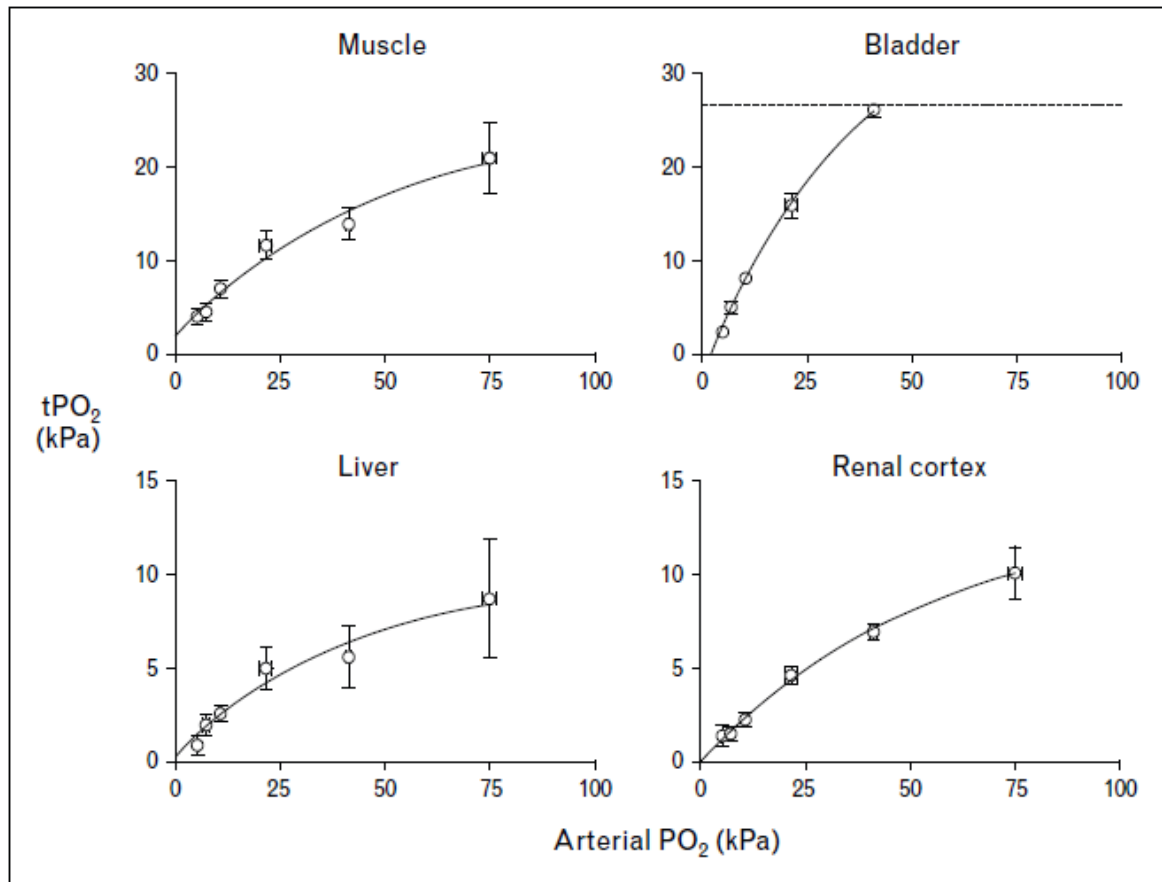
Flow-dependent oxygen consumption present

Hypothesis:
Tissue PO₂ does not ↑ with ↑ PaO₂

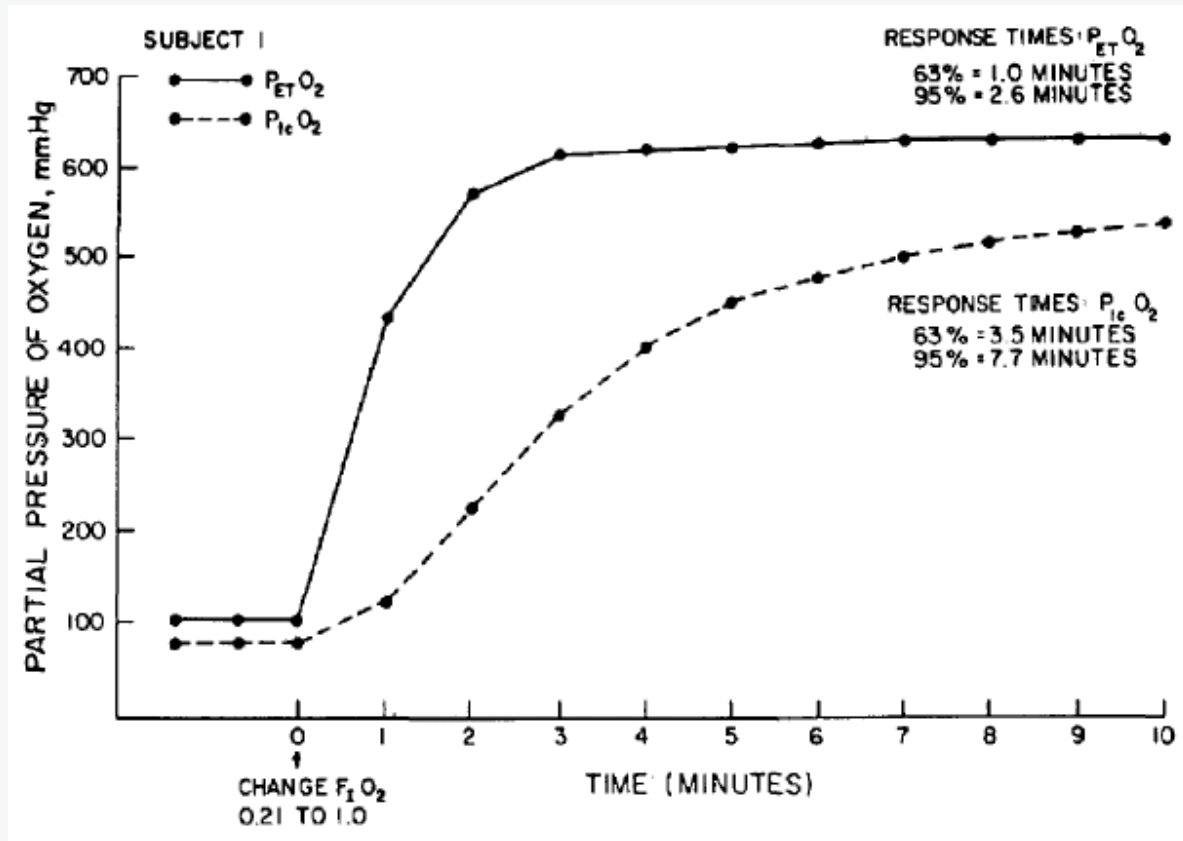
tPO₂ 氧负荷试验

- 增氧(5L/min)20min ,t PO₂增加幅度>20%
- 增氧(100% O₂) 5min ,5minPtcO₂增氧> 40mmHg
- 增氧(100% O₂) 10min 10minPtcO₂增氧> 66mmHg
- 增氧的方式、时间、判断的标准?

tPO₂ 氧负荷试验



tPO₂ 氧负荷试验



tPO₂ 氧负荷试验

- tPO₂ index = base tPO₂/base PaO₂
- 10min-OCT = Δ tPO₂
- Oxygen challenge index = (10minOCT)/ Δ PaO₂

tPO₂ 氧负荷试验

TABLE 3. The areas under the ROC curves for the indicators predicting low CI

	ROC area	95% CI	Cutoff value	Sensitivity, %	Specificity, %
ScvO ₂	0.743	0.616–0.845	66%	71	71
PtcO ₂ index	0.559*	0.427–0.685	0.55	73	48
10 OCT, mmHg	0.855	0.742–0.931	53	83	86
OCl	0.819	0.701–0.931	0.36	85	76

* $P < 0.05$ for comparison of PtcO₂ index versus 10 OCT and OCl.
CI indicates confidence interval.

tPO₂ 氧负荷试验

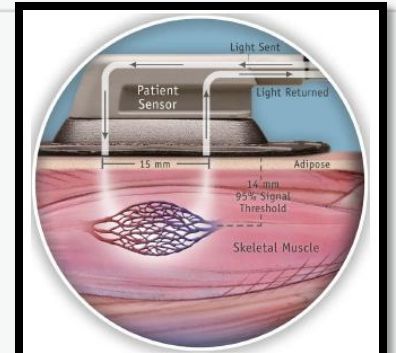
Table 5. Comparison of the areas under the ROC curves for predicting ICU mortality in the septic patients

	ROC area	95% CI	Cutoff Value	Sensitivity (%)	Specificity (%)
Lactate	0.80	0.658-0.905	4.2	45	84.62
Pv-a CO ₂	0.62 ^a	0.469-0.762	7	40	88.46
PI	0.84	0.698-0.929	0.2	65	92.3
ScvO ₂	0.62 ^a	0.468-0.762	0.67	55	73.08
PtcO ₂	0.66 ^b	0.508-0.795	61	55	80.8
PtcO ₂ index	0.54 ^c	0.387-0.688	0.51	30	76.92
10min-OCT	0.81	0.662-0.907	66	65	96.2
OCI	0.74	0.588-0.857	0.55	60	88.5

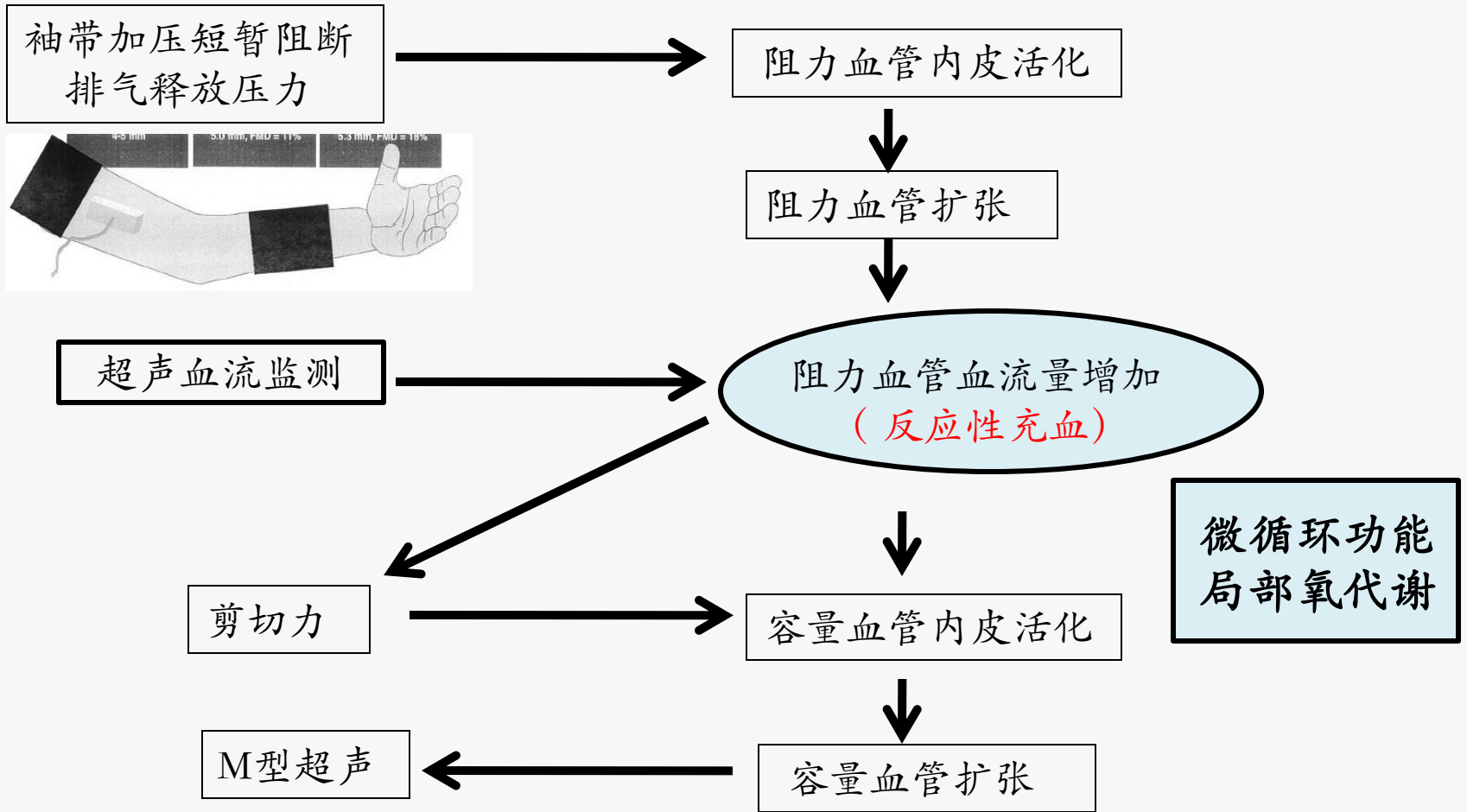
Pv-a CO₂, difference between central venous and arterial PCO₂ (mmHg); PI, peripheral perfusion index measured by pulse oximetry; ScvO₂, central venous O₂ saturation; 10min-OCT, 10min-Oxygen Challenge test value (mmHg); OCI, oxygen challenge index. CI confidence interval.

血管阻断试验

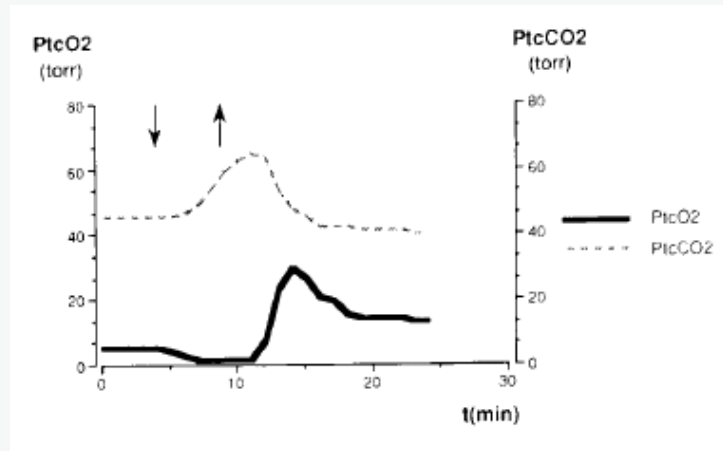
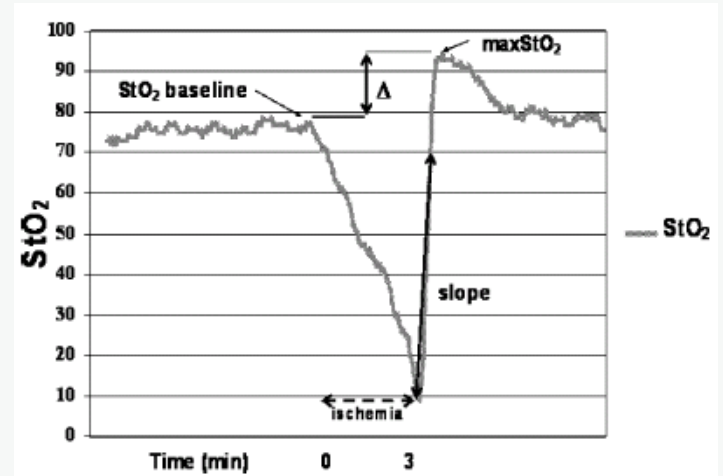
- 缺血负荷试验
- 反应性充血试验
- 观察指标：stO₂、tPO₂、PI



血管阻断试验



血管阻断试验





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