EEG: ICU monitoring & 2 interesting cases
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Electroencephalography
• Techniques
  • Paper EEG → digital video-electroencephalography
  • Routine EEG → long-term monitoring
  • Continuous EEG monitoring (cEEG)
  • Quantitative EEG (qEEG)

Continuous EEG in ICU
• Propose
  • To detect nonconvulsive seizures (NCS) & nonconvulsive status epilepticus (NCSE) in critically ill patients
  • Monitoring treatment of NCS and NCSE, assessing level of sedation
  • Distinguishing nonepileptic from epileptic events

Role of EEG in NCSE
• Comatose after convulsive seizures
  • 48% have NCSE
  • 19% of comatose patients have seizures
  • 90% nonconvulsive seizures
• Comatose patients
  • Require at least 48 hours cEEG to detect >90% of seizures versus only 10% detection with routine EEG alone

Compared overnight EEG vs. first routine 30-minutes
• Overnight EEG could detect
  • Overall
    • New or additional epileptiform abnormalities by 14%
    • Clinical and/or electrographic seizures 6%
    • Change in treatment 8%
    • Improvement attributed to change in treatment 4%
  • In known cases with epilepsy
    • Treatment change with improvement 46%
  • Seizures did not obviously affect outcome

EEG pattern in status epilepticus
• EEG is an important tool in diagnosing NC-SE > convulsive-SE

  • EEG
    • Continuous or repetitive discharges of polyspikes spike-and-waves
    • Lateralized periodic discharges
    • Bilateral periodic epileptiform discharges (Bi-PEDS)
    • Generalized periodic epileptiform discharges (GPEEDS)
    • Diffuse rhythmic waxing and waning delta or theta activity
    • Some degrees of electrographic response to benzodiazepine injection***
EEG in non-convulsive status epilepticus

- **Primary**
  - 1) Repetitive generalized or focal spike, sharp waves, spike-and-wave, or sharp-and-slow complexes at > 3 sec
  - 2) As above but < 3 sec, but also meeting criteria 4 (below)
  - 3) Sequential rhythmic waves along with secondary criteria 1, 2, 3 +/- 4

- **Secondary**
  - 1) Incrementing onset: increase in voltage and/or increase/decrease in frequency
  - 2) Decrementing offset: decrease in voltage or frequency
  - 3) Post-discharge slowing or voltage attenuation
  - 4) Significant improvement in clinical state or EEG with anticonvulsant therapy

Focal NCSE

- Focal electrographic seizure activity

Generalized NCSE

- Generalized electrographic seizure activity

Absence status epilepticus

- Classic generalized 3-Hz spike-and-wave EEG activity

NC-SE in severe anoxic encephalopathy

Continuous spike-wave

- Obtundation and mute, improved after benzodiazepine trial
Bilateral periodic epileptiform discharges in a patient with subarachnoid hemorrhage

Continuous spike-wave activity

Clinical: acute confusion and bradykinesia 1 day

After a benzodiazepine injection

Clinical and EEG improved after benzodiazepine trial

Burst suppression: target Rx EEG for NCSE

Quantitative EEG (qEEG)-newer technology

Case 1
An 80-year-old lady

- 1 year
  - Psychotic features
  - Partially controlled by antipsychotic agents
- 2 months
  - Confusion
  - Impaired cognition/activities of daily living
- 2 weeks
  - Bedridden, mute, stimulus sensitive myoclonus
  - 2 generalized tonic-clonic seizures → ICU

Physical examination

- Low grade fever
- Heart, lung, abdomen: WNL
- Neurological examination:
  - E3V1M5 with confusion
  - No cranial nerve palsy, no papilledema
  - Motor: grade III/V
  - No meningeal irritation signs

Investigations

- All the result were negative
- MRI: brain atrophy
- Except
  - CSF: high CSF protein
  - EEG: continuous multifocal spikes

Treatment

- Empirical antibiotics for bacterial infection
- Try Rx as herpes simplex encephalitis until PCR herpes negative → then off
- Aggressive Rx status epilepticus until burst suppression
- On ventilator in ICU

Progression of 2 months in PMK hospital

- In comatose state
  - Convulsive status epilepticus
  - Subtle convulsive
  - Non convulsive
- Anesthetic agent dependency
- Multiple high dose AEDs
- No identifiable etiologies of CNS problems

EEG
An 80-year-old lady

- Further investigations
  - Thyroid function test: euthyroid state
  - **Anti-TPO: positive high titer**

Diagnosis

Neuropsychological disorders & refractory status epilepticus

&

Hashimoto encephalopathy
**Treatment, progression, plans**

- **Treatment**
  - Pulse methylprednisolone → oral steroid
- **Progression**
  - 1 week later: seizures controllable without anesthetic agents
  - 2 week later: communicable (nonverbally) with family members
  - EEG → return to normal awake and sleep record

**Key messages**

- EEG monitoring is essential for diagnosis and plans of treatment esp. comatose state
- Autoimmune encephalitis should be one of differential diagnoses among cases with neuropsychiatric symptoms, refractory epilepsies without identifiable etiologies

**Case 2. A 24-year-old female**

- SLE: skin lesion, photosensitivity, arthralgia, leukopenia(x3)
- History of Guillain-Barre syndrome receiving IVIG 1 year ago
- April 2015: 1st GTC, suspected Neuropsychiatric SLE
  - Basic lab & MRI brain normal
  - Rx: phenobarbital (60) 2xhs, adjusting steroid
- Admit July 2015: vertigo, fatigue and arthralgia
  - Developed (x3)
    - Sudden loss of consciousness with eye staring/rolling up
    - Tonic stiffness of limbs and body

**Video-EEG during generalized tonic attacks and comatose states**
Case 2

Diagnosis

Non-epileptic psychogenic seizures

Pseudo-coma

Key messages

- In patients that seizures are difficult to treat, non-epileptic psychogenic attacks should be considered
- Video EEG-monitoring is helpful in detecting non-epileptic attacks

Non-convulsive seizures (NCS) and non-convulsive status epilepticus (NCSE)

How Long to Monitor?

Controversial

Prognosis
Appropriate duration of continuous EEG monitoring in critical ill patients

- Sensitivities > 90% for seizure detection
  - Non-comatose: approximately 24 h
  - Comatose: 48 to 72 h
- Patients with epileptiform EEG abnormalities including periodic lateralized epileptiform discharges (PLEDs), regardless of mental status: > 24 h

Controversial in EEG

- Periodic lateralizing epileptic discharges
  - PLEDs if unilateral
  - BiPLEDs if bilateral/independent
  - PEDs if bilateral/uniform
  - Triphasic waves
- An interictal vs. ictal event
  - BiPLEDs (mortality of 61%) vs. PLEDS (29%)
Thank You