Christian Doppler Laboratory for Cardiac and Thoracic Diagnosis & Regeneration

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Cardiopulmonary Bypass

Denise Traxler

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History

1812: Le Gallois showed that extracorporeal circulation is possible

1858: Brown-Sequard arterialized desaturated blood

1869: Ludwig & Schmid first reported of an artificial oxygenator

1882: first “bubble”-oxygenator by von Schroeder

1884: first “film”-type oxygenator
first prototype of a heart-lung-machine

STAMMERS AH (1997). Historical Aspects of Cardiopulmonary Bypass: From Antiquity to Acceptance

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History

1890: Jacobj described an device with a bubble oxygenator & bladder pump in order to provide pulsatile flow

1915: Hooker invented an forerunner for the disk oxygenator

1916: discovery of heparin by McLean

significant step in evolution of heart-lung-machine

1928: Dale & Schuster described the prototype pumping mechanism (valved pump)

1934: Debakey modified the twin roller pump

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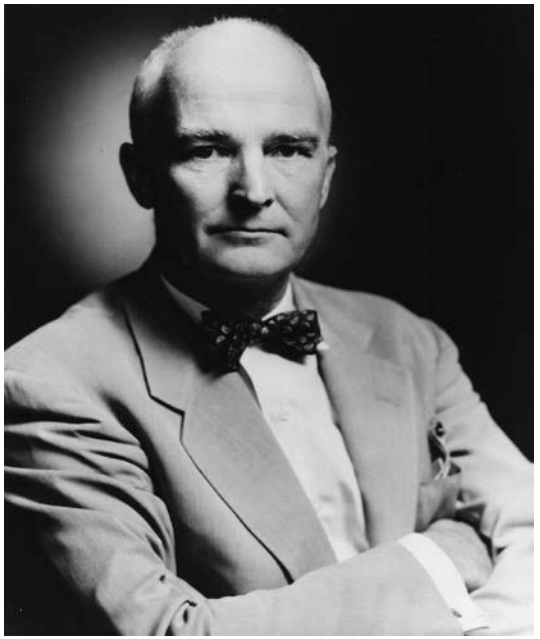
History

John H. Gibbon

1931: idea of an extracorporeal blood circuit that could perform a part of the cardiorespiratory function first occurred to him

cooperation with IBM (3 models)



„father of cardio-pulmonary bypass“

STONEY WS (2009). Evolution of Cardiopulmonary Bypass
GIBBON JH (1973). The Development of the Heart-Lung Apparatus

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History

Gibbon's heart-lung-machine:

Debakey roller pumps

film oxygenator

1st patient: a year old girl with a presumed large atrial septal defect

2nd patient: 18 year old woman with a large atrial septal defect

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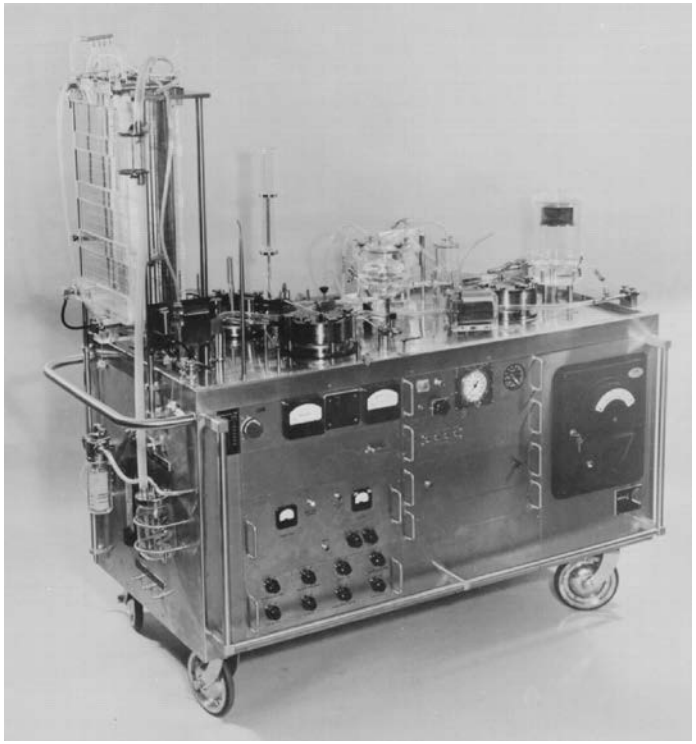
History

further development by John Kirklin (Mayo-Gibbon heart-lung machine)



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History

Walton Lillehei's cross circulation

donor: mother/father

28 survivors of 45 operations

2 serious accidents involving the donor parents

„father of open heart surgery"

cessation of this method because of high risk for donor parents (200% mortality) and limited application

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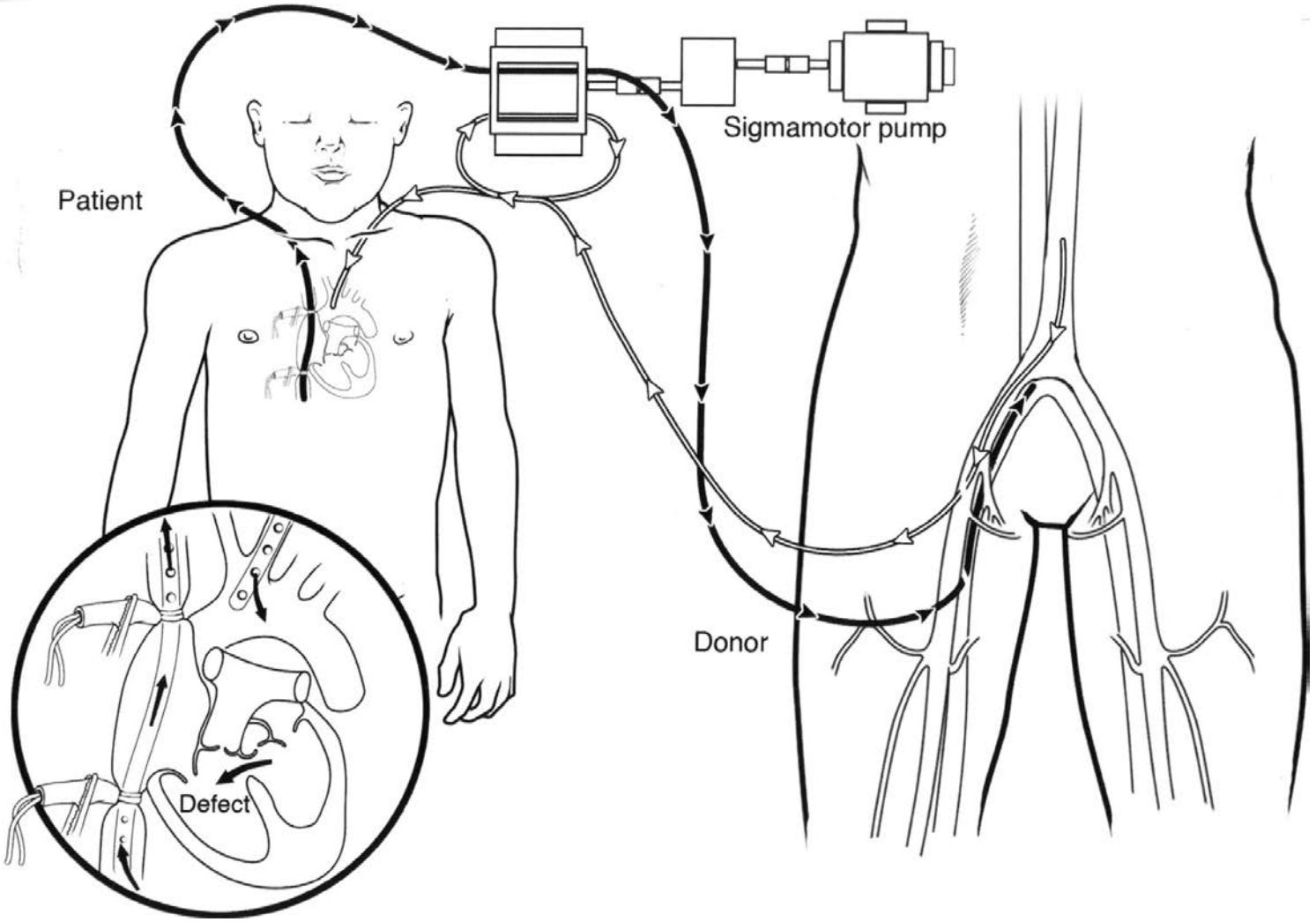
History



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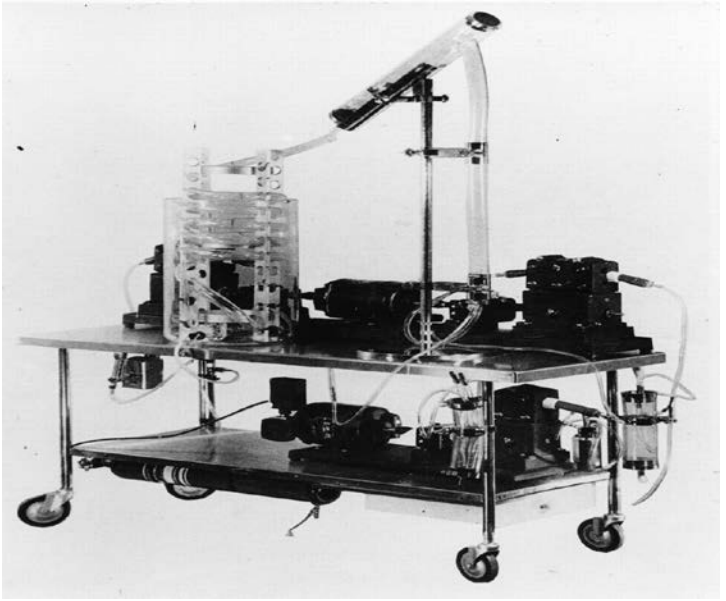
History

Walton Lillehei's heart-lung-machine

- bubble oxygenator (DeWall oxygenator)
- Sigmamotor pump
- disposable plastic tubing
- inexpensive



"can opener to the cardiac surgery picnic"

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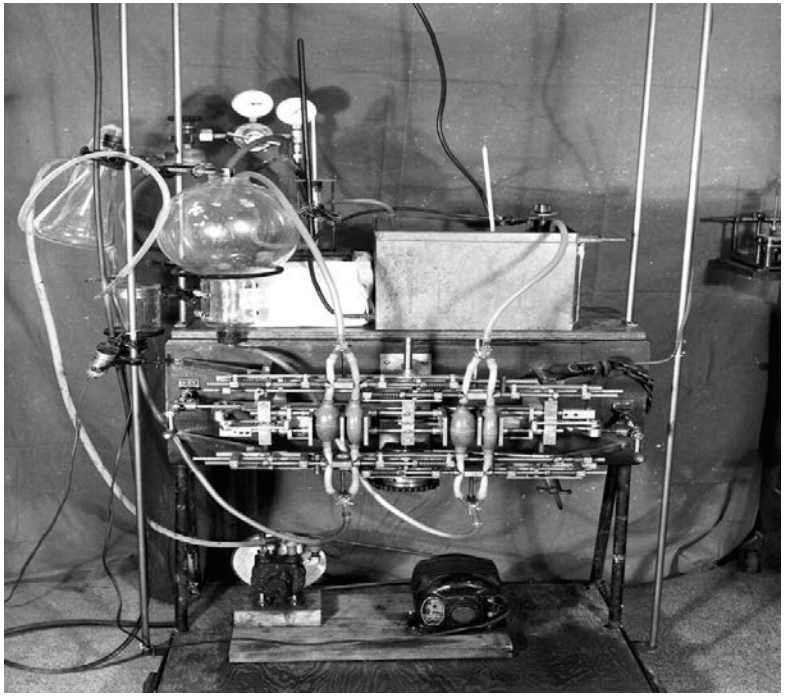
History

Unpractical/not realistic ideas

1950s: Dodrill had the intention to bypass only the right/left heart (without oxygenation) or to use the patients own lung as an oxygenator

William T. Mustard used a monkey lung oxygenator



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History

first attempts at cardiopulmonary bypass in the 1950s were a series of disasters, as

- everyone built his own device
- surgeons were inexperience with this new technology
  - poor myocardial protection
  - accidental intraoperative air embolism
  - postoperative bleeding
- only the sickest patients were referred to surgeons
- error rate in preoperative diagnosis was high

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Requirements

1. anticoagulation which could be reversed at the end of the operation
2. method of pumping blood without destruction of red blood cells
3. oxygenation of blood & dissipation of carbon dioxide

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Principles

hypothermia

has already been postulated in 1959 by Charles Drew, but did not gain wide acceptance because of rumours of neurological injuries

revival in the 1980s

prolongs hypoxic time

STONEY WS (2009). Evolution of Cardiopulmonary Bypass
MORRIS PJ, WOOD WC (2nd edition). Oxford Textbook of Surgery

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Principles

cardioplegia

- 4°C
- arresting agents: potassium
  procaine
  magnesium
- injection in the aortic root
- blood cardioplegia

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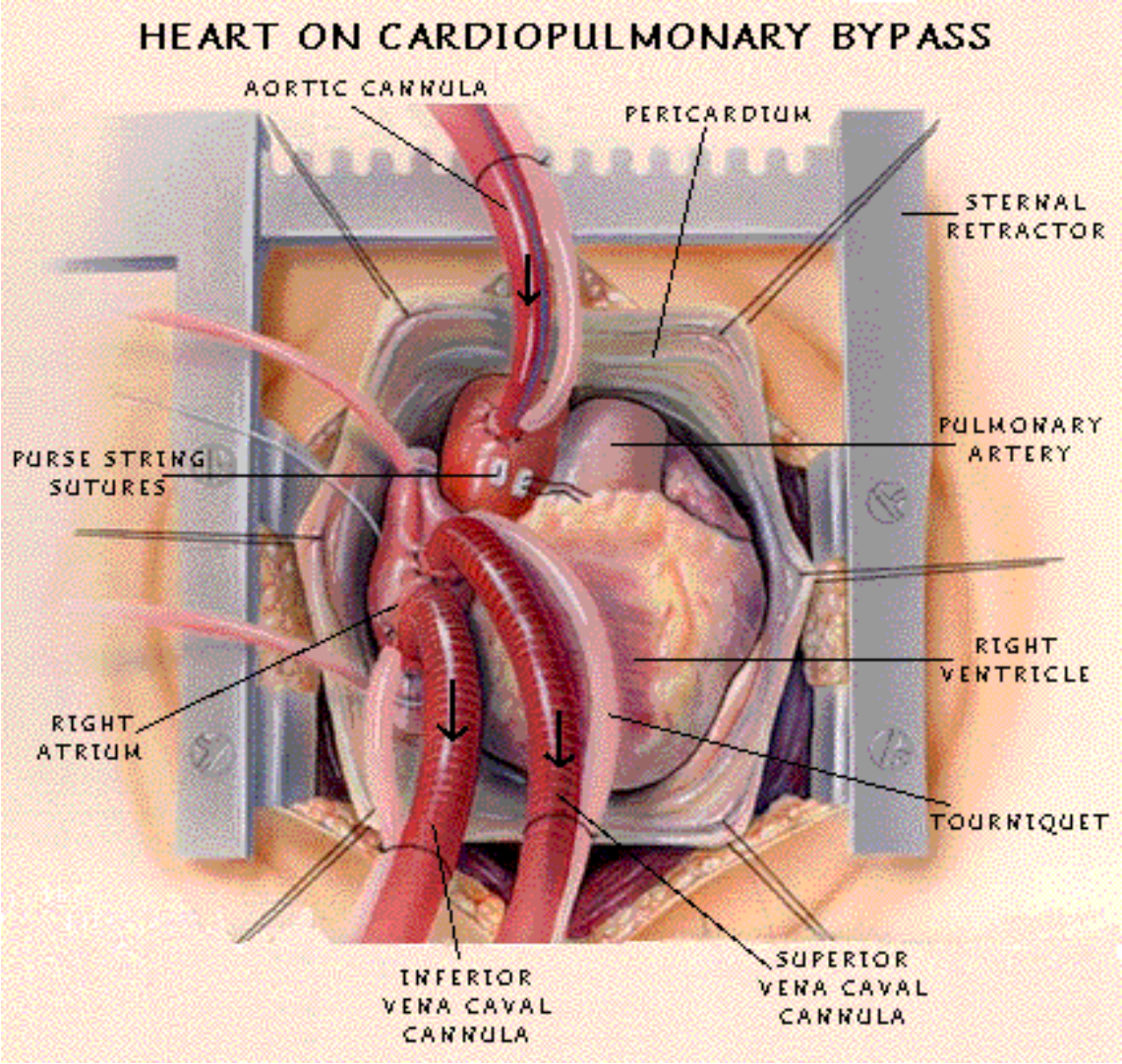
Principles



http://www.herz.at/therapien/HLM/hlm_1.htm (December 16th, 2013)

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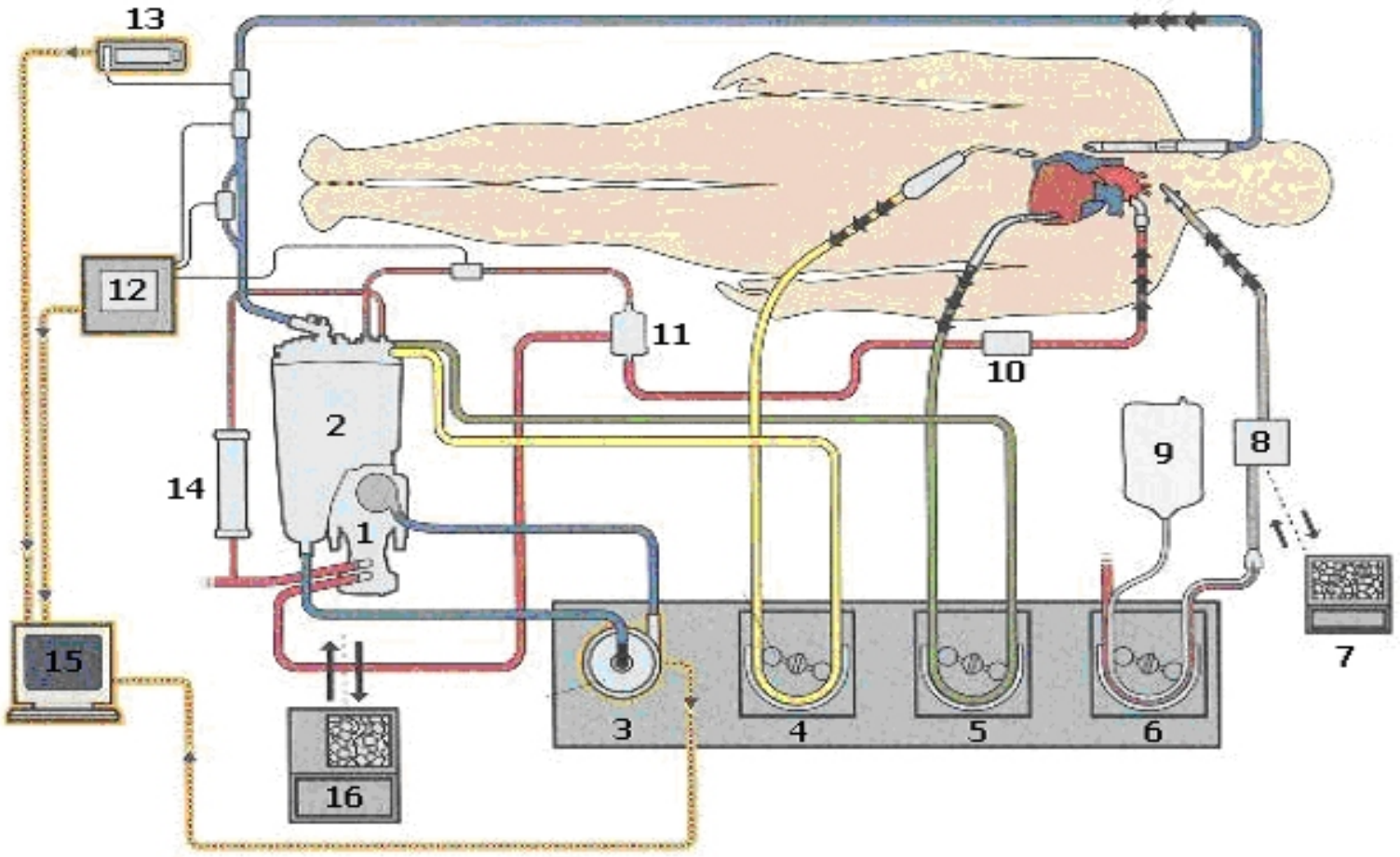
Principles



http://www.herzchirurgie.uk-erlangen.de/e1799/e323/e328/index_ger.html (December 16th, 2013)

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Application

heart-/lung transplantation

rupture of the aorta

atrial septal defect

coronary artery bypass

pulmonary embolectomy

valvular heart disease

BRUCH HP, TRENTZ O (6th edition). Berchtold Chirurgie

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ECMO

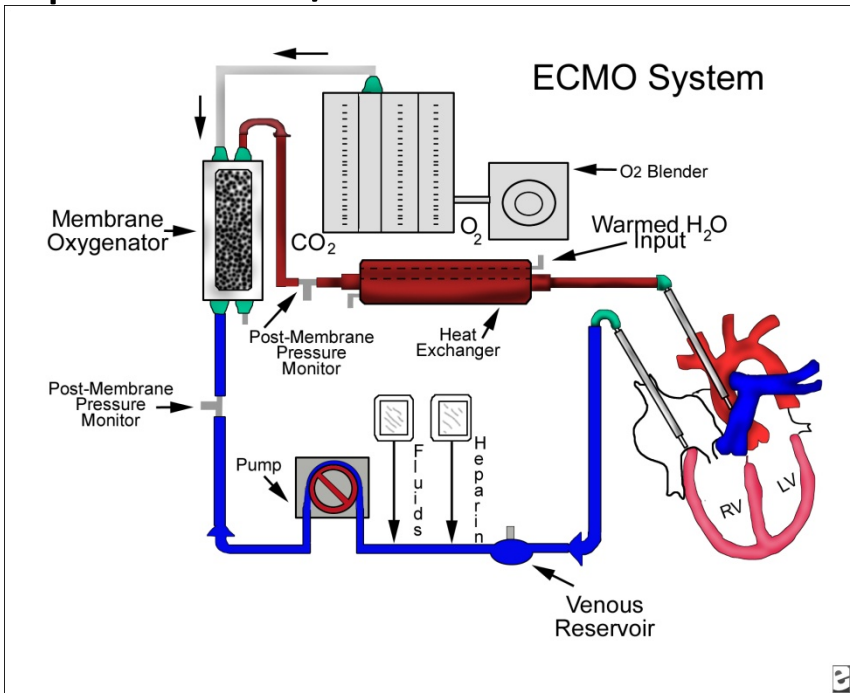
consists of a oxigenator & pump

application

- supportive after heart-/lung transplantation/reanimation
- pneumonia
- bridge-to-transplant
- ARDS

complications

- bleeding
- infection
- air embolism



http://www.herz-lungen-maschine.de/herz-lungen-maschine/ecmo.html (December 16th,2013)
http://blog.mejobs.ro/2013/04/ecmo-the-resuscitating-technique-of-the-future/ (December 16th,2013)

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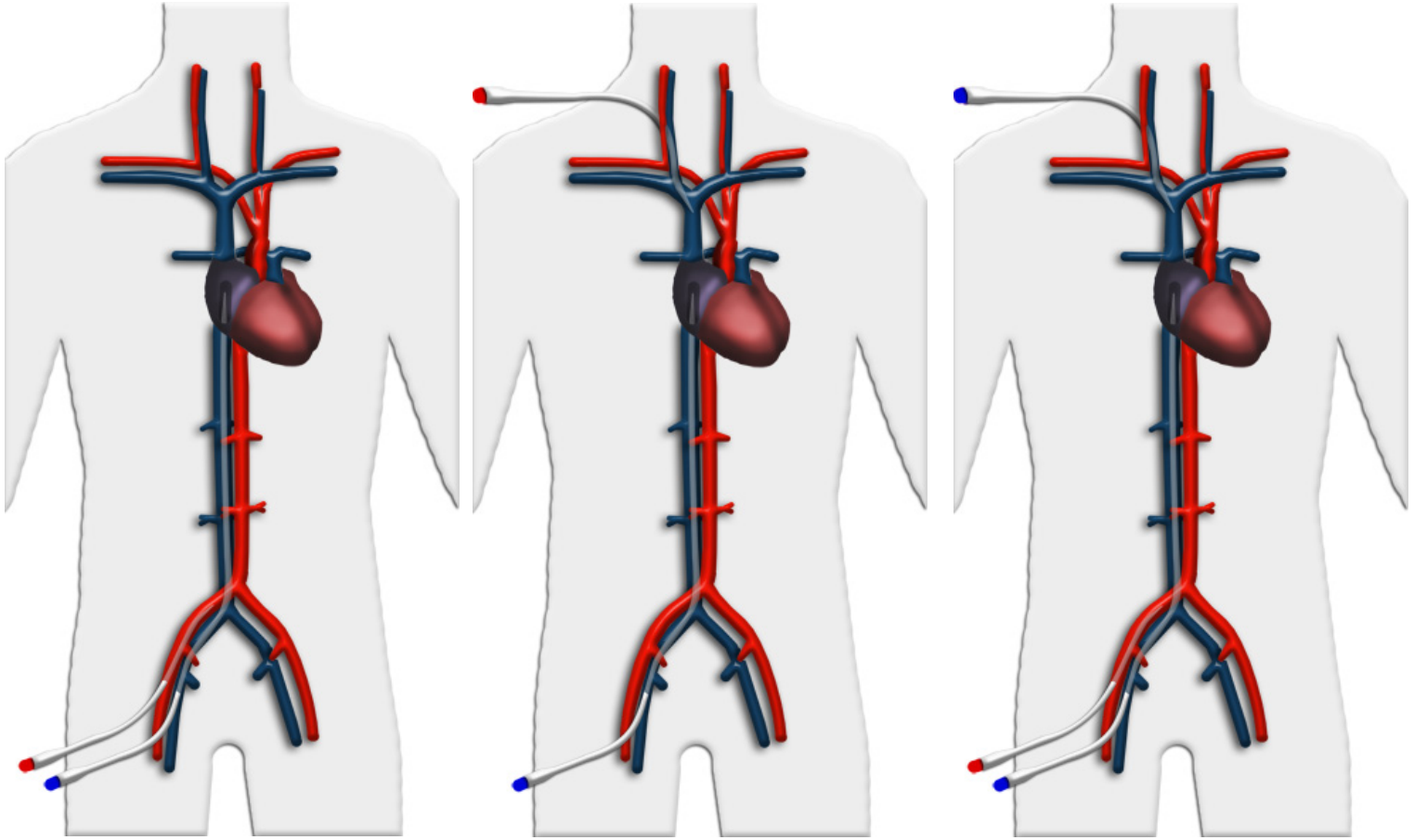
ECMO



venoarterial | venovenous | venovenoarterial

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