



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?

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# 全身和局部

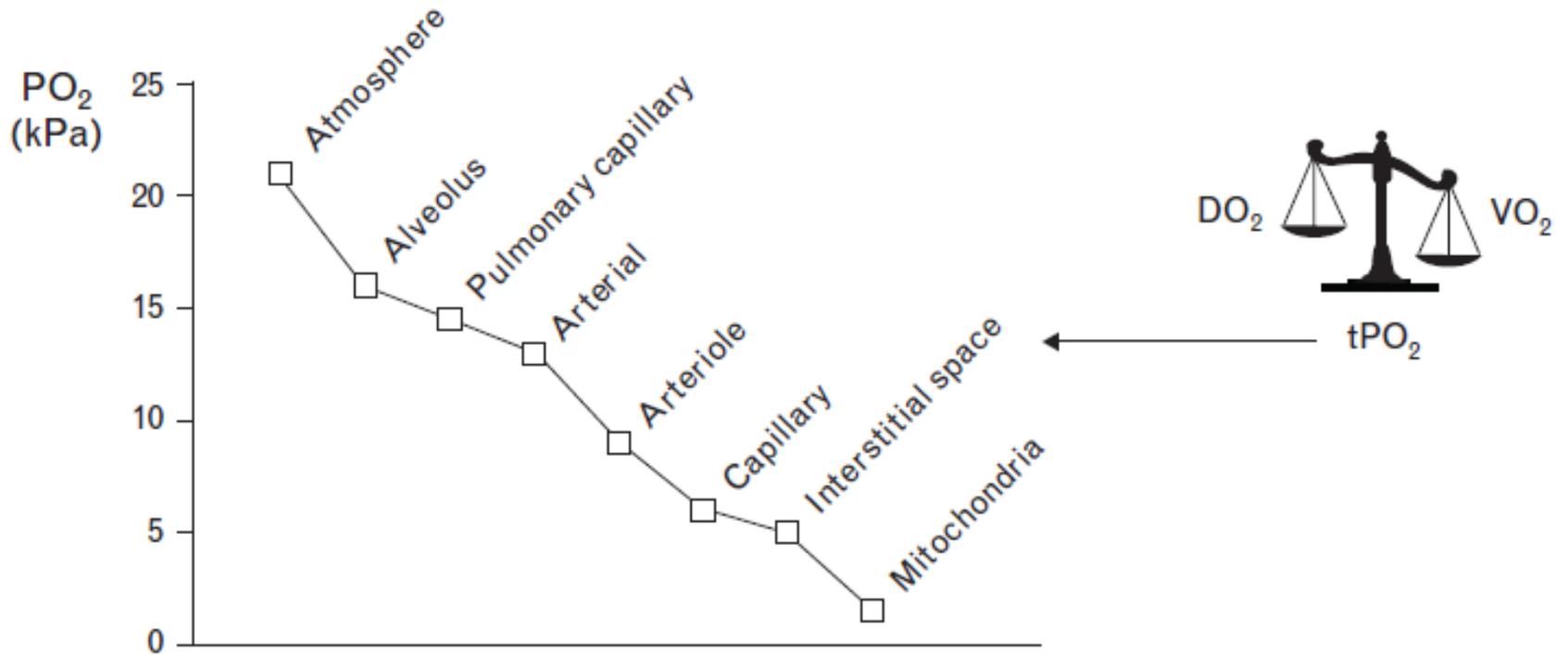


## 休克复苏的监测

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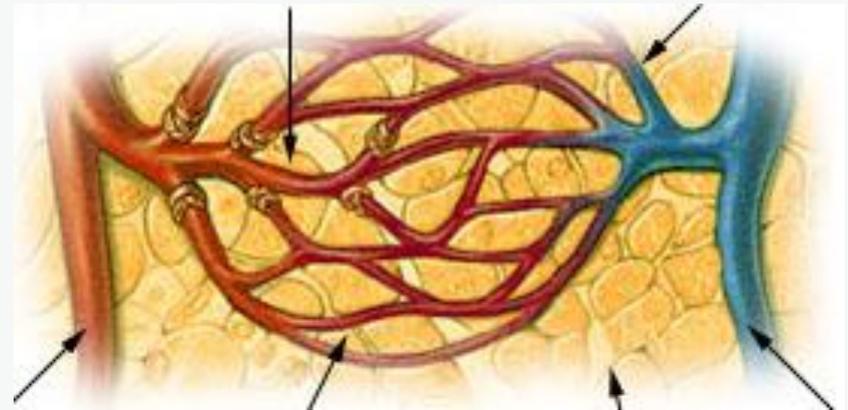
- 血流动力学：HR、CVP、CO、MBP、SVRI
- 全身代谢：Lac、ScvO<sub>2</sub>、CO<sub>2</sub>gap  
CO<sub>2</sub>gap / CaO<sub>2</sub>-CvO<sub>2</sub>
- 局部灌注：OPS、PI、CRT
- 局部代谢：tPO<sub>2</sub>、tPCO<sub>2</sub>、stO<sub>2</sub>

# 氧的运输



# 组织氧分压

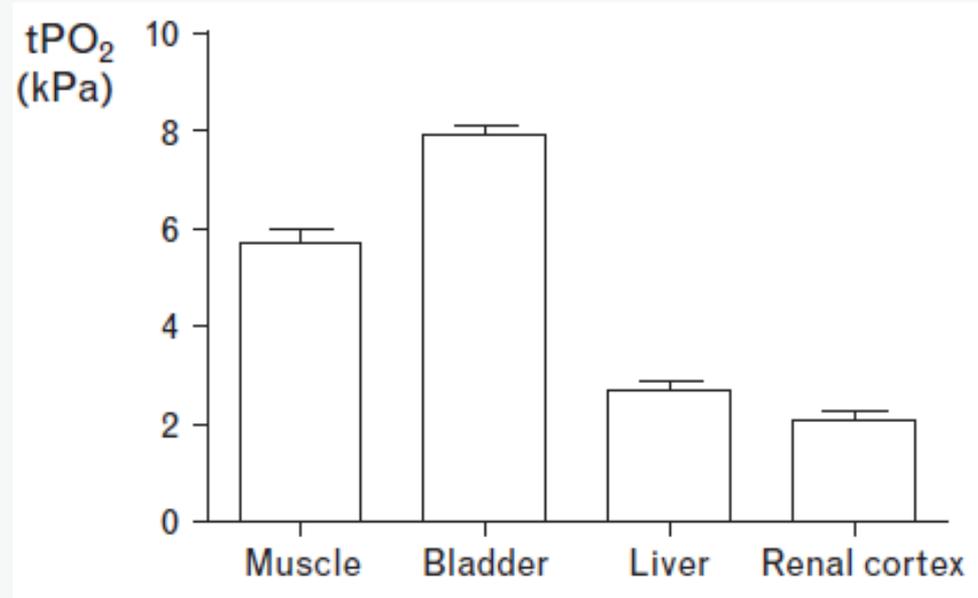
- 线粒体氧代谢
- 氧化磷酸化
- 局部 $DO_2$ 和 $VO_2$ 的平衡



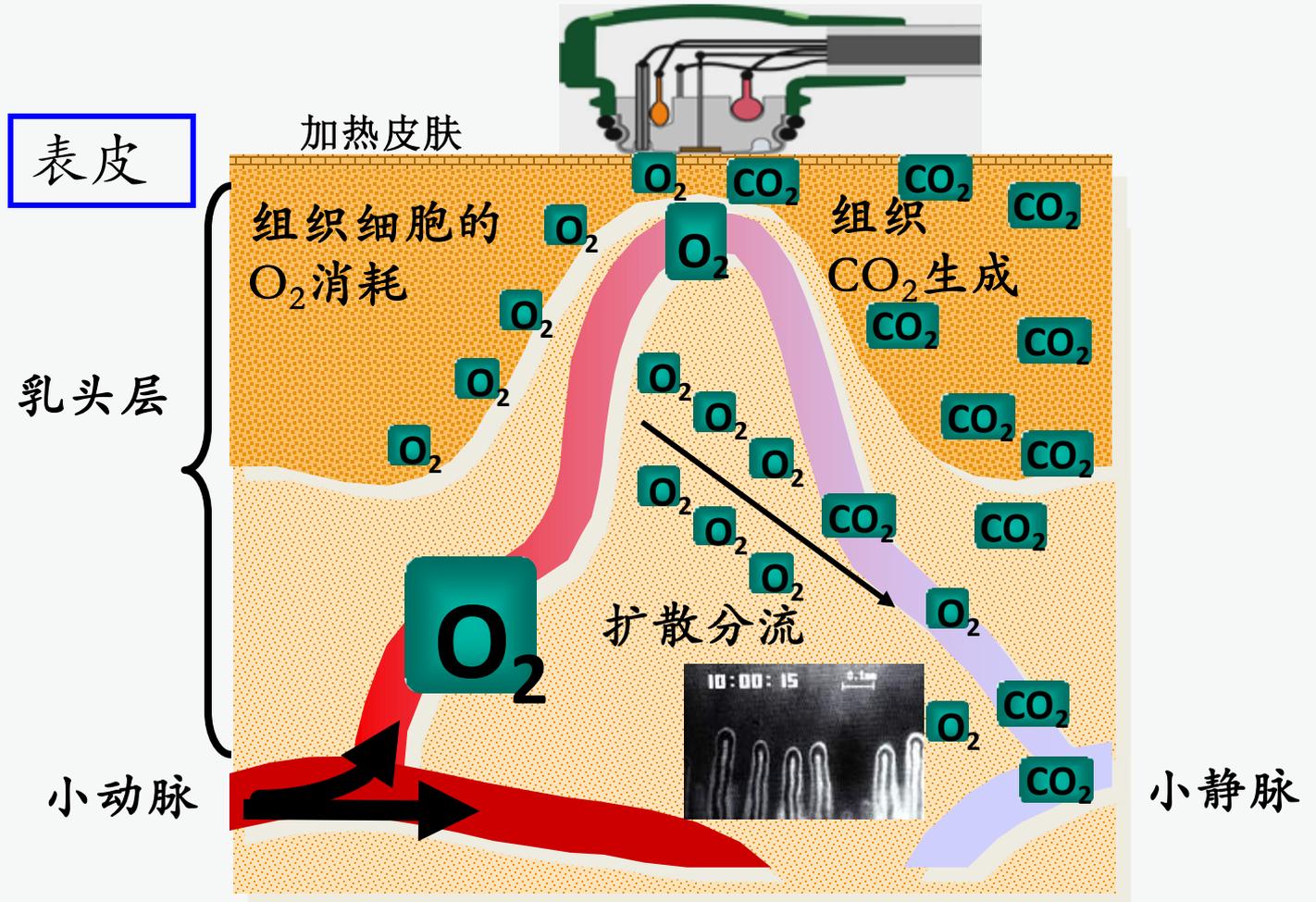
组织

## 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O<sub>2</sub>/CO<sub>2</sub>电极测量



## tPO<sub>2</sub>在其它疾病的应用

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- 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

## tPO<sub>2</sub>在其它疾病的应用

### TISSUE OXYGEN TENSION VALUES FOR PROGRESSIVELY INCREASED INSPIRED PO<sub>2</sub>

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

1 - TRANSCUTANEOUS O<sub>2</sub> DATA FROM SHEFFIELD (1998)

2 - TRANSCUTANEOUS O<sub>2</sub> DATA FROM DOOLEY (1997)

3 - TRANSCUTANEOUS O<sub>2</sub> DATA FROM HART (1990)

(CHART FROM PJ SHEFFIELD, 1998)

# tPO<sub>2</sub>在其它疾病的应用

Table 5: Protocol for PtcO<sub>2</sub> Assessment<sup>a</sup>

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

<sup>a</sup>Values are from experience at the Jefferson C. Davis Wound Care & Hyperbaric Medicine Center (Heimbach RD, 1998, personal communication).

## tPO<sub>2</sub>在其它疾病的应用

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

# 氧负荷试验

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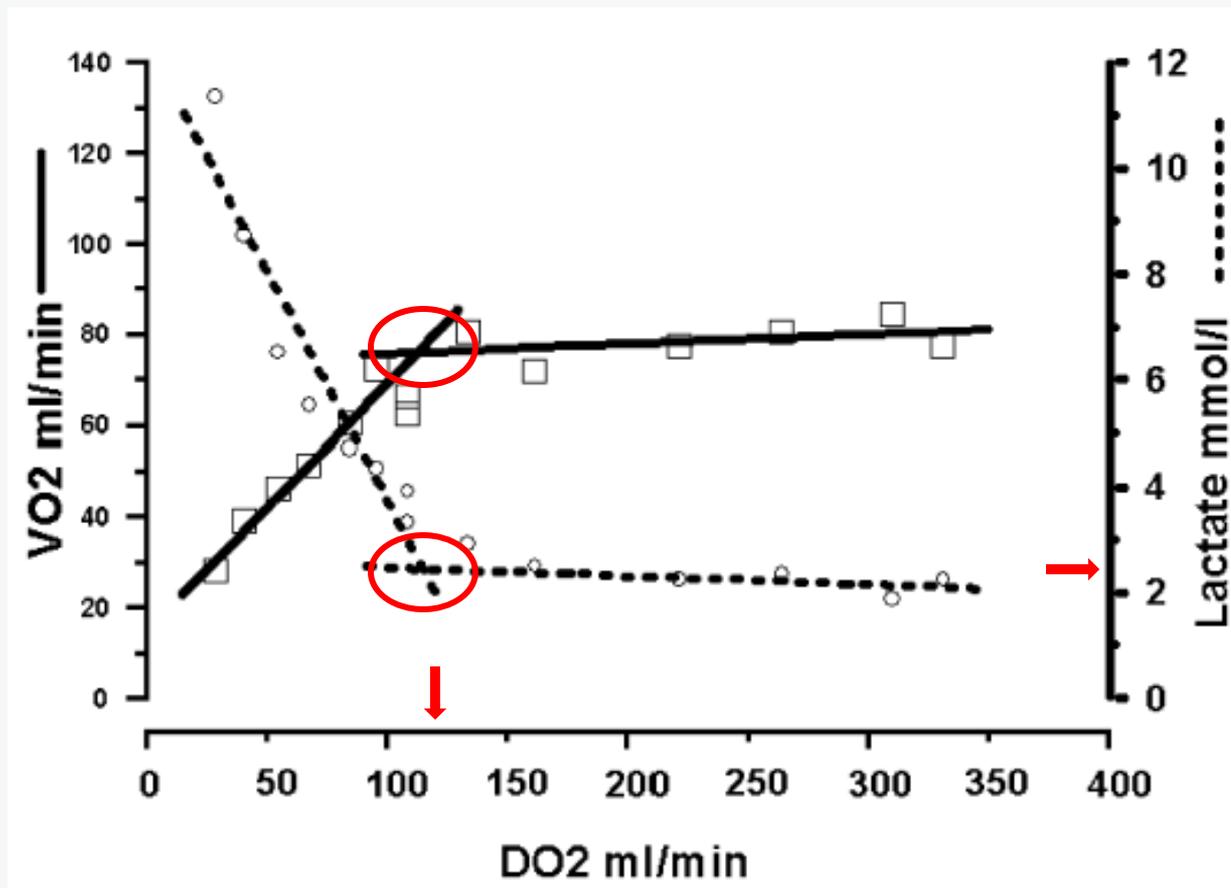
- 增加氧输送来观察机体的反应
- 评价提高氧输送有效性和安全性
- 方法：扩容、强心、输血、吸氧？

## 氧负荷试验

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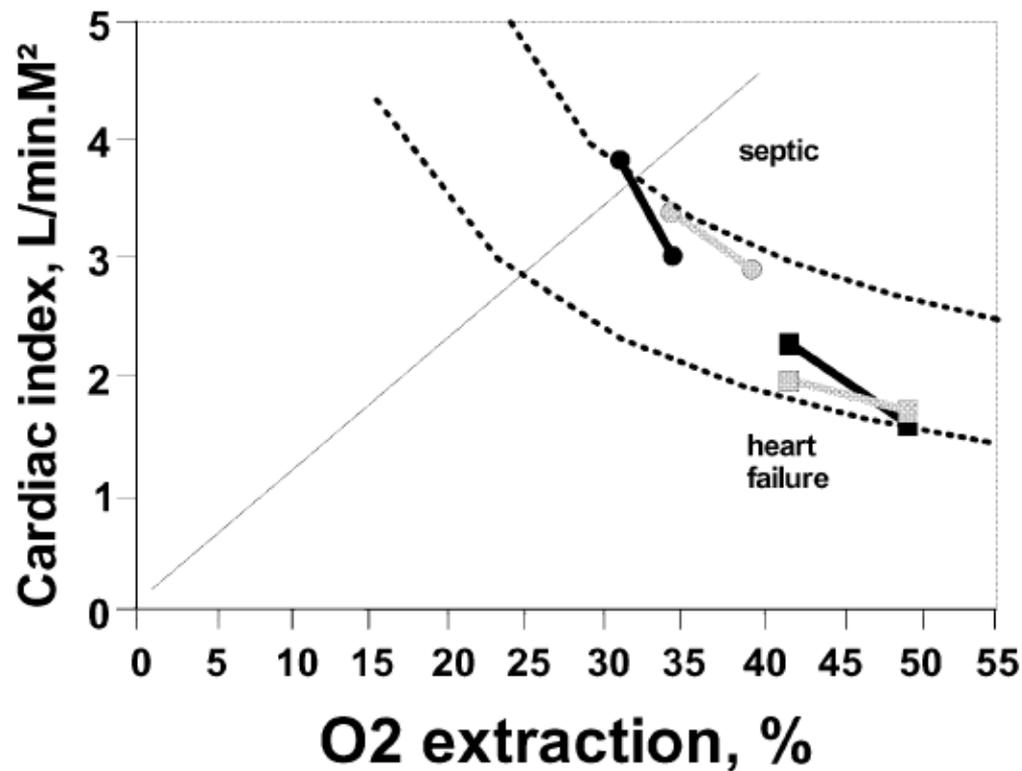
- $DO_2$ 增加  $> 80$ ,  $VO_2$ 相应增加  $>15$
- 氧供氧耗曲线斜率至少增加10%
- $VO_2$ 增加  $>15\%$

# 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

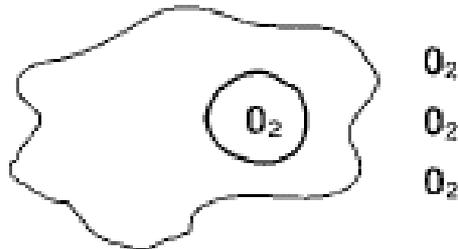
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- $VO_2/DO_2$  依赖 **不存在** 稳定的重症患者
- $VO_2/DO_2$  依赖 **存在** 严重循环衰竭
- $VO_2/DO_2$  依赖 **可能存在** 感染性休克
- 局部的  $VO_2/DO_2$ : 肝静脉血氧饱和度、 $tPO_2$ ?

# tPO<sub>2</sub> 氧负荷试验

## Adequate Resuscitation

Adequate Cellular Oxygenation

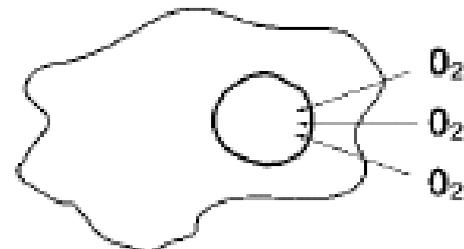


Flow-dependent oxygen consumption not present

Hypothesis:  
Tissue PO<sub>2</sub> ↑ with ↑ PaO<sub>2</sub>

## Inadequate Resuscitation

Inadequate Cellular Oxygenation



Flow-dependent oxygen consumption present

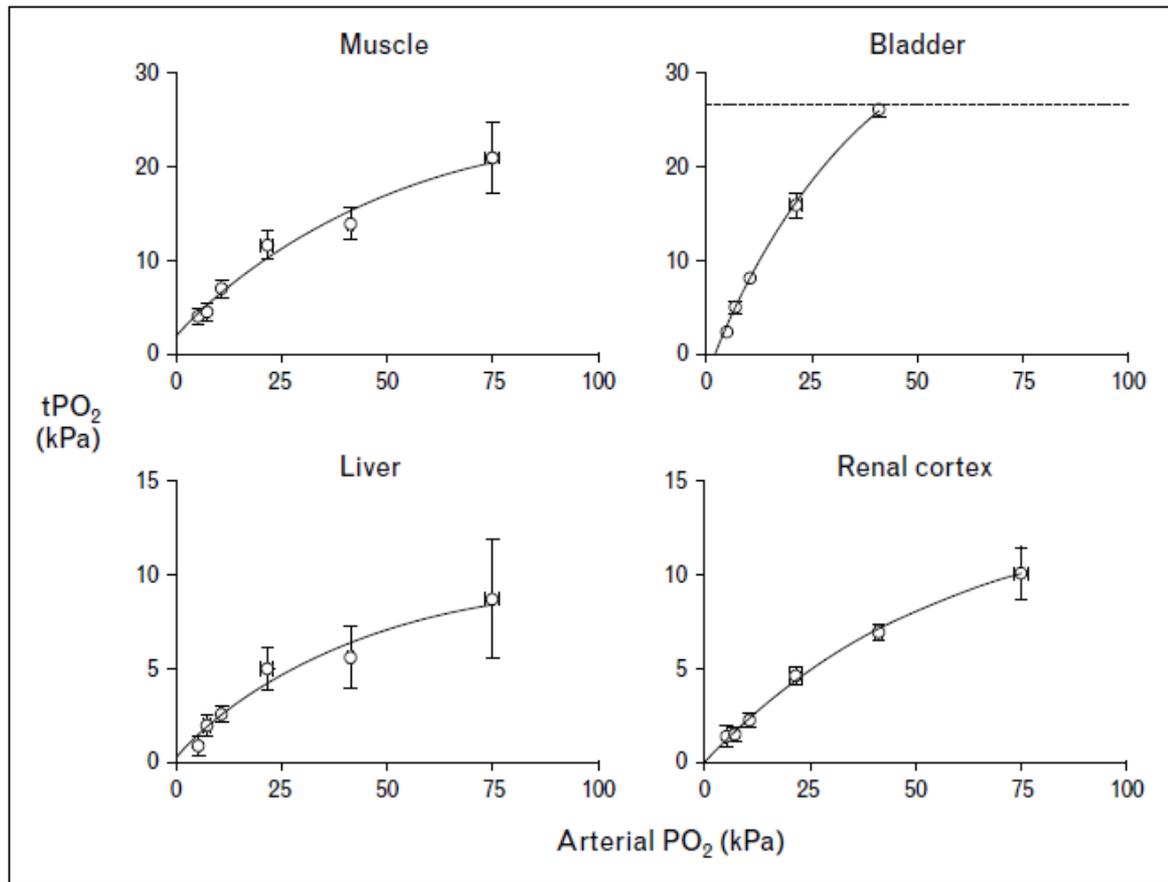
Hypothesis:  
Tissue PO<sub>2</sub> does not ↑ with ↑ PaO<sub>2</sub>

## tPO<sub>2</sub> 氧负荷试验

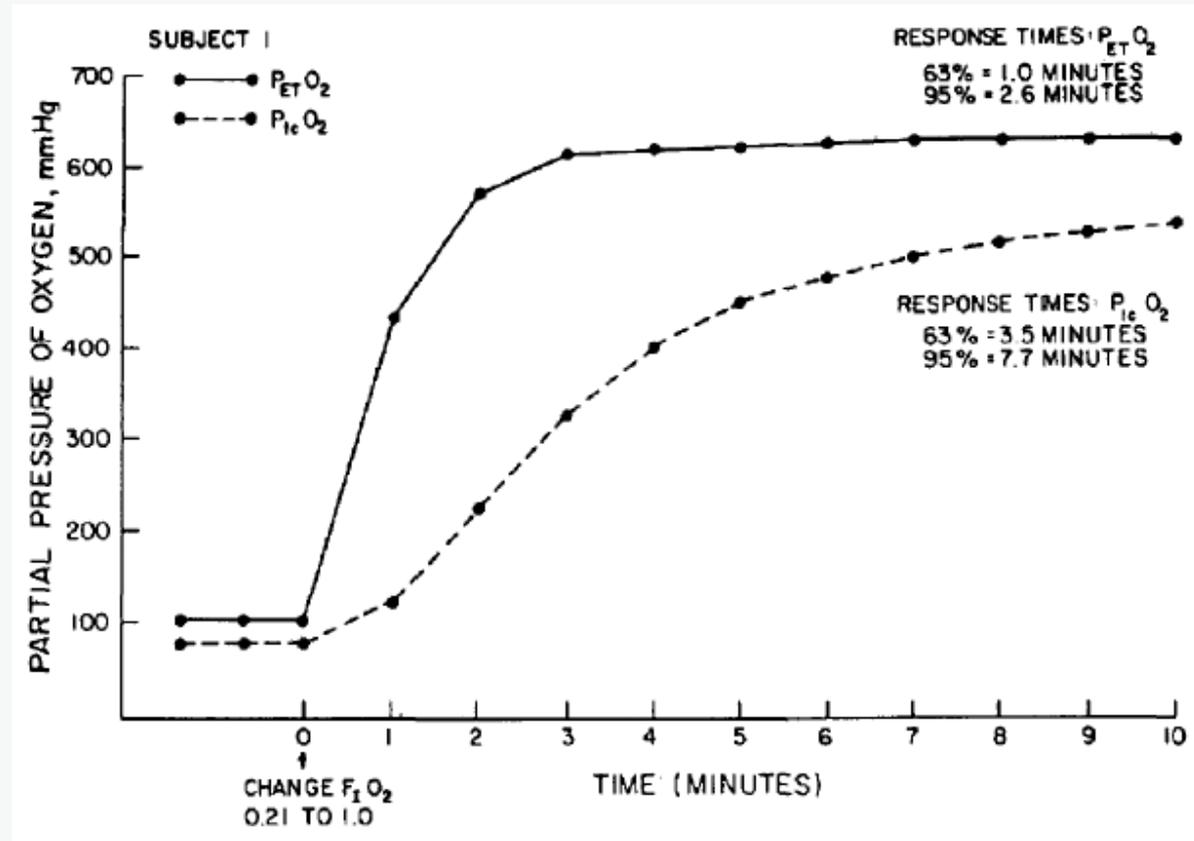
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- 增氧(5L/min)20min ,t PO<sub>2</sub>增加幅度>20%
- 增氧(100% O<sub>2</sub>) 5min ,5minPtcO<sub>2</sub>增氧> 40mmHg
- 增氧(100% O<sub>2</sub>) 10min 10minPtcO<sub>2</sub>增氧> 66mmHg
- 增氧的方式、时间、判断的标准?

# tPO<sub>2</sub> 氧负荷试验



# tPO<sub>2</sub> 氧负荷试验



## tPO<sub>2</sub> 氧负荷试验

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- tPO<sub>2</sub> index = base tPO<sub>2</sub>/base PaO<sub>2</sub>
- 10min-OCT =  $\Delta$ tPO<sub>2</sub>
- Oxygen challenge index = (10minOCT)/ $\Delta$ PaO<sub>2</sub>

## tPO<sub>2</sub> 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 <sub>2</sub>	0.743	0.616–0.845	66%	71	71
PtcO <sub>2</sub> 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 PtcO<sub>2</sub> index versus 10 OCT and OCl.  
CI indicates confidence interval.

## tPO<sub>2</sub> 氧负荷试验

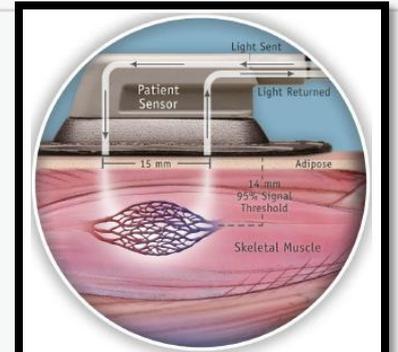
**Table 5. Comparison of the areas under the ROC curves for predicting ICU mortality in the septic patients**

	<b>ROC area</b>	<b>95% CI</b>	<b>Cutoff Value</b>	<b>Sensitivity (%)</b>	<b>Specificity (%)</b>
Lactate	0.80	0.658-0.905	4.2	45	84.62
Pv-a CO <sub>2</sub>	0.62 <sup>a</sup>	0.469-0.762	7	40	88.46
PI	0.84	0.698-0.929	0.2	65	92.3
ScvO <sub>2</sub>	0.62 <sup>a</sup>	0.468-0.762	0.67	55	73.08
PtcO <sub>2</sub>	0.66 <sup>b</sup>	0.508-0.795	61	55	80.8
PtcO <sub>2</sub> index	0.54 <sup>c</sup>	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

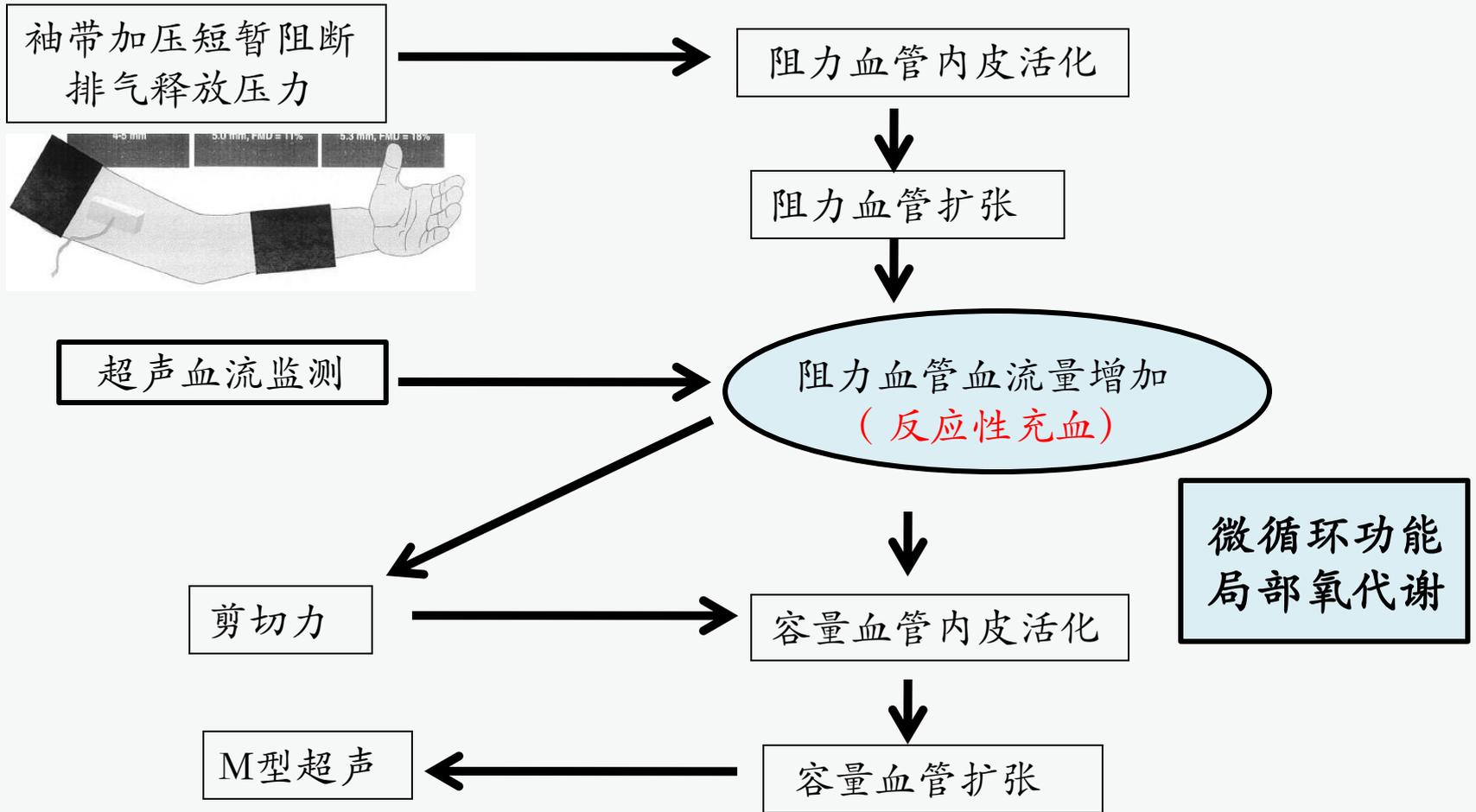
Pv-a CO<sub>2</sub>, difference between central venous and arterial PCO<sub>2</sub> (mmHg); PI, peripheral perfusion index measured by pulse oximetry; ScvO<sub>2</sub>, central venous O<sub>2</sub> saturation; 10min-OCT, 10min-Oxygen Challenge test value (mmHg); OCI, oxygen challenge index. CI confidence interval.

# 血管阻断试验

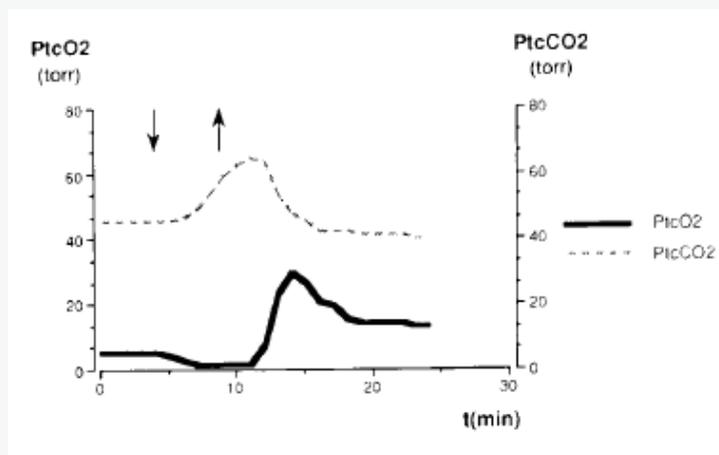
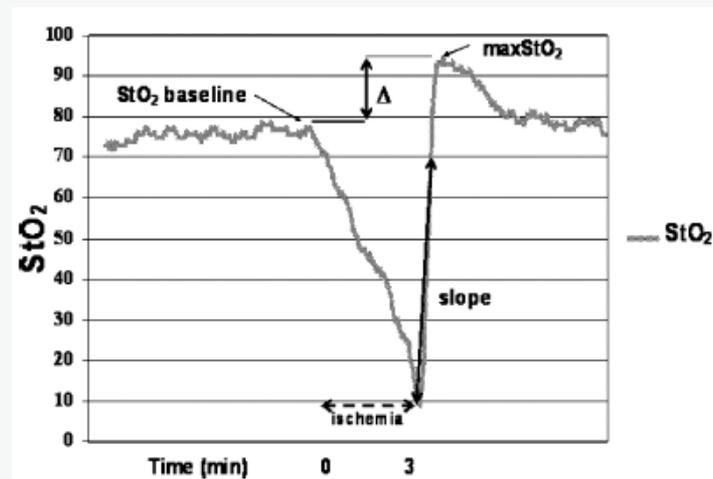
- 缺血负荷试验
- 反应性充血试验
- 观察指标：stO<sub>2</sub>、tPO<sub>2</sub>、PI



# 血管阻断试验



# 血管阻断试验





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# Thanks

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