# THE OFF-LINE BRAIN – IS THERE SUCH A THING? APALLIC SYNDROME AND LOCKED-IN SYNDROME

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Coma Vigile (Wachkoma), a special form of a coma, is the leading symptom of the Apallic Syndrome/Vegetative State. The patient is conscious, but without higher and highest brain functions and shows more or less uniform neurological symptoms.

Pathophysiologically the Apallic Syndrome is comparable to the physiological brain functions of a new born or a young child. An Apallic Syndrome after acute severe brain damage shows a typical course going through from an initial state to a full state. In a great number of patients, a remission is following (Gerstenbrand, 1967). In the remission state the disturbed consciousness in form of a coma vigile shows a reintegration, motor deficits and sensory dysfunctions are restored, higher and highest brain functions, the cognitive abilities, are redeveloping. The Apallic Syndrome after a progressive brain process (Alzheimer Disease etc.) shows a disintegration of all brain functions to the end stage of an Apallic Syndrome (Vegetative State).

The Apallic Syndrome/Vegetative State must not be equated with an Off-line Brain, but can be compared with a partly On-line Brain. The irreversible Off-Line Brain corresponds with the Brain Death Syndrome. The term Coma cannot be equated pathophysiologically with an Off-Line Brain, because of the various accompanying symptoms, which are not recognized.

In contrast to the Apallic Syndrome/Vegetative State the classical Locked-In Syndrome shows only a loss of the motor functions. The patients are conscious with sleep/wake rhythm and full active sensory functions. In the extended Locked-In Syndrome based on enlarged lesions in the mesodiencephalic region, sometimes including parts of the thalamus, symptoms of a stupor, parasomnia, hypersomnia, acinetic mutism and thalamic symptoms can be found.

Only the irreversible Brain Death, the total Brain Break Down, can be called Off-Line Brain.

Karl Landsteiner Institute of Neurorehabilitation and Space Neurology

# The Offline Brain - is there such a thing? Apallic Syndrome and Locked-In Syndrome

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42nd Danube Symposium for Neurological Sciences and Continuing Education
October 21-23, 2010
Zagreb, Croatia

## „The Online Brain" Brain functions

- Control center of the body
- Responsible for consciousness
- Processing all incoming data, sensory feelings, etc.
- Acts as an operator by sending messages from all over the body to their proper destination
- Controlling of outgoing messages
- Operating all body movements
- Archive and memory of life experience

## Consciousness Medical overview

- Awareness
- Alertness
- Wakefulness
- Attention
- Arousal
- Responsiveness
- Subjectivity

## „Offline Brain" Coma

Definition after Brihaye et al.

- Coma is defined as the pathological status of a patient who cannot be aroused to a wakeful state and whose eyes are continuously closed and do not open on command or on receipt of nociceptive stimuli.

Brihaye J, Frowein RA, Lidgren S, et al. Report of the meeting of the WFNS Neuro-traumatology Committee, 1. Coma-Scaling. Acta Neurochir 1978;40:181.

## „Offline Brain" Coma

Definition after Plum and Posner

- Deep unarousable unconsciousness

Plum, F, Posner J.B., The Diagnosis of Stupor and Coma. F.A. Davis Company, Philadelphia, 3rd Edition, 1980,

## „Irreversible Offline Brain" Brain Death

- The term *brain death* is defined as "irreversible unconsciousness with complete loss of brain function," including the brain stem, although the heartbeat may continue.

Encyclopedia of Death and Dying
http://www.deathreference.com/Bl-Ce/Brain-Death.html

## Brain Death
## Definition after Shewmon

Brain Death is stated in patients where continuing treatment of this patient does not include any hope of regaining any level of brain function. A continuation of therapeutic measures in brain death is neither in the interest of the patient nor ethically permitted. To treat a living corpse is unethical, it reduces a human being „ to a mere collection of organs" Shewmon (1998).

„Chronic Brain Death": Brain dead patients still "alive": 56 patients for more than 1 month, 7 patients over 6 months , for more than 1 year, 1 patient 14,5 years
Shewmon (1998)

## Brain Death

## Differential diagnoses

- apallic syndrome / vegetative state
- locked-in Syndrome

## Symptoms of Apallic Syndrome

- Coma vigile
- No recognition of the surrounding
- No contact to the surrounding
- No reaction to external stimuli
- Sleep-wake-rhythm fatigue regulated
- Optomotoric disturbances
- Flexed-stretched position of the extremities and trunk
- Rigido-spasticity
- Primitive motor patterns (oral, grasping, etc.)
- Dysregulation of the vegetative system

## Etiology of Apallic Syndrome

1. After acute, severe brain injuries
   TBI, encephalitis, hypoxia, malignant stroke etc.
   – *Possibility of remission*
2. After progredient, diffuse brain processes
   CJD, M. Alzheimer, M. Pick, Chorea Huntington, etc.
   Final stage
   – *Remission not possible*
3. Intoxication
   3a Acute
   Exogenous (neuroleptics etc.)
   Endogenous (hepatic, uremic etc.)
   – *Full remission possible*
   3b Chronic
   Exogenous (Minamata disease etc.)
   Endogenous (hepatic, thyreotoxic etc.)
   – *Partial remission possible*

## Historical background to the diagnosis of Apallic Syndrome

Coma:

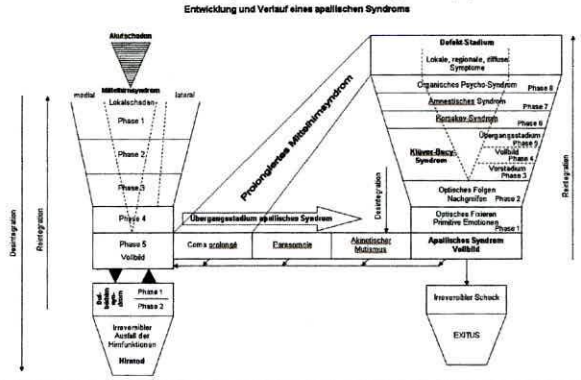
- State of deep unarousable unconsciousness — Plum, Posner 1972
- Prolonged unconsciousness — French, 1952
- Coma prolongé — Vigouroux et al. 1964
  three stages
  – Coma carus
  – Coma avec stabilisation des phénomènes végétatifs
  – Coma, phase sortie de l'état comateux

## Coma prolongé, three stages
## Vigouroux et al. 1964

- Coma carus:
  - Acute midbrain syndrome } Gerstenbrand and
  - Acute bulbar brain syndrome } Lücking, 1971
  - Upper pons stage } Plum and Posner, 1972
  - Medullary stage }
- Coma avec stabilisation des phénomènes végétatifs
  - Apallic syndrome, full stage — Kretschmer, 1940, Gerstenbrand, 1967
  - Vegetative state — Jennett, Plum, 1972
- Coma phase sortie de l'état comateux
  - AS, remission stage — Gerstenbrand, 1967

## Apallic Syndrome

Course after acute severe brain damages (traumatic, hypoxic, etc.)
F. Gerstenbrand, 1967, 1977, F. Gerstenbrand, E. Rumpl, 1983




## Persistent Vegetative State (PVS)
## Critical aspects

- Persistent Vegetative State
  - Term as a mixture of diagnoses and prognosis
  - Only suboptimal rehabilitation possible (B. Jennet, 2002)
- Vegetative State
  - no detailed neurological description of full stage
  - No pathophysiological analysis
  - no description of initial stage, transitory stage, remission stage
  - assumed as a static condition (B. Jennet, 2002)
  - No therapeutic concept (B. Jennet, 2002)
  - critics of the international community and pro life committee of catholic bishops in the US. "The term vegetative can suggest the patient is a vegetable, therefore it is subhuman and discriminatory".

## Apallic Syndrome
### Attempt of a neurophysiological explanation
### F. Gerstenbrand, 1967

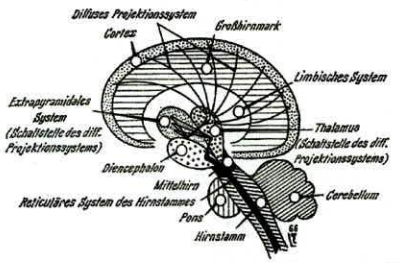



Abb. 67. Schematische Darstellung der verschiedenen Hirnformationen durch deren Ausfall das Symptomenbild des apallischen Syndroms entstehen kann. Einzeichnung des reticulären Systems im Hirnstamm und des diffusen Projektionssystems.

Regional, multi-regional defects in different brain areas

Main lesion of ascending reticular system

## Apallic Syndrome
## Comparison with Anencephalus

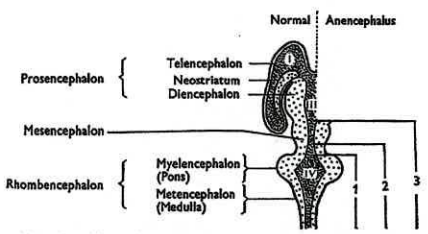
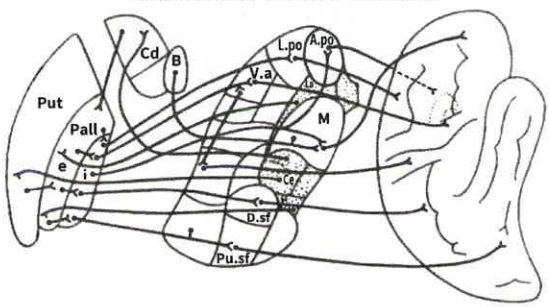



Abb. 69. Schematische Darstellung der 3 Typen des Anencephalus. 1. Rhombencephaler, 2. mesorhombencephaler, 3. mesencephaler Anencephalus (aus *M. Monnier*, Die Regulierung des Bewußtseins und ihre Störungen, in Bewußtseinsstörungen, Symp. vom 10. bis 12. I. 1961, St. Moritz, Schweiz, G. Thieme-Verlag, Stuttgart, S. 25).

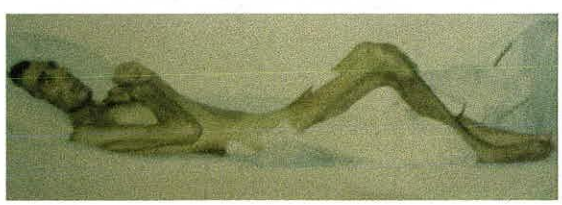
Different forms of anencephalus, after Monnier, 1961)

## Unspecific Projection System of the Thalamus to the Cortex




Scheme of the connection mechanism between thalamus, the basal ganglia and the cortex. After: R. Hassler, 1964

## Apallic syndrome, pat. G.B., 36ª
## traumatic brain injury, 1975



No modern treatment

Irreversible tertiary lesions, complications

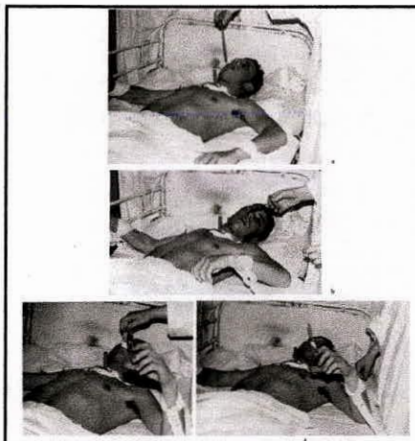
Exitus after 14 months

## Apallic syndrome, pat. E.S., 19a
**traumatic brain injury, 1992**

Modern treatment program in special center for apallic syndrome patients

No tertiary lesions, minimal complications

Remission after 5 months to minimal defect state



Pat. G.N., 39a

Full stage, traumatic apallic syndrome

Optic oral mechanism, Bulldogg-reflex

## Apallic Syndrome
## full stage, traumatic

Abb. 20 Abb. 21

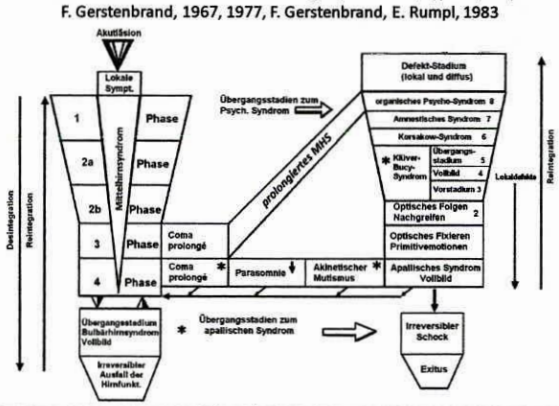
Abb. 20. Vollstadium des traumatischen apallischen Syndroms (Fall 2), tonisches Greifen.
Abb. 21. Vollstadium des traumatischen apallischen Syndroms (Fall 10/40), phasisches Greifen.

- Grasping reflex
  - Abb. 20: tonic
  - Abb. 21: phasic

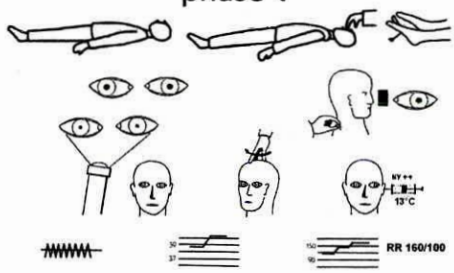
## Apallic Syndrome, traumatic
## full stage

L.G., 32a, full stage, died 9 months after accident,
Diffuse lesion of the white matter frontotemporal with local cystic necrosis, arterial compression necrosis in thalamus, cystic lesions periaquaeductal. (Heidenhain)

## Apallic Syndrome
Course after acute severe brain damages (traumatic, hypoxic, etc.)
F. Gerstenbrand, 1967, 1977, F. Gerstenbrand, E. Rumpl, 1983




## Acute Midbrain Syndrome, central, phase V

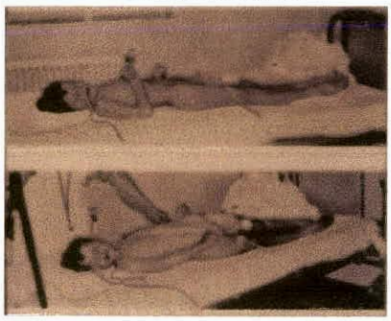



*Akutes traumatisches Mittelhirnsyndrom, 4. Phase (Vollbild)* Schematische Darstellung:
- Körperhaltung, Reaktion auf Schmerzreize (Orbita-Druck), Babinski'sches Zeichen.
- Pupillenweite, Reaktion auf Licht, cilio-spinaler Reflex (Kneifen am oberen Trapezrand).
- Bulbusstellung, oculo-cephaler Reflex (Puppenkopf-Phänomen), vestibulo-okulärer Reflex (Kaltkalorisation mit Leitungswasser).
- Atmung, Temperatur, Puls, Blutdruck.

Phase V, Stretch position, disinhibition of autonomic system

## Acute Secondary Midbrain Syndrome

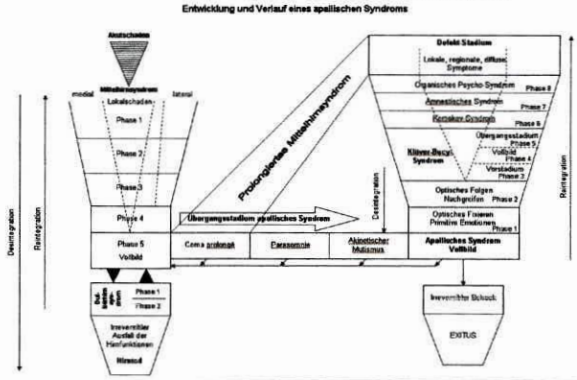
**Traumatic brain injury, brain edema**



Phase IV, V

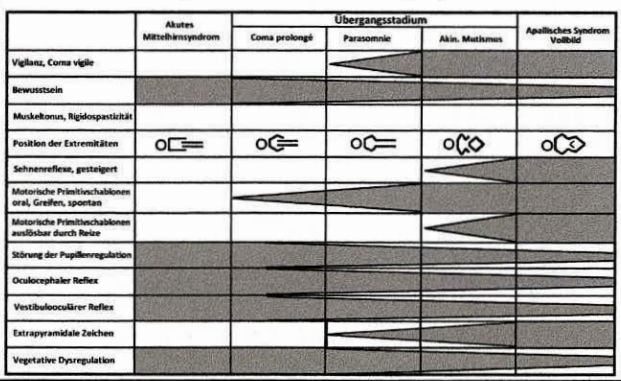
## Apallic Syndrome

Course after acute severe brain damages (traumatic, hypoxic, etc.)
F. Gerstenbrand, 1967, 1977, F. Gerstenbrand, E. Rumpl, 1983




| STADIEN DER HIRNSTAMMSCHÄDEN NACH SUPRATENTORIELLER RAUMFORDERUNG / ZENTR. HERNIATION | | MHS | | | | | BHS | |
|---|---|---|---|---|---|---|---|---|
| | | I | II A | II B | III | IV | I | II |
| VIGILITÄT | | SOMNOLENZ | SOPOR | COMA | COMA | COMA | COMA | COMA |
| REAKTION | AKUSTISCHE REIZE | GERING VERZÖGERT MIT ZUWENDUNG | VERZÖGERT OHNE ZUWENDUNG | FEHLEND | FEHLEND | FEHLEND | FEHLEND | FEHLEND |
| | SCHMERZREIZE | PROMPT GERICHTETE ABWEHR | VERZÖGERT UNGERICHTETE ABWEHR | RESTE UNGERICHTETER ABWEHR | BEUGE-STRECK-STELLUNG | STRECK-SYNERGISMEN | REST-STRECK-SYNERGISM. | FEHLEND |
| OPTOMOTORIK | STELLUNG BULBUS | NORMAL | NORMAL | BEGINNENDE DIVERGENZ | DIVERGENZ | DIVERGENZ | DIVERGENZ FIXIERT | DIVERGENZ FIXIERT |
| | BEWEGUNG | PENDELND | SCHWIMMEND | DYSKUN./GIERT | FEHLEND | FEHLEND | FEHLEND | FEHLEND |
| | PUPILLENWEITE | ● ● | ● ● | ● ● | ● ● | ● ● | ● ● | ● ● |
| | LICHTREAKTION | ● ● | ● ● | ● ● | ● ● | ● ● | ● ● | ● ● |
| KÖRPERMOTORIK | KÖRPERHALTUNG | | | | | | | |
| | SPONTANMOTORIK | MASSEN- UND WÄLZBEWEGUNGEN | MASSENBEWEG. ARME STRECKBEWEG. BEINE | MASSENBEWEG. ARME STRECKBEWEG. BEINE | BEUGE-STRECK-HALTUNG | STRECK-HALTUNG | REST-; NACH-STRECK-HALTUNG | SCHLAFFE HALTUNG |
| | TONUS | NORMAL | BEINE GERING ERHÖHT | BEINE ERHÖHT | ERHÖHT | STARK ERHÖHT | GERING ERHÖHT | SCHLAFF |
| | BABINSKI PHÄNOMEN | ↑ ↑ | ↑ ↑ | ↑ ↑ | ↑ ↑ | ↑ ↑ | ↑ ↑ | — |
| OBLIGAT | ATMUNG | | | | | | | — |
| VEGETATIV NICHT OBLIGAT | PULS | LEICHT ERHÖHT | NORMAL | BESCHLEUNIGT | BESCHLEUNIGT | STARK BESCHLEUNIGT | BESCHLEUNIGT | VERLANGSAMT |
| | RR | NORMAL | NORMAL | NORMAL | LEICHT ERHÖHT | ERHÖHT | NORMAL | ERNIEDRIGT |
| | KÖRPERTEMPERATUR | NORMAL | NORMAL | LEICHT ERHÖHT | ERHÖHT | STARK ERHÖHT | ERHÖHT | NORMAL ERNIEDRIGT |

## Transitory stage of apallic syndrome, development of detailed symptoms




## Apallic Syndrome after progredient, diffuse brain processes as final stage

F. Gerstenbrand, 1967, 1977, F. Gerstenbrand, E. Rumpl, 1983

- Desintegration of higher and highest brain function
  Diffuse organic psychosyndrome
- Multilocular cerebral Symptoms
  Aphasia, Apraxia, motoric disabilities, etc.
- Klüver-Bucy Phase
  3 different stages
- Pre-apallic Phase
  „dementia", motoric primitive patterns, mass movements, decerebrate rigidity, etc.
- Apallic Syndrome, Full Stage
  No remission signs

## Apallic Syndrome - Remission Stages Innsbruck Remission-Scale - 1

- Phase I: Optic fixation – reduction of Coma vigile, sopor
- Phase II: Optic tracking – sleep-wake-rhythm nomalized, stupor
- Phase III: Pre-Klüver-Bucy-phase – combination of primitive motor reflexes, hypersomnia – awake
- Phase IV: Klüver-Bucy-phase – typical Klüver-Bucy reflexes, obnubilation

**Apallic Syndrome - Remission Stages**
**Innsbruck Remission-Scale - 2**

- Phase V: Post-Klüver-Bucy-phase – hypersomnia, communication possible
- Phase VI: Korsakov syndrome – voluntary behavior, disorientation, confusional state
- Phase VII: Amnestic phase – emotional irritaion, flat emotions
- Phase VIII: Psycho-organic syndrome – clear consciousness, aware

**Symptoms of Locked-in syndrome**

- No possibility to communicate with surrounding
- Consciousness and perception fully maintained
- Total paralysis of all extremities, trunk, neck and motor brain nerves
- Eye opening and vertical eye movements possible
- Impairment of swallowing
- Spontaneous respiration possible
- Alpha-EEG

## Etiology of Locked-In Syndrome Lesion in Pons

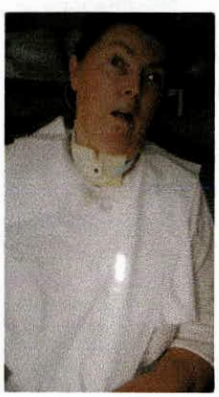
- Infarction caused by basilar thrombosis
- Hemorrhage
- Encephalitis
- Tumor
- Traumatic lesion

- Disconnection of the motor system, sensory connections undisturbed

## Different Types of LIS (after Bauer et al)

- Classic Locked-In syndrome
- Complete Locked-In syndrome
- Passagere Locked-In syndrome (semblance death, Scheintod)

## Patient L.I.S , 45ª, female



Post traumatic etiology

Defect state

**Profound differences between apallic syndrome and locked-in syndrome**

- Apallic syndrome
  Loss of all brain functions, reduction to the midbrain-level (coma vigile, no voluntary motor action, primitive motor patterns)

  temporary or permanent

- Locked in syndrome
  Loss of all motoric abilities, except rest in optomotor functions, undisturbed vigilance, full contact to the surrounding, normal body sensation

  temporary or permanent

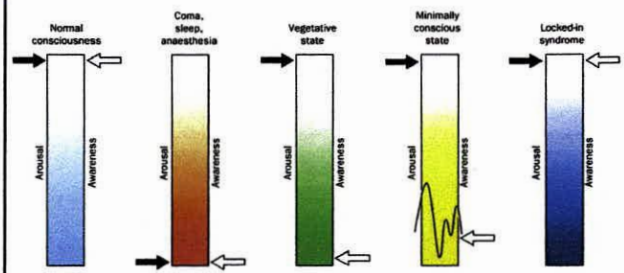
## Minimally Conscious States

(Giacino et al, 1997)

- Crude consciousness: alertness
- Phenomenal consciousness: registration of external and internal phenomena
- Access consciousness: directed attention, cognitive awareness, decision making

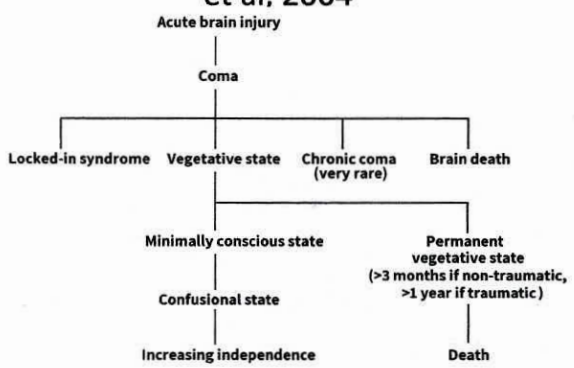
- Critics:
  - No detailed neurological symptomatology
  - Only phenomenological description
  - In some cases to compare with a remission phase AS/VS
  - Etiology generally open

## Remission of a coma state after Laureys et al

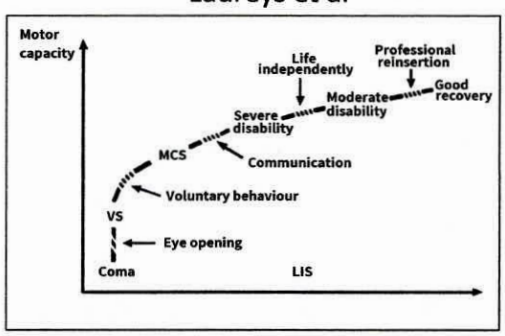



Arousal and awareness, the 2 components of consciousness in coma, vegetative state, minimally consciousness state and Locked-In syndrome

## Severe acute brain injury after Laureys et al, 2004



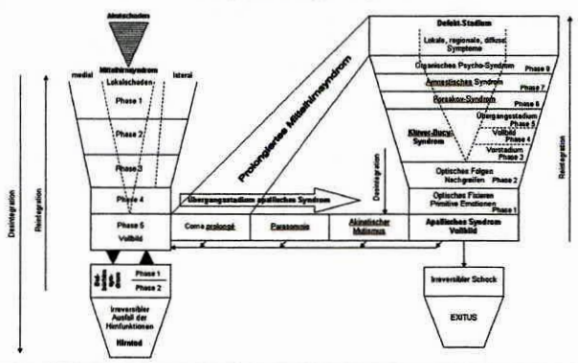

## Restoration of a Coma State after Laureys et al




Acute coma, passing, vegetative state, minimally consciousness state, good recovery

## Apallic Syndrome

Course after acute severe brain damages (traumatic, hypoxic, etc.)
F. Gerstenbrand, 1967, 1977, F. Gerstenbrand, E. Rumpl, 1983




## Partly „Online" Brain Statuses

- Akinetic mutism (Cairns et al, Skultety)
  - Lesion region 3rd ventricle, periaqueductal
- Sopor
- Stupor (Plum, Posner)
  - Lesion intralaminar nucleus thalami
- Hypersomnia (Jefferson)
  - Lesions mesodiencephal
- Parasomnia (Facon et al)
  - Lesion periaqueductal

## Changement in Consciousness

- Akinetic mutism (Cairns et al, Skultety)
  - Disturbance in the initiation of spontaneous and intentional movement
  - Awareness undisturbed
- Sopor
  - Abnormal deep sleep, not awakenable
- Stupor (Plum, Posner)
  - Deep sleep, unresponsiveness, temporarily arousable
- Hypersomnia (Jefferson)
  - Dormancy, continuously, not arousable
- Parasomnia (Facon et al.)
  - Permanent dormancy, awakening on its own after months

## Offline - Online
## Which structures are broken down?

- Cortical network for the different detailed brain functions
- Activation system of the cortical network (ascending reticular system)
- Functioning working system to accept and evaluate incoming stimuli as well as control of outgoing messages
- Access to the archive of memories and ability to add new experiences

## Offline – Online
## „Main Operating System"

- Ascending reticular system
  - Functioning
    - unimpaired
  - Activation with different methods
    - Stimulation with all incoming sensory stimuli
      - Optic and acoustic stimulation, etc.
      - Stimulation of proprioceptive system
    - Medication
- Functional, biochemical, physical activation
  - Operating like a "joy stick"
- "Switches" unknown

***The 42nd International Danube Neurology Symposium*** *(by Professor Vida Demarin)*
***Date:*** 21-23 October, 2010
***Place:*** The Regent Esplanade Hotel, Zagreb, Croatia

***Wednesday, October 20, 2010***

19:00 Opening Ceremony and welcome reception

***Thursday, October 21, 2010***

Main Theme: Stroke
(Convenors: Vida Demarin, Zagreb, Ana Czlonkowska, Warszaw)

| | | |
|---|---|---|
| 09:00 - 09:30 | Ana Czlonkowska: | TIA as an Emergency |
| 09:30 - 10:00 | Natan Bomstein: | Management of Hypertension and Hyperglycemia in Acute Ischemic Stroke |
| 10:00 - 10:30 | Nadežda Sternić: | Diabetes and Stroke |
| 10:30 - 11:00 | Break | |
| 11:00 - 11:30 | Kurt Niederkorn: | Neurosonology in Acute Stroke |
| 11:30 - 12:00 | Vida Demarin: | Recent Concept of Stroke Prevention |
| 12:30 - 13:00 | Dafin Muresanu: | The Impact of Co-morbidities and Neuroprotective Treatments in Stroke Recovery |

13:00 Lunch symposium: Approach to aging brain
(Convenors: Danilo Hodoba, Zagreb, Zvezdan Pirtošek, Ljubljana)

| | | |
|---|---|---|
| 15:00 - 17:00 | Workshop: | Diagnosis of Brain Death |
| 16:00 - 17:00 | Franz Gerstenbrand: | The off-line Brain - is there such a thing? |

| | | |
|---|---|---|
| 15:00 - 17:00 | Teaching course: | Fabry Disease and Enzyme Replacement Therapy in Neurology |

(Convenors: Vida Demarin, Zagreb, Vanja Bašić Kes, Zagreb)

15:00 - 17.00 Society for the Study of Neuroprotection and Neuroplasticity (SSIMIM) Panel
(Convenor: Dafin Muresanu, Cluj)

| | | |
|---|---|---|
| 17:00 - 18:00 | Franz Gerstenbrand: | Modern neurology and the Hippocratic principles |
| 17:00 - 19:00 | Posters | |

***Friday, October 22, 2010***

Main Theme: Movement Disorders - Non-Motor Symptoms in Parkinson's Disease
(Convenors: Maja Relja, Zagreb, Zvezdan Pirtošek, Ljubljana)

| | | |
|---|---|---|
| 09:00 - 09:30 | Werner Poewe: | Continuous dopaminergic stimulation in Parkinson's disease |
| 09:30 - 10:00 | Maja Relja: | Non-motor symptoms in Parkinson's disease |
| 10:00 - 10:30 | Vladimir Kostić: | Depression in Parkinson's disease |
| 10:30 - 11:00 | Break | |
| 11:00 - 11:30 | Zvezdan Pirtošek: | Cognition in Parkinson's disease |
| 11:30 - 12:00 | David Vodušek: | Urogenital symptoms in differential diagnosis of Parkinsonism |

Joint Meeting of Danube Society for Neurological Sciences and Continuing Education with Central and Eastern European Stroke Society (CEESS) and Croatian Stroke Society: Stroke Management

| | | |
|---|---|---|
| 09:00 - 09:30 | Ana Czlonkowska: | Thrombolysis in the Region |
| 09:30 - 10:00 | Ljiljana Bumbaširević: | Stroke Unit - Secondary Prevention Center |
| 10:00 - 10:30 | Vida Demarin: | Carotid Disease |
| 10:30 - 11:00 | Bojana Žvan: | Management of subarachnoidal hemorrhage |
| 11:00 - 11:30 | Osman Sinanović: | Post-stroke aphasia |

09:00 - 17:00 Cochrane European Association Young Neurologists and Trainees (EAYNT) Workshop

15:00 - 17:00 Experimental Pain and Therapy
(Convenors: Claudia Sommer, Wuerzburg, Zdravko Lacković, Zagreb)

| | |
|---|---|
| Claudia Sommer: | Therapy of neuropathic pain |
| Lidia Bach-Rojecky: | Experimental model of pain |
| Zdravko Lacković: | Central effects of botulinum toxin-type A |
| Alfredo Berardelli: | The impact of botulinum toxin treatment on cortical excitability |
| Maja Relja: | Botulinum toxin in migraine treatment |

17:00 - 19:00 Teaching Course: Dystonia: Diagnosis and Treatment

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|---|---|---|
| 17:00 - 18:00 | Franz Gerstenbrand: | Space Neurology and the use of astronaut/cosmonauts equipments in neurorehabilitation |
| 17:00 - 19:00 | Posters | |

***Saturday, October 23, 2010***

Main Theme: Headache and Pain
(Convenors: Laszlo Vecsei, Szeged, Zdravko Lacković, Zagreb)

| | | |
|---|---|---|
| 09:00 - 09:30 | Laszlo Vecsei: | The Role of Kynurenate Derivate in Nociception |
| 09:30 - 10:00 | Zdravko Lacković: | Experimental Model of Migraine |
| 10:30 - 11:00 | Vanja Bašić Kes: | Migraine and Stroke Connection |
| 11:00 - 11:30 | Ivo Lušić: | Central Post-stroke Pain |
| 12:00 | Closing ceremony | |

All participants are most welcome to participate in all social and scientific activities
Deadline for abstract submission: June 1, 2010.
Congress venue: REGENT ESPLANADE HOTEL
Mihanovićeva 1
10000 Zagreb, Croatia
www.regenthotels.com
CONGRESS OFFICIAL TOURIST AGENCY AND TECHNICAL ORGANIZATION
TOP TOURS D.O.O
MESNIČKA 3, 10 000 ZAGREB, Email: top-tours@zg.t-com.hr

All abstracts will be available on CD and via CROSBI, editor Vida Demarin.

# ZAGREB 2010


42nd DANUBE SYMPOSIUM FOR NEUROLOGICAL SCIENCE AND CONTINUING EDUCATION
**WITH A FULL-DAY COCHRANE-EAYNT WORKSHOP IN EVIDENCE-BASED NEUROLOGY**

## 20. - 23.10.2010

5th CONGRESS OF THE CROATIAN SOCIETY FOR NEUROVASCULAR DISORDERS OF THE CROATIAN MEDICAL ASSOCIATION AND THE CROATIAN STROKE SOCIETY

10th CONGRESS OF EUROPEAN SOCIETY FOR CLINICAL NEUROPHARMACOLOGY

JOINT MEETING OF CENTRAL EASTERN EUROPEAN STROKE SOCIETY

Gerstenbrand, Franz ; Binder, Heinrich; Golaszewski, Stefan;
THE OFF-LINE BRAIN - IS THERE SUCH A THING? // *Abstracts: The 42nd International Danube Neurology Symposium October 21 - 23, 2010, Zagreb CD* / Vida Demarin (ur.).
Zagreb, 2010. str. CD-CD (plenarno, nije recenziran, sažetak, znanstveni)

**Naslov**
THE OFF-LINE BRAIN - IS THERE SUCH A THING?

Title

**Autori**
Gerstenbrand, Franz ; Binder, Heinrich; Golaszewski, Stefan;

Autors

**Vrsta, podvrsta i kategorija rada**
Sažeci sa skupova, sažetak, znanstveni

Type, subspecies and category of work
Summary of meetings, abstracts, scientific

**Izvornik**
Abstracts: The 42nd International Danube Neurology Symposium October 21 - 23, 2010, Zagreb CD / Vida Demarin - Zagreb, 2010, CD-CD

Original

**Skup**
The 42nd International Danube Neurology Symposium October 21 - 23, 2010, Zagreb

Event

**Mjesto i datum**
Zagreb, Hrvatska, 21.-23. listopada 2010

Location and date

**Vrsta sudjelovanja**
Plenarno

Kind of participation
Plenary

**Vrsta recenzije**
Nije recenziran

Type of review
No review

**Ključne riječi**
coma vigile; apallic syndrome/vegetative state; brain death syndrome; locked-in syndrome;

Keywords
coma vigile; apallic syndrome/vegetative state; brain death syndrome; locked-in syndrome;

**Sažetak**

Abstract

Coma vigile is a special form of coma, the leading symtom of the apallic syndrome/vegetative state. The patient is conscious, but without higher and highest brain functions and shows more or less uniform neurological symptoms.