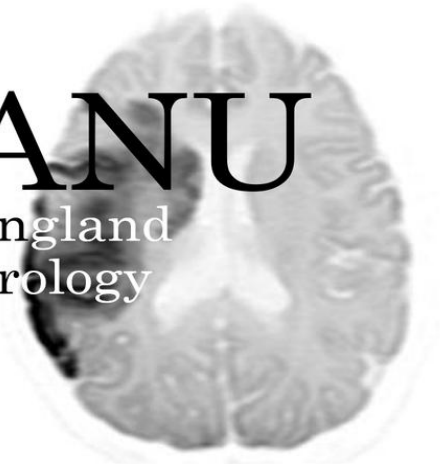
NEANU
North of England
Acute Neurology
Update



“Off legs” – understanding the neurophysiology
EEG

Dr Rachel Todd
10/09/2025

MANCHESTER 1824
The University of Manchester

Manchester Centre for Clinical Neurosciences

Salford Royal NHS
NHS Foundation Trust

Disclosures

NEANU
North of England
Acute Neurology
Update

- None relevant

Objectives

NEANU
North of England
Acute Neurology
Update

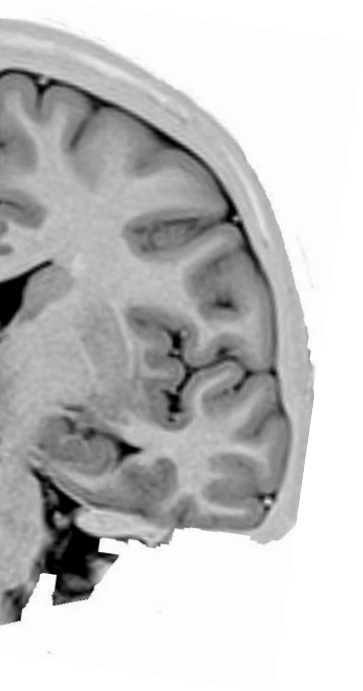
What is EEG?

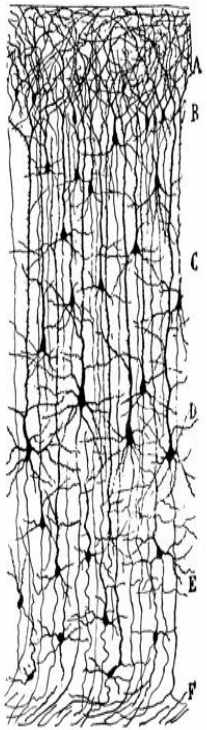
When should I request an EEG?

Clinical cases

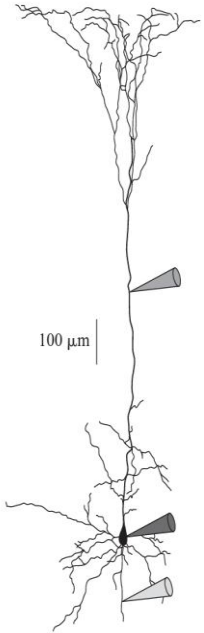
Where does the EEG come from?

NEANU
North of England
Acute Neurology
Update

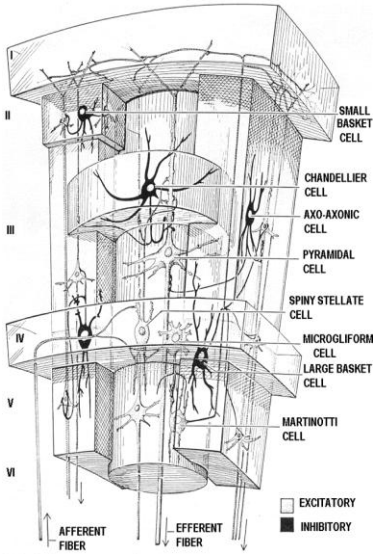




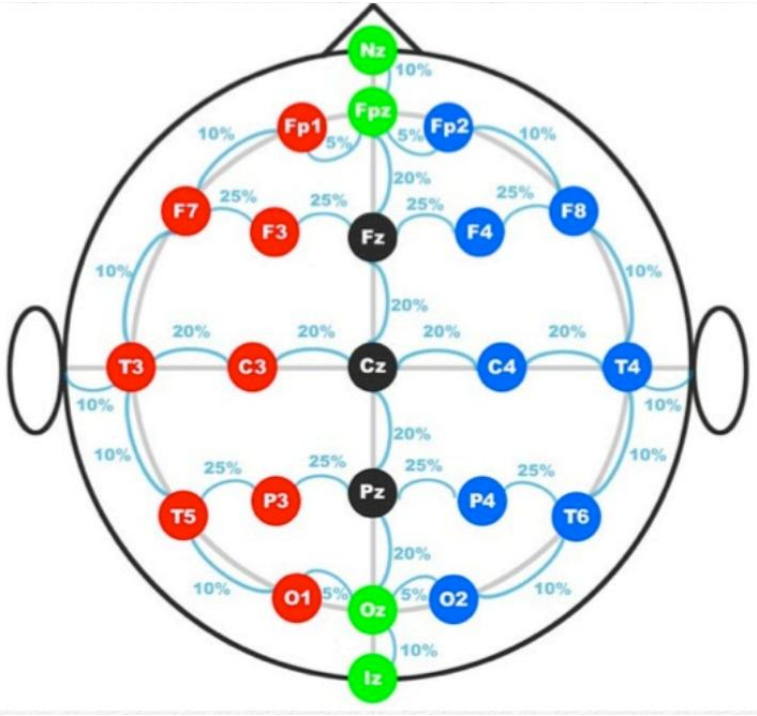
Mammalian cerebral cortex
Santiago Ramón y Cajal

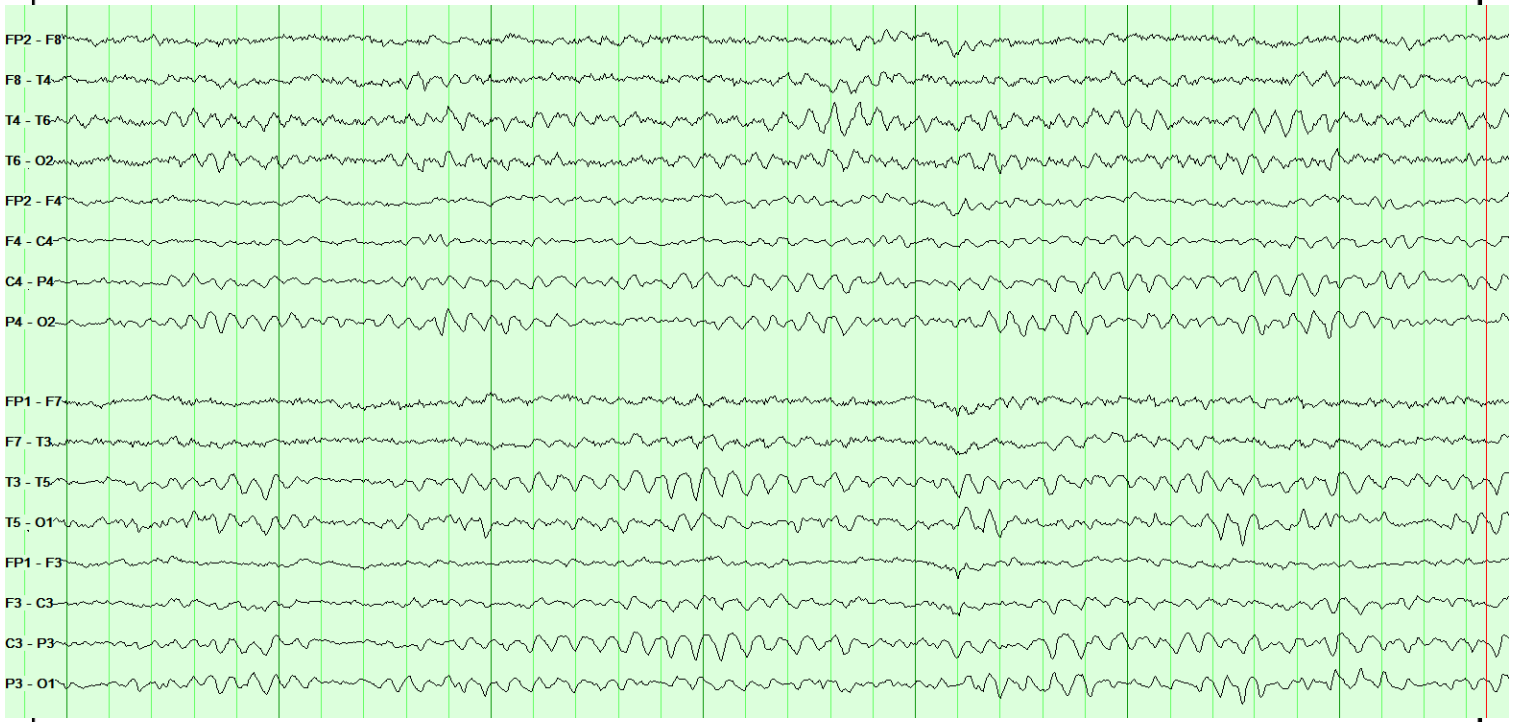


Pyramidal cell



Cortical column


Nz
Fp1
Fpz
Fp2
F7
F3
Fz
F4
F8
T3
C3
Cz
C4
T4
T5
P3
Pz
P4
T6
O1
Oz
O2
Iz
10%
5%
20%
25%


FP2 - F8
F8 - T4
T4 - T6
T6 - O2
FP2 - F4
F4 - C4
C4 - P4
P4 - O2
FP1 - F7
F7 - T3
T3 - T5
T5 - O1
FP1 - F3
F3 - C3
C3 - P3
P3 - O1

Characteristics of EEG waveforms

NEANU
North of England
Acute Neurology
Update

- Frequency
  - Beta
  - Alpha
  - Theta
  - Delta
- Distribution of the wave form
  - Generalised
  - Lateralised
  - Regional
- Repetition pattern (unless isolated)
  - Monomorphic / Rhythmic
  - Polymorphic / Arrhythmic
  - Periodic
  - Intermittent
- Specific morphology
- Reactivity

Types of EEG

NEANU
North of England
Acute Neurology
Update

- Routine OP – 20 minutes including hyperventilation and photic stimulation
- Prolonged (NEAD protocol) – longer recording
- Sleep deprived EEG – sleep for 2/3 hours the night prior to the EEG

- Ambulatory EEG – at home with video equipment
- Video telemetry – 5 day admission to ANU

When should I request an EEG?

NEANU
North of England
Acute Neurology
Update

- Any suggestions?

When should I request an EEG?

NEANU
North of England
Acute Neurology
Update

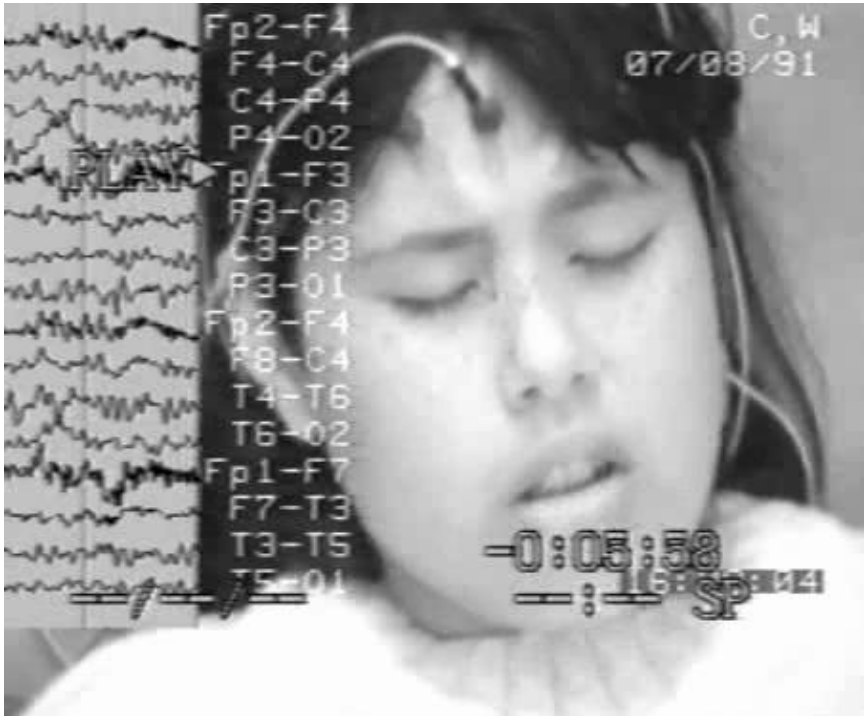
- Status epilepticus
- Epilepsy classification
- 1st seizure
- Encephalitis
- CJD
- Encephalopathy
- Reduced conscious level
- Neuro-prognostication

Clinical cases

NEANU
North of England
Acute Neurology
Update

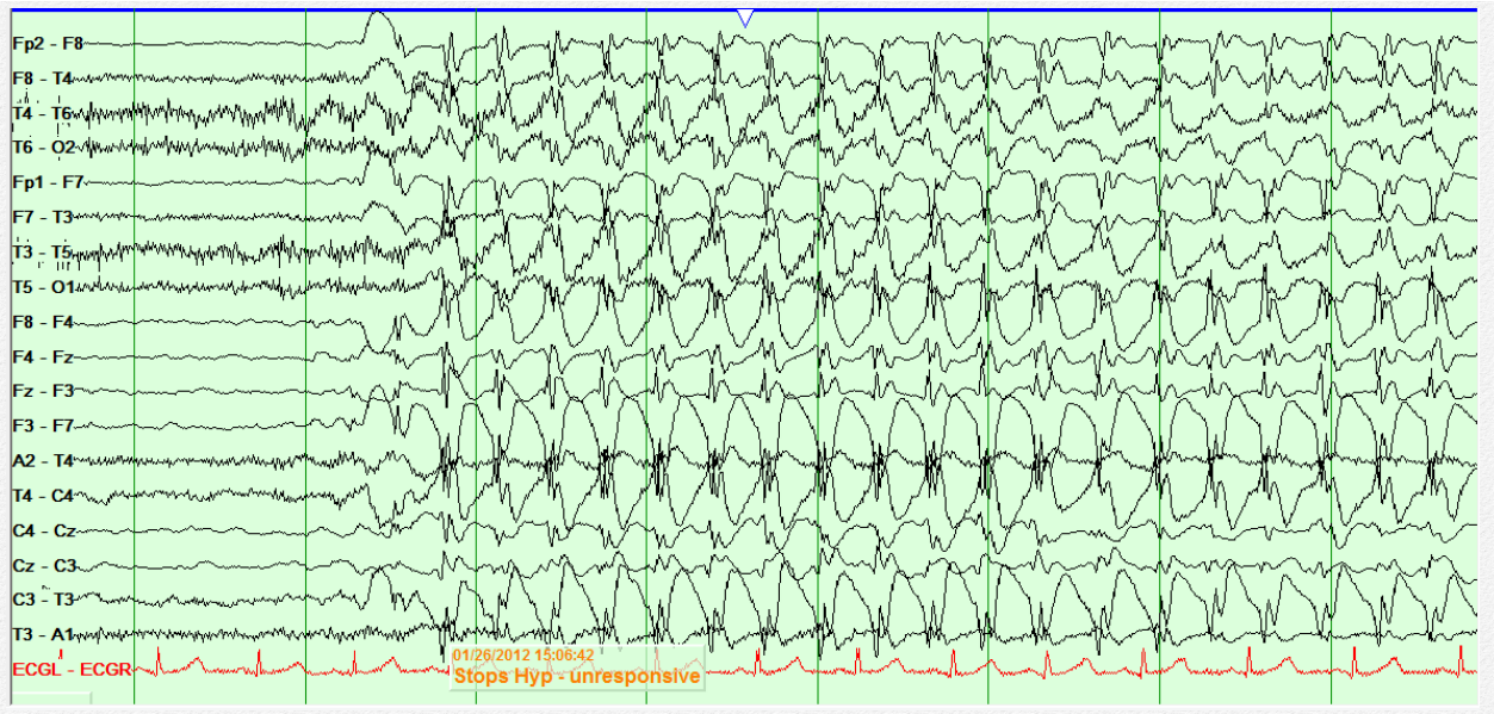
Case 1

NEANU
North of England
Acute Neurology
Update



Case 1

NEANU
North of England
Acute Neurology
Update



Case 2

NEANU
North of England
Acute Neurology
Update

- 55-year-old female
- 5 day history of confusion
  - Forgetting PIN / phone numbers
- Speech slurred
- Veering off to the left on walking
- Behaving out of character
  - Standing with hands under cold tap for 45 minutes
  - Appears vacant
  - Slept for 15 hours the previous day

Case 2

NEANU
North of England
Acute Neurology
Update

- 3 months previously
  - Tired all the time
  - GP – iron deficiency anaemia – iron sup – ref for endoscopy
- Office worker, lives with mother and sister
- Does not drink alcohol
- Smokes 5 / day
- On examination
  - Temp 35.6
  - O2 sats 100%
  - Crackles and reduced AE right base
  - Speech slow and slurred
  - No neurological deficits
  - Rest NAD

Case 2

NEANU
North of England
Acute Neurology
Update

- Diagnosed ?encephalitis , started ceftriaxone and acyclovir
- LP – WCC <1, RCC 72, Protein 0.47, glucose 6.9
  - Bacterial culture, viral PCR negative
- Discharged after 5 days

Case 2 – 6 months later

NEANU
North of England
Acute Neurology
Update

Neurology clinic

- Still off work
- Speech slow, word finding difficulty
- Tired, sleeps 2 hours during the day
- Emotionally labile

- MRI unchanged from previous
- VGKC Abs 101, NMDA negative
- Admitted

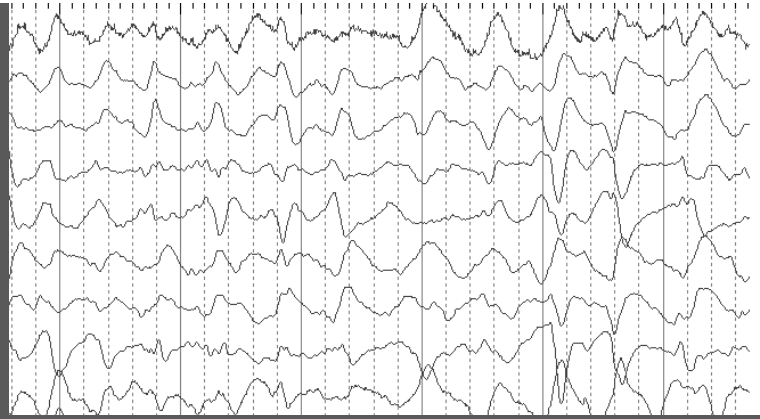
Case 2 – EEG

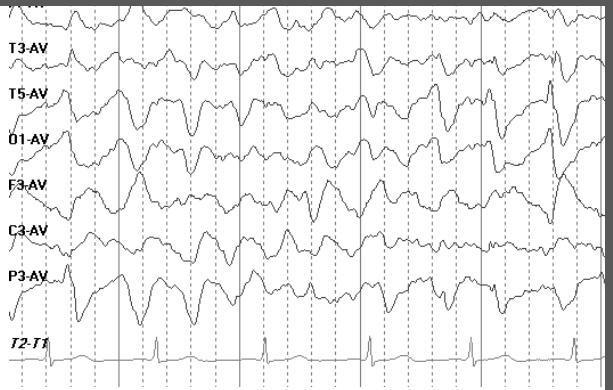
NEANU
North of England
Acute Neurology
Update

Severely abnormal record

Background rhythms in the delta range (excessively slow),

Periodic sharp and slow and triphasic complexes





Severe encephalopathic picture

Possible non convulsive status epilepticus

Repeat EEG after trial of benzodiazepines (clobazam)

Case 2

NEANU
North of England
Acute Neurology
Update

- Started on Clobazam 10mg BD
  - Extremely drowsy
  - Bed bound
  - Barely able to speak

- Repeat EEG

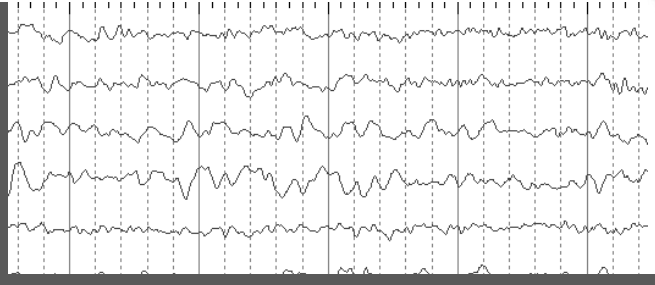
Case 2 – Repeat EEG

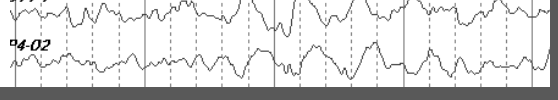
NEANU
North of England
Acute Neurology
Update

Record still abnormal

Background rhythms in the theta range (slow)

Periods of fast activity and rhythmic delta



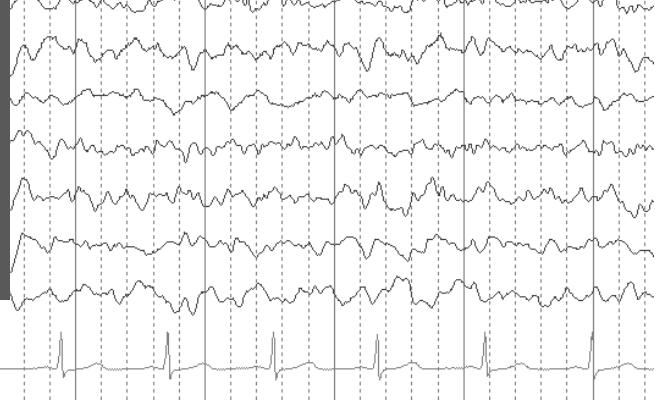


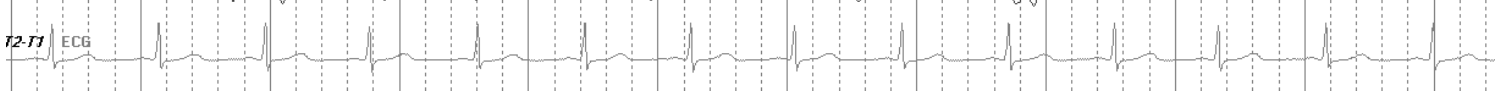
WE ARE MISSING SOMETHING!

Moderate encephalopathy

EEG improved with clobazam

Repeat study in 1 week recommended





Case 2 – diagnosis

NEANU
North of England
Acute Neurology
Update

- Ammonia 110

- Diagnosis: hepatic encephalopathy

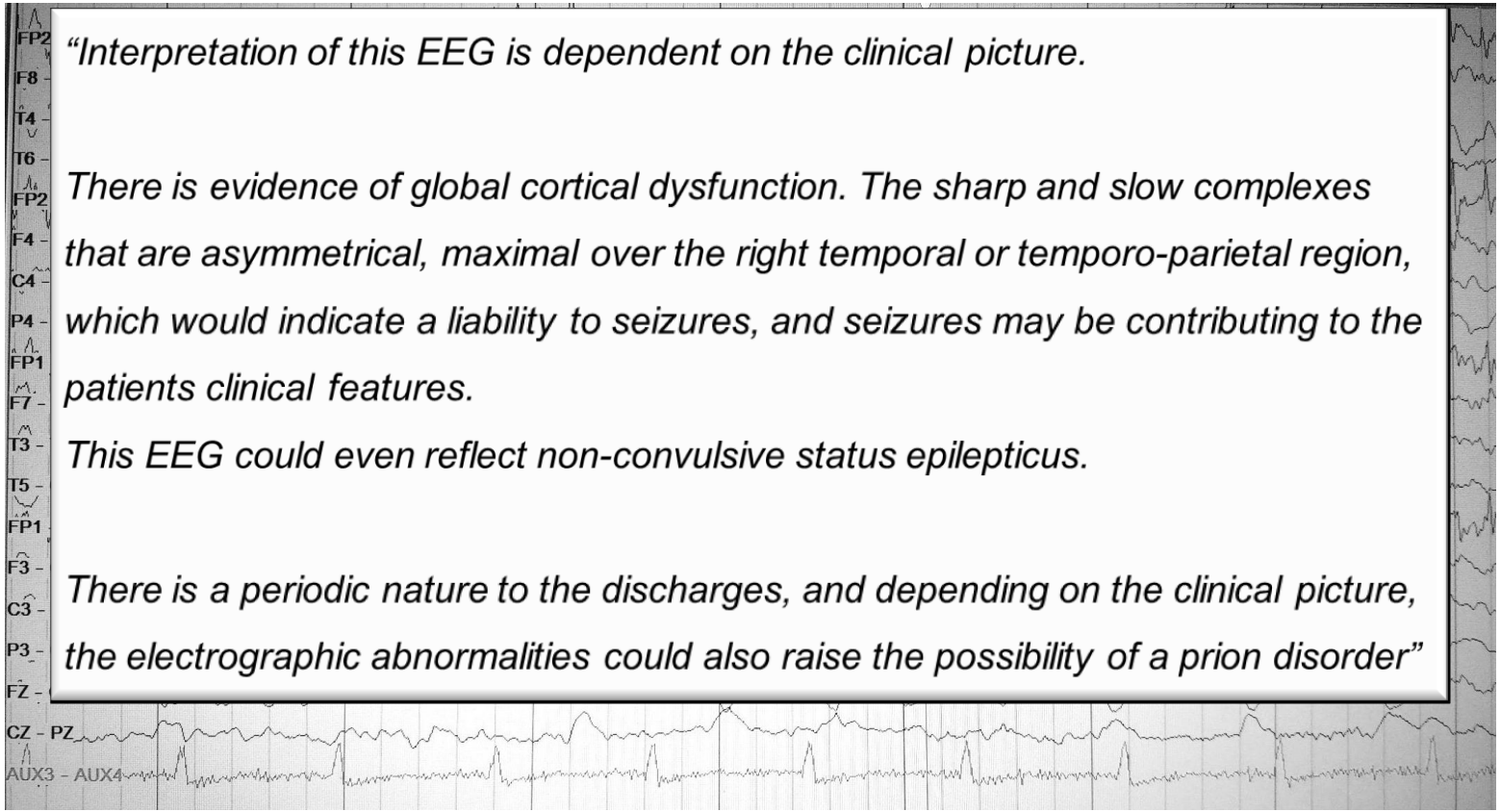
Case 3

NEANU
North of England
Acute Neurology
Update

- 90 F, nursing home resident
- Admitted with chest infection
  - Febrile
  - Confused
  - CRP 25
- 3 days later
  - Unresponsive
- CT brain – age related atrophy
- LP – CSF protein 0.8, otherwise normal

Case 3 – EEG

NEANU
North of England
Acute Neurology
Update



"Interpretation of this EEG is dependent on the clinical picture.

There is evidence of global cortical dysfunction. The sharp and slow complexes that are asymmetrical, maximal over the right temporal or temporo-parietal region, which would indicate a liability to seizures, and seizures may be contributing to the patients clinical features.

This EEG could even reflect non-convulsive status epilepticus.

There is a periodic nature to the discharges, and depending on the clinical picture, the electrographic abnormalities could also raise the possibility of a prion disorder"

Case 3

NEANU
North of England
Acute Neurology
Update

- Discussed with on call neurology registrar
  - ‘We have a 90 year old in non convulsive status’
  - Loaded with valproate
  - Comatose

- Referred to neurology

Case 3 – Diagnosis

NEANU
North of England
Acute Neurology
Update

- CRP 326

- Diagnosis: Sepsis Associated Encephalopathy

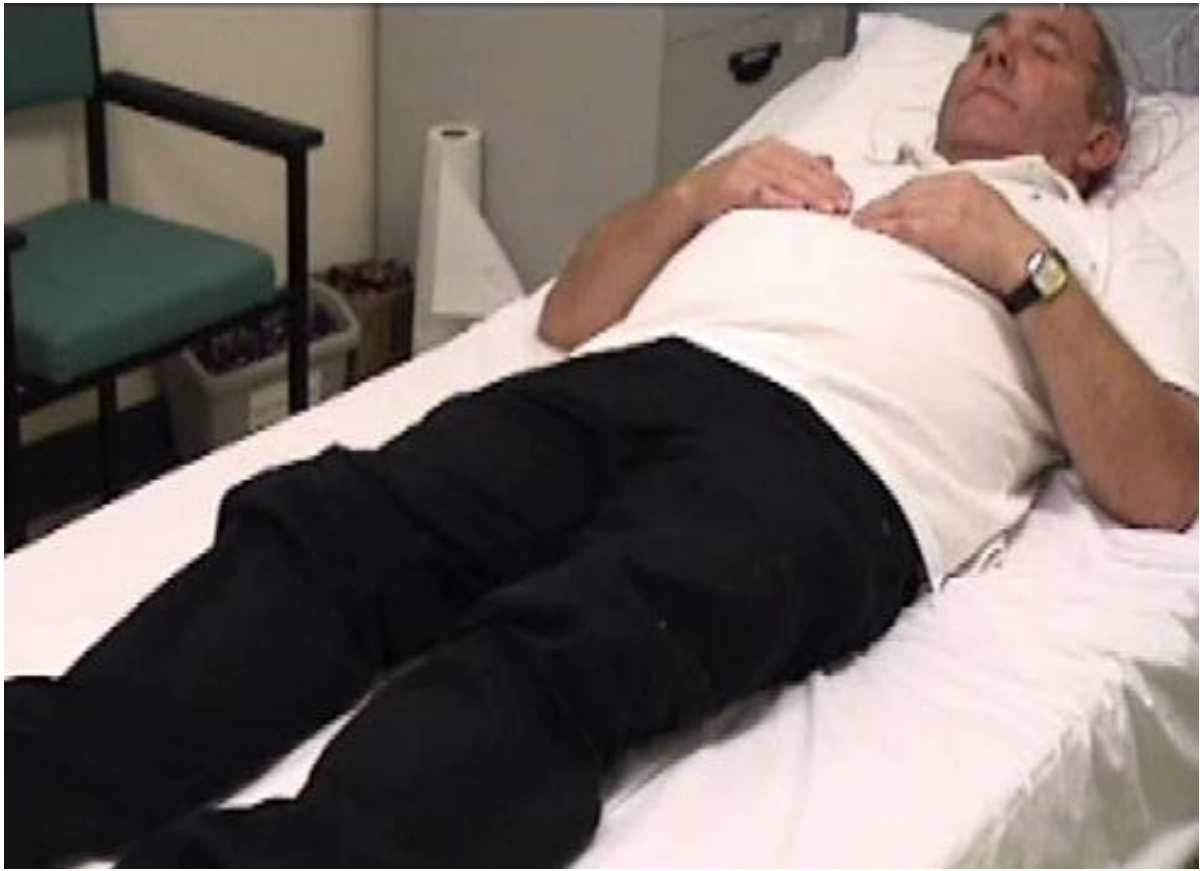
Case 4

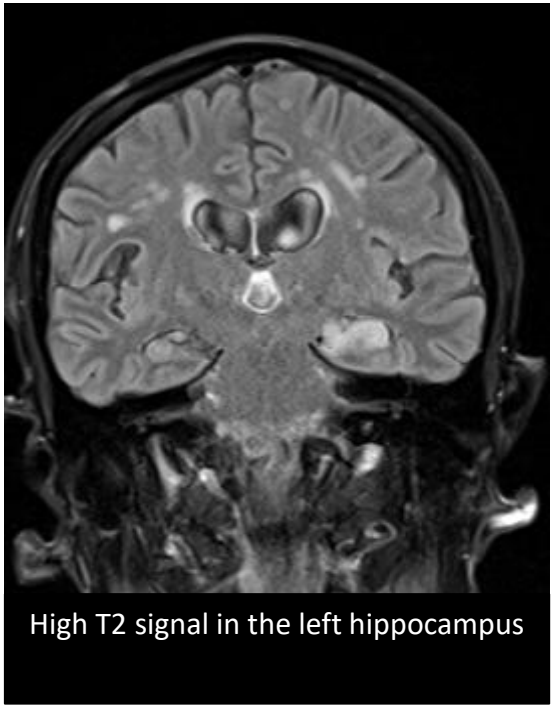
NEANU
North of England
Acute Neurology
Update

- 62-year-old man presents with confusion
- Sodium 124
- FBC, LFT, ESR, CRP normal
- Hyponatremia was corrected, but encephalopathy persists

Case 4

NEANU
North of England
Acute Neurology
Update





High T2 signal in the left hippocampus

Case 4 – EEG

NEANU
North of England
Acute Neurology
Update

- Multiple events captured – no epileptiform correlate on EEG

Case 4 – Diagnosis

- LGI1 encephalitis

NEANU
North of England
Acute Neurology
Update

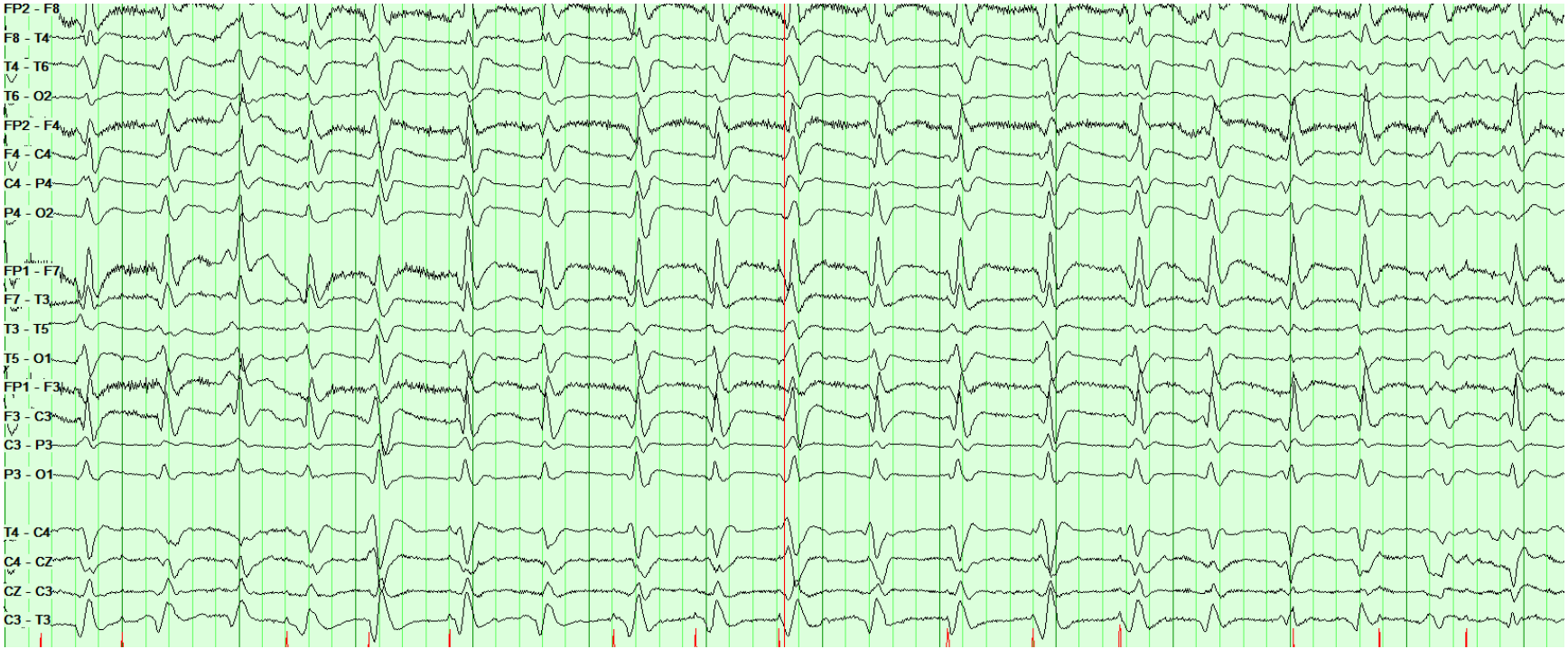
Case 5

NEANU
North of England
Acute Neurology
Update

- A 65-year-old man presents with rapid cognitive decline and behaviour change
- MRI – non-specific changes
- Antibodies for autoimmune encephalitis – pending

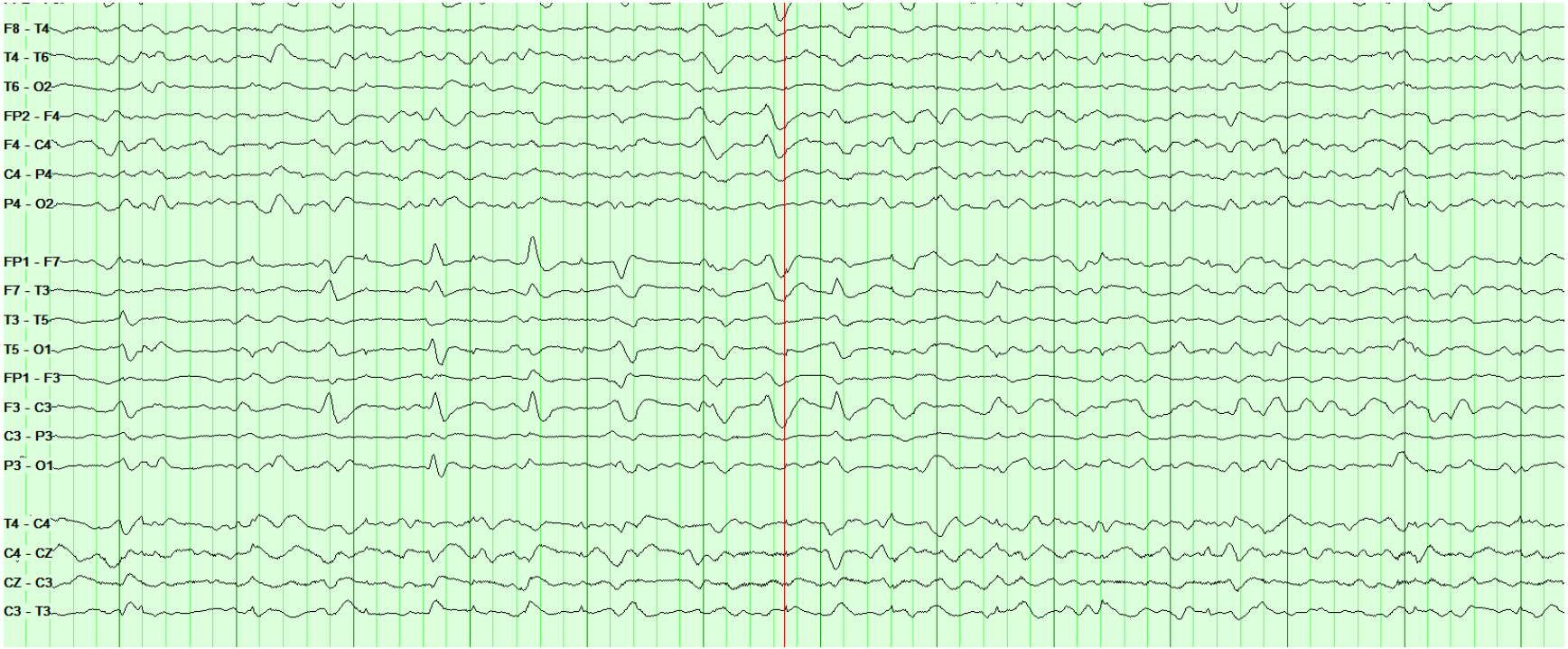
Case 5 – EEG

NEANU
North of England
Acute Neurology
Update



Case 5 – EEG

NEANU
North of England
Acute Neurology
Update



Case 5 – Diagnosis

- CJD

NEANU
North of England
Acute Neurology
Update

Take home messages

NEANU
North of England
Acute Neurology
Update

- Some seizures do not have a correlate on scalp EEG
- Some EEG patterns are diagnostic
- If you’re not sure what an EEG report means – ask for advice
- Be clear with the clinical question when requesting an EEG

Any questions?

NEANU
North of England
Acute Neurology
Update