



# Neurological Monitoring



**Agilent Technologies**  
Innovating the HP Way

**AACN**  
AMERICAN ASSOCIATION  
OF CRITICAL-CARE NURSES  
A supplement to *Critical Care Nurse*®

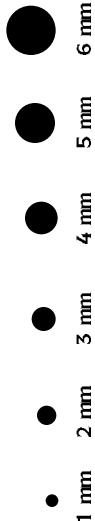
Agilent #59980-080EE  
Printed in USA 5/00

## Glasgow Coma Scale

<b>Eye Opening</b>	Assesses arousal state
<b>4</b>	Spontaneously Operates eyes without stimulation
<b>3</b>	To voice Operates eyes when spoken to
<b>2</b>	To pain Operates eyes when noxious stimuli are applied
<b>1</b>	None Does not open eyes to any stimulus
<b>Best Verbal Response</b>	Assesses level of consciousness in terms of ability to produce speech
<b>5</b>	Oriented States his or her name, where he or she is, and the date
<b>4</b>	Confused Cannot state either who or where he or she is or the date
<b>3</b>	Inappropriate words Speaks words without intent on communicating
<b>2</b>	Incomprehensible sounds Grunts, groans, or other sounds
<b>1</b>	None No attempt at vocalizing—causes may include intubation, speaking only foreign language, inability of very young child, or aphasia
<b>Best Motor Response</b>	Assesses both arousal and level of consciousness
<b>6</b>	Obeys Follows simple commands
<b>5</b>	Localizes Attempts to remove noxious stimuli
<b>4</b>	Withdraws Arm or leg is pulled away from painful stimuli
<b>3</b>	Abnormal flexion Adduction, internal rotation, and rigid flexion of hand and arm with hand clenched and thumb grasped "Flexor posturing"
<b>2</b>	Abnormal extension Adduction, internal rotation, and rigid extension with thumb grasped in clenched fist "Extensor posturing"
<b>1</b>	Flaccid No motor movement of any kind to any stimuli
<b>3-15</b>	<b>Total Score</b>

## Pupillary Examination

### Size



### Direct Light Reflex

Constriction of pupil  
Tests cranial nerves II and III  
Lost with oculomotor or optic nerve damage

### Consensual Light Reflex

Constriction of the opposite pupil when light stimulates the eye  
Reflex present—oculomotor nerve and midbrain connections intact

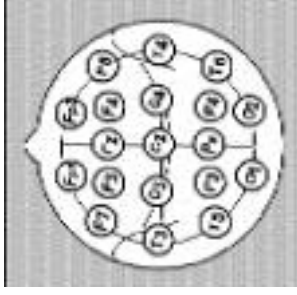
### Oculocephalic Reflex (Doll's Eye Sign)

In a comatose patient, brisk turning of the head will cause the eyes to move in the opposite direction—cranial nerves III, VI, and VIII intact (doll's eye sign present). Eyes remaining in fixed position are "doll's eye sign absent."

### Oculovestibular Reflex – Caloric Irrigation Test

Pathway from vestibular portion of cranial nerves VIII, II, and VI is intact if the eyes deviate toward the irrigated ear and nystagmus occurs. If the eyes stay midposition, the pathways are impaired.

## EEG Lead Placement International 10/20



F Frontal-Cortical

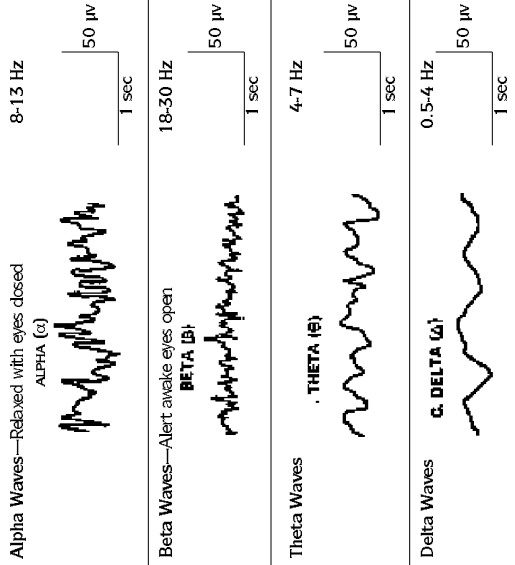
C Central-Cortical

P Parietal-Cortical

T Temporal-Cortical

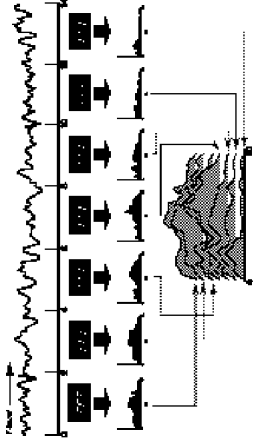
O Occipital-Cortical

## EEG Waveforms



## Compressed Spectral Array (CSA)

Frequency analysis takes the raw EEG waves, mathematically analyzes them, and breaks them into their component frequencies. The most popular method of doing this is called fast Fourier transform (FFT).



The CSA "stacks" each samples spectrum one "right" below the other, usually at 2-second intervals.

## Assessing the EEG wave

**Amplitude**  
Amplitude refers to the height of the EEG and is measured in microvolts.  
Low amplitude < 20  $\mu$ V  
Medium amplitude 20 to 50  $\mu$ V  
High amplitude > 50  $\mu$ V

**Symmetry**  
The EEG is generally symmetrical over both hemispheres. Where there is a loss of symmetry, there may be pathology or ischemia in one of the hemispheres.

**EEG Patterns**  
Many conditions can change the EEG. The most common are seizures, cerebral ischemia, reactions to drugs, and coma.

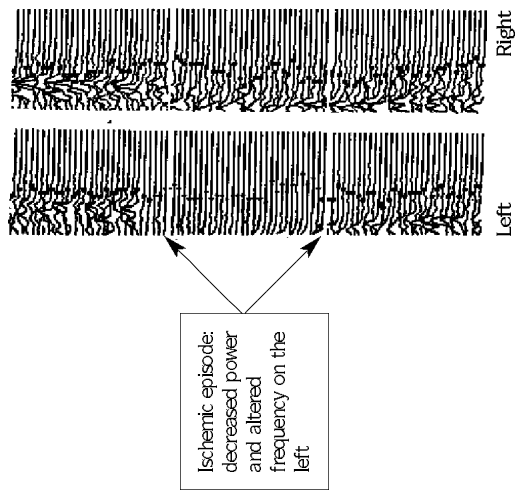
**Seizures**  
EEG is the definitive way to diagnose a seizure. Seizures come in many different varieties.  
• Rhythmic pattern  
• Gradual build  
• Multiple channels with high amplitude  
• Return to normal or a brief isoelectric period

**Coma**  
Patterns depend on the cause, depth, and prognosis of coma.  
• Generalized slowing  
• Variable EEG = Good prognosis  
• Monotonous, invariable EEG = Poor prognosis

**Cerebral Ischemia**  
• Generalized slowing if hypoxic  
• Focal slowing if ischemic event  
• Progresses to isoelectric if prolonged

**Drugs**  
Most anesthetics have an effect on the EEG because the target organ of their action is the brain.  
• Initial amplitude increases and frequency decreases  
• Decreases in amplitude  
• Isoelectric and/or burst suppression

## Cerebral ischemia during carotid endarterectomy



## Burst suppression pattern followed by isoelectric periods in barbiturate therapy

