

ECLS u ARDS

- jak to všechno začalo?

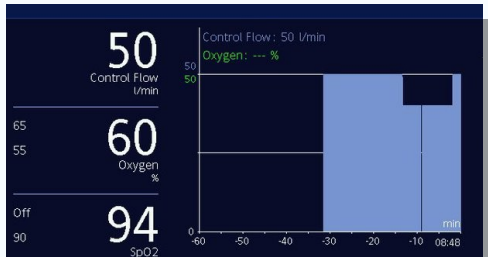
OA Dr. Stibor B.

ICU, Landeskrankenhaus Baden bei Wien, Austria

no conflict of interest

OA Dr. Stibor B.

ICU, Landesklinikum Baden bei Wien, Austria



1952



ECMO



minimalizace **VILI**

zlepšení **oxygenace** a **dekarboxylace**

časná **mobilizace** pacienta

není nutnost hluboké **sedace** ev. **relaxace**

časný **perorální** příjem

umožní vyhnout se **intubaci** (COPD, Tx)

umožní **transportovat** pacienta

umožní operační výkon (**Tx**)

snížení **mortality**?

zlepšení dlouhodobého **outcome**?

ECMO serves as a **bridge therapy** (not curative)

bridge to recovery

bridge to decision

bridge to transplant

(pre)
historie



Maximilian von Frey

- born in Salzburg
- University of Leipzig, Würzburg, Zürich

developed early prototype of a **heart-lung** machine

Max von Frey, 1852-1932

Fig 1

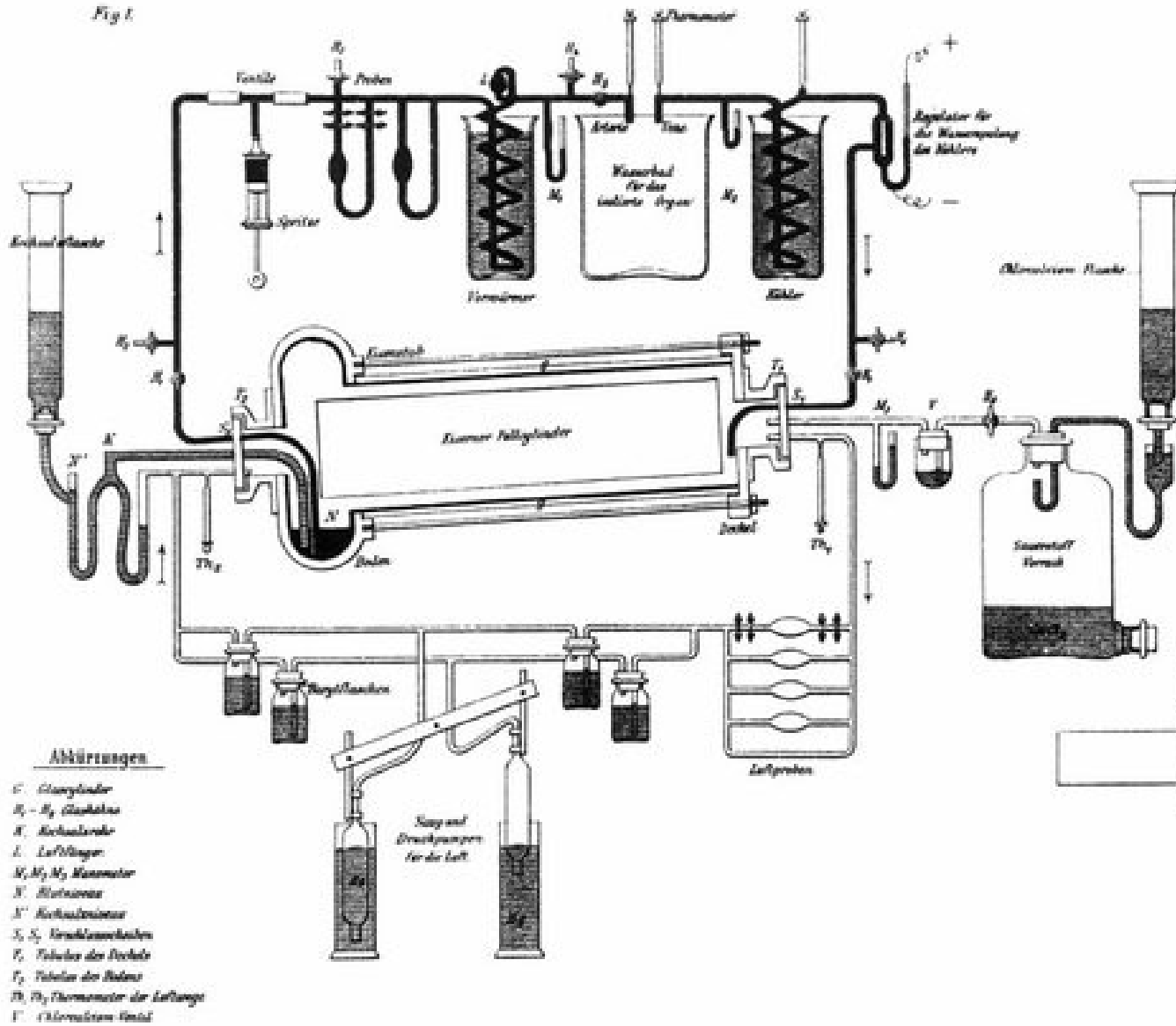
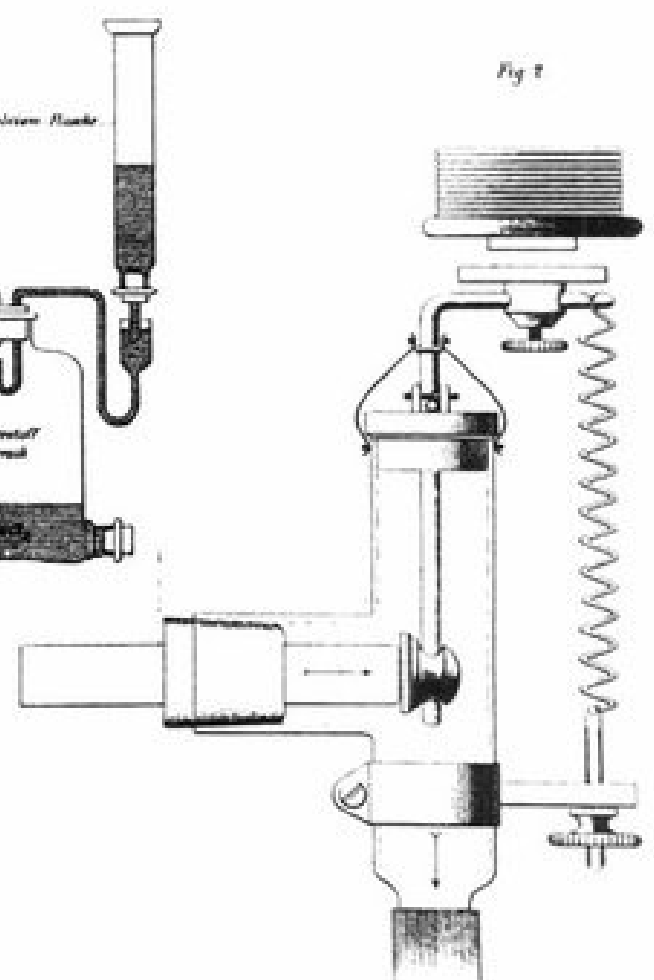


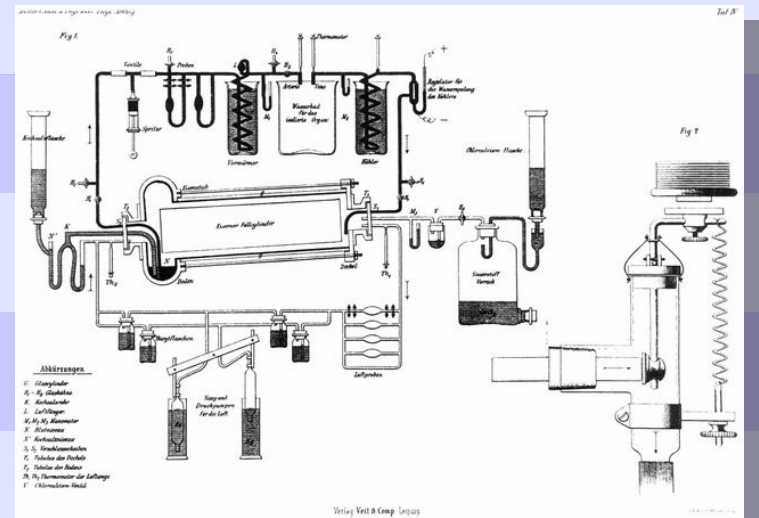
Fig 2



- Abkürzungen**
- C. Glaszylinder
 - M₁ - M₃ Manometer
 - N. Kesselwasser
 - L. Luftgefäße
 - M₁, M₂, M₃ Manometer
 - N. Nitrobenzol
 - N' Nitrobenzol
 - S₁, S₂ Kesselwasser
 - F₁ Füllrohr des Deckels
 - F₂ Füllrohr des Bodens
 - T₁, T₂ Thermometer der Luftwege
 - F. Chlorwasserstoff

„Respirationsapparat“

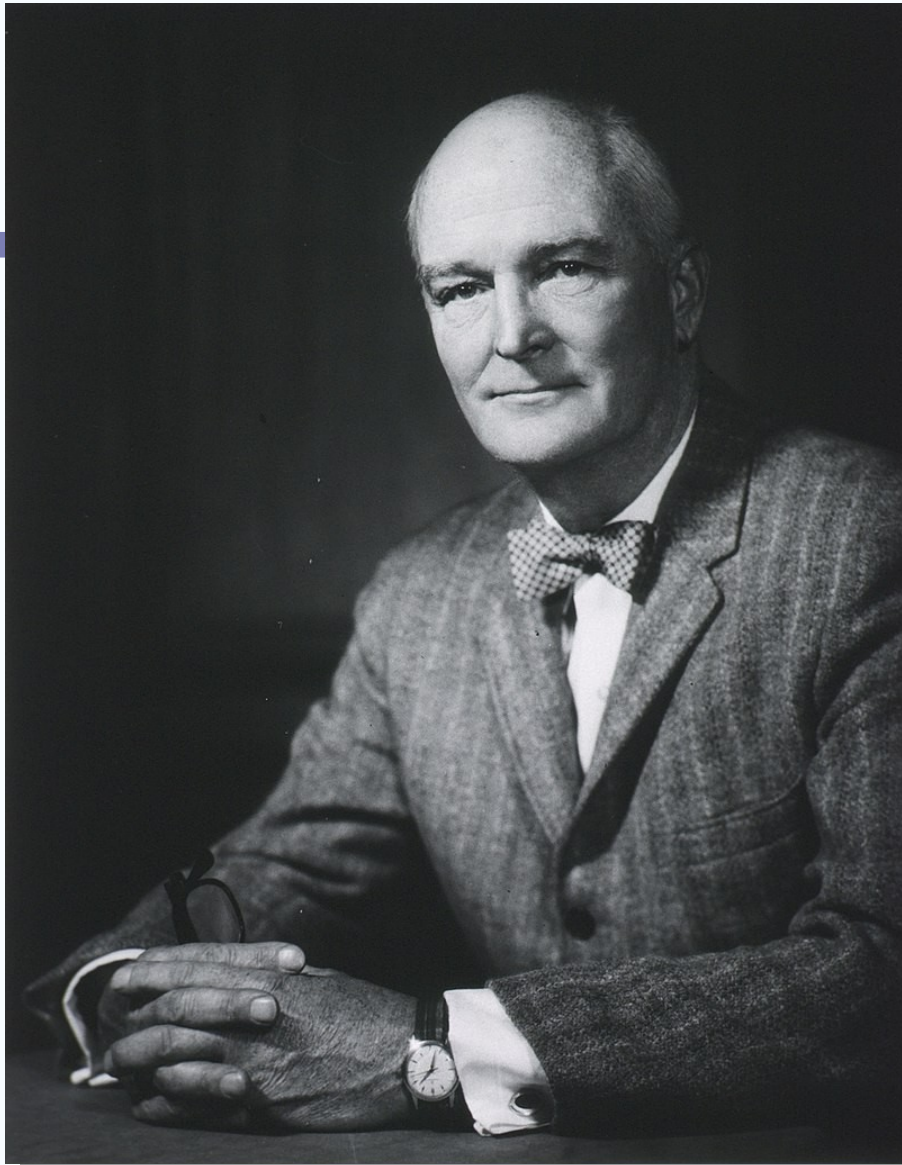
- monoorgánová perfúze
- uzavřený oběh
- skleněný oxygenátor 70x14 cm
- výměník tepla
- teploměr
- vzduchová komůrka
- měření tlaku
- konstantní (řiditelný) tok krve





historie





John Gibbon

John H. Gibbon

Jefferson Medical
College Hospital

Philadelphia, USA

first **successful use** of
cardiopulmonary bypass

John H. Gibbon

1931: witnessing the death of patient from pulmonary embolectomy

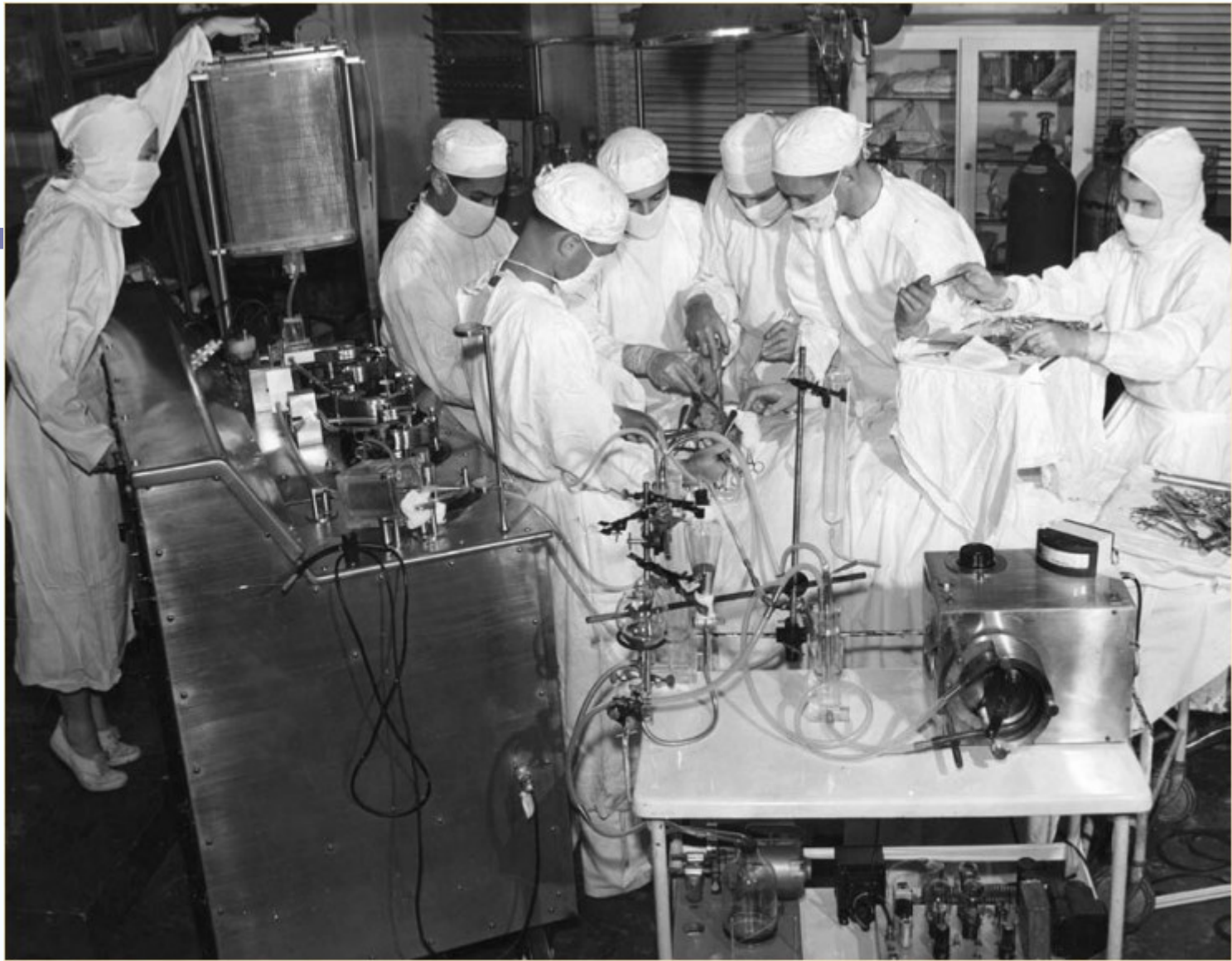
1932: idea for a machine that could take the deoxygenated blood, oxygenate it, and pump it back into the arterial system

1934-1942: developing an extracorporeal circulatory device (collaborating with Dr. Mary Gibbon)

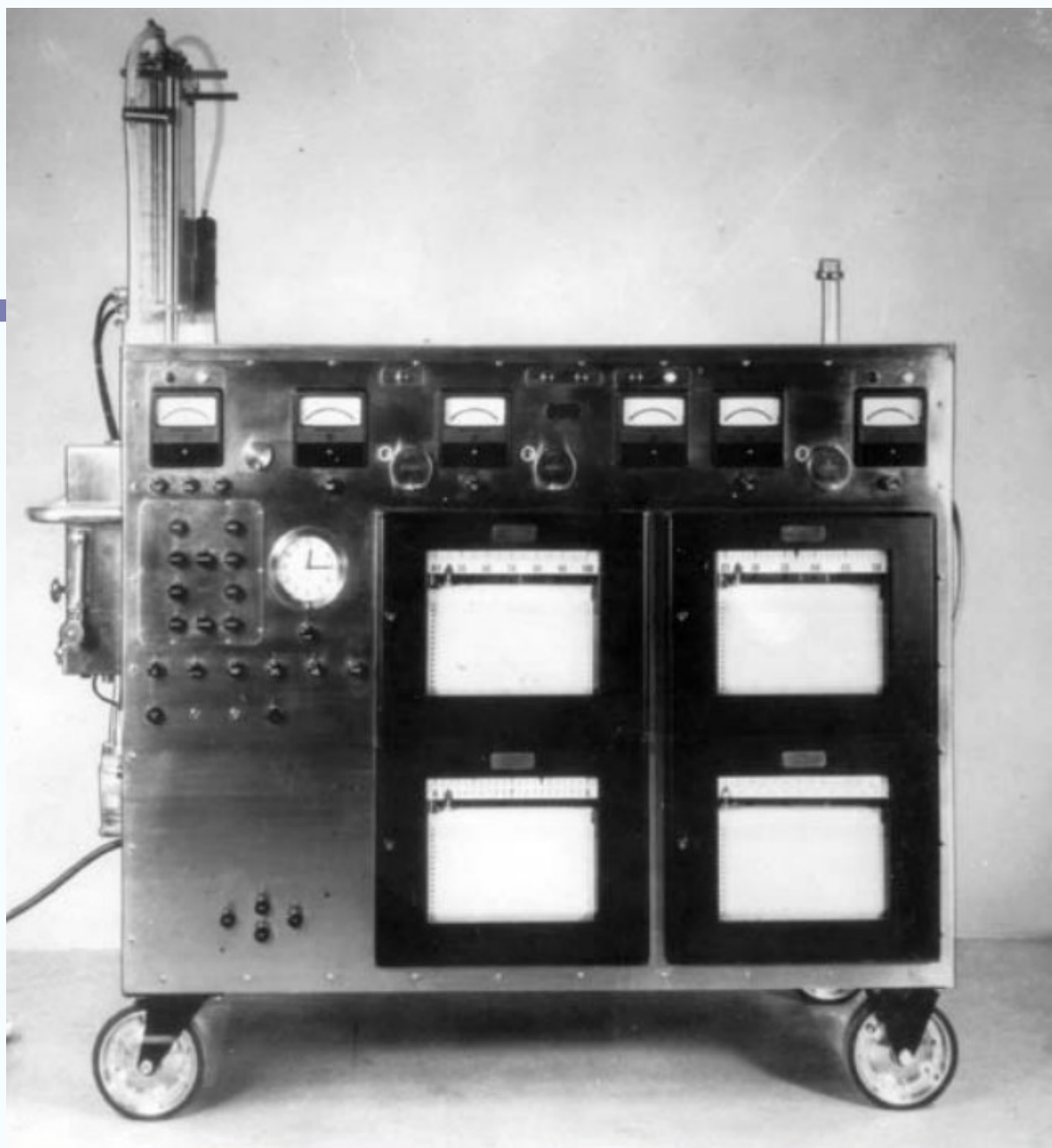
1942: able to keep cats alive on these devices with continued survival after bypass

1950: support from IBM

1953, May 6: first successful operation using an extracorporeal circuit



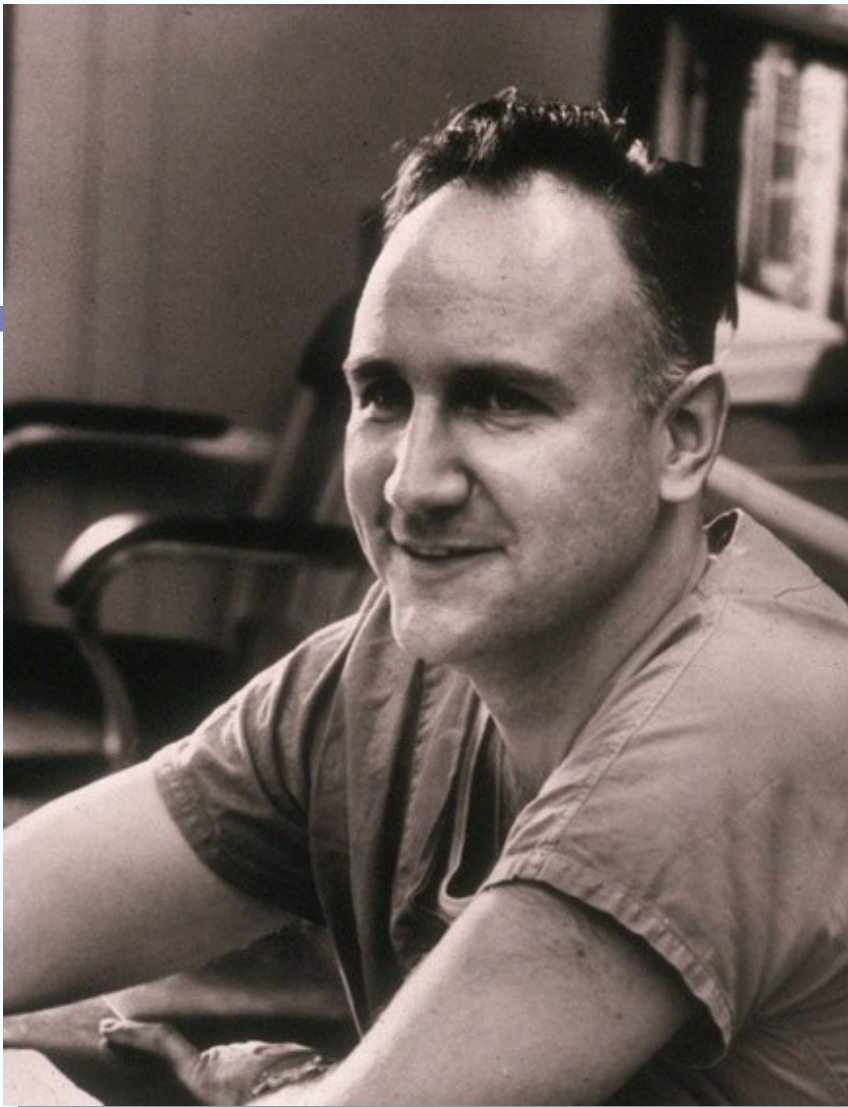
In 1952, Dr. Dr Bernard J. Miller tests the heart-lung machine which helped Gibbon perfect. The experimental patients (dogs) had a survival rate of about 90%.



Heart-Lung Machine

1953, on May 6

- 18-year-old woman
- large atrial septal defect
- large left-to-right shunt (*cca 9 L/min*)
- connected with apparatus for 45 minutes
- all cardiorespiratory functions maintained for 26 minutes
- patient survived



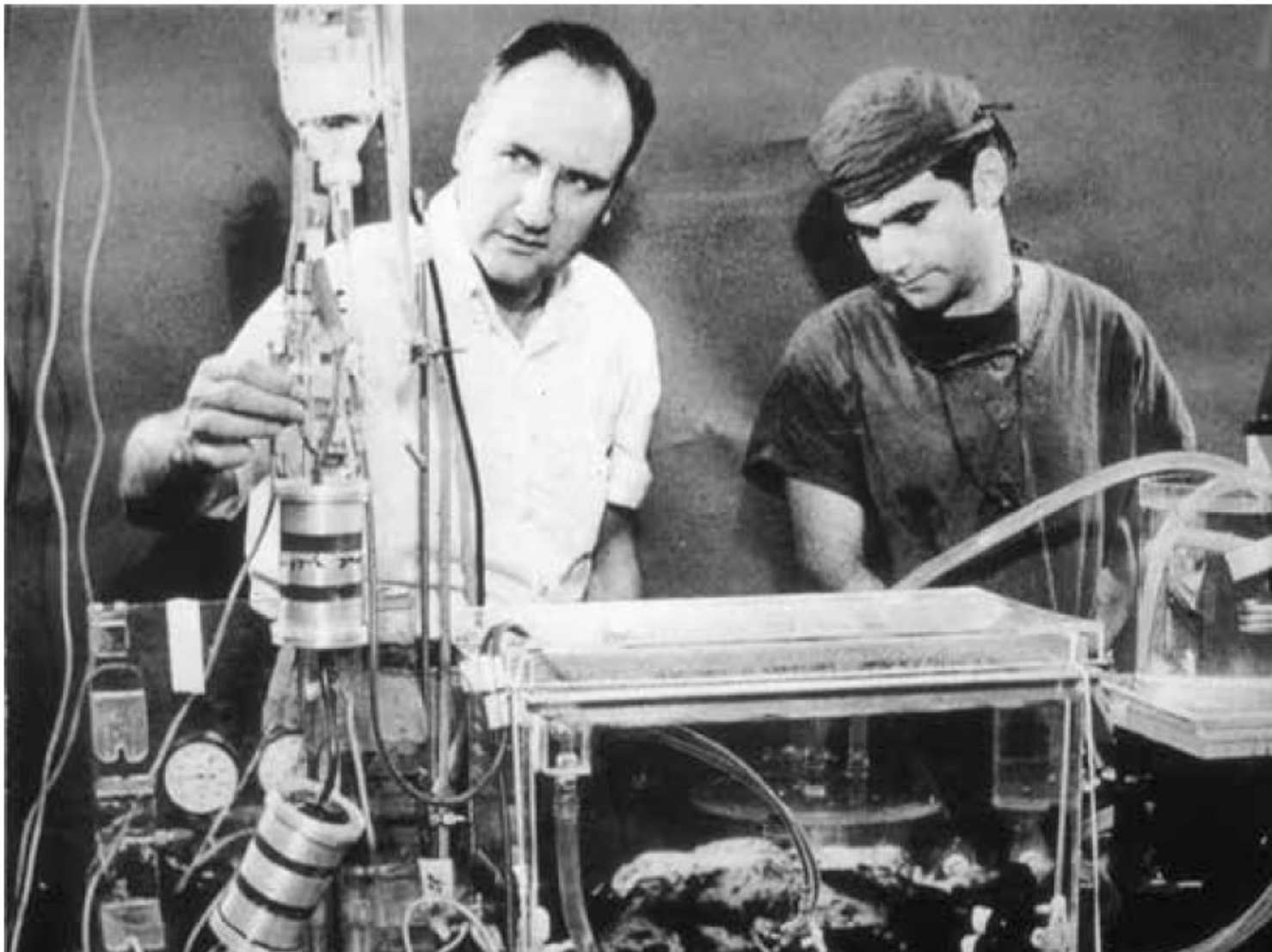
Dr. Theodor Kolobow

Theodor Kolobow

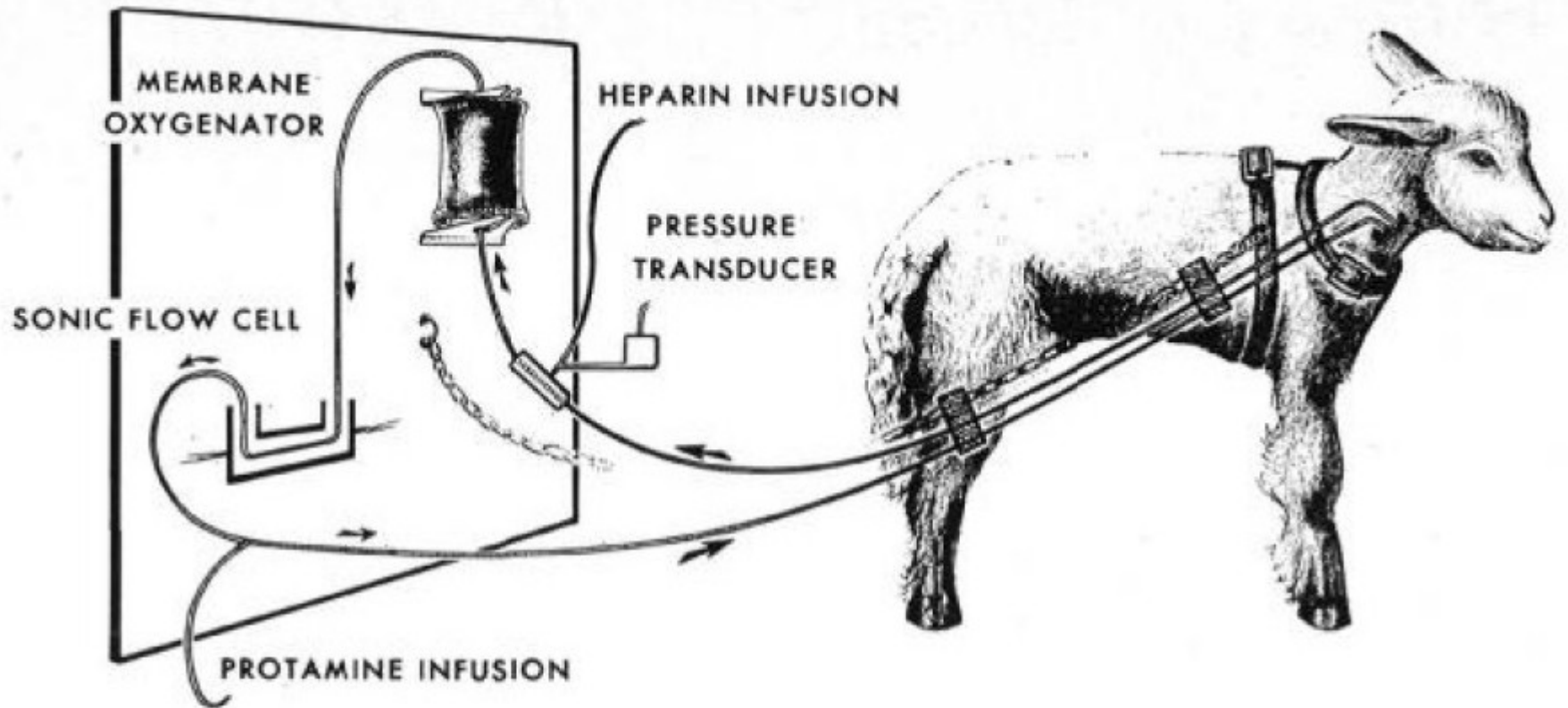
National Heart and
Lung Institute

Bethesda/Maryland (USA)

developed the first
membrane oxygenator
permitting prolonged
extracorporeal oxygenation



Cover photo: Theodor Kolobow (left) and Warren Zapol (right), from the National Heart Institute (later the National Heart, Lung, and Blood Institute), Bethesda, monitoring a fetal lamb supported by extracorporeal membrane oxygenation, c. 1969. Image courtesy of Warren Zapol.



In this diagram a lamb is connected to spiral coil membrane lung via tubes inserted into neck artery and vein. Tethered lamb can walk about within confines of cage. Blood circuit includes provisions for measuring pressure and flow, and for adding an anticoagulant drug, heparin, to blood entering oxygenator. Normal blood coagulability is subsequently restored by adding protamine to blood returning to the lamb.

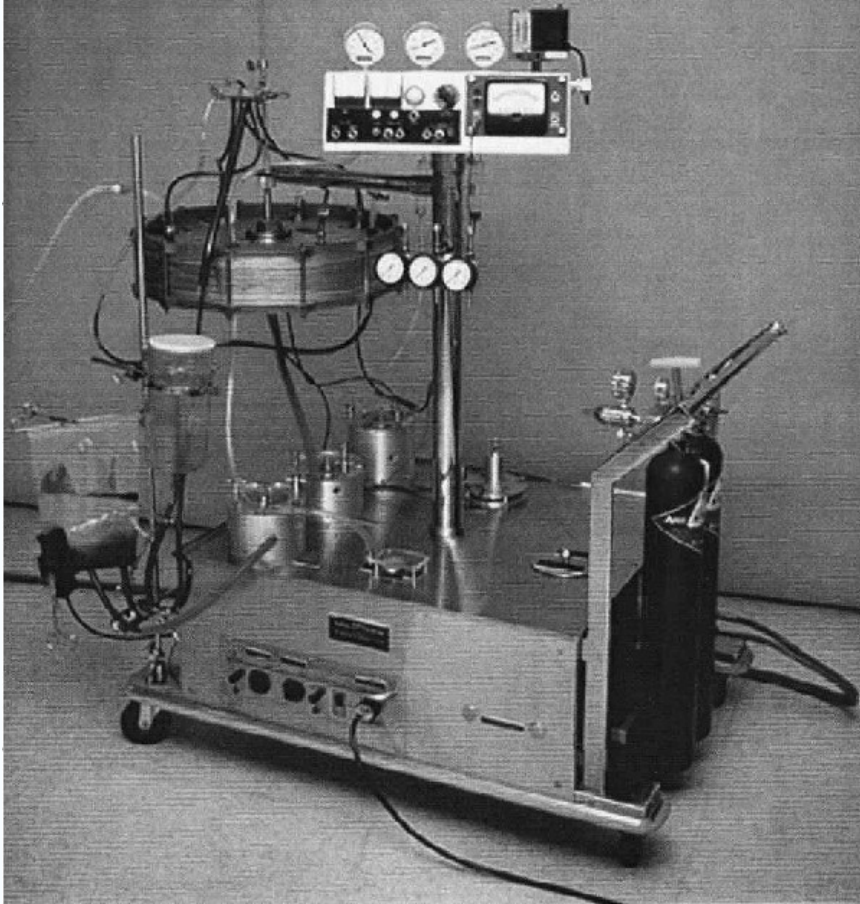
- experimenty zaměřeny na patofyziologii
- zvířecí experimenty (ovce)
- v-v prepulmonální výměna plynů
- ECMO v běhu několik týdnů
- konec 70tých let: EC-CO₂-R
- ↓df, ↓Vt, ↑PEEP
- „protektivní“ ventilací předběhl *ARDSnet study* o 20 let !!!



*„... his thinking
was always
outside the box

... because he
never was in a
box“*

BRAMSON
(BML)

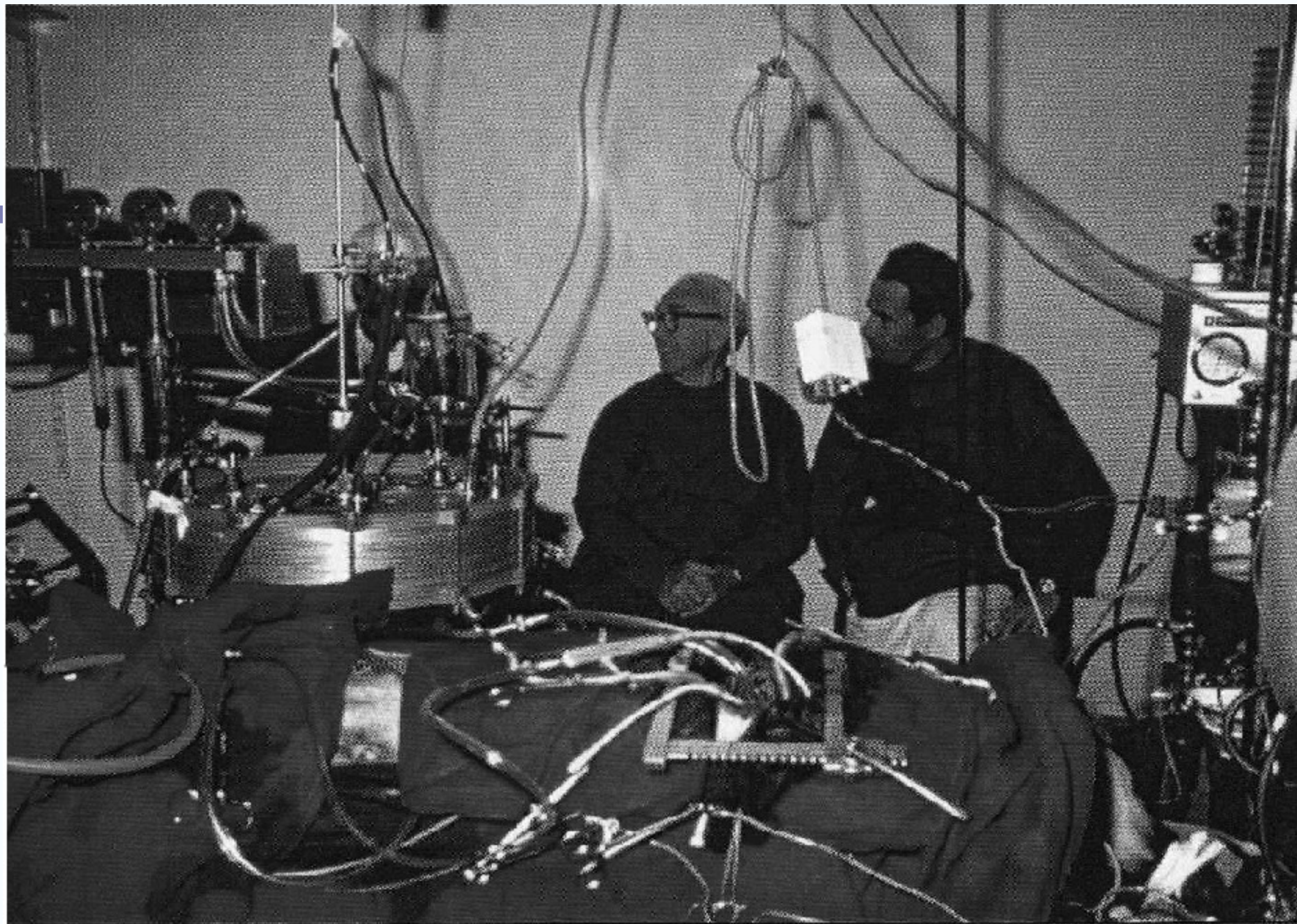


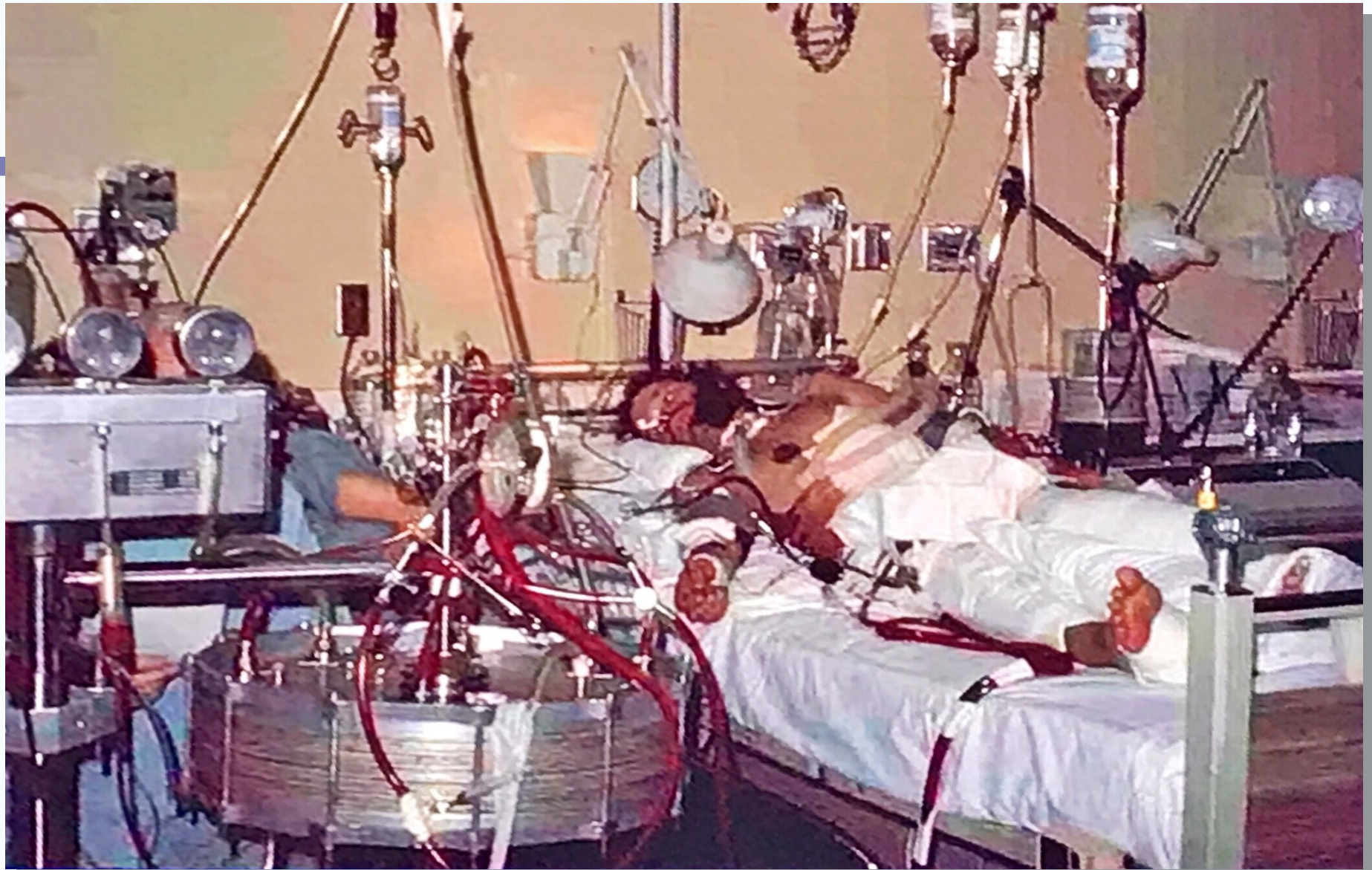
J.D. Hill, M.L. Bramson

Santa Barbara Cottage
Hospital, Santa Barbara

Pacific Medical Center
San Francisco

first **successful adult
ECMO** in ARDS patient





Prolonged Extracorporeal Oxygenation for Acute Post-Traumatic Respiratory Failure (Shock-Lung Syndrome) — Use of the Bramson Membrane Lung

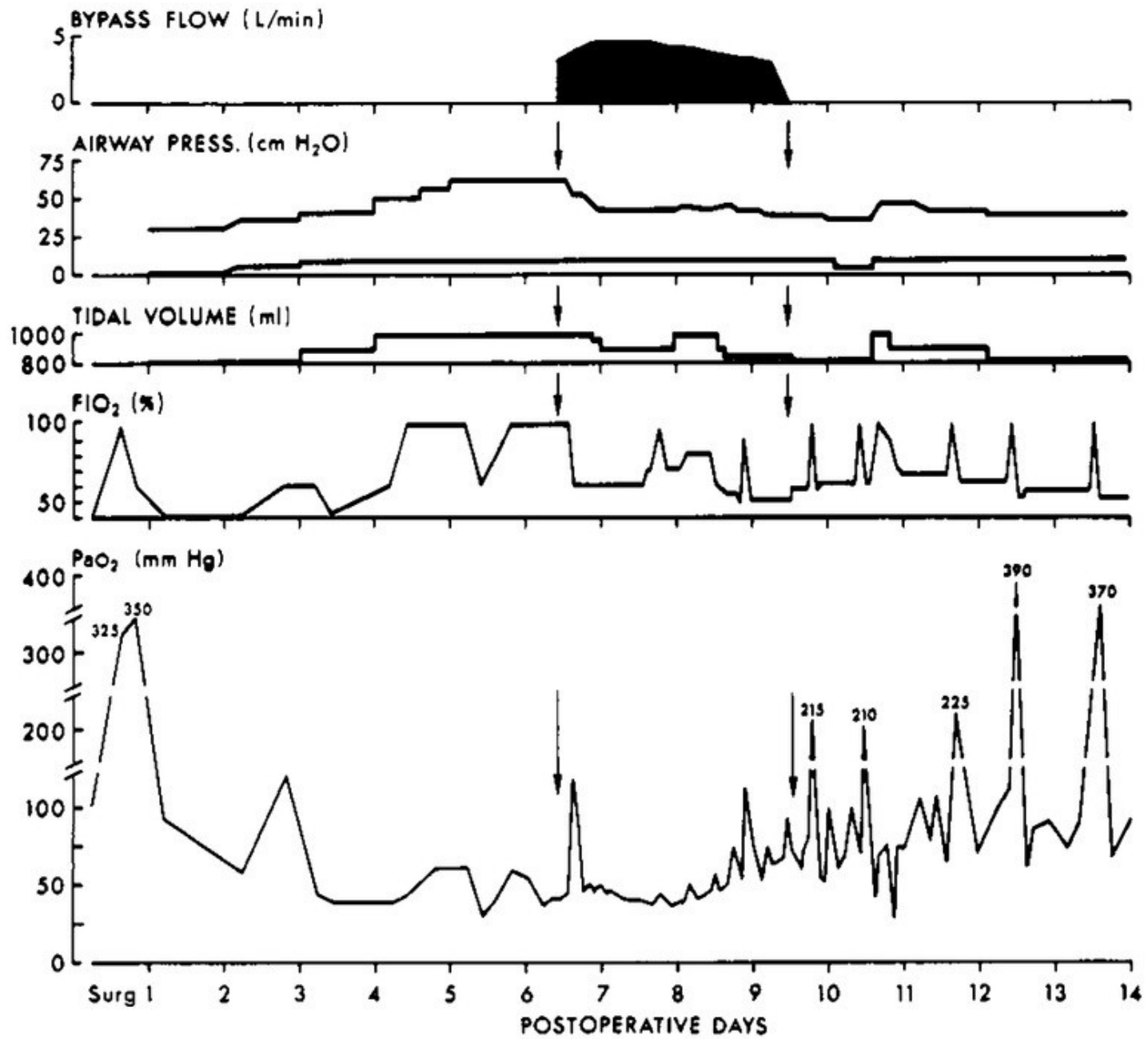
J. Donald Hill, M.D., Thomas G. O'Brien, M.D., James J. Murray, M.D., Leon Dontigny, M.D., M. L. Bramson, A.C.G.I., J. J. Osborn, M.D., and F. Gerbode, M.D.

N Engl J Med 1972; 286:629-634

Abstract:

A 24-year-old man sustained subadventitial transection of the thoracic aorta and multiple orthopedic injuries resulting from blunt trauma. The aortic injury was repaired. Because respiratory failure occurred four days later and worsened despite maximal conventional supportive therapy, partial venoarterial perfusion with peripheral cannulation, with use of the Bramson-membrane heart-lung machine, was initiated and continued for 75 hours. At a by-pass flow of 3.0 to 3.6 increased from 38 to 75 mm of mercury, inspired oxygen concentration was reduced liters per minute, oxygen tension from 100 to 60 per cent, and peak airway pressure decreased from 60 to 35 cm of water. The shock-lung syndrome was reversed, and the patient recovered.

End-stage shock lung may be reversible if the patient receives adequate gas exchange through partial extracorporeal circulation with an appropriate membrane lung.



Robert Bartlett, Alan Gazzaniga

University of California, Irvine

1972:

ECMO to support a two-year-old boy with cardiogenic shock

1975:

first successful use of ECMO for neonatal respiratory failure

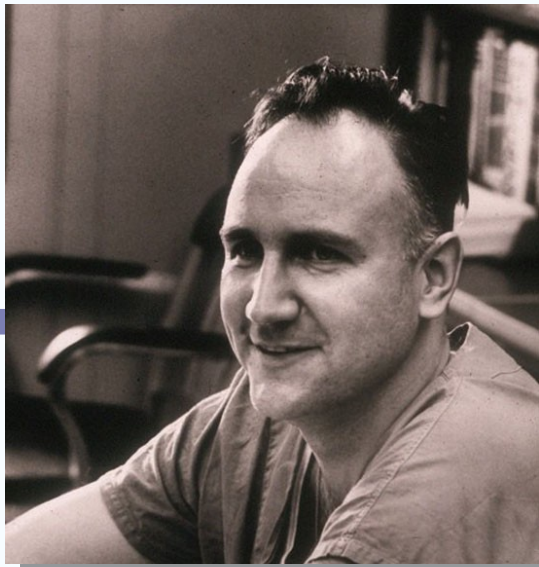
By the end of the decade ECMO became
an **accepted therapy** in this patient group.
(survival approached 50%)



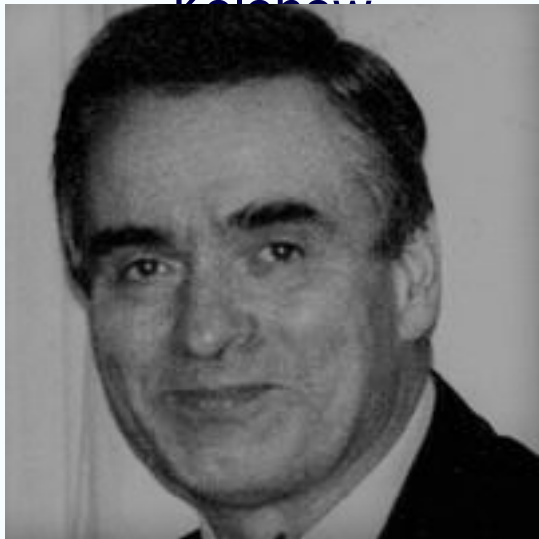
Esperanza, Age 1 day 1975



Esperanza, age 21



Dr. Theodor
Kolchou



Dr. Konrad Falke



Dr. Warren Zapol



Luciano Gattinoni und Antonio Pesenti ca. 1980 in Mailand.

Dr. Luciano Gattinoni,
Dr. Antonio Pesenti



Luciano Gattinoni und Antonio Pesenti ca. 1980 in Mailand.



Luciano Gattinoni



Antonio Pesenti

Luciano Gattinoni, Antonio Pesenti

University of Milan, Italy

1978-1980:

first successful use of ECCO₂-R in severe ARDS

Treatment of acute respiratory failure with low-frequency positive-pressure ventilation and extracorporeal removal of CO₂

L Gattinoni, A Agostoni, A Pesenti, A Pelizzola, G P Rossi, M Langer, S Vesconi, L Uziel, U Fox, F Longoni, T Kolobow, G Damia

[Lancet](#). 1980 Aug 9;2(8189):292-4.

November 16, 1979

Extracorporeal Membrane Oxygenation in Severe Acute Respiratory Failure

A Randomized Prospective Study

JAMA[®]

Warren M. Zapol, MD; Michael T. Snider, MD, PhD; J. Donald Hill, MD; *et al*

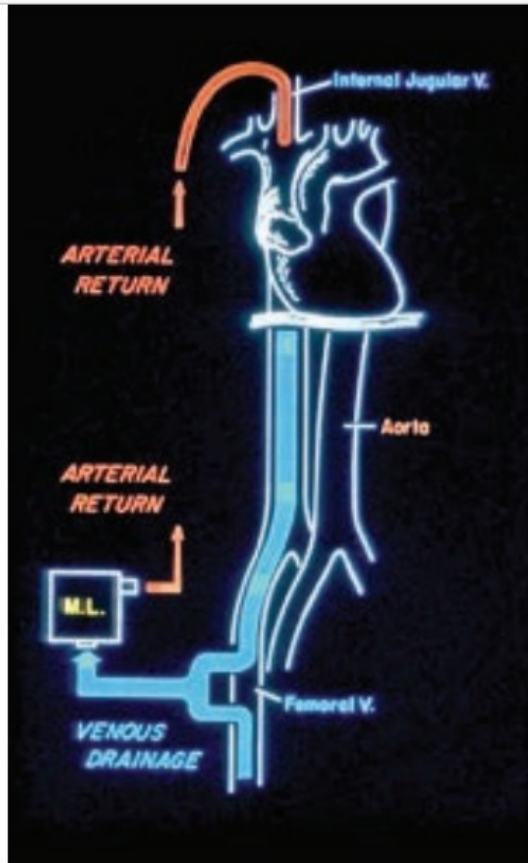
We conclude that ECMO can support respiratory gas exchange but **did not increase** the probability of long-term **survival** in patients with severe ARF.

1979 saw the publication of a multicentre randomised controlled trial comparing conventional mechanical ventilation plus partial VA ECMO, to conventional mechanical ventilation alone, in patients aged 12–65 years, with severe acute respiratory failure²⁵. Survival rates were poor in both groups (9.5% and 8.3% respectively). As a result, interest in ECMO for adult respiratory failure diminished, and it would be almost a decade before significant research resumed²⁶.

problémy
a
komplikace

some difficulties

- heparin Carmeda Bioactive Surface (1989)
- plasma leak (micropore membranes)
- coagulopathy (polytransfusion)
- septic shock
- cannulation (percutaneous via Seldinger, Pesenti)
- others



Schema der veno-venösen Perfusion und die von Antonio Pesenti handgefertigte Polyurethan-Doppellumen-Kanüle für die untere Hohlvene, die bei der ersten Düsseldorfer Patientin 1982 verwendet wurde.

ECLA/ECLS

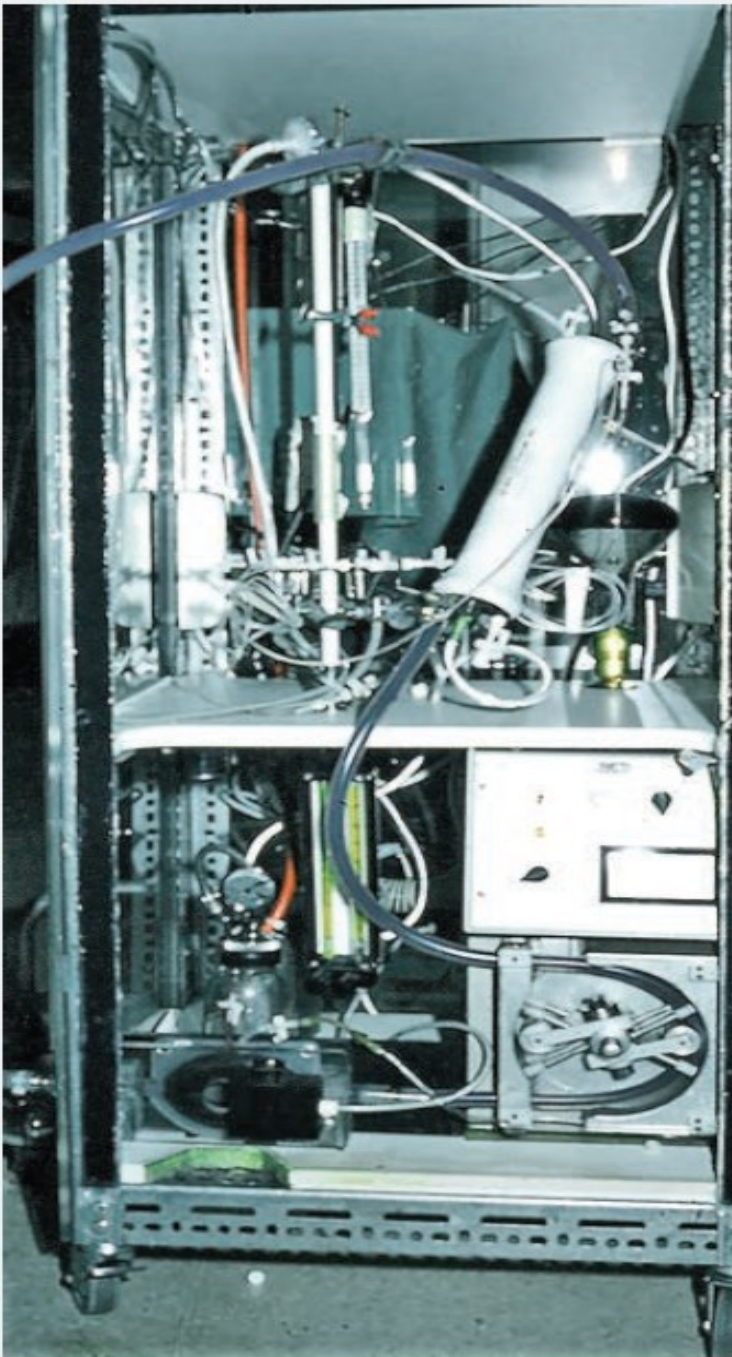


Herbert Lennartz

- *extracorporeal lung assist ECLA*
- *extracorporeal lung support ECLS*

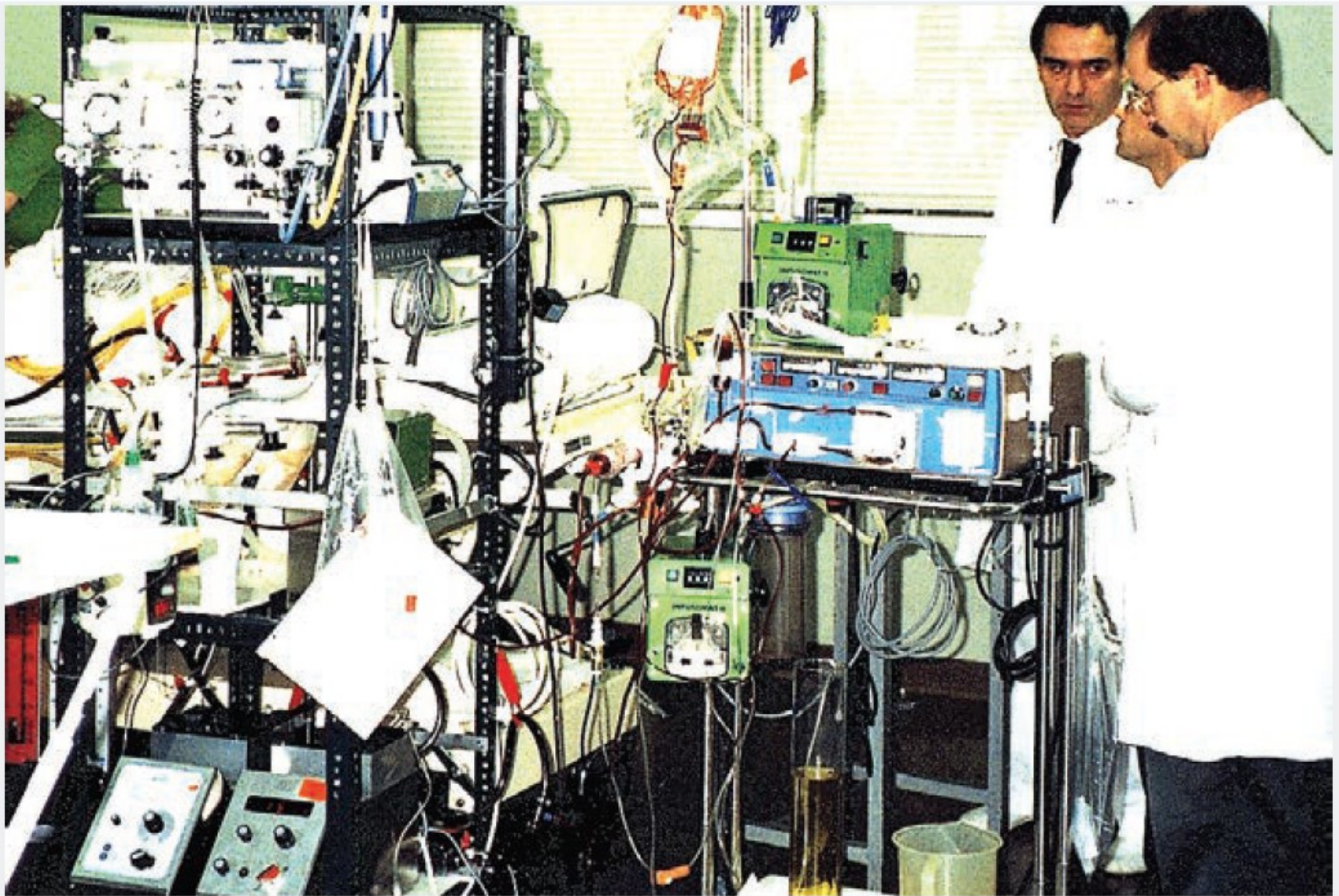


- Marburg – first ARDS/ECMO centre in Germany
- světově nejaktivnější a nejúspěšnější centrum



Düsseldorf

- 1982 first successful use in Germany
- 21-years old woman
- 10 days on ECMO
- A. Pesenti



VV-ECMO und Hämofiltration ca. 1992 am Klinikum Rudolf Virchow mit Oberarzt Dirk Pappert und dem Verfasser.



Maquet
PALP®



Hemodec
Decap®



Xenios
iLA-active®



Alung
Hemolung®



CO₂ eliminace



oxygenace



perfúze

VV modus

ECMO

modus VA



současnost







...děkuji Vám za pozornost