

微创体外循环的进展

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微创体外循环的概念

- Ø 国际上已提出Mini-ECC和Mini-CPB的概念
- Ø 体外循环的发展方向：微创
包括设备微型化，一系列技术和方法
- Ø 微创体外循环的相对性
- Ø 需要国内的工程技术人员和体外循环医生
努力奋斗

改良传统体外循环问题

最小化:

剪切力、淤滞、
湍流

避免过度血液稀释

避免血栓形成

减少血细胞损伤

减少输血

维持内环境稳态



表面

生物相容性表面

避免气液界面

最小化异物接触面

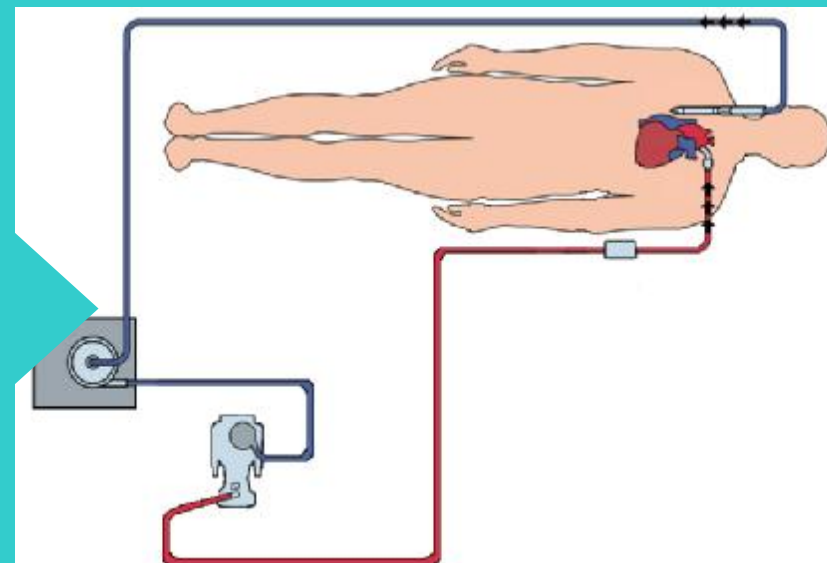
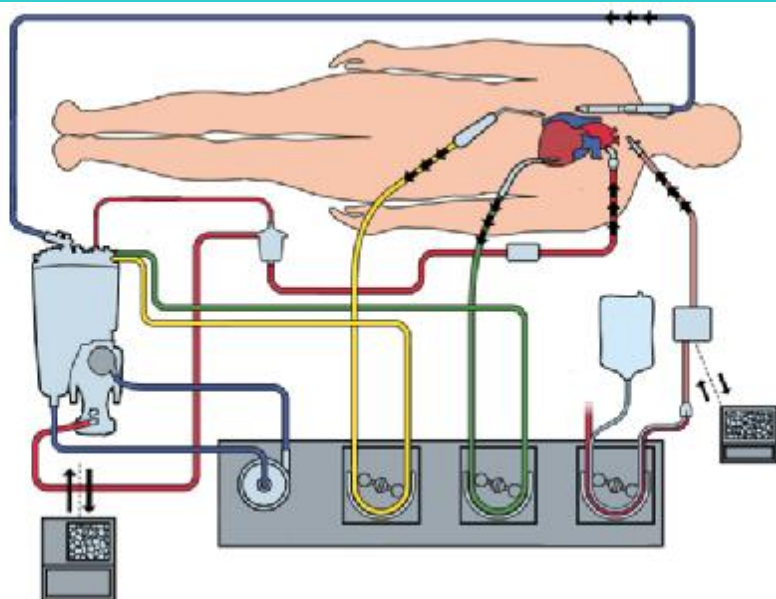
降低炎症反应

微创体外循环设备的特点

- 整体集成化
- 预充量小
- 结构紧密
- 表面积小
- 生物相容性好
- 表面涂层
- 密闭性
- 避免血气界面
- 静脉排气装置
- 其他设备改进

微体外循环设备的特点

Standard HLM



BHS

微体外循环的临床意义

Ø减少术后出血（胸腔引流）

Ø减少红细胞、血小板

与新鲜血浆的输入

Ø减少呼吸机使用时间

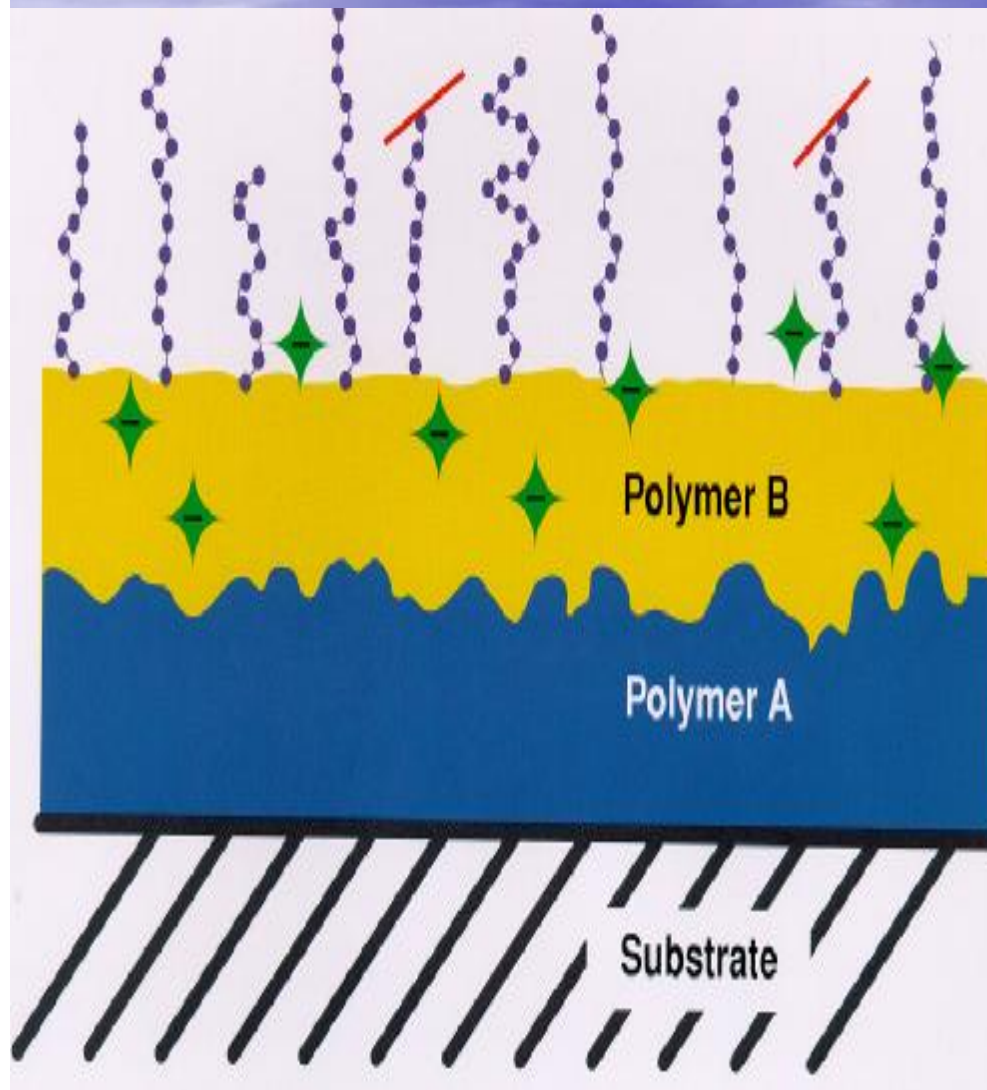
Ø减少ICU停留时间

Ø减少病人费用

不同公司的生物涂层

- **Medtronic**: Trillium™ and Carmeda®
heparin biocompatible surfaces
- **Jostra** : bioline coating
- **Maquet** : bioline coating, safeline
- **Terumo** : non heparin X-coating
- **Dideco** : phosphorylcholine polymer
(磷酸胆碱聚合物)
- **COBE** : SMARxT coating

Trillium Biopassive Surface



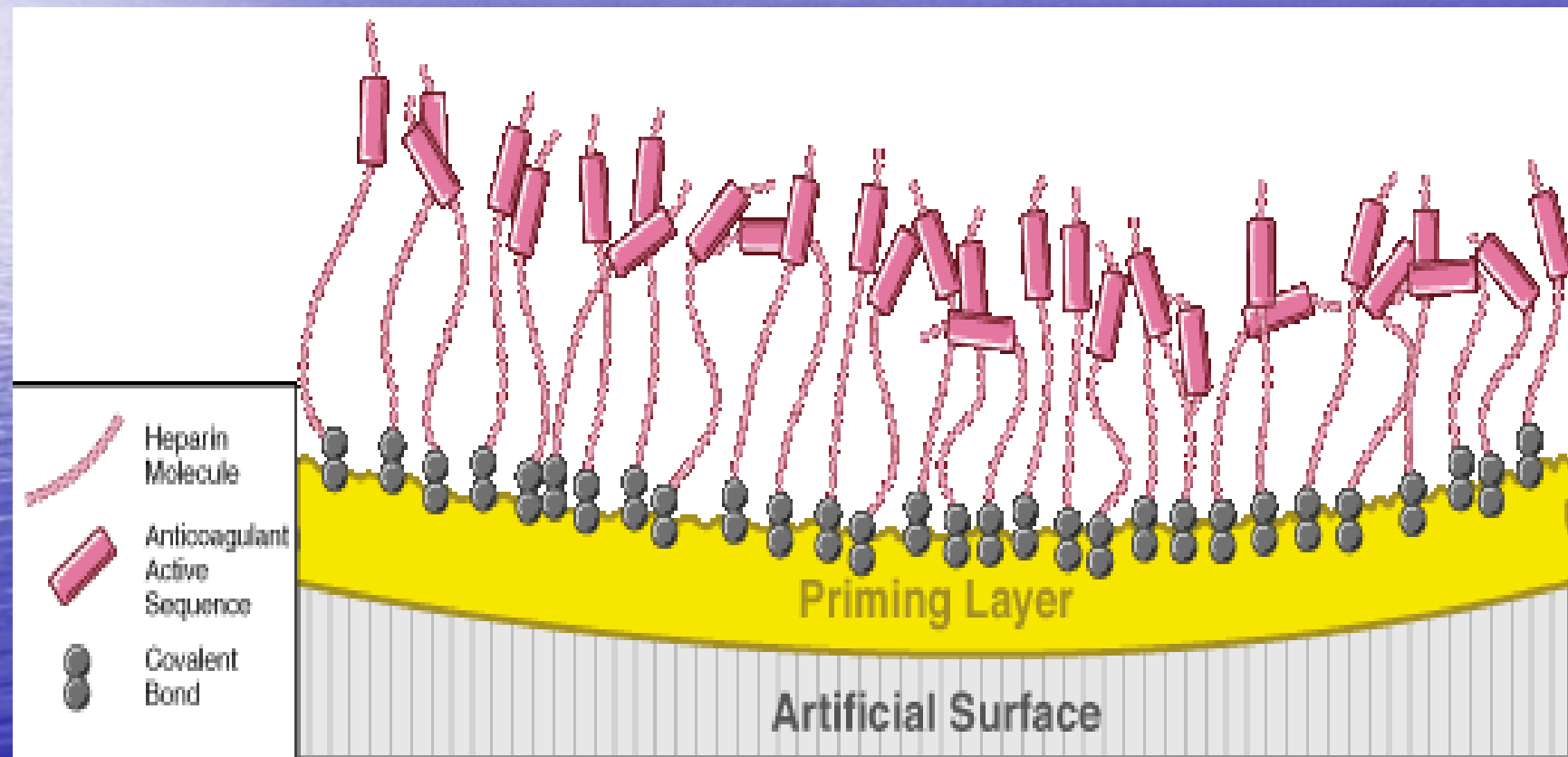
●●●●● PEO chains

— Heparin

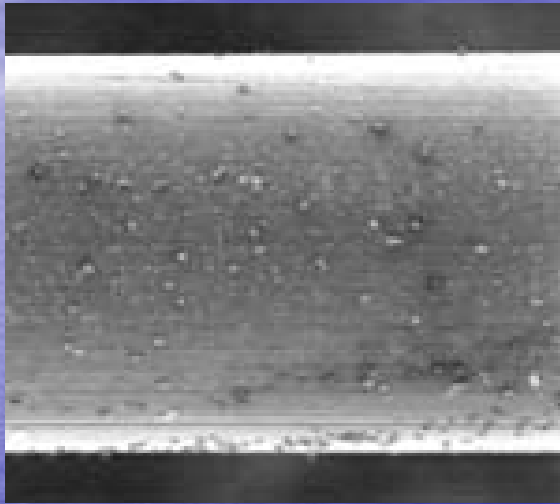
◆⁻ Sulfonate

- 水合动力表面 — PEO
- 磺酸盐 — 抗凝
- 电荷层 — 抗血栓
- 10%肝素 ~ 生物活性表面

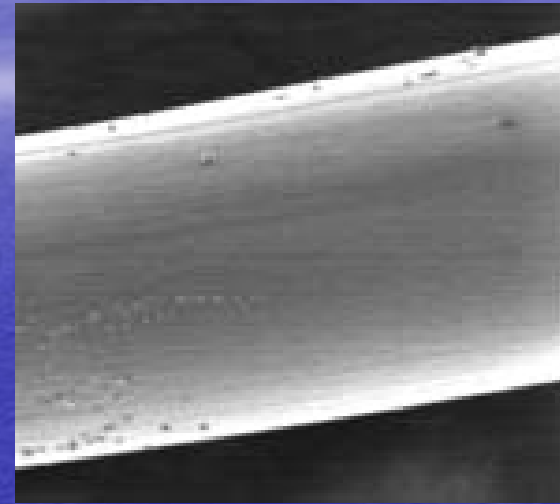
Carmeda Bioactive Surface



Trillium涂层的电镜效果



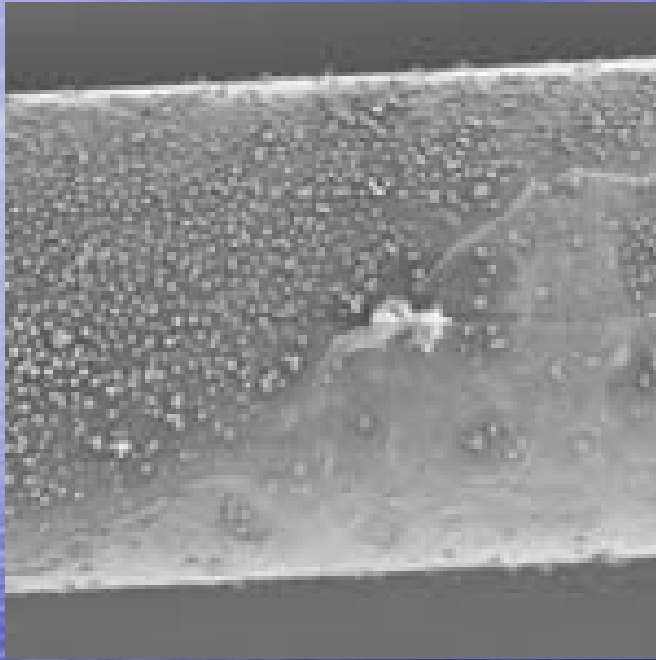
无生物涂层



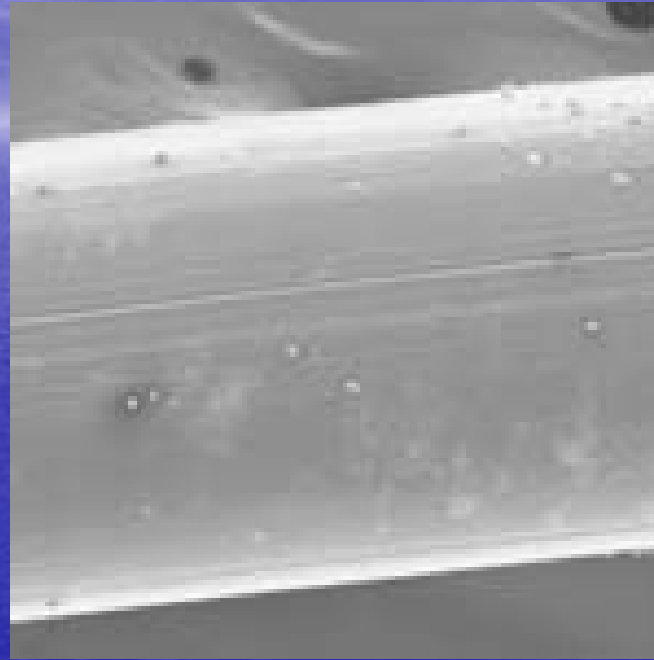
有生物涂层

Scanning electron micrographs of oxygenator fiber surfaces after one hour of in vitro circulation in a closed system using heparinized, diluted human blood. (100X magnification)

Carmeda 涂层的电镜下效果



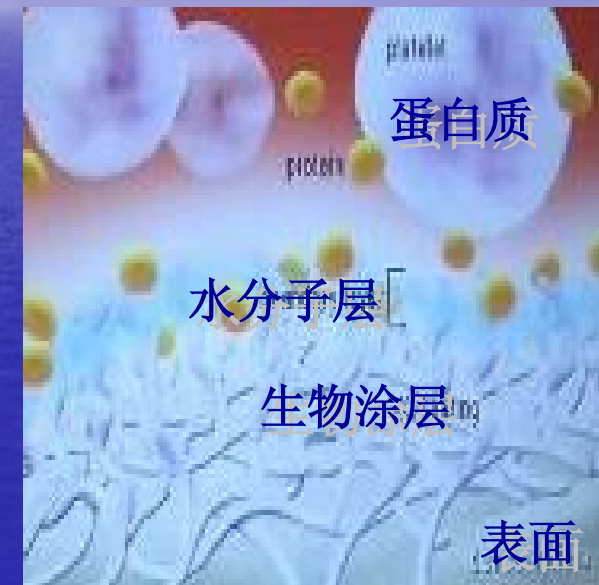
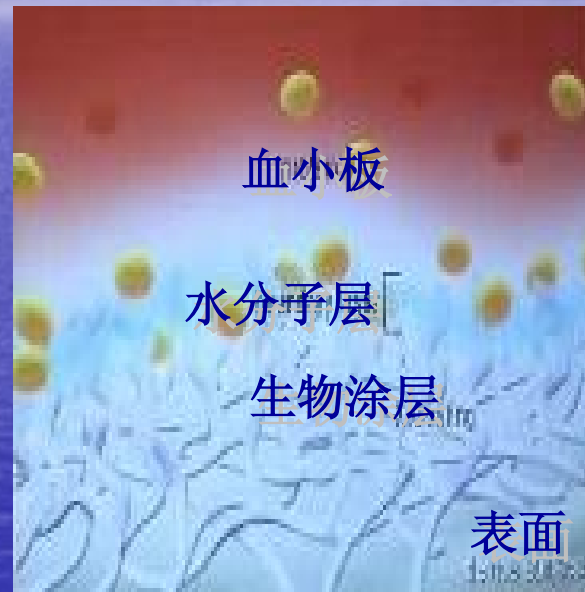
uncoated



coated

Scanning electron micrographs of oxygenator fiber surfaces after one hour of in vitro circulation in a closed system using heparinized, diluted human blood. (100X magnification)

Terumo X-coating



- 水在亲水层聚集
- 涂层膨胀建立分子筛
- 血小板不黏附
- 蛋白质不变性

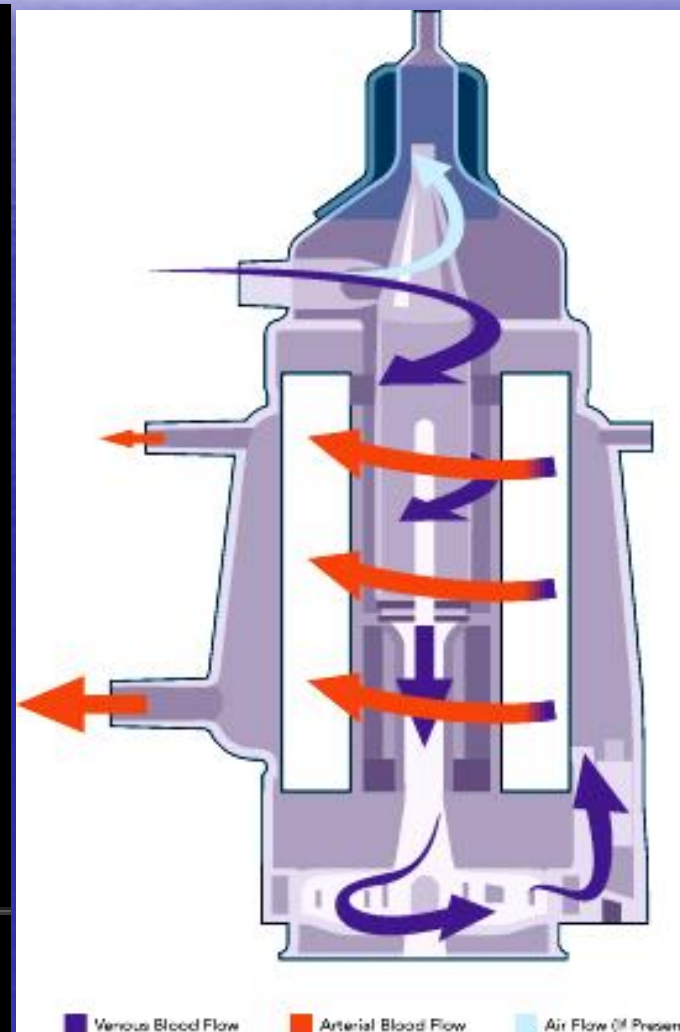
微创体外循环设备

- V CardioVention :** **CORx System**
- V Terumo :** **Mini-x System**
- V Medtronic :** **Resting Heart System**
- V Jostra :** **Ready System**
MECC System
- V Dideco :** **IDEAL System**
- V Medos :** ***DELTASTREAM* Pump**
- V Maquet:** **Quadrox**
- V Eurosets:** **Admiral**

CardioVentation CORx系统



CardioVention CORx系统特点



CardioVention CORx系统特点

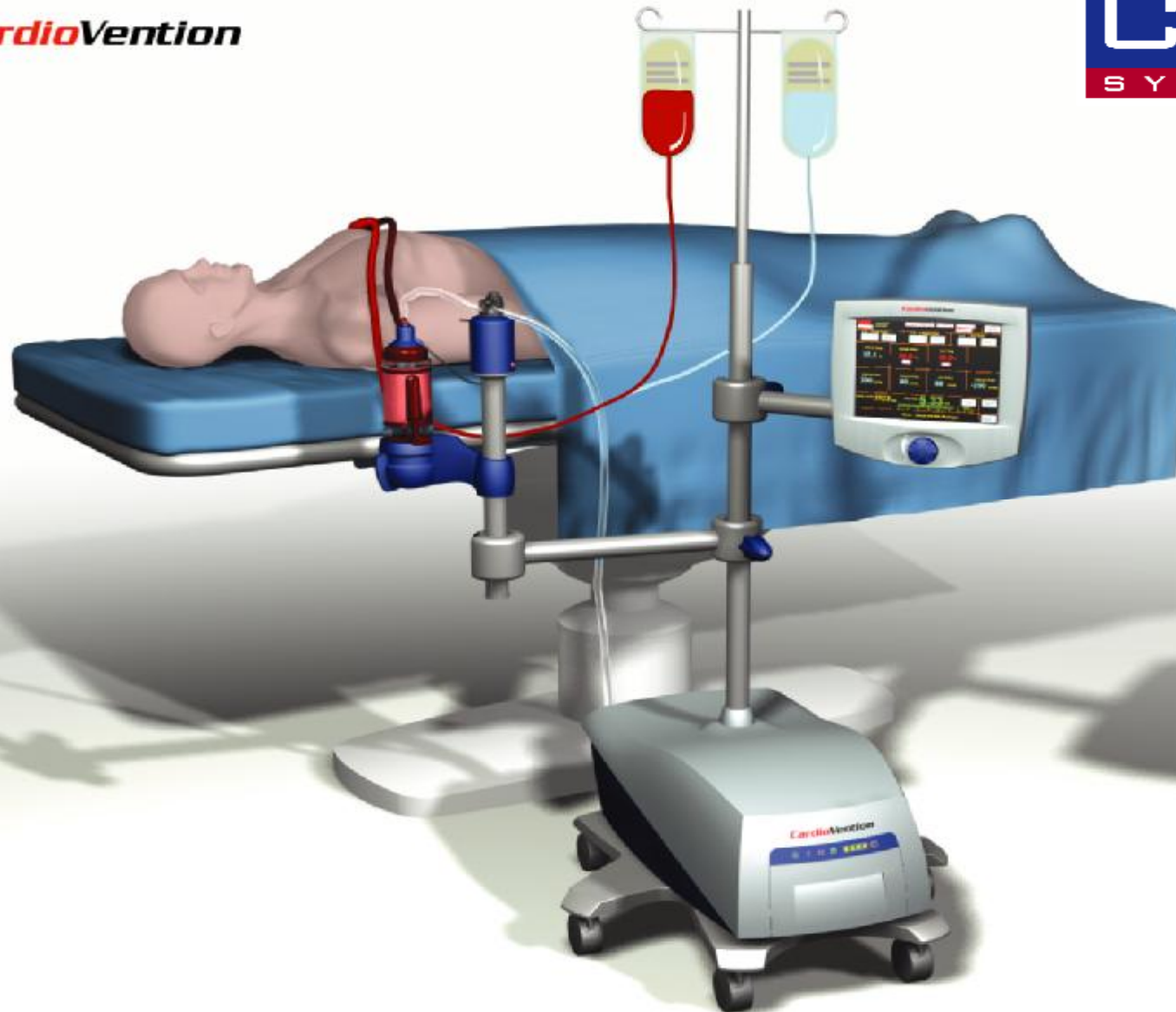


血液接触面积: 1.2m^2
总预充量 400ml
最优氧合
最大限度的微气栓滤过
节省空间
移动性强

Micro-Circuitry

CardioVention

COR
SYSTEM X



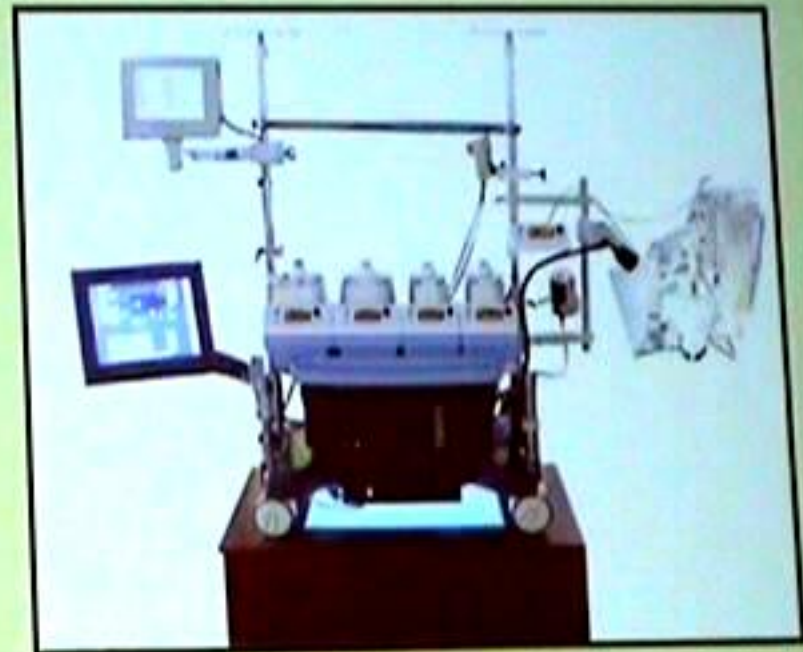
CardioVention CORx系统特点

CardioVention
CORx
"assisted
beating heart"
platform



Terumo Mini-x系统

Mini – X and System One



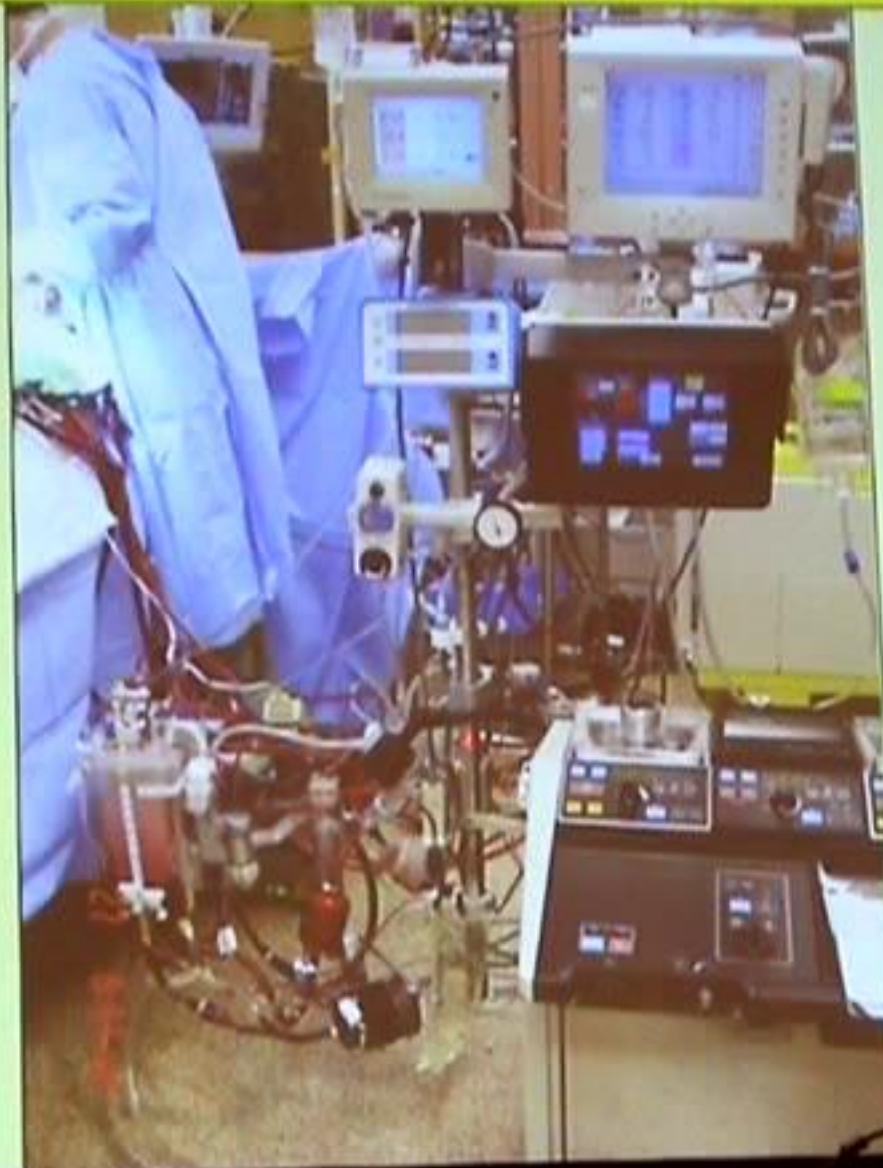
Terumo Mini-x系统

Terumo Mini-X Prestige Pack



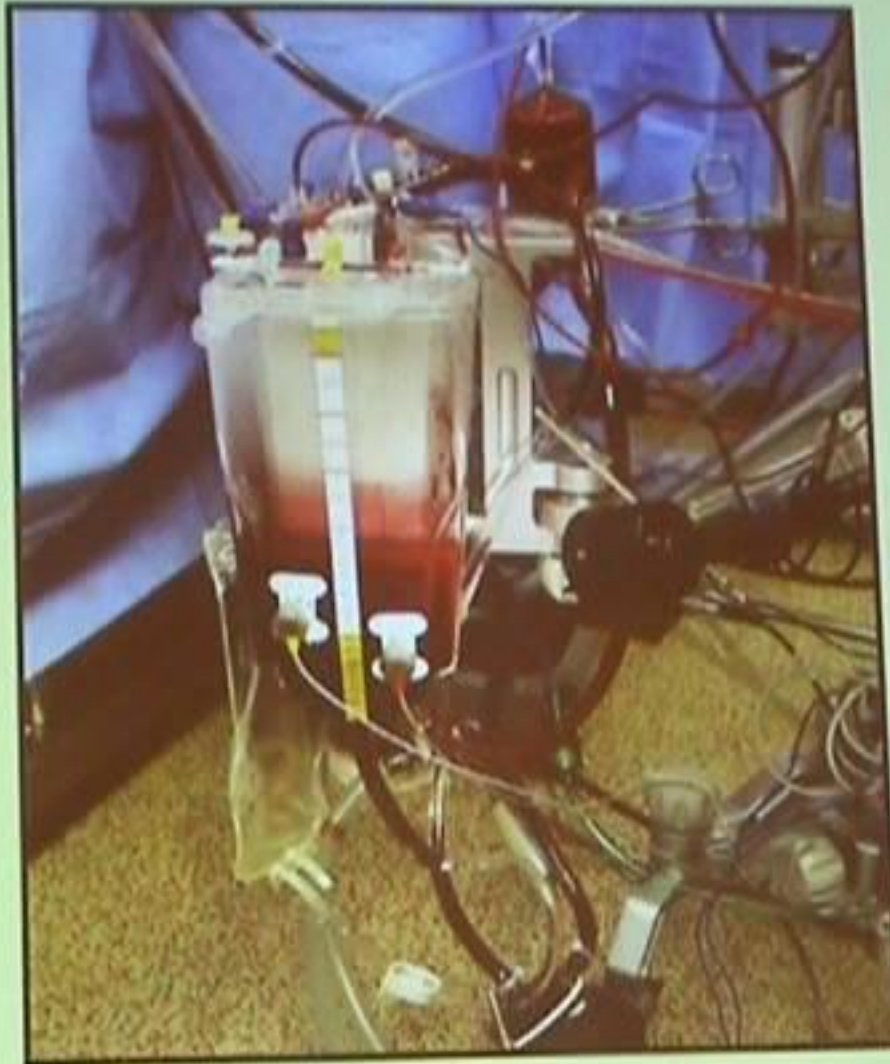
Terumo Mini-x系统

Mini – X and Strategic Leuko-reduction



Terumo Mini-x系统

Terumo/
Asheville
mini-X
CPB circuit



Terumo Mini-x系统



Terumo Mini-x系统

- Ø快速安装预充: 预先组装, 4个连接
- Ø适应广: 32-163kg
- Ø流量: VAVD辅助 $\geq 4\text{L/min}$
- Ø涂层: X-coating
- Ø氧合器: SX-18
- Ø滚压泵或离心泵
- Ø预充量: 1000ml (RAP前)

Terumo Mini-x系统

Retrograde and Antegrade
Autologous Prime Sequence
Video

Terumo Mini-x系统

- 70岁，男性
- 严重的 MR AI/AS COPD 3 Vessel
ASCAD AF HTN CHF NIDDM
- 183 cm , 93kg, 体表面积: 2.1m^2
- 术前HCT 35.5 % 血小板 285000
- 射血分数: 40%

灌注方法

- 术前连续自体血成分分离 (CATS)
预留750ml血浆, 400ml血小板
- Sarns Soft flow 动脉插管
- CDI-500血气检测仪
- Terumo Mini-x 涂层管道
- 去白细胞过滤
- “RAP +AAP”, 预充量 750ml

手术过程

- **CPB前HCT33 % 转中第一个HCT 29 %**
- **阻断时间 219min**
- **转机时间 269min**
- **停机后将分离的血液成分回输**
- **鱼精蛋白后血小板计数—166000**
- **术中给2u悬红, CATS—1470ML**
- **手术: CABx6, AVR, MVR, TVR,
MAZE**

结果

- 未用IABP C.I. >2.2
- 极少量升压药
- 住院期间输血量: 2u 血浆, 0 血小板, 3u 悬红
- 拔管--- 术后4.5 h
- 无神经系统损害
- 术后5天低心排
- 随访6 周---良好

Medtronic Resting Heart System



- FAST SET UP & PRIME
- INTUITIVE IN USE
- EFFECTIVE AIR HANDLING



Medtronic Resting Heart System

A New State of the Practice

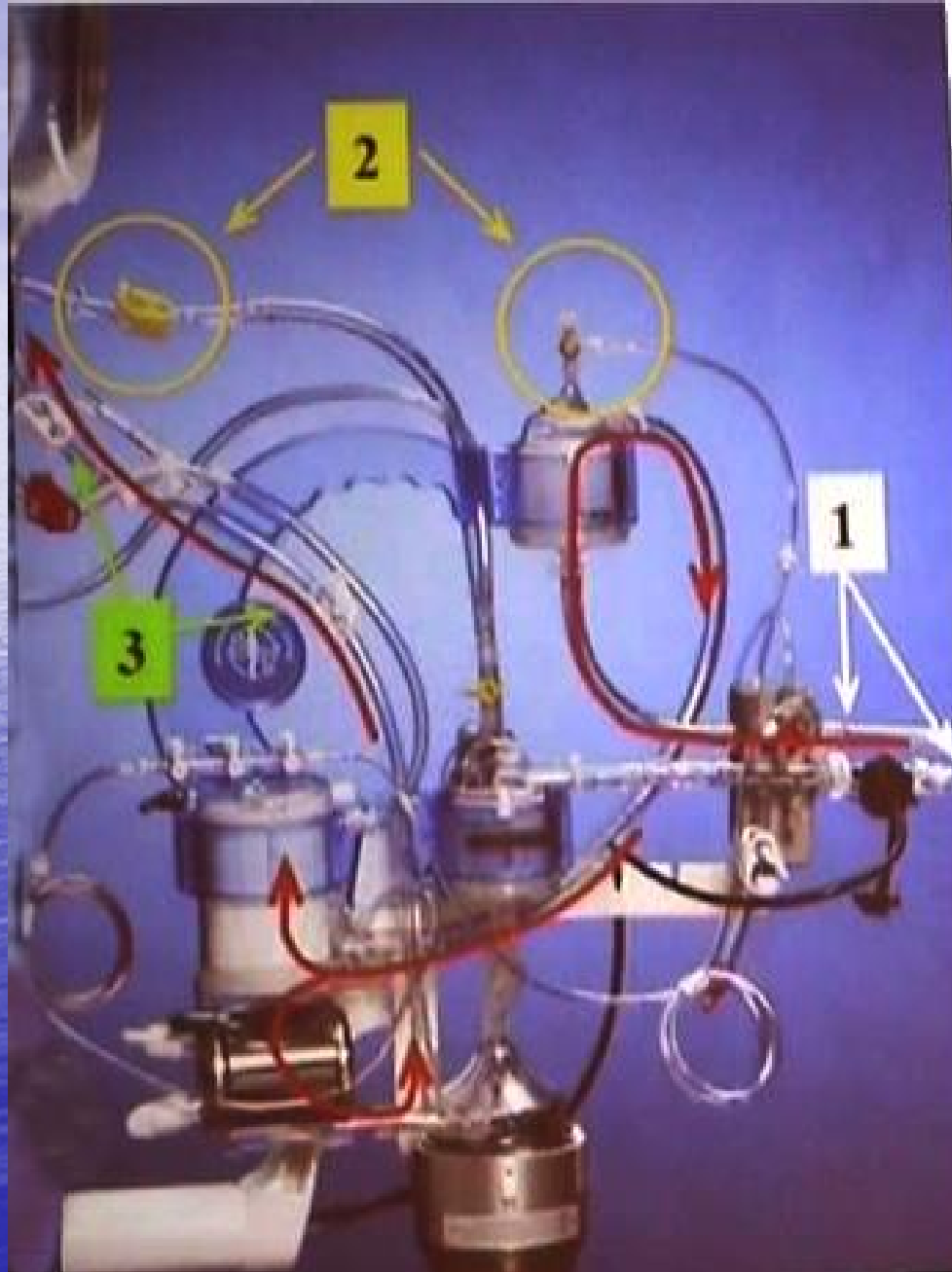


- Pre-connected and ready to use
- Primes quickly and easily
- Accessory pack available to your specification
- Provides for all Sat/hct and pressure monitoring
- With or without Cannulae inclusions

Medtronic Resting Heart System



Medtronic Resting Heart System



RAP Arterial Circuit

1. Place clamps on the arterial and venous lines
2. Close the "yellow" infusion line and arterial filter purge stopcock.
3. Open the "white" Prime Line to the empty prime bag.
4. Slowly release the arterial clamp. Prime will be displaced into the empty prime bag.
5. Clamp the arterial line per patient tolerance or when blood reaches the prime bag.

Medtronic Resting Heart System



RAP Venous Circuit

1. Place clamps on the arterial and venous lines.
2. Close the "yellow" infusion line and arterial filter purge stopcock.
3. Open the "white" Prime Line to the empty prime bag.
4. Start the pump at minimal RPM and slowly unclamp the venous line. Prime will be displaced into the empty prime bag.
5. Clamp the venous line per patient tolerance or when blood reaches the prime bag.

Medtronic Resting Heart System

VARD

Venous Air Removal Device

Active Venous
Air Removal™
System



Upper Level Sensor - *Alert*

Lower level Sensor - *Warning*

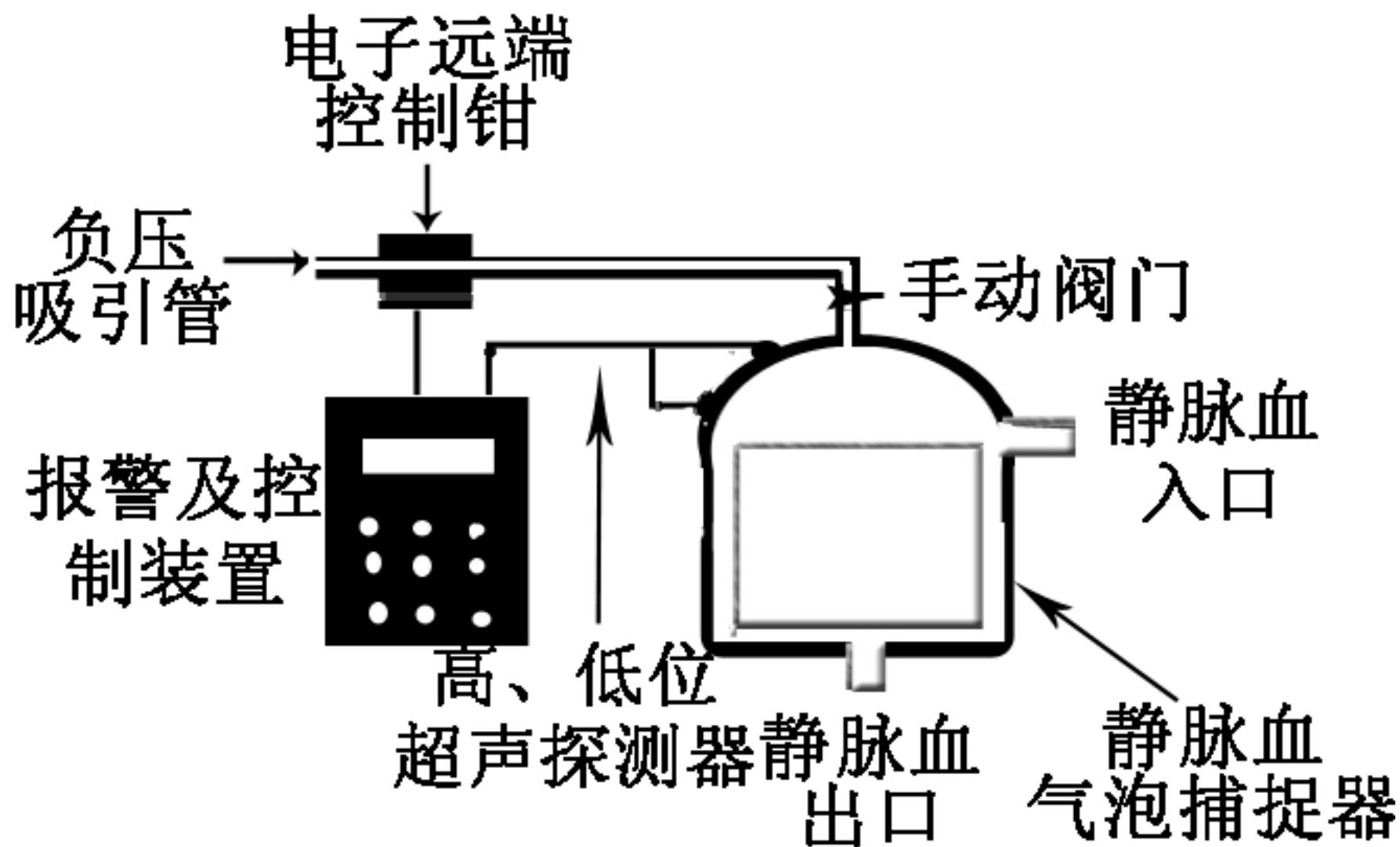


Automated Pinch Valve

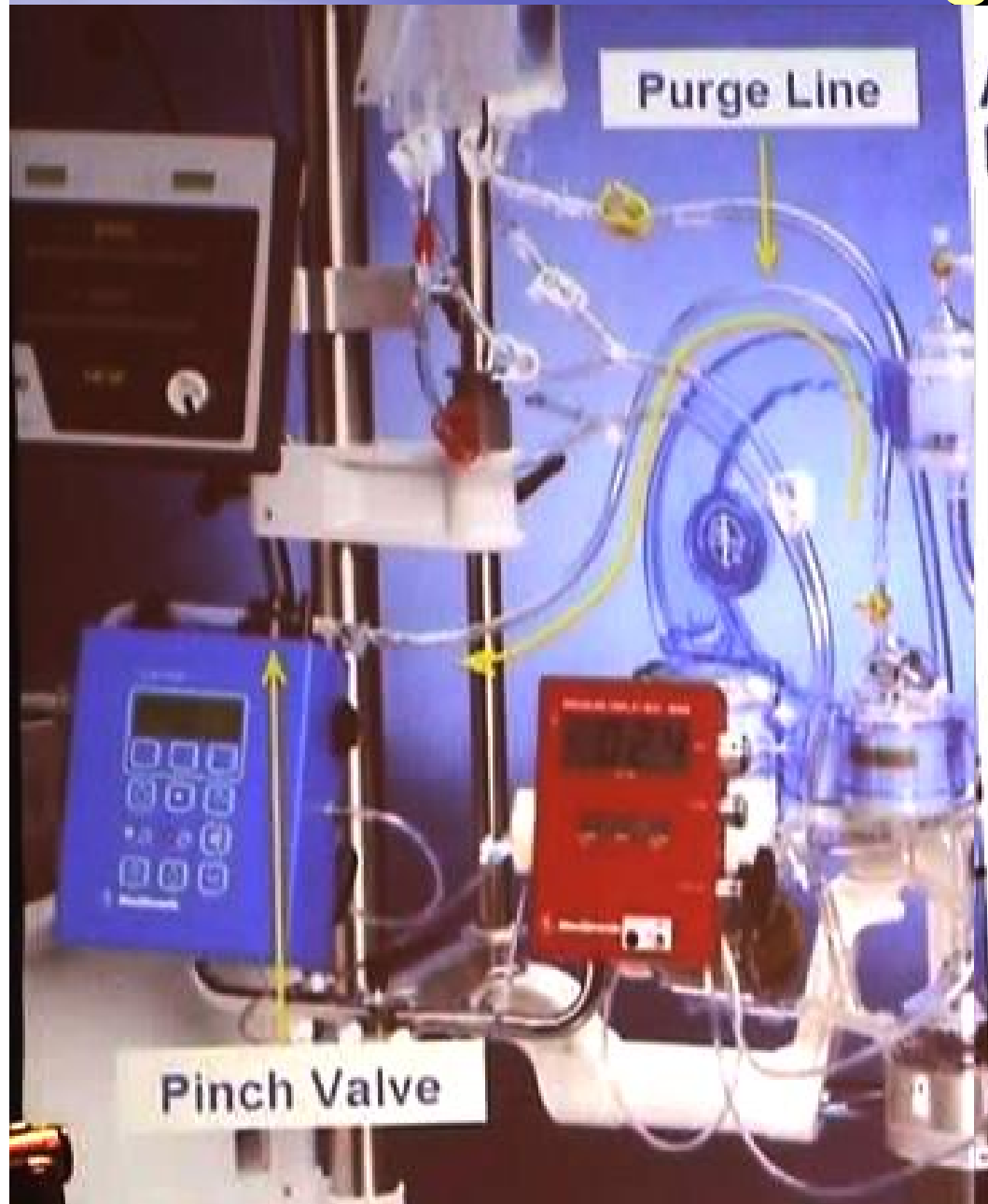


38 micron filter
Vacuum Sensor

静脉排气装置 (VARD)



Medtronic Resting Heart System



Automatic Air Removal Principles of Operation

- An air Purge Line that exits the top of the VARD is placed in the Pinch Valve.
- The end of the Purge Line is connected to a blood collection cannister.
- The cannister is connected to a regulated wall vacuum source set to a pressure of -200 mmHg.
- The resting position of the Pinch Valve is CLOSED.

Medtronic Carmeda® * AFFINITY®

静脉排气装置 (VARD)



AAR—1000
自动气体去除
装置



AAR—1000
静脉血排气
装置



**VARD 超声液
面探头**

MEDTRONICTM RESTING HEARTTM SYSTEM

Surgical Utility

Active Air Removal



Venous Air Removal Device

Laboratory Simulation

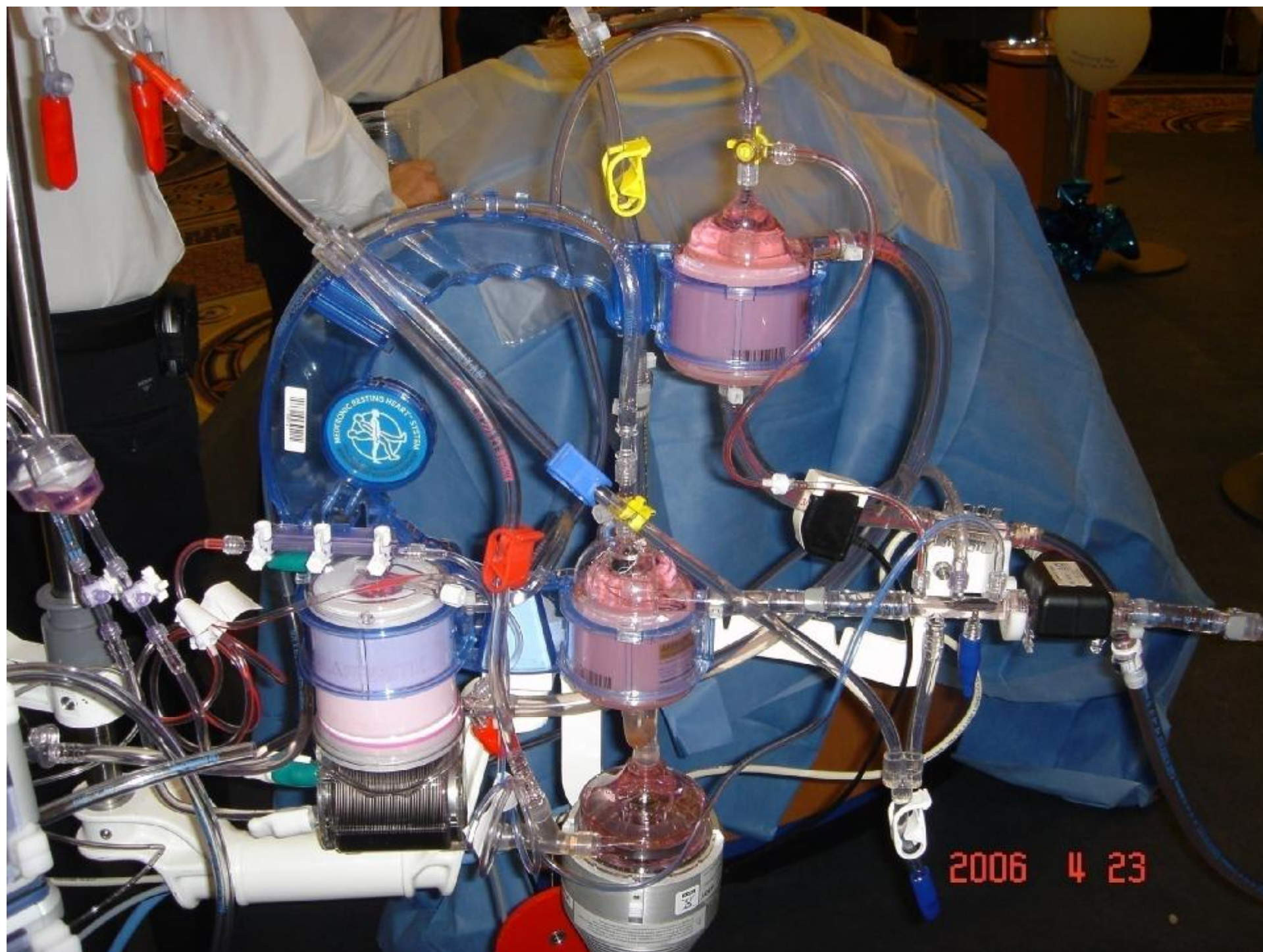
Medtronic Cannulae

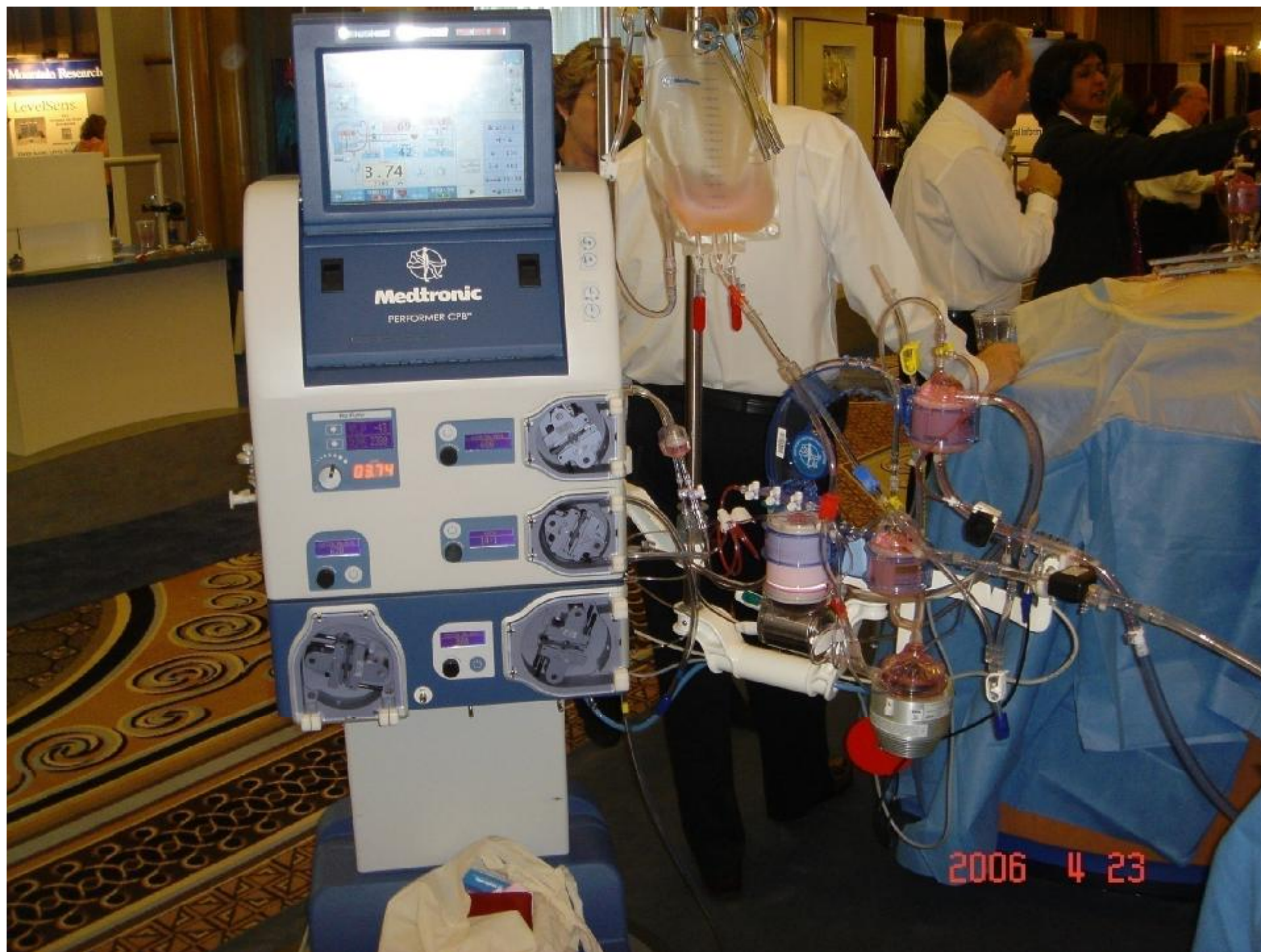
MEDTRONIC[®] RESTING HEART[™] SYSTEM

System Integrated Cannulae

- Avoid the Aorta
- Being Gentle to the Aorta
- Minimal Incisions
- Maximized Venous Return
- Added Surgical Utility







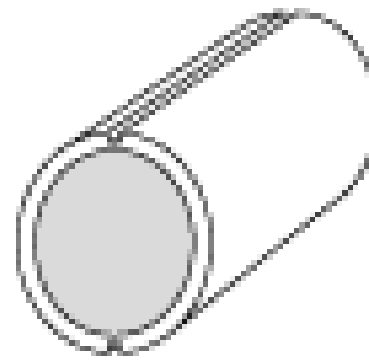




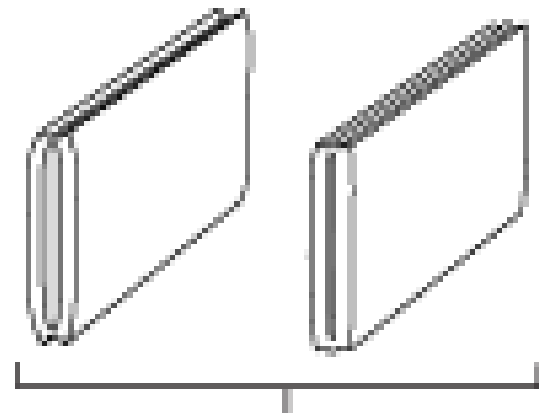
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Medtronic Gentle Vent™

吸引泵管



negative
pressure
0 to -150 mmHg

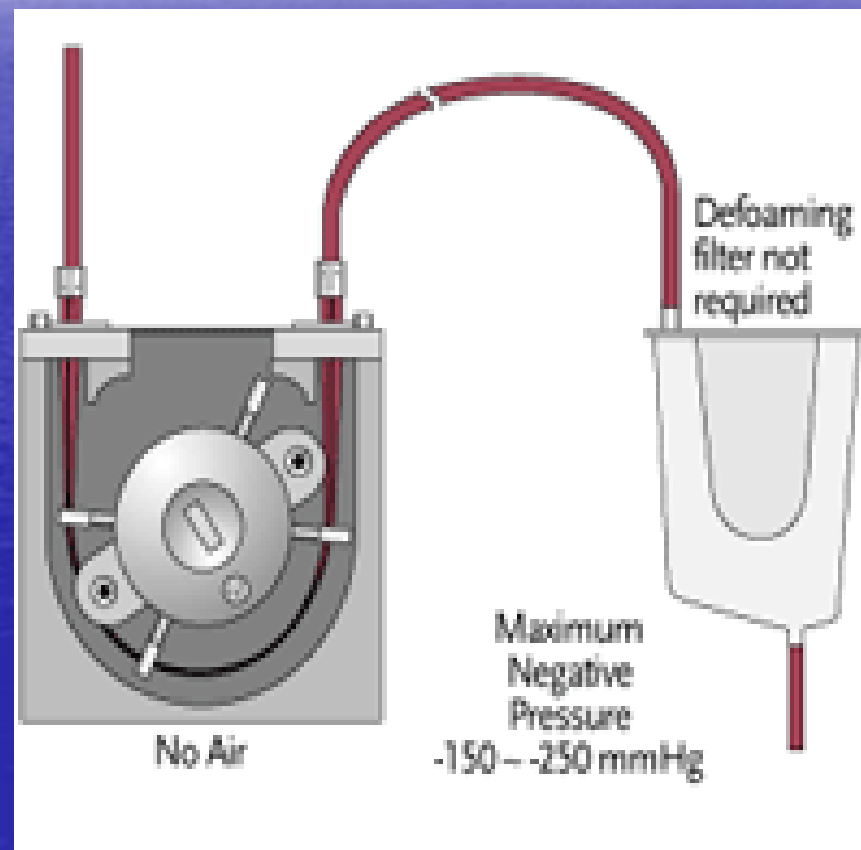
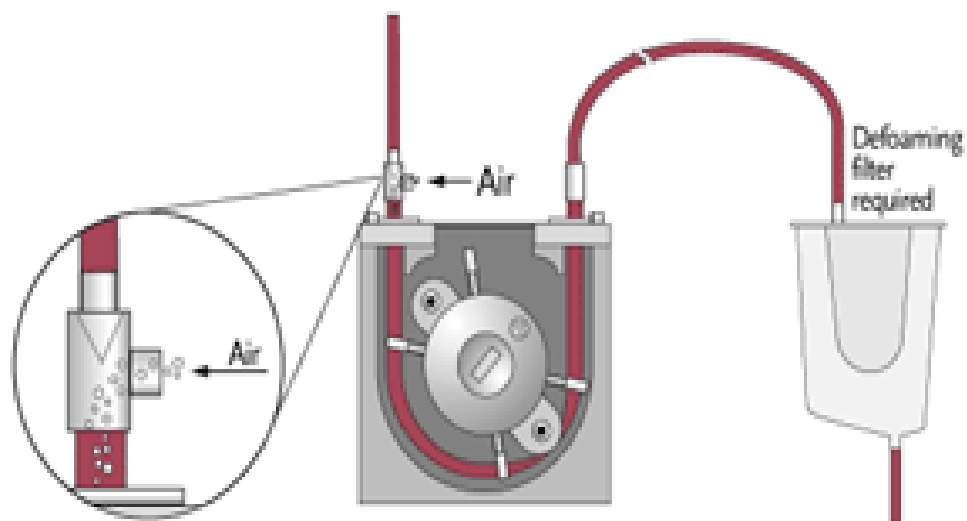


negative
pressure
-150 to -250 mmHg

Medtronic Gentle Vent™

吸引泵管

Traditional Vacuum Relief Valve (VRV)



Medtronic 总设计目标

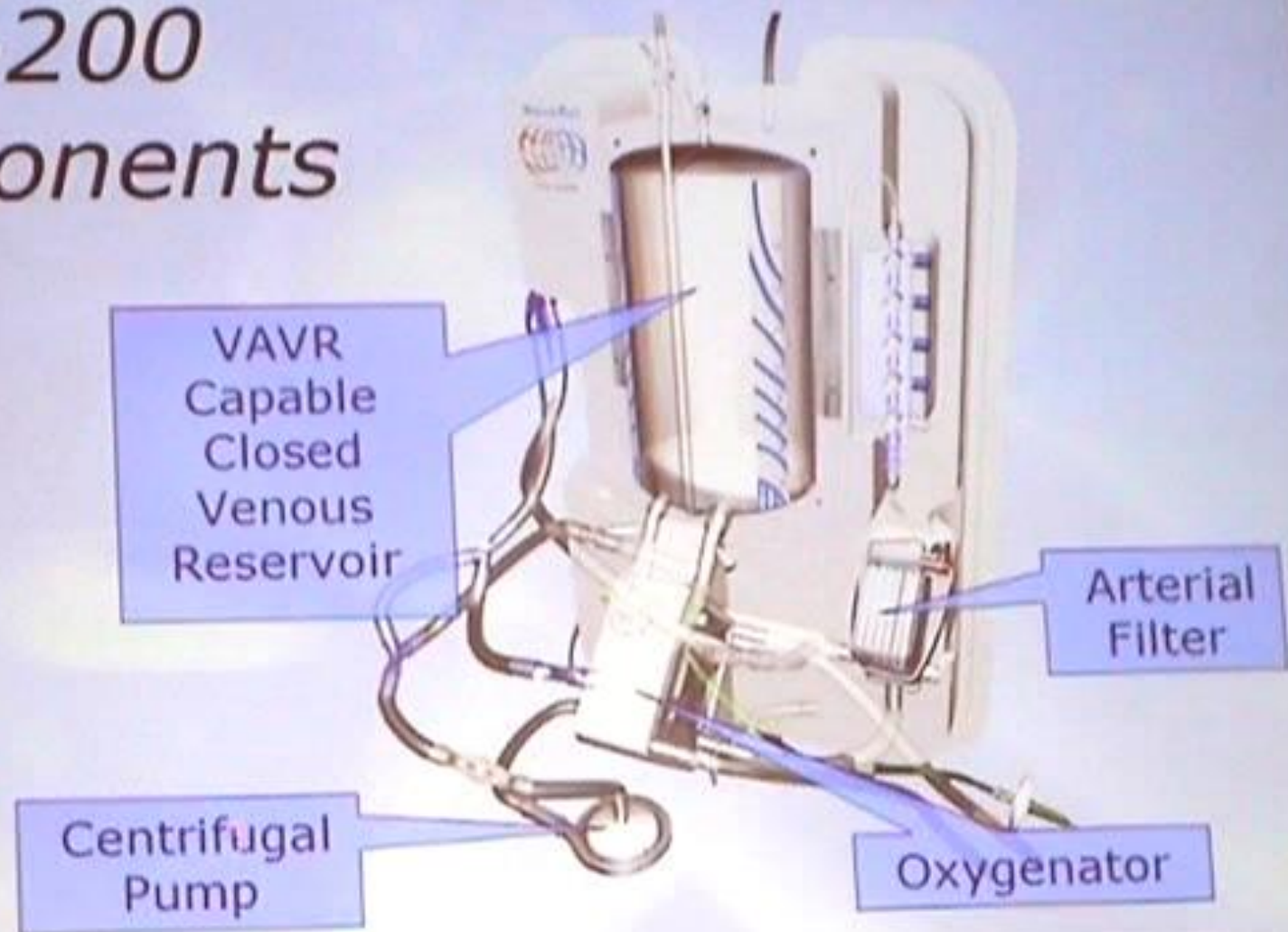
- 病人安全
- 新型气泡排除技术
- 新型插管及插管技术
- 柔和的左心减压系统
- 完全的**Carmeda**生物活性涂层
- 密闭的循环管路
- 减轻血液稀释

Read System –200

安全、方便、多种应用方式

- 预先组装、可快速应用
- 三种使用方式
 - 重力静脉引流
 - 负压辅助静脉引流
 - 动力辅助静脉引流
- 预充量低 **650ml**
- 可用于各种心血管手术
- 表面涂层

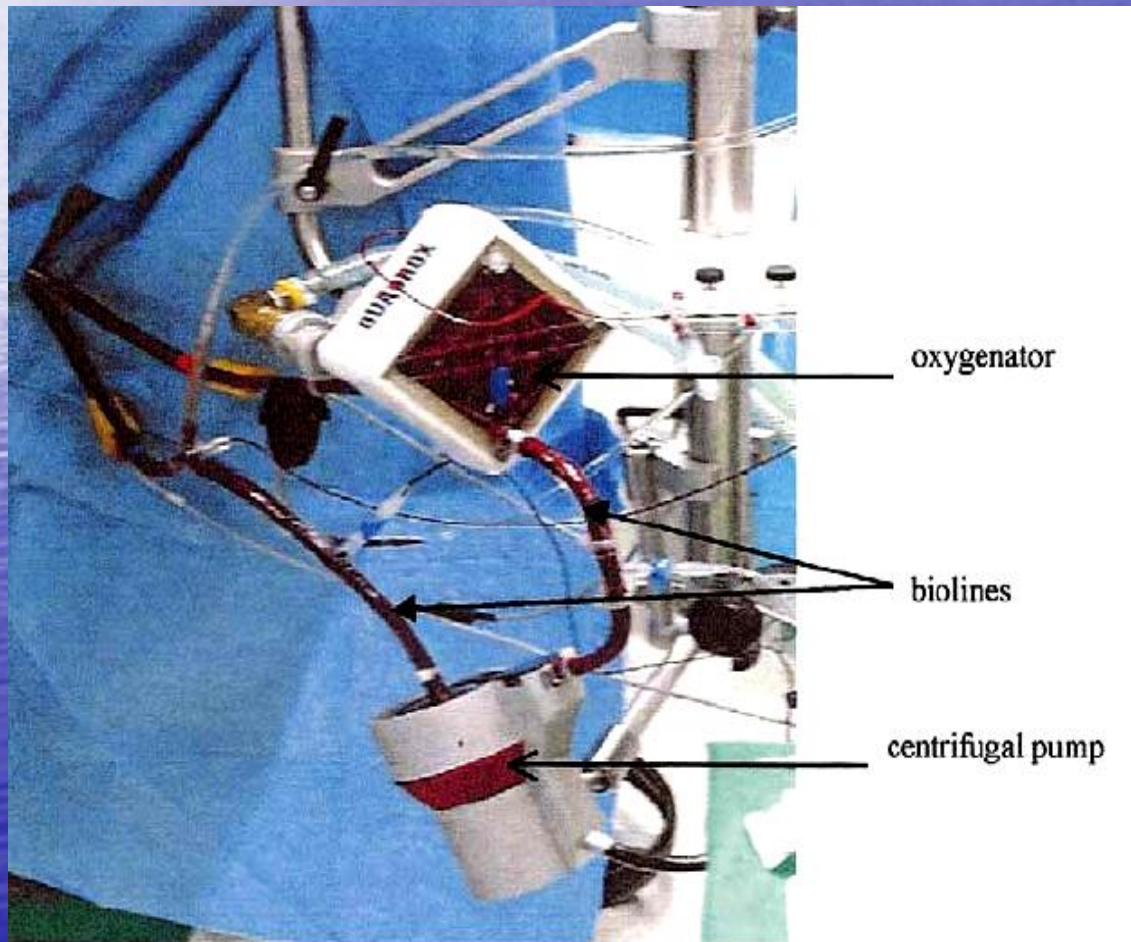
RS-200 Components



NovoSci[™]



Jostra MECC 特点



∅ 闭合的环路

∅ 距离病人头部近

∅ 管道长度
< 1m

Dideco ECC.O system



**Minimized Priming
Volume: 380 ml**

**Reduced Membrane
Surface Area: 1.1 m²**

**Maximum Rated Flow:
5 liters/minute**







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SORIN
COMPLETE SOLUTIONS
FOR IMPROVED PATIENT OUTCOMES



BLOOD MANAGEMENT
SYSTEMS

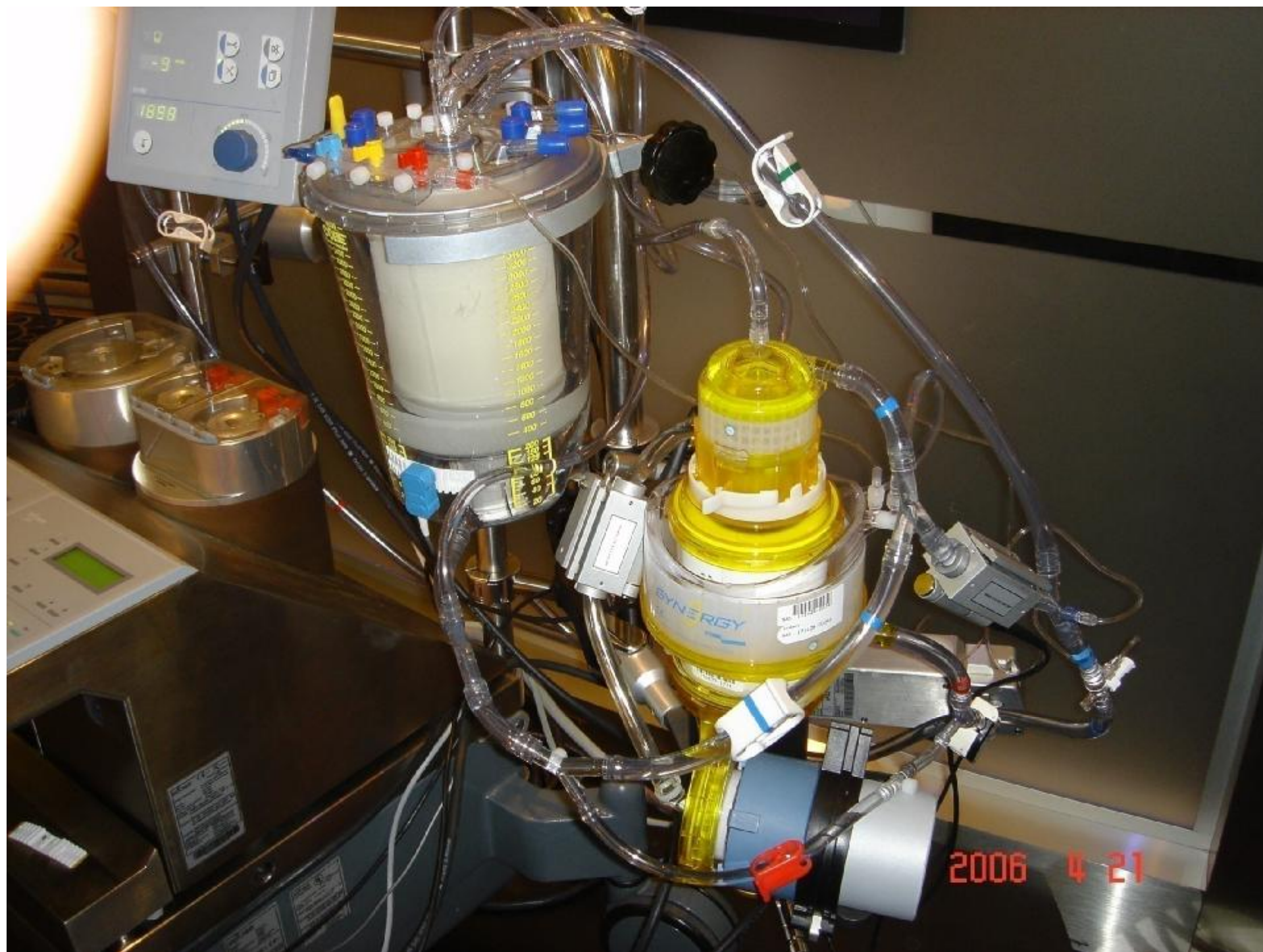


SORIN GROUP
www.sorin.com

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MEDOS DELTASTREAM 血泵



Deltastream



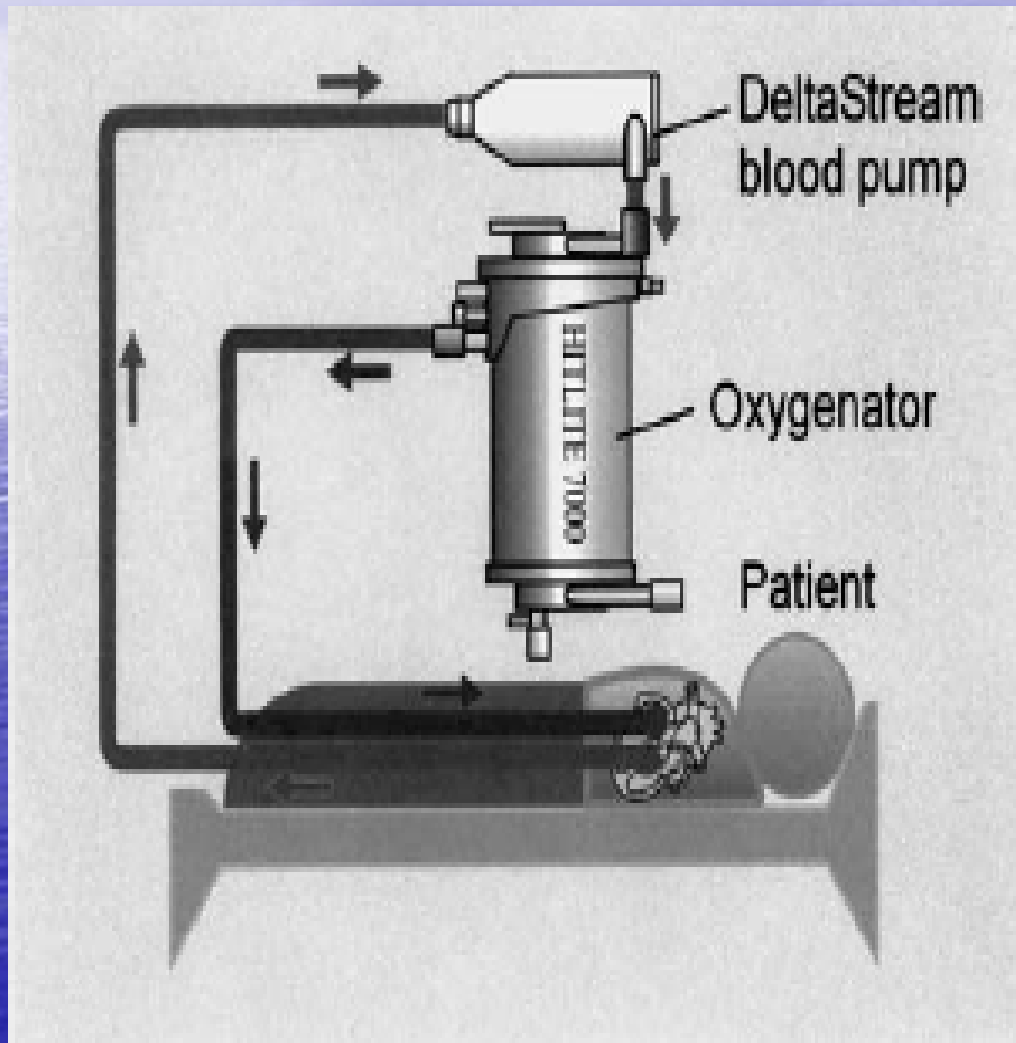
Deltastream DP1

长: 150mm 直径: 40mm

DELTASTREAM®

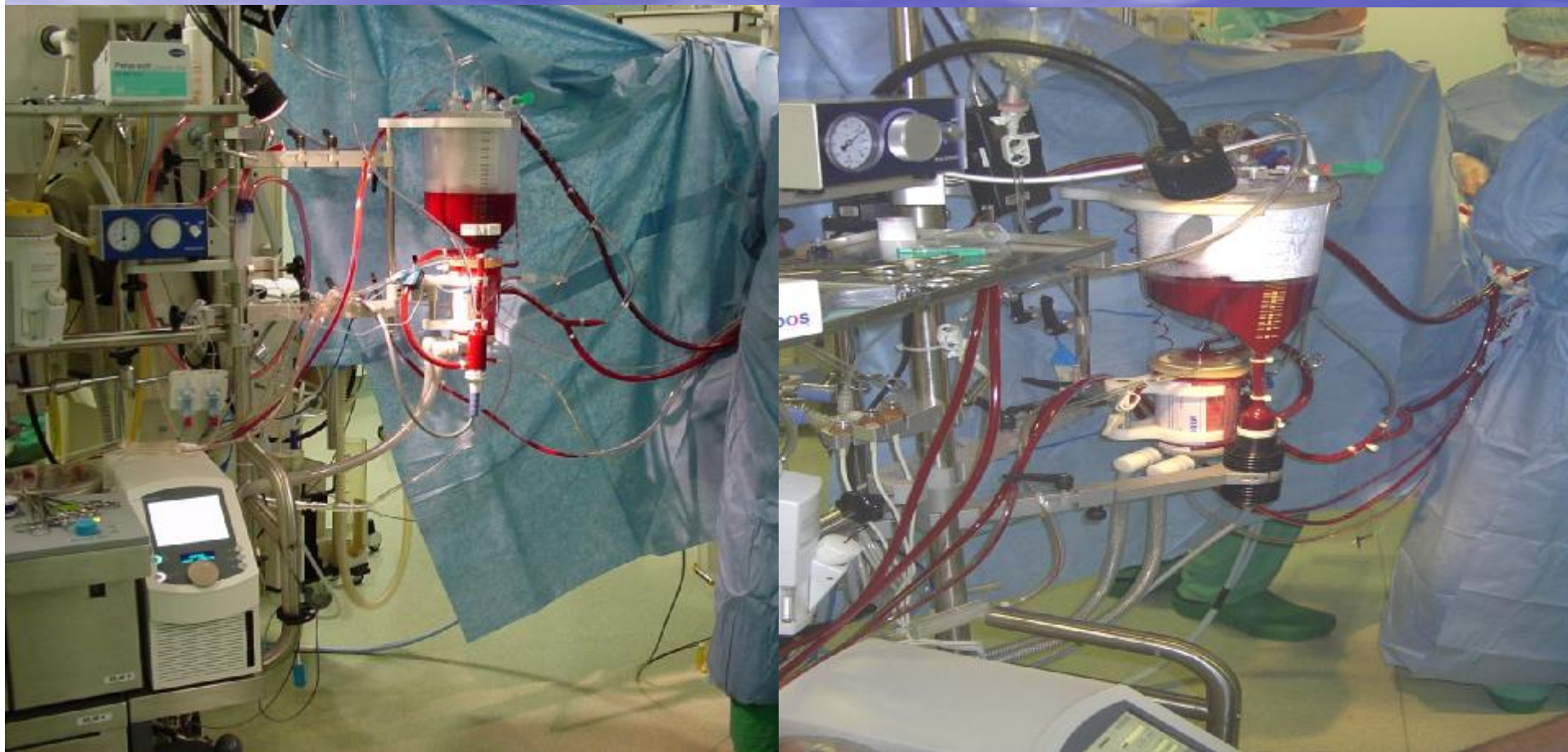
容量: 30ml 重: 280g

MEDOS DELTASTREAM 血泵特点



- 体积小
- 设计简单
- 低能量需要
- 所需管道少
- 血液损伤小
- 泵表面温度低

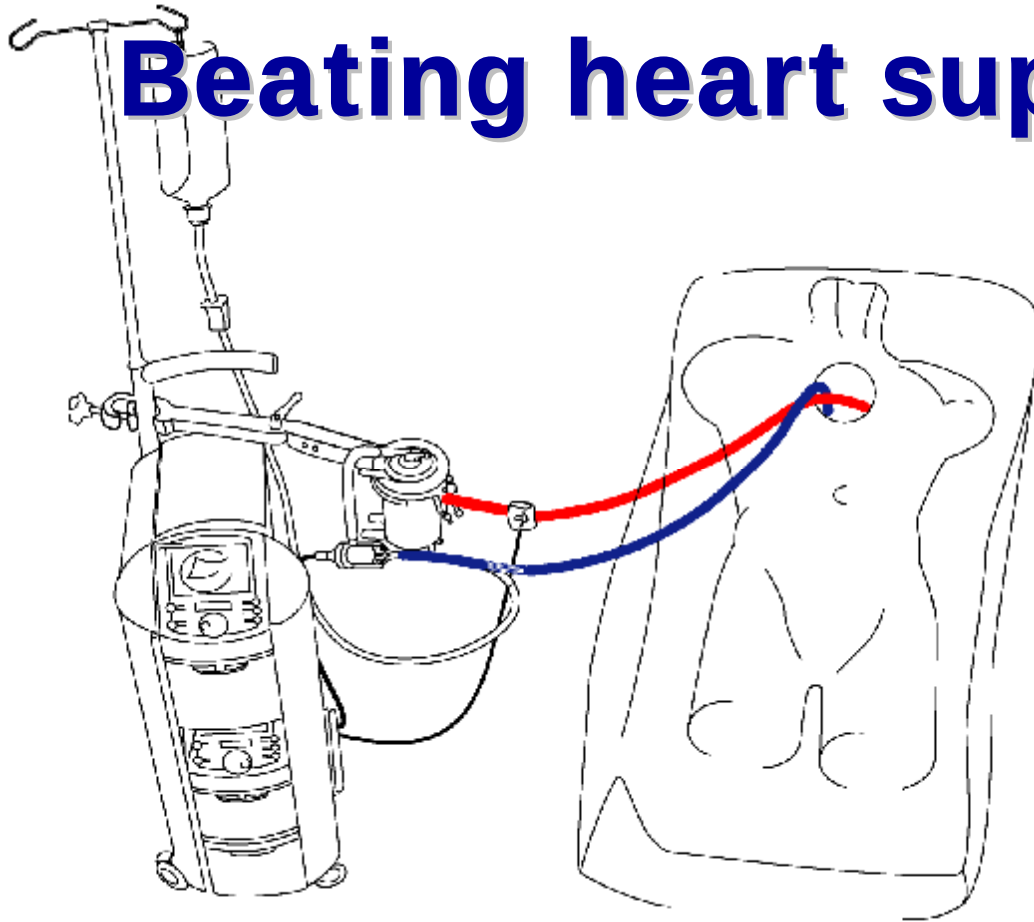
MEDOS 负压辅助引流



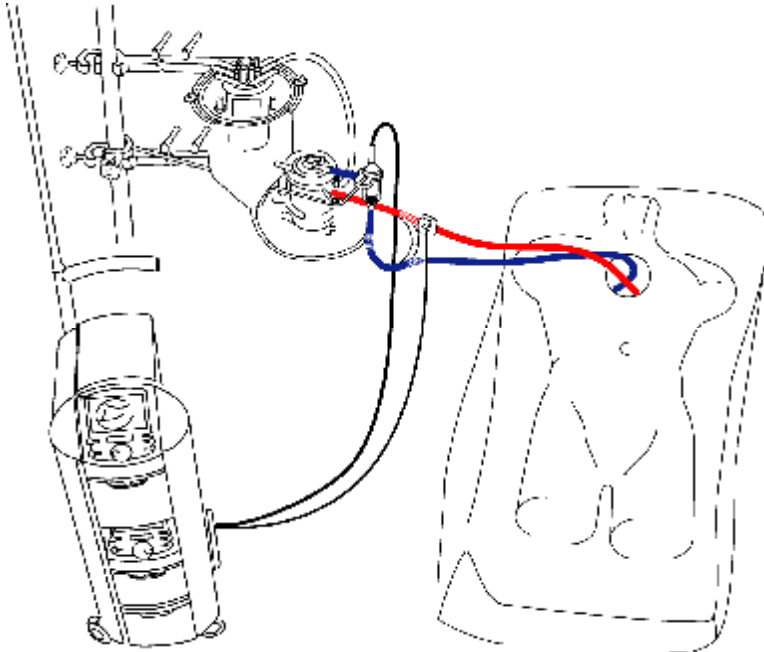
DELTASTREAM®

- 预充量 < 1000ml
- 缩短与患者距离

Beating heart support / ECMO



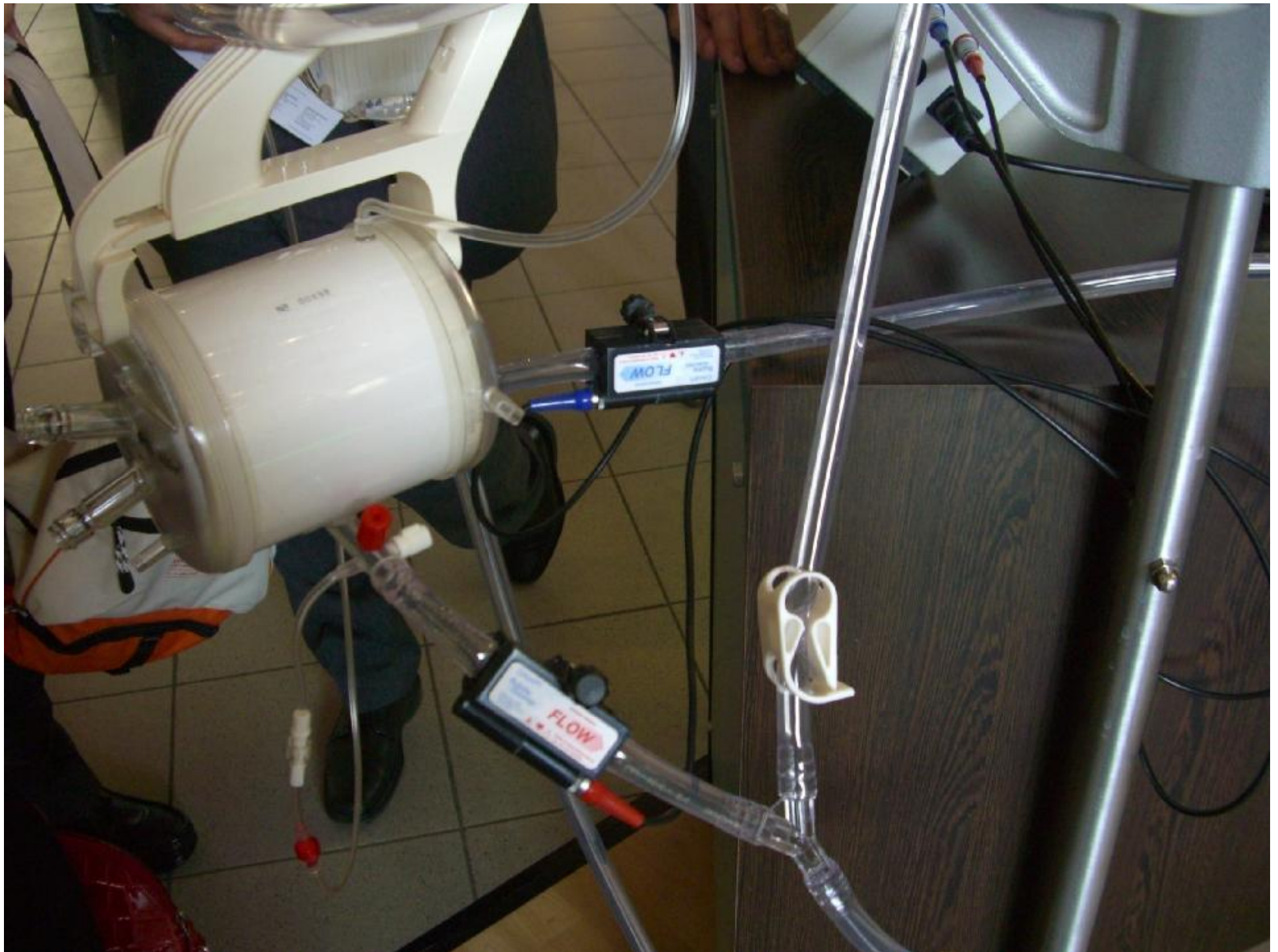
safe manipulation on beating heart
priming < 500ml
preload controle



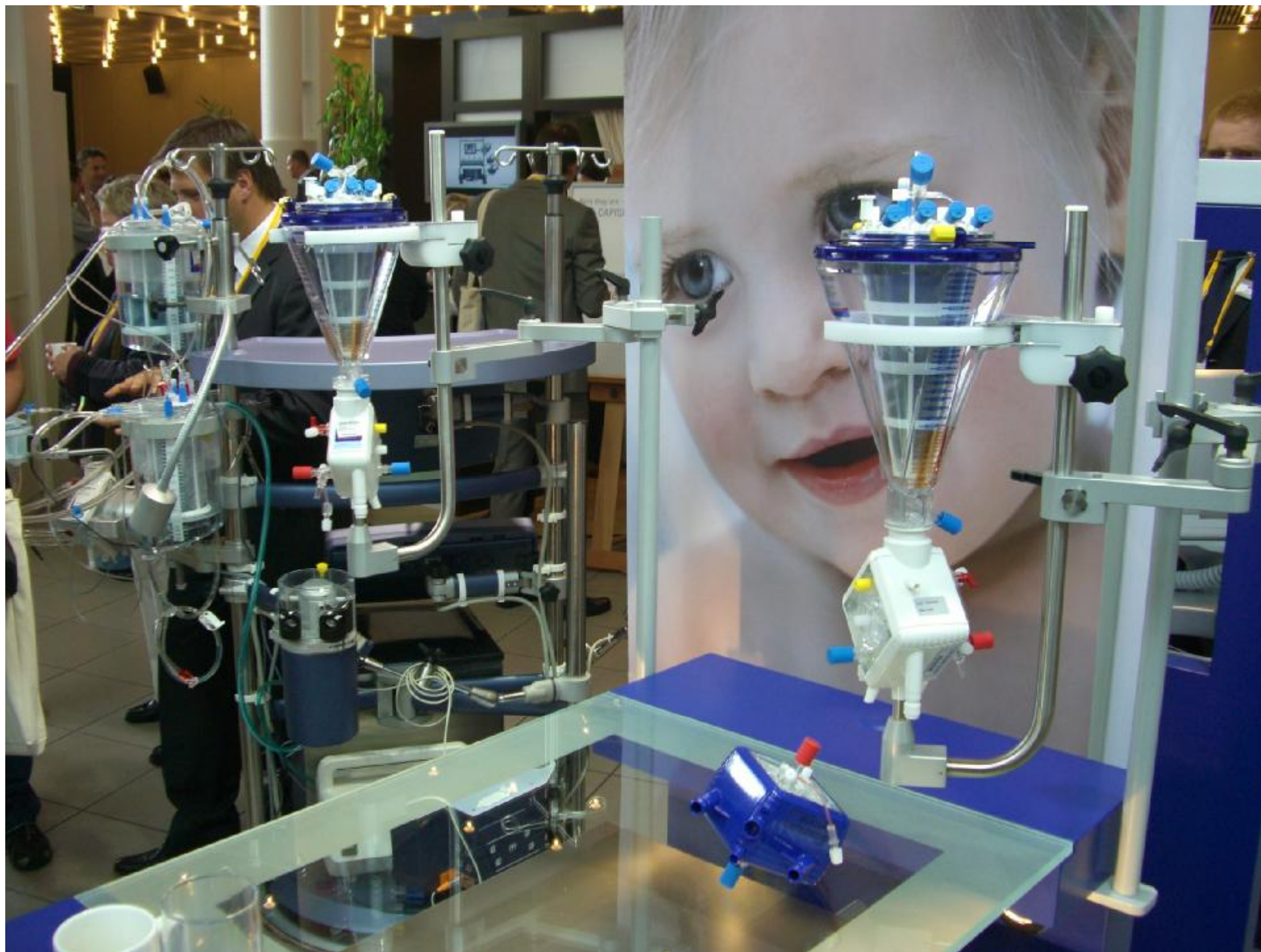
- *minimal priming volume of 100 to 200 mL due to autologous priming*
- *volume controlled pressure management*
- *preload control*



















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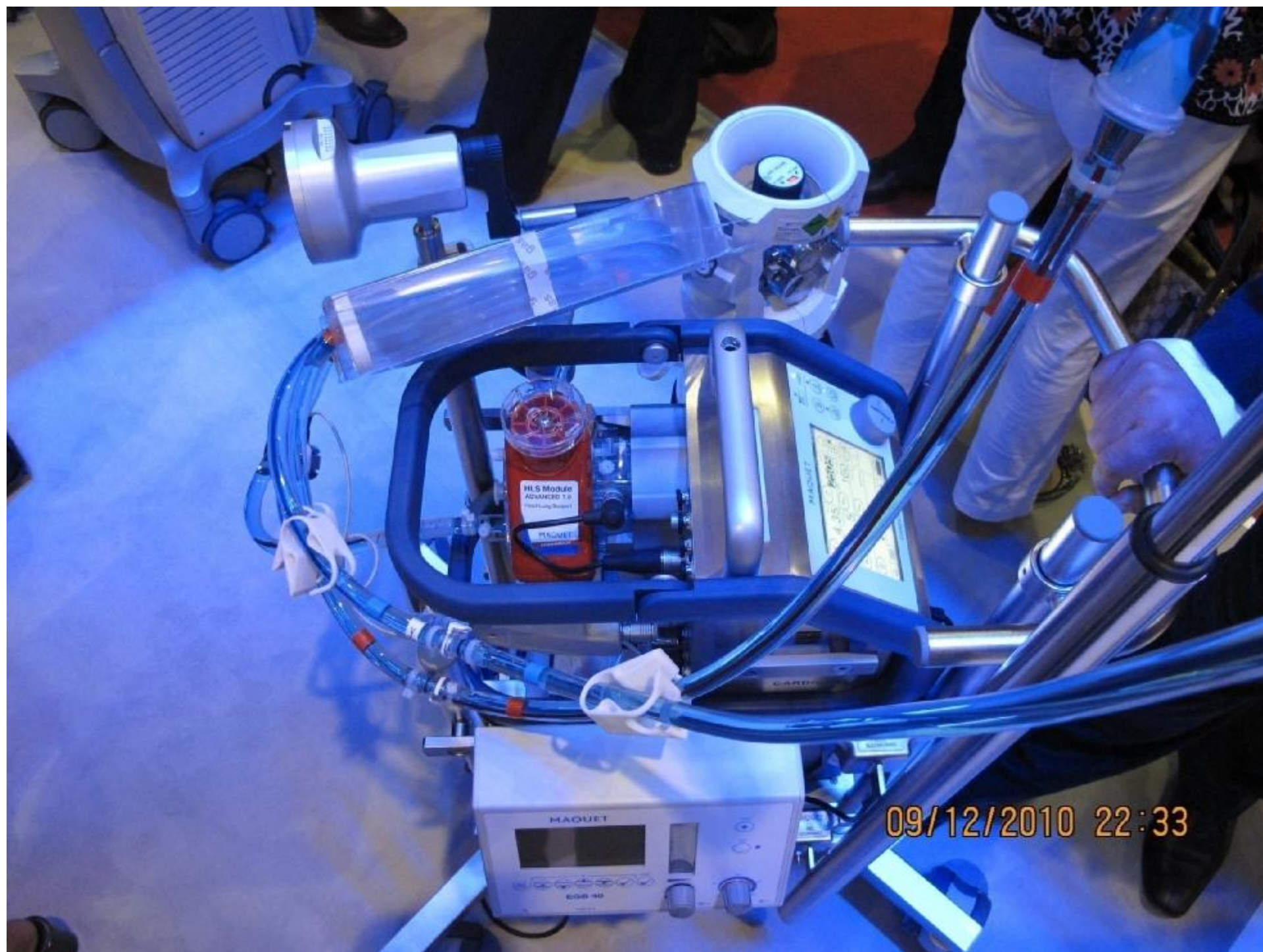


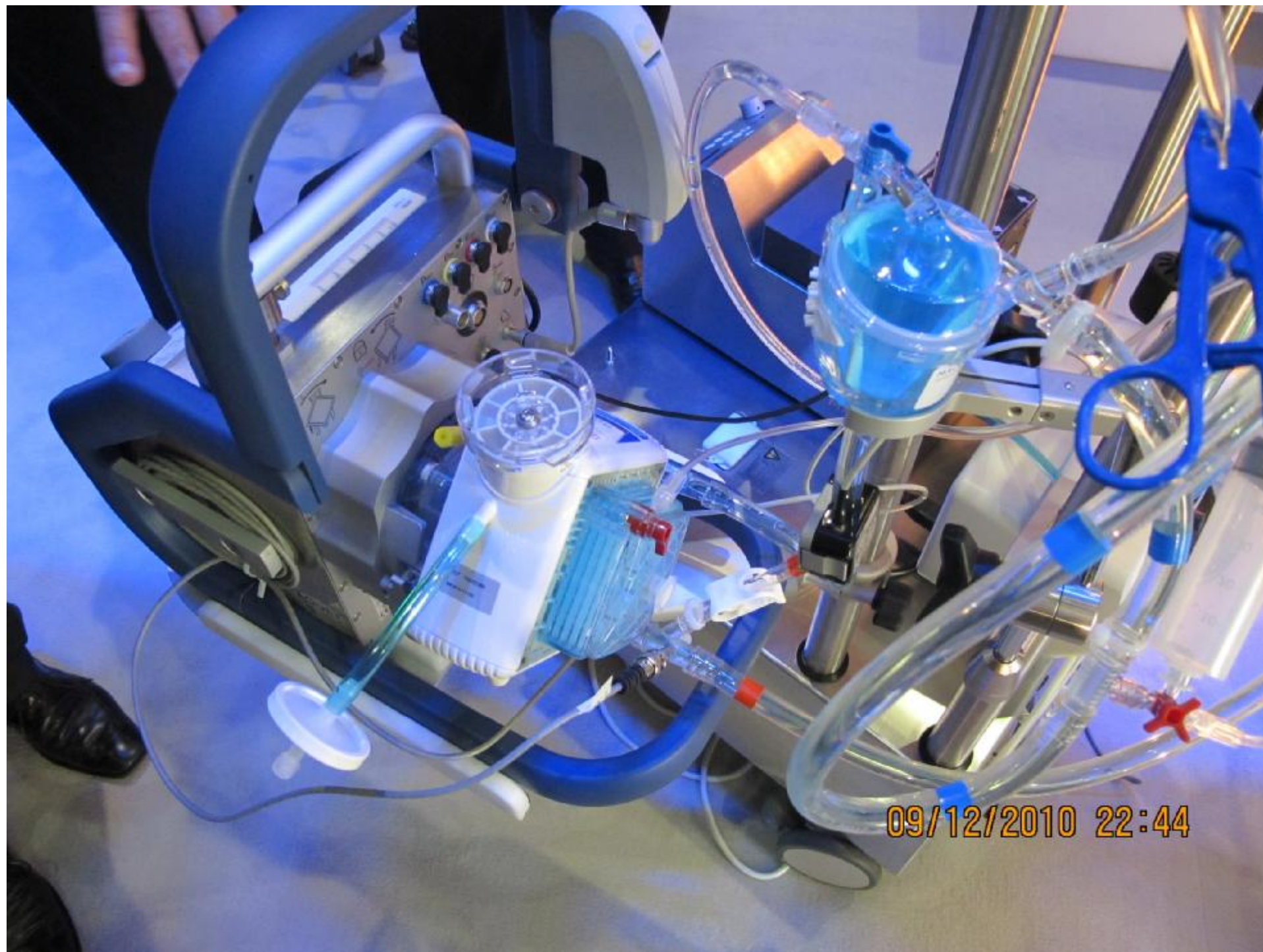
















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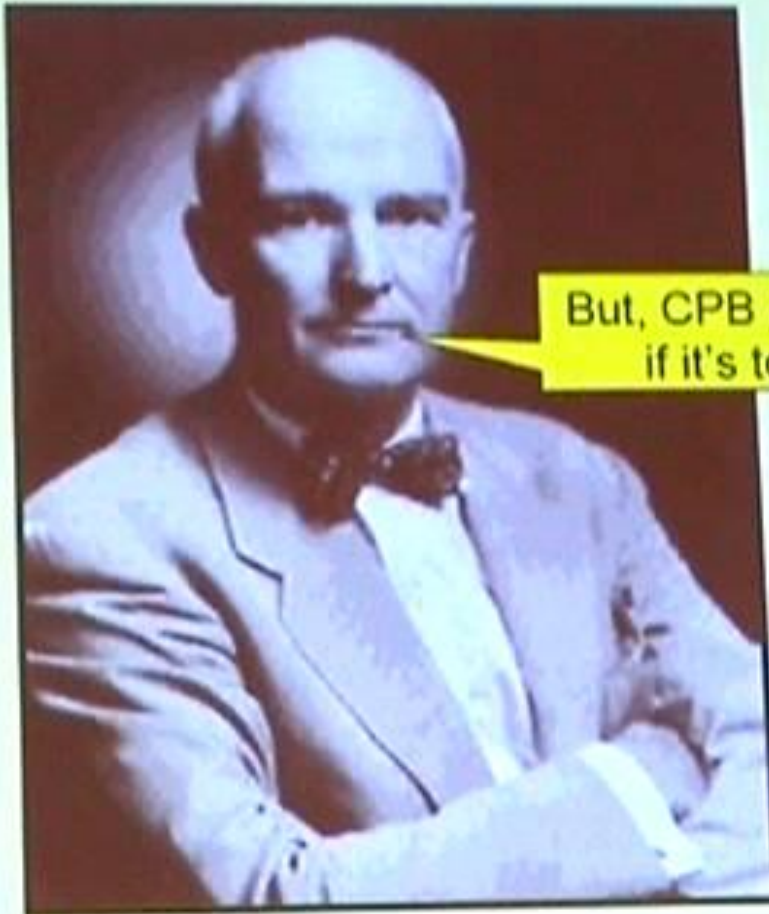
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微创设备国内应用情况

- 武汉亚洲心脏病医院 60例
- 北京阜外医院 10例
- 北京安贞医院 5例

小 结

- V** 微创CPB优于传统CPB
- V** 仍需要完善
- V** 费用较昂贵
- V** 国内尚未生产，但已应用
- V** 发展方向--微创体外循环



But, CPB must change
if it's to survive!

Dr. John H. Gibbon, M.D.

谢谢