Sleep
and
sleep disorders

Prof. Zoran Đogaš, MD, PhD

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President of the Croatian Sleep Research Society
Past Member of the Executive Committee of the European Assembly of National Sleep Societies

SLEEP

- The complex neurobiology of the behavioral features of sleep has been explored for more then 40 years at
  - molecular,
  - cellular, and
  - systemic levels.

- Sleep Medicine is a “new discipline”
- Sleep diseases are “new diseases”

SLEEP

- **Although numerous studies provided substantial insight into physiology and pathology of sleep,**

  many unanswered questions remain about this behavioral state that consumes approximately

  one third of our lives.

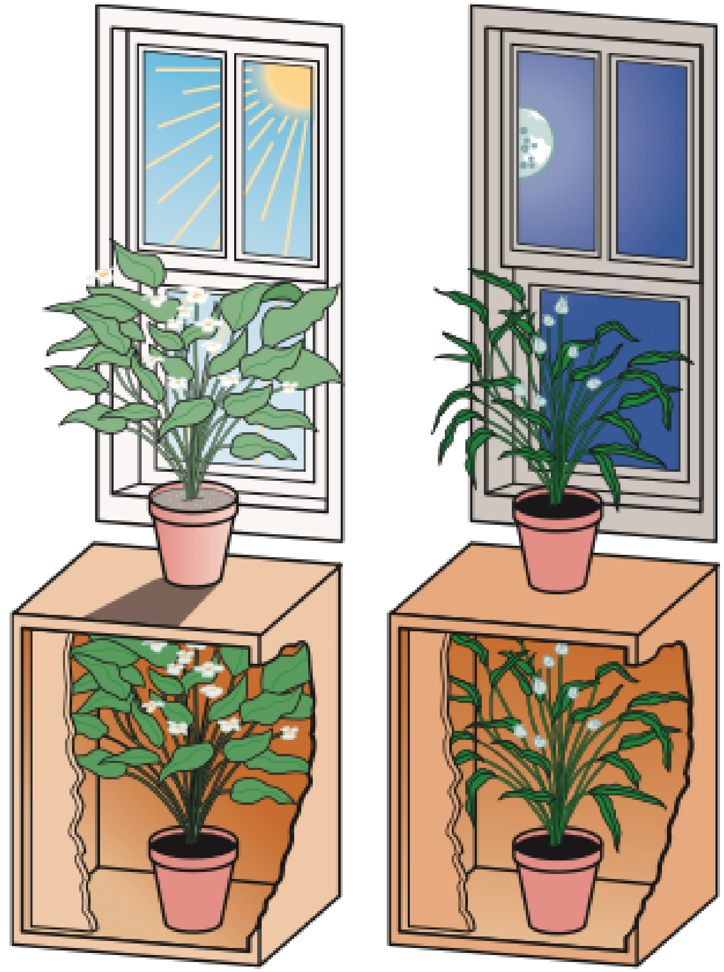


Figure 1-2 Representation of de Mairan's original experiment. When exposed to sunlight during the day (upper left), the leaves of the plant were open; during the night (upper right), the leaves were folded. De Mairan showed that sunlight was not necessary for these leaf movements by placing the plant in total darkness. Even under these constant conditions, the leaves opened during the day (lower left) and folded during the night (lower right). (Redrawn from Moore-Ede MC, Sulzman FM, Fuller CA. The clocks that time us: physiology of the circadian timing system. Cambridge, Mass: Harvard University Press; 1982. p. 7.)

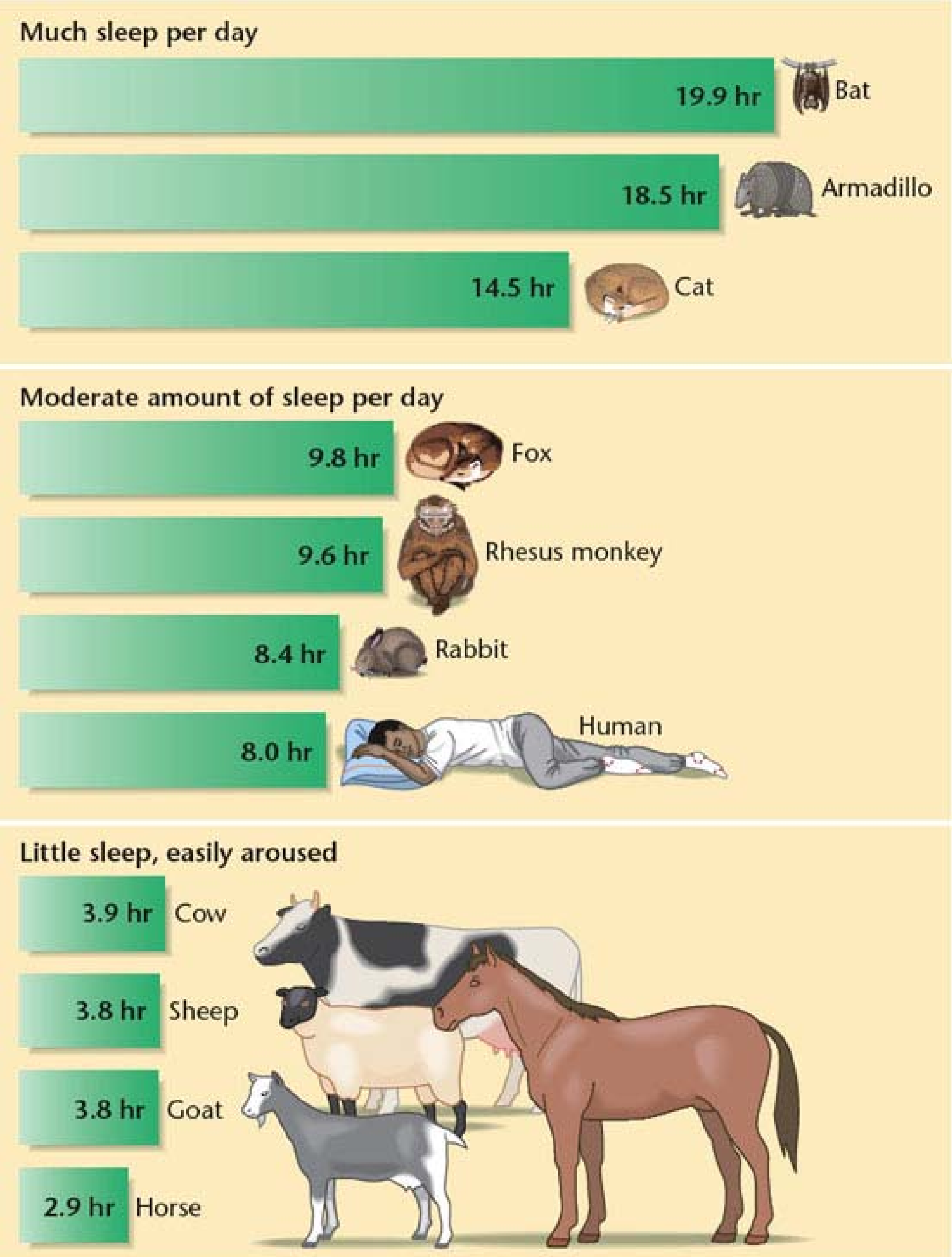

Much sleep per day
19.9 hr
Bat
18.5 hr
Armadillo
14.5 hr
Cat
Moderate amount of sleep per day
9.8 hr
Fox
9.6 hr
Rhesus monkey
8.4 hr
Rabbit
8.0 hr
Human
Little sleep, easily aroused
3.9 hr
Cow
3.8 hr
Sheep
3.8 hr
Goat
2.9 hr
Horse

Fig. 9-17, p. 287

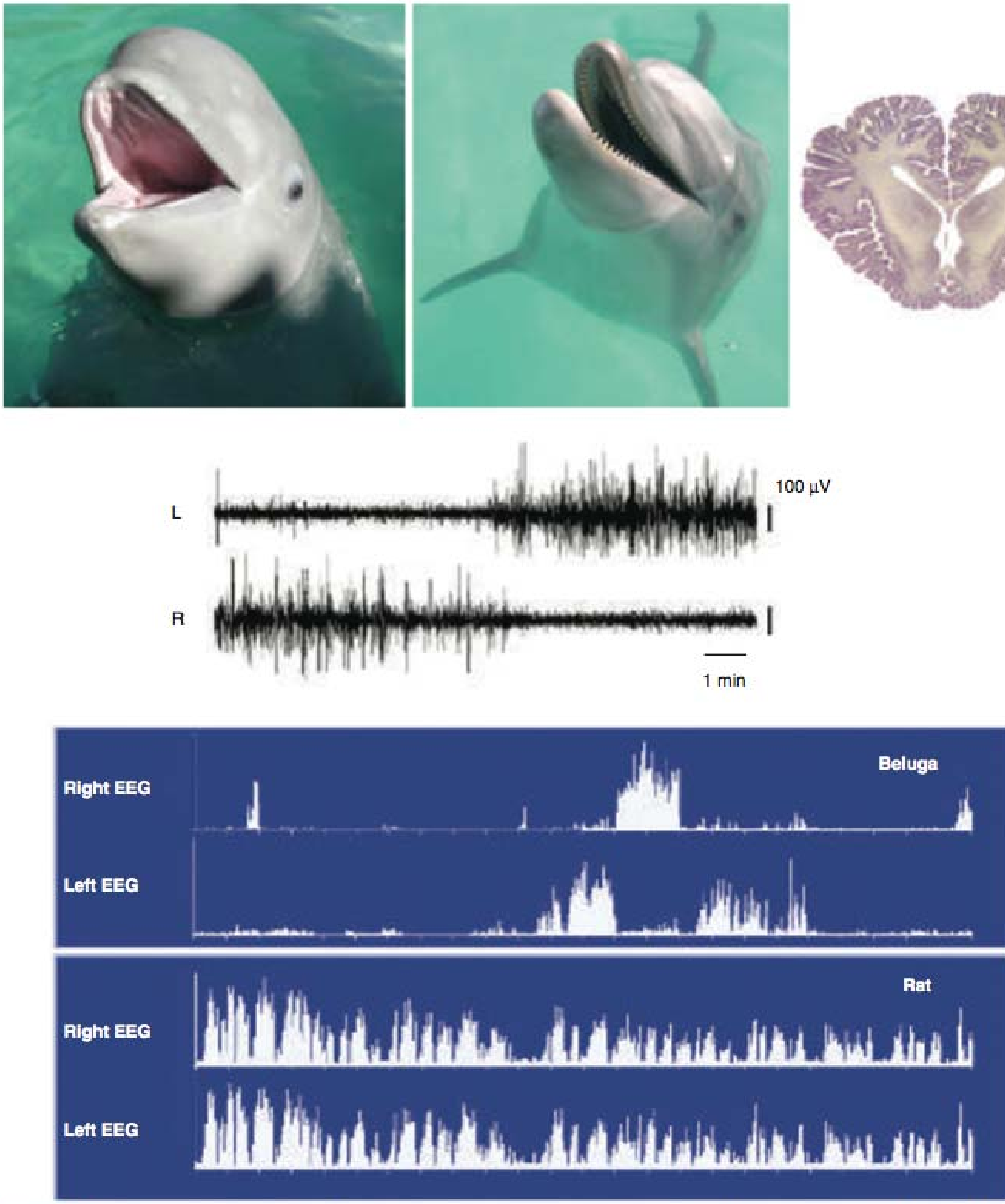
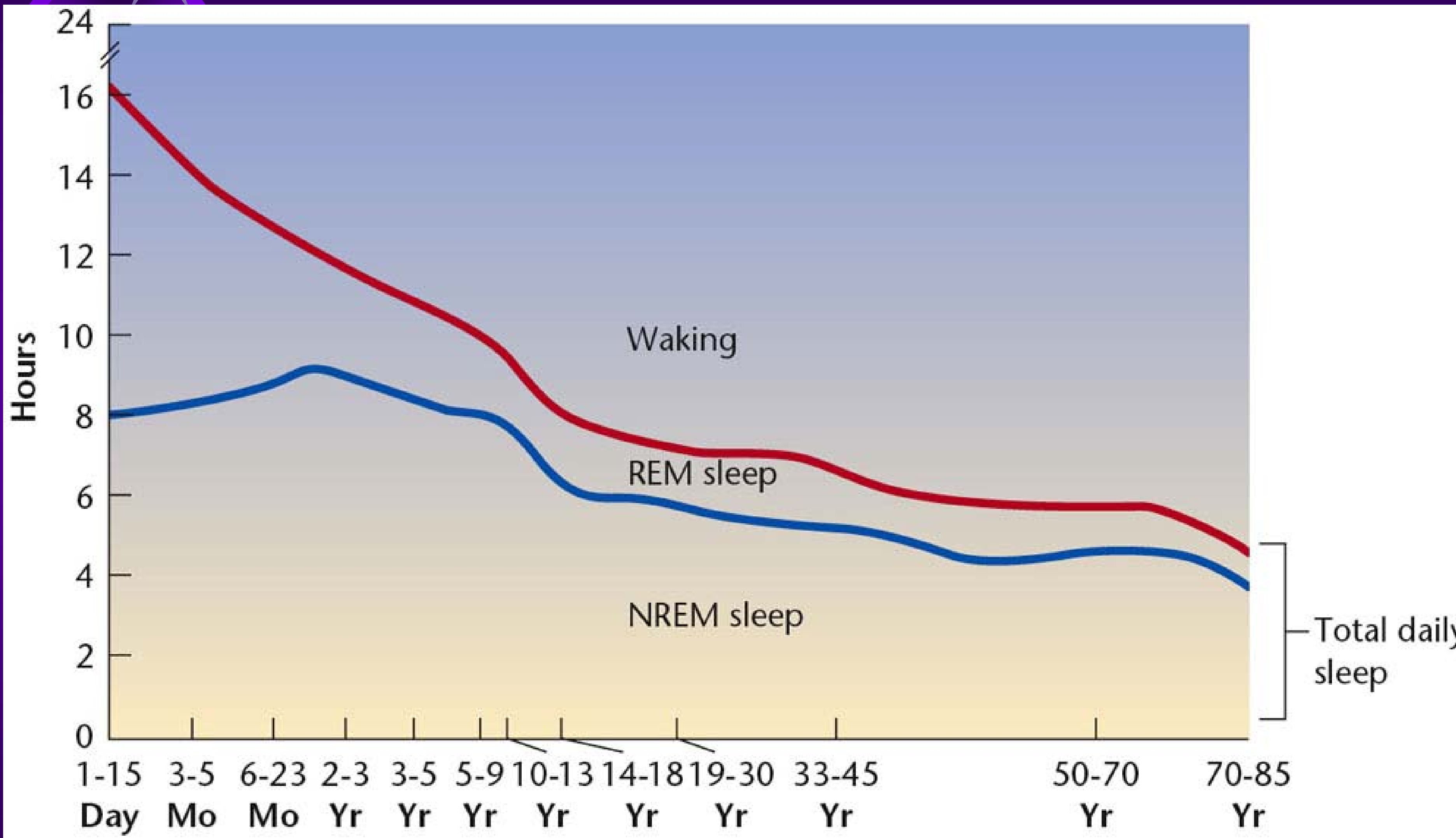


Figure 10-6 Cetacean sleep, unihemispheric slow waves in cetaceans. *Top*, photos of immature beluga, adult dolphin and section of adult dolphin brain. Electroencephalogram (EEG) of adult cetaceans, represented here by the beluga, during sleep are shown. All species of cetacean so far recorded have unihemispheric slow waves. *Top traces* show left and right EEG activity. The spectral plots show 1- to 3-Hz power in the two hemispheres over a 12-hour period. The pattern in the cetaceans contrasts with the bilateral pattern of slow waves seen under normal conditions in all terrestrial mammals, represented here by the rat (*bottom traces*). (From Siegel JM. Clues to the function of mammalian sleep [review]. Nature 2005;437:1264-1271.)



Hours
24
16
14
12
10
8
6
4
2
0
Waking
REM sleep
NREM sleep
Total daily sleep
1-15 Day
3-5 Mo
6-23 Mo
2-3 Yr
3-5 Yr
5-9 Yr
10-13 Yr
14-18 Yr
19-30 Yr
33-45 Yr
50-70 Yr
70-85 Yr

Fig. 9-18, p. 289

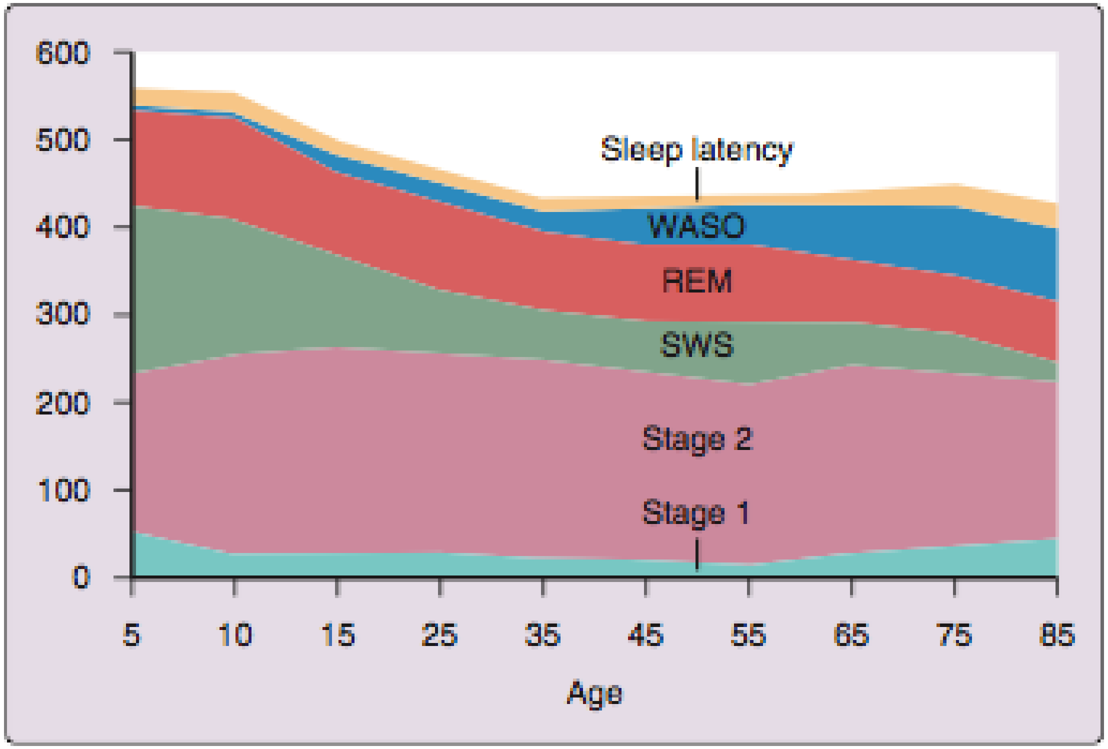
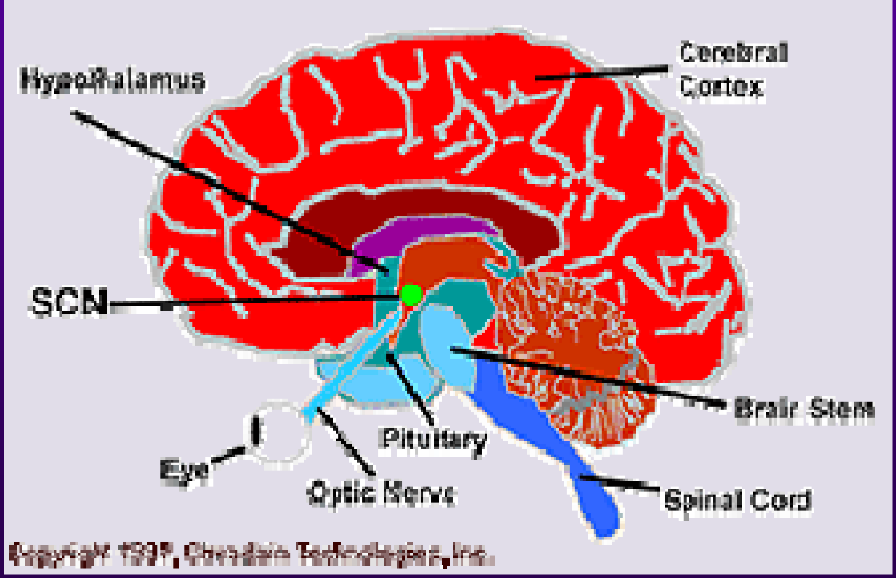


Figure 2-8 Changes in sleep with age. Time (in minutes) for sleep latency and wake time after sleep onset (WASO) and for rapid eye movement (REM) sleep and non-REM (NREM) sleep stages 1, 2, and slow wave sleep (SWS). Summary values are given for ages 5 to 85 years. (Ohayon M, Carskadon MA, Guilleminault C, et al. Meta-analysis of quantitative sleep parameters from childhood to old age in healthy individuals: developing normative sleep values across the human lifespan. Sleep 2004;27:1255-1273.)

The role of Endogenous pacemakers & Exogenous Zeitgebers

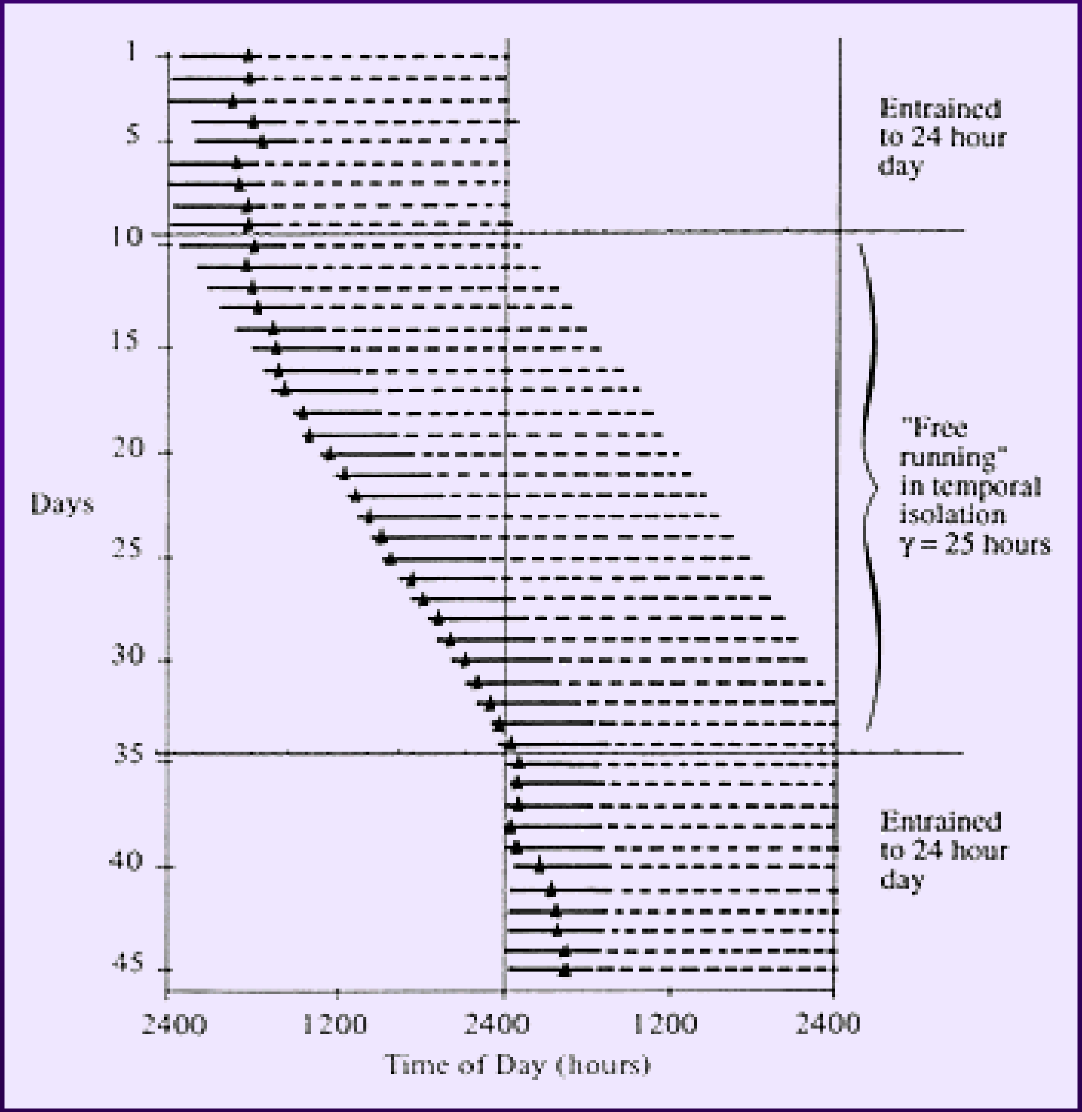
- The main pacemaker for endogenous (internal) rhythms is the **supracheasmatic nucleus** (SCN). This is a small group of cells located in the area of the brain called the **hypothalamus.** Its called the SCN because it lies just above the **optic chiasm**, therefore it can receive information directly from the eye and the rhythm can be rest by the amount of light entering the eye.



Rhythms of Waking and Sleep

- Experiments designed to determine the length of the circadian rhythm place subjects in environments with no cues to time of day.
- Human circadian clock generates a rhythm slightly longer than 24 hours when it has no external cue to set it.

- Human studies:
- 24.5-25 hours rhythms
- "free run"



Rhythms of Waking and Sleep

- Most people can adjust to 23- or 25- hour day but not to a 22- or 28- hour day.

- Bright light late in the day can lengthen the circadian rhythm.

Rhythms of Waking and Sleep

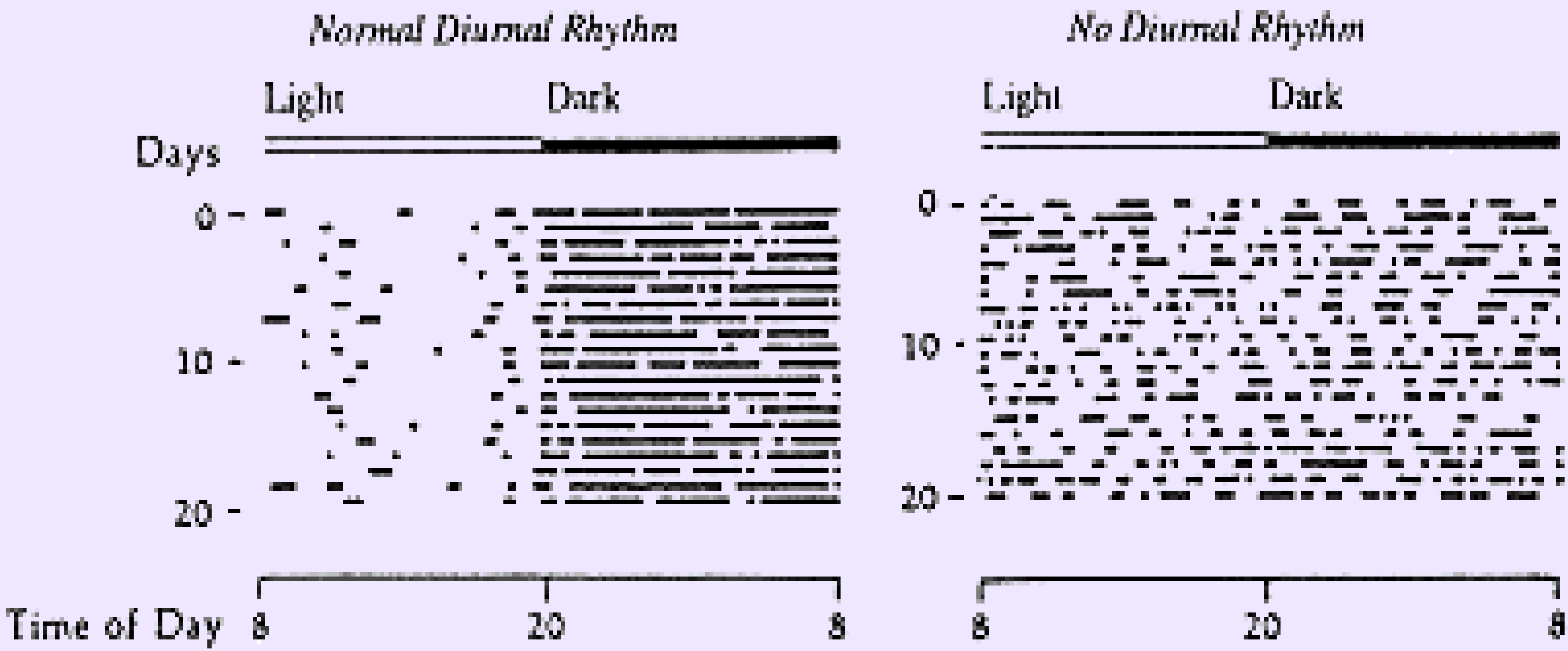
- Mechanisms of the circadian rhythms include the following:
  - The Suprachiasmatic nucleus.
  - Genes that produce certain proteins.
  - Melatonin levels.

Rhythms of Waking and Sleep

- The suprachiasmatic nucleus (SCN) in the brain is a part of the hypothalamus and the main control center of the circadian rhythms of sleep and temperature.

Damage to the SCN results in less consistent body rhythms that are no longer synchronized to environmental patterns of light and dark.

- In mammals, destroying the SCN will not destroy the wake-sleep transition, but will disrupt the normal ~24-hour rhythm



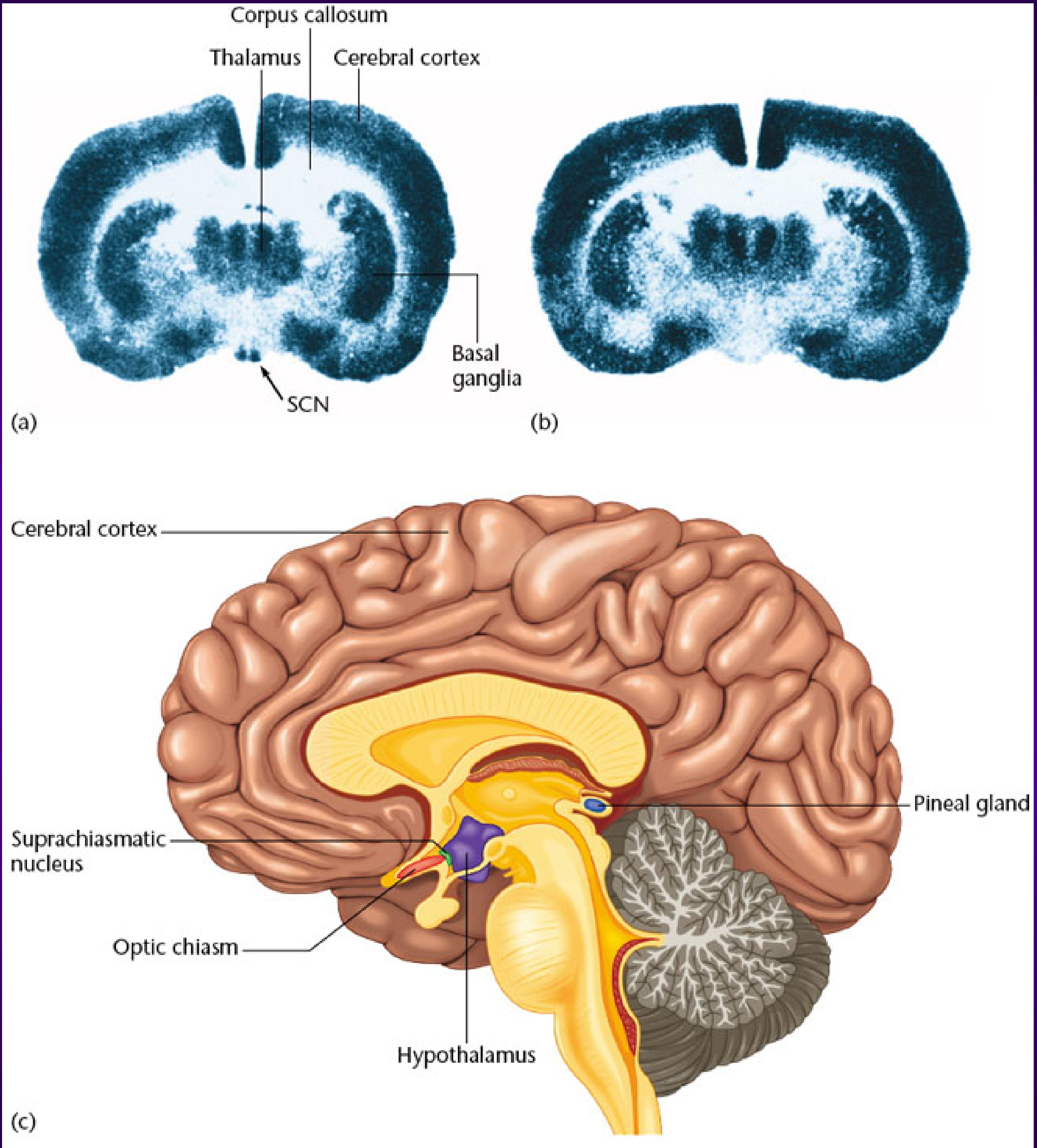

Corpus callosum
Thalamus
Cerebral cortex
Basal ganglia
SCN
(a)
(b)
Cerebral cortex
Pineal gland
Suprachiasmatic nucleus
Optic chiasm
Hypothalamus
(c)

Fig. 9-4, p. 269

Rhythms of Waking and Sleep

- Two types of genes are responsible for generating the circadian rhythm.
  1. Period - produce proteins called Per.
  2. Timeless - produce proteins called Tim.
- Per and Tim proteins increase the activity of certain kinds of neurons in the SCN that regulate sleep and waking.
- Mutations in the Per gene result in odd circadian rhythms.

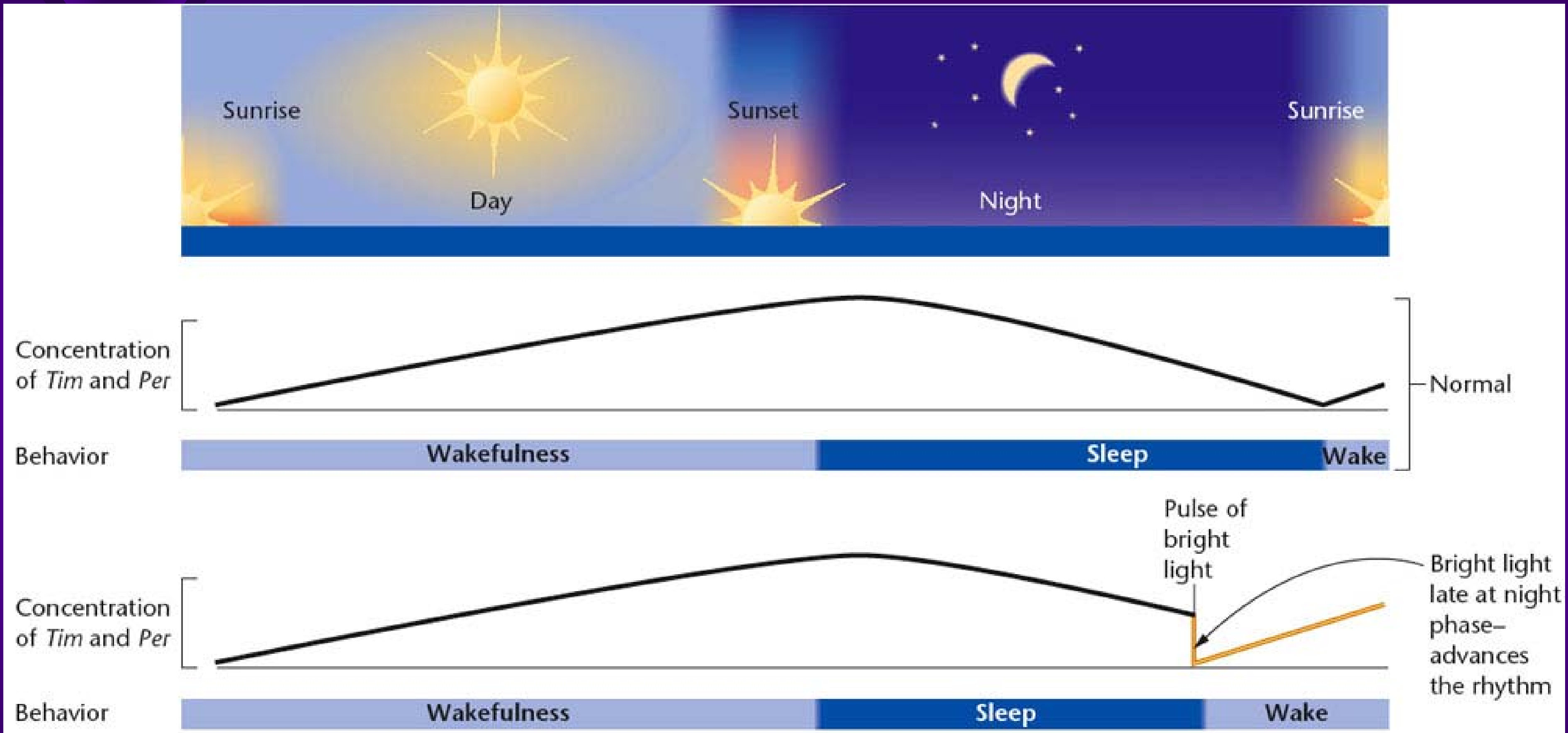

Sunrise
Sunset
Sunrise
Day
Night
Concentration of *Tim* and *Per*
Normal
Behavior
Wakefulness
Sleep
Wake
Pulse of bright light
Bright light late at night phase–advances the rhythm
Concentration of *Tim* and *Per*
Behavior
Wakefulness
Sleep
Wake

Fig. 9-5, p. 270

Rhythms of Waking and Sleep

- The SCN regulates waking and sleeping by controlling activity levels in other areas of the brain.
- The SCN regulates the pineal gland, an endocrine gland located posterior to the thalamus.
- The pineal gland secretes melatonin, a hormone that increases sleepiness.

Rhythms of Waking and Sleep

- Melatonin secretion usually begins 2 to 3 hours before bedtime.
- Melatonin resets the biological clock.
- Melatonin taken in the afternoon can phase-advance the internal clock and can be used as a sleep aid.

Rhythms of Waking and Sleep

- Jet lag refers to the disruption of the circadian rhythms due to crossing time zones.

- Characterized by sleepiness during the day, sleeplessness at night, and impaired concentration.
- Traveling west "phase-delays" our circadian rhythms.
- Traveling east "phase-advances" our circadian rhythms.

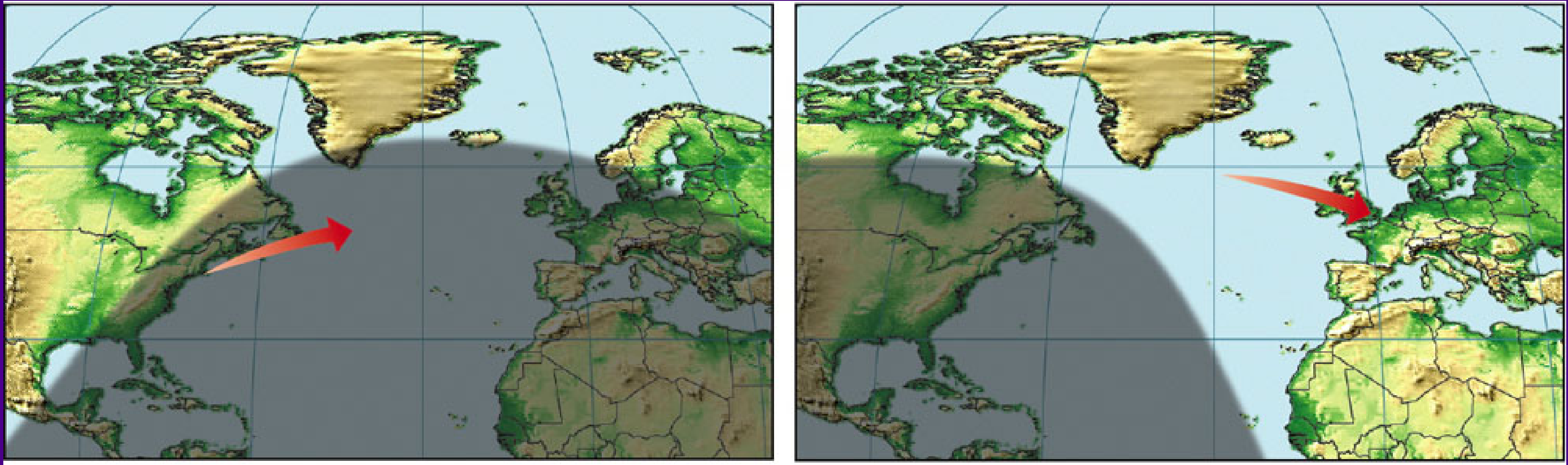
Jet Lag….The Facts.

Jet Lag only occurs when flying from East-West or from West to East.
in other words when we change time zones.

Jet Lag does not occur form North-South and vice versa!!

<u>Example</u>

You fly from Split, Croatia to New York, USA. You leave at 11 am and arrive at 5 pm. In Croatian time actually it is 11 pm. In NY...by 8 pm US Eastern time you'll be tired as it is 2 am to you normally!



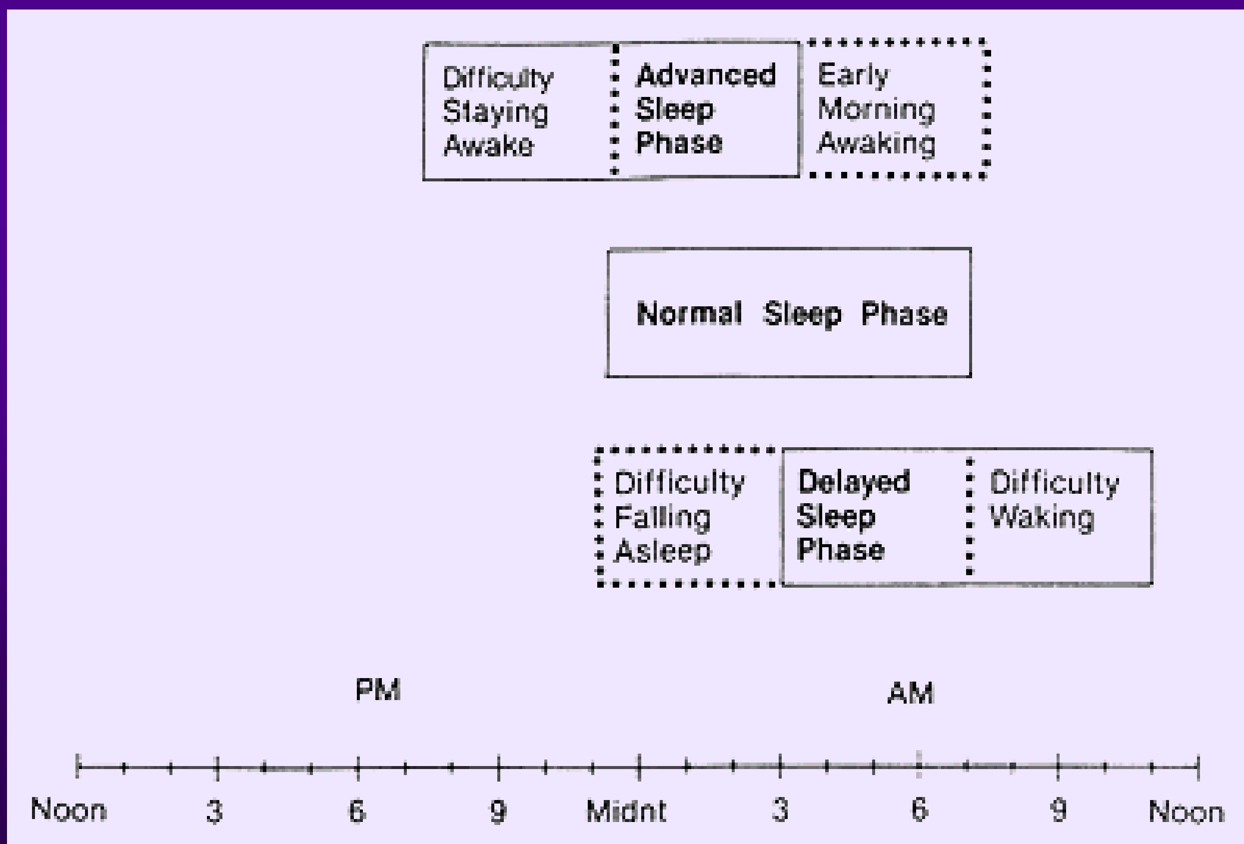
(a) Leave New York at 7 PM

(b) Arrive in London at 7 AM, which is 2 AM in New York

Fig. 9-6, p. 272

Disorders of "timing" of biological clock

- Advanced and Delayed Sleep Phase Syndrome (ASPS and DSPS)

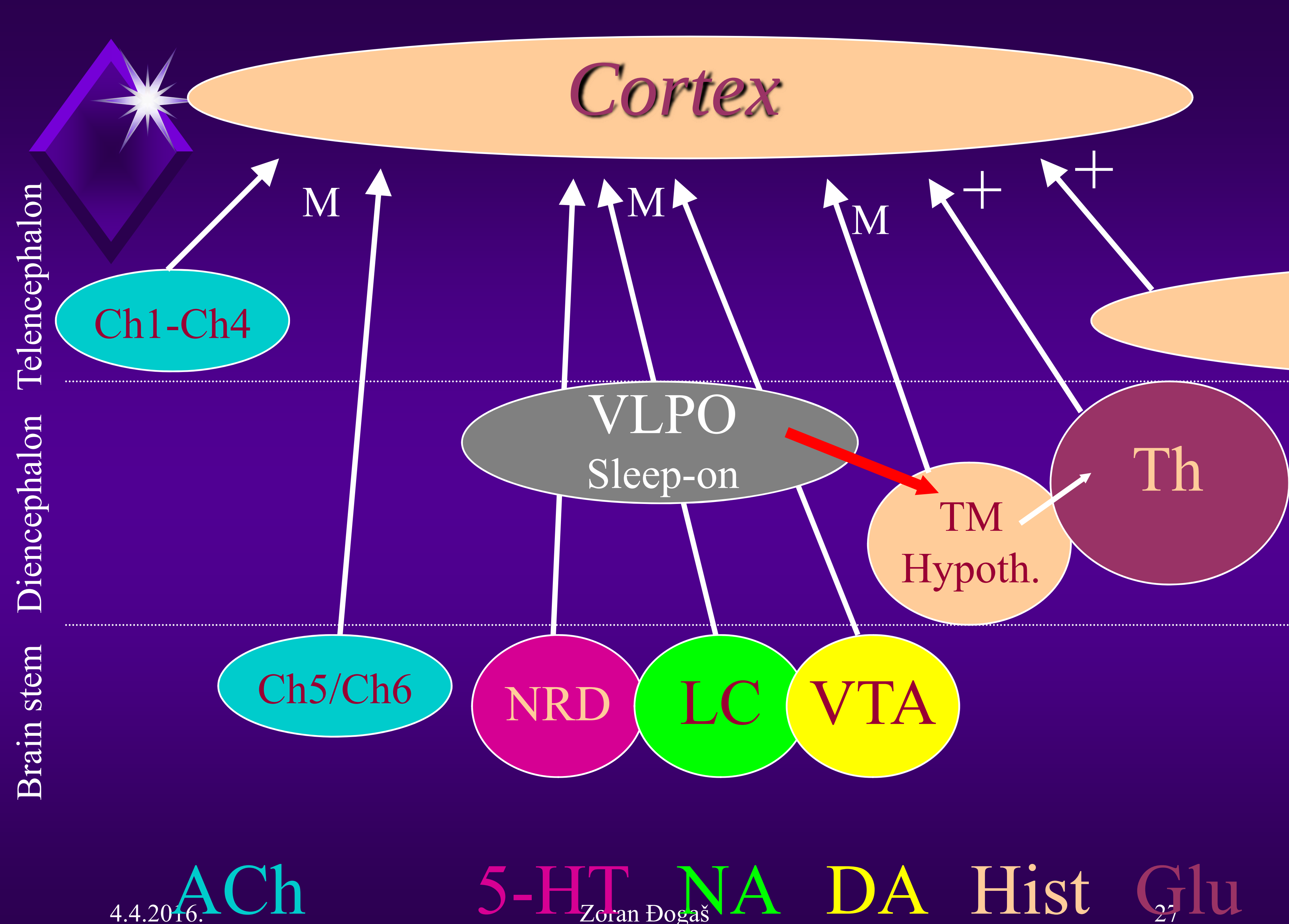


Origin of sleep

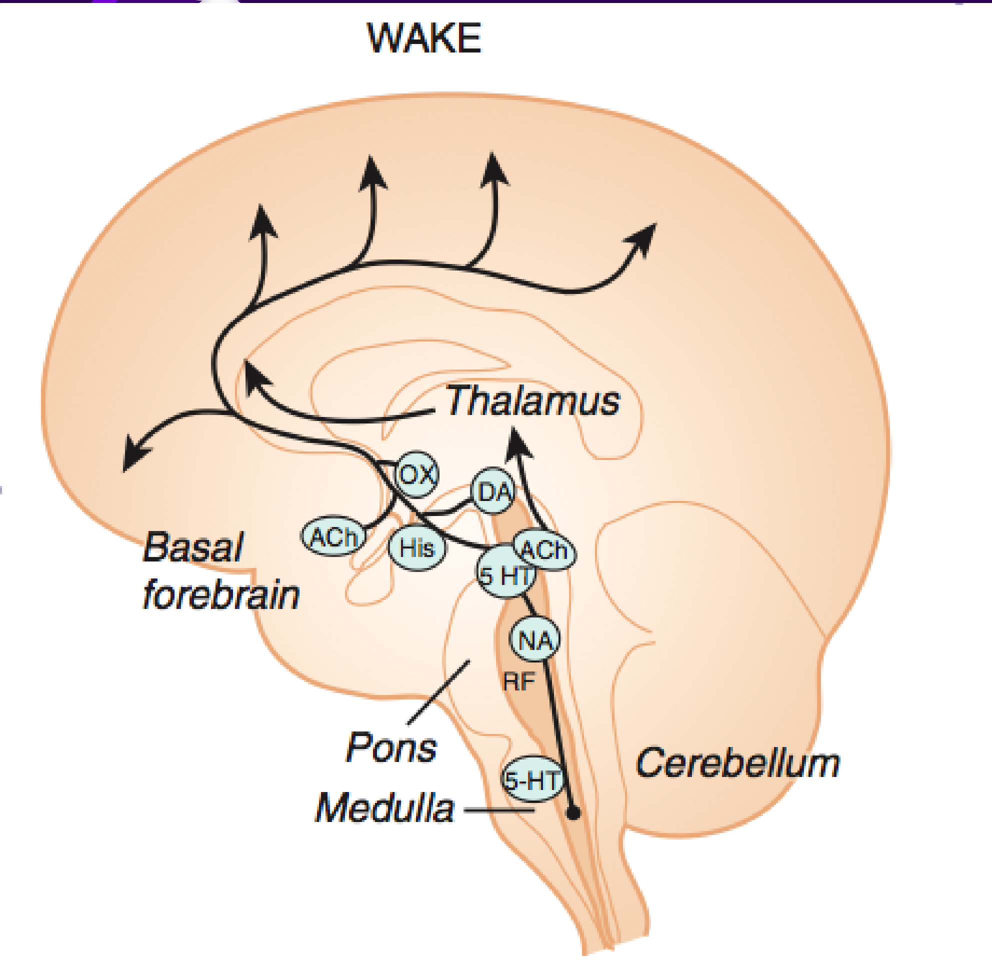
- **Identifying a “sleep substance”**
- **It is likely that many factors contribute to the homeostatic regulation of sleep**
- **Posterior hypothalamic lesions produced prolonged sleeplike state**
- **Lesions of the preoptic area in anterior hypothalamus markedly suppressed sleep**
- **This implies that the sleep center may be located in the hypothalamus.**

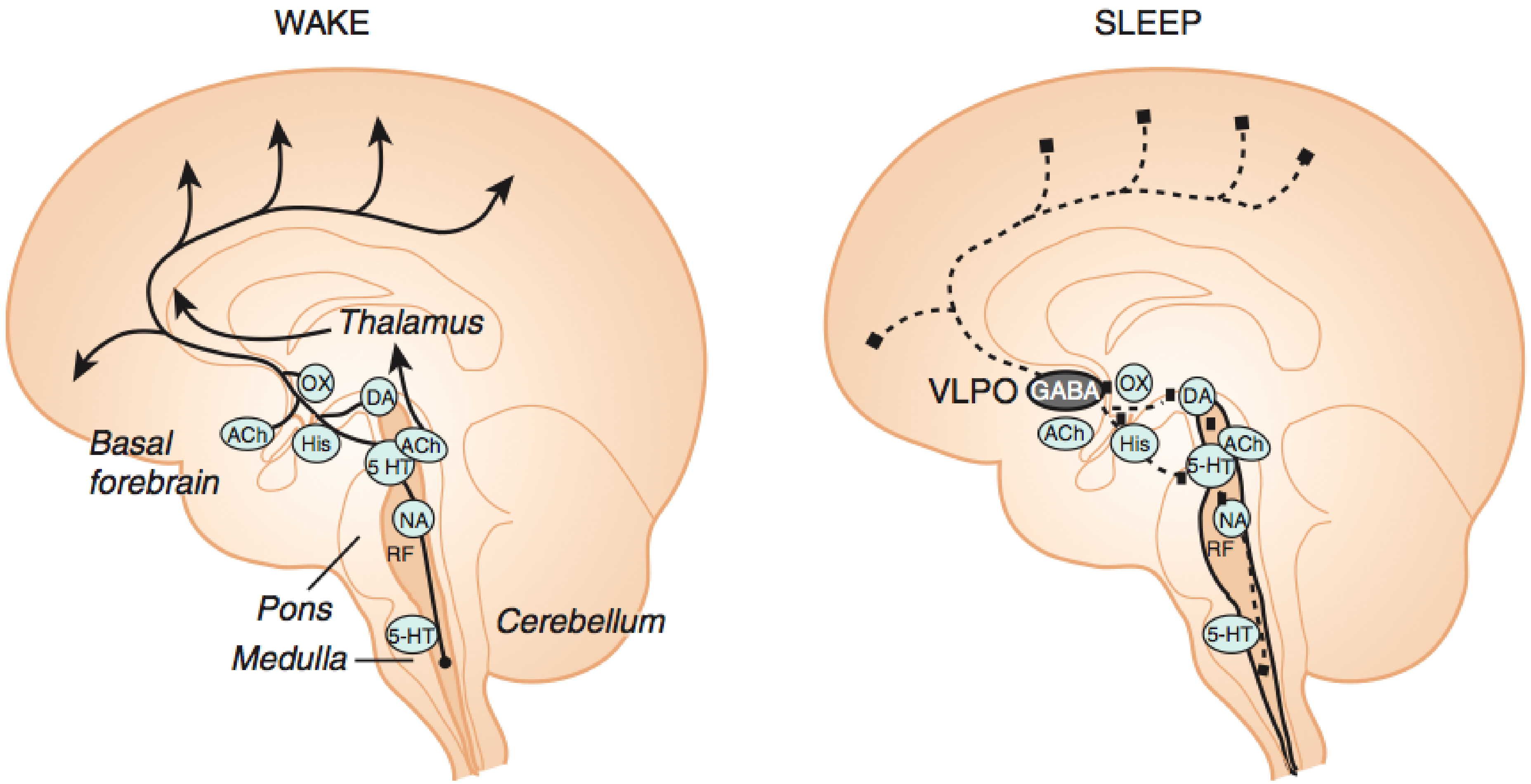
Origin of sleep

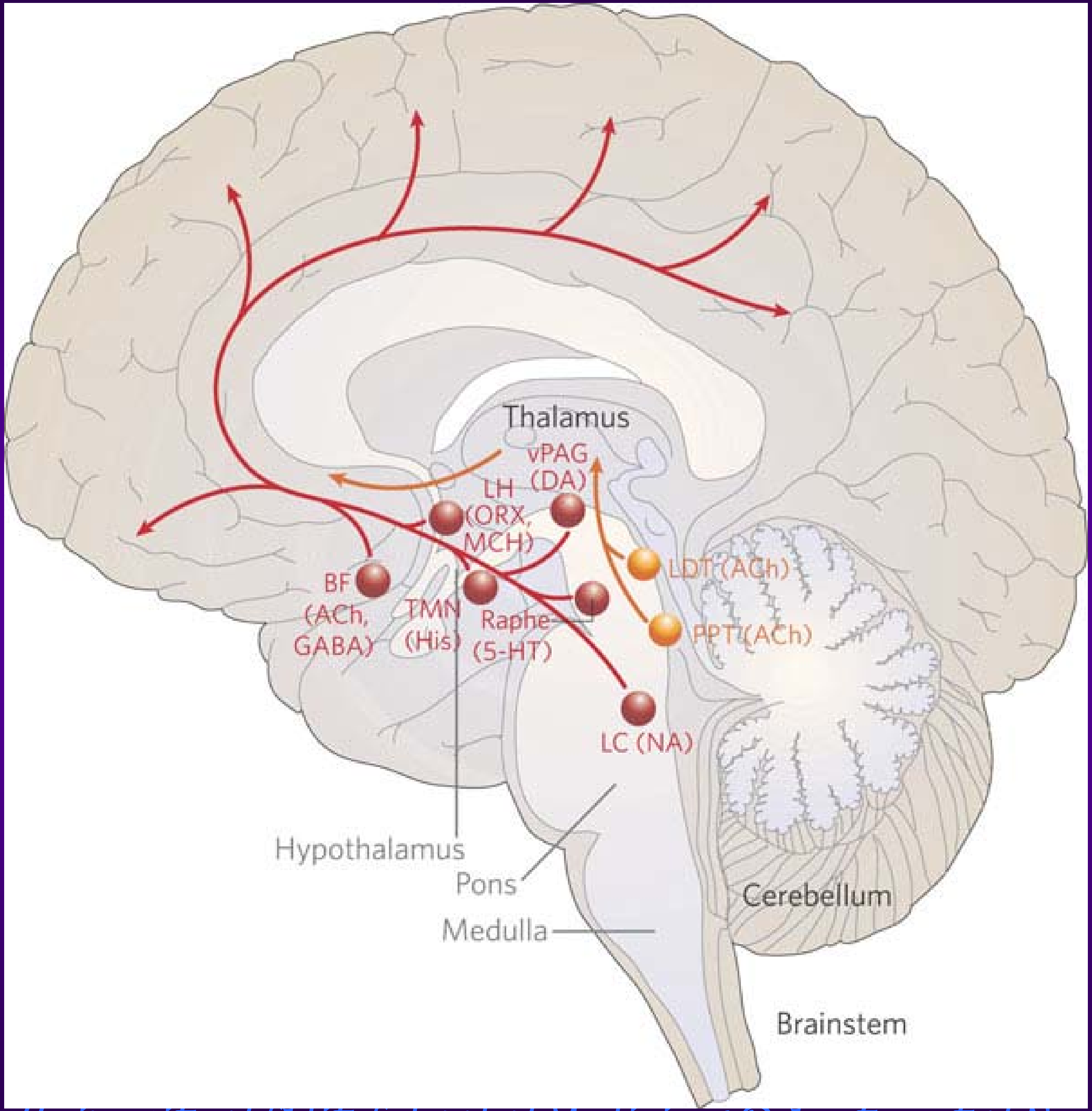
- GABA from the ventrolateral preoptic area (**VLPO**) of the hypothalamus may inhibit histaminergic activation of the thalamus and cerebral cortex by TMN.
- Such a mechanism would allow complex thalamocortical interactions that may result in NREM sleep.

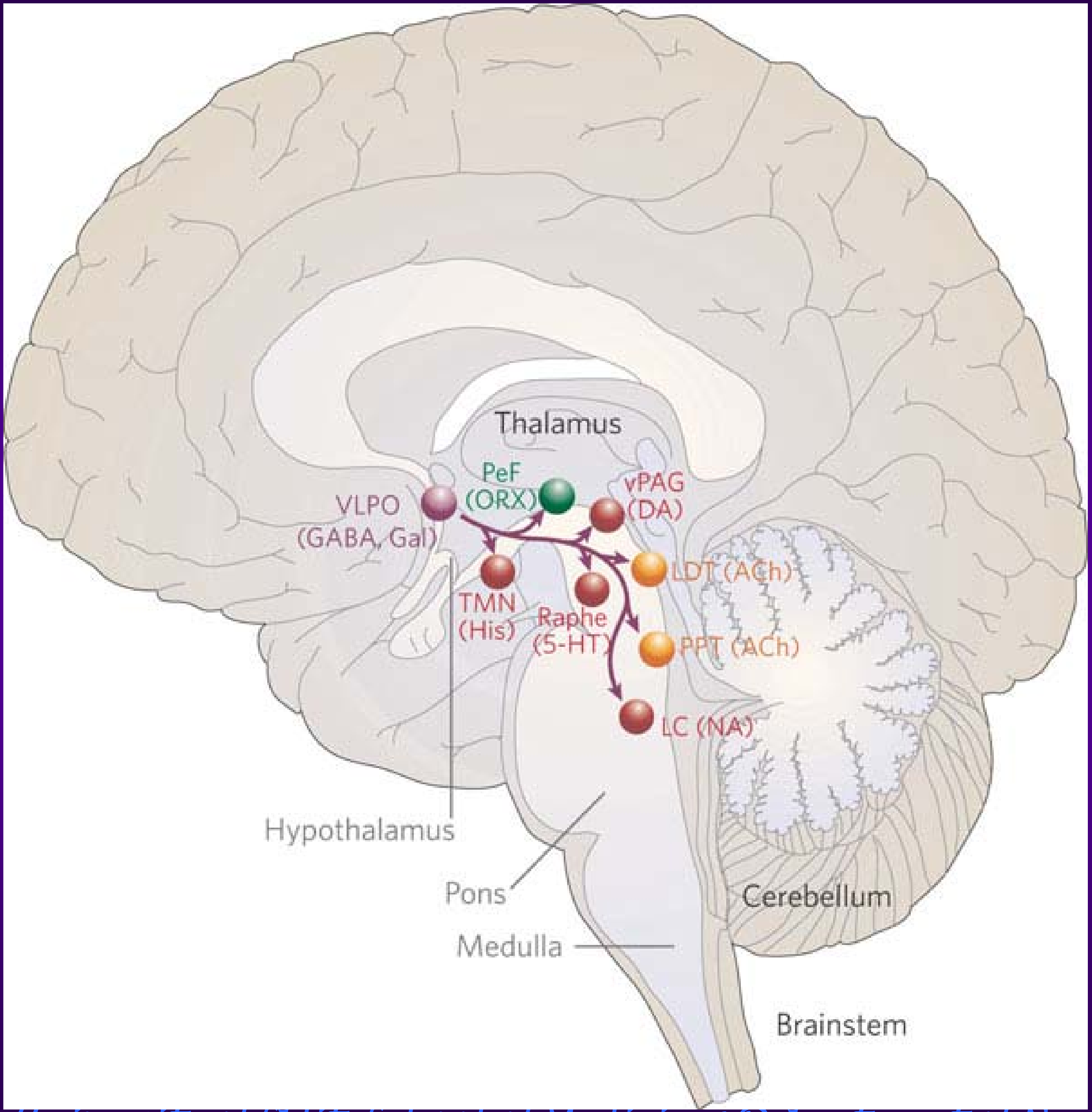

Cortex
Telencephalon
Diencephalon
Brain stem
Ch1-Ch4
M
M
M
+
+
VLPO
Sleep-on
TM
Hypoth.
Th
Ch5/Ch6
NRD
LC
VTA
ACh
5-HT
NA
DA
Hist
Glu

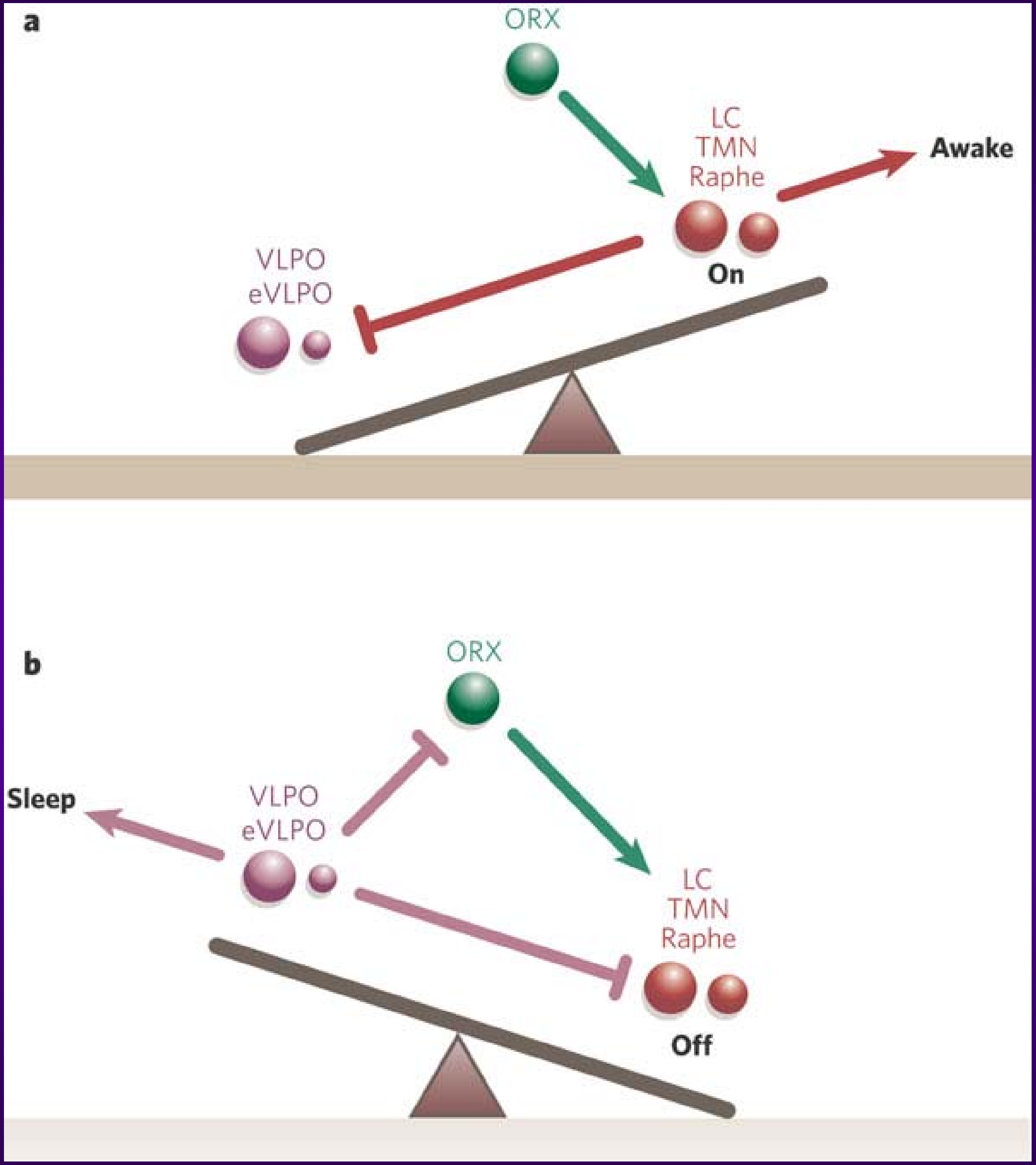
Neural control of sleep?


WAKE
Thalamus
OX
DA
ACh
His
ACh
5 HT
Basal forebrain
NA
RF
Pons
Cerebellum
5-HT
Medulla

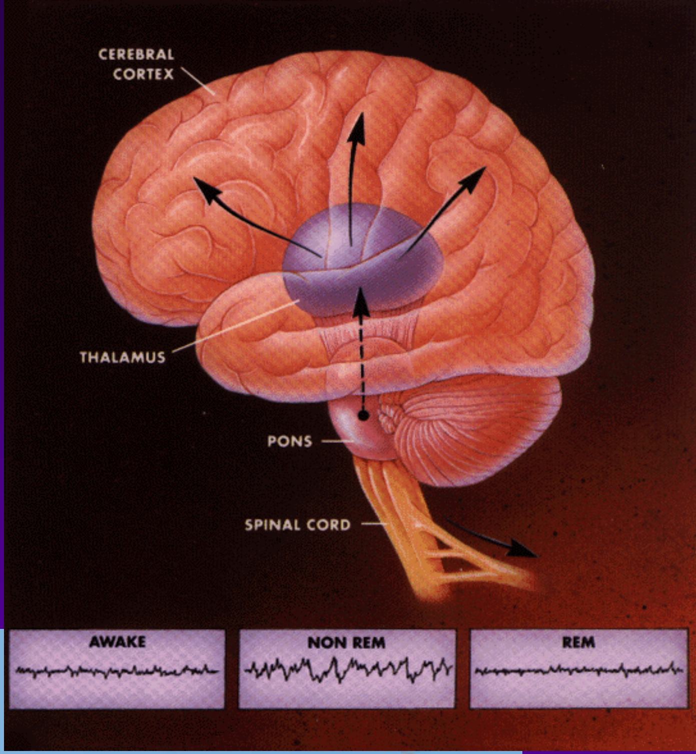

WAKE
SLEEP
Thalamus
OX
DA
ACh
His
ACh
5 HT
NA
RF
Basal forebrain
Pons
Medulla
5-HT
Cerebellum
VLPO
GABA
OX
DA
ACh
His
ACh
5-HT
NA
RF
5-HT

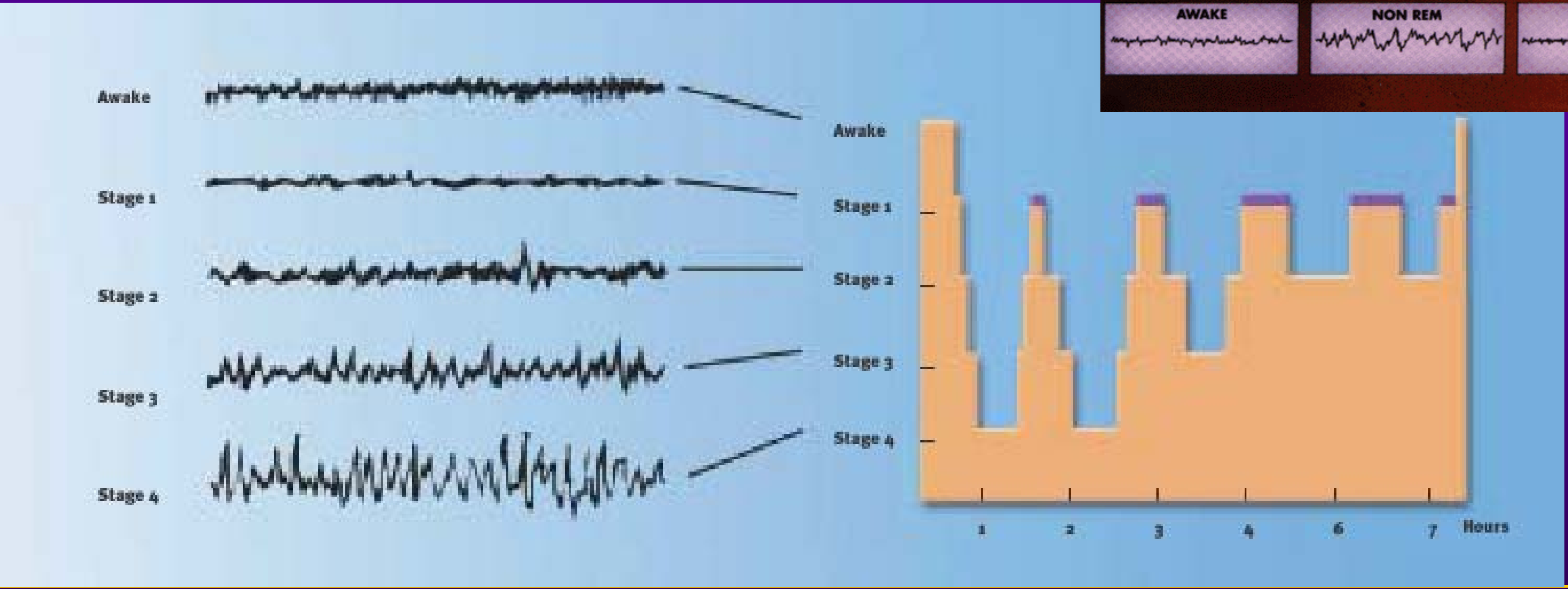

Thalamus
vPAG
(DA)
LH
(ORX,
MCH)
LDT (ACh)
BF
(ACh,
GABA)
TMN
(His)
Raphe
(5-HT)
PPT (ACh)
LC (NA)
Hypothalamus
Pons
Cerebellum
Medulla
Brainstem


Thalamus
PeF
(ORX)
vPAG
(DA)
VLPO
(GABA, Gal)
LDT (ACh)
TMN
(His)
Raphe
(5-HT)
PPT (ACh)
LC (NA)
Hypothalamus
Pons
Cerebellum
Medulla
Brainstem


a
ORX
LC
TMN
Raphe
Awake
VLPO
eVLPO
On
b
ORX
Sleep
VLPO
eVLPO
LC
TMN
Raphe
Off

Sleep stages





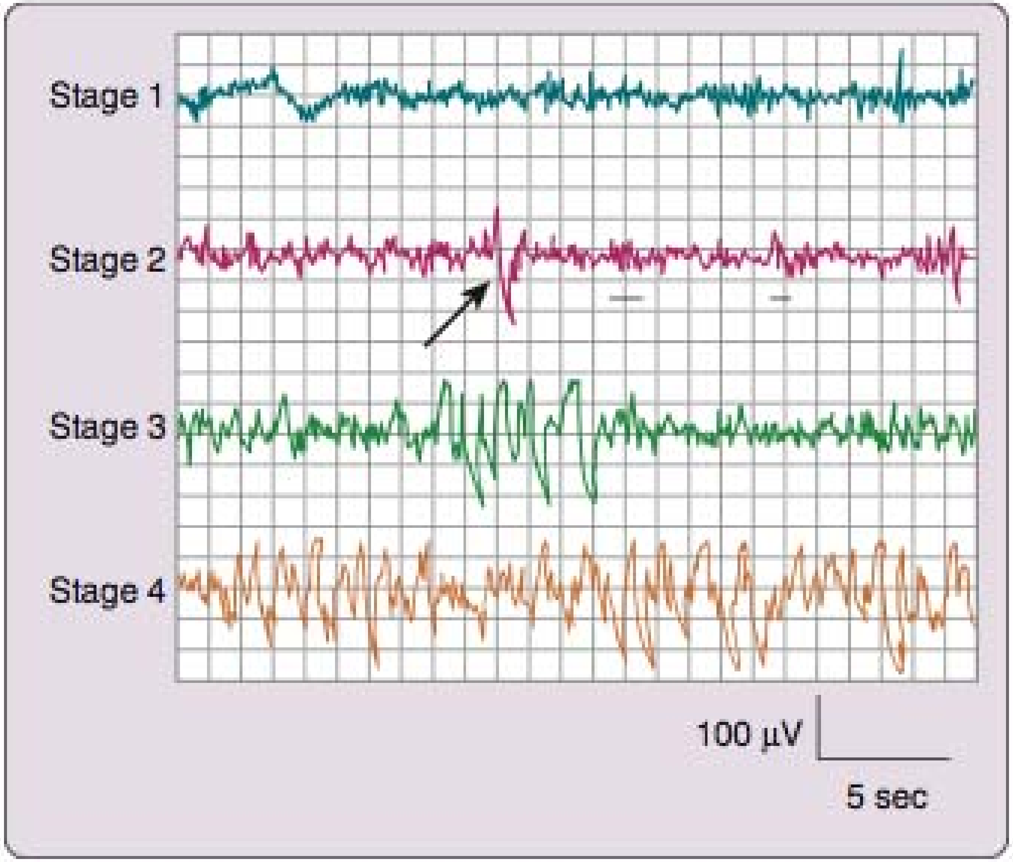
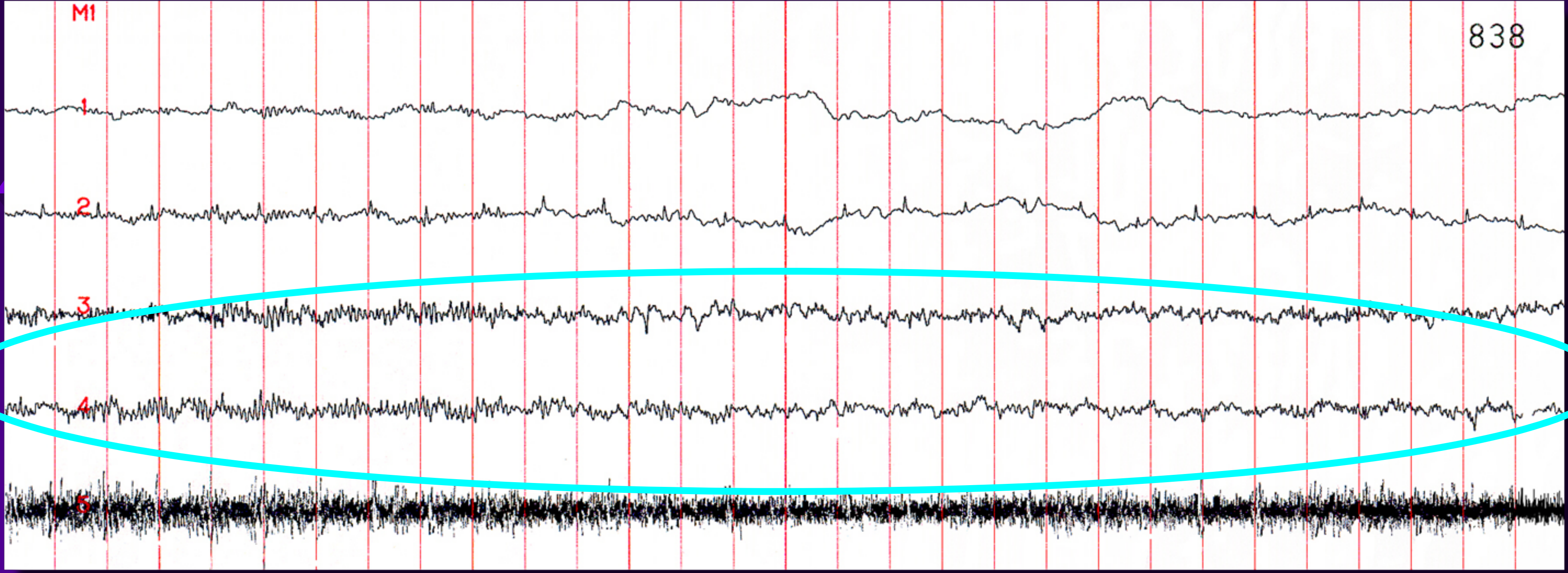
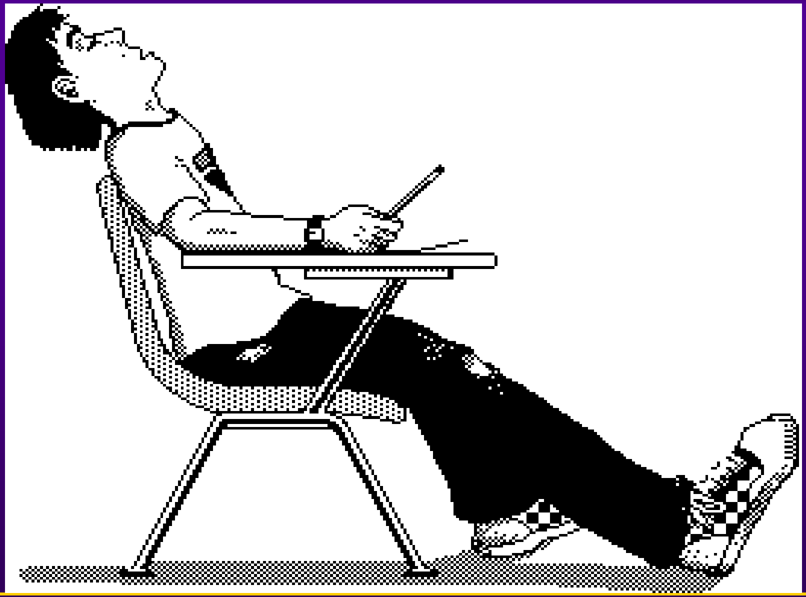
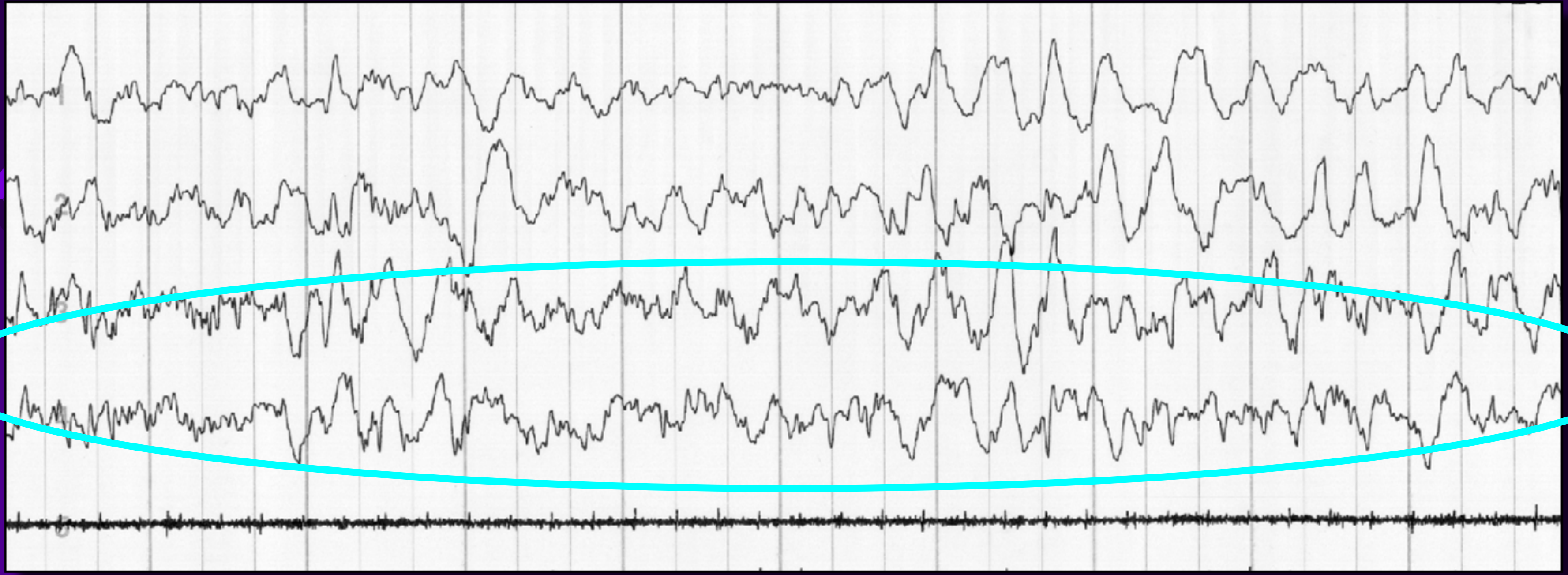


Figure 2-1 The stages of non–rapid eye movement sleep. The four electroencephalogram tracings depicted here are from a 19-year-old female volunteer. Each tracing was recorded from a referential lead (C3/A2) recorded on a Grass Instruments Co. (West Warwick, R.I.) Model 7D polygraph with a paper speed of 10 mm/sec, time constant of 0.3 sec, and ½ -amplitude high-frequency setting of 30 Hz. On the second tracing, the *arrow* indicates a K-complex and the *underlining* shows two sleep spindles.

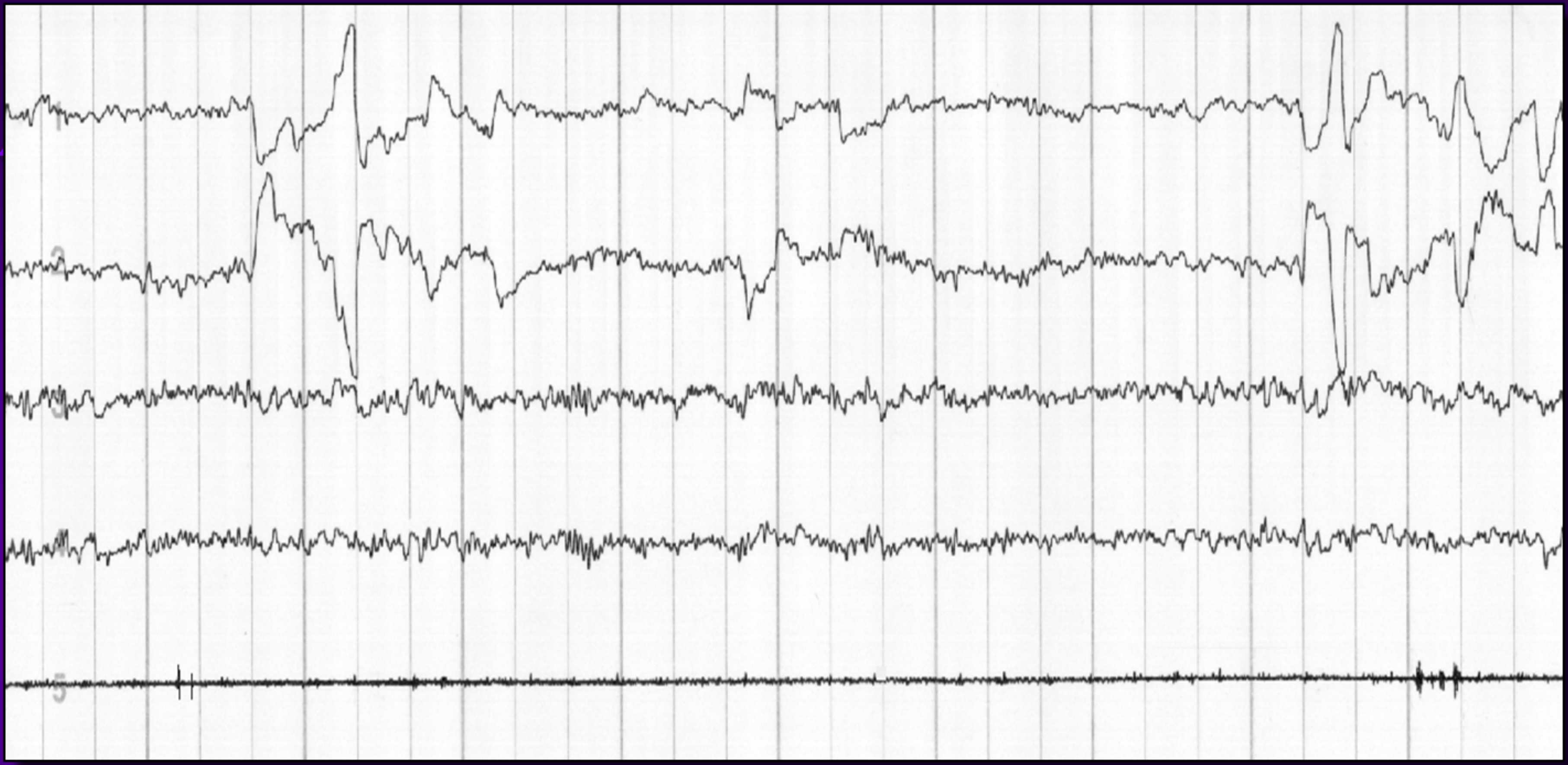




Church sleep
Car driving sleep
“Boring lecture sleep”



Slow wave sleep



REM sleep

- REM; Rapid Eye Movements,
- High frequency brain activity,
- Atonia of the muscles

SLEEP DISORDERS

Related to:

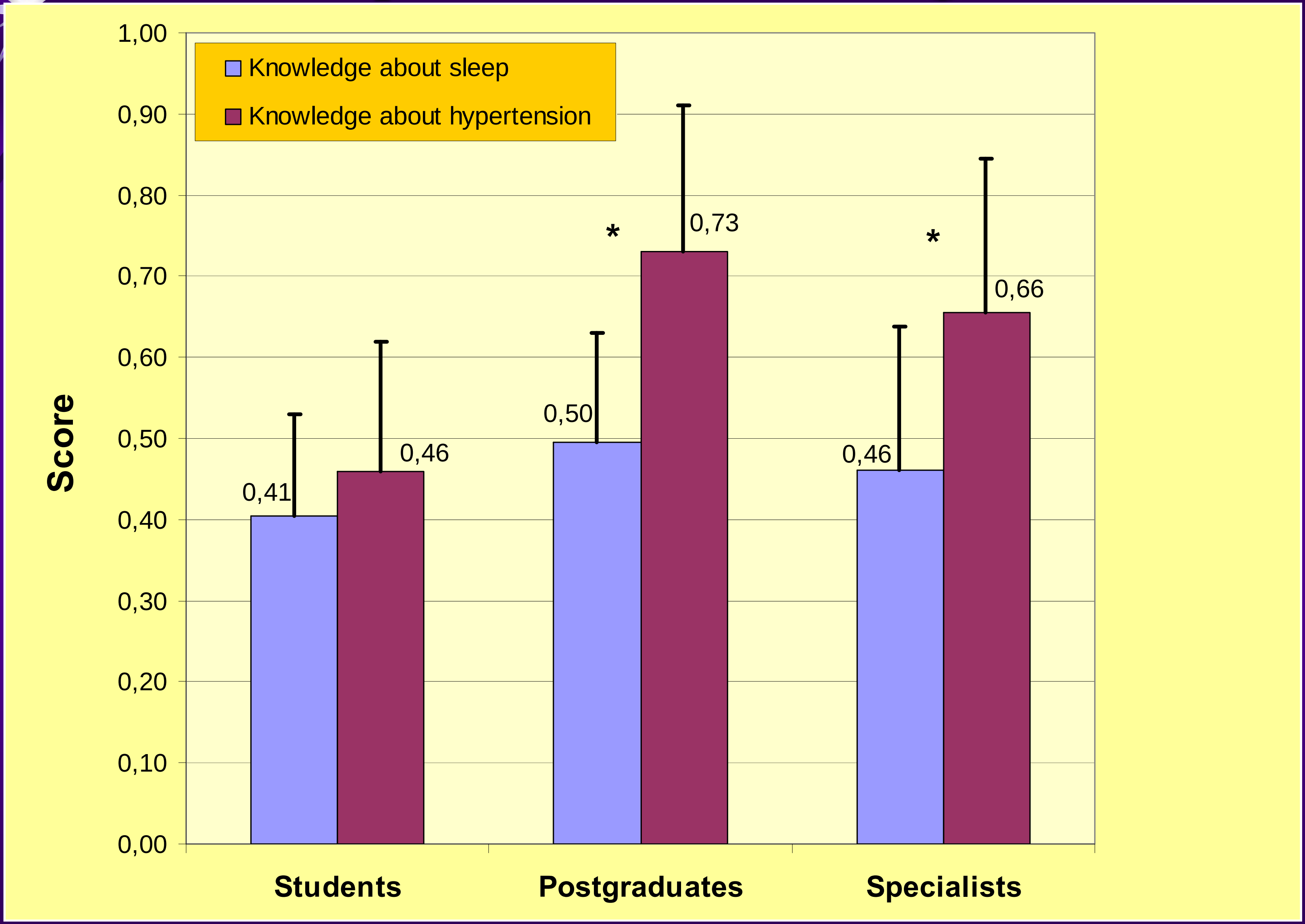
- **Internal medicine (cardiology, endocrinology, etc.)**
- **Pulmology**
- **ENT surgery**
- **Neurology**
- **Psychiatry**
- **Pediatrics, etc.**

Sleep disorders are

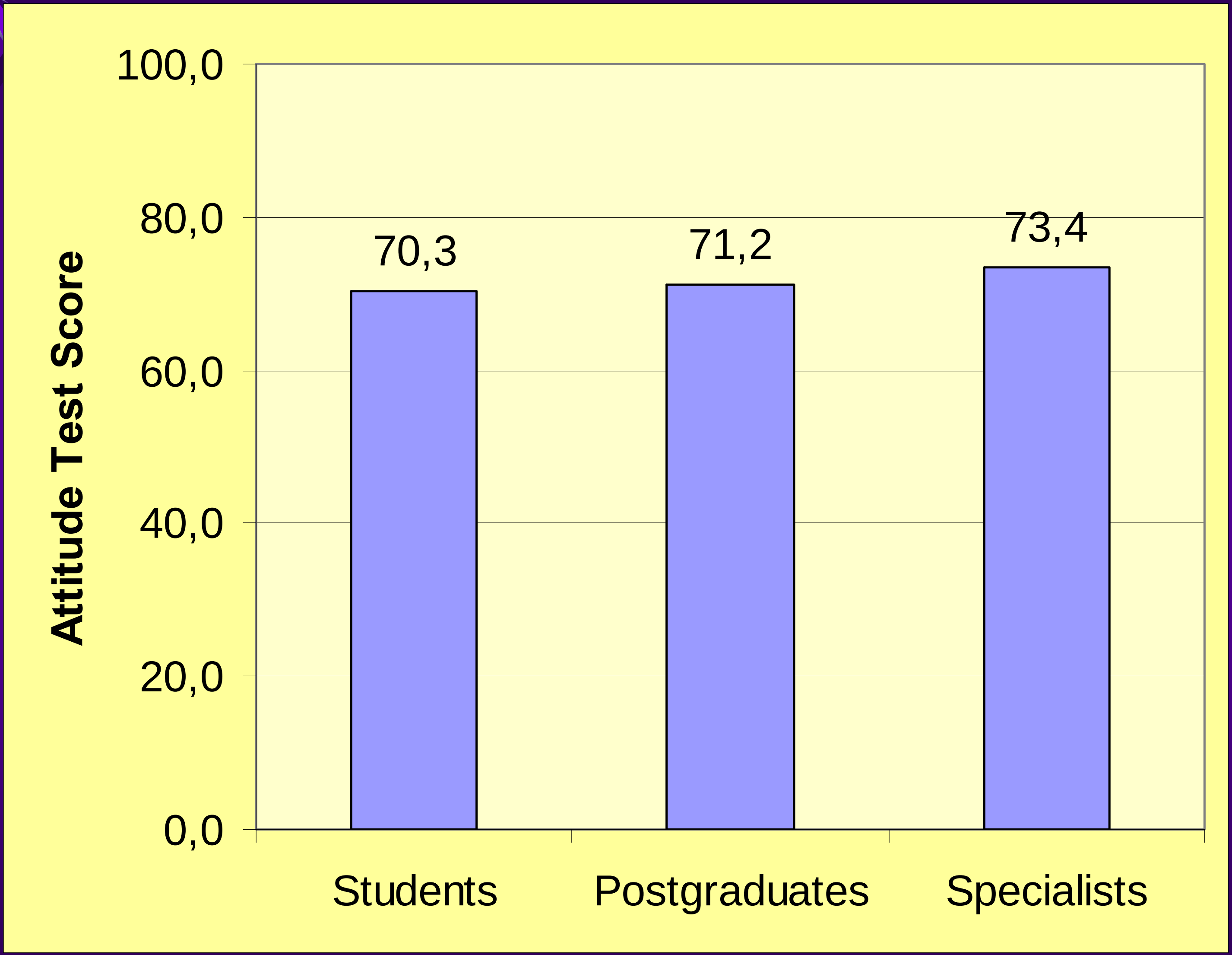
Risk factor for:

-cardiovascular diseases,
-depression,
-injuries at work,
-learning and memory impearement
-difficulties in growth and development
-other

Sleep medicine knowledge test



Attitude towards Sleep medicine test



Conclusions

- Poor knowledge in Sleep medicine

- Positive attitude towards Sleep Medicine

- A need for better education in Sleep medicine *in regular curriculas and extracurricular activities*

How to move foreward?

Wake up!

How to move foreward?

Dalmatian speciality: FJAKA (SIESTA)

State of stupor with a potentiated desire for NOTHING!

Wake up!

What to do?

Upside down!

Croatian Sleep Research Society (CSRS)

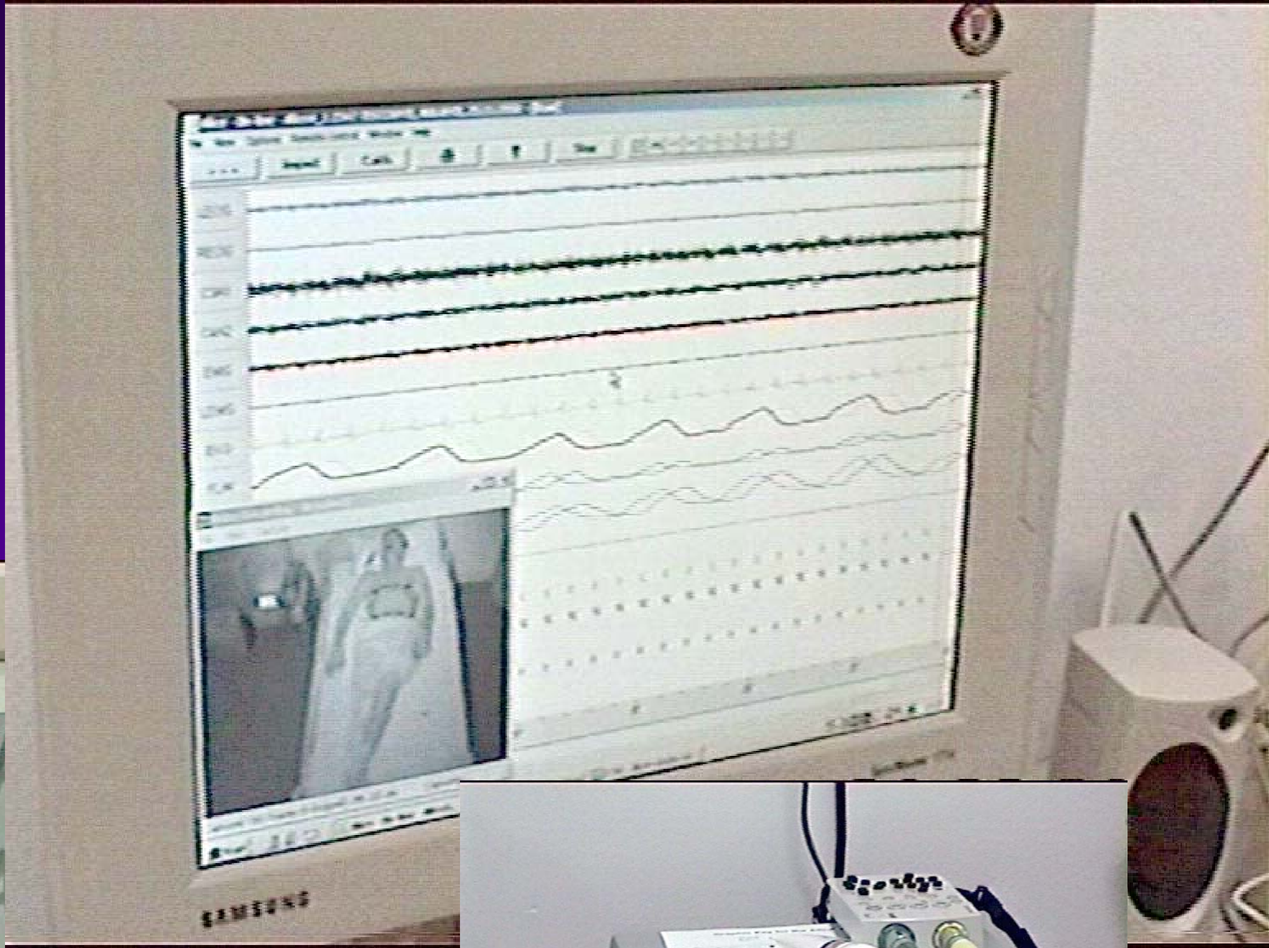
Also member of the Croatian Medical Association

Memberships mainly from two major cities Zagreb and Split

Sleep Laboratory in Zagreb has longer tradition
(Director: Prim. Danilo Hodoba, MD, PhD, Past-president of the CSRS)

Sleep Laboratory in Split started in 2002
(Director: Prof. Zoran Dogas, MD, PhD, President of the CSRS)

The sleep lab in Split, Croatia




MF Split

Some labor was provided by ourselves...

(Speeks about fundings and enthusiasm)

IMPROVING EDUCATION

- Basic Neuroscience course (2nd year)
  - More teaching hours of sleep medicine
- Postgraduate level
  - Elective course in Split
  - Elective course in Zagreb
  - MSc and PhD theses

IMPROVING EDUCATION

- Courses for GPs
- Public coverage (media, etc.)
- Info materials for patients (brochures, etc.)

European Sleep Research Society
Sleep Research and Sleep Medicine in Europe

Public awareness

Sleep Disordered Breathing – Sleep Apnea

Link with Traffic Accidents (sleepiness behind the wheel)

University of Split, School of Medicine; Department of Neuroscience

EU PARLIAMENT

Sleep Medicine

- In March 2014, the third edition of the International Classification of Sleep Disorders (**ICSD-3**) was published by the American Academy of Sleep Medicine, replacing the previous edition.

- The ICSD-3 includes six main clinical divisions:
    1 Insomnia
    2 Sleep-related breathing disorders
    3 Central disorders of hypersomnolence
    4 Circadian rhythm sleep–wake disorders
    5 Parasomnia
    6 Sleep-related movement disorders
    Plus "Other sleep disorders"

Sleep Medicine in Europe

Great diversity among countries in:

- Development
- Status of sleep experts
- Education/Training
- Practice standards
- Reimbursement of Dg and Th procedures

Sleep Medicine in Europe

Great need for standardization of:

- Status of sleep experts
- Education/Training
- Standard operational procedures (SOPs)
- Reimbursement of Dg and Th procedures

Sleep Medicine in Europe

What has been done so far?

Journal of Sleep Research, 2006

European Sleep Research Society
Sleep Research and Sleep Medicine in Europe

J. Sleep Res. (2006) **15**, 231–238

European guidelines for the accreditation of Sleep Medicine Centres

STEERING COMMITTEE OF THE EUROPEAN SLEEP RESEARCH SOCIETY

SUMMARY This document describes guidelines for accreditation of Sleep Medicine Centres in Europe. These guidelines are the result of a consensus procedure, in which representatives of the European Sleep Research Society (ESRS) and representatives of different European National Sleep Societies (ENSS) were involved. The information obtained during different rounds of consultation was gathered and processed by the members of the Steering Committee of the ESRS. The scope of the guidelines is to define the characteristics of multidisciplinary Sleep Medicine Centres (SMCs), in terms of requirements regarding staff, operational procedures and logistic facilities. Accreditation of SMCs is proposed to be the responsibility of the individual ENSS. The Accreditation Guidelines may thus be considered an instrument for the national societies to develop new or standardize existing accreditation questionnaires, as well as procedures for visiting the site, drafting the accreditation report, and finally, granting the accreditation. The Accreditation Guidelines are meant to be a line of action, that ideally should be followed as close as possible, but that may be subject to certain exceptions, depending on local customs or regulations.

KEYWORDS accreditation, europe, guidelines, sleep medicine

Journal of Sleep Research, 2009

European Sleep Research Society
Sleep Research and Sleep Medicine in Europe

J. Sleep Res. (2009) 18, 136–141 ESRS task force report

doi: 10.1111/j.1365-2869.2008.00721.x

European guidelines for the certification of professionals in sleep medicine: report of the task force of the European Sleep Research Society

ESRS TASK FORCE: DIRK PEVERNAGIE[1,*,†], NEIL STANLEY[2,*], SÖREN BERG[3,*], JEAN KRIEGER[4,*], ROBERTO AMICI[5,†], CLAUDIO BASSETTI[6,†], MICHEL BILLIARD[7,‡], FABIO CIRIGNOTTA[8,‡], DIEGO GARCIA-BORREGUERO[9,‡], IRENE TOBLER[10,‡] and JÜRGEN FISCHER[11,*]

[1]Sleep Medicine Centre, Kempenhaeghe Foundation, The Netherlands; Faculty of Medicine and Health Sciences, Ghent University, Belgium, [2]Norfolk and Norwich University Hospital, Norfolk, UK, [3]Lund Sleep Group, University Hospital Lund, Lund, Sweden, [4]Faculté de Médecine, Université Louis Pasteur, Strasbourg, France, [5]Department of Human and General Physiology, University of Bologna, Bologna, Italy, [6]Neurologische Poliklinik, Universitätsspital Zürich, Zürich, Switzerland, [7]Department of Neurology, Gui de Chauliac Hospital, Montpellier, France, [8]UO Neurology, S.Orsola-Malpighi Hospital, University of Bologna, Bologna, Italy, [9]Sleep Research Institute, Madrid, Spain, [10]Institute of Pharmacology and Toxicology, University of Zurich, Zurich, Switzerland and [11]Klinik Norderney, Klinik der Deutschen Rentenversicherung Westfalen, Klinik der Universität Witten/Herdecke, Norderney, Germany

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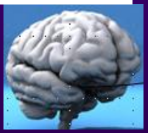

Journal of Sleep Research, 2012

European Sleep Research Society
Sleep Research and Sleep Medicine in Europe

J. Sleep Res. (2011) Review Paper

doi: 10.1111/j.1365-2869.2011.00987.x

Standard procedures for adults in accredited sleep medicine centres in Europe

JÜRGEN FISCHER[1], ZORAN DOGAS[1], CLAUDIO L. BASSETTI[1], SØREN BERG[1], LUDGER GROTE[1], POUL JENNUM[1], PATRICK LEVY[1], STEFAN MIHAICUTA[1], LINO NOBILI[1], DIETER RIEMANN[1], F. JAVIER PUERTAS CUESTA[1], FRIEDHART RASCHKE[2], DEBRA J. SKENE[1], NEIL STANLEY and DIRK PEVERNAGIE[1]

[1]Members of the Executive Committee (EC) of the Assembly of the National Sleep Societies (ANSS) and of the Board of the European Sleep Research Society (ESRS), Regensburg, Germany and [2]Institute of Rehabilitation Research, Norderney, Germany

Accepted in revised form 28 October 2011; received 19 August 2011

SUMMARY The present paper describes standardized procedures within clinical sleep medicine. As such, it is a continuation of the previously published European guidelines for the accreditation of sleep medicine centres and European guidelines for the certification of professionals in sleep medicine, aimed at creating standards of practice in European sleep medicine. It is also part of a broader action plan of the European Sleep Research Society, including the process of accreditation of sleep medicine centres and certification of sleep medicine experts, as well as publishing the *Catalogue of Knowledge and Skills* for sleep medicine experts (physicians, non-medical health care providers, nurses and technologists), which will be a basis for the development of relevant educational curricula. In the current paper, the standard operational procedures sleep medicine centres regarding the diagnostic and therapeutic management of patients evaluated at sleep medicine centres, accredited according to the European Guidelines, are based primarily on prevailing evidence-based medicine principles. In addition, parts of the standard operational procedures are based on a formalized consensus procedure applied by a group of Sleep Medicine Experts from the European National Sleep Societies. The final recommendations for standard operational procedures are categorized either as 'standard practice', 'procedure that could be useful', 'procedure that is not useful' or 'procedure with insufficient information available'. Standard operational procedures described here include both subjective and objective testing, as well as recommendations for follow-up visits and for ensuring patients' safety in sleep medicine. The overall goal of the actual standard operational procedures is to further develop excellence in the practice and quality assurance of sleep medicine in Europe.

KEYWORDS sleep medicine centres, standard procedure, sleep medicine

University of Split, School of Medicine, Department of Neuroscience

Journal of Sleep Research, 2013

European Sleep Research Society
Sleep Research and Sleep Medicine in Europe

J Sleep Res. (2013) Regular Research Paper

Catalogue of knowledge and skills for sleep medicine

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Keywords
curriculum, educational programme, medical education, sleep medicine, training

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SUMMARY
Sleep medicine is evolving globally into a medical subspeciality in its own right, and in parallel, behavioural sleep medicine and sleep technology are expanding rapidly. Educational programmes are being implemented at different levels in many European countries. However, these programmes would benefit from a common, interdisciplinary curriculum.

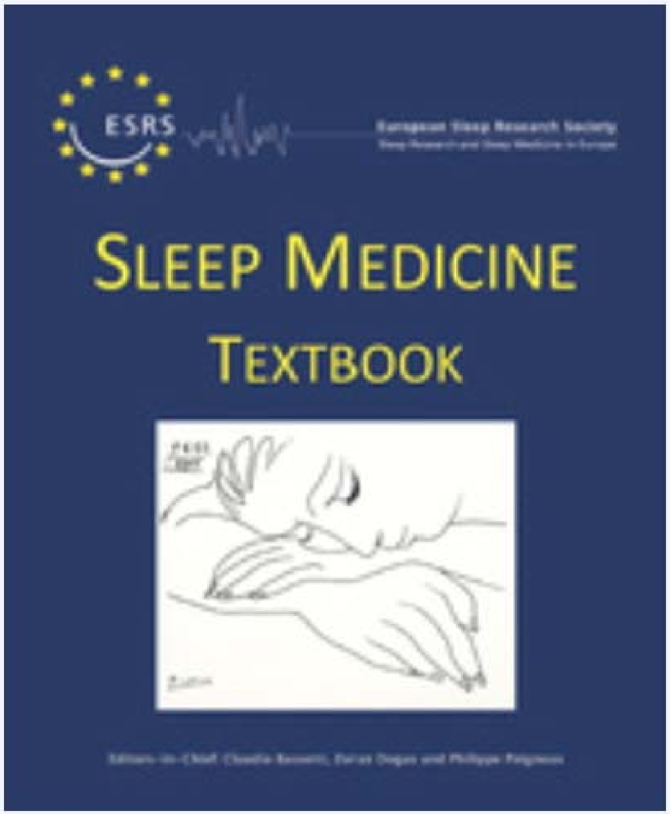
Catalogue of Knowledge and Skills – 10 Sections

The SMC proposes to base a sleep medicine fellowship on a comprehensive and clearly defined educational program. To this goal, a catalogue of knowledge and skills (CK&S) for the education and training of professionals in sleep medicine is being elaborated. The preliminary draft of the CK&S comprises 8 comprehensive chapters with a total of more than 400 learning outcomes:

A. Physiological basis of sleep
B. Assessment of sleep disorders and diagnostic procedures
C. Insomnia
D. Sleep-related breathing disorders
E. Hypersomnias of central origin
F. Circadian rhythm sleep disorders
G. Parasomnias
H. Sleep-related movement disorders
I. Miscellaneous sleep-related conditions and disorders
J. Societal, economical, organisational and research in Sleep Medicine

The CK&S is based on the ECTS credit point system. Credits for theoretical education and practical training are included. The target groups are: physicians, professionals with a master degree (e.g. psychologist), technologists and nurses. The aim of the SMC is to submit the finalized document to the ESRS board by March 31, 2011.

Sleep Medicine Textbook



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European Sleep Research Society (ESRS)

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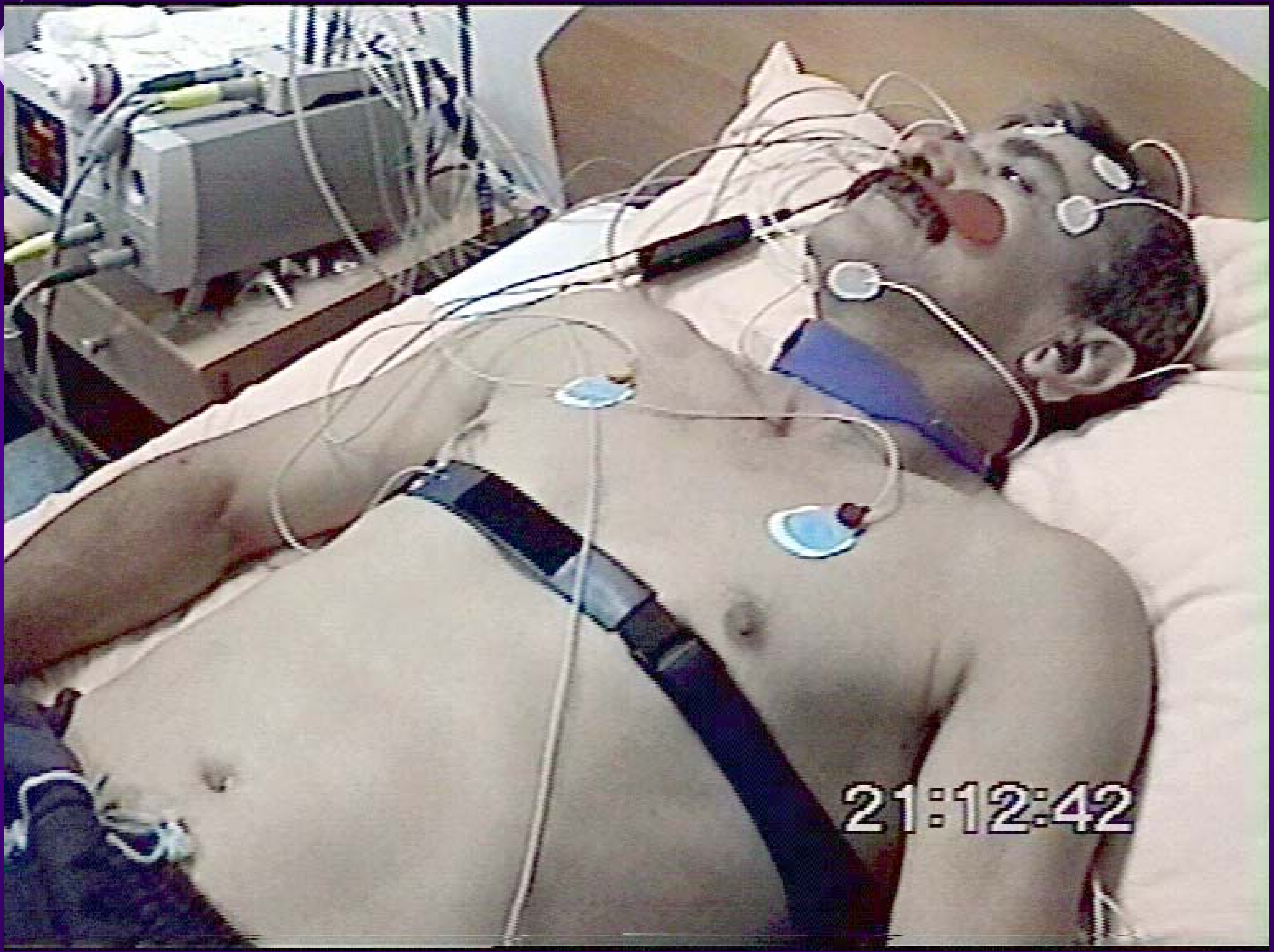
ISBN: 9781119038931

Endorsed by ERS

Polysomnography

- Diagnostic method
- In a specialized sleep laboratory
- Useful in many clinical applications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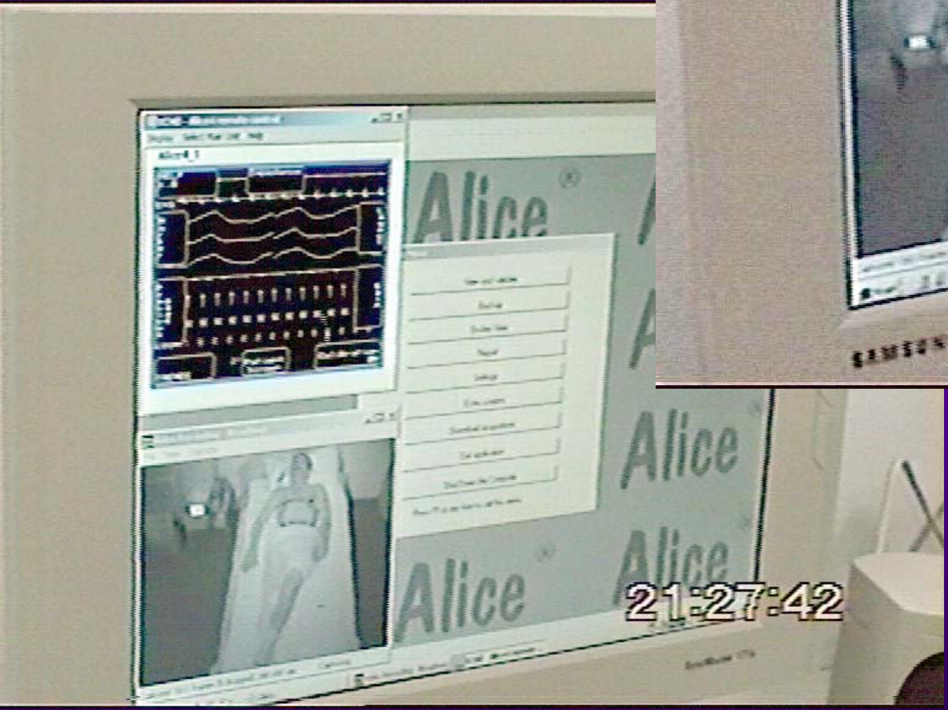
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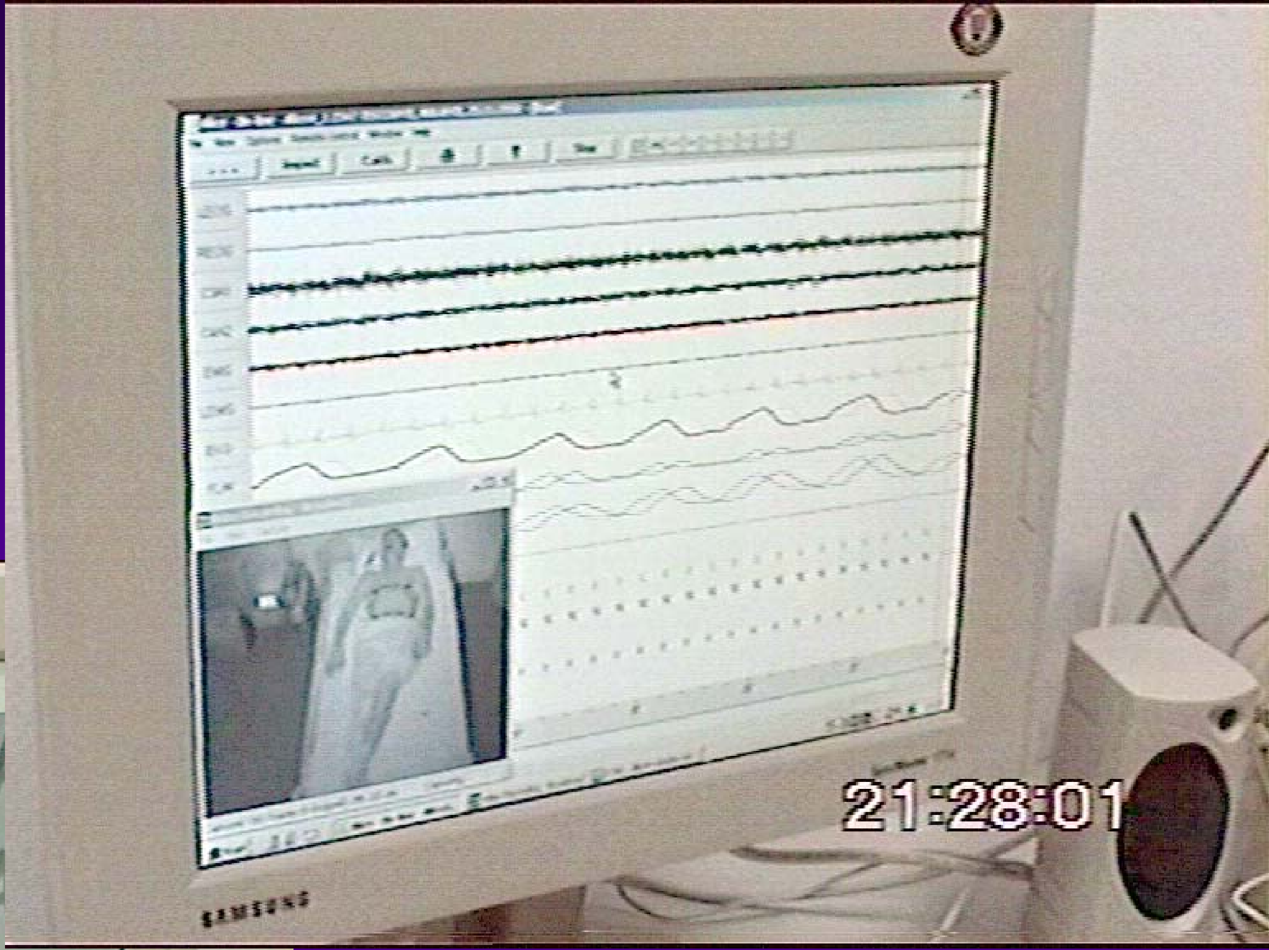
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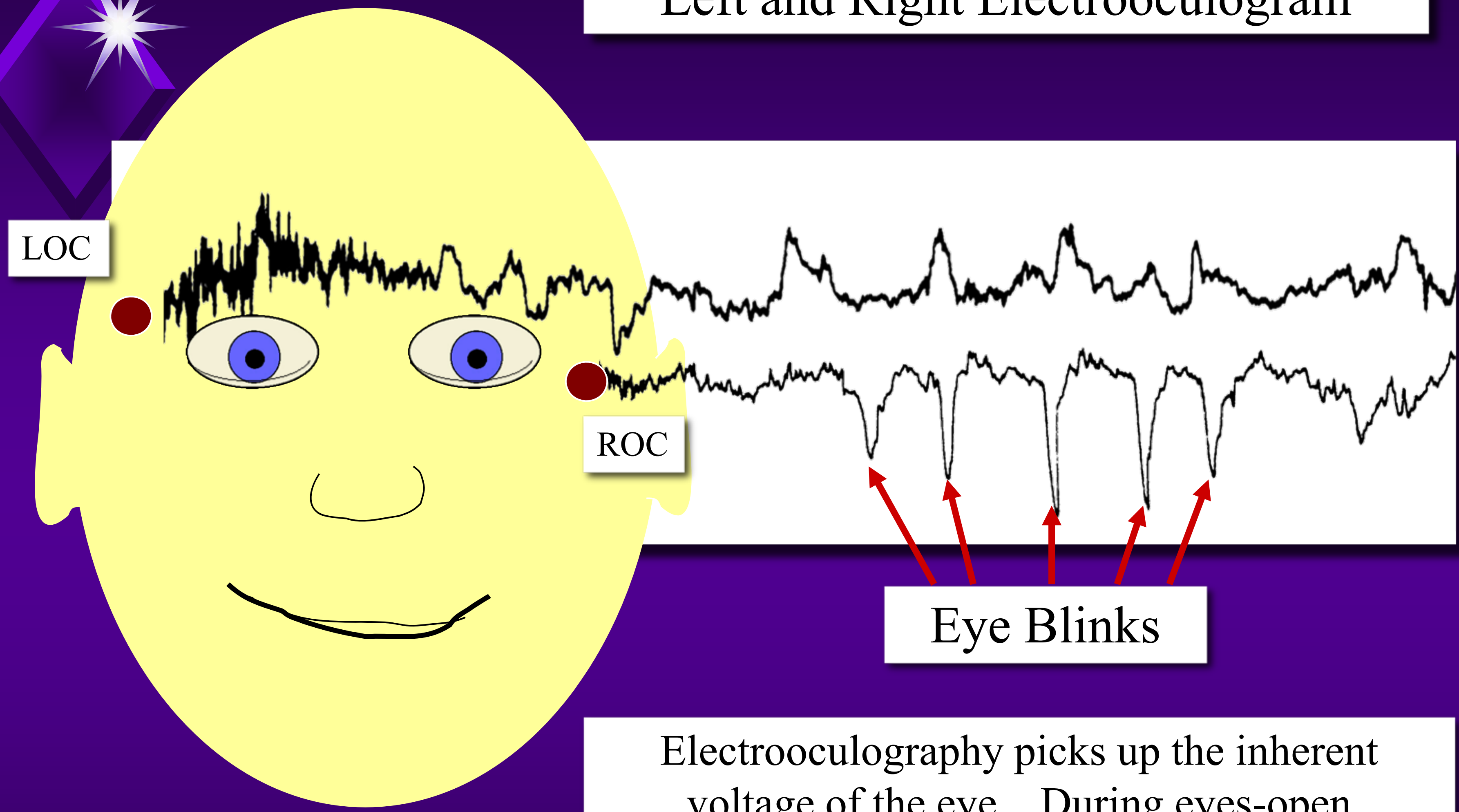
SAMSUNG

Polysomnography

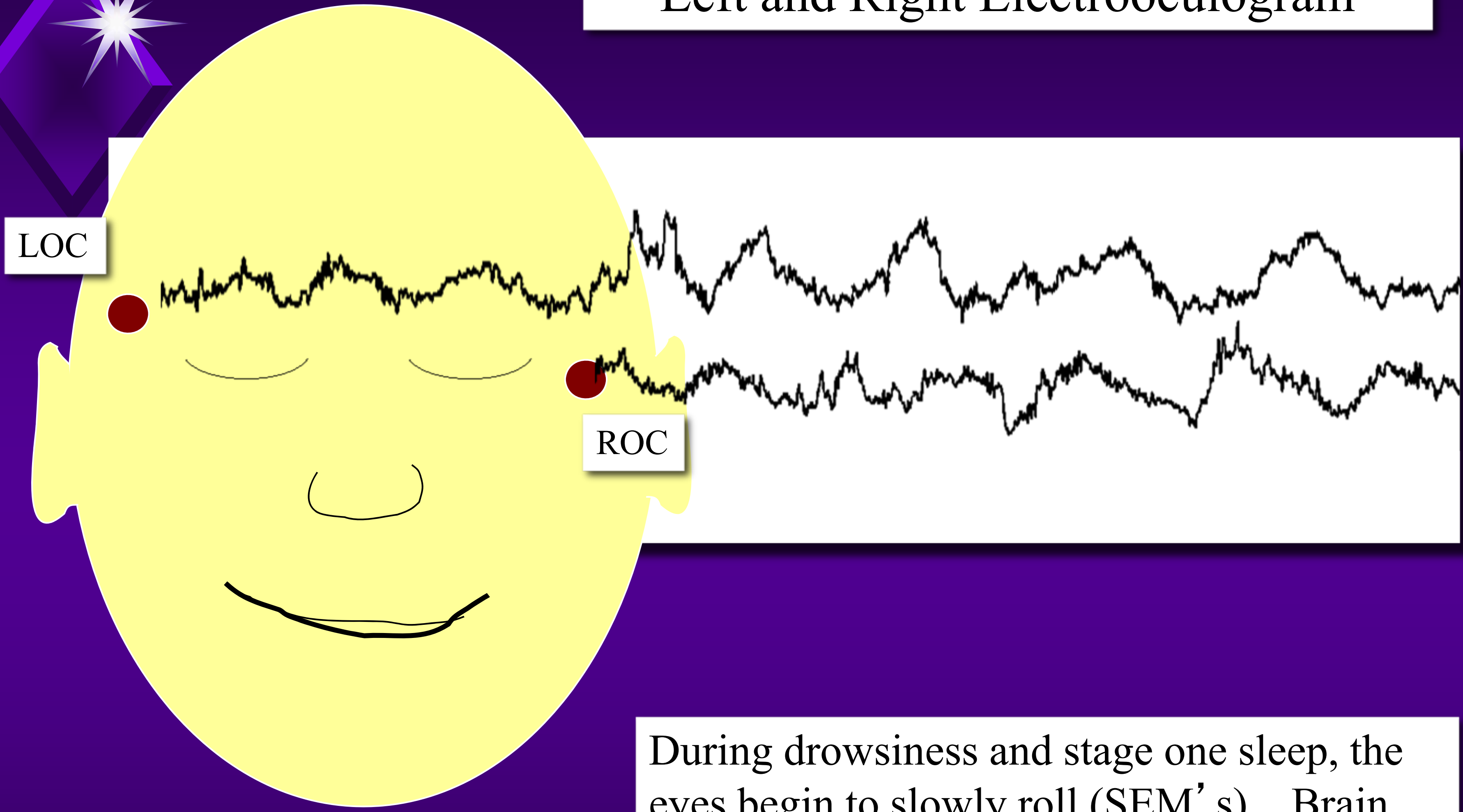
- EOG - Electrooculogram
- EEG - Electroencephalogram
- EMG - Electromyogram
- EKG - Electrocardiogram
- Sound from trachea (microphone)
- Air flow through the mouth and nose
- Respiratory efforts of thoracic and abdominal muscles
- Pulse oxymetry

Left and Right Electrooculogram



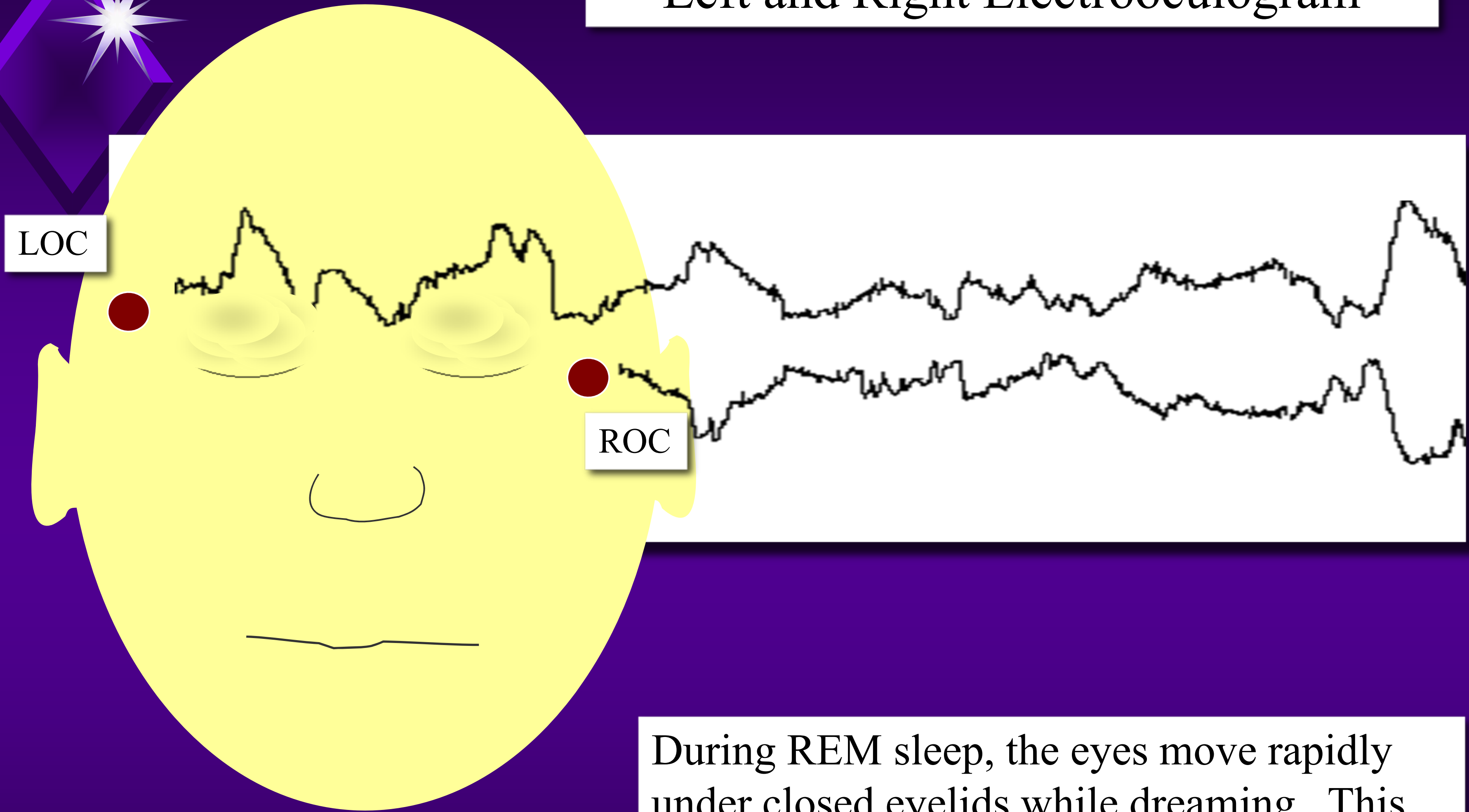
Electrooculography picks up the inherent voltage of the eye. During eyes-open wakefulness, sharp deflections in the EOG tracing may indicate the presence of eye blinks.

Left and Right Electrooculogram

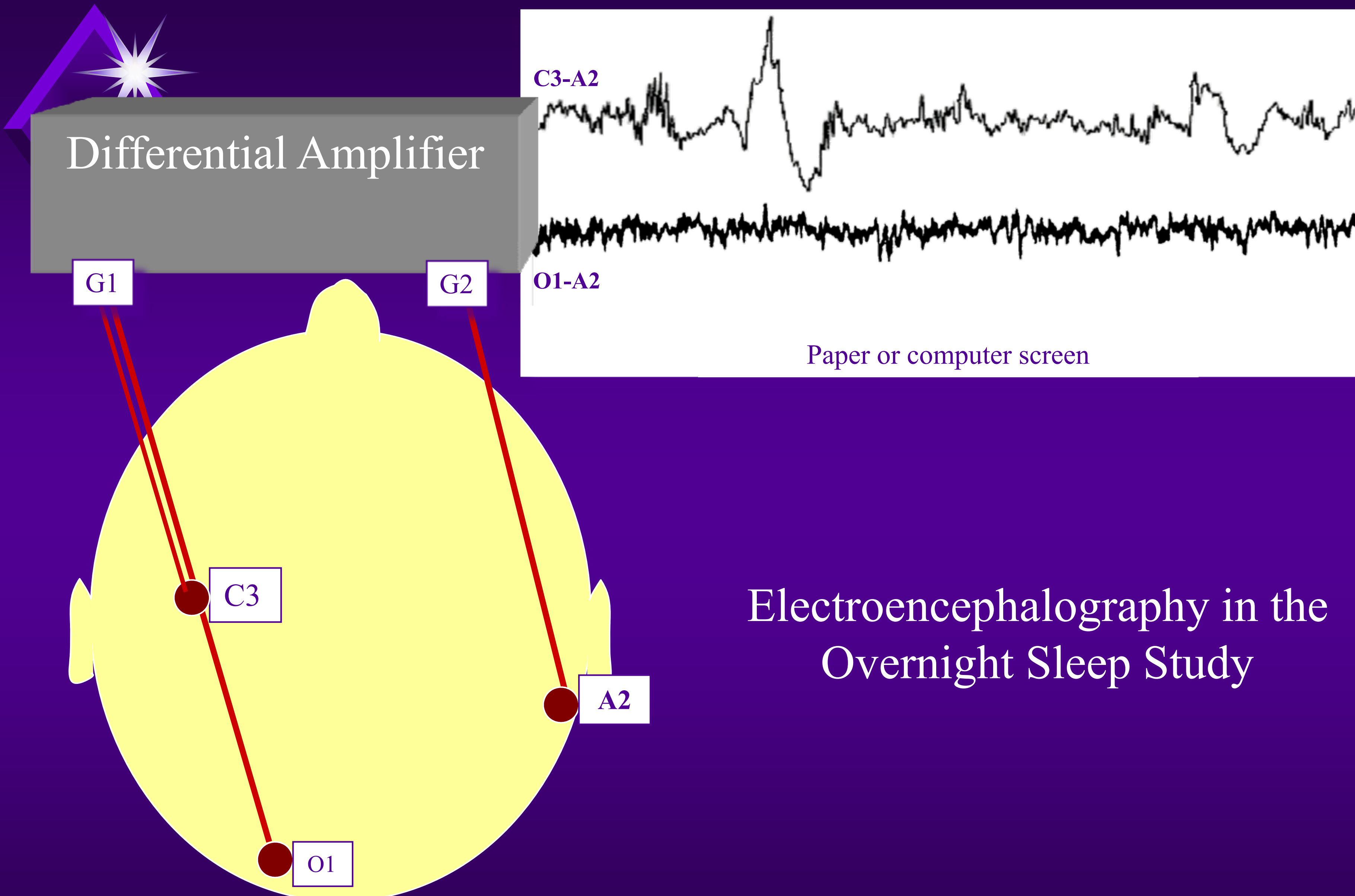


During drowsiness and stage one sleep, the eyes begin to slowly roll (SEM’ s). Brain wave activity (theta) starts to enter into the EOG tracing as an artifact.

Left and Right Electrooculogram

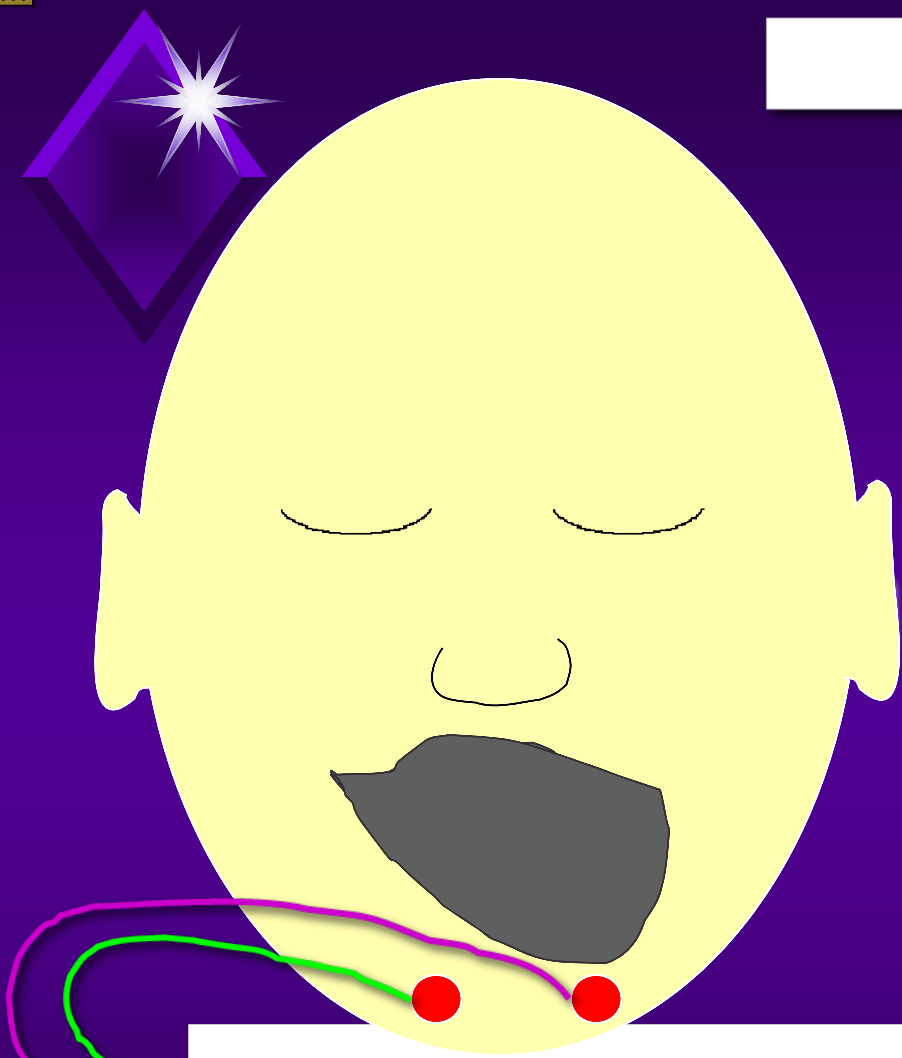


During REM sleep, the eyes move rapidly under closed eyelids while dreaming. This produces rapid conjugate eye movements which appear as out-of-phase EOG channel deflections.

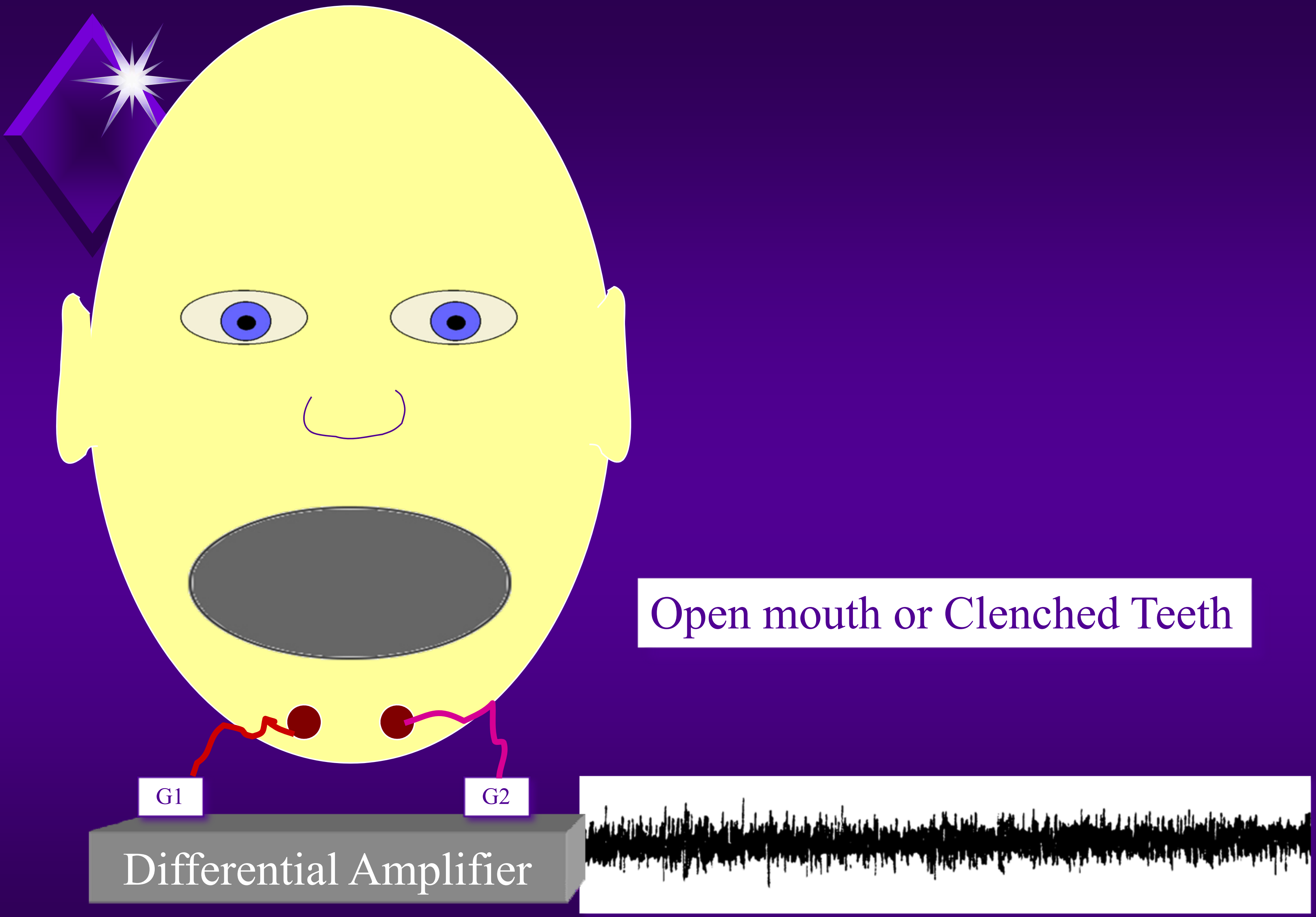


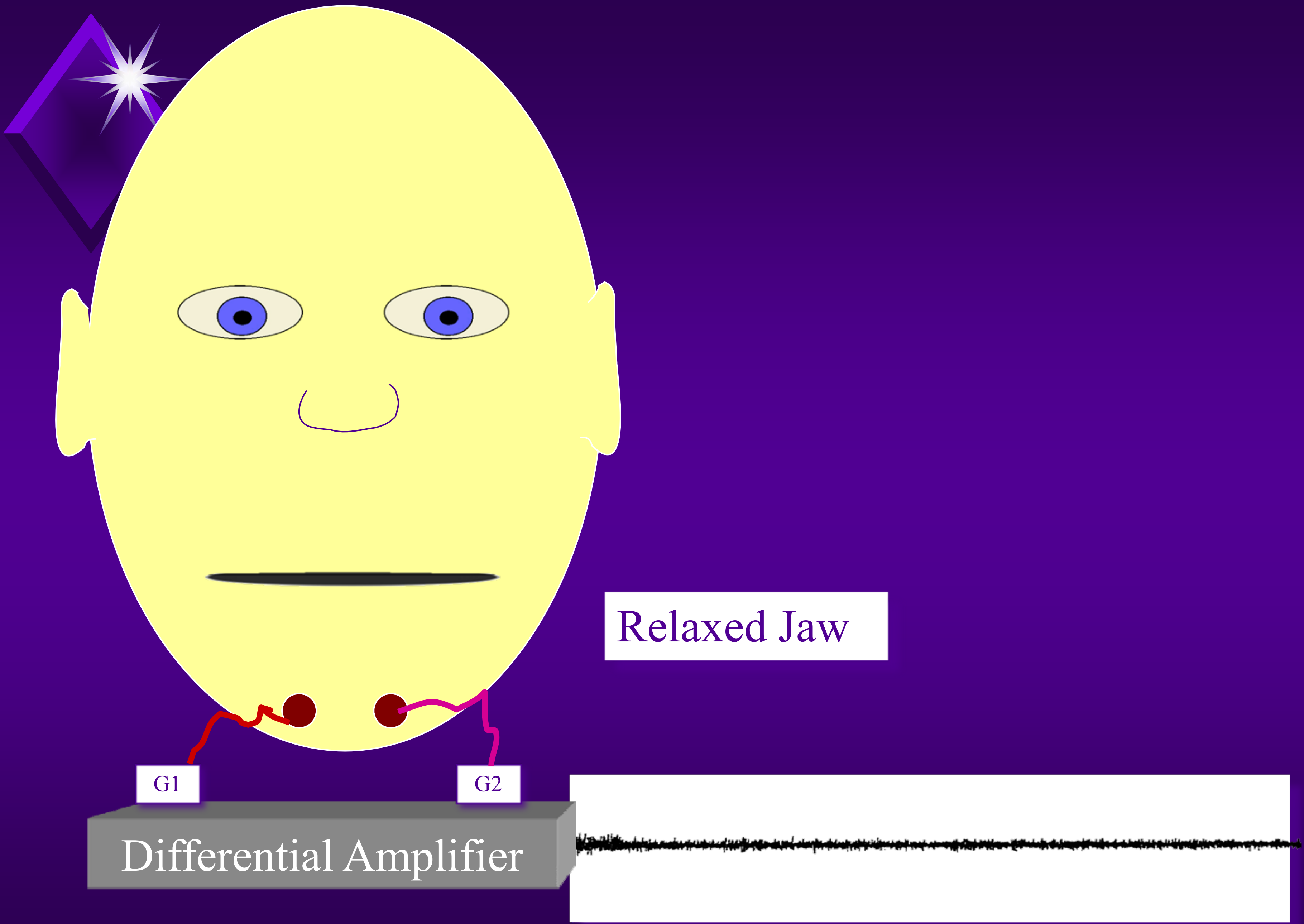
Electroencephalography in the Overnight Sleep Study

Mental/Submental EMG

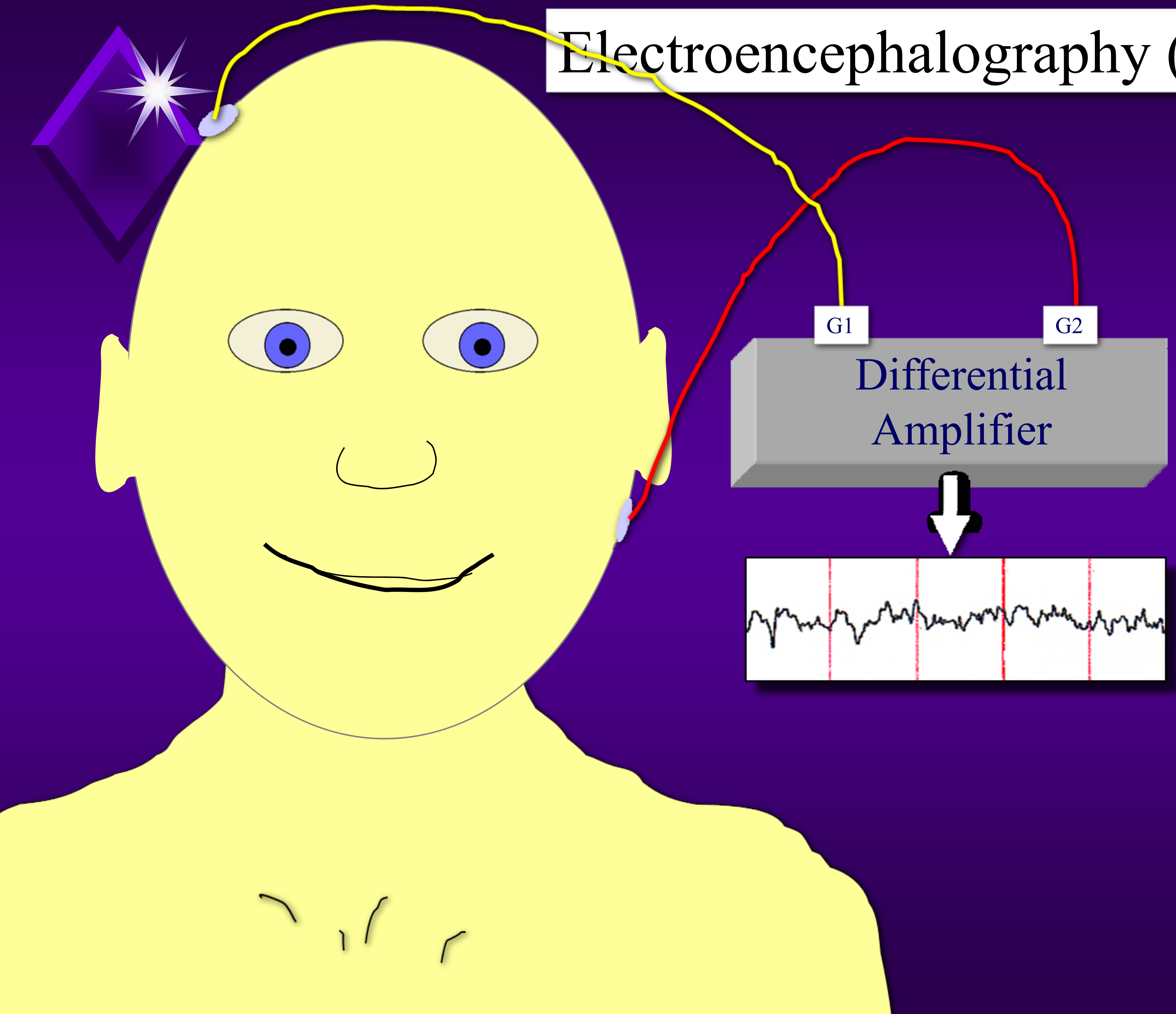


Submental EMG records muscle Tone. This is a mandatory recording parameter for staging sleep (REM vs. NREM). Yawns, swallows, and tooth grinding may also increase muscle tone.

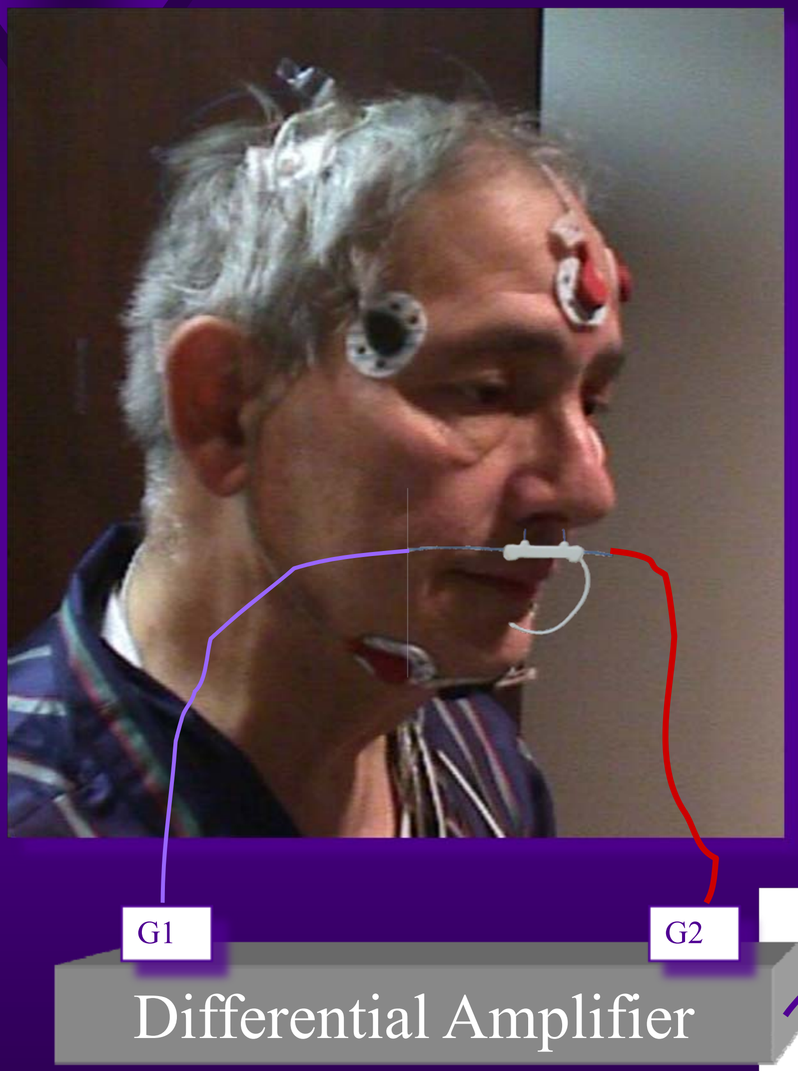

Open mouth or Clenched Teeth
G1
G2
Differential Amplifier


Relaxed Jaw
G1
G2
Differential Amplifier

Electroencephalography (EEG)

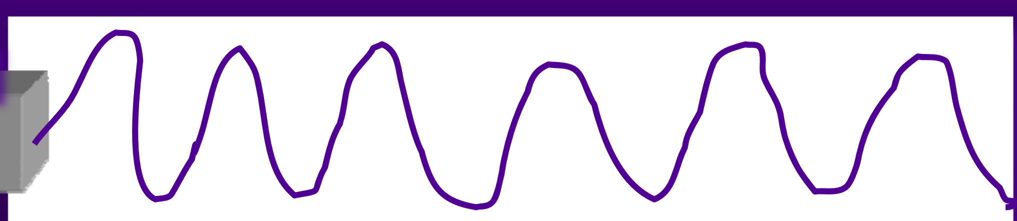


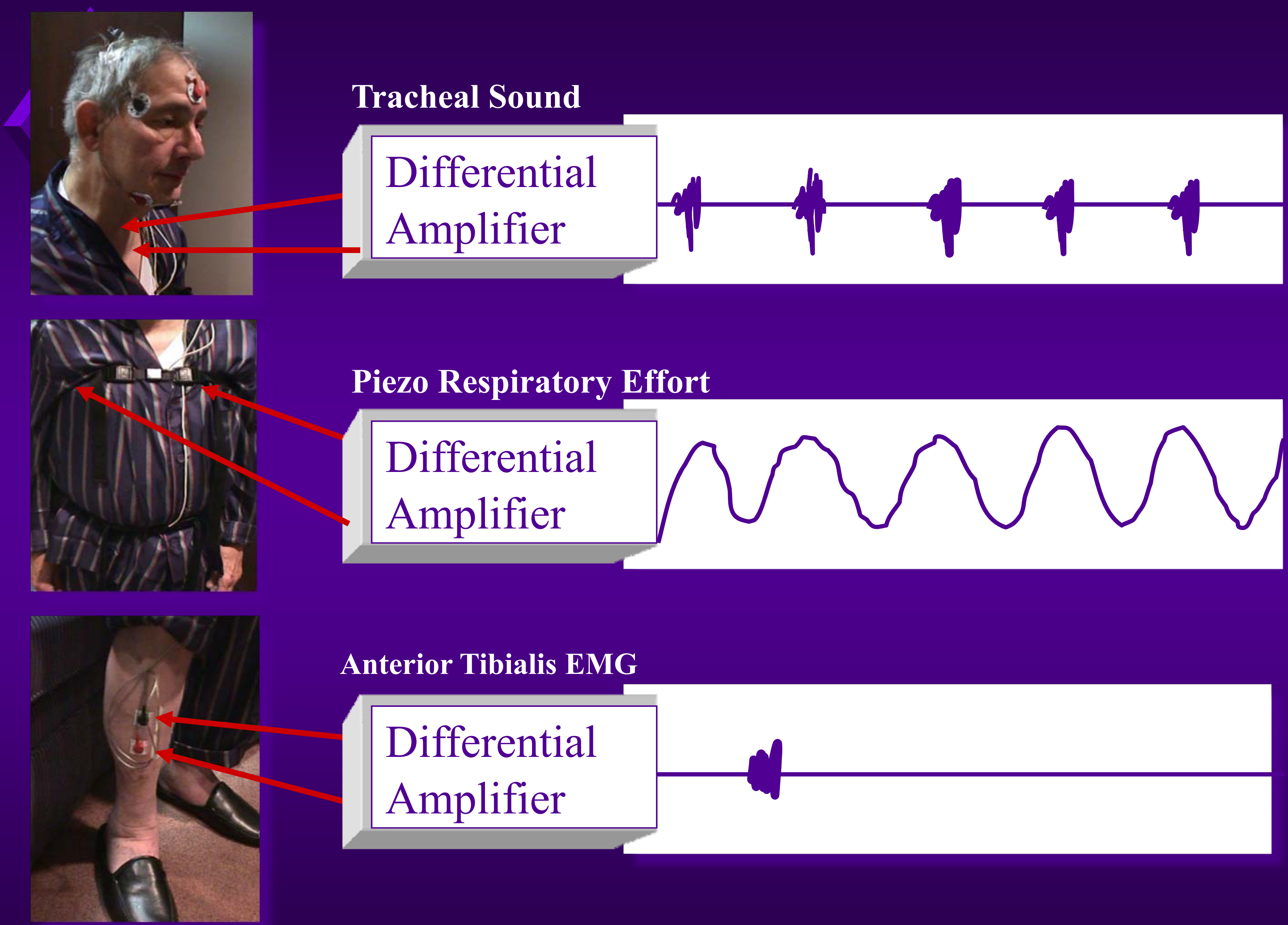
Thermocouple

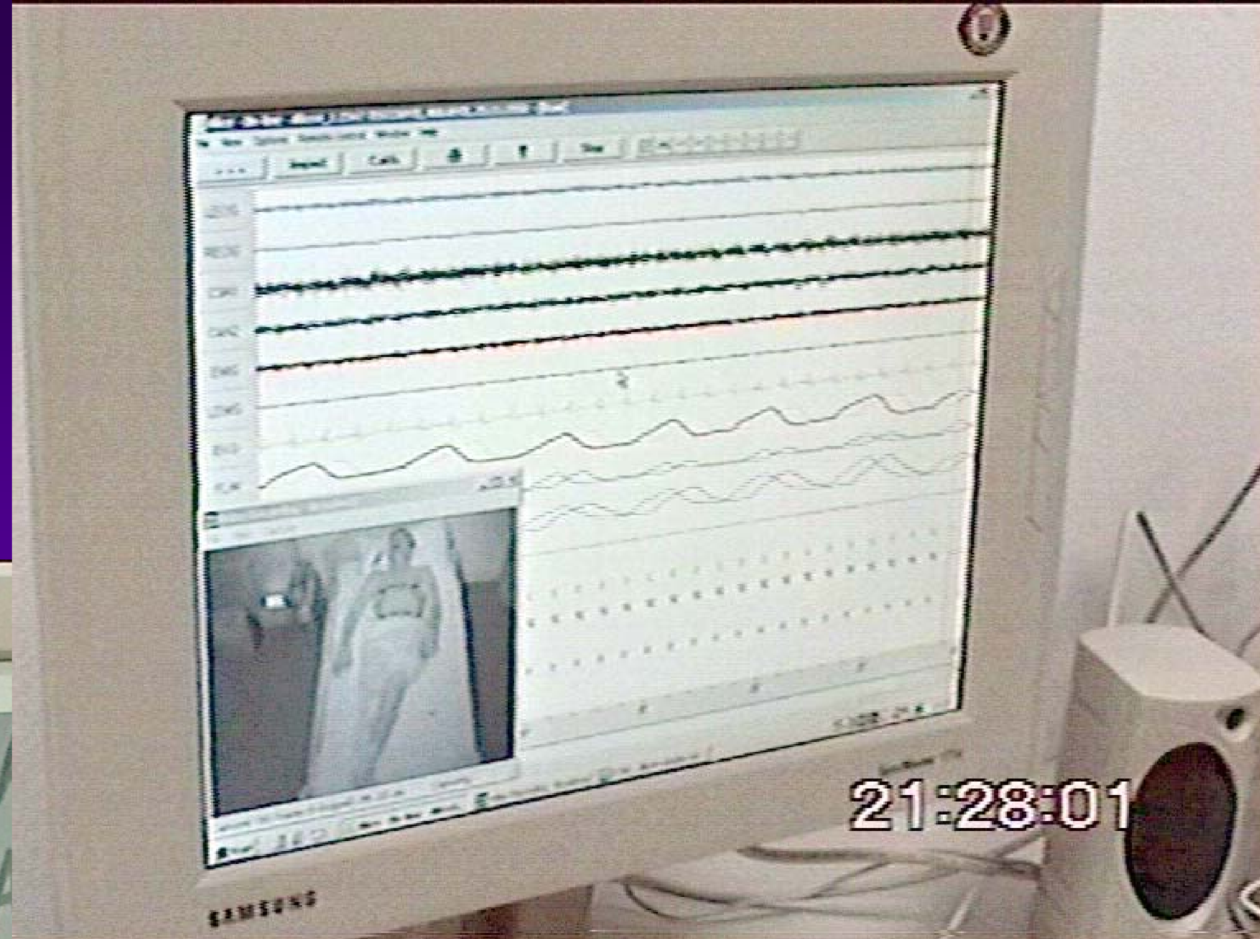


Combination of two dissimilar metals

Voltage changes are seen with exhalation and inhalation

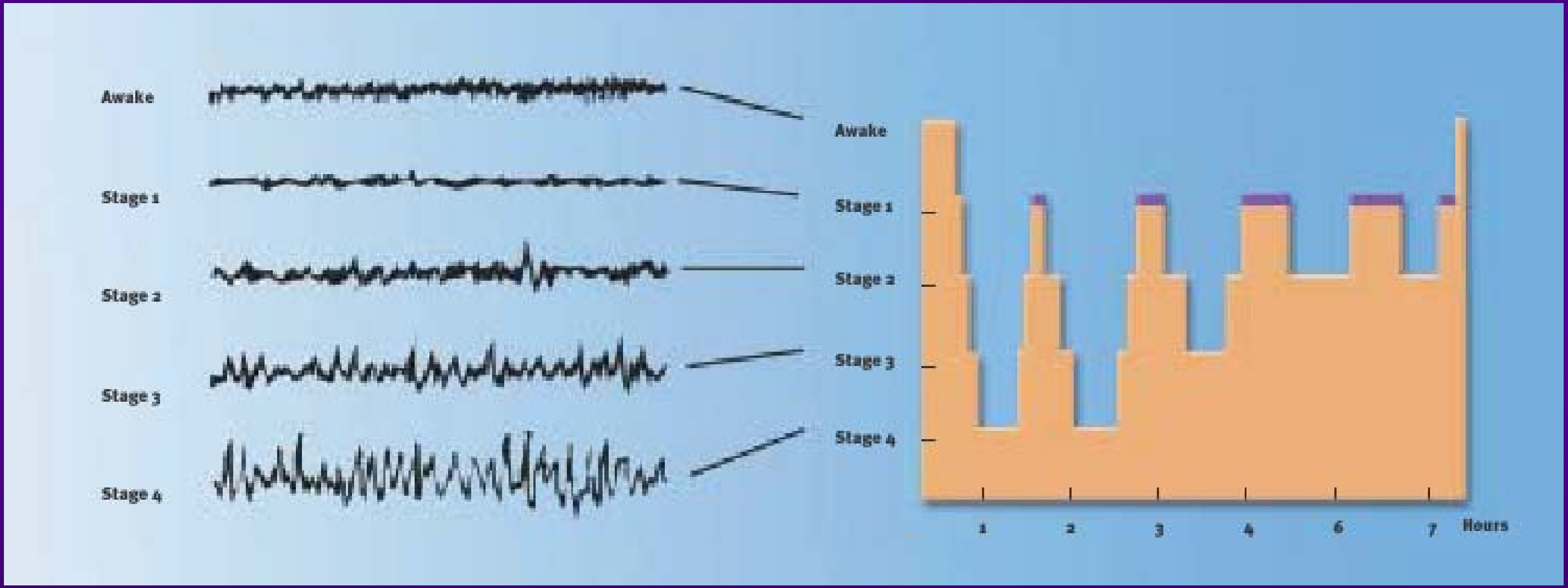



Tracheal Sound
Differential Amplifier
Piezo Respiratory Effort
Differential Amplifier
Anterior Tibialis EMG
Differential Amplifier



Zoran Đogaš, 2002.

Sleep stages



Sleep History "BEARS"

- **B**edtime
- **E**xcesive daytime sleepiness
- **A**wakenings – during the night
early in the morning
- **R**egularity
- **S**noring

Sleep Disordered Breathing - SDB

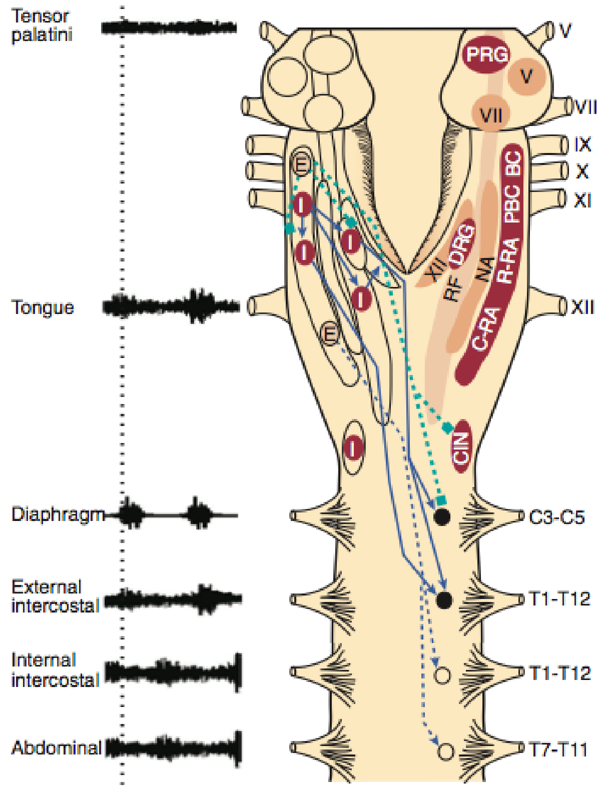


Figure 21-1 Ventral view of the brainstem (cerebellum removed) showing the main aggregates of respiratory neurons in the dorsal respiratory group (DRG) and ventral respiratory group (VRG). In the latter, the location of the expiratory (E) and inspiratory (I) neurons in the Bötzinger complex (BC), pre-Bötzinger complex (PBC), rostral retroambigualis (R-RA), and caudal retroambigualis (C-RA) are shown. The location of cervical inspiratory neurons (CIN) and respiratory-related neurons in the lateral reticular formation (RF) projecting to the hypoglossal motor nucleus (XII) are also shown. The projections of inspiratory and expiratory neurons are depicted as solid and dashed lines, respectively, while excitatory and inhibitory synaptic connections are depicted by arrowhead and square symbols, respectively. Inspiratory and expiratory motor pools in the spinal cord are depicted by closed and open circles, respectively. The electromyographic activities of various inspiratory-related (e.g., tongue, diaphragm, and external intercostal) and expiratory (e.g., internal intercostal and abdominal) muscles are shown. Note that the level of respiratory-related and tonic activities varies for different muscles, with some muscles such as the tensor palatini expressing mainly tonic activity. The onset of muscle activity with respect to the diaphragm is shown by the dashed line. The rootlets of cranial nerves V, VII, IX, X, XI, XII, and the cervical (C) and thoracic (T) segments of the spinal cord are also shown, as are the motor nuclei of cranial nerves XII, VII and V. The locations of the pontine respiratory group (PRG) and the nucleus ambiguus (NA) are shown, although their projections are not included for clarity.

Heterogeneity of SDB

- **Obstructive**
  - apnea
  - hypopnea
  - UARS (Upper Airway Resistance Syndrome)

- **Non-obstructive**
  - transitional apnea
  - periodic breathing
  - “ventilatory pump failure”

Scoring Respiratory Events

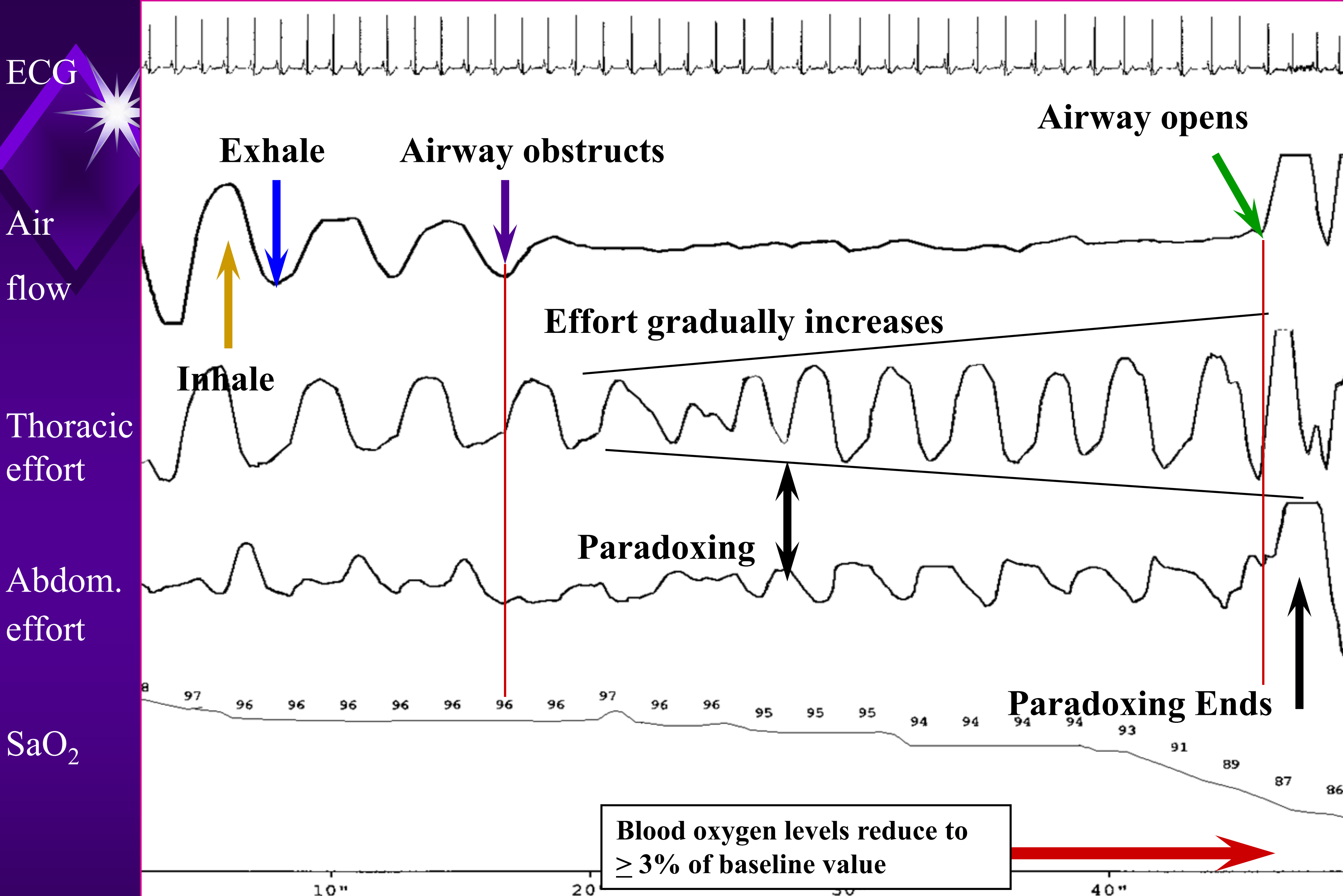
- Obstructive apnea
- Central apnea
- Mixed apnea
- Hypopnea

Common rules

- All respiratory events must last at least 10 s
- Desaturation (SaO_2) of at least 3% (or 4%)
- EEG arousal (“microaweakening”) occurs with most respiratory events

Obstructive apnea

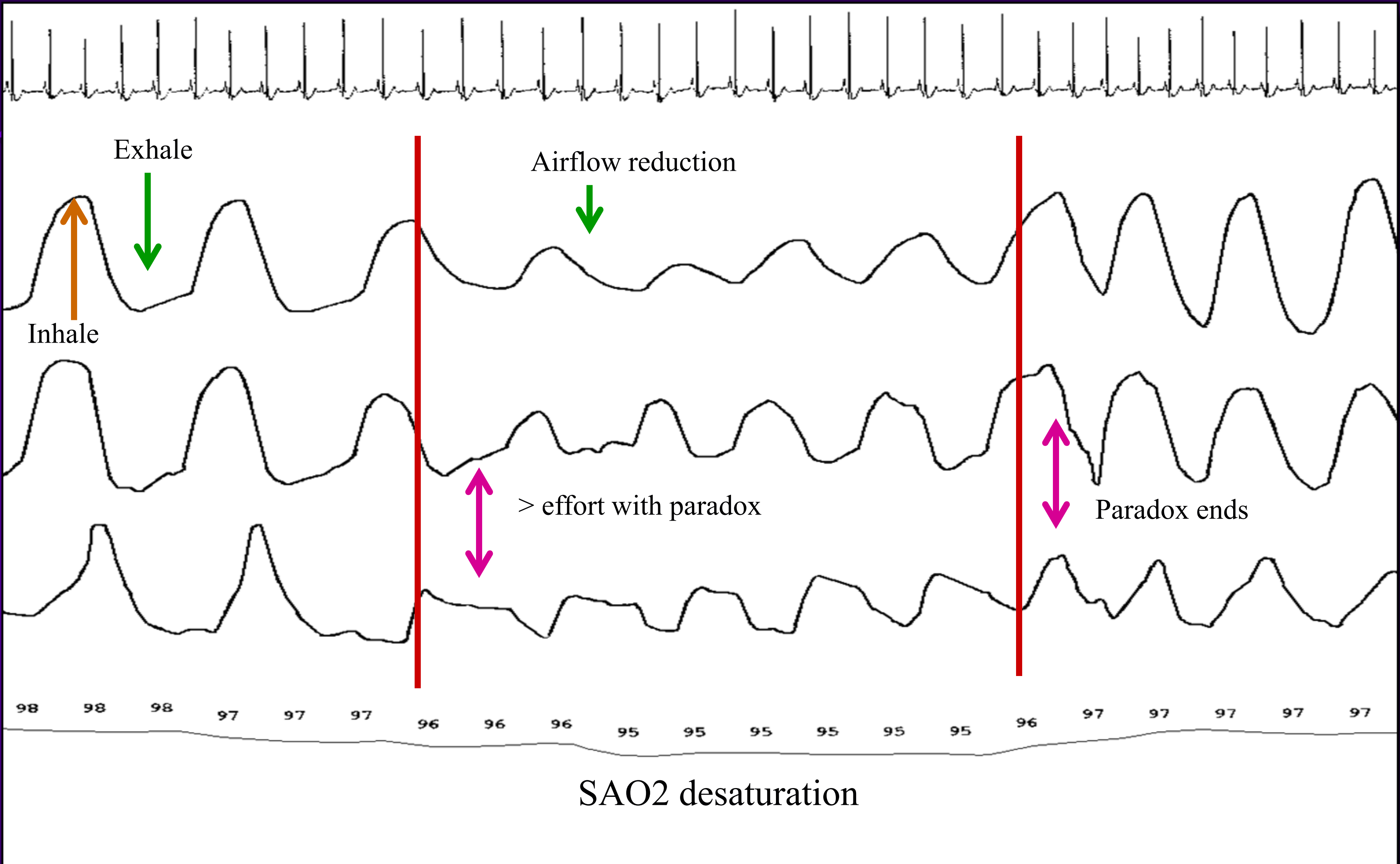
- No airflow for $\geq$10 seconds
- Increased respiratory efforts. Usually seen as a paradoxical.
- SaO_2 desaturation $\leq$3% (or $\leq$4%)



<u>Obstructive Apnea:</u> A complete blockage of the airway despite efforts to breath. Note the effort gradually increasing ending in airway opening.

Hypopnea

- Reduction in airflow of 50% of control values
- SaO_2 desaturation $\geq$3%
- Usually with steady increase of respiratory efforts
- Arousal



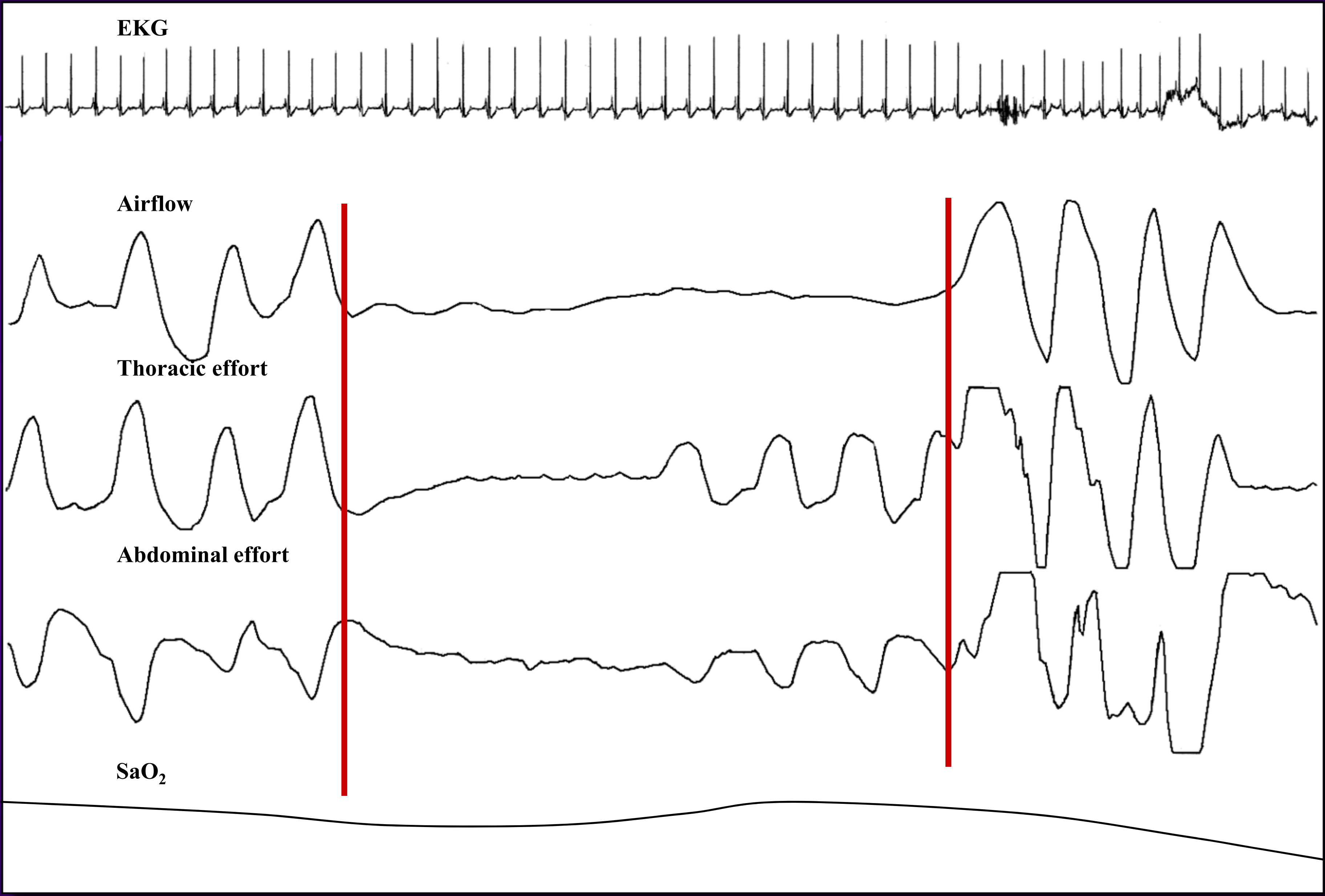
<u>Hypopnea:</u> Approximately 18 seconds. The airflow signal is reduced by approximately 50% during this event.

When hypopnea is scored as apnea?

- Hypopneas are scored as apneas when SaO_2 desaturation of $\geq$10% of the control value is present
- When the airflow drops <20% of baseline value
- When significant cardiac effect artifacts are seen during the event
- Same physiological consequences as apneas

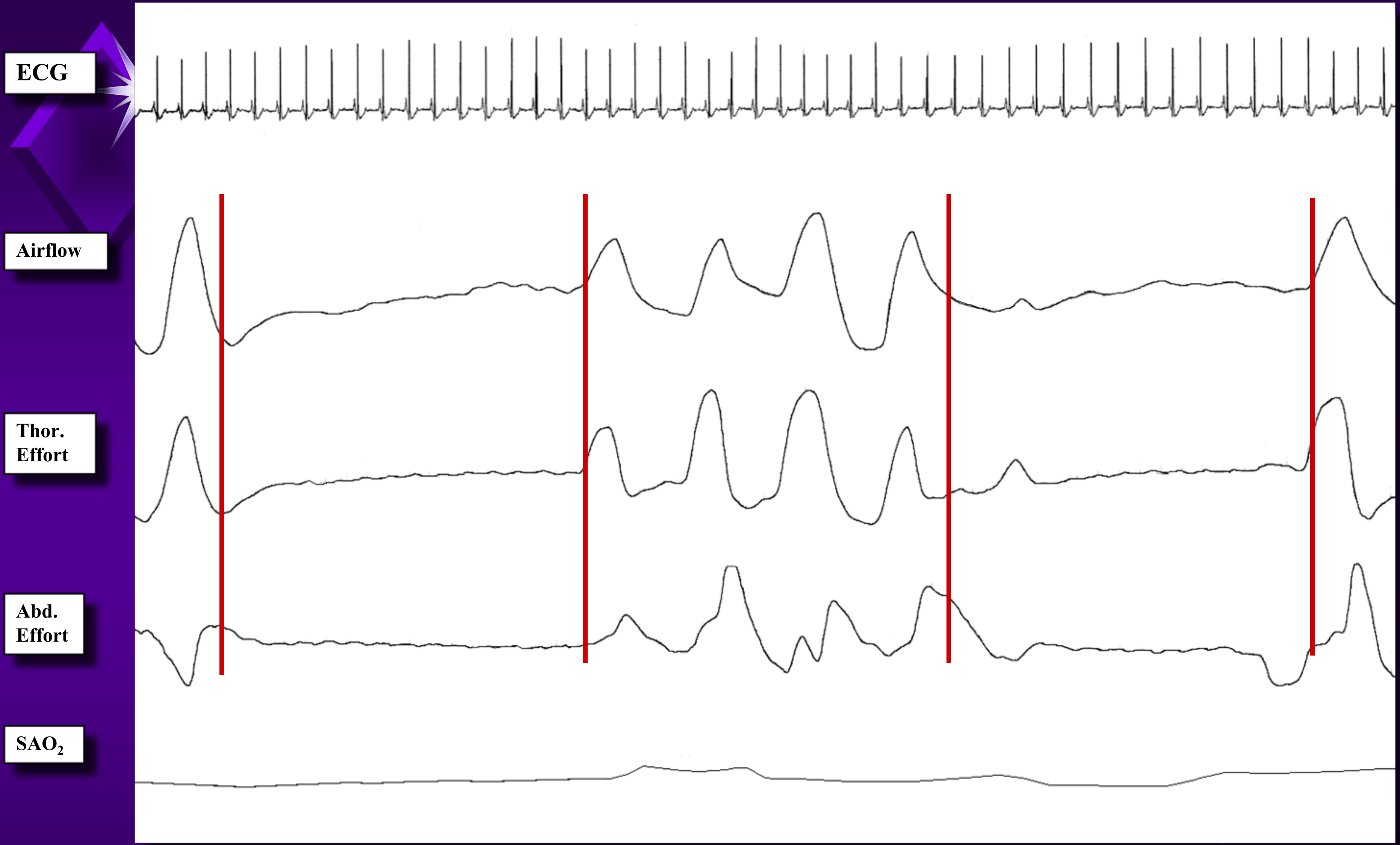
Mixed apnea

- A complete absence of nasal and oral airflow of $\geq$10 seconds
- A total absence of respiratory effort at the beginning of the event, followed by a gradual increase in effort which eventually breaks the apnea
- An oxygen desaturation of $\geq$3%


EKG
Airflow
Thoracic effort
Abdominal effort
SaO_2

Central Apnea

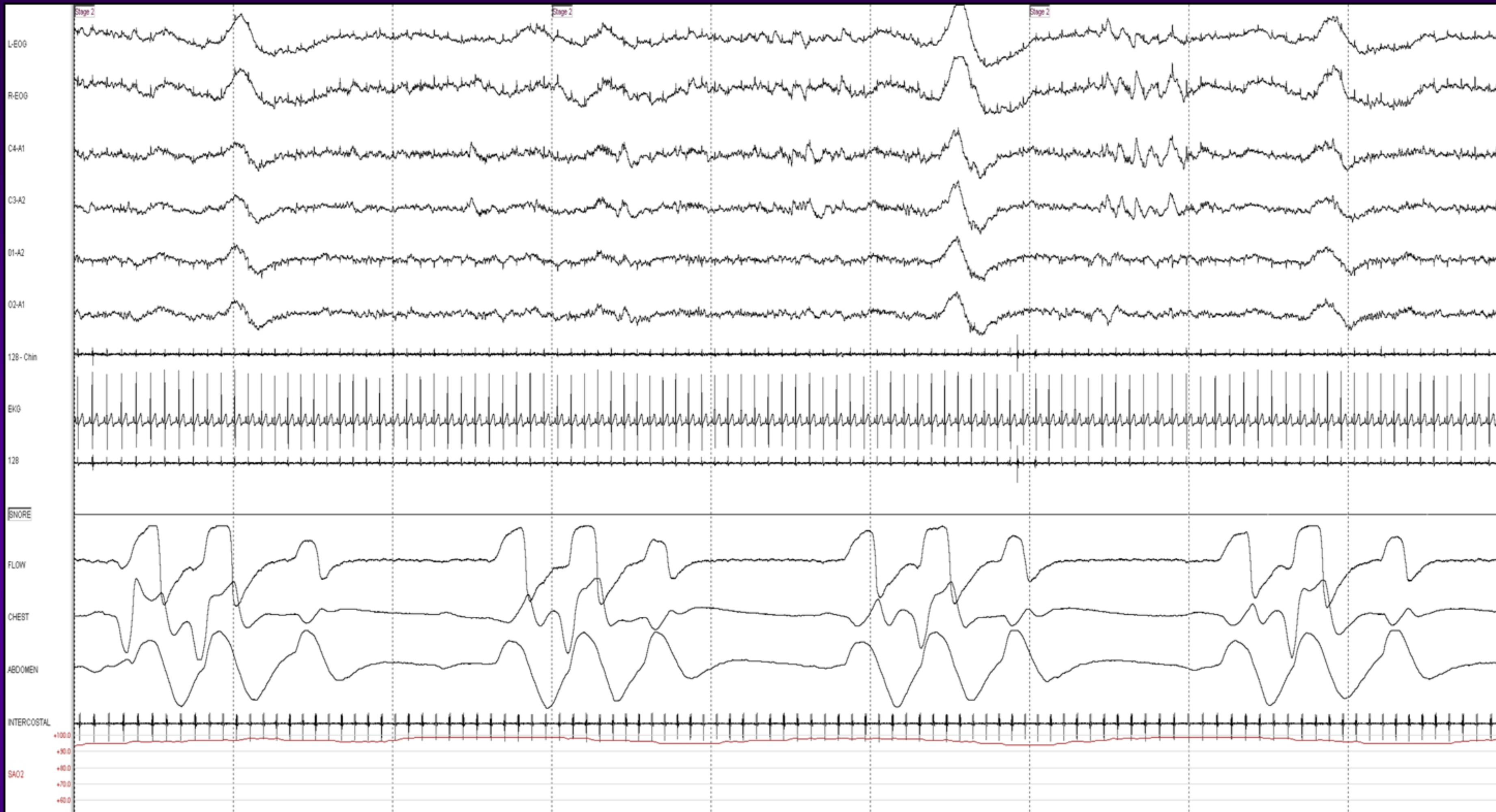
- Absence of airflow at the nose and mouth for $\geq$10 seconds
- A complete absence of respiratory effort as measured by:
  - Thoracic Expansion
  - Abdominal Expansion
  - Intercostal / Diaphragmatic EMG
- SaO_2 drop of $\geq$ 3%



Central apnea: These are central apneas (2) with minimal oxygen desaturation. Notice the low SAO2 at the beginning of this tracing. This is associated with a previous apnea. Both of these events between 13-16 seconds in duration.

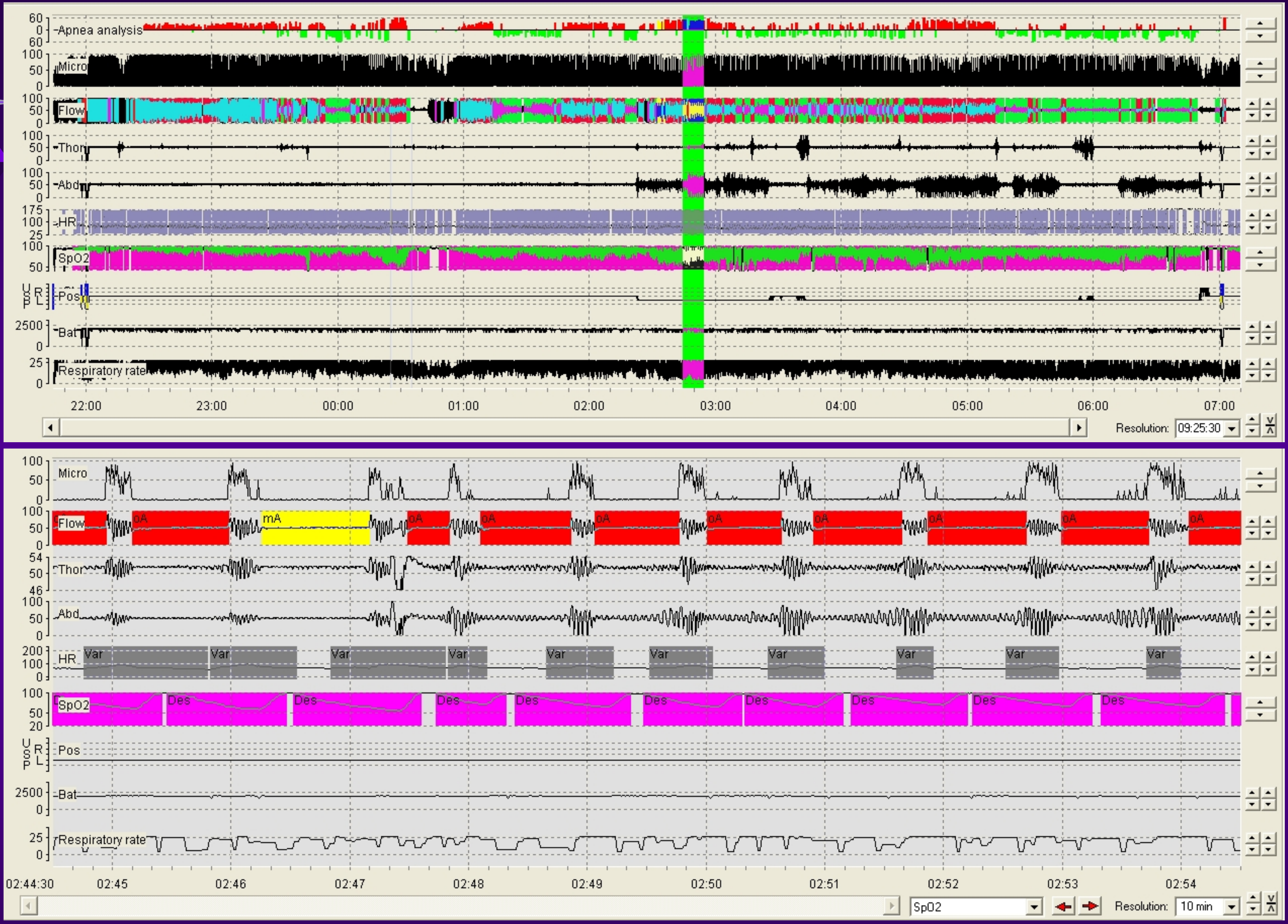
Cheyene-Stokes Respiration

- A crescendo-decrescendo respiratory pattern
- Usually associated with CHF
- Atrial Fibrillation may be present

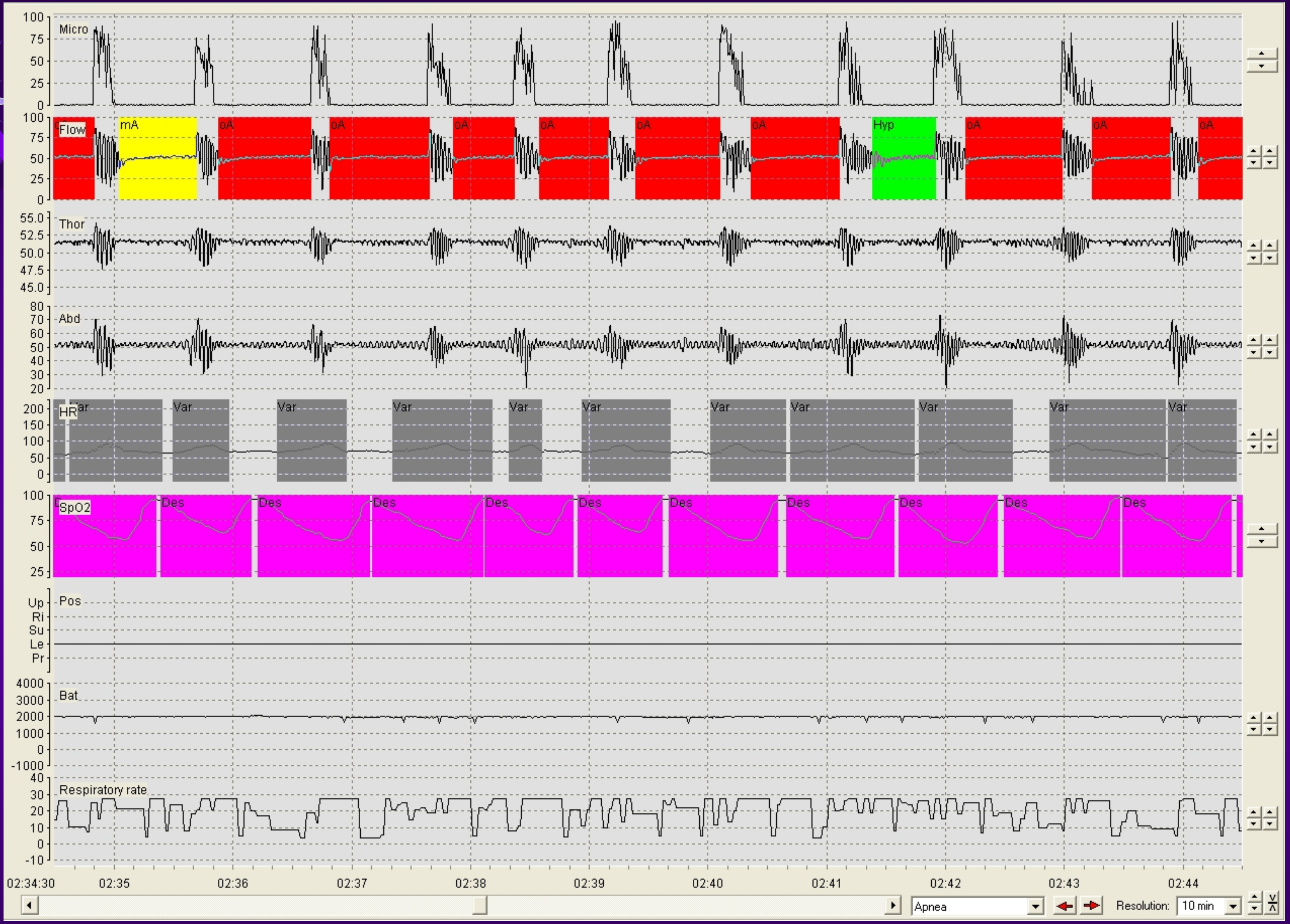


90 seconds

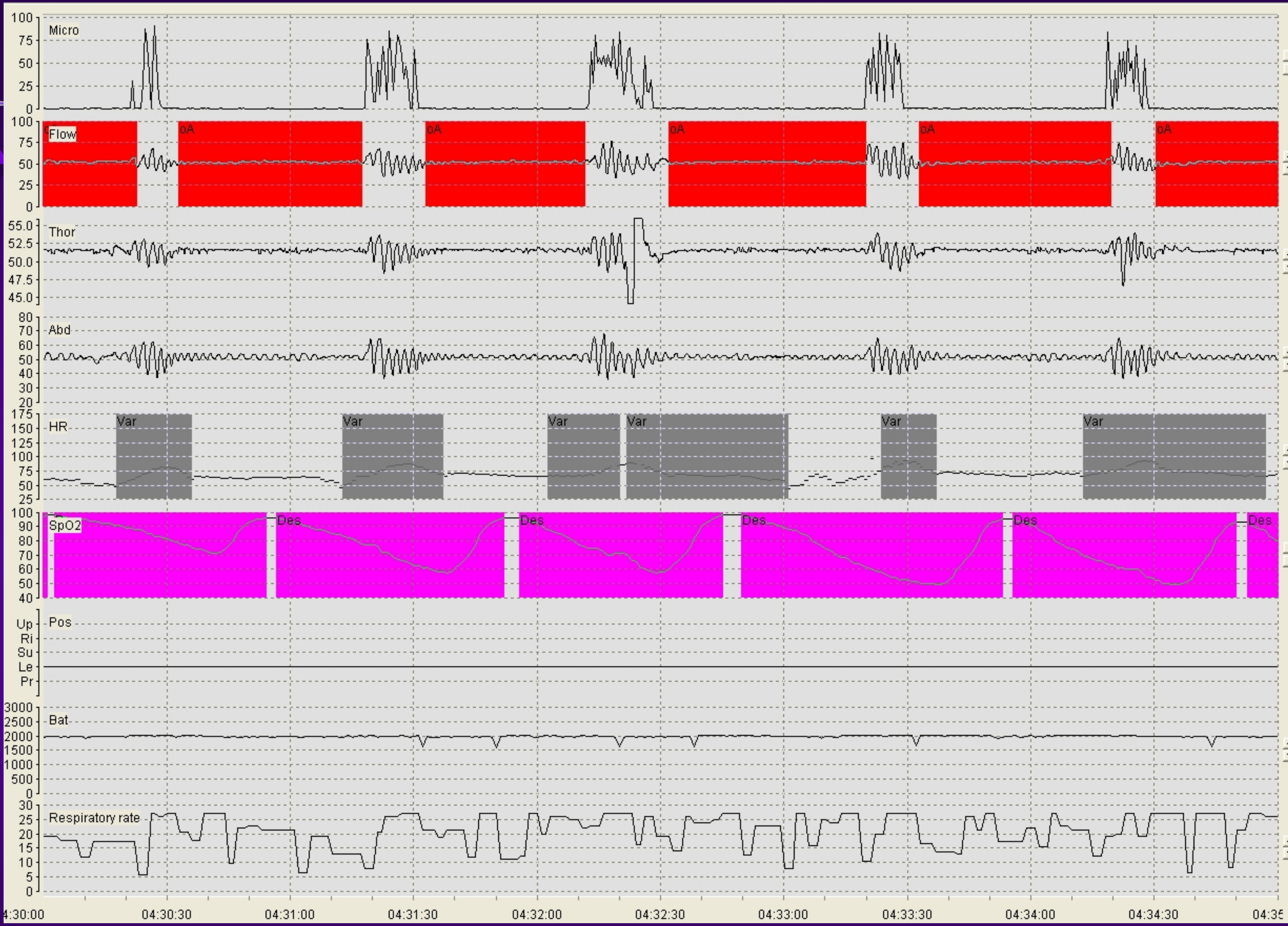
Cheyne-Stokes breathing



From our Laboratory. Numerous apneas followed by significant desaturations; Periodic breathing. Upper: Whole-night recordings; Lower: 10-minute recordings.



From our Laboratory. Numerous apneas followed by significant desaturations; Periodic breathing. 10-minute recordings



From our Laboratory. Apneas followed by significant desaturations; Periodic breathing.

OSA treatement

- Obesity:
  - Diet
  - Changes in behavior
- Posture therapy:
  - Uplifting the head and neck
  - Alarm
  - Tennis balls in a sleepwear
- Increasing the muscle tone:
  - Drugs
  - Elektrical stimulation of m. genioglossus

OSA treatment

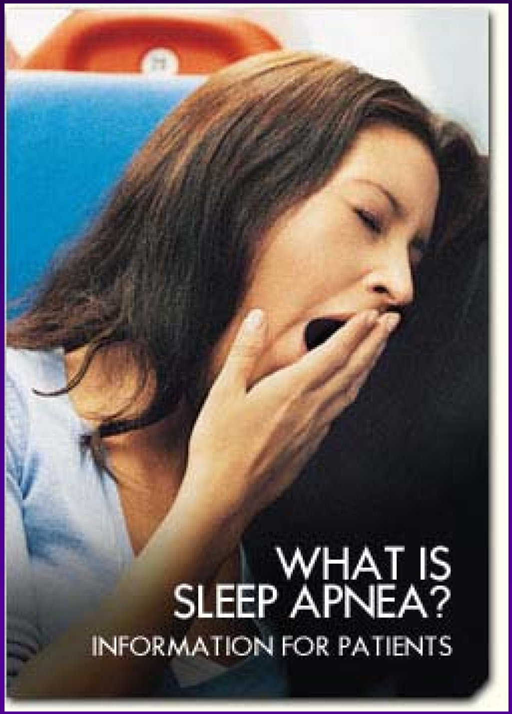
- Mechanical (air) device in upper airways:
    - Nasal CPAP, BiPAP, Auto CPAP
    - Oral devices
- Reconstruction of upper airways:
    - Soft tissue surgery
    - Bone surgery
- Bypass of upper airways:
    - Tracheostomy

Surgical treatment of OSA

- UPPP - Uvulo-Palato-Pharingo Plasty
- LAUP- Laser Assisted Uvulo Plasty
- CAUP - Coblation Assisted Uvulo Plasty
- Surgery of the tongue
- Tracheotomy

CPAP therapy

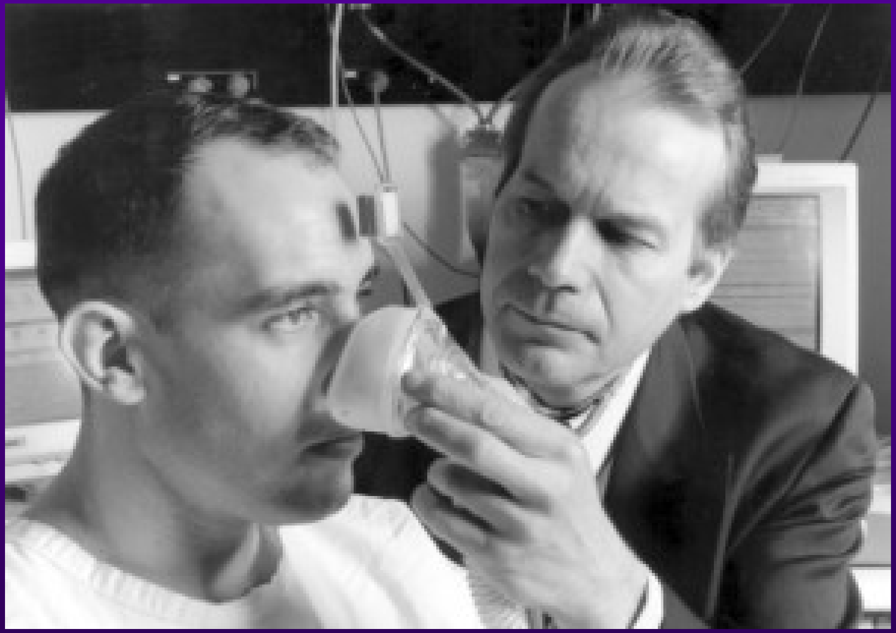
Continuous Positive Airway Pressure



GOLD STANDARD in the treatment of OSA

Device CPAP- ***C**ontinous **P**ositive **A**irways **P**ressure*

- To prevent upper airways closure



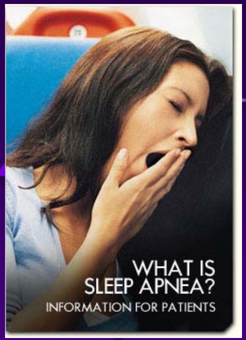
Colin Sullivan, Lancet, 1981.

With Colin Sullivan in Barcelona, 2015

OSA treatment

Goal:

- To find a balanced approach between surgical and conservative therapy



CPAP therapy

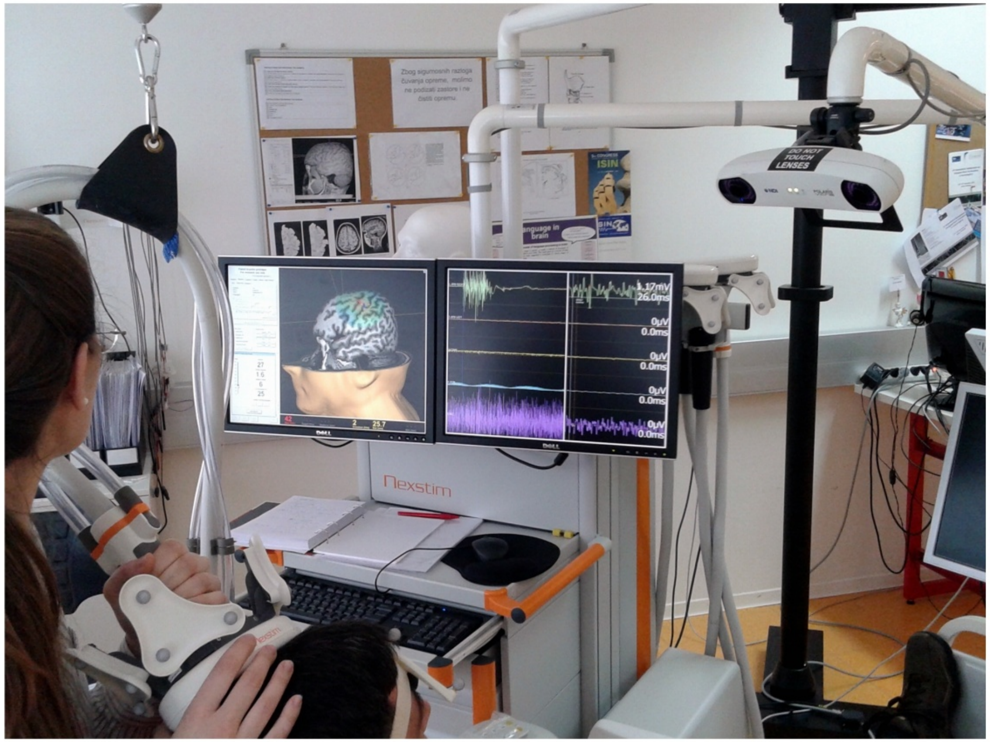
Continuous Positive Airway Pressure

- CPAP Th is presently covered in Croatia by the National Health Insurance Department!?
- As well as PSG

OSA and Transcranial Magnetic Stimulation TMS/MRI studies

TMS mapping in our Laboratory, Department of Neuroscience, School of Medicine, Split

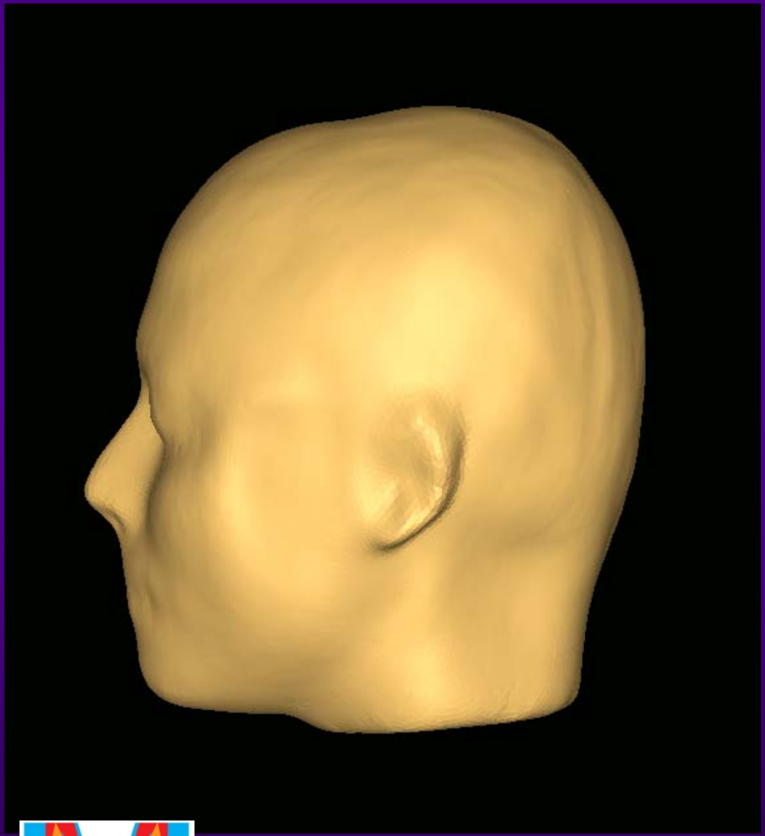
Performing individual MRI of the head

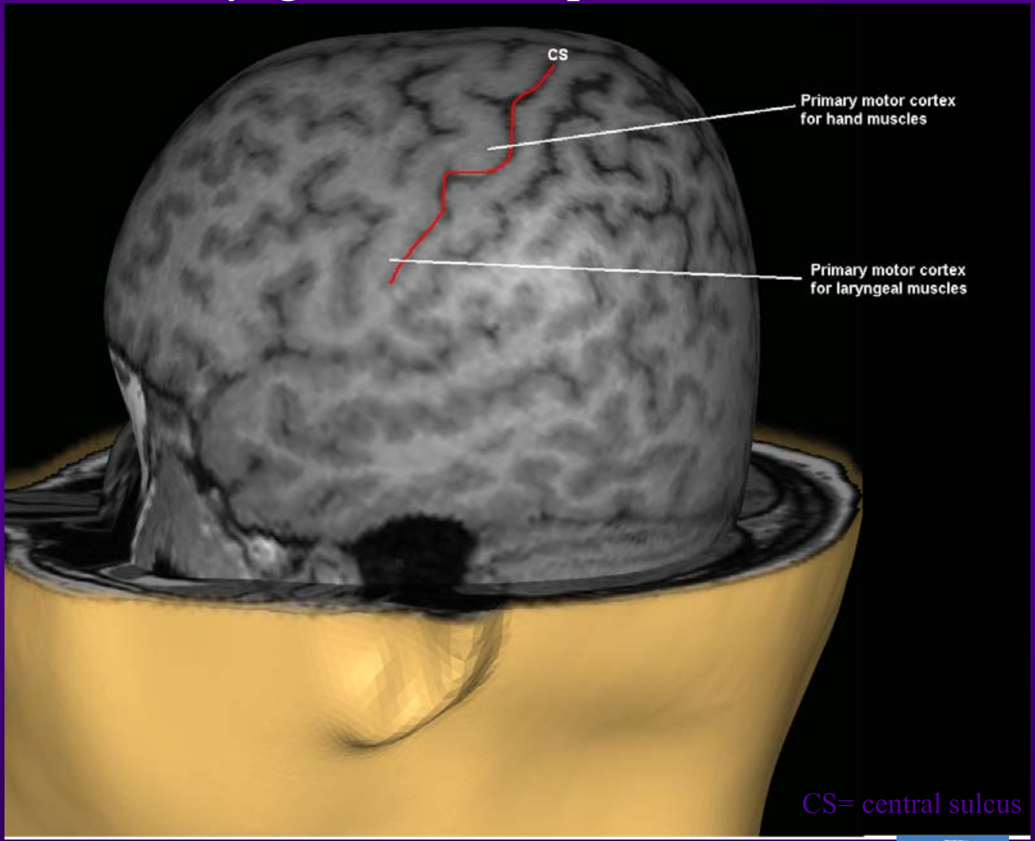


Cortical excitability of primary motor cortices in OSAS patients

- The aim is to test excitability of corticospinal vs. corticobulbar projections

Transcranial magnetic stimulation (TMS) will be used to perform **mapping of primary motor cortices for hand muscle and laryngeal muscle representation**



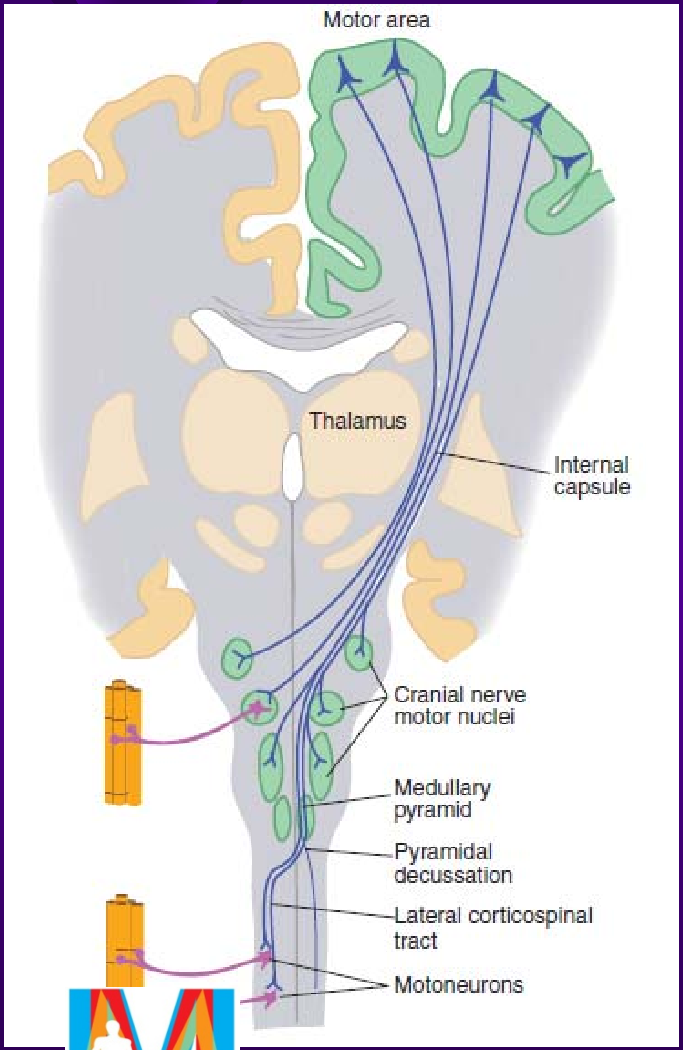


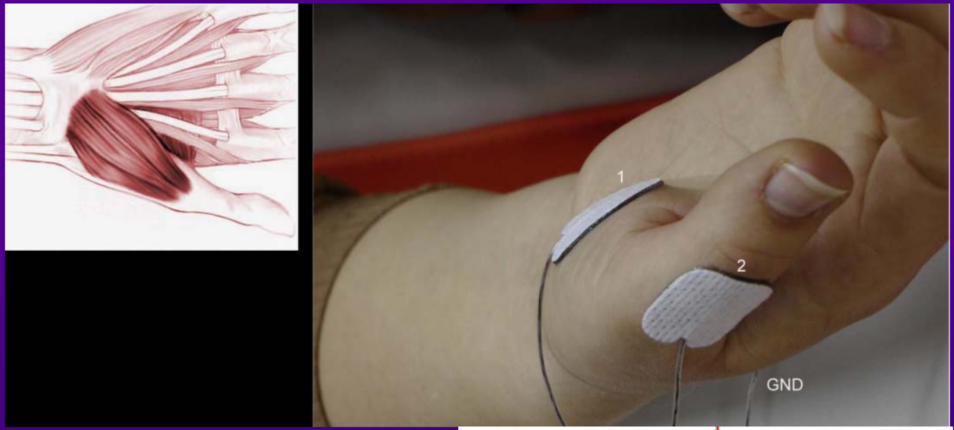
CS= central sulcus

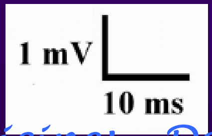
Mapping of primary motor cortices for hand muscle

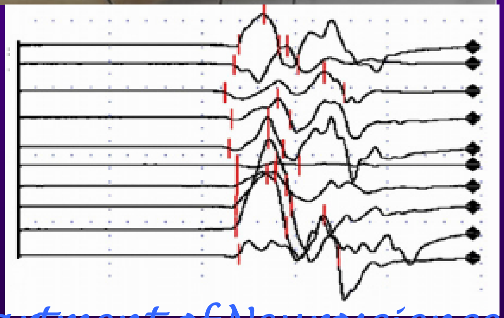
Magnetic stimulation of primary motor cortex for hand muscle (abductor pollicis brevis, APB) and recording motor evoked potentials (MEPs) from APB muscle.

Different neurophysiologic measures will be taken (e.g. Cortical silent period)



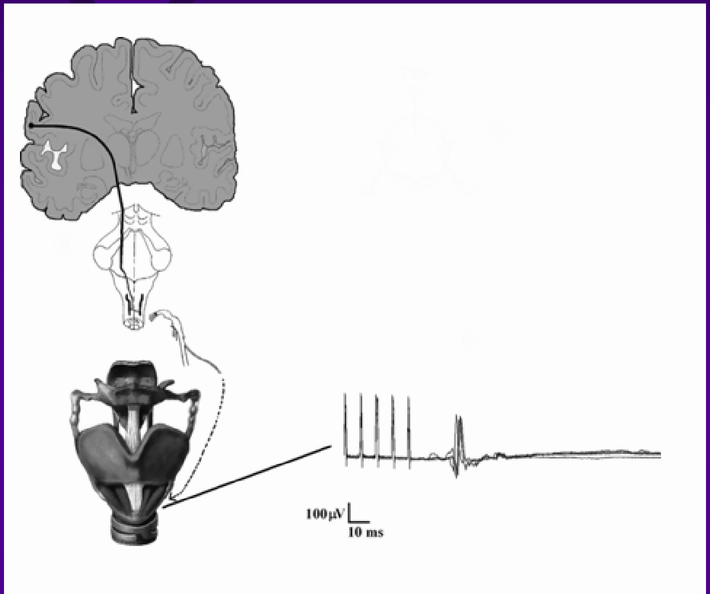


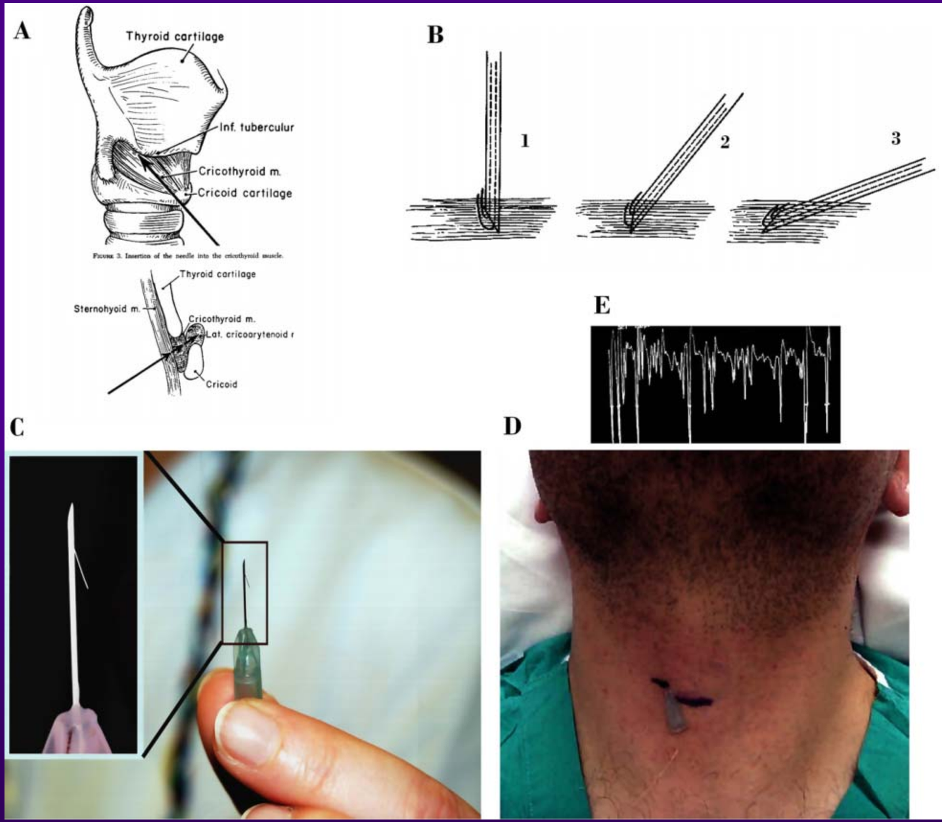




Mapping of primary motor cortices for laryngeal muscle

Magnetic stimulation of primary motor cortex for laryngeal muscle (cricothyroid) and recording motor evoked potentials (MEPs) from cricothyroid muscle.





A novel approach for monitoring writing interferences during navigated transcranial magnetic stimulation mappings of writing related cortical areas.
Rogić Vidaković M, Gabelica D, Vujović I, Šoda J, Batarelo N, Džimbeg A, Zmajević Schönwald M, Rotim K, Đogaš Z.
J Neurosci Methods. 2015;255:139-150. doi: 10.1016/j.jneumeth.2015.08.003.

Excitability of contralateral and ipsilateral projections of corticobulbar pathways recorded as corticobulbar motor evoked potentials of the cricothyroid muscles.
Rogić Vidaković M, Schönwald MZ, Rotim K, Jurić T, Vulević Z, Tafra R, Banožić A, Hamata Ž, Đogaš Z.
Clin Neurophysiol. 2015;126(8):1570-7. doi: 10.1016/j.clinph.2014.11.001.

Conclusion

- Do not forget OSA in the treatment of your patients
- Ask them about their sleep
- Ask about Excesive Daytime Somnolence
- “Stanford study” showed that 50% of patients have complaints about sleep, and only 2% of patients have those complaints registered by their Family Doctors

Special news

Croatian Somnological Society – Society for Sleep Medicine
of the Croatian Medical Association

The necktie originates from **cravat** worn by 17th-century **Croat soldiers**

Not so obvious link to Sleep Medicine

(neck size in OSA patients?, pathophysiology of OSA, etc.)

The take home message:

“God put me on Earth to accomplish certain number of things.

Right now, I am so far behind I think I will never die.”

On the lab door of one of my colleagues

TEAM:

Zoran Đogaš
Maja Valić
Renata Pecotić
Ivana Pavlinac
Linda Lušić
Tea Galić
Maja Rogić Vidaković
Ana Šarić
Joško Božić
Jelena Baričević
Natalija Ivković
Dijana Radanović
Mladen Carev
Nenad Karanović
Božena Ivančev
Vjera Mladinov

Collaborators:

Goran Račić
Željka Roje
Tina Tičinović Kurir
Zoran Valić
Mario Mihalj
Slaven Lupi Ferandin
Dušan Šuput, Slovenia
Sanda Mustapić
Toni Brešković

With students
of the Neuroscience
section


Thank you !

Split, February 3, 2012