



Rete
Nazionale
Trapianti



*Transplant
Procurement
Management*



Determinazione di Morte con criteri neurologici (Brain Death)

Francesco Procaccio

Bologna 27 maggio 2015

Obiettivi didattici

1. Conoscere le basi fisiopatologiche del concetto di morte
2. Saper rispondere alle domande inerenti la “morte encefalica”
3. Sapere come si effettua in pratica la diagnosi di morte con criteri neurologici
4. Conoscere quando e quali test confermatori utilizzare

Human hibernation: Secrets behind the big sleep

The big sleep

Scientists believe two key genes could induce hibernation in humans

Astronauts will be able to travel into deep space when put into a state of hibernation

OTHER USES

On the battlefield: severely injured soldiers could be induced to hibernate until they receive proper medical attention

Donor organs: organs could be placed in a state of 'sleep' and stockpiled, reducing waiting times

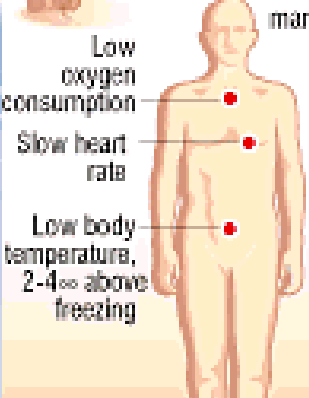
The effects of hibernation

The hibernation genes discovered in squirrels are also found in man

Low oxygen consumption

Slow heart rate

Low body temperature, 2-4°C above freezing



Home Future Our technology Registration Client zone Press room

Experience the real future

... leave today and come back after 50 years...



- Discover great new technologies
- Have fun with your great-grandchildren
- Enjoy yields of your long-term investments
- Day by day enjoy achievements of the new era

Let your body freeze.

Are you interested in more information? Insert your e-mail address please and press OK.*

@

* Your address will be used only for the purposes of delivering IceLift project information. It won't be given out to third persons.

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Indice

1. Razionale clinico per la diagnosi di morte
storia e basi fisiopatologiche della ME
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Filosofia di Errore Zero – ridondanza
4. Simulazione pratica
Esercitazione in plenaria

Vita

in 1950

Morte

Funzione cardiocircolatoria

Cardiocirculatory function

Ventilazione

(**encefalo**)

Ventilation

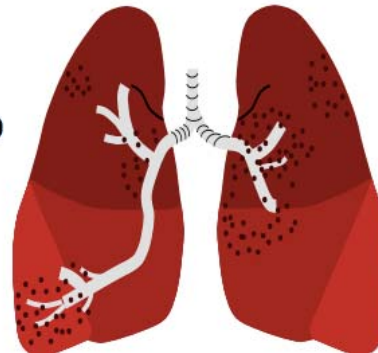
Quando il cuore
si ferma.....



il cervello muore
perché non
riceve sangue...



e il respiro
cessa



p.p.d. 2012

Vita

in 1950

Morte

Funzione cardiocircolatoria

Cardiocirculatory function

Ventilazione

(*encefalo*)

Ventilation

[October 16, 1953]

The Epidemic of Poliomyelitis in Copenhagen, 1952

By H. C. A. LASSEN

*Professor of Epidemiology, University of Copenhagen
Chief Physician Blegdam Hospital, Copenhagen, Denmark*

Vita

in 1950

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(Encefalo)

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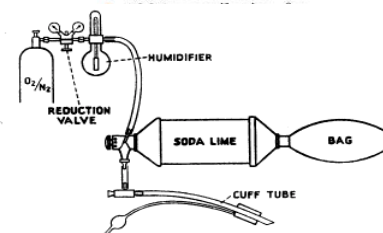
Bjørn Ibsen (1952)



ANAESTHESIA AND INTENSIVE CARE



1929: tank ventilator



World Anesthesia Day 16th Oct

Vita



Morte

Ventilazione

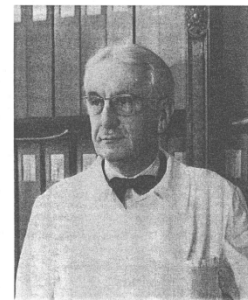
Meccanica NEUROLOGIQUE

Coma Dépassé 1959

LE COMA DÉPASSÉ
(MEMOIRE PRÉLIMINAIRE)

PAR MM.

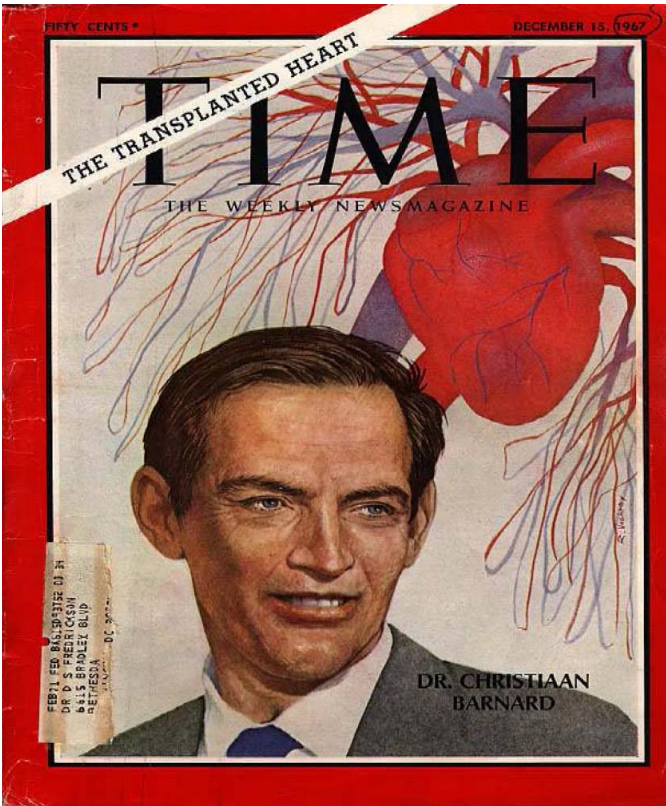
P. MOLLARET et M. GOULON



flexion, nous croyons venu le moment d'ajouter, en hommage à la XXIII^e Réunion Neurologique, que le problème du coma dépassé a été mis, l'année dernière, à l'ordre du jour de la prochaine Journée de Réanimation de la Société de Neurologie, le 7 octobre 1959, en vue d'une mise au point

on, qui n'a ainsi qu'une valeur préliminaire, en hommage à la XXIII^e Réunion Neurologique, nous acceptons de tenir une de ses séances dans le but d'élaborer ce travail. Précisons également que nous nous sommes inspirés de l'important volume qui a été publié par Gold et P. Mathis (*Obnubilations, comas et coma dépassé*, 1959, p. 5 et pp. 51-52) ; nous remercions les auteurs de nous avoir fait présenter les premiers malades et d'avoir mis à notre disposition certains de nos documents.

Vita



You are dead when your doctor says you are.

(Newsweek, December 1967)

Morte

Harvard Criteria - 1968

A Definition of Irreversible Coma

Report of the Ad Hoc Committee of the Harvard Medical School
to Examine the Definition of Brain Death

The Neurological Standard

The Neurological Standard

The gold standard

A seminal paper on neurological determination of brain death was written by the Harvard ad hoc Committee.² There was a desire in the 1960s to produce a brief but succinct document due to a pressing need in the critical care community for guidelines. To this day, the Harvard criteria remain an example of simplicity. The criteria were as follows:

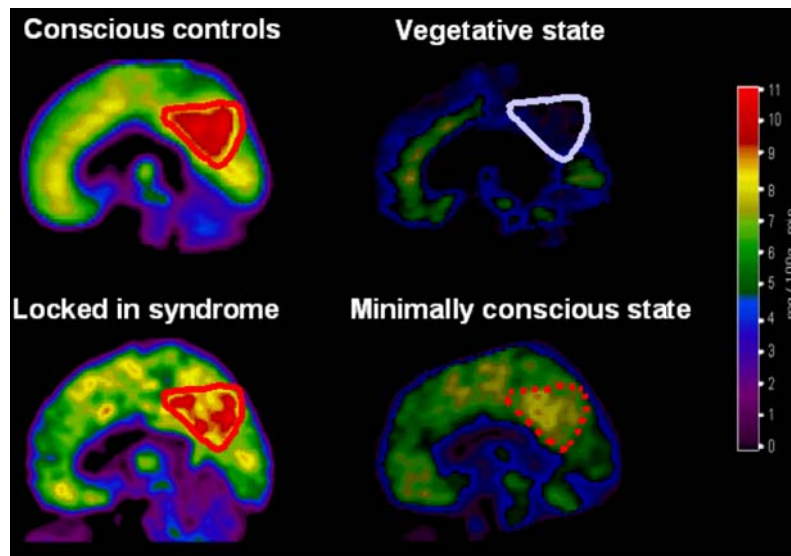
1. Unreceptivity and unresponsiveness;
2. No movement or breathing;
3. No brainstem reflexes;
4. Flat electroencephalogram;
5. All tests repeated at least 24 hr later, with no change, and exclusion of hypothermia (body temperature $< 90^{\circ}\text{F}$ or 32.2°C) or central nervous system depressants.

The Ad Hoc Committee
man; Raymond D. ...
J. Curran, LL.M., S ...
Farnsworth, MD; ...
PhD; John P. Mer ...
ThD; Robert Schw ...
Reprint requests
02114 (Dr. Henry K ...

Life



Death



Due storie in una:

Morte cerebrale e Trapianti

La certezza della morte prima della donazione è il fattore che per molti cittadini influisce maggiormente sulla scelta a favore o contro la donazione.

COSA E' LA MORTE ?

Risposta medica - pragmatica

The Astonishing Hypothesis

Crick, 1994

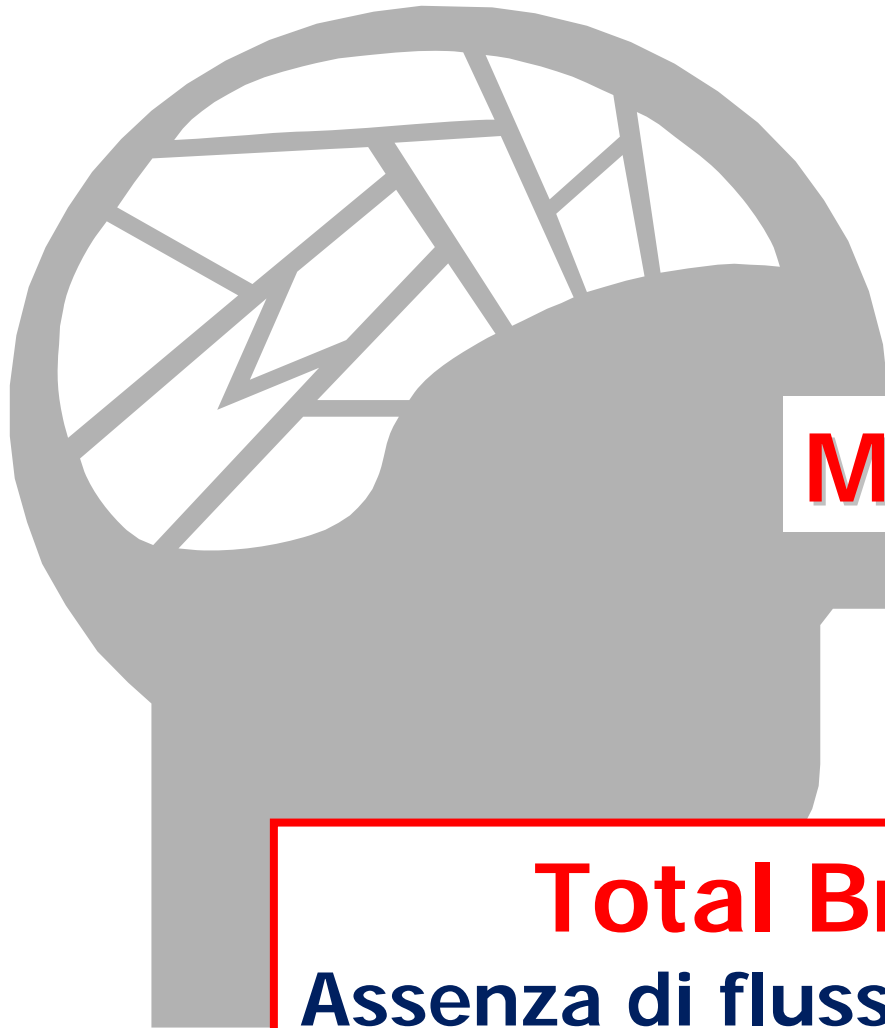
L'ipotesi sorprendente

Tu con le tue gioie, i tuoi dispiaceri,
i tuoi ricordi e i tuoi desideri,
il tuo senso di identità
il tuo pensiero...

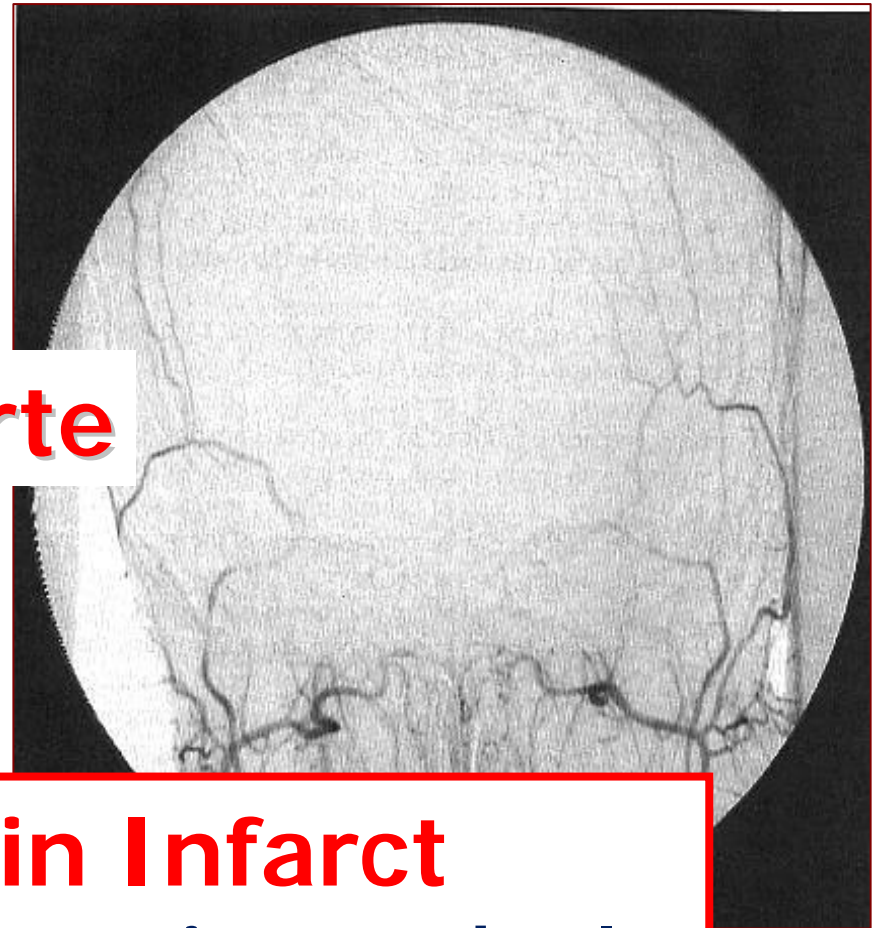
You are nothing but a pack of neurons !!

avrebbe detto Alice nel mondo delle meraviglie !

Cosa è la Morte ?



Morte



Total Brain Infarct
Assenza di flusso ematico cerebrale

*Perchè
la morte “encefalica”
è l’unica morte ?*

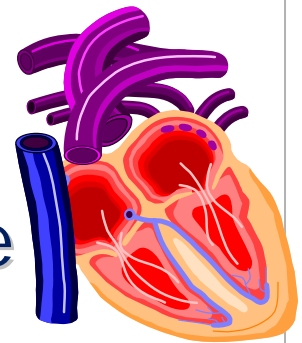
Patofisiologia

Quando una persona è morta?

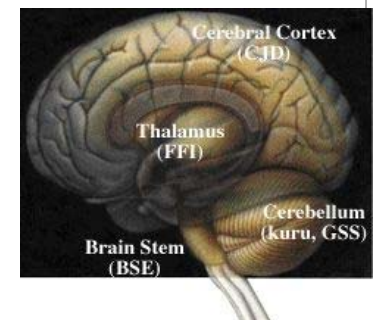
Perdita irreversibile di tutte le funzioni dell'encefalo

Due differenti meccanismi:

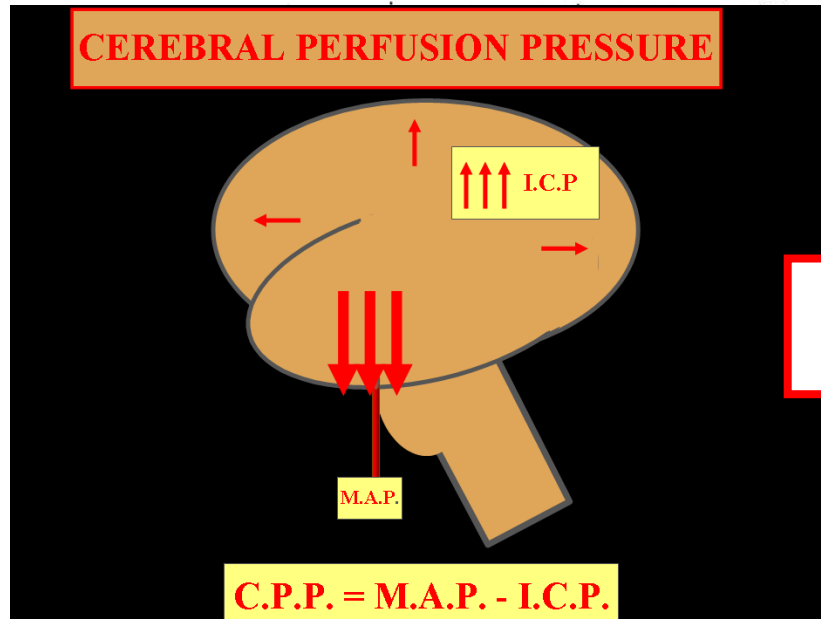
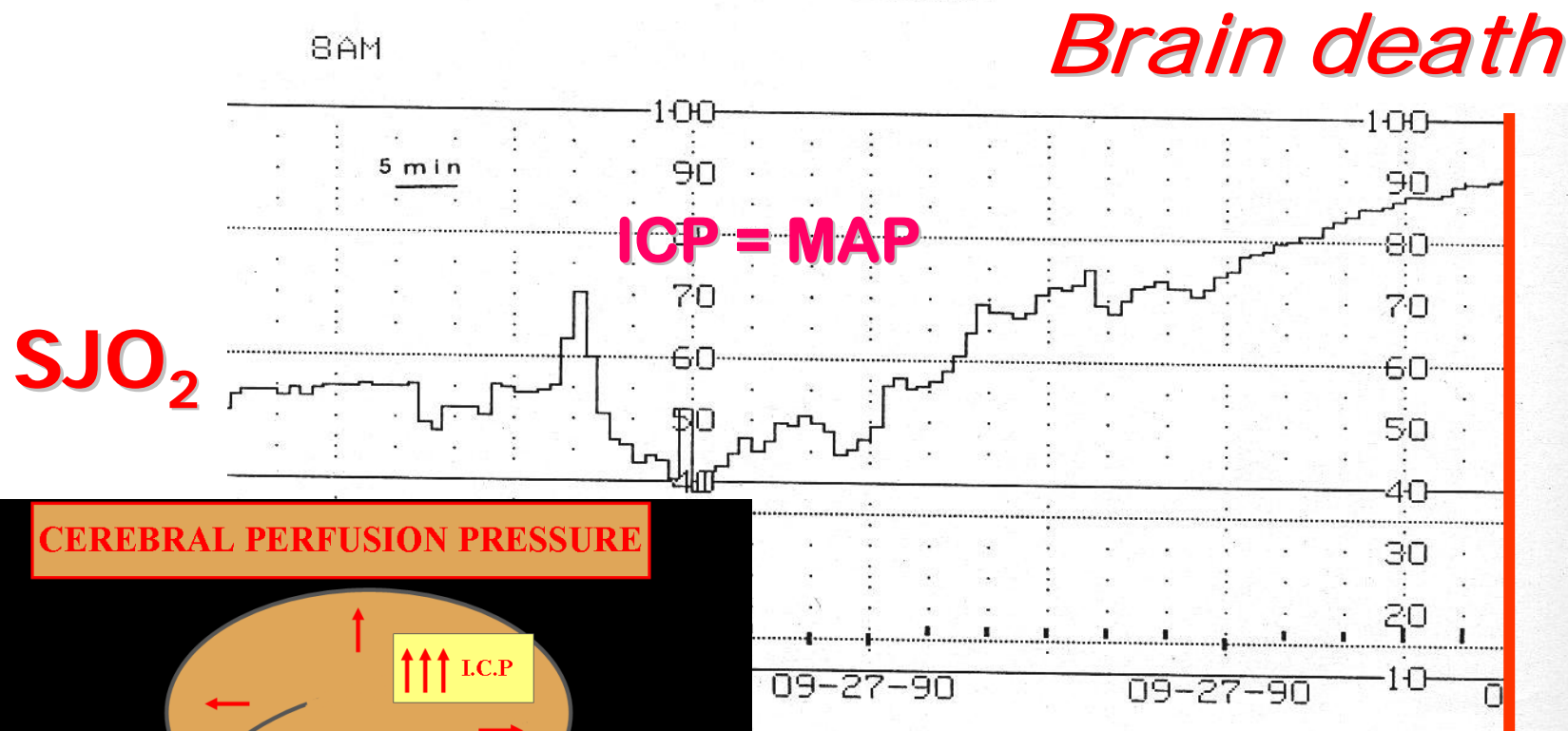
1. Arresto respiratorio e circolatorio
con danno cerebrale secondario irreversibile
(cadavere a cuore fermo)



2. Lesione cerebrale devastante
che causa la perdita totale
e irreversibile delle funzioni cerebrali
(Brain Death – cadavere a cuore battente)



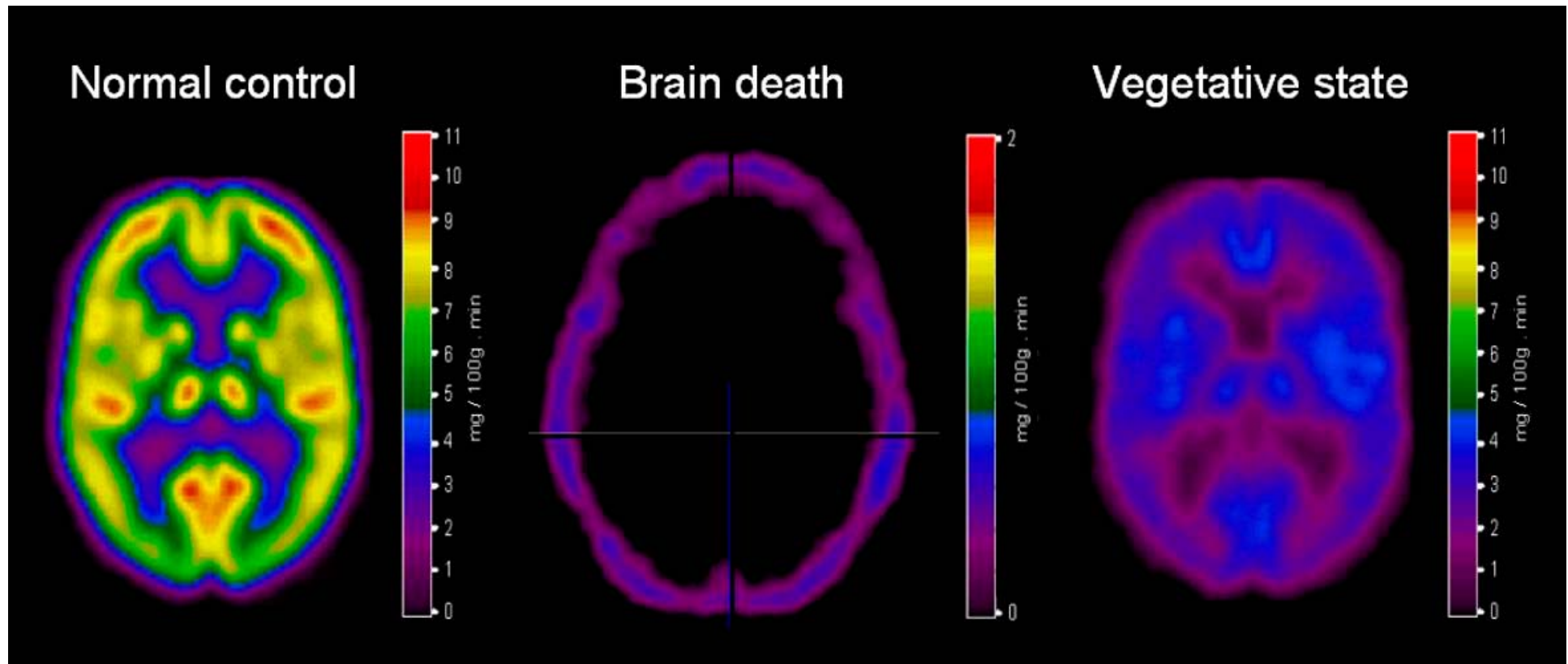
Cerebral Oxygen Metabolism



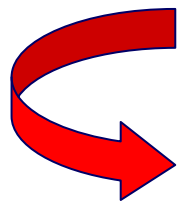
**La Morte è un
processo**

Conci F & Procaccio F, 1991

Cerebral Oxygen Metabolism



Morte (encefalica)



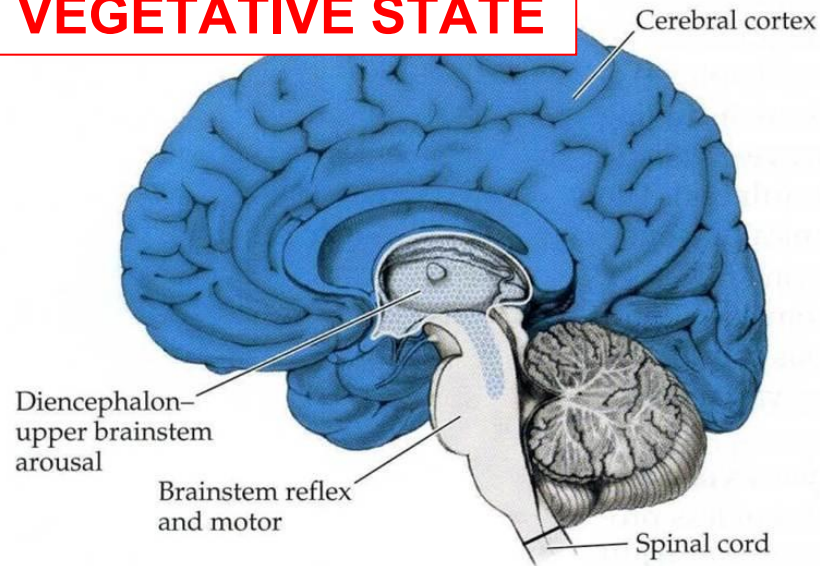
***“Perdita irreversibile di
tutte le funzioni
dell’encefalo”***

BD Definition

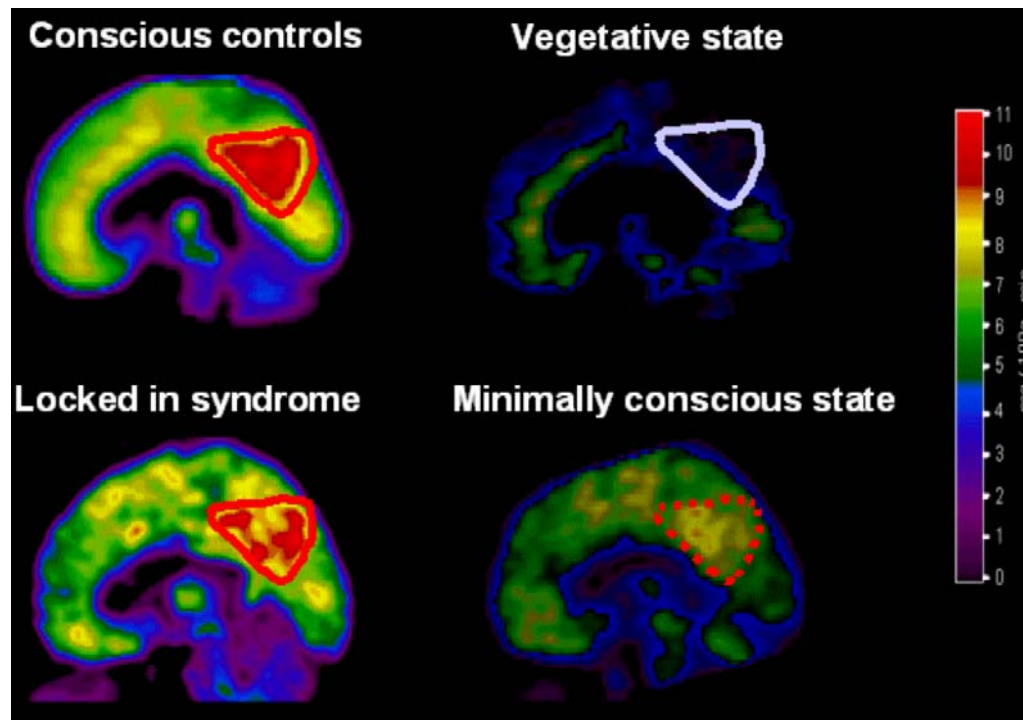
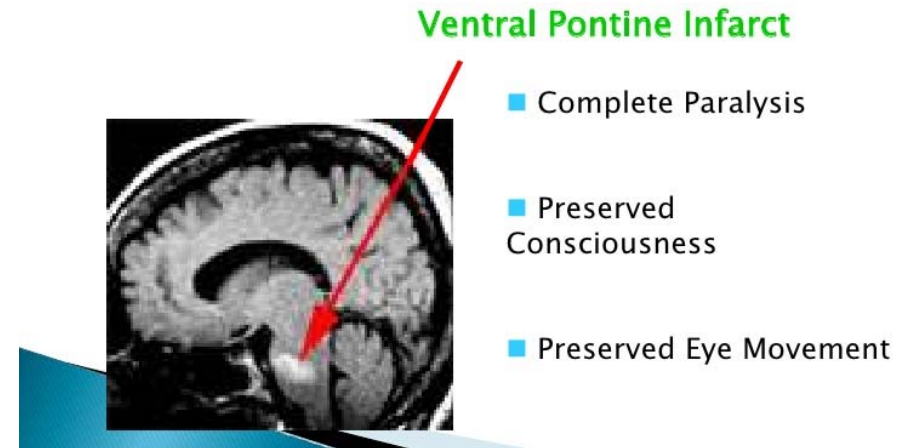
Brain Death is the irreversible loss of capacity for consciousness combined with the irreversible loss of all brainstem functions including the capacity to breathe.

**The Canadian Neurocritical Care Group,
1999**

VEGETATIVE STATE



LOCKED-IN SYNDROME



... the two essential components of human life (the capacity for consciousness and the capacity to breathe) depend on the integrity of these few cubic centimetres of [brainstem] tissue. (Pallis and Harley, 1996)

Brainstem death

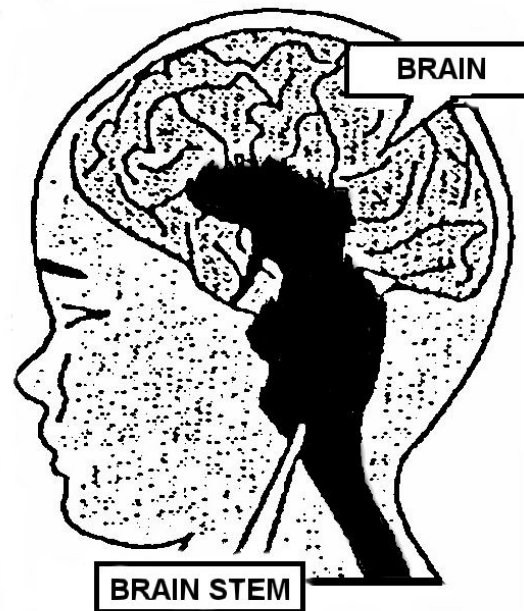


Anencefalia

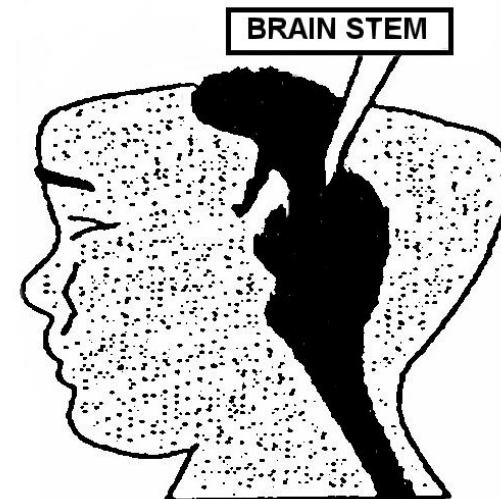
**Assenza delle funzioni
corticali
Tronco encefalico vitale**



NORMAL INFANT



ANENCEPHALIC INFANT



Determinazione di morte con standard neurologico

Determinazione di Morte con criteri neurologici

PATOFISIOLOGIA

TEST

IRREVERSIBILITA'

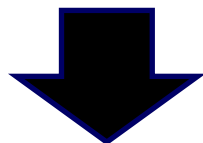
↓ **PRESSIONE PERFUSIONE CEREBRALE (CPP)** CPP

**EZIOLOGIA
&
PATOGENESI**

↓ **FLUSSO EMATICO CEREBRALE (CBF)** CBF

**No
CAUSE
REVERSIBILI**

↓ **METABOLISMO CEREBRALE (CMRO2)** CMRO2



**Funzioni dell'encefalo
Incluso il brainstem**

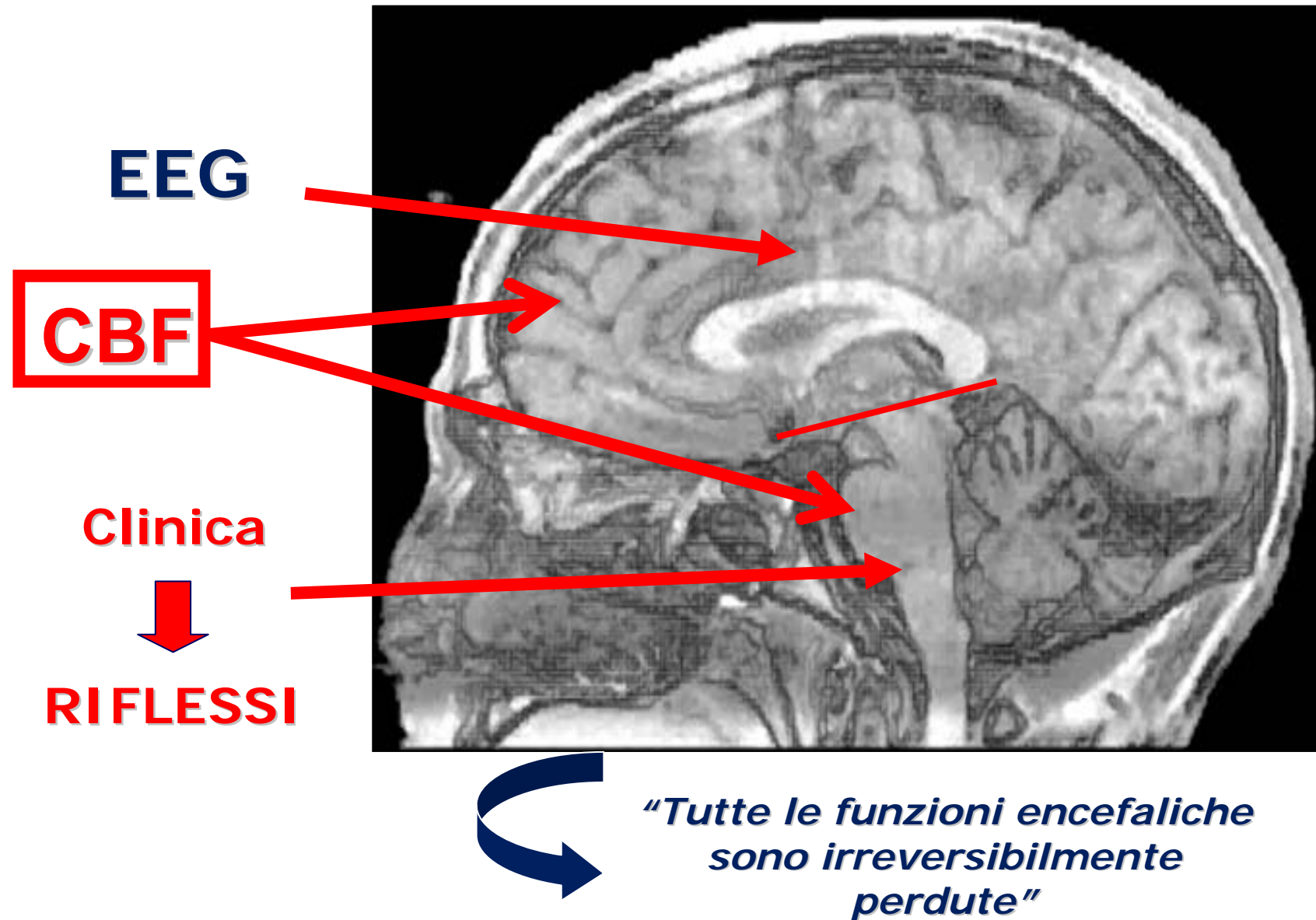
TEMPO

COMPLETA ASSENZA

Morte cerebrale = Morte

E' UNA DIAGNOSI CLINICA

Determinazione di Morte con criteri neurologici



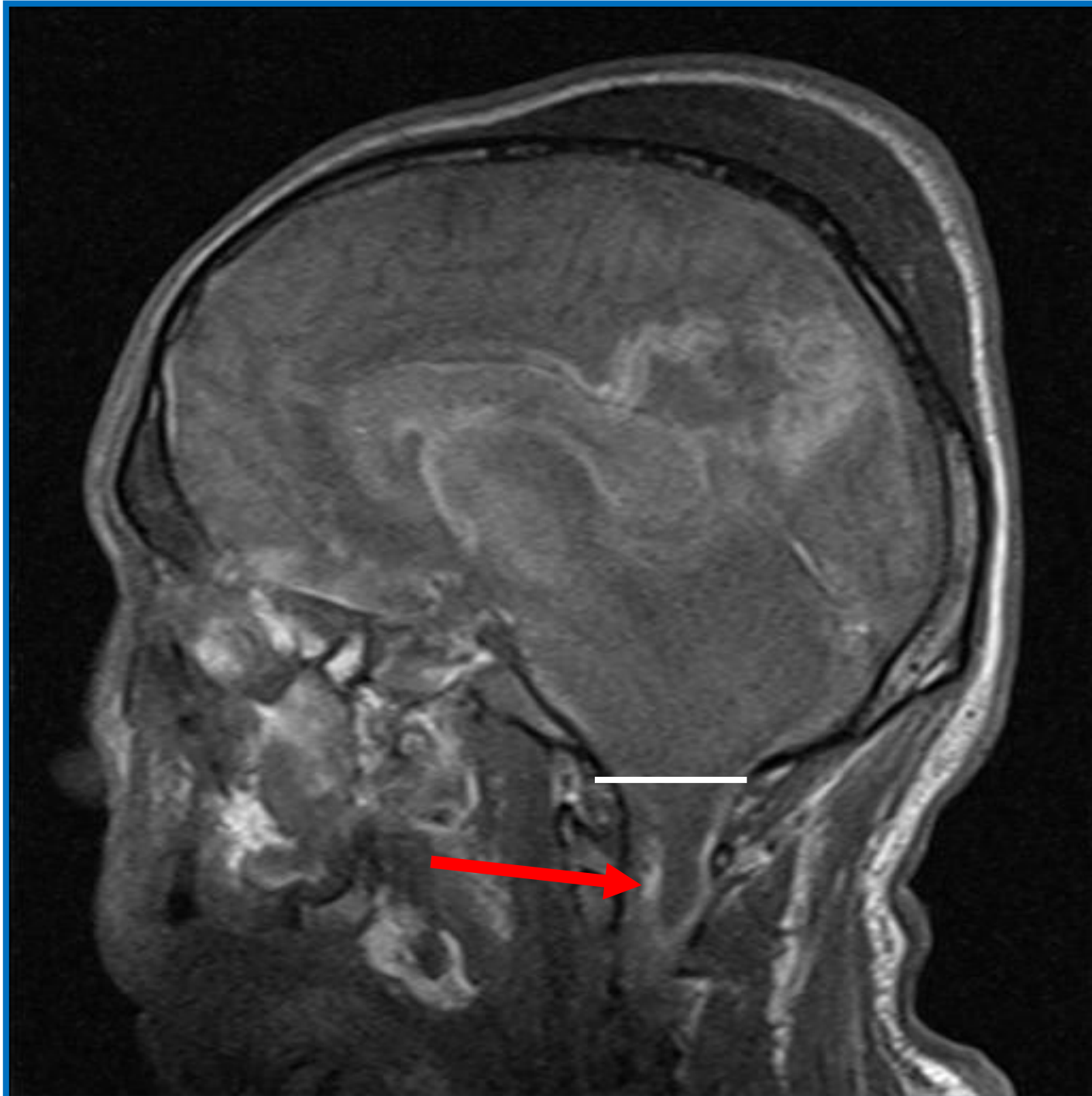
Pietre miliari

nella Determinazione di Morte con criteri neurologici

- 1. Esclusione tutti potenziali fattori confondenti**
- 2. Eziopatogenesi nota (irreversibile)**
- 3. Esame clinico completo con la presenza di tutti i segni e criteri**



Eziologia

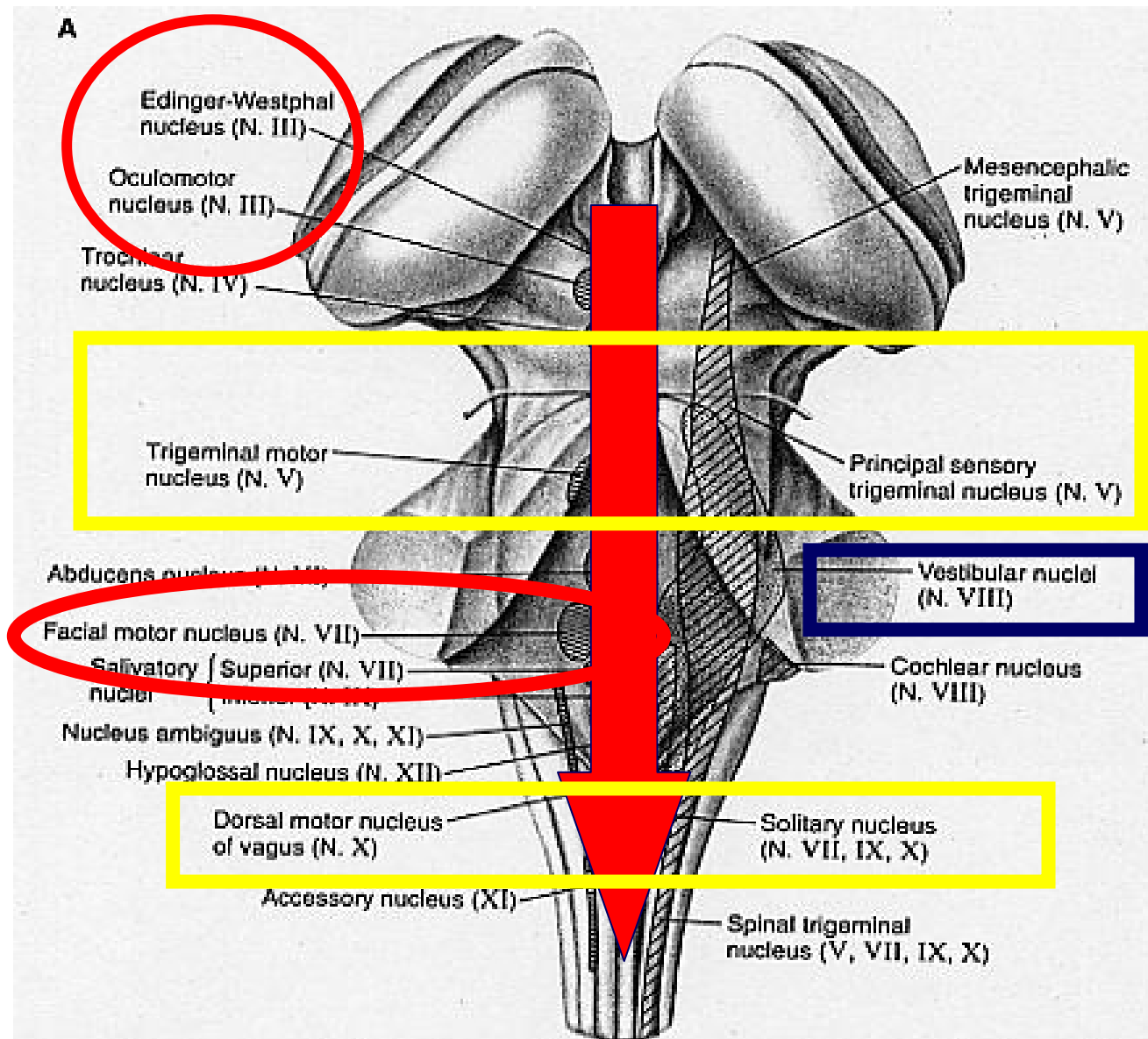


NMR

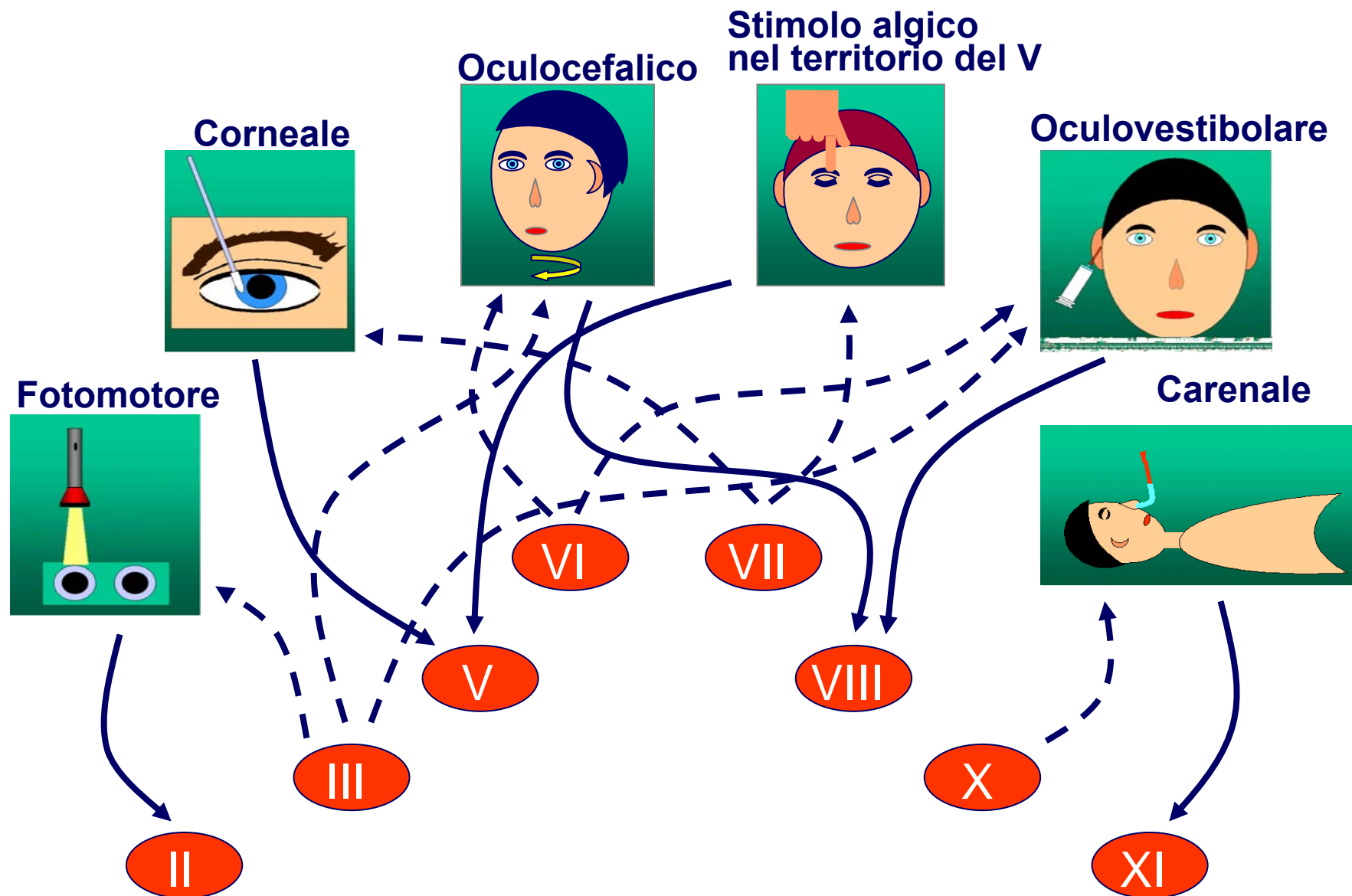
Prerequisiti per effettuare la diagnosi di morte

- 1. Certezza della causa e dell'entità del danno cerebrale (*imaging !*)**
- 2. Escludere effetto farmaci sul SNC**
(*barbiturici, curarici, atropina ...*)
- 3. Assicurare l'omeostasi sistemica**
(*Temperatura, PA, Ossigenazione, Na⁺ ...*)
- 4. Esame clinico affidabile e completo**

The Brainstem

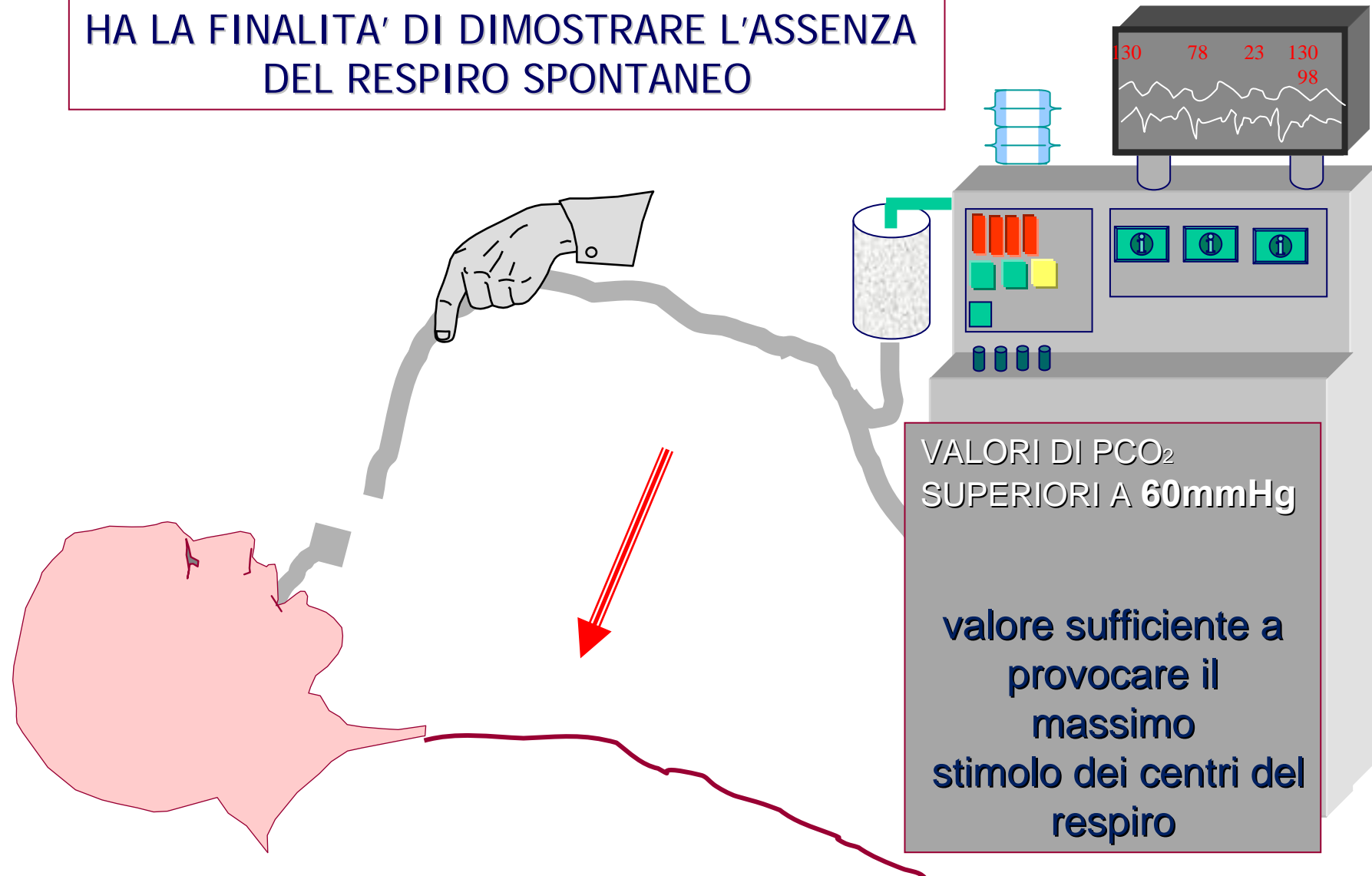


RIFLESSI DEL TRONCO CEREBRALE: VIE AFFERENTI ED EFFERENTI



TEST DELL'APNEA

HA LA FINALITA' DI DIMOSTRARE L'ASSENZA
DEL RESPIRO SPONTANEO



Apnea test metodologia

Emogas ripetute

Capnografia

Lung strategy (CPAP)

Situazioni critiche:

- Falso respiro
(pulse aortico – riflessi spinali)
- Lesione cervicale alta
- Patologia respiratoria
- Instabilità circolatoria

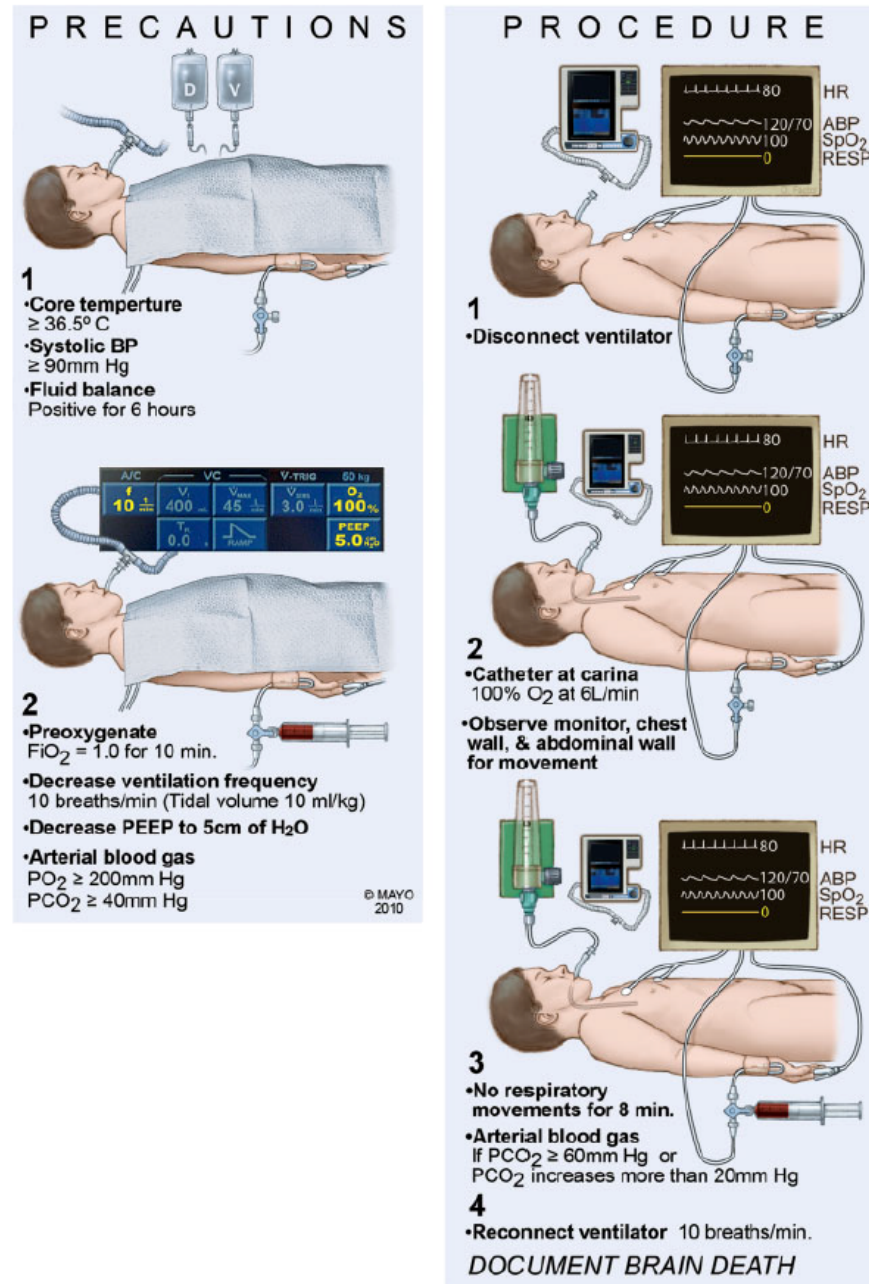


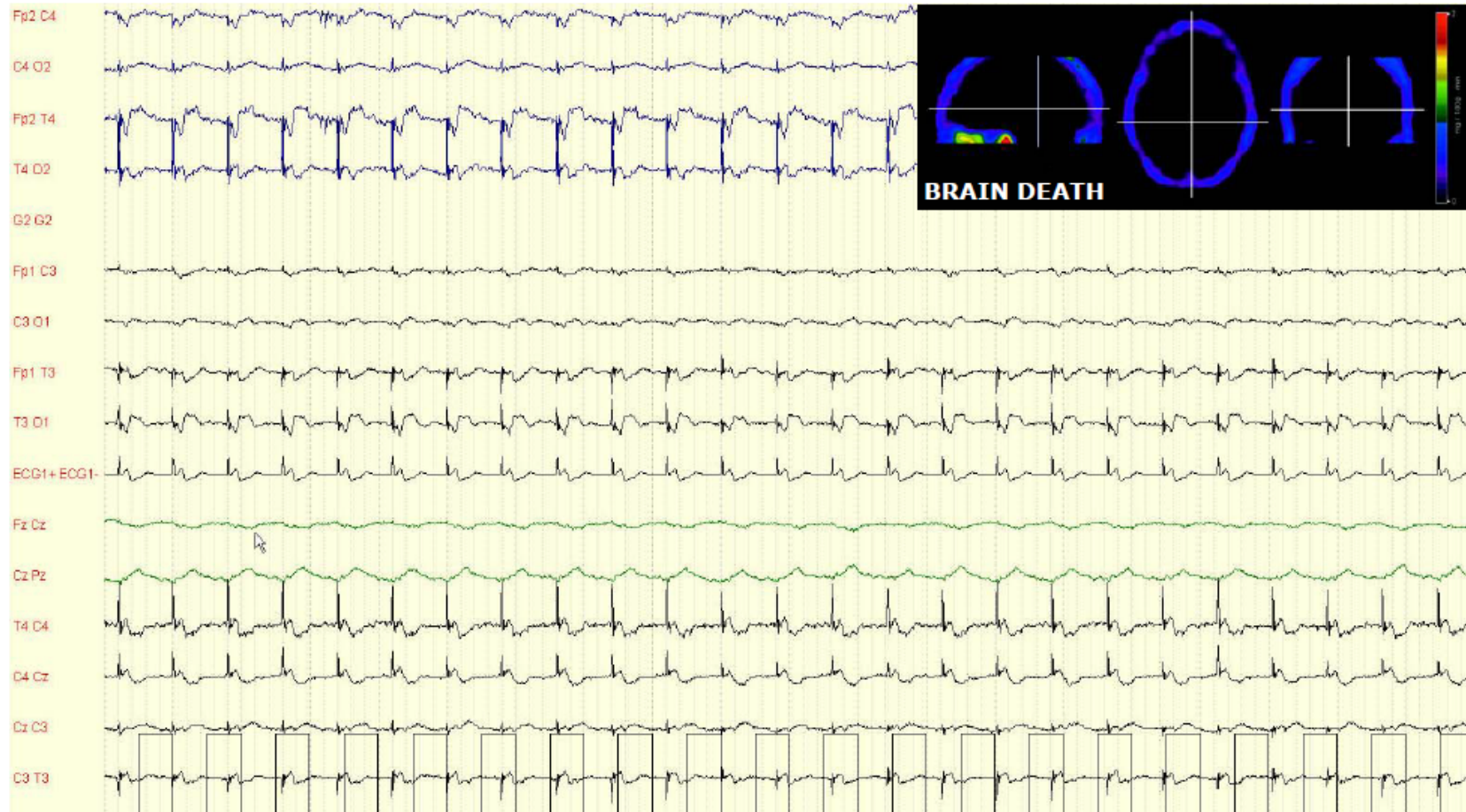
Fig. 2 Procedures associated with the apnea test. (Copyrighted by Mayo Clinic)

*Legge 29.12.93 n.578
D.M. 22.08.94 – 11.04.2008*

- ***EEG***

 indagine obbligatoria per legge
eseguito secondo modalità tecniche riportate in
DM del 2008

EEG: isoelectrical



Cerebral blood flow < 15 ml/100g/min

www.comascience.org

***L'assenza
di perfusione cerebrale
è un criterio
semplice, chiaro,
facilmente comprensibile
ed accettabile da tutti.***

Indicazioni alla Determinazione di assenza di Flusso Cerebrale

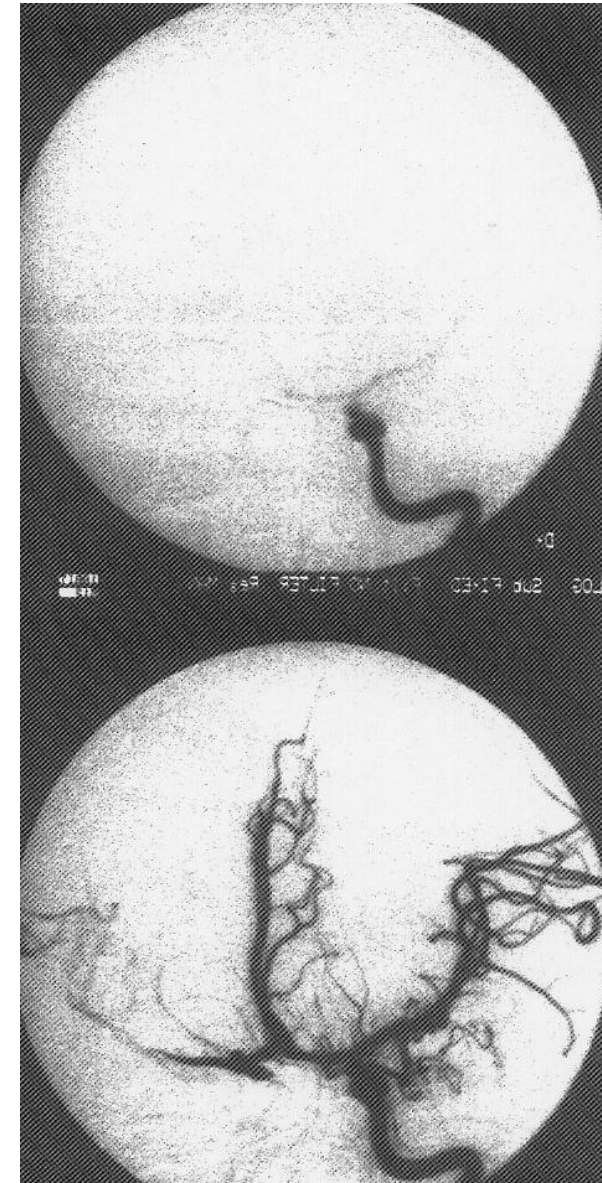
Bambini < 1 anno

**Fattori interferenti
con la diagnosi
clinica**

**Impossibilità ad:
esplorare il tronco o
effettuare EEG**

Farmaci sedativi

**Alterazione grave
dell'omeostasi**



Facial Trauma



Determinazione di assenza di flusso cerebrale

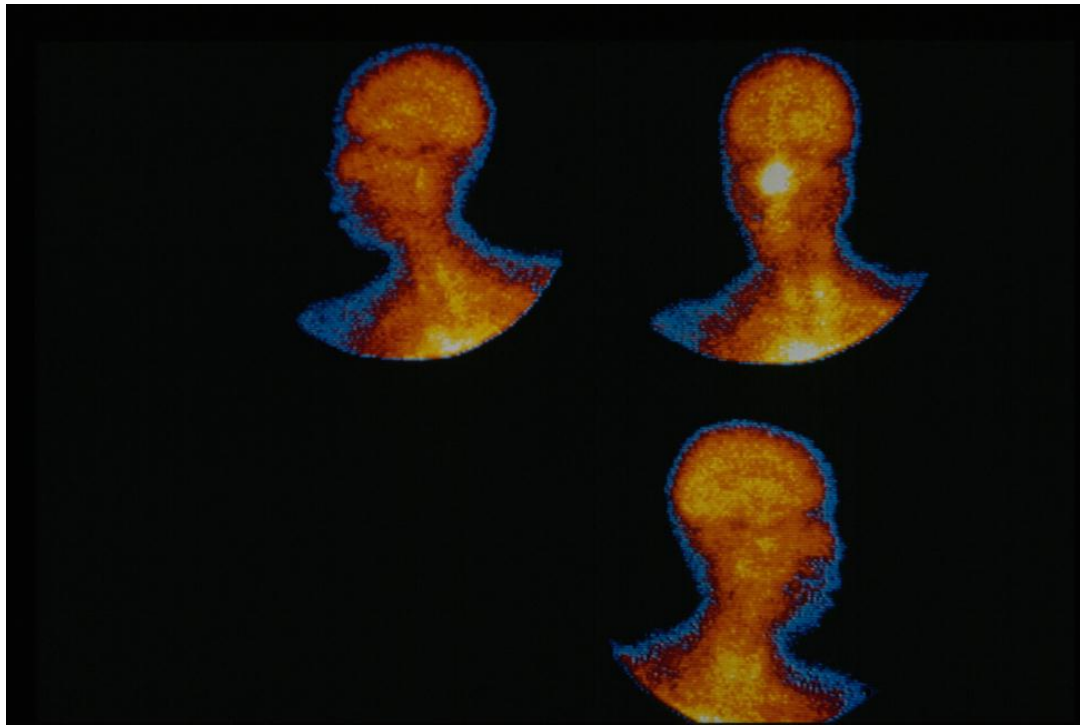
- **Criteri - Fattori confondenti**
- **Metodologia**
- **Metodiche strumentali**
(Angiografia, AngioTAC, Doppler, Scintigrafia)

Lineeguida Nazionali, 2009

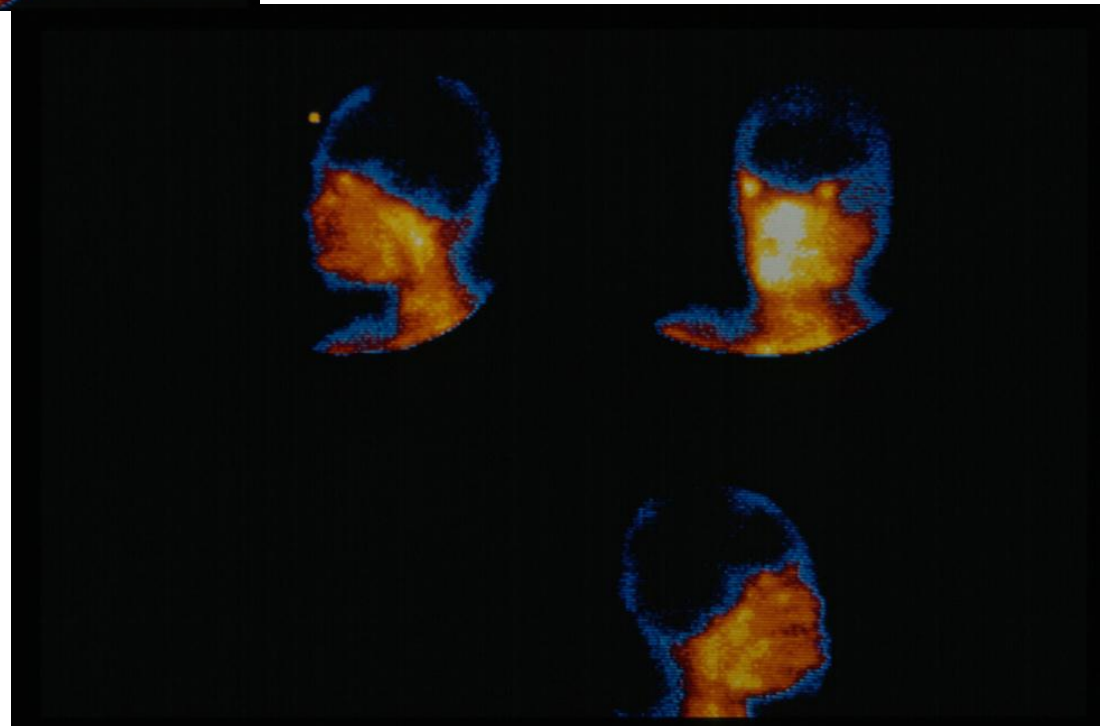
Angiografia Cerebrale



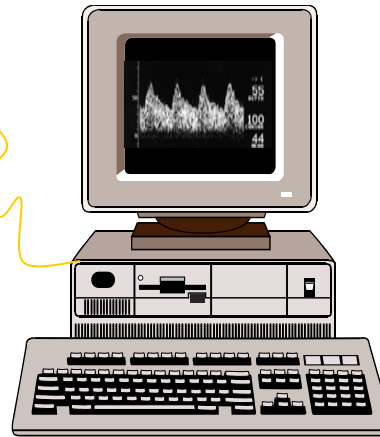
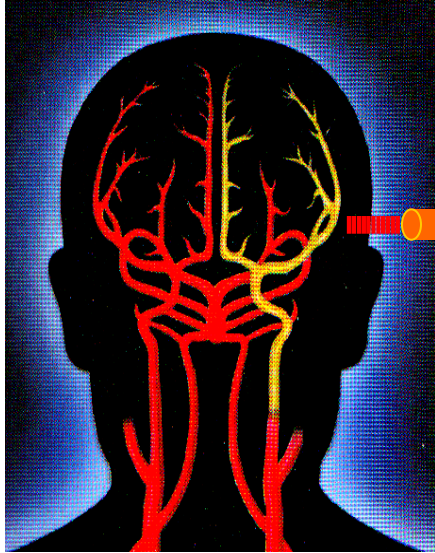
Wijdicks, 2001



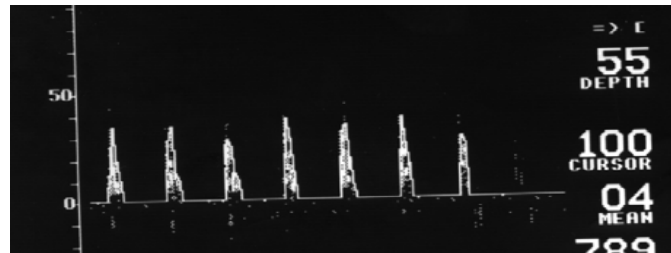
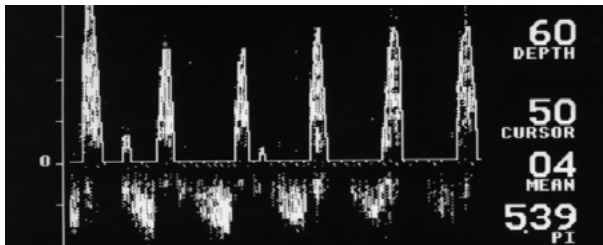
Scintigrafia



Trans Cranial Doppler



TCD



Brain Death *patters*

Fig. 1 CTA revealing the lack of blood flow in the brain. 3D-image reconstruction. *Fine arrows* point to the superficial temporal artery, a branch of the external carotid artery. *Thick arrow* indicates the site of craniectomy

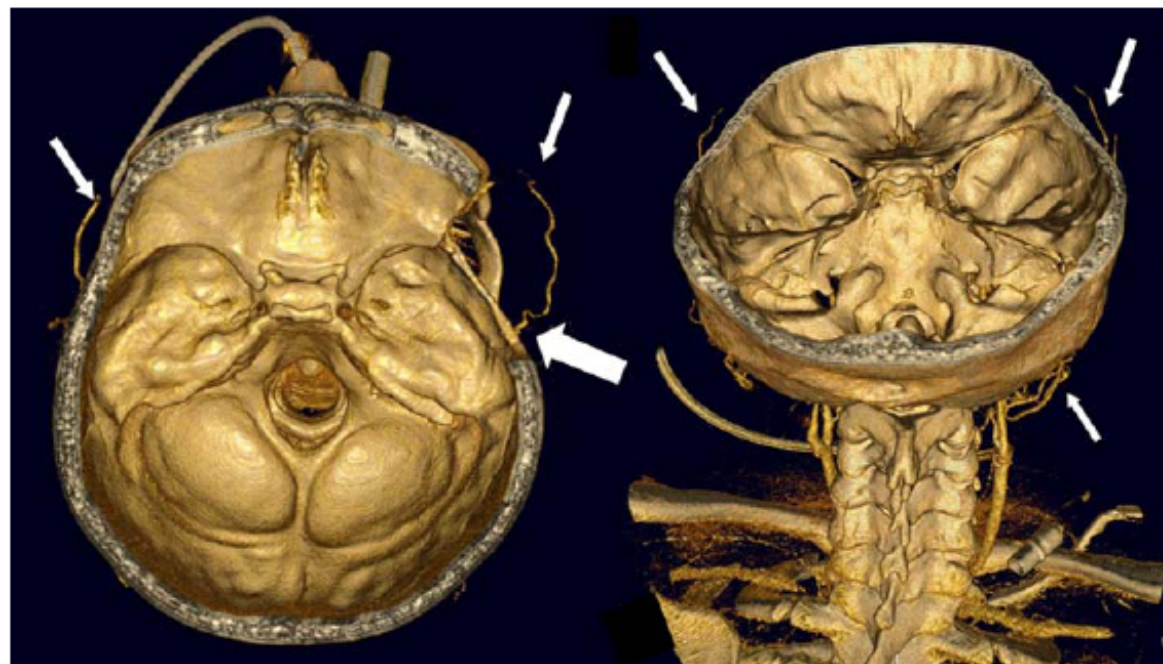
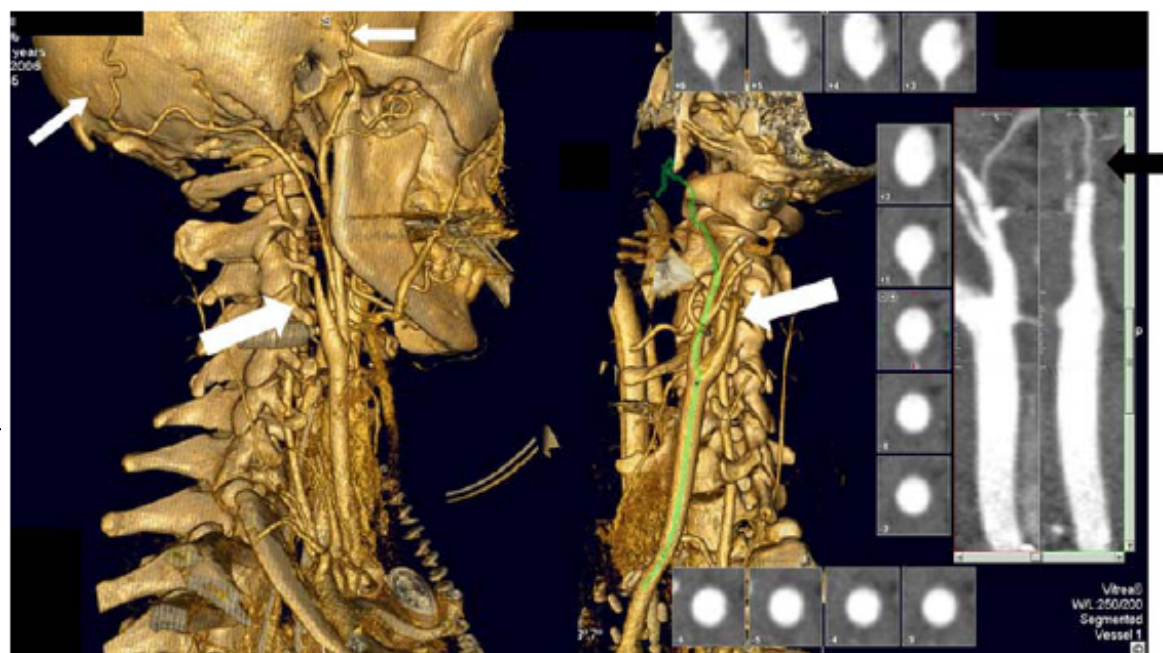


Fig. 2 Autotracing revealing the progressive narrowing of the internal carotid artery of the neck. 3D-image reconstruction in which the contrast medium stop (*thick arrows*) can be observed. *Fine arrows* point to the different branches of the external carotid artery



Diagnosing Brain Death by CT Perfusion and Multislice CT Angiography

Dolores Escudero · Jesús Otero · Lara Marqués · Diego Parra ·
José Antonio Gonzalo · Guillermo M. Albaiceta · Luis Cofiño ·
Armando Blanco · Pedro Vega · Eduardo Murias · Ángela Meilan ·
Ricardo López Roger · Francisco Taboada

Perché i morti si muovono ?

Morte “cerebrale” e riflessi spinali

Encefalo in necrosi

**Midollo
senza
controllo superiore**

1

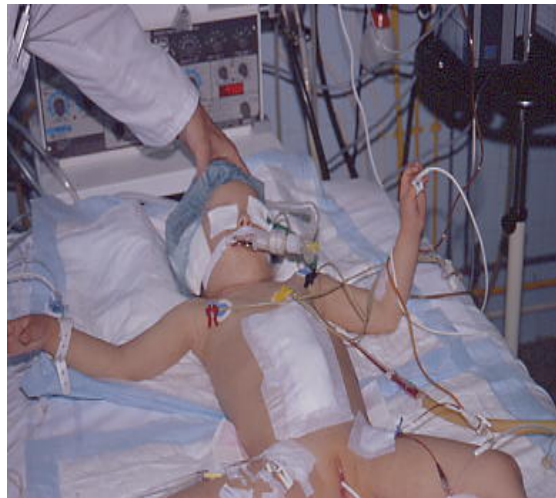
**Shock
Midollare**

2

**Recupero
funzionalità**

3

Ipereccitabilità



***Does the donor feel pain
during organ retrieval ?***

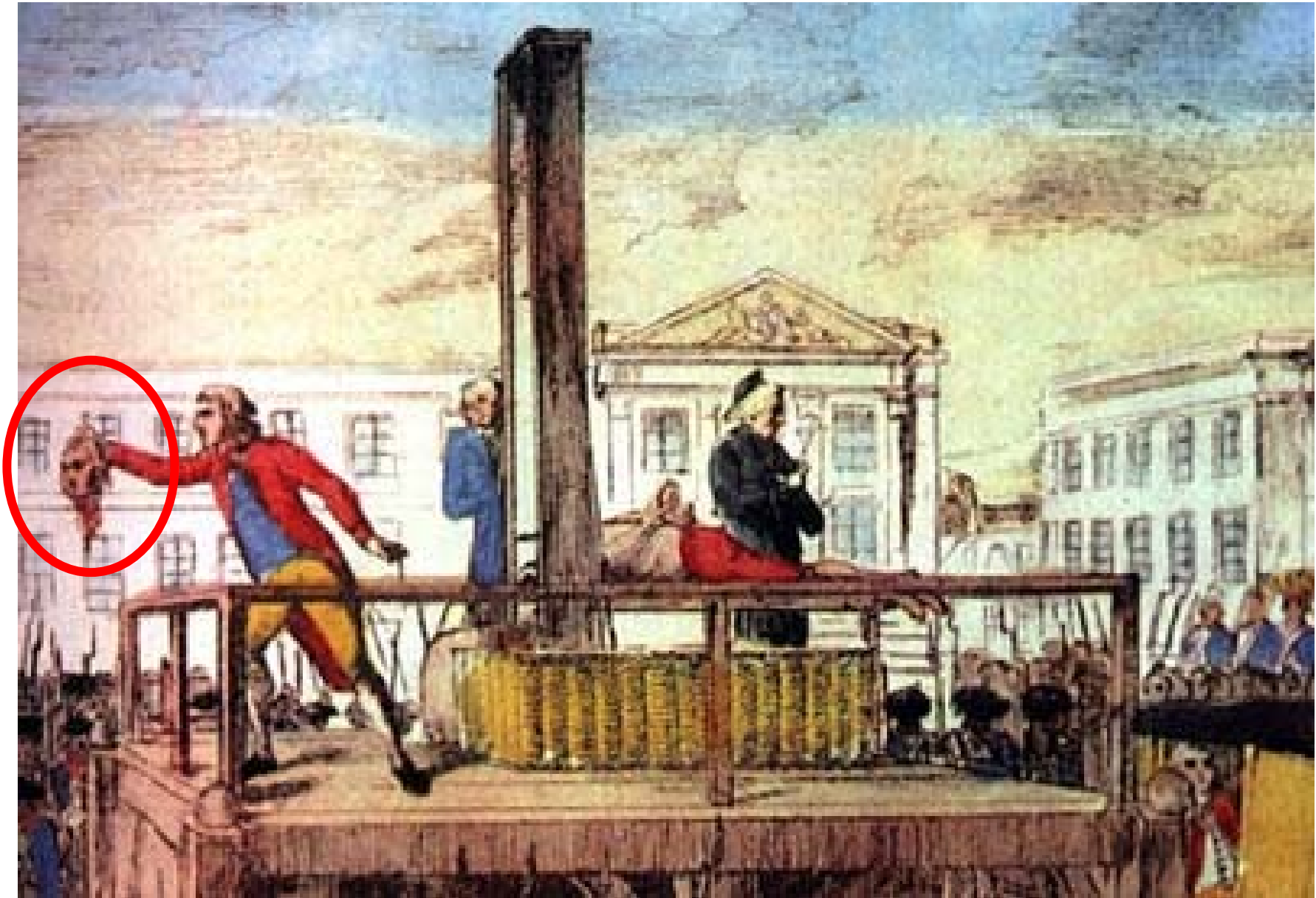
Spinal Viscero-visceral reflexes

**Spinal reflexes anesthesia during
organ retrieval**

Conci & Procaccio, J Neurol Neurosurg Psych , 1986

Fattori che possono creare
dubbi

Dead or not dead ?



Alan Lane
Andrew Westbrook
Deirdre Grady
Rory O'Connor
Timothy J. Coughlin
Brian Marsh
John G. Laffey

Maternal brain death: medical, ethical and legal issues

**Longest duration of
successful maternal somatic support
following BD :
more than 100 days**



Determinazione di morte con standard neurologico

CNT Position Paper

www.trapianti.ministerosalute.it

Elementi informativi essenziali

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A. M. BERNASCONI, *Presidente ANED*

A. GIANELLI CASTIGLIONE, *Second Opinion medico-legale del Centro Nazionale Trapianti*

A. NANNI COSTA, *Direttore del Centro Nazionale Trapianti*

Situazioni critiche

Recommendation	Evidence Score	Recommendation Score
1. Determination of brain death in neonates, infants and children relies on a clinical diagnosis that is based on the absence of neurologic function with a known irreversible cause of coma. Coma and apnea must coexist to diagnose brain death. This diagnosis should be made by physicians who have evaluated the history and completed the neurologic examinations.	High	Strong
2. Prerequisites for initiating a brain death evaluation		
a. Hypotension, hypothermia, and metabolic disturbances that could affect the neurological examination must be corrected prior to examination for brain death.	High	Strong
b. Sedatives, analgesics, neuromuscular blockers, and anticonvulsant agents should be discontinued for a reasonable time period based on elimination half-life of the pharmacologic agent to ensure they do not affect the neurologic examination. Knowledge of the total amount of each agent (mg/kg) administered since hospital admission may provide useful information concerning the risk of continued medication effects. Blood or plasma levels to confirm high or supratherapeutic levels of anticonvulsants with sedative effects that are not present should be obtained (if available) and repeated as needed or until the levels are in the low to mid therapeutic range.	Moderate	Strong
c. The diagnosis of brain death based on neurologic examination alone should not be made if supratherapeutic or high therapeutic levels of sedative agents are present. When levels are in the low or in the mid-therapeutic range, medication effects sufficient to affect the results of the neurologic examination are unlikely. If uncertainty remains, an ancillary study should be performed.	Moderate	Strong
d. Assessment of neurologic function may be unreliable immediately following cardiopulmonary resuscitation or other severe acute brain injuries and evaluation for brain death should be deferred for 24 to 48 hours or longer if there are concerns or inconsistencies in the examination.	Moderate	Strong
3. Number of examinations, examiners and observation periods		
a. Two examinations including apnea testing with each examination separated by an observation period are required.	Moderate	Strong
b. The examinations should be performed by different attending physicians involved in the care of the child. The apnea test may be performed by the same physician, preferably the attending physician who is managing ventilator care of the child.	Low	Strong
c. Recommended observation periods: (1) 24 hours for neonates (37 weeks gestation to term infants 30 days of age) (2) 12 hours for infants and children (> 30 days to 18 years).	Moderate	Strong
d. The first examination determines the child has met neurologic examination criteria for brain death. The second examination, performed by a different attending physician, confirms that the child has fulfilled criteria for brain death.	Moderate	Strong
e. Assessment of neurologic function may be unreliable immediately following cardiopulmonary resuscitation or other severe acute brain injuries and evaluation for brain death should be deferred for 24 to 48 hours or longer if there are concerns or inconsistencies in the examination.	Moderate	Strong
4. Apnea testing		
a. Apnea testing must be performed safely and requires documentation of an arterial $Paco_2$ 20 mm Hg above the baseline $Paco_2$ and ≥ 60 mm Hg with no respiratory effort during the testing period to support the diagnosis of brain death. Some infants and children with chronic respiratory disease or insufficiency may only be responsive to supranormal $Paco_2$ levels. In this instance, the $Paco_2$ level should increase to ≥ 20 mm Hg above the baseline $Paco_2$ level.	Moderate	Strong
b. If the apnea test cannot be performed due to a medical contraindication or cannot be completed because of hemodynamic instability, desaturation to $< 85\%$, or an inability to reach a $Paco_2$ of 60 mm Hg or greater, an ancillary study should be performed.	Moderate	Strong
5. Ancillary studies		
a. Ancillary studies (EEG and radionuclide CBF) are not required to establish brain death unless the clinical examination or apnea test cannot be completed	Moderate	Strong
b. Ancillary studies are not a substitute for the neurologic examination.	Moderate	Strong
c. For all age groups, ancillary studies can be used to assist the clinician in making the diagnosis of brain death to reduce the observation period or when (i) components of the examination or apnea testing cannot be completed safely due to the underlying medical condition of the patient; (ii) if there is uncertainty about the results of the neurologic examination; or (iii) if a medication effect may interfere with evaluation of the patient. If the ancillary study supports the diagnosis, the second examination and apnea testing can then be performed. When an ancillary study is used to reduce the observation period, all aspects of the examination and apnea testing should be completed and documented.	Moderate	Strong
d. When an ancillary study is used because there are inherent examination limitations (ie, i to iii), then components of the examination done initially should be completed and documented.	High	Strong
e. If the ancillary study is equivocal or if there is concern about the validity of the ancillary study, the patient cannot be pronounced dead. The patient should continue to be observed until brain death can be declared on clinical examination criteria and apnea testing, or a follow-up ancillary study can be performed to assist with the determination of brain death. A waiting period of 24 hours is recommended before further clinical reevaluation or repeat ancillary study is performed. Supportive patient care should continue during this time period.	Moderate	Strong
6. Declaration of death		
a. Death is declared after confirmation and completion of the second clinical examination and apnea test.	High	Strong
b. When ancillary studies are used, documentation of components from the second clinical examination that can be completed must remain consistent with brain death. All aspects of the clinical examination, including the apnea test, or ancillary studies must be appropriately documented.	High	Strong
c. The clinical examination should be carried out by experienced clinicians who are familiar with infants and children, and have specific training in neurocritical care.	High	Strong

Morte in ICU

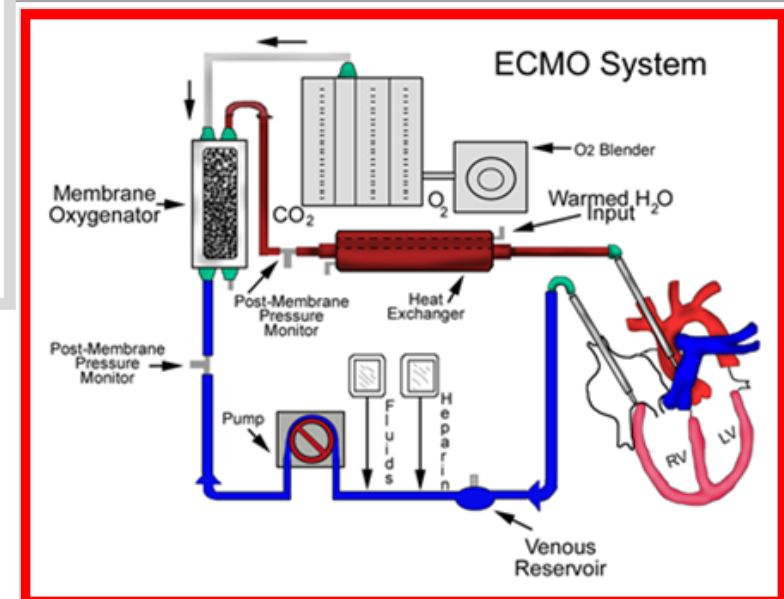
Nuovi scenari clinici

Morte in ECMO

Lineeguida nazionali CNT 2015

(criteri neurologici vs cardiologici)

Donatori DBD & DCD



Case Report

Reversible brain death after cardiopulmonary arrest and induced hypothermia*

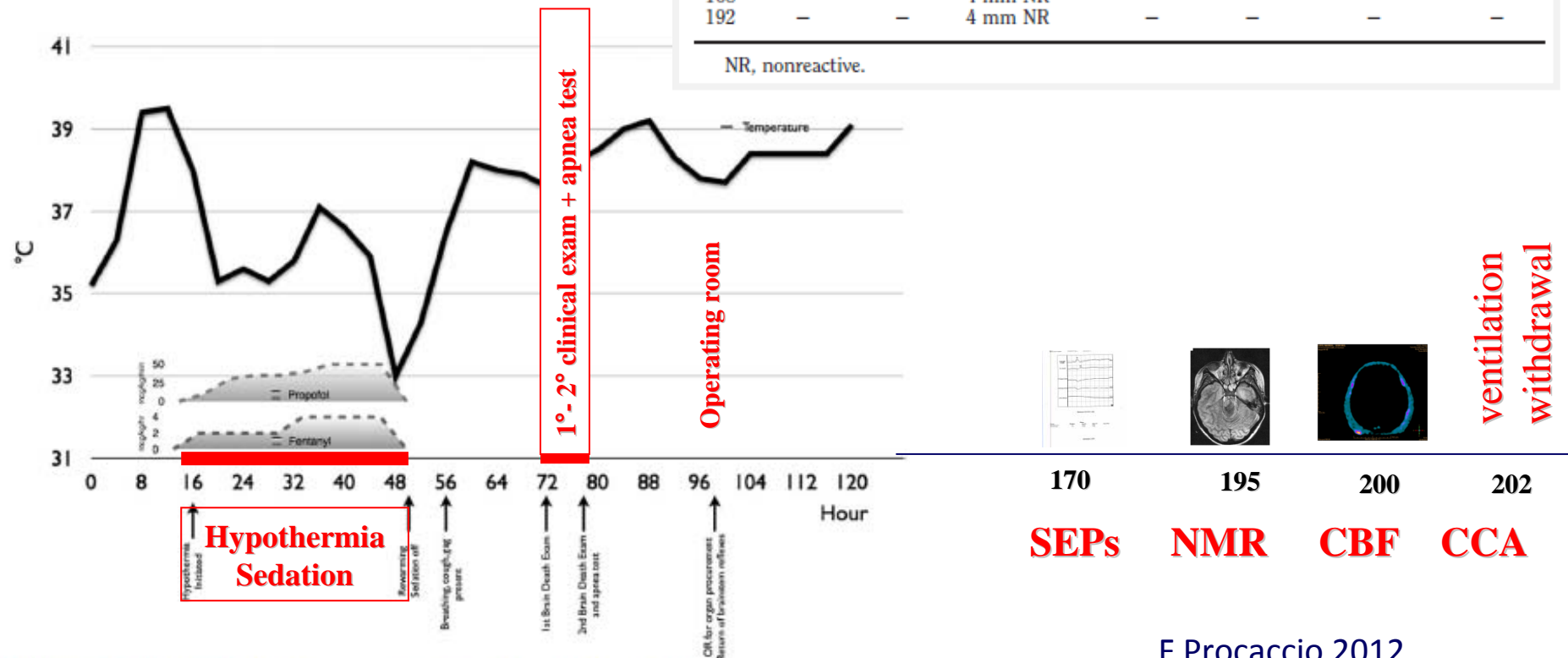
Adam C. Webb, MD; Owen B. Samuels, MD

Crit Care Med 2011 Vol. 39, No. 6

Table 2. Timing and details of neurologic examinations

Hours	Eye Opening	Motor Responses	Pupillary Responses	Corneal Reflex	Cough/Gag	Spontaneous Respirations	Myoclonic Movements
2	—	—	2 mm NR	—	—	—	+
56	—	+	2 mm, sluggish	—	+	+	+
72	—	—	4 mm NR	—	—	—	—
78	—	—	4 mm NR	—	—	—	—
98	—	—	4 mm NR	+	+	+	—
120	—	—	4 mm NR	+	+	+	—
145	—	—	4 mm NR	—	—	—	—
168	—	—	4 mm NR	—	—	—	—
192	—	—	4 mm NR	—	—	—	—

NR, nonreactive.



F Procaccio 2012

Persistence of cerebral blood “flow” after brain death

Flowers WM et al. Southern Medical Journal 93:364,2000

Decompressing fractures

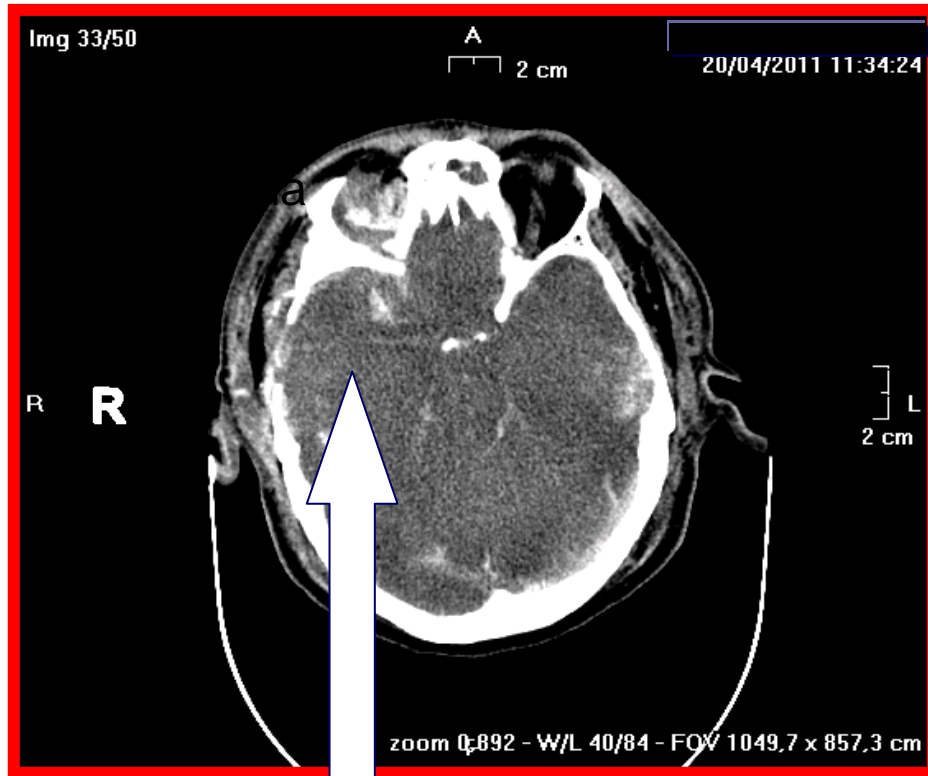
- Ventricular shunts
- Reperfusion (*post-anoxic !*)
- Decompressive Eemicraniectomy

D.A. emorragia cerebrale - 74 anni



Pregressa sedazione – SjO₂ > 90% - DI

Angio-CT scan



BD standard – no confounding factors

*Emendamento Linee guida CBF
approvato dal CNT novembre 2014*

**METODOLOGIA ANGIO-TC
NELLA DIAGNOSI di MORTE ENCEFALICA**

3 FASI:

- **Fase pre-contrastografica**
- **Fase arteriosa**
- **Fase venosa**

unica iniezione di MDC

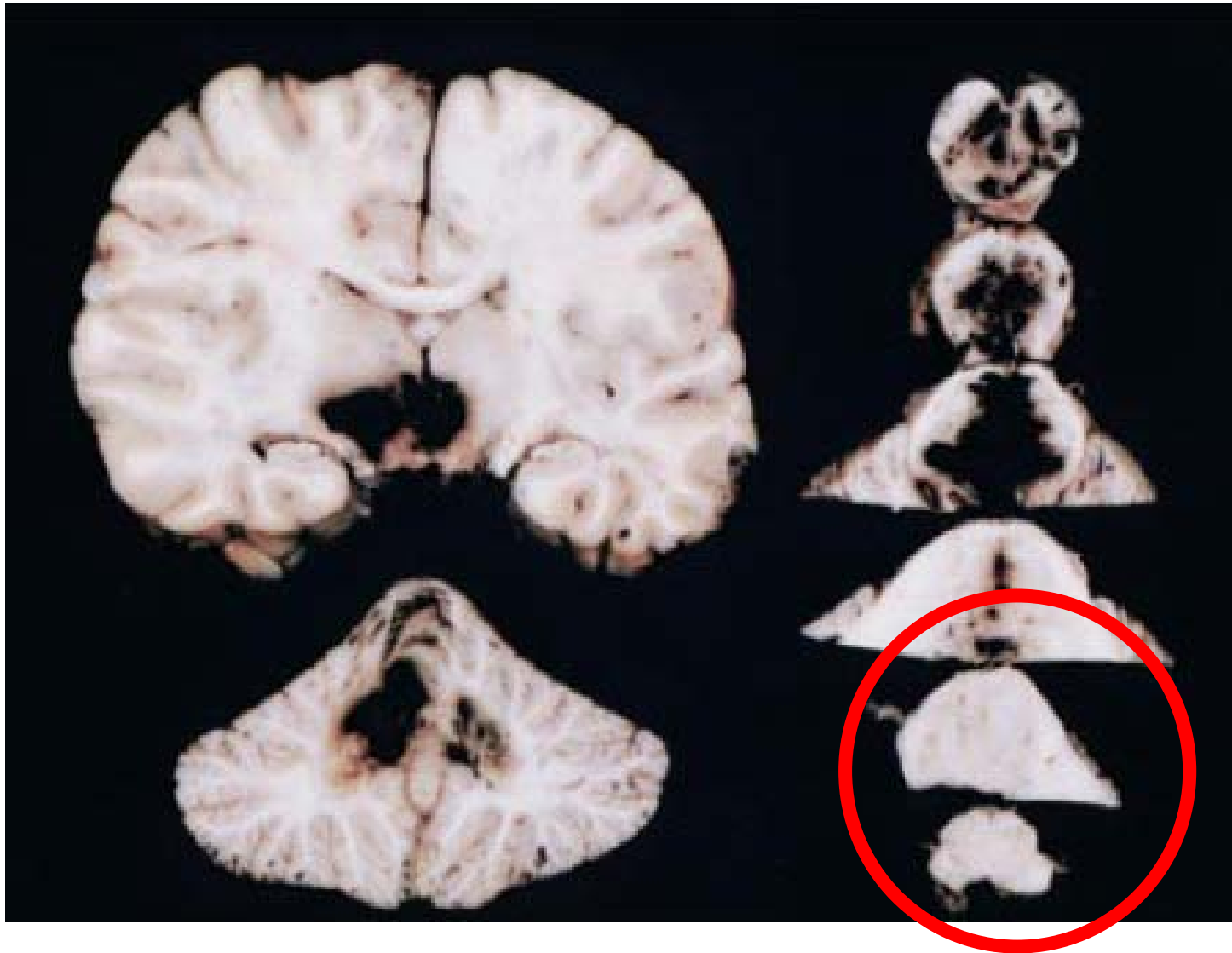
Situazioni cliniche che possono mimare la ME

- Ipotermia
- Barbiturici
- Avvelenamento acuto
- Crisi endocrine
(glucosio – cortisolo– T4)
- *Patologie neurologiche*

“Neurological” conditions that may be confused with Brain Death

- Locked-in syndrome
- Guillain-Barré syndrome
- Demyelinating conditions
- Post-anoxic coma
- Brainstem encephalitis
- “Medulla man”

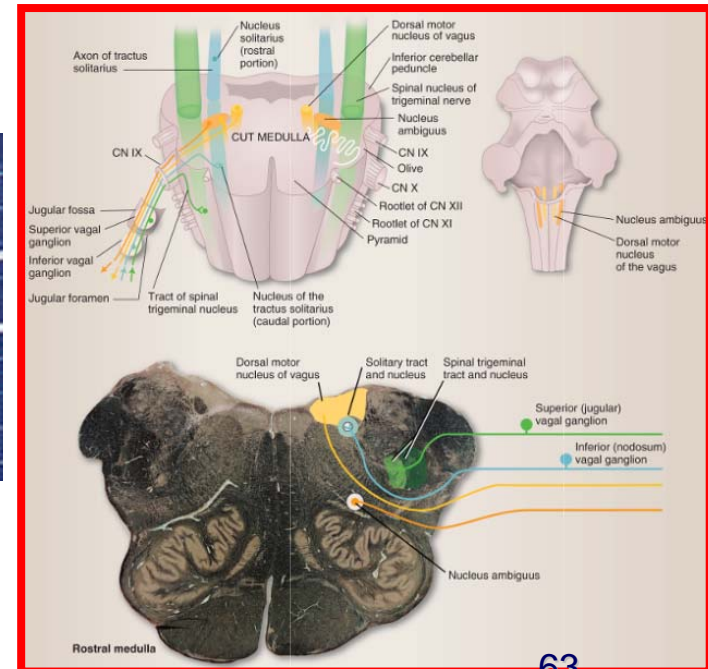
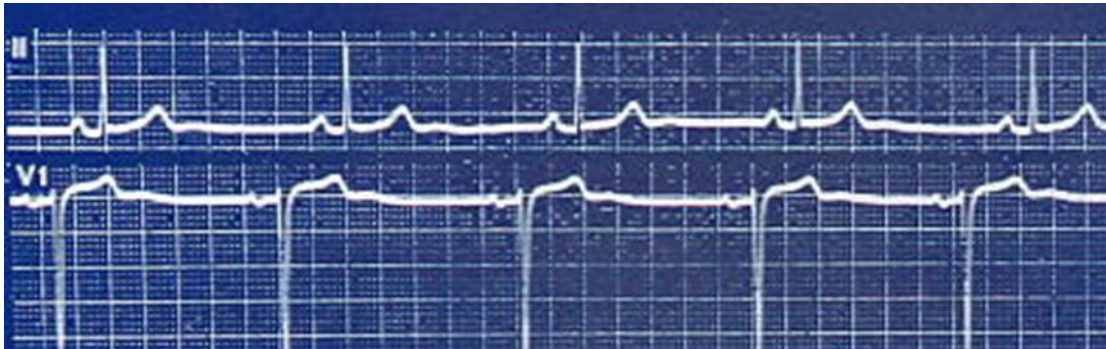
The Medulla Man



Wijdicks E. J Neurol Neurosurg Psych 2001

Brainstem Vagus X nerve Test

**Atropine i.v.
0.04 mg/Kg/weight**



Man declared dead, says he feels 'pretty good'



This photo provided by the NBC Today television program shows Doug Dunlap, left, and his son Zach Dunlap, during their interview with Today show correspondent Natalia Morales 24 3 2008

STORY HIGHLIGHTS

Family members were paying last respects when Dunlap moved hand and foot

He remembers hearing doctors pronounce him dead

Father says brain scan showed no activity

Mother says it was a miraculous feeling to discover son still alive

scandal news

Section Editors

David C. Spencer, MD
Steven Karczeski, MDSteven Laureys, MD,
PhD
Joseph J. Fins, MD,
FACP

Are we equal in death?

Avoiding diagnostic error in brain death

Variability of brain death determination guidelines in leading US neurologic institutions

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MD, PhD
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Boston, MA 02114
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ABSTRACT

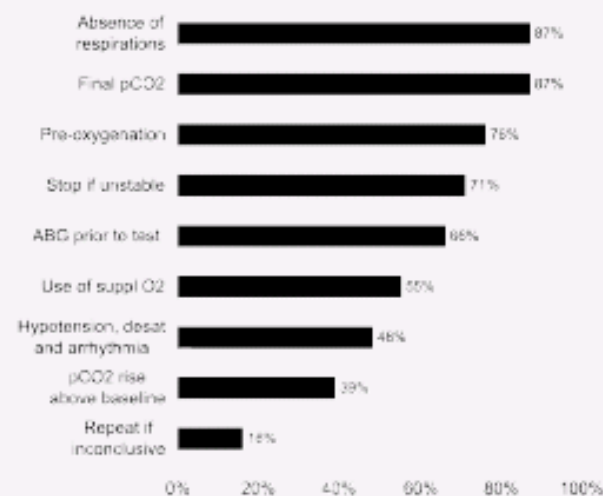
Background: In accordance with the Uniformed Services for the Disabled Veterans Health Administration, brain death determination are developed at an institutional level. We evaluated the differences in practice. We evaluated the differences in the strong presence of neurology and neurosurgery variation from the guidelines as put forth by the American Academy of Neurology.

Methods: We requested the guidelines for the *News and World Report* top 50 neurology/neurosurgery hospitals for five categories of data: guideline, apnea testing, and ancillary tests. We evaluated the consistency/differences.

Results: There was an 82% response rate to the survey from 10 institutions for all five categories. Variability in the performance of the evaluation, prerequisites prior to apnea testing, and what types of ancillary tests might exist.

Conclusions: Major differences exist in brain death determination in US hospitals. Adherence to the guidelines is variable. If the guidelines reflect actual practice, the variability in practice which may have consequences for the determination of death and initiation of a brain and organ transplant procedures. *Neurology*® 2008;70:284-289

Figure 4 Apnea testing: Compliance with American Academy of Neurology guidelines (%)



Relatively poor compliance with American Academy of Neurology guidelines was seen in the category of apnea testing. Discrepancies occurred in the performance of the testing, the values to be obtained, and the procedures in case of instability or inconclusiveness.

Diagnosi ed accertamento di morte in Italia

- Non dipende da un unico Medico
- Prove cliniche e strumentali ridondanti
- Collegio Medico multispecialistico
- Periodo di osservazione

Conclusioni

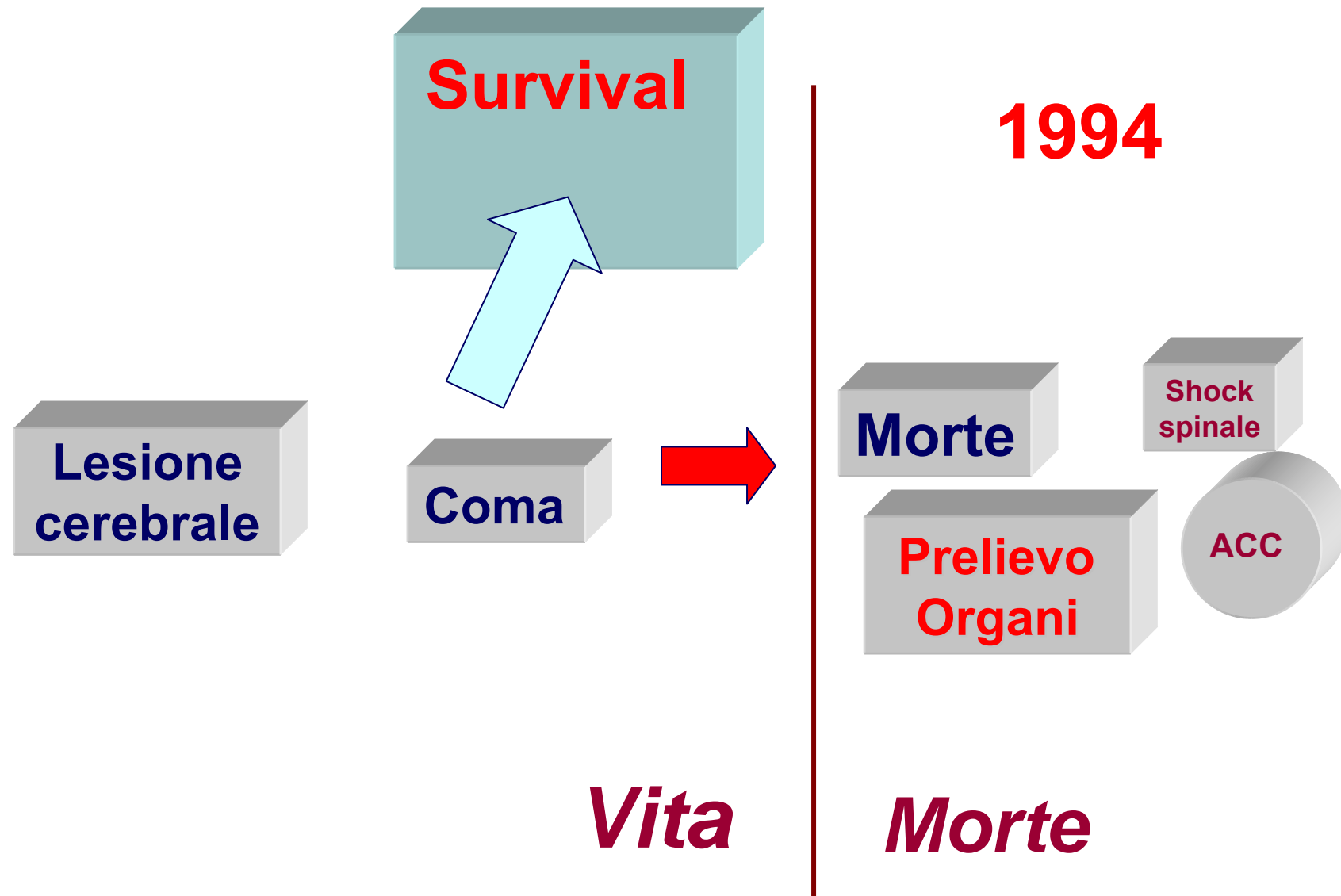
**Diagnosi clinica
semplice e sicura**

**Deve essere
completa sistematica
*rigorosa***

It must be driven by a concern regarding the accurate assessment of fatally injured patients. However, more physicians and more confirmatory tests cannot solve this problem. What is required is standardization of policy, appropriate education of staff, introduction of checklists in intensive care units, and brain death examination by designated, experienced physicians who have documented proficiency in brain death examination.

Eelco F. M. Wijdicks MD

Terapia Intensiva Neurologica



Legge 1993

Art. 1. Definizione di Morte

1. La morte si identifica con la cessazione irreversibile di tutte le funzioni dell'encefalo.

Art. 2. *Accertamento di morte*

1. La morte per arresto cardiaco si intende avvenuta quando la respirazione e la circolazione sono cessate per

Morte determinata con criteri cardiaci e le modalità riportate

Nel Decreto del Ministro della Sanità

dal Ministro della sanità.

2. La morte nei soggetti affetti da lesioni encefaliche e sottoposti a misure rianimatorie si intende avvenuta

Morte determinata con criteri neurologici e le modalità riportate

Nel Decreto del Ministro della Sanità

Ministro della sanità.



Principi per il presente / futuro?

La morte significa morte encefalica

La morte di una Persona

è

la morte del suo encefalo

Il termine “morte encefalica”
dovrebbe essere abolito
e sostituito dal termine
morte determinata con criteri neurologici.

Ten changes that could improve organ donation in the Intensive Care Unit

Beatriz Domínguez-Gil, Paul Murphy, Francesco Procaccio

Intensive Care Medicine 2015

4. Systematic brain death testing

Brain death testing is not undertaken when this is a likely diagnosis in up to 21% of cases in European Hospitals, this representing an important unrealized opportunity for organ donation.

Testing for brain death should be performed whenever relevant criteria are met, regardless of whether organ donation seems likely.

In countries with a controlled Donation after Circulatory Death (DCD) programme, shifting towards the DCD pathway at this time point should be avoided unless there is no option for Donation after Brain Death (DBD).

Esercitazione pratica

Criteri neurologici

Diagnosi clinica

Presupposti

- ◌ **Certezza della causa (*patogenesi*) del danno cerebrale**
- **Imaging coerente**
- **Andamento clinico coerente (*monitoraggio cerebrale !*)**
- **Esame clinico completo e test strumentali, quando necessari**

Prerequisiti per effettuare la diagnosi di morte

- **Escludere effetto farmaci sul SNC**
(barbiturici, curarici, atropina ...)
- **Assicurare l'omeostasi sistemica**
(Temperatura, PA, Ossigenazione, Na+ ...)



Eziologia

DIAGNOSI DI MORTE ENCEFALICA

CLINICA

STRUMENTALE

RIFLESSI
APNEA

EEG - CBF

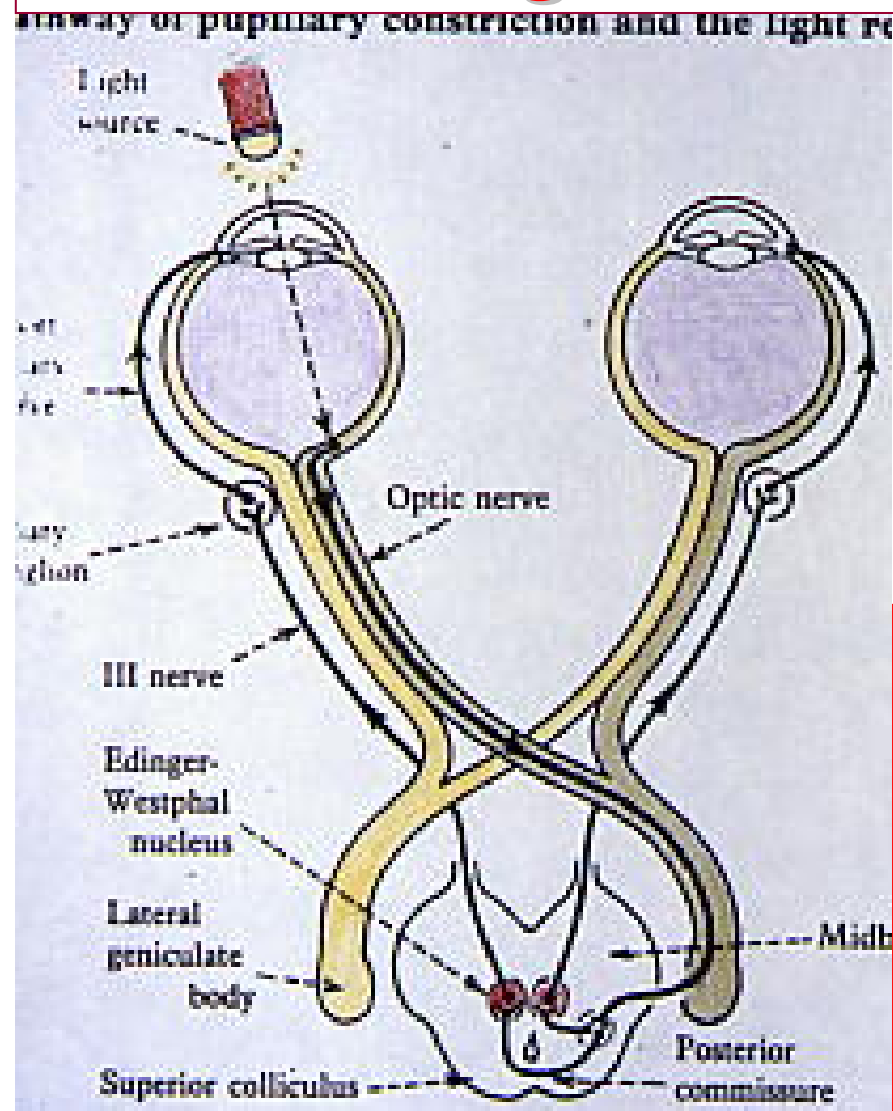


TRONCO ENCEFALICO

INTERO ENCEFALO

Riflesso fotomotore:

Metodologia ed esperienza clinica

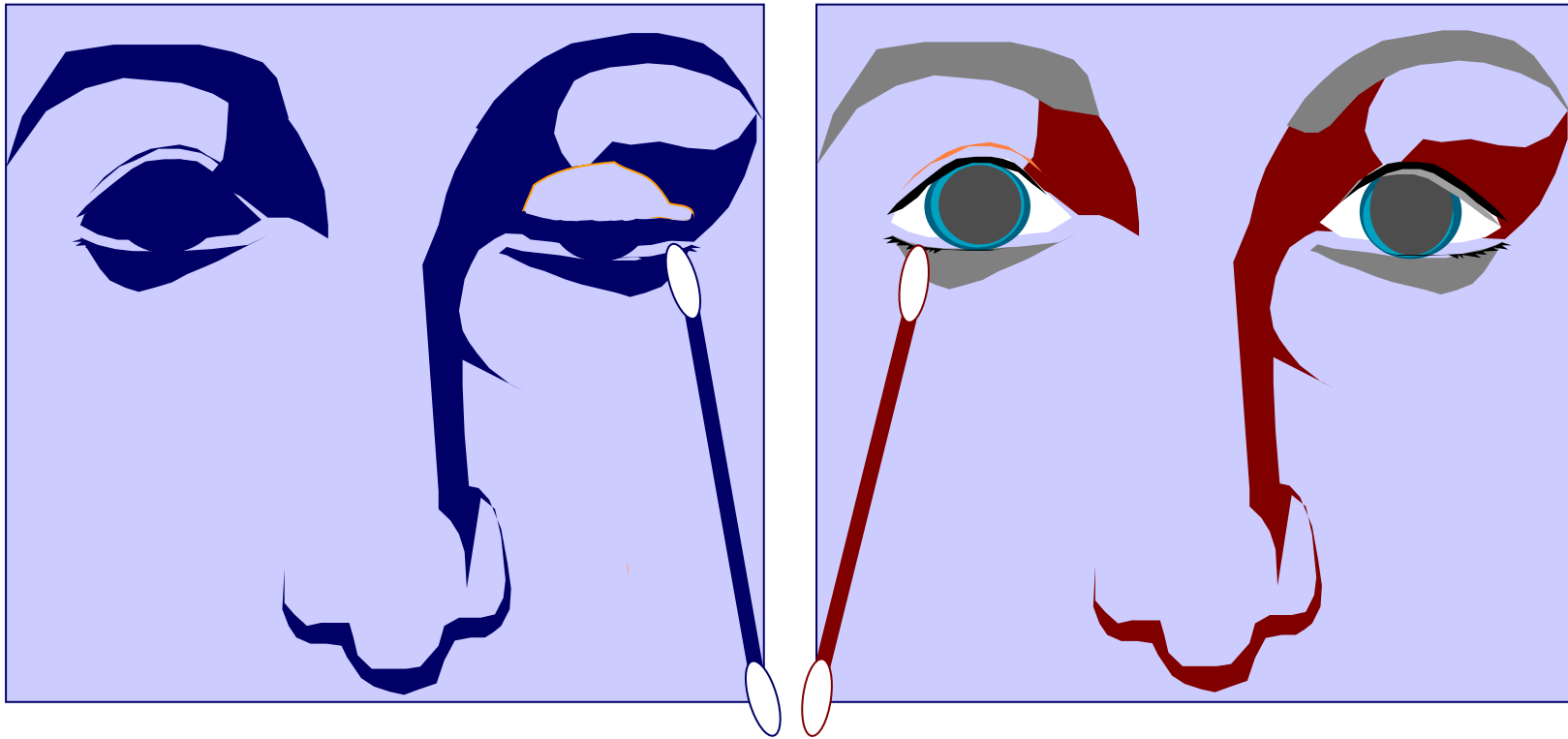


B. Absence of brainstem reflexes.

- Absence of pupillary response to a bright light is documented in both eyes. Usually the pupils are fixed in a midsize or dilated position (4–9 mm). Constricted pupils suggest the possibility of drug intoxication. When uncertainty exists, a magnifying glass should be used.

RIFLESSO CORNEALE

STIMOLO CON CORPO ESTRANEO
PER APPREZZARE LA CONTRAZIONE PALPEBRALE



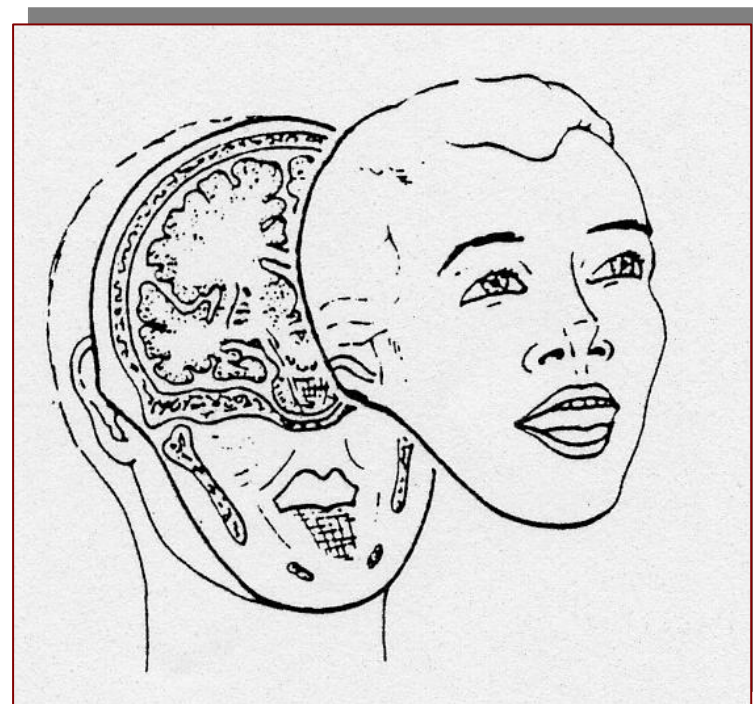
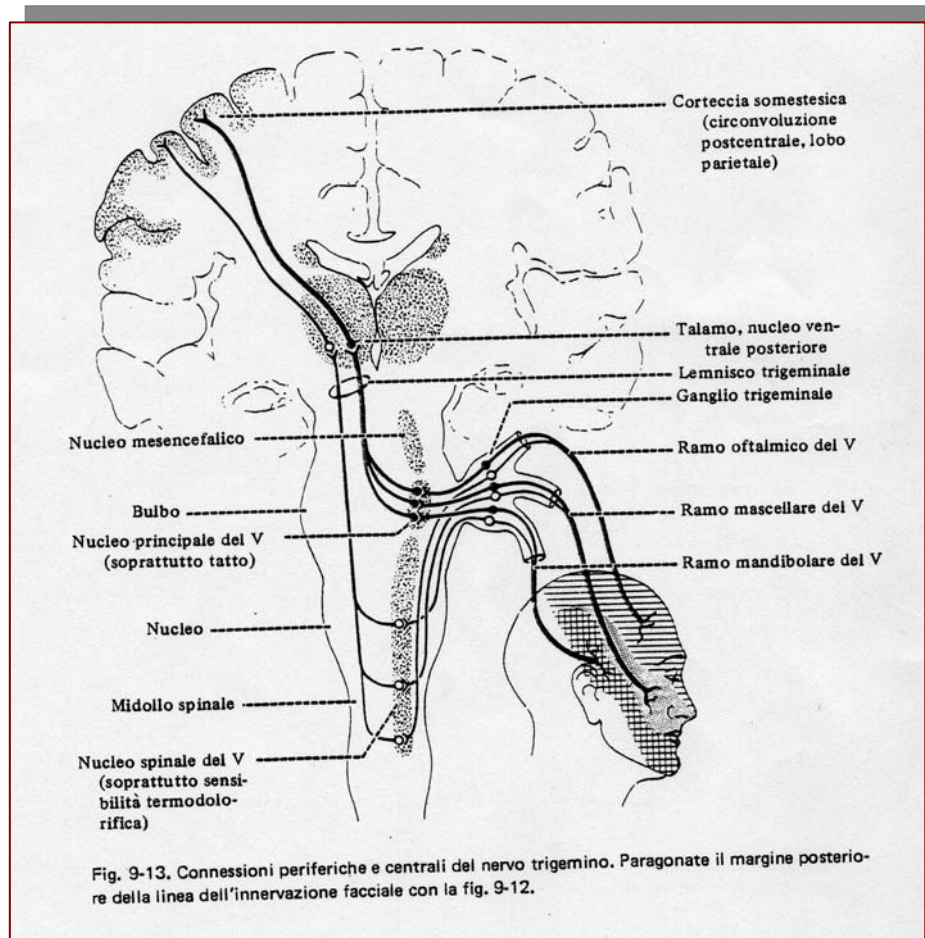
VIA AFFERENTE: NERVO TRIGEMINO (5° PAIO N.C.)
VIA EFFERENTE: NERVO FACIALE (7° PAIO N.C.)

assenza di reattività
Motoria e Vegetativa
su Stimolo doloroso
nel territorio del nervo
Trigemino

- Absence of facial muscle movement to a noxious stimulus.

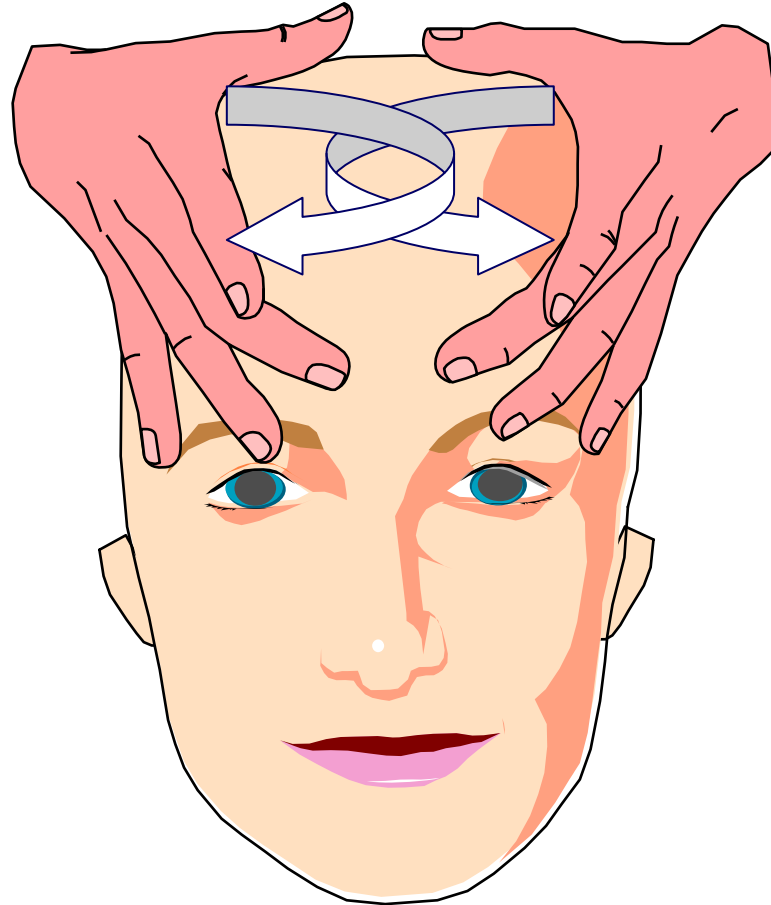
Deep pressure on the condyles at the level of the temporomandibular joints and deep pressure at the supraorbital ridge should produce no grimacing or facial muscle movement.

Territorio del Trigemino



Once the integrity of the cervical spine is ensured, the head is briskly rotated horizontally and vertically. There should be no movement of the eyes relative to head movement.

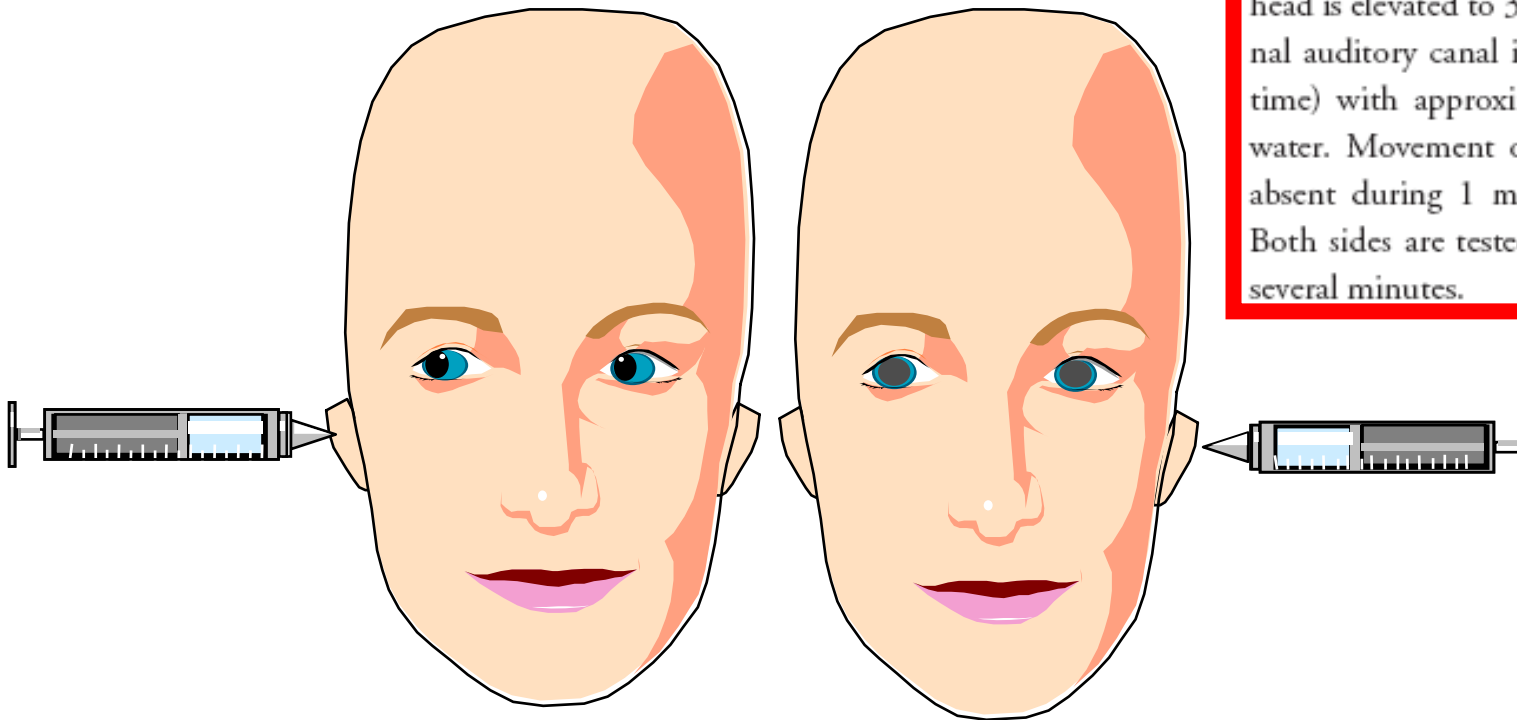
Oculocephalic reflex *(doll's eyes)*



The head is turned abruptly from side to side:
The eyes follow the head movement

OCULOVESTIBULAR REFLEX

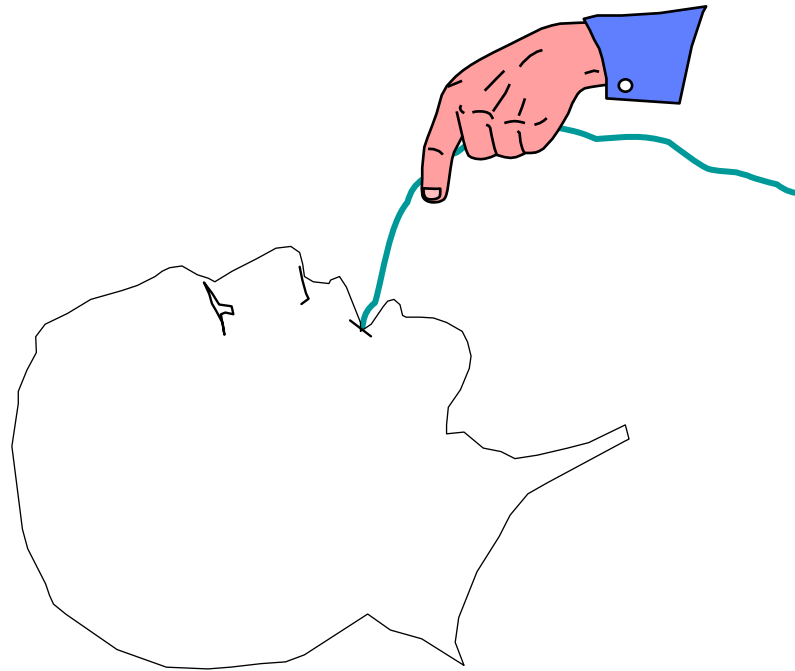
The oculovestibular reflex is tested by irrigating each ear with ice water (caloric testing) after the patency of the external auditory canal is confirmed. The head is elevated to 30 degrees. Each external auditory canal is irrigated (1 ear at a time) with approximately 50 mL of ice water. Movement of the eyes should be absent during 1 minute of observation. Both sides are tested, with an interval of several minutes.



HEAD 30° - INJECT COLD WATER INTO THE EXTERNAL AUDITORY CONDUCT:
NO OCULAR MOVEMENT – NO VEGETATIVE RESPONSE

RIFLESSO GLOSSO FARINGEO

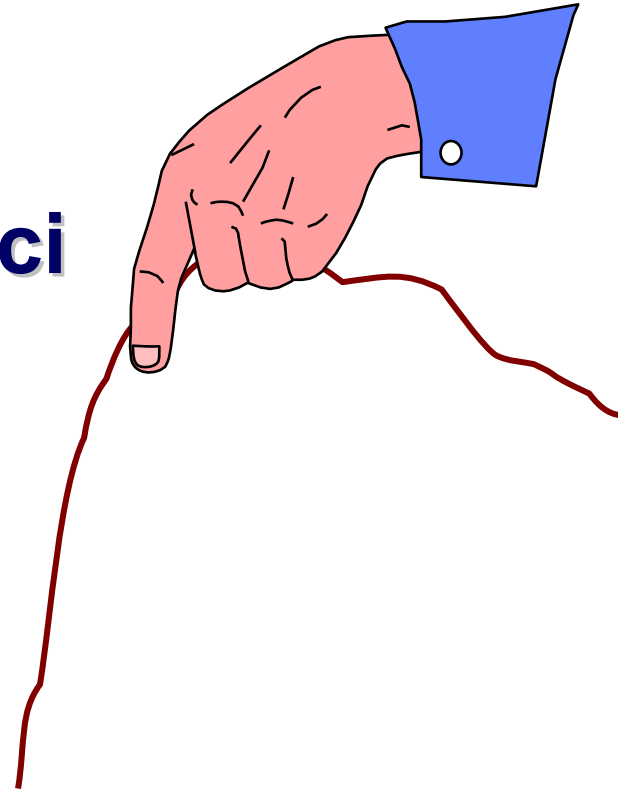
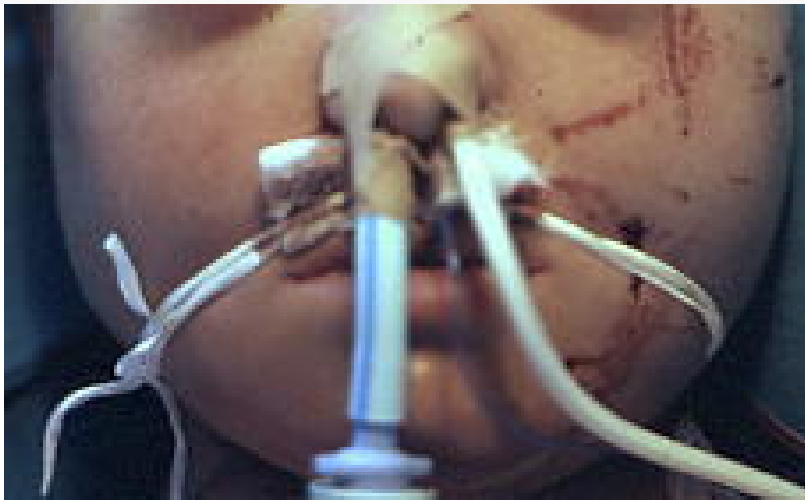
CON UN SONDINO SI STIMOLA IL VELO PALATINO E L'OROFARINGE



VIA AFFERENTE: NERVO GLOSSO FARINGEO (9° PAIO N.C.)
VIA EFFERENTE: NERVO VAGO (10° PAIO N.C.)

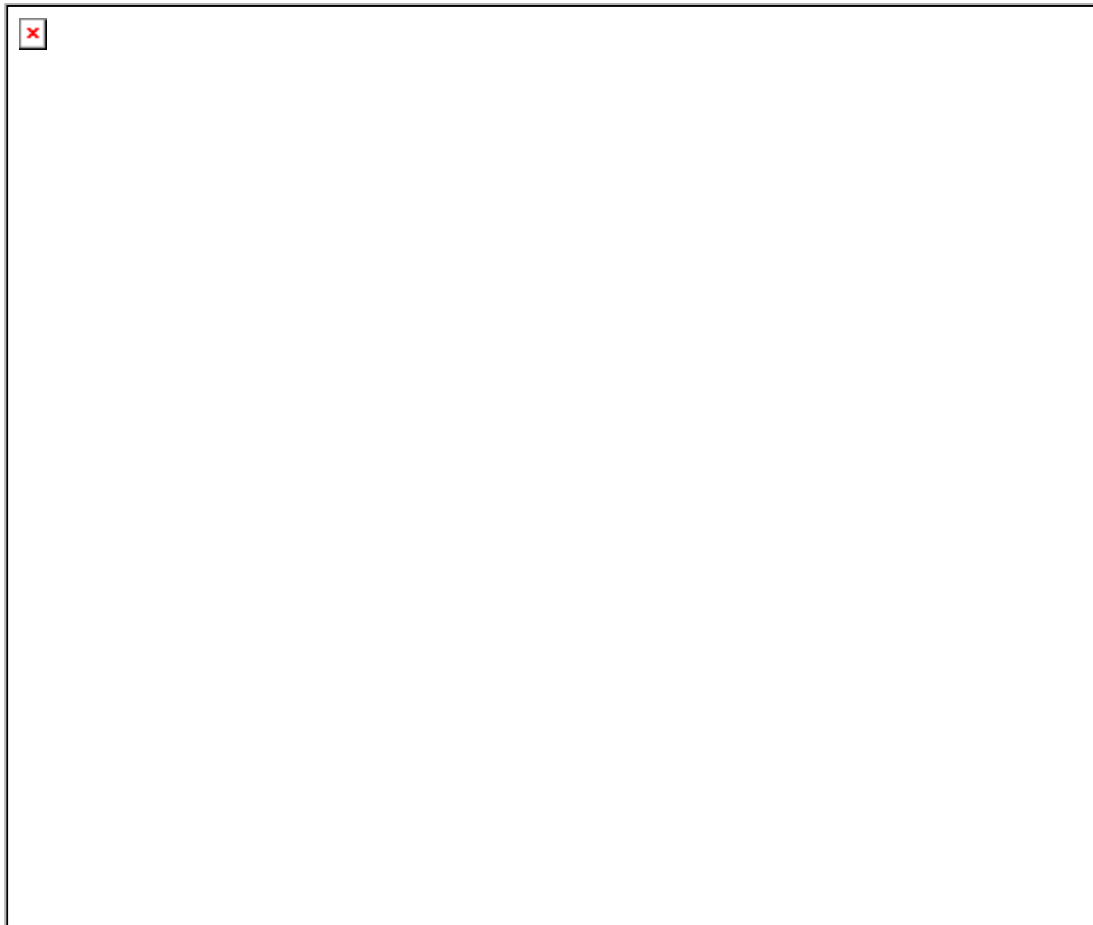
Riflesso Carenale

**Assenza di Tosse
o movimenti diaframmatici
su stimolazione
della carena tracheale**

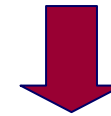


TEST DELL'APNEA

HA LA FINALITA' DI DIMOSTRARE L'ASSENZA DEL RESPIRO SPONTANEO



**Tecnica
dell'ossigenazione
e apneica**



VALORI DI
 $PCO_2 \geq 60\text{mmHg}$
 $pH < 7.4$

valore sufficiente a
provocare il massimo
stimolo dei centri del
respiro

Apnea testing (all must be checked)

- Patient is hemodynamically stable
 - Ventilator adjusted to provide normocarbica (PaCO_2 34–45 mm Hg)
 - Patient preoxygenated with 100% FiO_2 for > 10 minutes to PaO_2 > 200 mm Hg
 - Patient well-oxygenated with a PEEP of 5 cm of water
 - Provide oxygen via a suction catheter to the level of the carina at 6 L/min or attach T-piece with CPAP at 10 cm H_2O
 - Disconnect ventilator
 - Spontaneous respirations absent
 - Arterial blood gas drawn at 8–10 minutes, patient reconnected to ventilator
 - $\text{PCO}_2 \geq 60$ mm Hg, or 20 mm Hg rise from normal baseline value
- OR:
- Apnea test aborted

Wijdicks et al. Neurology, 2010