Karl Landsteiner Institute for Neurorehabilitation and Space Neurology

Hyperbaric Oxygenation Treatment in neurological disorders

Use in acute and long term neurologic conditions

F. Gerstenbrand, S.M. Golaszewski,
A. Kunz, Ch. Kurzmann, M. Seidl
Karl Landsteiner Institute for Neurorehabilitation and Space Neurology, Vienna

44th International Danube Neurology Symposium
7-9 th June, 2012
Szeged, Hungary,

The pressurized environment is not new

The first recorded use in history was a diving bell Alexander the Great used in the siege of Tyrus in 332 BC.

Oxygen was discovered by Priestly 1774

- He warned that increased pressure may be toxic
- This held the field back for many years

In the early 19th century, pressurized air Health Spas were sprouting up throughout Europe

Healing properties were demonstrated

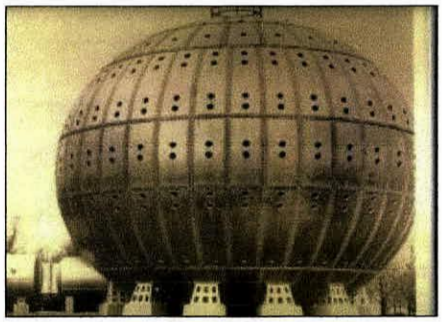
1920s – 30s

Remarkable clinical results were obtained by Orville Cunningham, Professor of Anesthesia, University of Kansas

1928

The six stories stainless steel Domicilium was erected for Cunningham by Timken Ball Bearing Company in Cleveland

Cunningham's Domicilium



Hyperbaric Oxygen Therapy

is the use of 100% oxygen at more

than atmospheric pressure

Pressurized O_2 adheres to all gas laws of physics

Henry's Law states there is a direct relationship between pressure and the amount of gas dissolved in solutes

Under hyperbaric condition oxygen is increased in:

- bone
- urine
- plasma
- lymph
- and most importantly in the cerebrospinal fluid

How is O_2 processed

in the body ?

Under pressure free molecular oxygen is delivered directly to the cell for immediate metabolic use without energy exchange.

Edward Teller, Ph.D.

Dose Equals

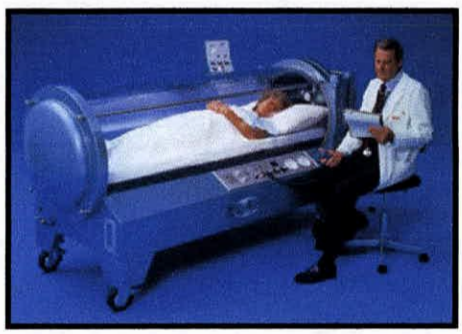
- Strength of pressure
- Time (length) of exposure
- Frequency
- Total number of treatments

How is it administered - Pressure Vessel

- Multiplace chamber
- Monoplace chamber
- Low pressure portable chamber

Multiplace Chamber

Monoplace Chamber



Proper Protocols

- For insurance reimbursement 20 – 60 treatments may be recommended
- Some patients may require hundreds of treatments

Effects of Pressurized Oxygen in acute Brain Insult - 1

- Reduces adhesion of WBCs (white blood cells) to endothelium
- Perfuses all tissue spaces
- Life sustaining O_2 available via retrograde perfusion in absence of a trickle phenomena
- Delivers metabolically available O_2 without chemical energy transfer – *enough to sustain life without blood*

Effects of Pressurized Oxygen in acute Brain Insult - 2

- Under pressure, O_2 adheres to all the gas laws of physics
- Displaces all other gases in the body:
  - N_2, CO
- Follows the law of mass action
- Completely saturates hemoglobin
- Increases plasma O_2 by 2000%
- Dissolves in cerebrospinal fluid, lymph, bone and urine

Effects of Pressurized Oxygen in acute Brain Insult - 3

- Reduces cerebral edema & ICP
- Limits the ischemic cascade
- Reduces CNS lactate peak in hypoxia
- Neutralizes toxic amines
- Disaggregation of platelets
- Increases Phagocytic activity of PMN cells (white blood cells)

Effects of Pressurized Oxygen in Chronic Brain Insult - 1

- Reactivates idling neurons
- Enhances plasticity
- Efficiently elevates diffusional driving force for O_2, thereby increasing tissue oxygen availability
- Promotes phagocytosis (internal debridement)
- Ameliorates multiple biochemical changes

Effects of Pressurized Oxygen in Chronic Brain Insult - 2

- Restores the integrity of the blood brain barrier and cell membranes
- Improves cell respiration, reduces cell byproducts – cytokines
- Promotes neovascularization
- Promotes epithelization

Effects of Pressurized Oxygen in Chronic Brain Insult - 3

- Acts as scavenger of free radicals
- Bacteriostatic effects, synergizes with certain antibiotics
- Neutralizes certain toxins: clostridium, anaerobes
- Stimulates the adaptive immune system, especially in elderly (mice)

Influence on certain drugs

HBOT may enhance the effectiveness of certain drugs and extend the longevity of the product

Applications in Neurology

- **Acute neurological conditions:**
  - TBI, Stroke (encephalitis?), diving accidents
- **Progredient neurological conditions:**
  - MS, progredient dementia of different origin
- **Chronic neurological states:**
  - cerebral palsy
  - apallic syndrome/vegetative state
  - hypoxic encephalopathy
  - vascular dementia, mixed dementia
  - Alzheimer dementia

If HBOT is so beneficial, why is it not used in general?

- Lack of knowledge
  - Not taught in medical school
- Lack of facilities
- Expense
  - nothing to be patented

What is needed?

- Basic research on humans
  - Extensive animal work in the literature
- Education
- Less expensive methodology
  - Portable inflatable chamber

Future Aspects

- Education of medical students & the practicing physician
- Continued education of the family
- Possible insurance reimbursement

Hopefully in the future HBOT will become more of a standard treatment than an examination of TBI

"Here is better than the open air : Take it thankfully."

William Shakespeare
1564 - 1616

"King Lear"

16.40-17.00 Szalárdy L., Zádori, D., Plangár, I., Vécsei, L., Weydt, P., Ludolph, AC., Klivényi, P., Kovács, GG.:
Neuropathology of PGC-1α deficiency recapitulates features of mitochondrial encephalopathies.

17.00-17.30 General discussion

19.30 Dinner

9TH JUNE (SATURDAY)

9.00-12.00

DANUBE NEUROLOGY SYMPOSIUM and EUROPEAN SOCIETY FOR CLINICAL NEUROPHARMACOLOGY organize

TRIBUTE TO ABEL LAJTHA FOR HIS 90TH BIRTHDAY

New Frontiers in Basic and Clinical Neurosciences
Chairs: Thome, J. (Rostock) and Vécsei, L. (Szeged)

9.00-9.15 Introduction by BATTISTIN, L. (Italy)

9.15-9.30 Korczyn, A. (Tel Aviv):
Do we need a new definition of Parkinson's disease?

9.30-9.45 Gerstenbrand, F., Golaszewszki, St., Kunz, A. (Vienna, Salzburg):
Hyperbaric oxygen treatment in neurological disorders.

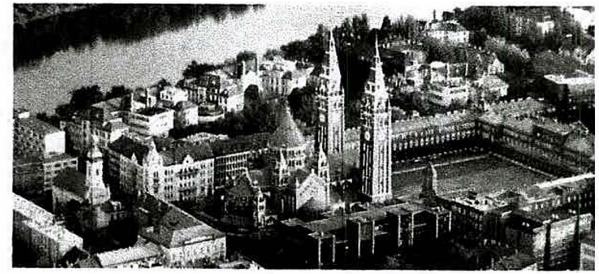
9.45-11.40

Round Table Discussion: Frontiers in Basic and Clinical Neuroscience
Chairs: Battistin, L. (Italy) and Vizi, E.S. (Hungary)
Participants: Bodis-Wollner I., (USA), Gerstenbrand, F. (Austria), Korczyn, A. (Israel), Spano P. (Italy); Thome J. (Germany), Vécsei, L. (Hungary), Vizi E. S. (Hungary)

11.40-12.00 Conclusion by LAJTHA, A. (USA, New York)

Supported by an educational grant by Epitech Neuroscience Project

44th INTERNATIONAL DANUBE NEUROLOGY SYMPOSIUM



50TH ANNIVERSARY OF THE DONAUSYMPOSIUM:
1962, VIENNA - 2012, SZEGED

7-9. JUNE, 2012.
SZEGED, HUNGARY
PROGRAMME