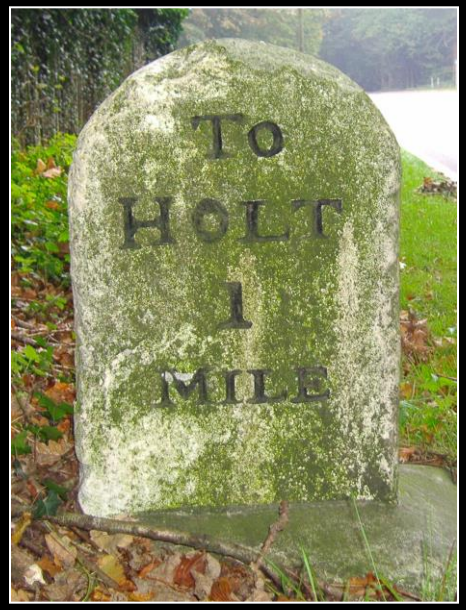
Beatmung des Neugeborenen

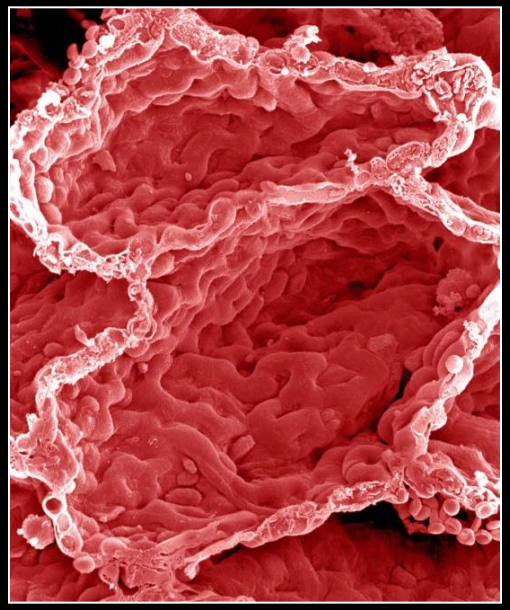
Prof. Dr. Thomas M. Berger
Chefarzt NeoIPS
Kinderspital Luzern

Übersicht

Geschichte
der Beatmung



Fortschritt
und Irrtum



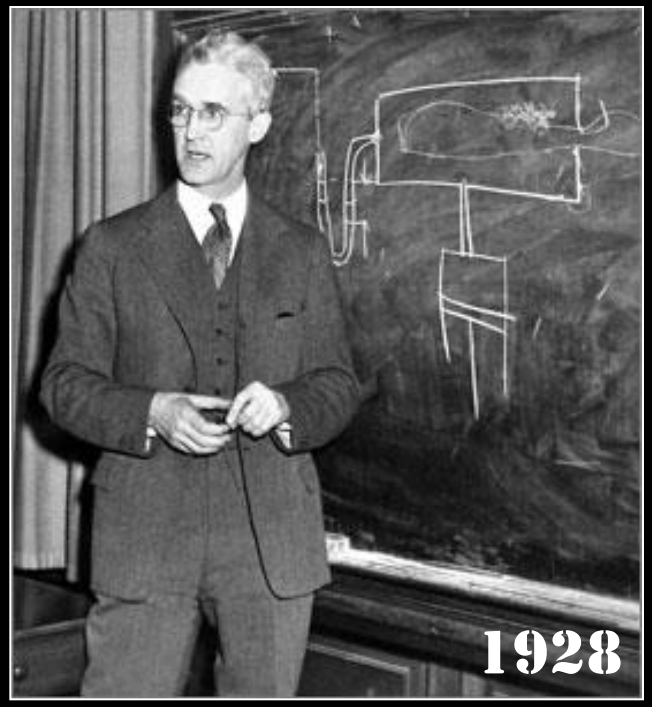
Lung
Protection

Geschichte


Hippocrates medic?

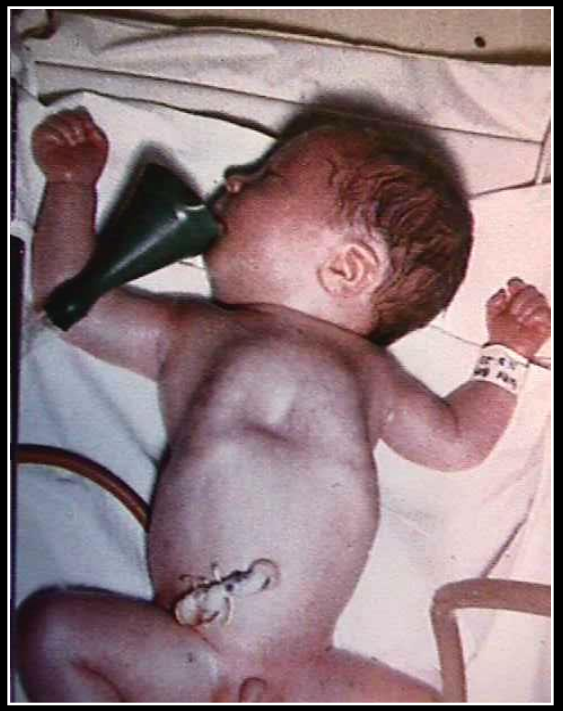

ANDREAS VESALIUS ANATOMICUS
Nasc. Bruxellis
Ao. 1514.
Obijt circa Zacynthum,
Ao. 1564. Mr. Oct.
Corporis humani qui membra secaret & artus,
Vesalio nemo doctior ante fuit.

Philip Drinker & Louis Agassiz Shaw

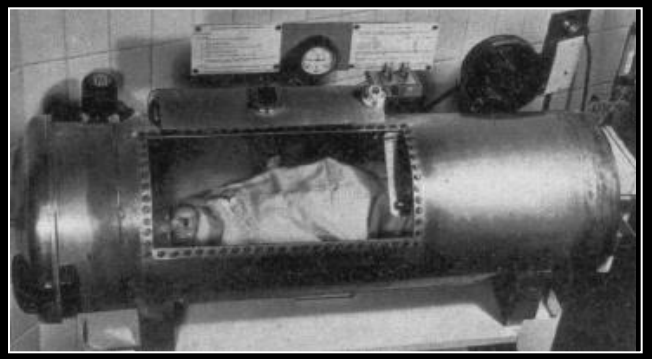


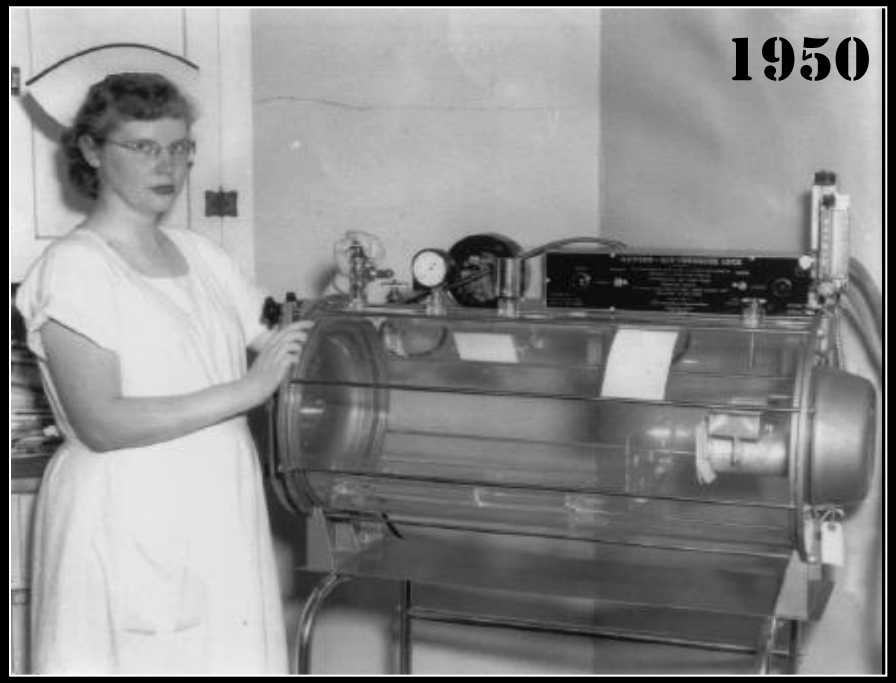
HARVARD
School of Public Health

Atemunterstützung 1950



Allan P. Bloxsom





The Bloxsom Oxygen Air Lock (AL)

- warmed humidified oxygen (FiO_2 0.6)
- positive pressure cycled between 70-211 mbar at 1-minute intervals

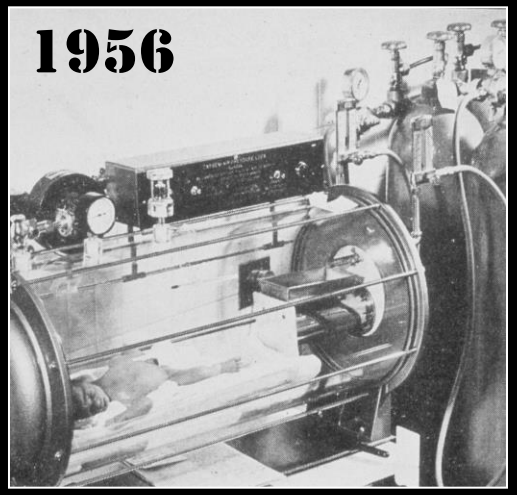
Allan P. Bloxsom

The American Academy of Pediatrics
PEDIATRICS

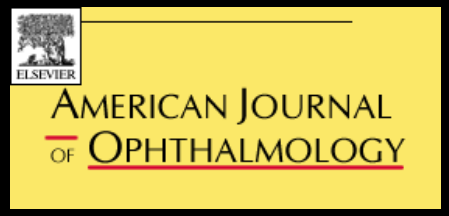
Reichelderfer TE, Nitowsky HM.

A controlled study of the use of the Bloxsom air lock.

Pediatrics 1956;18:918-927



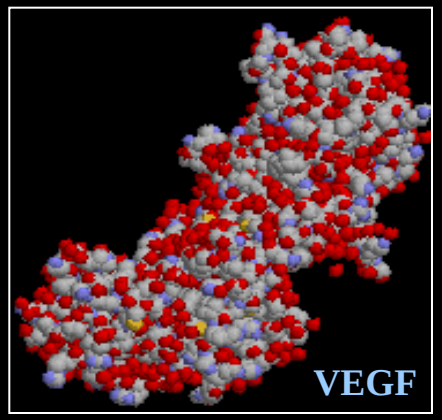
Kate Campbell



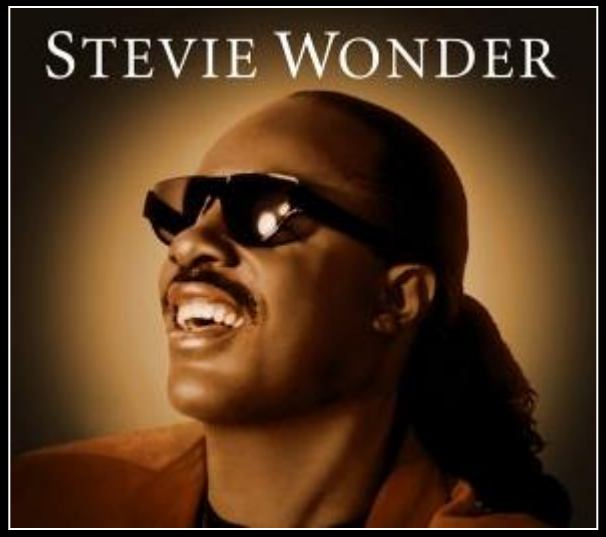
Campbell K.

Intensive oxygen therapy as a possible cause of retrolental fibroplasia in premature infants.

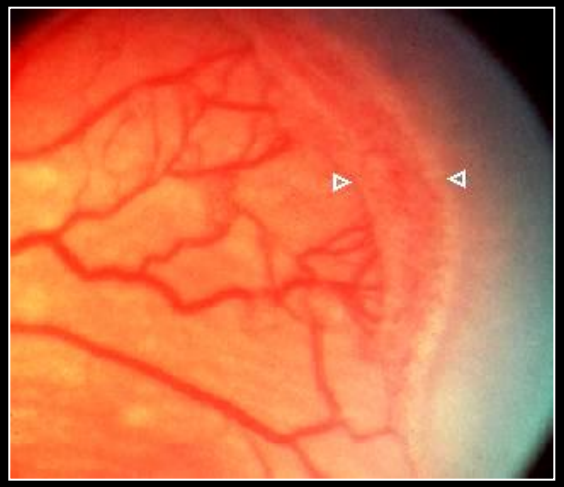
Am J Ophthalmol 1951;2:48-50



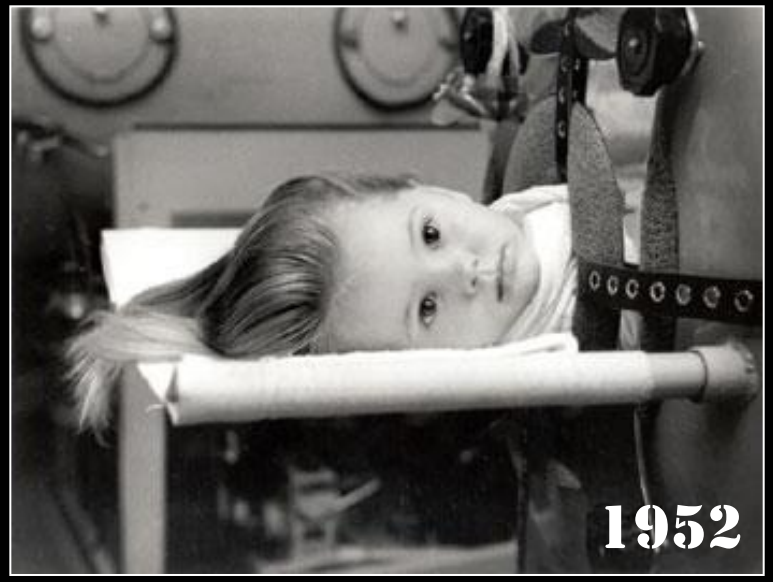
Kate Campbell



Stevie Wonder was born Steveland Hardaway Judkins in Saginaw, Michigan on May 13, 1950. Born premature, baby Steveland was placed in an incubator for oxygen treatment. Sadly, he received too much oxygen, causing him to suffer from premature blindness.

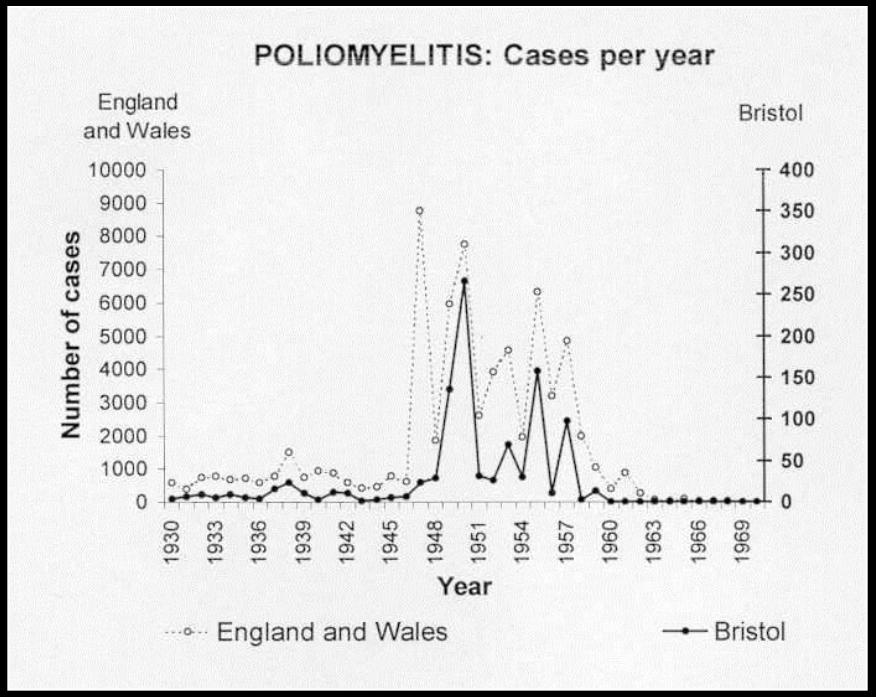


Poliomyelitis Epidemie

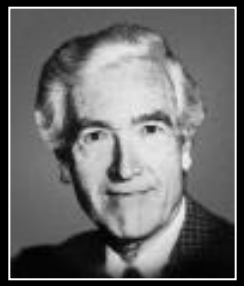


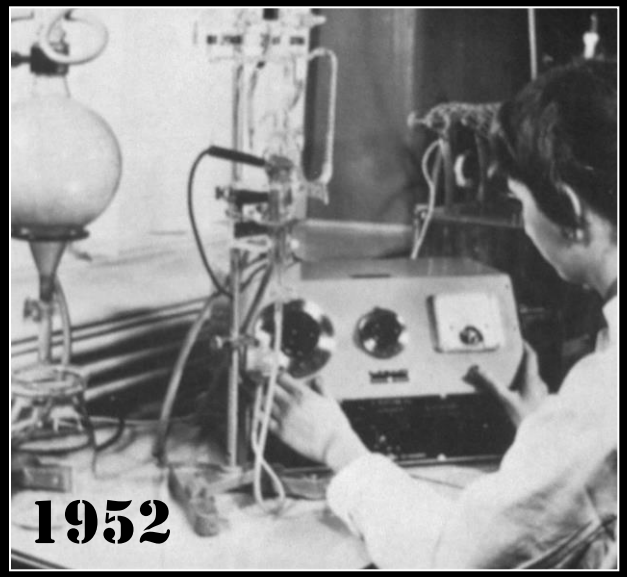
John Haven "Jack" Emerson

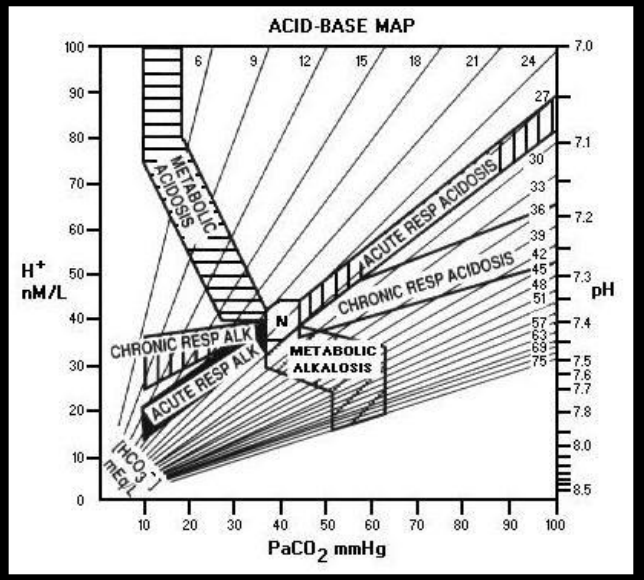
Poliomyelitis Epidemie



Poul B. Astrup & Bjorn Ibsen







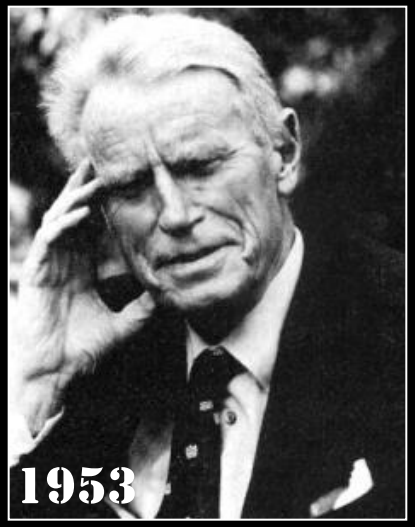
Erste Berichte: Modified Drinker

THE LANCET

Donald I, Lord J.

Augmented respiration: Studies in atelectasis neonatorum.

Lancet 1953;1:9-17



Erste Berichte: Modified Drinker

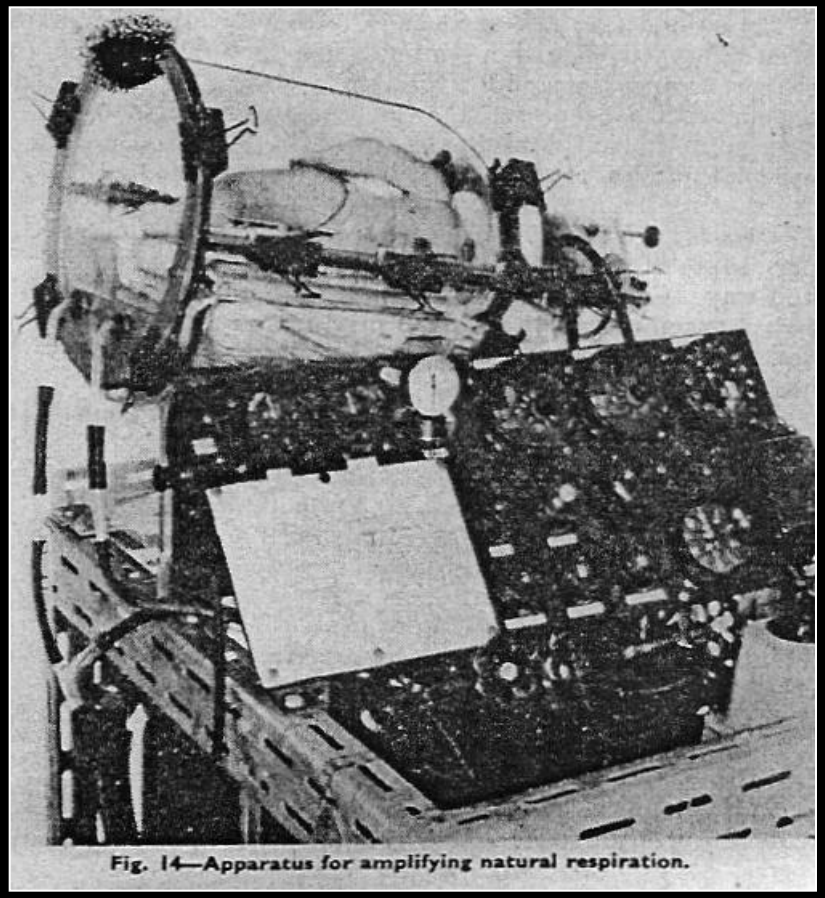
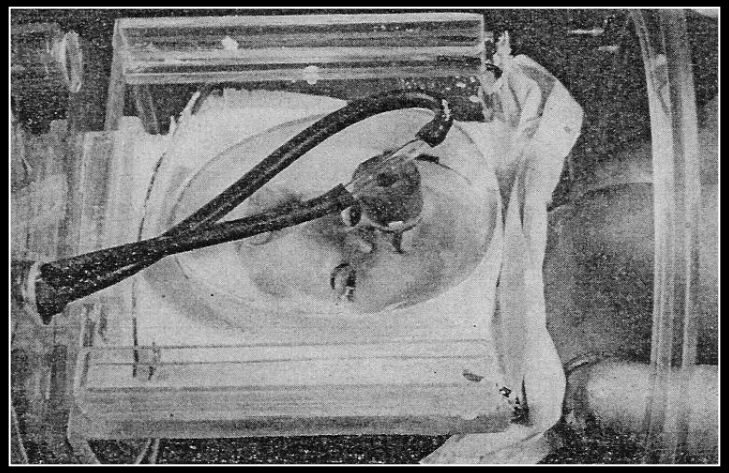


Fig. 14—Apparatus for amplifying natural respiration.



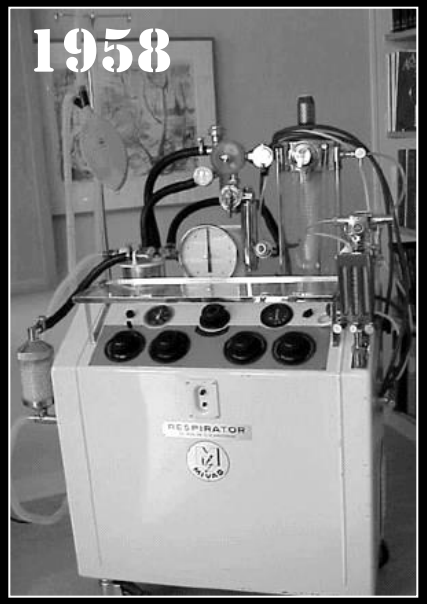
Erste Berichte: Engström

Acta Anaesthesiologica Scandinavica
An International Journal of Anaesthesiology and Intensive Care, Pain and Emergency Medicine

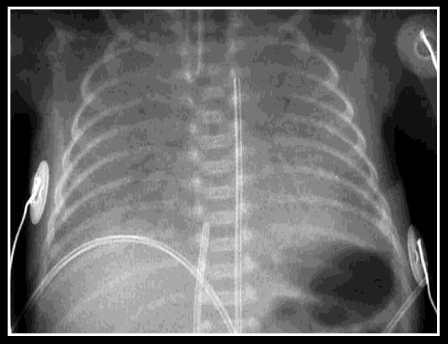
Benson F, Celander O, Haglund G, et al.

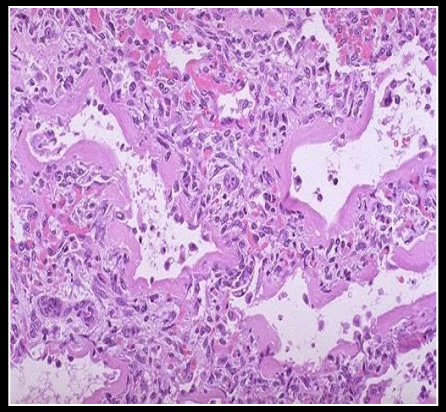
Positive-pressure ventilator treatment of severe pulmonary insufficiency in the newborn infant.

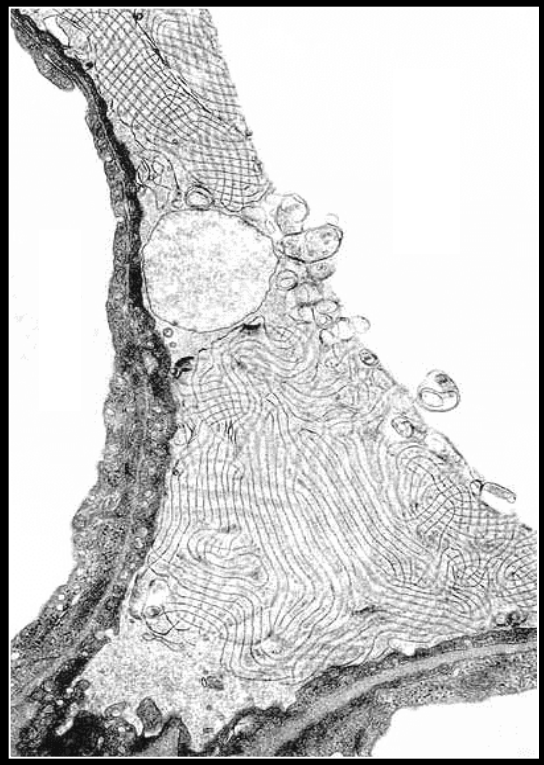
Acta Anesthesiol Scand 1958;2:37-43



Mary Ellen Avery







Robert H. Usher

The American Academy of Pediatrics
PEDIATRICS

Usher R.

Reduction of mortality from RDS of prematurity with early administration of intravenous glucose and sodium bicarbonate.

Pediatrics 1963;32:966-975

G10% 65 ml/kg/d
(4.5 mg/kg/Min)

NaBic 3-10 mmol/kg/d

Daniel Stowens

AJCP
American Journal of Clinical Pathology

Stowens D.

Hyaline membrane disease: morbid anatomy, hypothesis of its pathogenesis, and suggested method of treatment.

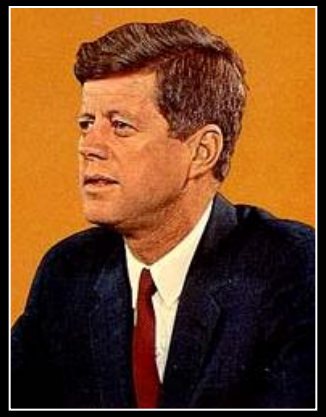
Am J Clin Pathol 1965;44:259-270

TIME

The Deadly Membrane

Last week Dr. Daniel Stowens, a Louisville pathologist, said he had found the explanation of H.M.D. and a simple, effective treatment: Epsom salts enemas.

Patrick Bouvier Kennedy



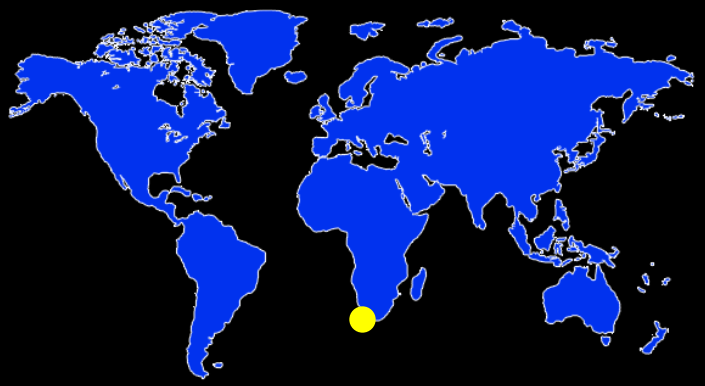
Patrick Bouvier Kennedy
born Aug. 7, 1963; died Aug. 9, 1963

Frühe PPV: East Radcliffe Pump

Heese HD, Wittman W, Malan AF.

The management of the respiratory distress syndrome of the newborn with positive-pressure respiration.

S Afr Med J 1963;37:123-126



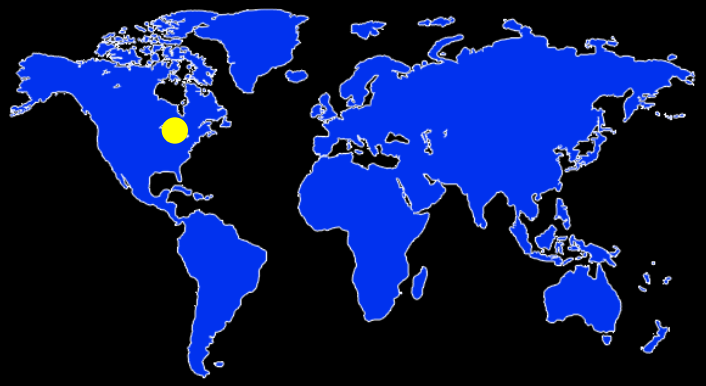
Frühe PPV: Bird Mark VIII

Archives of Disease in Childhood

Papadopoulos MD, Swyer PR.

Assisted ventilation in terminal hyaline membrane disease.

Arch Dis Child 1964;39:481-484



Frühe NPV: Emerson

the New York Academy of Sciences

Stahlman MT, Young WC, Gray J, Shepard FM.

The management of respiratory failure in the idiopathic respiratory distress syndrome of prematurity.

Ann N Y Acad Sci 1965;121:930-941

Graham Liggins

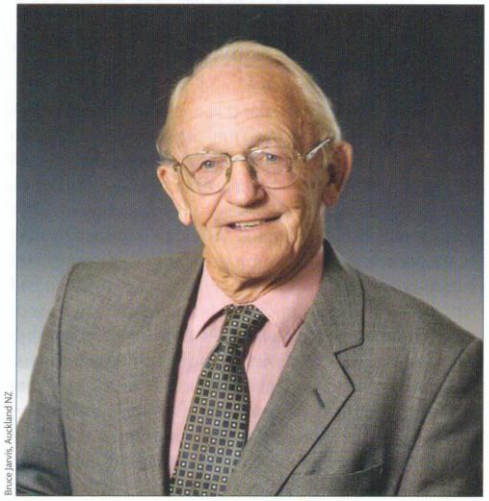
The American Academy of Pediatrics
PEDIATRICS

Liggins GC, Howie RN.

A controlled trial of antepartum glucocorticoid treatment for the prevention of RDS in premature infants.

Pediatrics 1972;50:515-525

Graham Liggins



Graham Collingwood Liggins

Gynaecologist who discovered the value of steroids in stimulating lung development in preterm infants. He was born on June 24, 1926, in Thames, New Zealand, and died on Aug 24, 2010, in Auckland, New Zealand.

Obituary

"I remember one morning", he wrote many years later in a letter to Sir Iain Chalmers, Director of the James Lind Library, "there was a lamb lying in a cage with its mother. A lamb that had been infused as a fetus with cortisol. And to my surprise this lamb was still breathing, not very healthy breathing, but it was alive and breathing. It had no right to be. It was so premature that its lungs should have been just like liver, and quite uninflatable. And this struck me as surprising."

Lungenreifungsinduktion

The Cochrane Collaboration

Crowley PA.
2000 (18 trials)

	OR (95% CI)	Comment
Death	0.60 (0.48-0.75)	14 trials (n=3544)
RDS	0.53 (0.44-0.63)	18 trials (n=3735)
IVH	0.48 (0.32-0.72)	6 trials (n=596)

Übrigens…

Lungenreifungsinduktion

PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

A CONTROLLED TRIAL OF ANTEPARTUM GLUCOCORTICOID TREATMENT FOR PREVENTION OF THE RESPIRATORY DISTRESS SYNDROME IN PREMATURE INFANTS

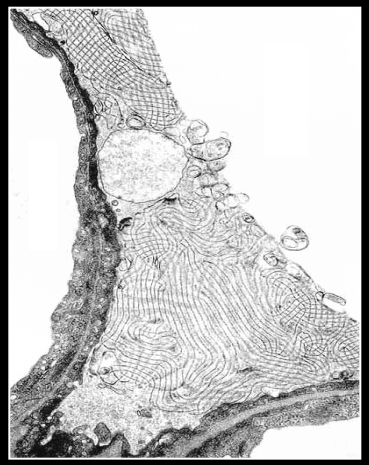
G. C. Liggins and R. N. Howie

Pediatrics 1972;50;515-525

Metaanalyse (1991)

Übrigens…

Lungenreifungsinduktion



Functional maturation

- surfactant (PC, SP-A, SP-B)
- AOE (SOD, Cat, GP)

Structural maturation

- thinning of alveolar septa
- microvascular maturation

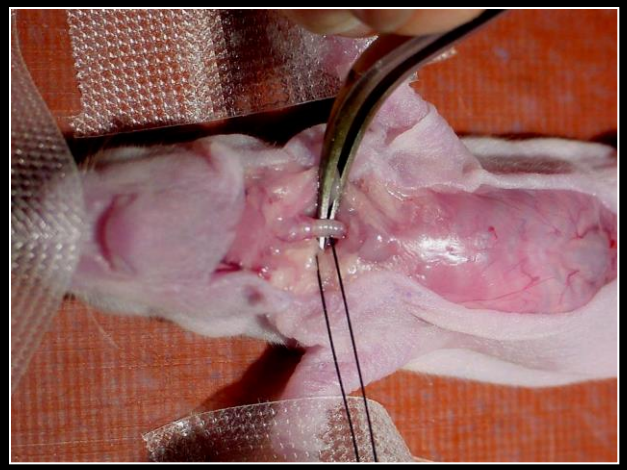
Extrapulmonary effects

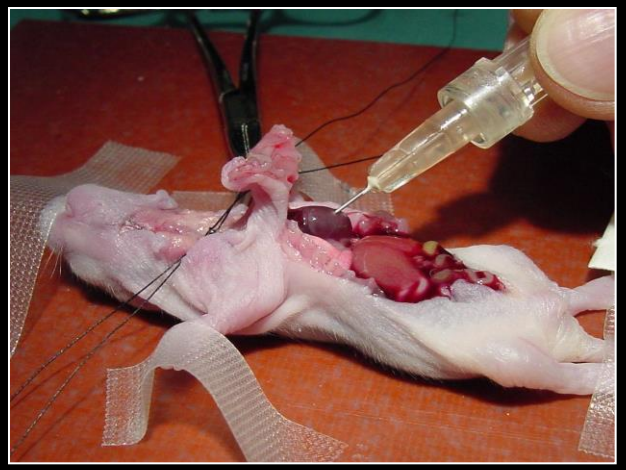
- improved hemodynamics

Microvascular Maturation

Roth-Kleiner M, Berger TM, Tarek MR, et al.
Dev Dynam 2005;233:1261-1271

Neonatal dexamethasone induces premature micro-vascular maturation of the alveolar capillary network

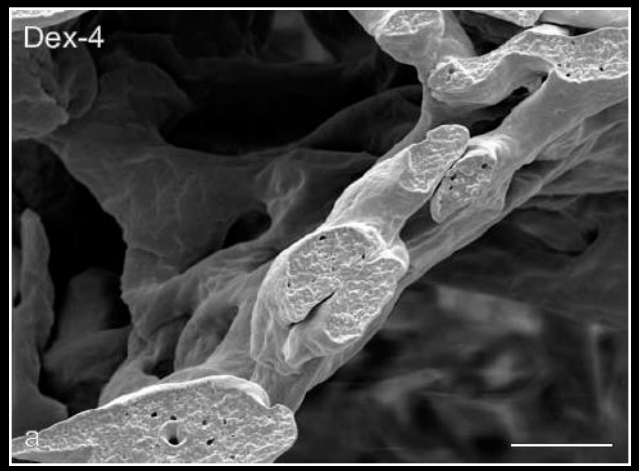


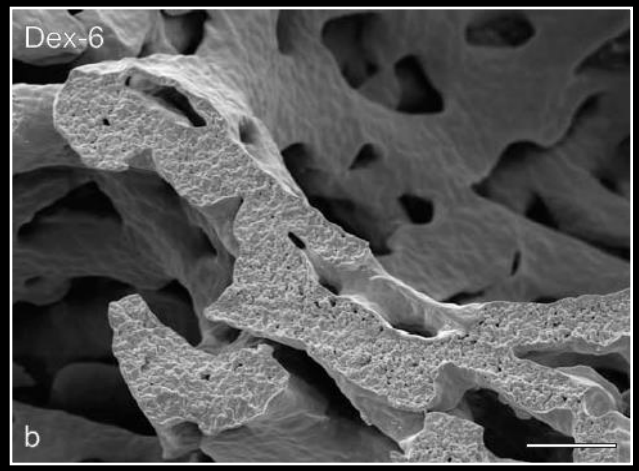


Microvascular Maturation

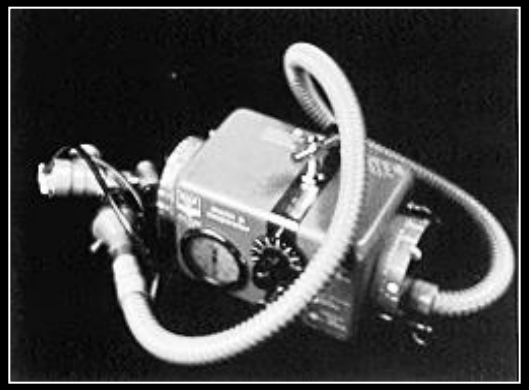
Roth-Kleiner M, Berger TM, Tarek MR, et al.
Dev Dynam 2005;233:1261-1271

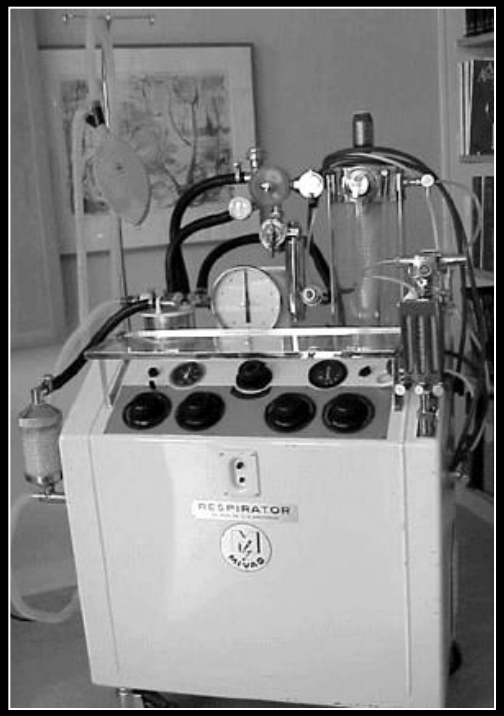
Neonatal dexamethasone induces premature micro-vascular maturation of the alveolar capillary network

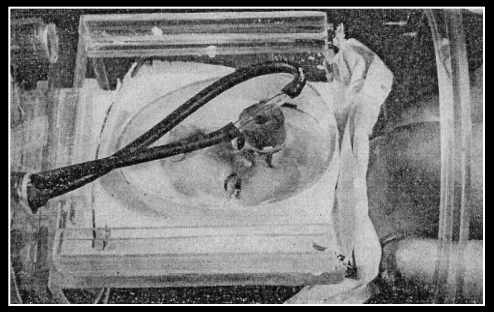




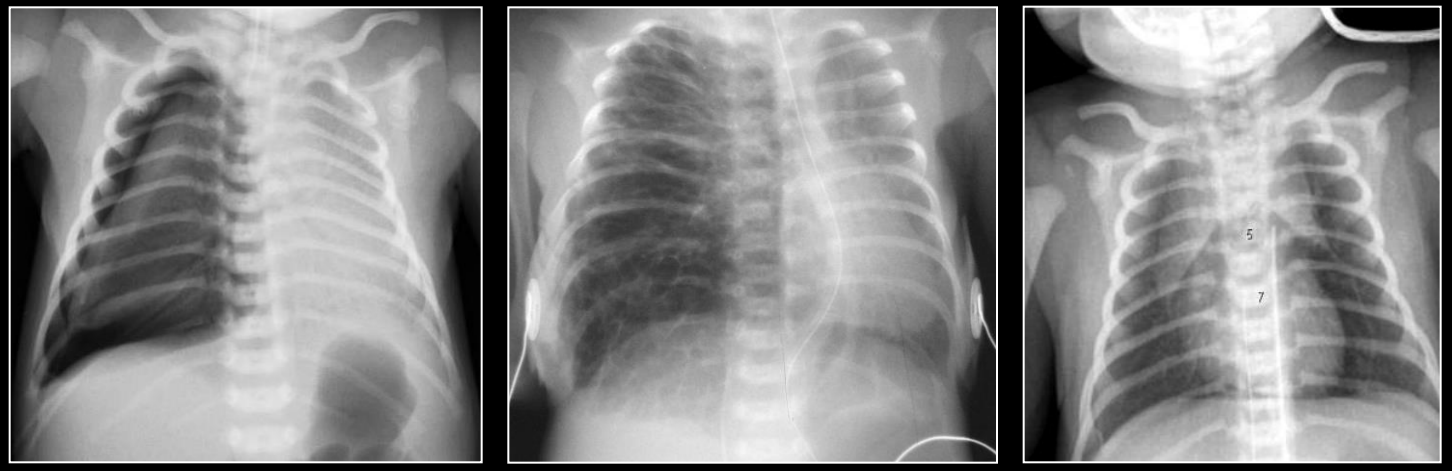
Lernkurve







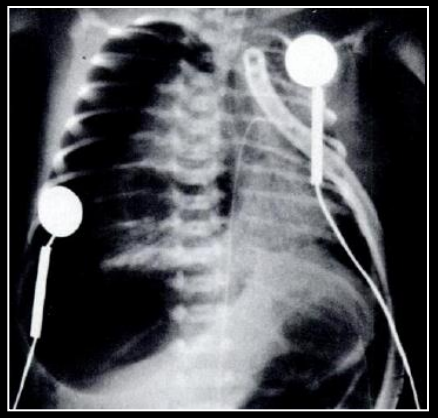
Air Leaks



High incidence of air leaks
High mortality associated with air leaks
Prophylactic chest tubes

Air Leaks

The American Academy of Pediatrics
PEDIATRICS



Kuhns LR, Bednarek FJ, Wyman ML, Roloff DW, Borer RC.

Diagnosis of pneumothorax or pneumomediastinum in the neonate by transillumination.

Pediatrics 1975;56:355-360

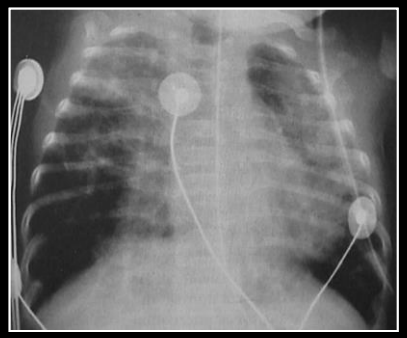
William Northway

The New England Journal of Medicine

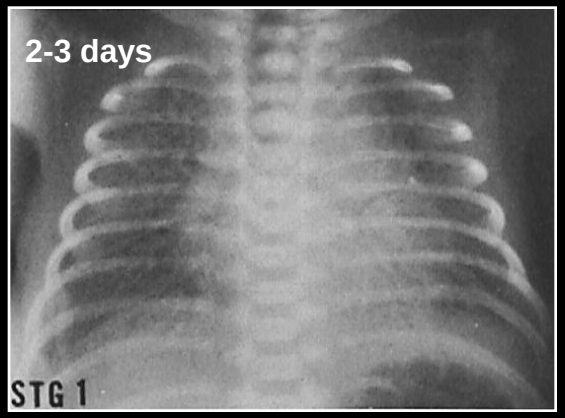
Northway WH Jr, Rosan RC, Porter DY.

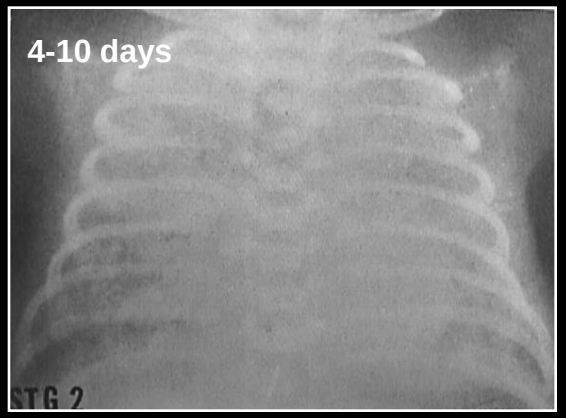
Pulmonary disease following respiratory therapy of hyaline membrane disease: Bronchopulmonary Dysplasia.

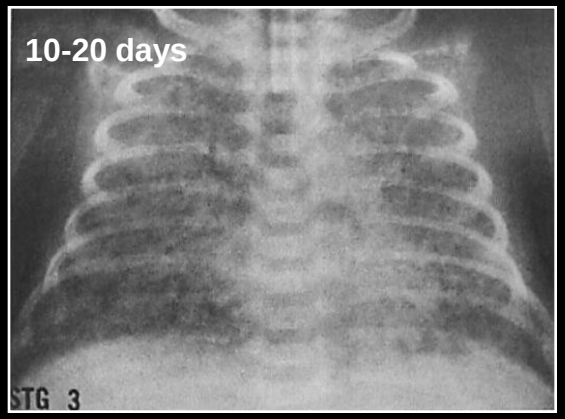
N Engl J Med 1967;267:357-368

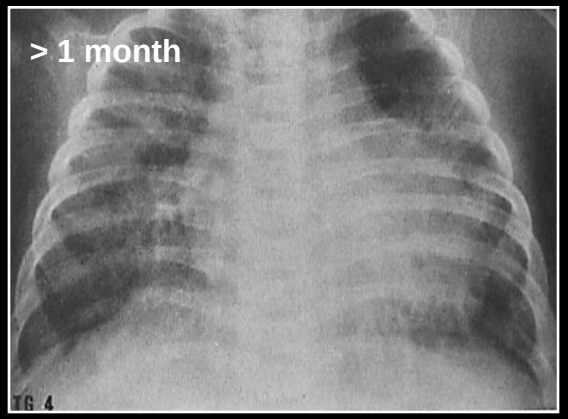


William Northway

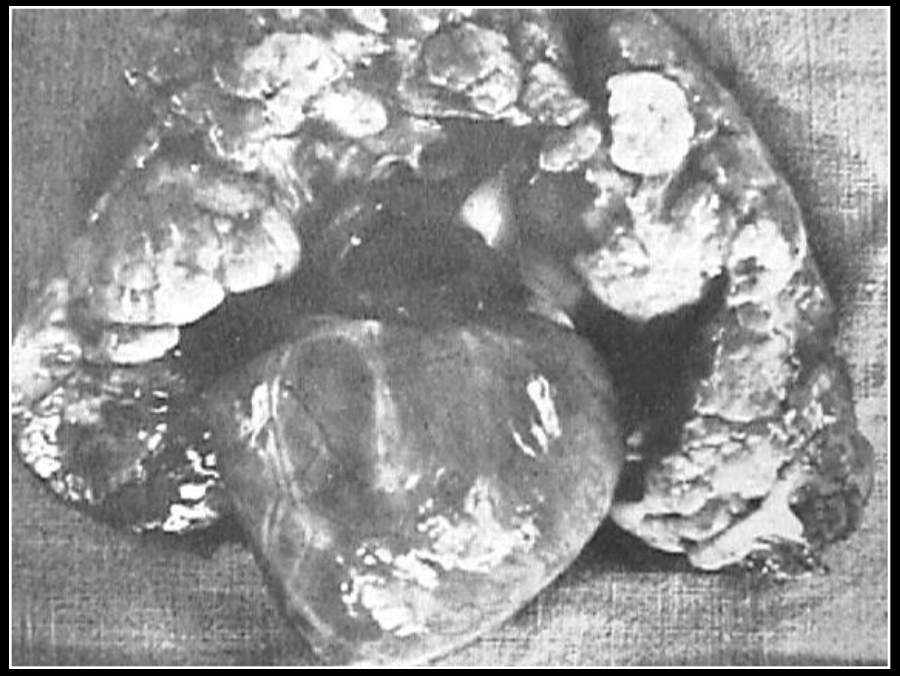






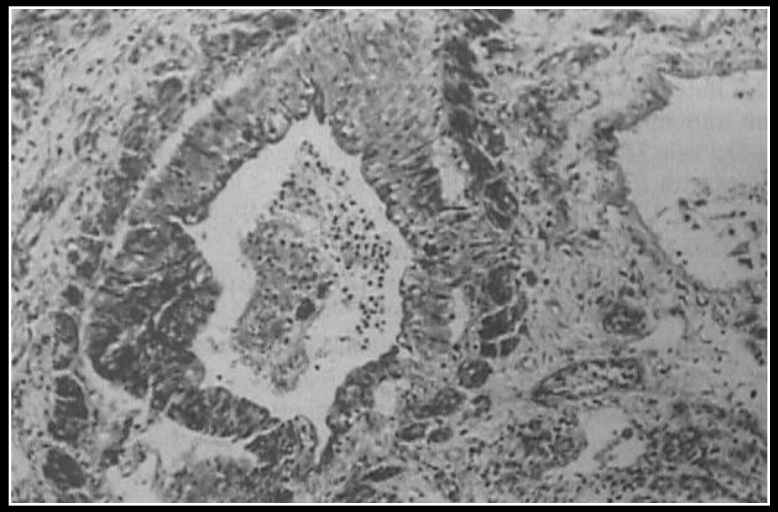


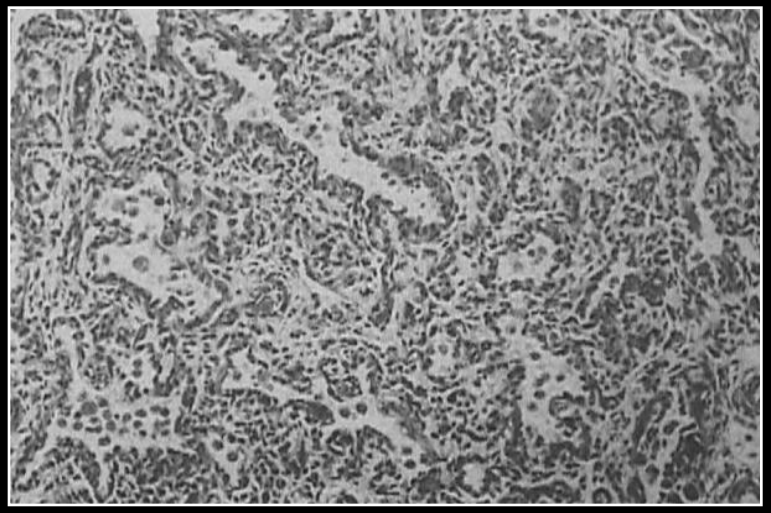
William Northway



11-month-old infant
with stage IV disease

William Northway



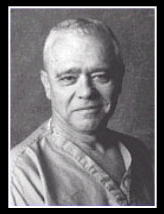


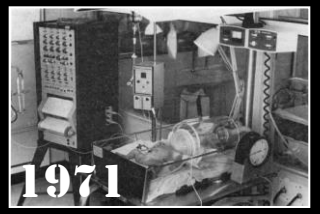
Bronchopulmonale Dysplasie (BPD)

- Epithelzellmetaplasie
- Muskelhypertrophie
- Atelektasen
- Hyperzellularität
- Fibrose

George Gregory

The New England Journal of Medicine





Gregory GA, Kitterman JA, Phibbs RH, Tooley WH, Hamilton WK.

Treatment of the idiopathic respiratory-distress syndrome with continuous positive airway pressure

N Engl J Med 1971;284:1333-1340

John Kattwinkel

The American Academy of Pediatrics
PEDIATRICS

Kattwinkel J, Fleming D, Cha CC, Fanaroff AA, Klaus MH.

A device for administration of continuous positive airway pressure by the nasal route.

Pediatrics 1973;52:131-134

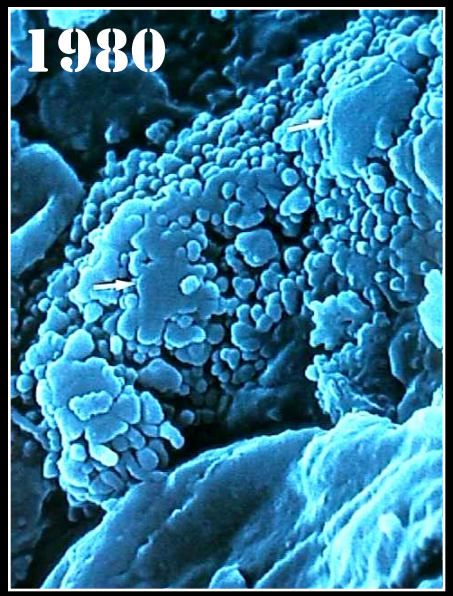
Tetsuro Fujiwara

THE LANCET

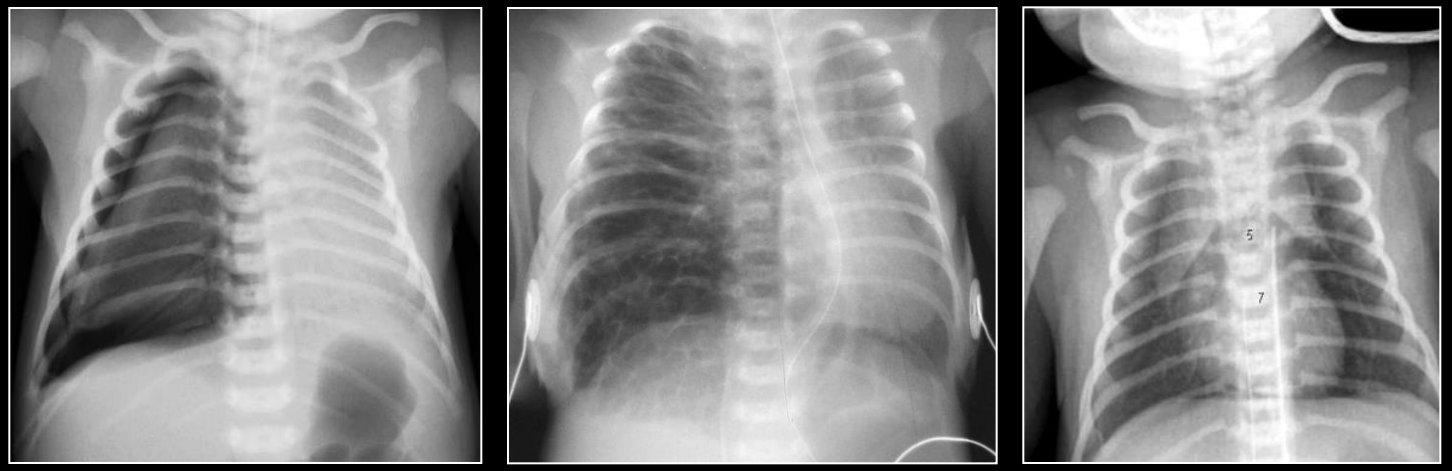
Fujiwara T, Maeta H, Chida S, Morita T, Watabe Y, Abe T.

Artificial surfactant therapy in hyaline-membrane disease.

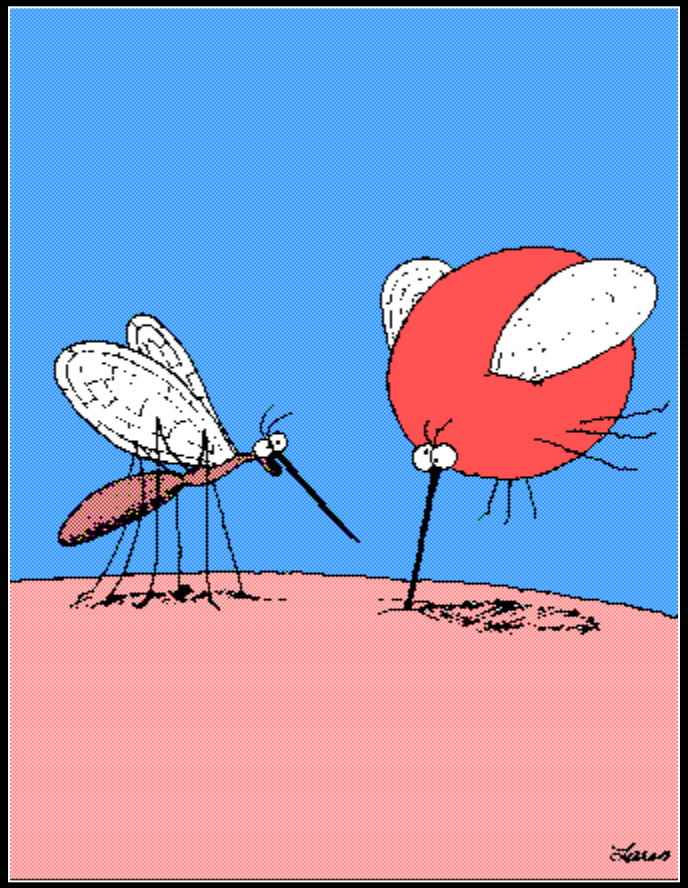
Lancet 1980;1(8159):55-59



Barotrauma and/or Volutrauma



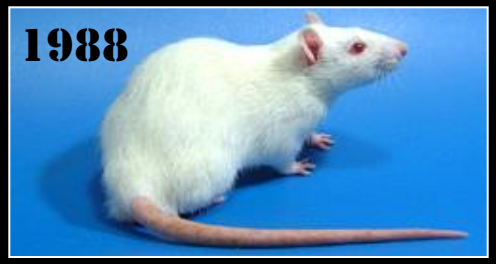
Barotrauma and/or Volutrauma



Pull out Betty, you've hit an artery!

Barotrauma and/or Volutrauma

AMERICAN JOURNAL OF
Respiratory and
Critical Care Medicine

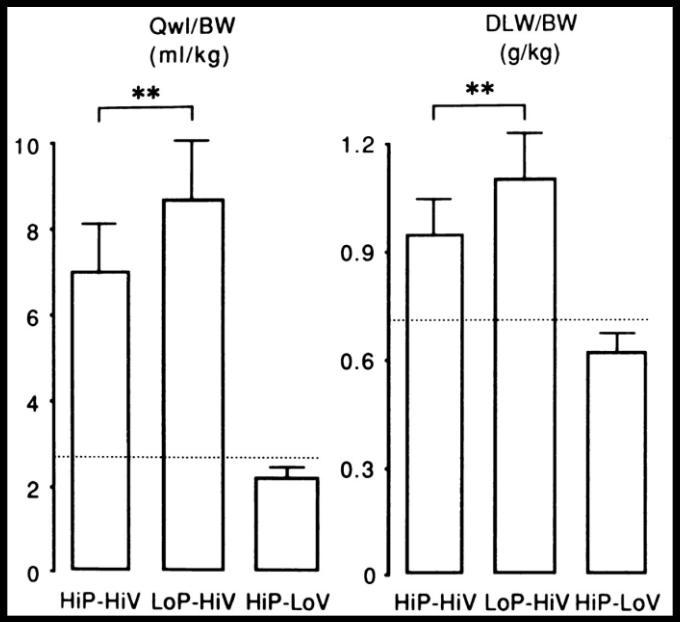


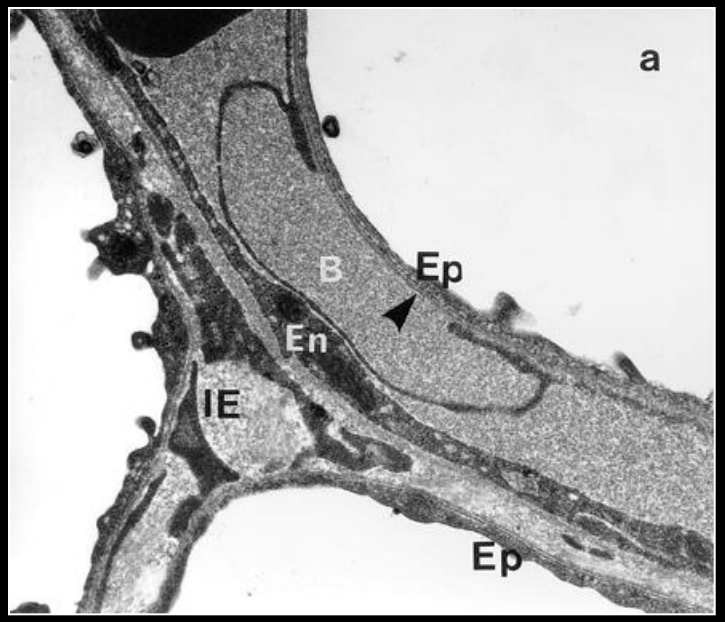
Dreyfuss D, Soler P, Basset G,
Saumon G.

High inflation pressure pulmonary edema. Respective effects of high airway pressure, high tidal volume, and positive end-expiratory pressure.

Am Rev Resp Dis 1988;132:1159-1164

Barotrauma and/or Volutrauma





Dreyfuss D, Soler P, Basset G, Saumon G. **High inflation pressure pulmonary edema. Respective effects of high airway pressure, high tidal volume, and positive end-expiratory pressure.** Am Rev Resp Dis 1988;132:1159-1164

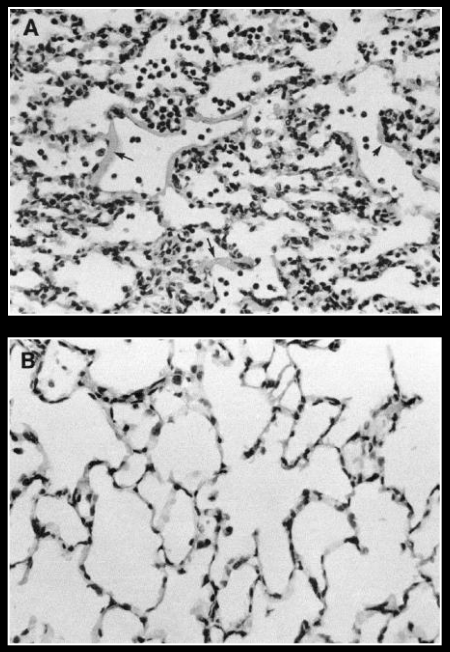
Oxygen Toxicity and Biotrauma

Journal of Applied Physiology

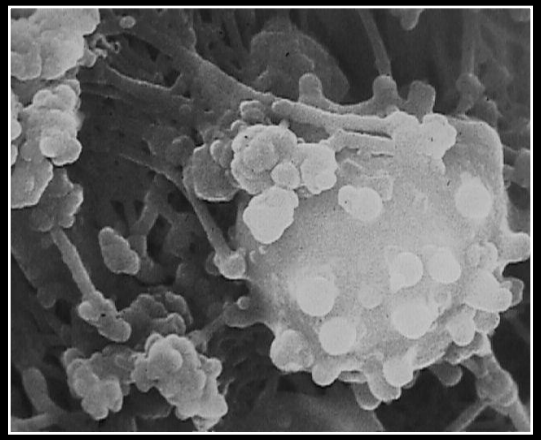
Kawano T, Mori S, Cybulsky M, Burger R, Ballin A, Cutz E, Bryan AC.

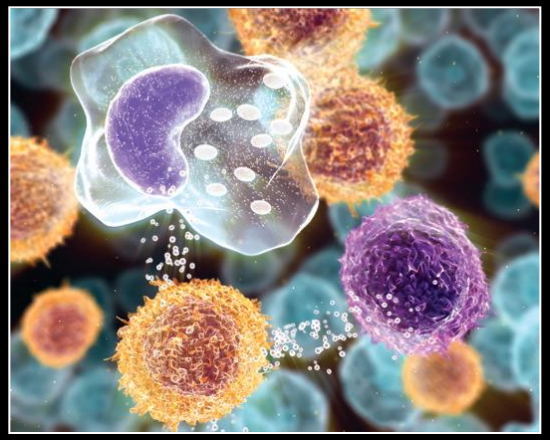
Effect of granulocyte depletion in a ventilated surfactant-depleted lung.

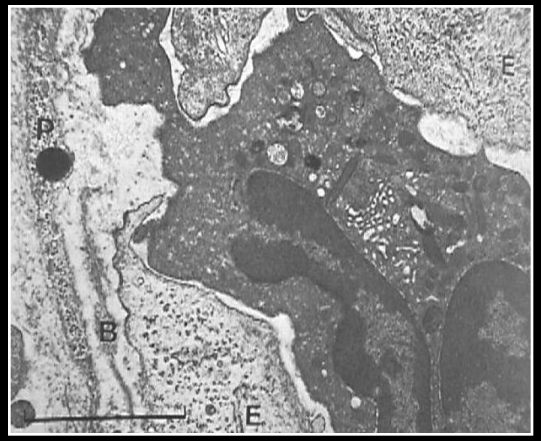
J Appl Physiol 1987;62:27-33

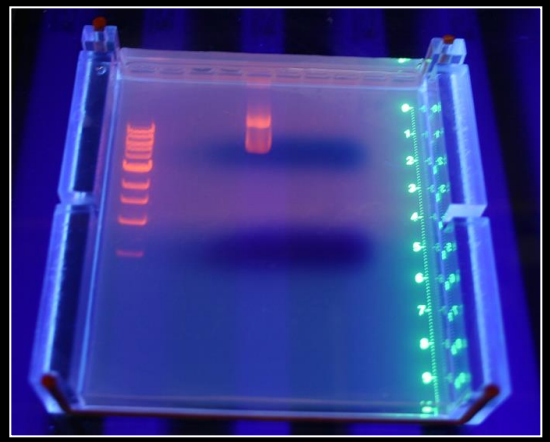


Oxygen Toxicity and Biotrauma









Oxygen Toxicity and Biotrauma

AMERICAN JOURNAL OF
Respiratory and
Critical Care Medicine

Uhlig S, Ranieri M, Slutsky AS.

To the Editor: Biotrauma hypothesis of ventilator-induced lung injury.

Am J Resp Crit Care Med 2003;167:314-315

Dreyfuss D, Ricard JD, Saumon G.

From the Authors

Am J Resp Crit Care Med 2003;167:315

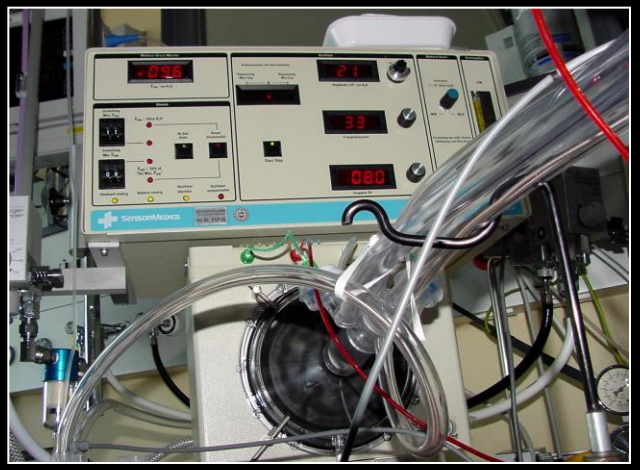
Oxygen Toxicity and Biotrauma

Their perspective finishes with a quote from Molière's comedy *The Doctor Despite Himself*. Unfortunately, even in this context, the literature is misinterpreted. The citation with respect to the "humeurs peccantes" (sinful humors) referred to in their perspective was not, as they implied, the belief of a doctor, but rather the beliefs of a drunken lumberjack who was impersonating a physician.

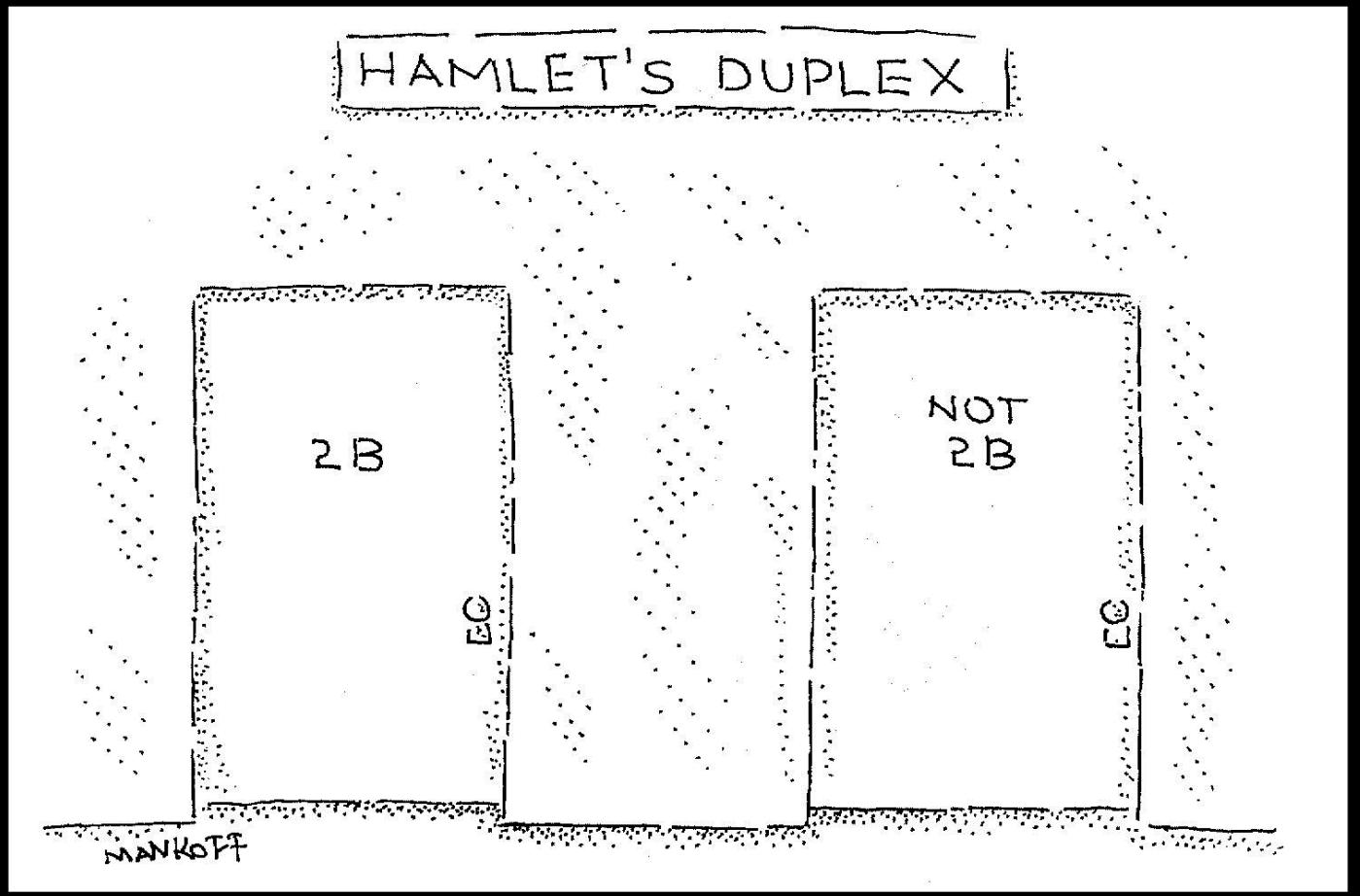
Oxygen Toxicity and Biotrauma

"Humeurs peccantes" is a medical term that was widely used, both before (9) and during Molière's time (…) Uhlig, Ranieri, and Slutsky can also learn from looking at a fourteenth century picture of the University of Bologna Library that shows a bloodletting performed to evacuate "materia peccante". We hope that Uhlig, Ranieri, and Slutsky's search and understanding of recent scientific literature will become more accurate than their review of the classics.

State-of-the-Art



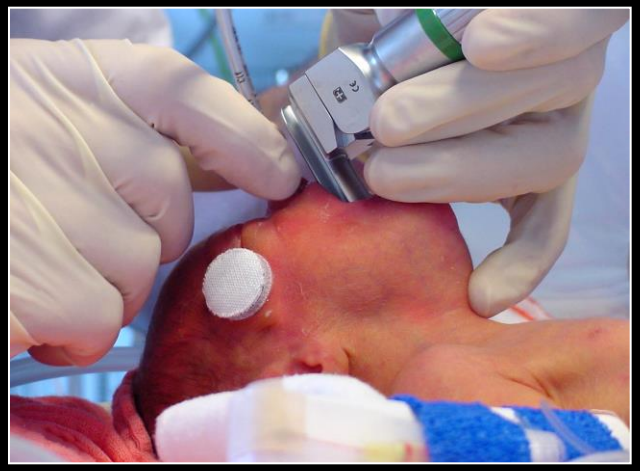
State-of-the-Art?



Lung Protection

Du sollst die Lungen bereits im Gebärsaal sanft behandeln

Lung Protection



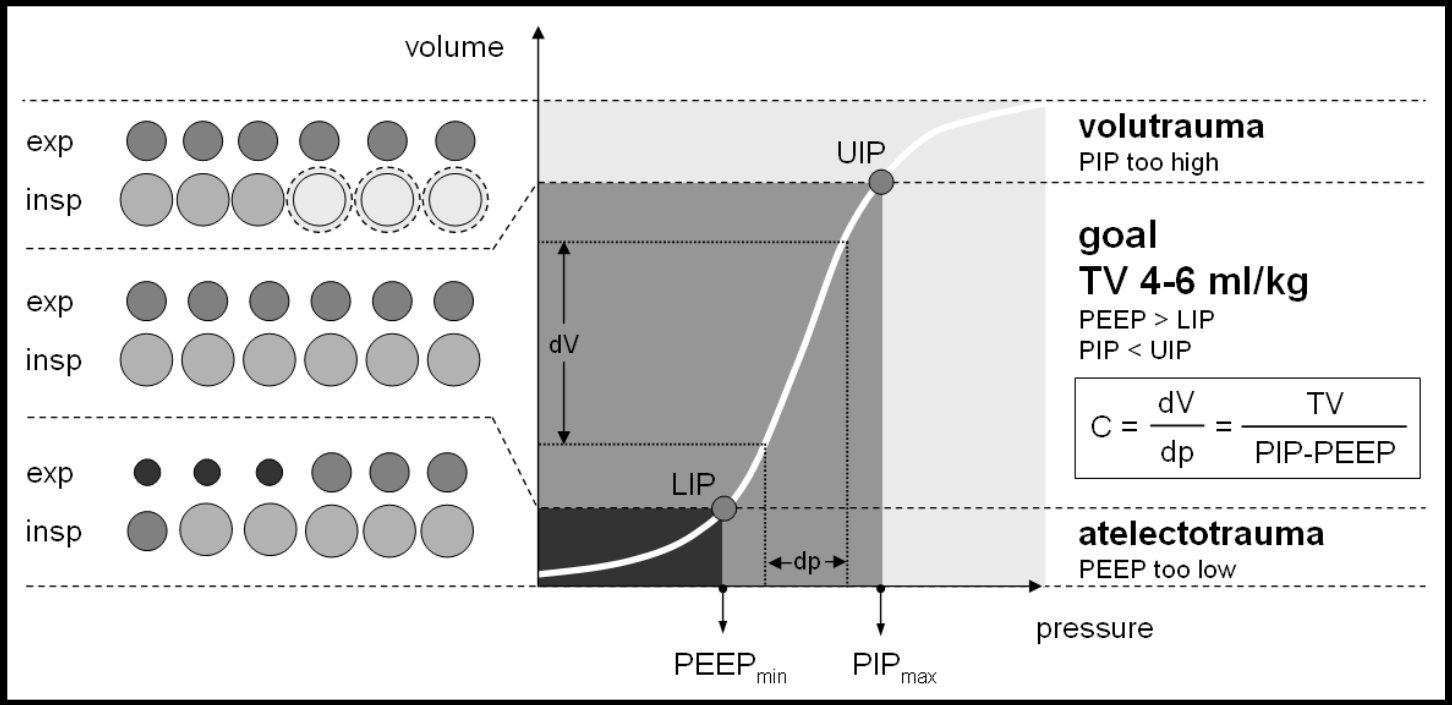
- Beatme sanft
- O_2-Mischgerät und O_2-Sättigungsmonitor
- Early CPAP
- Verwende (natürlichen) Surfactant (früh)

Lung Protection

II

Du sollst
Atelekto- und Volutraumata
vermeiden

Lung Protection



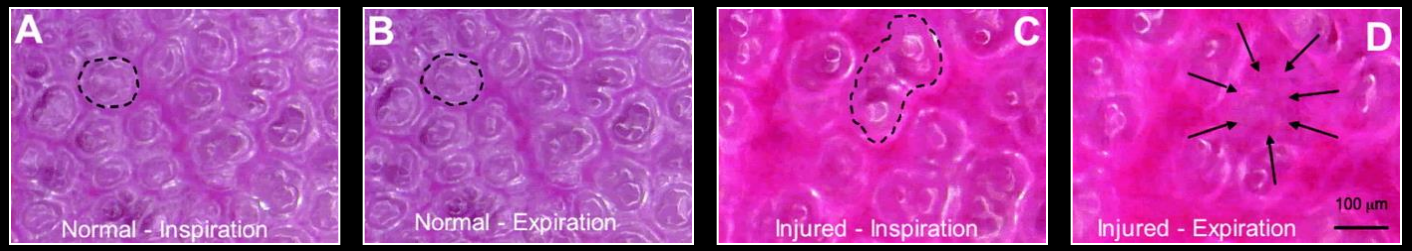
Lung Protection

Critical Care Medicine
OFFICIAL JOURNAL OF THE SOCIETY OF CRITICAL CARE MEDICINE

Carney D, DiRocco J, Nieman G

Dynamic alveolar mechanics and VILI.

Crit Care Med 2005;33:S122-S128



Lung Protection

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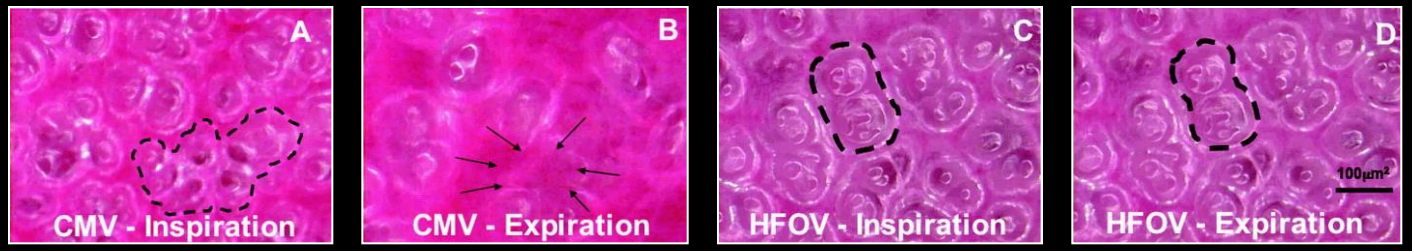
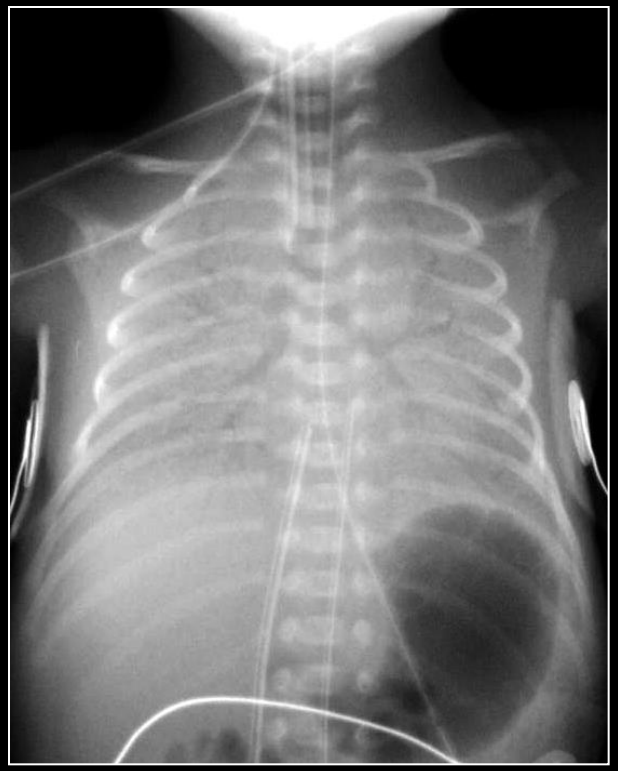


Lung Protection



Sick lungs are small lungs

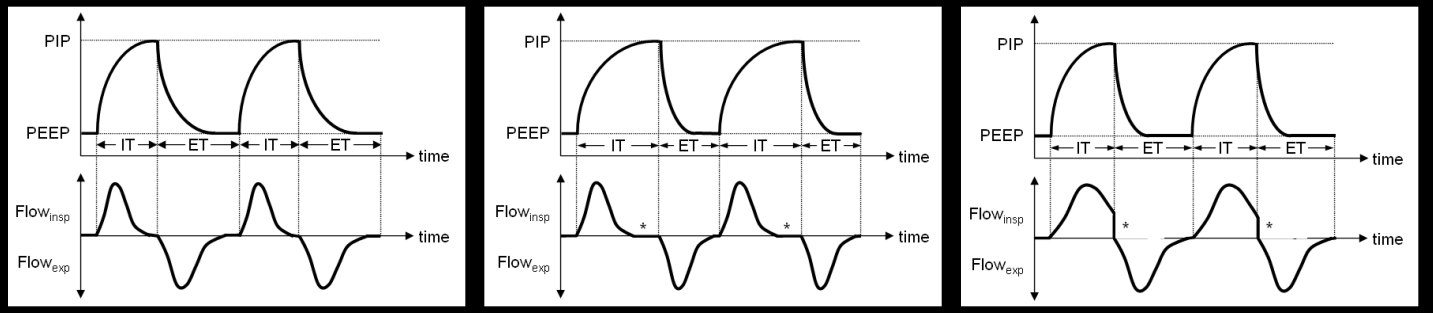
Lung Protection

III

Du sollst
das Atemzugvolumen
überwachen

Monitoring

AZV = 4-6 ml/kg



Sick premie lungs are fast lungs

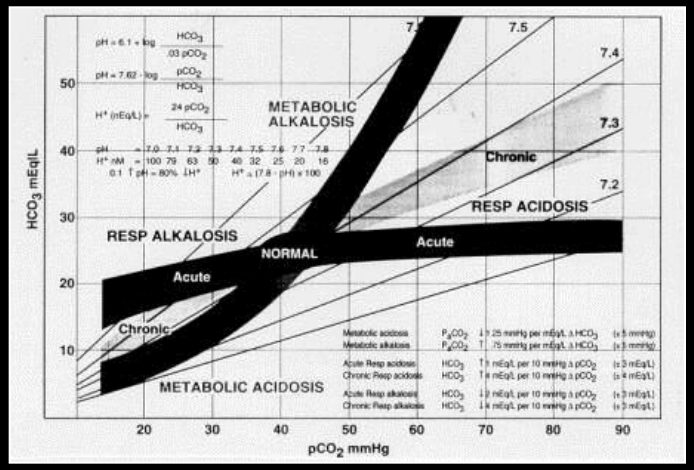
$TC = C \cdot R$

Lung Protection

IV

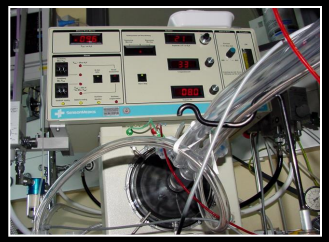
Du sollst
die Blutgase nicht
normalisieren

Lung Protection



- Vermeide Hyperventilation/Hypokapnie
- Konzept der permissiven Hyperkapnie
- Konzept der permissiven Hypoxämie

Technologie

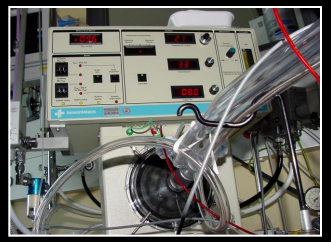


Achtung: one size doesn't fit all!

invasiv
konventionell
druck-limitiert

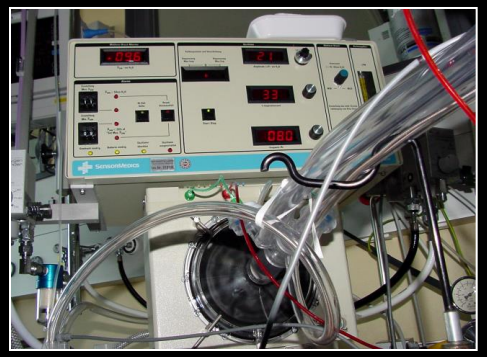
nicht-invasiv
hochfrequent
volumen-kontrolliert

Technology Assessment



It's the driver, not the machine.

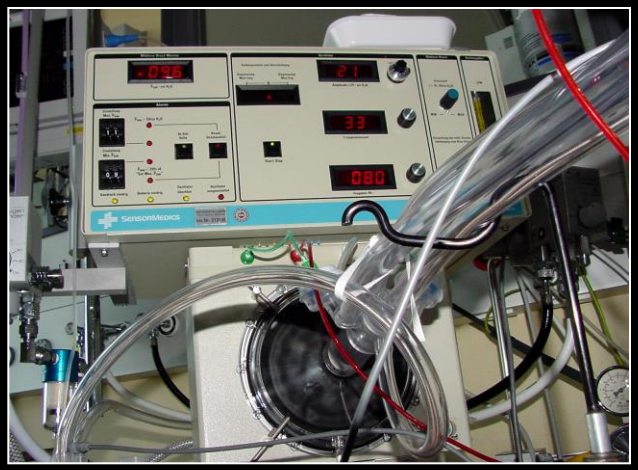
Technology Assessment

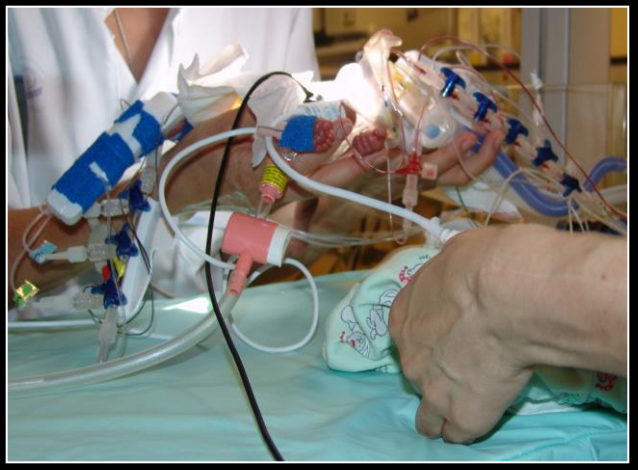


It's not what you use,
but how you use what you use.

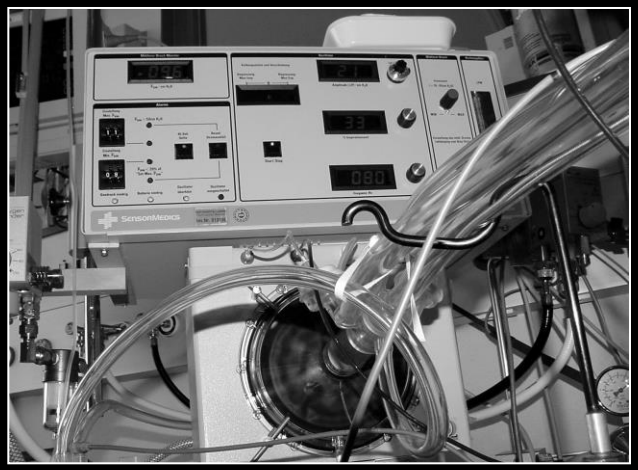
…but always use your brain!

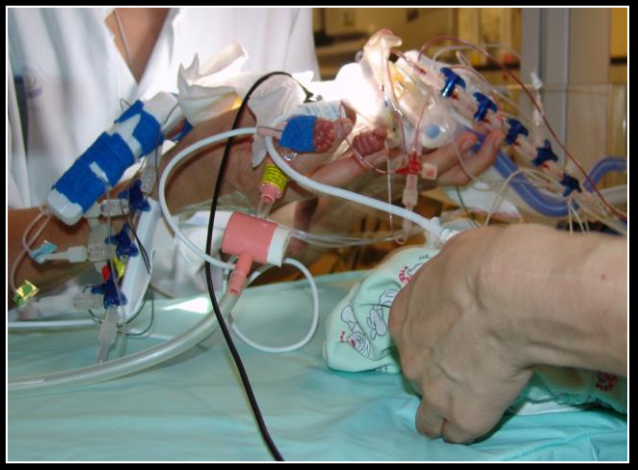
Technology Assessment





Technology Assessment





Vielen Dank!