ISRCTN 89547571

TOBY

Cerebral Function Monitoring

Addition to CFM handbook for users of the Olympic CFM 6000

The contents of this booklet were originally produced for the website

http://www.azzopardi.freeserve.co.uk/CFM

by

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Training Manual
Olympic 6000
Cerebral Function Monitor

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EQUIPMENT

Overview

The Olympic CFM 6000 records a single channel of EEG recorded from 2 electrodes placed on either side of the head. A third electrode acts as a ground. The signal is filtered and rectified and the range of amplitude of the signal in microvolts is displayed on the monitor at 6 cms per hour. This makes every major division of the CFM trace equal to 10 minutes of EEG. Frequencies <2 and >15 Hz are selectively filtered to reduce artefacts caused by movement, ECG and other electronic equipment. The CFM 6000 stores the underlying EEG allowing inspection of the unprocessed EEG at any point in the CFM trace, which helps in identifying artefacts and confirming seizure activity.

Interpreting the CFM trace

The CFM trace consists of a dense trace that can vary in width. Two features of the trace should be assessed: the amplitude of the trace, and the presence of seizure activity. The amplitude of the trace can be assessed by measuring the upper and lower margins of the trace against the scale shown on the monitor or printed on the printer paper. When measuring the amplitude of the CFM it is the dense trace of EEG activity

that is measured; the brief spikes that can sometimes be seen outside the dense trace are ignored. The position of the margins of the trace can usually be eyeballed, or a ruler can be used to draw a line along the margin of the trace.

Seizures are characterised by sudden rise and narrowing of the trace (reflecting the increase in EEG voltage). The trace returns to the previous appearance when the seizure activity stops. Inspection of the underlying EEG helps confirm the occurrence of seizures on the CFM trace. The underlying EEG usually shows a repetitive spike and wave discharge but other EEG seizure patterns may be seen. Seizures may only be identified if they are sufficiently prolonged, more than 2-3 minutes. Shorter lasting discharges may be missed since the CFM is recorded at a very slow speed. It may be difficult to distinguish burst suppression from brief seizures in a severely abnormal trace but the distinction can be made by inspecting the underlying EEG. It may not be possible to comment on the background amplitude of the CFM trace if seizures are very frequent.

CFM vs EEG

Since the CFM records the amplitude of the EEG at a very slow speed, continuous EEG activity is manifest on the CFM as a dense trace varying from about 10-40 microvolts. The width of the trace varies with the state of the infant. The trace is wider during quiet sleep and narrower in active sleep or when awake. Discontinuity of the EEG results in a wider trace because of a fall of the lower margin of the trace. The more discontinuous the EEG activities the wider the CFM trace. Severely disorganised EEG activity such as burst suppression is manifest as a narrower lower voltage CFM trace accompanied by bursts of higher voltage activity. Very low voltage EEG will be displayed as a very narrow CFM trace usually with the lower margin of the trace very close to the baseline.

Classification of the CFM

A simple semiquantitative classification is used in the Toby study:

1. Normal

The upper margin of the trace is above 10 microvolts and the lower margin is greater than 5 microvolts.

In healthy full term infants the trace alters in width according to the state of the infant. The trace is narrower when the infant is awake and widens during sleep. These changes in width of the trace with infant state are called sleep/wake cycling. In normal infants the width of the trace varies from approximately 10-40 microvolts.

2. Moderately abnormal

The upper margin of the trace is greater than 10 microvolts and the lower margin is less than 5 microvolts.

This appearance can be seen in infants with moderately severe encephalopathy, or immediately after administration of drugs such as anticonvulsants and sedatives. This pattern may also be seen in preterm infants (below 36 weeks gestation).

3. Severely abnormal

The upper margin of the trace is less than 10 microvolts. The lower margin is usually less than 5 microvolts but on occasion the lower margin may be raised above 5 microvolts because of interference from ECG or other artefacts.

A severely abnormal trace is characterised by a general suppression of amplitude so that the trace appears narrow and of low voltage. This pattern may be accompanied by brief bursts of higher voltage spikes, which appear as single spikes above the background activity. This appearance is sometimes called “burst suppression”. A severely abnormal trace is usually seen with severe encephalopathy and is often accompanied by seizure activity.

Points to Note

- The CFM does not give information about EEG frequency. It only displays the amplitude of the EEG.
- EEG activity less than 2 Hz or greater than 12 Hz is not recorded by the CFM trace.
- Focal abnormalities in the EEG may not be identified because the signal is obtained from a single channel.
- If the CFM trace looks odd or is not consistent with the clinical picture use the EEG display facility on the CFM 6000 to check for artefacts.
- Movement artefact associated with head bobbing due to breathing difficulty may show up as a wide trace on CFM. Changing the position of the head or supporting the head with a roll may lessen the artefact.
- Artefact from the ECG may falsely elevate the lower margin of the trace or even the whole CFM trace. Confirm by displaying the EEG.
- Pulse artefact may be difficult to distinguish from seizure on the EEG. The pulse artefact is regular with the pulse whilst a seizure discharge frequency usually varies. Resiting the electrodes further away from the fontanelle may help.

- Medications may affect the record. Anticonvulsants or sedatives such as morphine or chloral hydrate may transiently suppress the CFM record.
- Administration of drugs or other clinical events should be marked to facilitate interpretation of the CFM.

Attaching the electrodes

Three electrodes are attached to the scalp, as shown in the diagram displayed on the amplifier box. The electrode connected to the connector marked with the red dot is attached to the left parietal side and the electrode connected to the yellow marked connector is attached to the right parietal side of the head. The third electrode is used as a ground and can be connected to the front or back of the head in the midline, avoiding the anterior fontanelle. The CFM 6000 can be used with self adhesive EEG electrodes (hydrogel type) or disposable subdermal needle electrodes.

Self adhesive electrodes

- Clean the surface of the scalp with an alcohol swab.
- Gently rub the scalp using an abrasive skin paste, such as Nuprep.
- Wipe skin dry and attach self adhesive electrode.

Neonatal ECG electrodes may be used in place of the EEG electrodes. A small amount of EEG conducting paste such as 10/20 EEG paste will help reduce the impedance.

Needle electrodes

Needle electrodes can be applied easily with minimal preparation. The needle electrodes do not appear to cause discomfort and no anaesthetic is required for insertion. Care must be taken if the infant is moved to avoid dislodging the electrodes.

- Clean the application site with an alcohol swab.
- Insert the needle subcutaneously up to the plastic hub.
- Fix using a skin adhesive such as Collodion (supplied by SLE) or by adhesive tape.

The correct preparation of Collodion to use is the one supplied in small blue tubes by SLE. Do not use the Collodion fluid supplied in bottles. Replace cap on tube immediately after use or the nozzle will get blocked. After inserting the needle electrode apply a small drop of the Collodion on to the plastic hub of needle, smear over surrounding skin and allow Collodion to dry completely (usually 30 seconds) before handling electrode. After use the Collodion can be removed by acetone or preferably by a special no acetone remover supplied by SLE. Plaster remover does not work on Collodion.

BRIEF OPERATING INSTRUCTIONS FOR CFM 6000

Connect CFM 6000 to mains power.

Connect amplifier box to the CFM 6000.

Turn on CFM 6000.
- Switch is at back of monitor.
- Initial boot-up sequence takes about 1 minute.

Apply electrodes.
- Refer to section on electrodes.
- Use disposable single use needle electrodes in preference.

Press RECORD.
- The system enters calibration and then begins recording.
- When in Record mode you can enter patient data, print the CFM screen, review data, and place markers of interest.
- If patient data is on screen you can append new patient data to the current file.

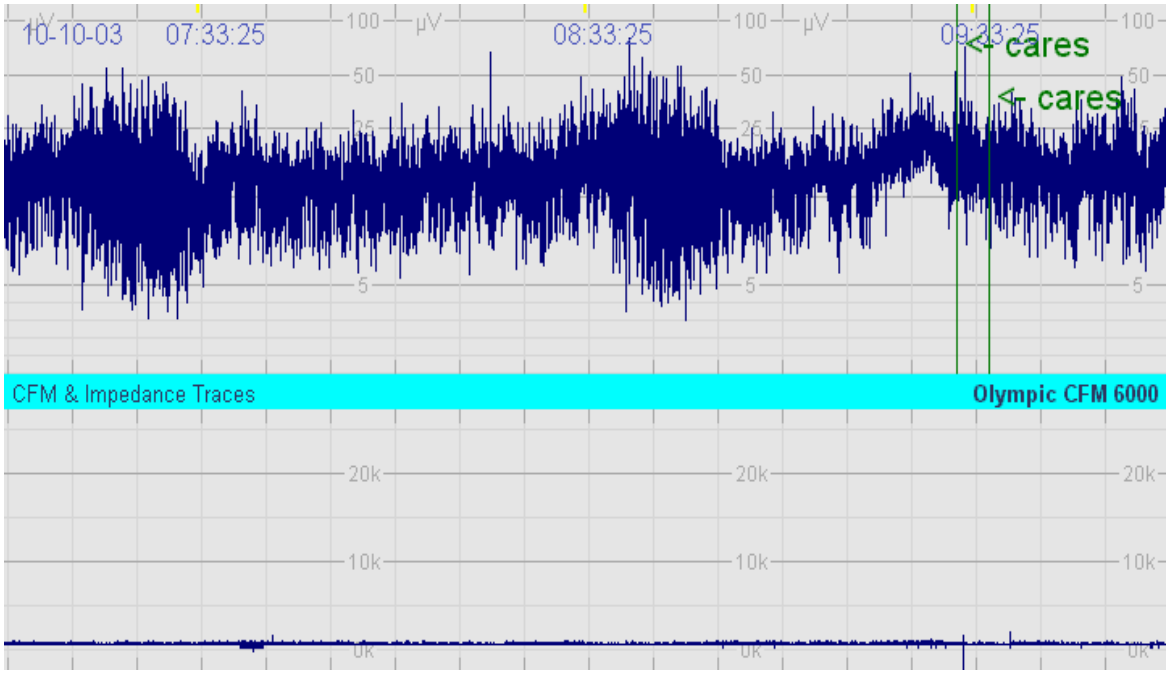
Press PATIENT to enter patient details.

To display the EEG Press EEG.
- Press EEG ON to exit EEG mode

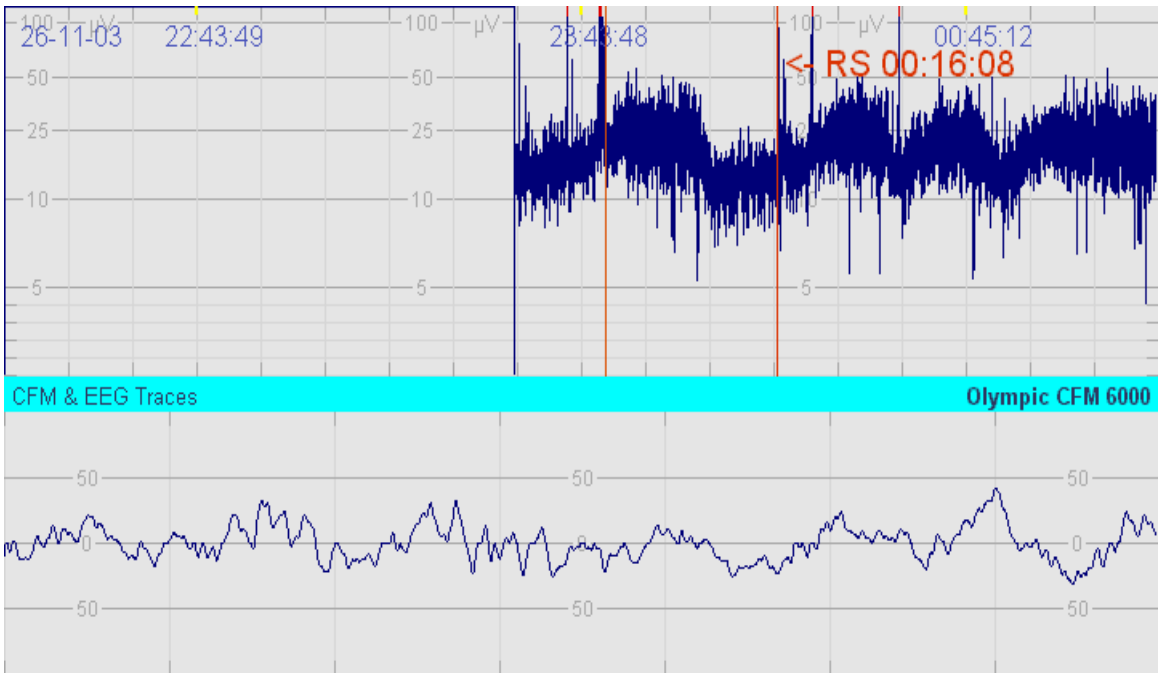
If PLAYBACK is displayed on screen press scroll control >> to display current data

Refer to Operator's Manual for more detailed information.

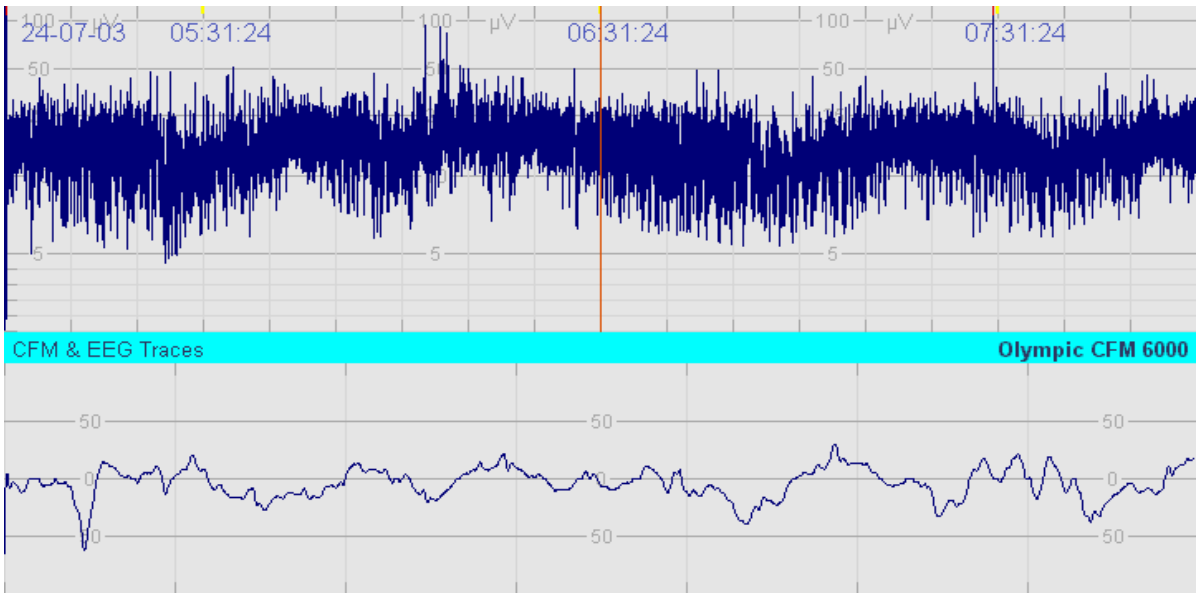
Sample traces recorded using the Olympic CFM 6000



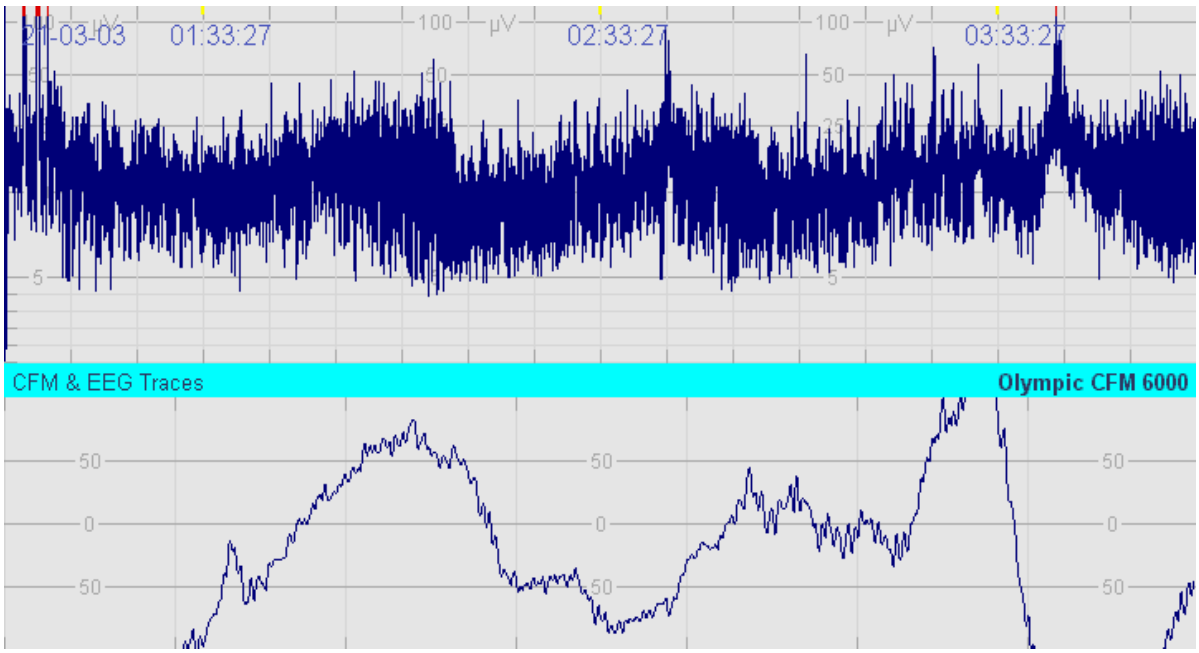
Sample 1: Normal CFM voltage. The CFM is disturbed during nursing care of infant. Sleep wake cycling can be observed.



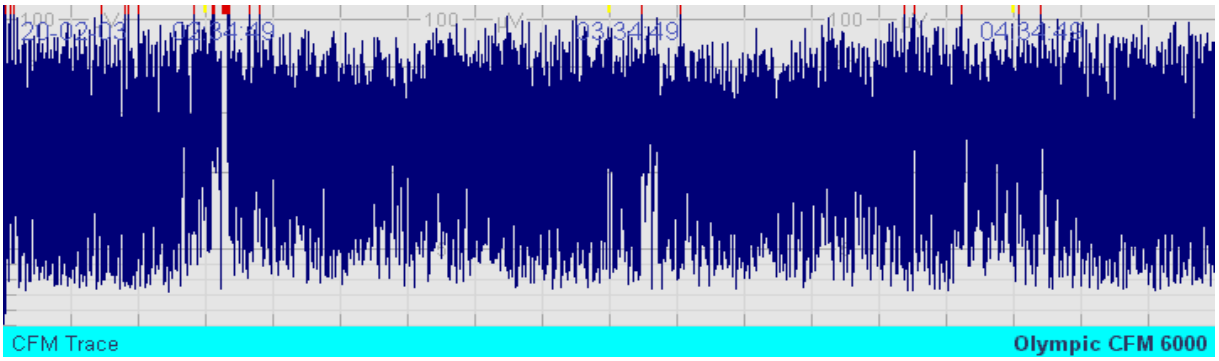
Sample 2: Normal CFM voltage. Sleep wake cycling can be observed.



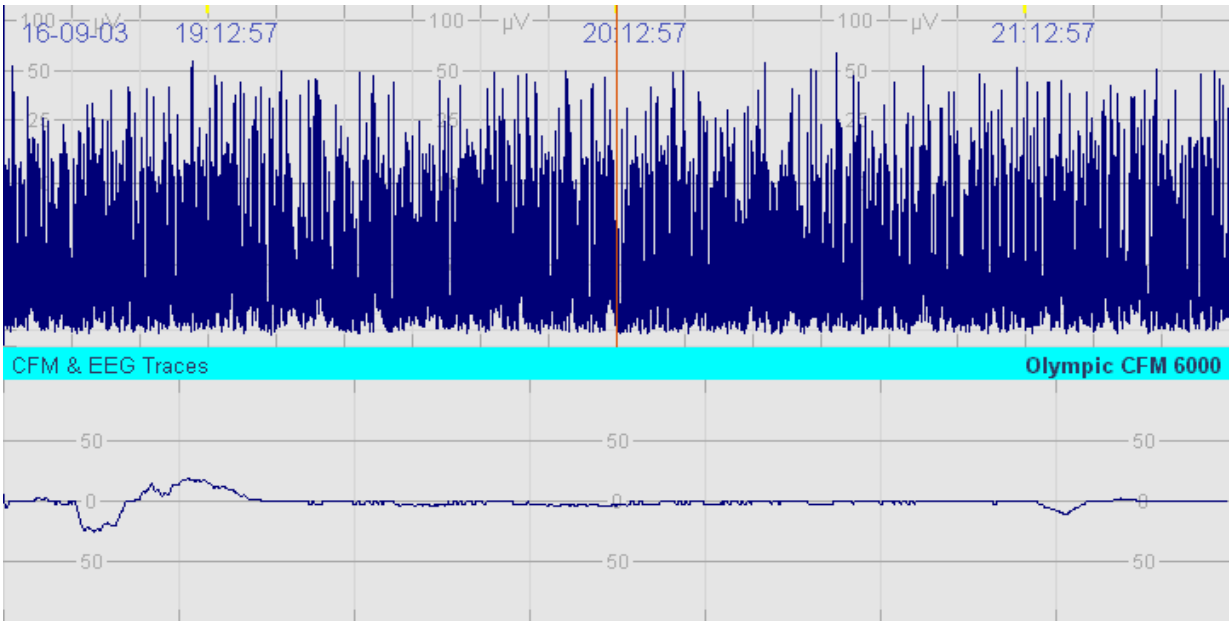
Sample 3: Normal CFM voltage. Sleep wake cycling can be observed.



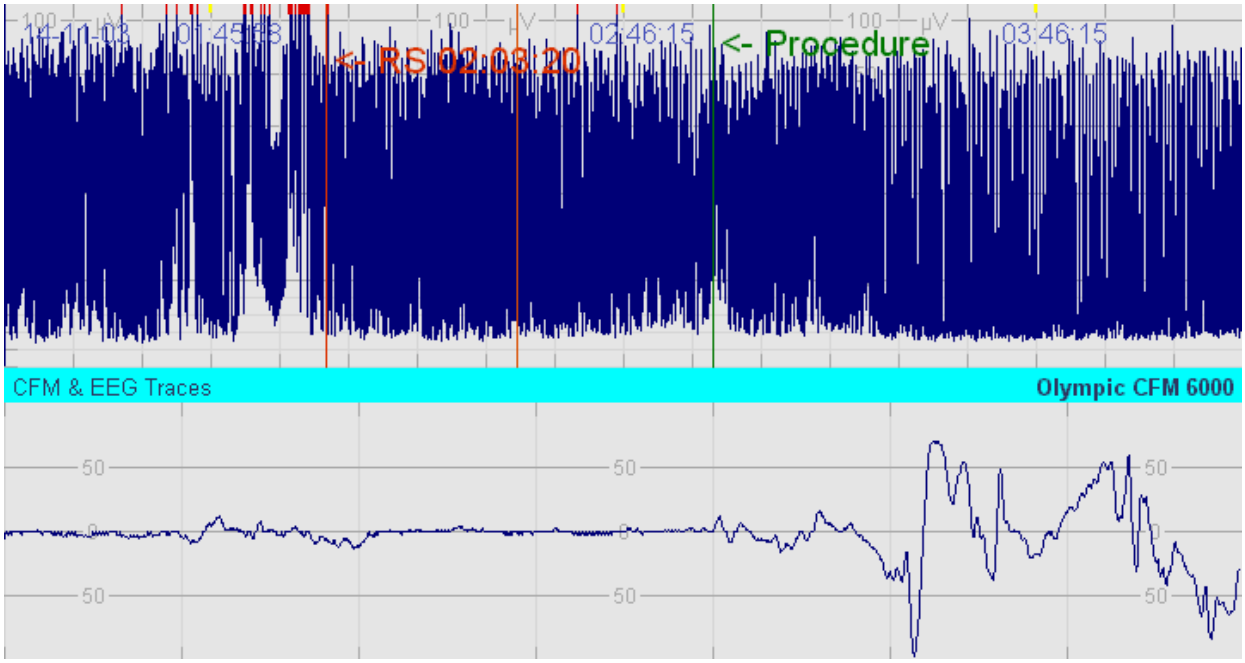
Sample 4: Normal CFM voltage. Sleep wake cycling can be observed. Movement artefact is present in part of trace.



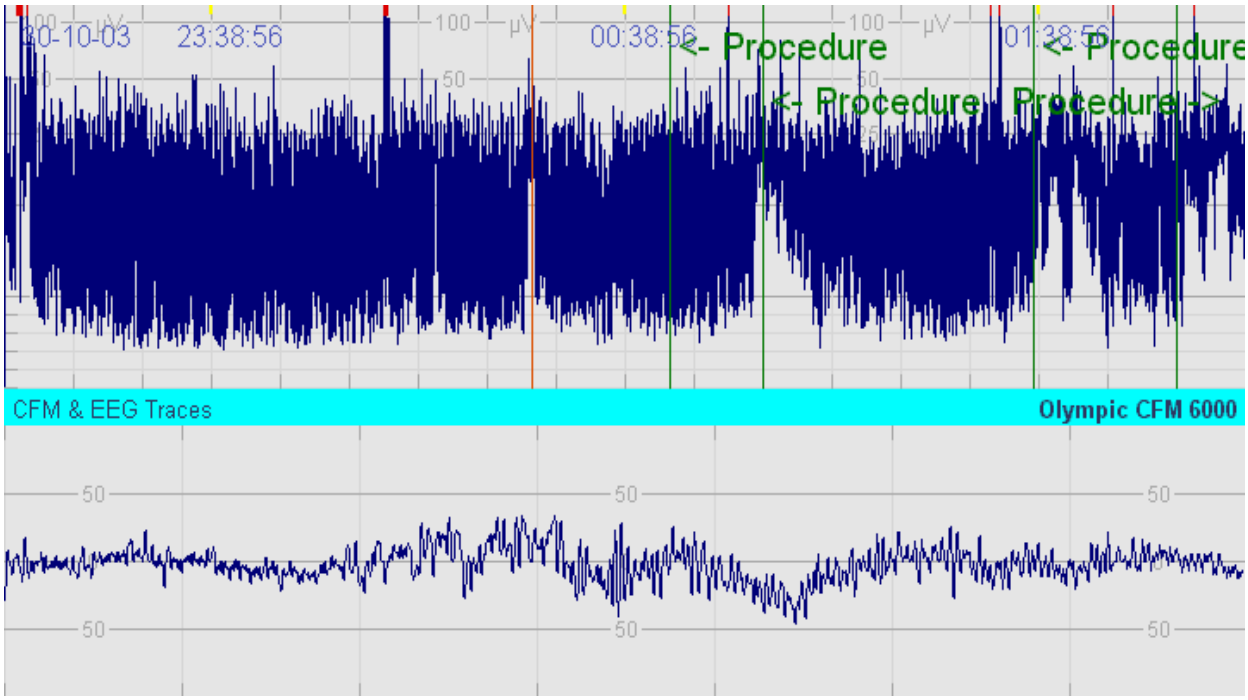
Sample 5: Moderately abnormal CFM.



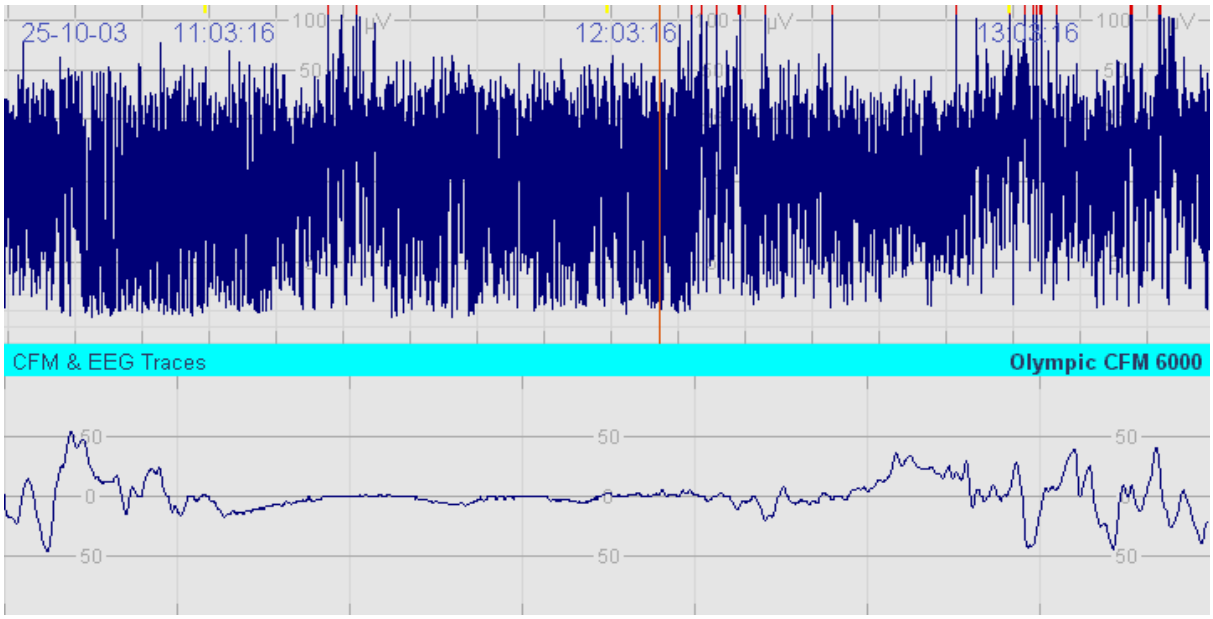
Sample 6: Severely abnormal CFM. Do not include the brief spikes when assessing the upper margin of CFM trace. EEG shows severe discontinuity.



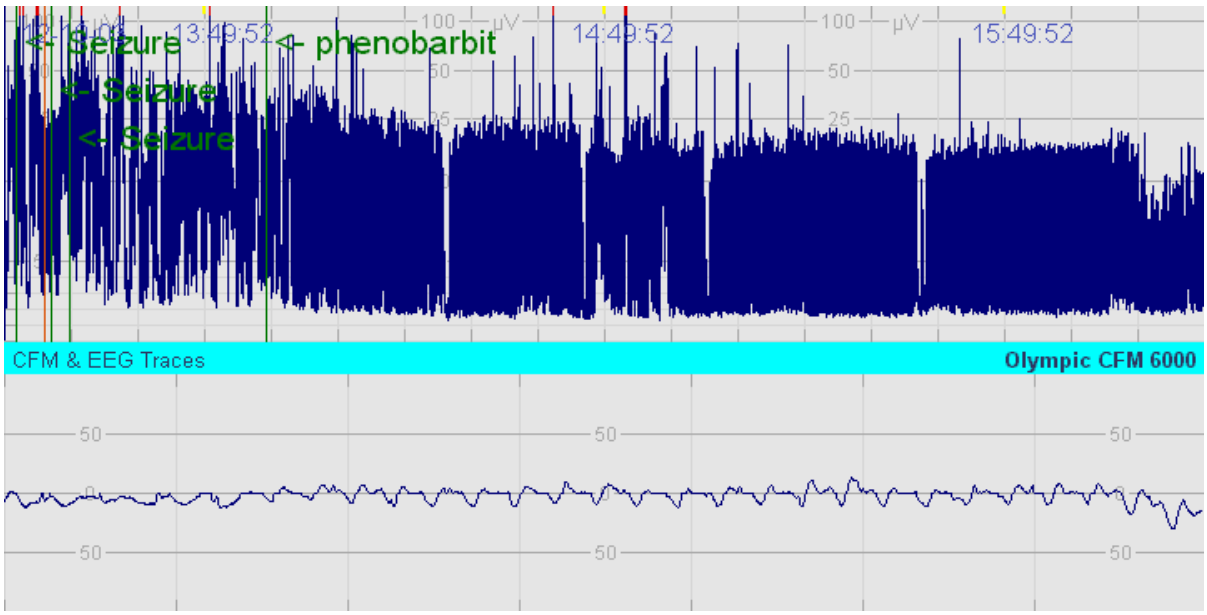
Sample 7: Moderate changing to severely abnormal CFM. EEG shows burst suppression pattern.



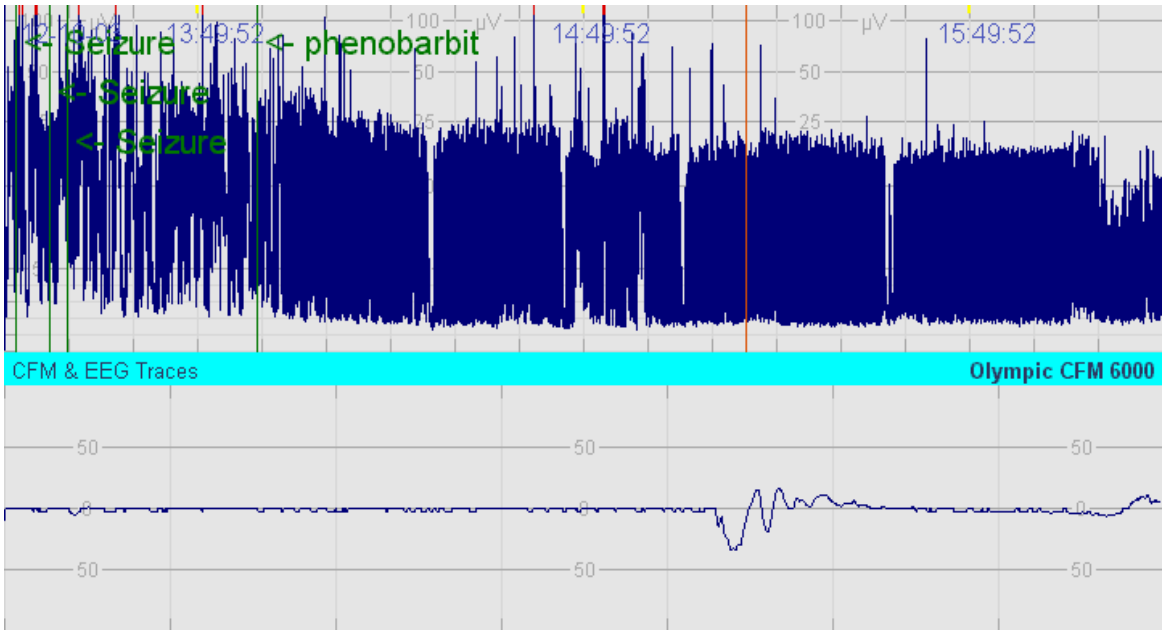
Sample 8: Moderately abnormal CFM. Movement induces artefacts on trace which can be confirmed on EEG.



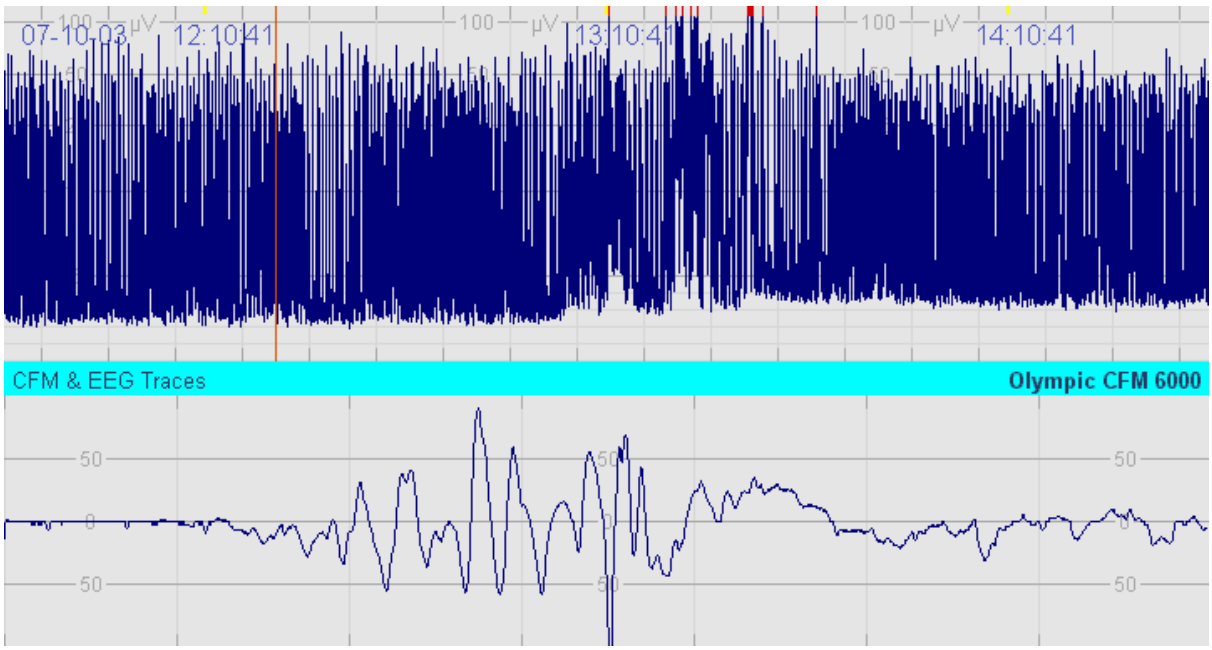
Sample 9: Moderately abnormal CFM. EEG shows discontinuity.



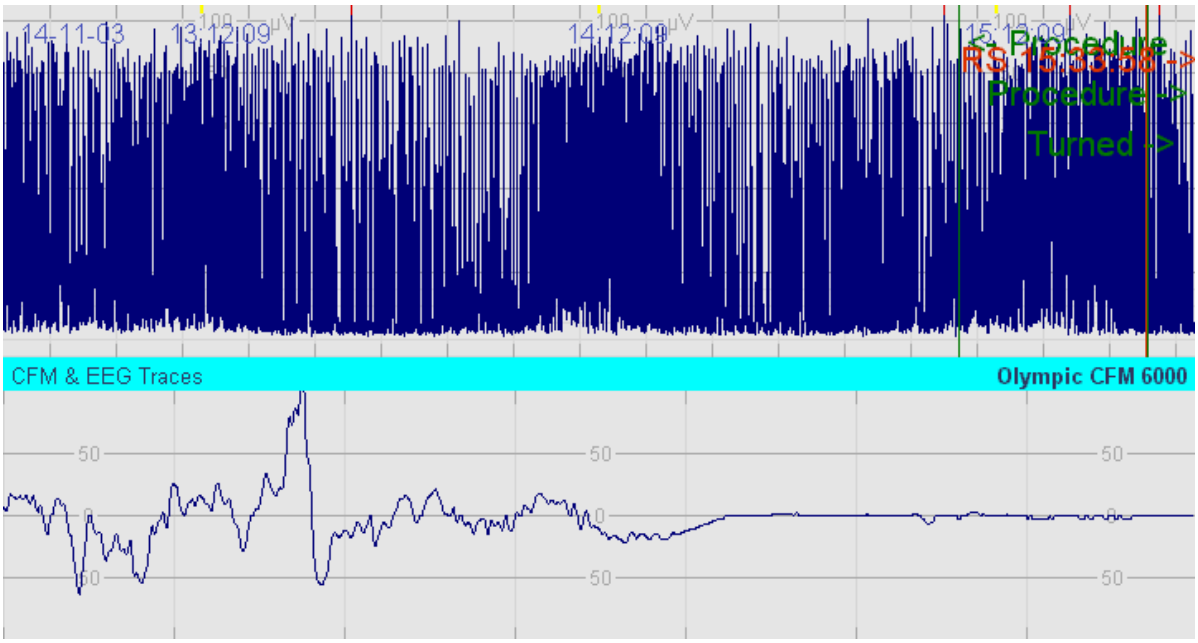
Sample 10: CFM trace disturbed by seizure discharge at beginning of trace. EEG shows seizure.



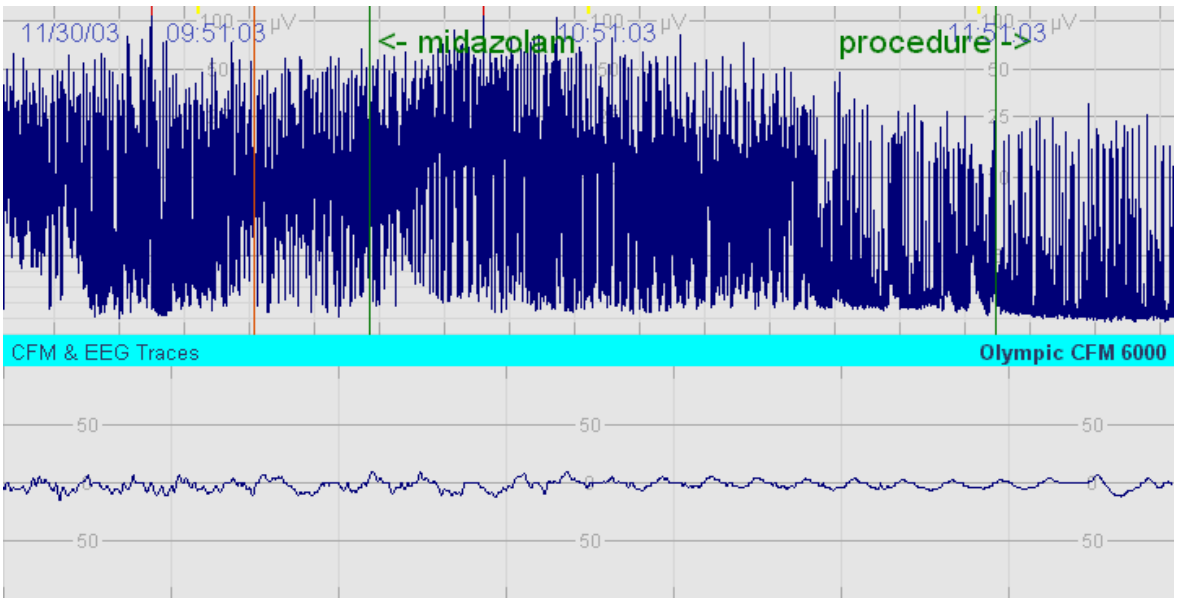
Sample 11: CFM amplitude becomes moderately abnormal following phenobarbitone. EEG shows severe discontinuity.



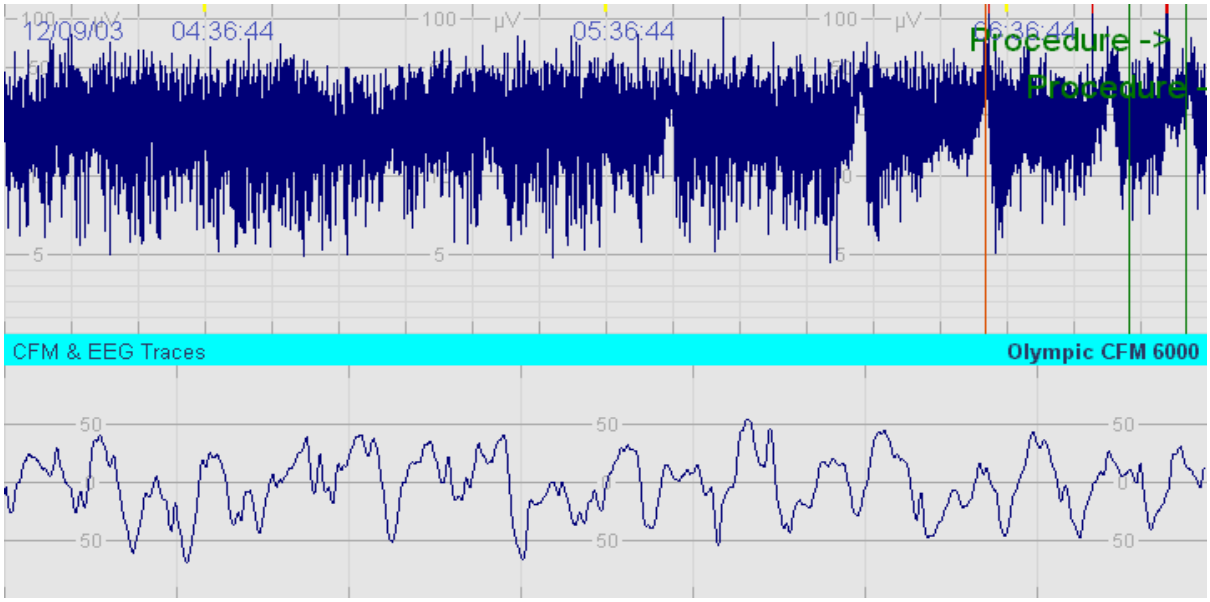
Sample 12: CFM amplitude varying between moderately and severely abnormal trace. EEG shows burst suppression pattern.



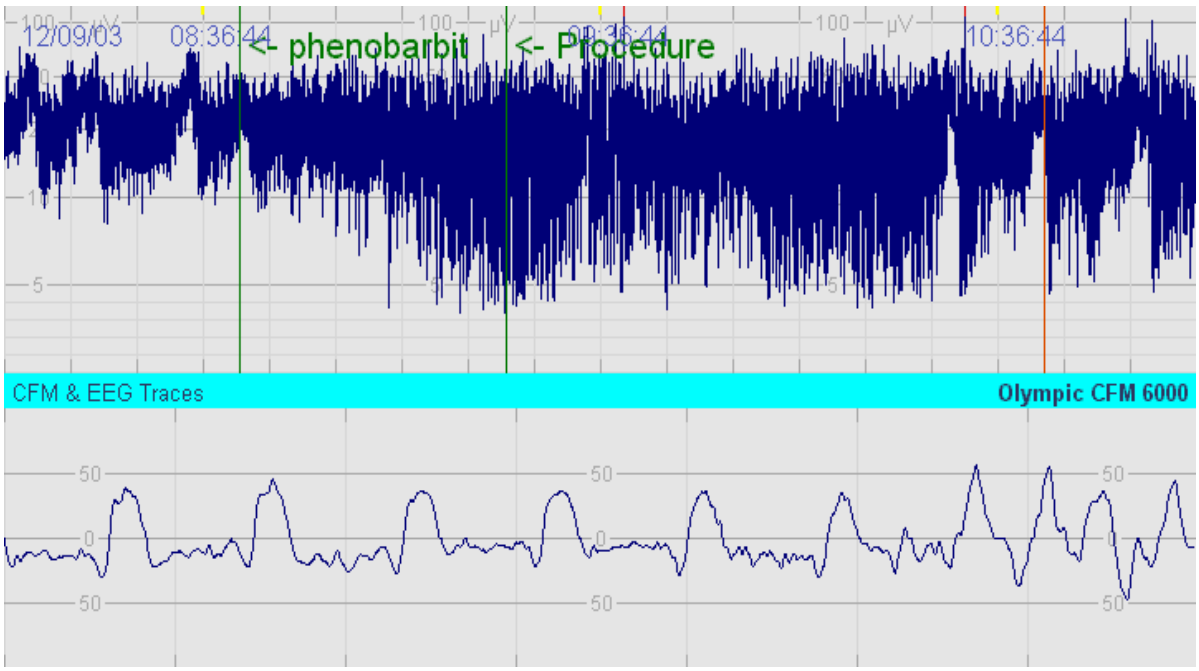
Sample 13: Similar to sample 12. CFM amplitude varying between moderately and severely abnormal trace. EEG shows burst suppression pattern.



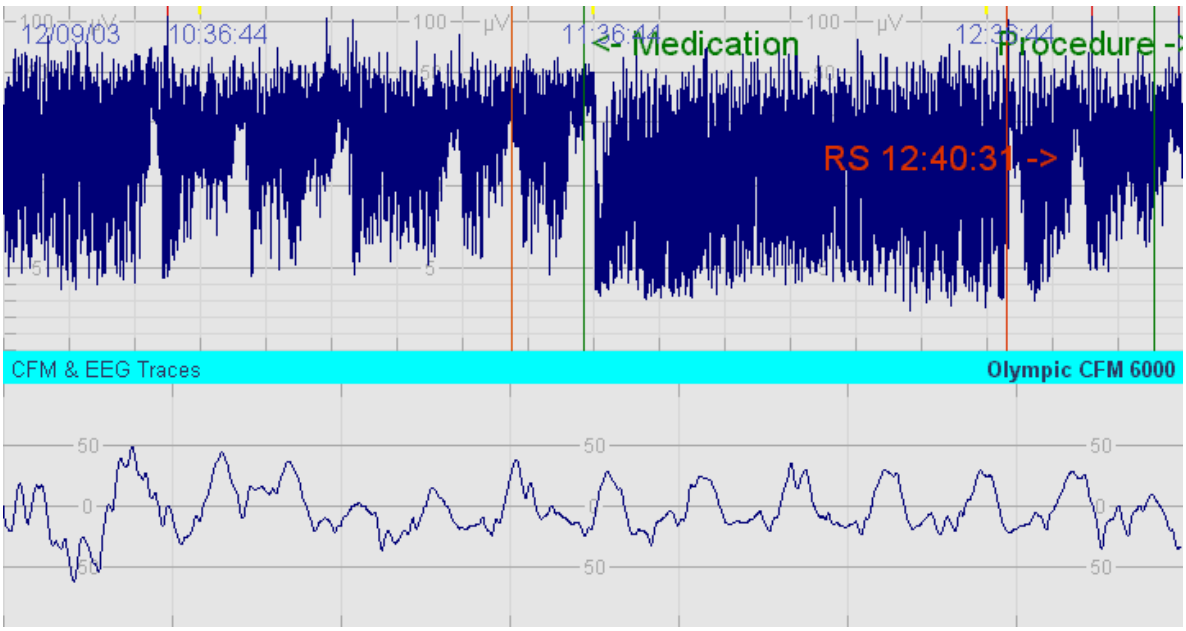
Sample 14: Irregular CFM amplitude with frequent bursts, EEG shows seizures. CFM amplitude severely abnormal following midazolam.



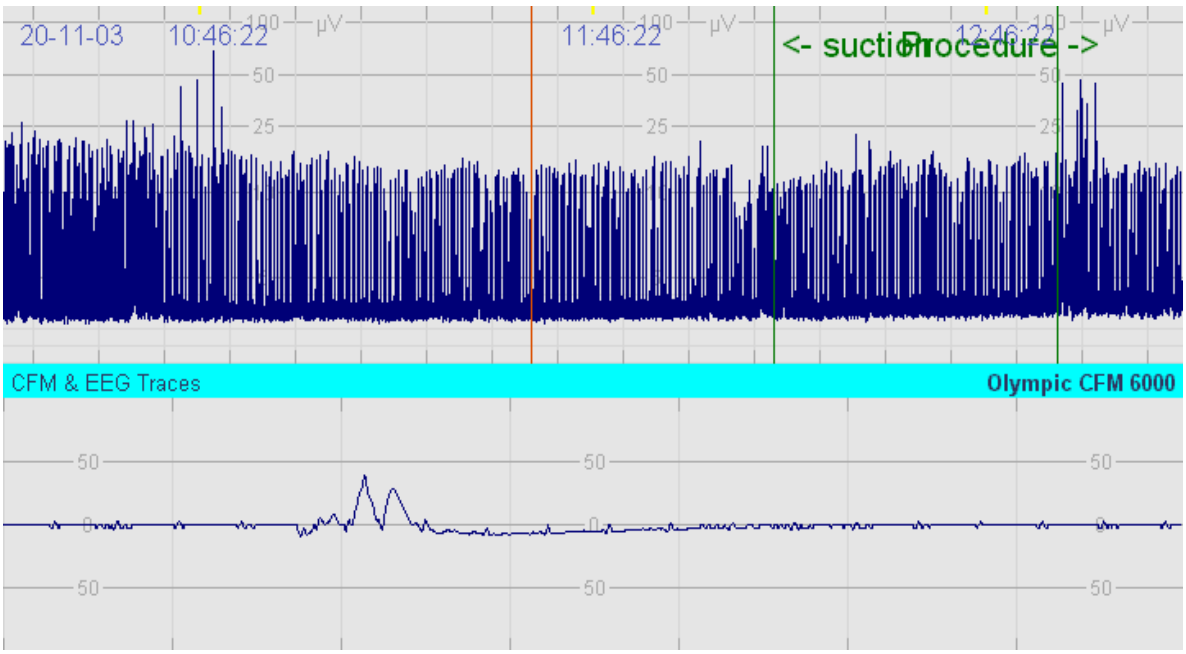
Sample 15: Normal CFM amplitude but seizures are present and confirmed on EEG.



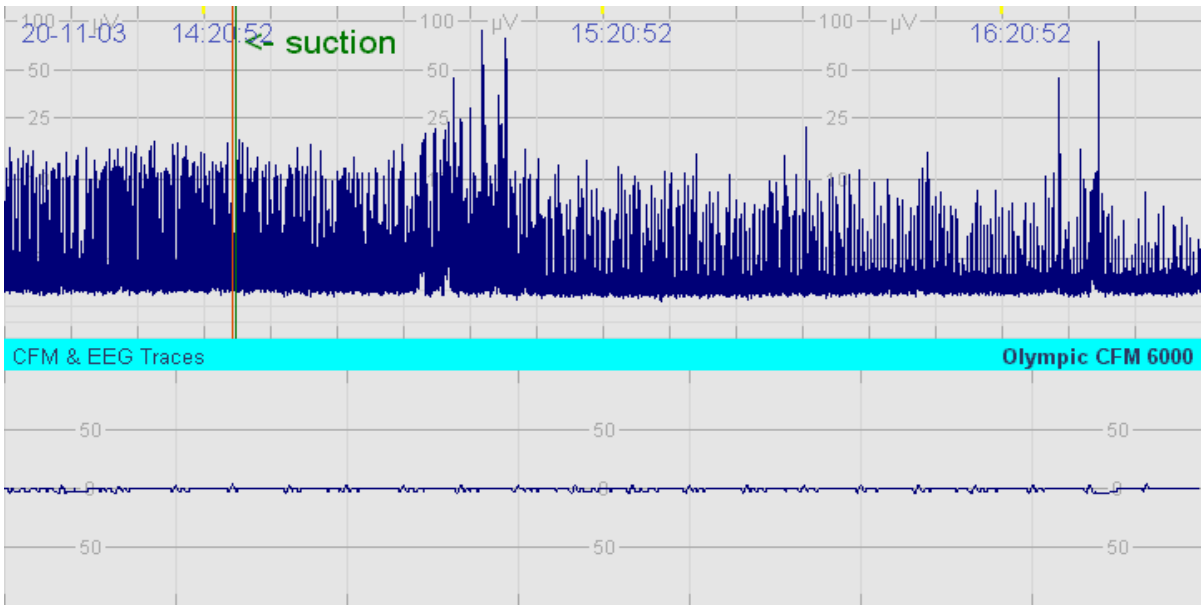
Sample 16: CFM shows seizures which are confirmed on EEG.
CFM background becomes moderately abnormal following phenobarbitone.



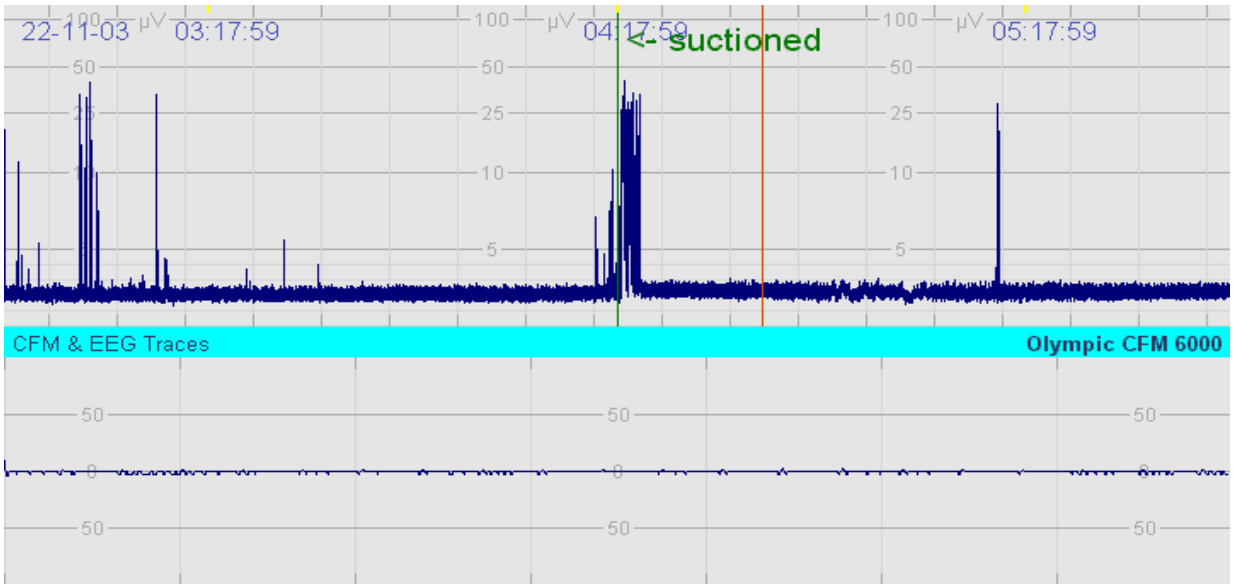
Sample 17: CFM amplitude borderline moderately abnormal. Seizures are present and confirmed on EEG.



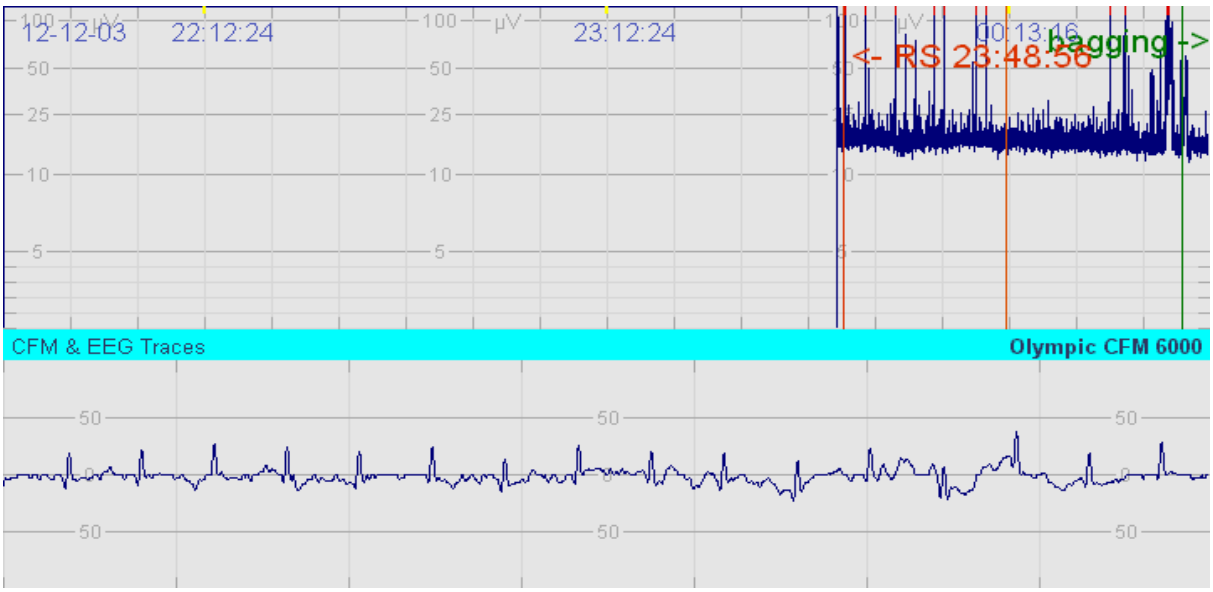
Sample 18: Severely abnormal CFM. EEG shows brief burst on isoelectric background.



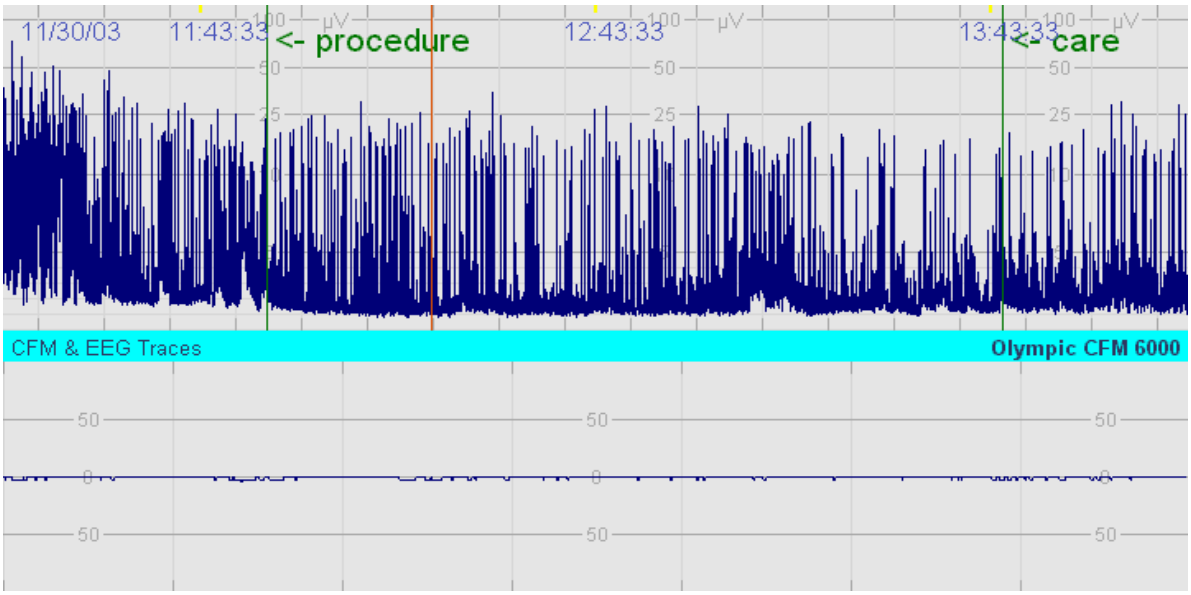
Sample 19: Severely abnormal CFM. EEG shows isoelectric background. Note ECG artefact in EEG results in elevation of lower margin of CFM trace.



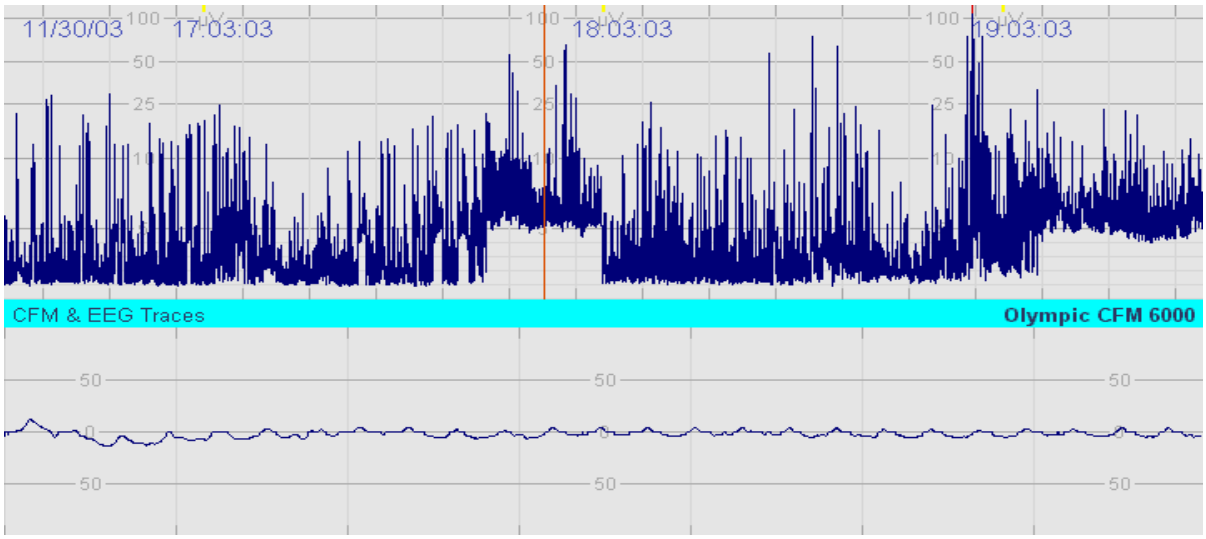
Sample 20: Severely abnormal CFM. EEG shows isoelectric background and ECG artefact.



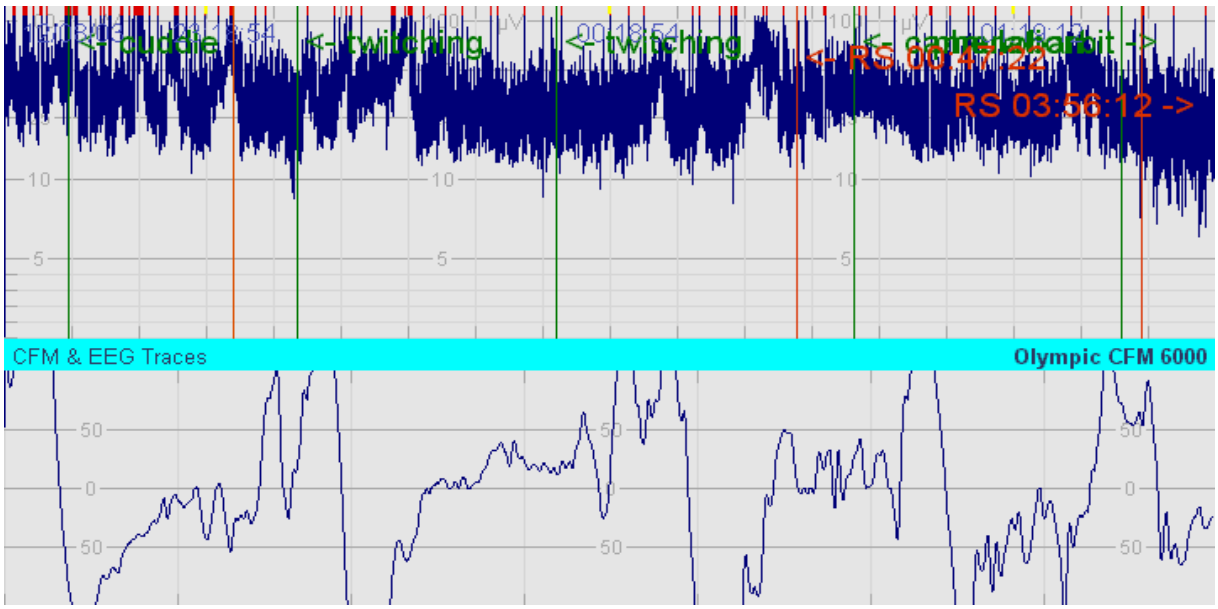
Sample 21: Only ECG artefact detected in this trace. This is causing the CFM trace to be falsely elevated.
Always check EEG trace if CFM looks odd.



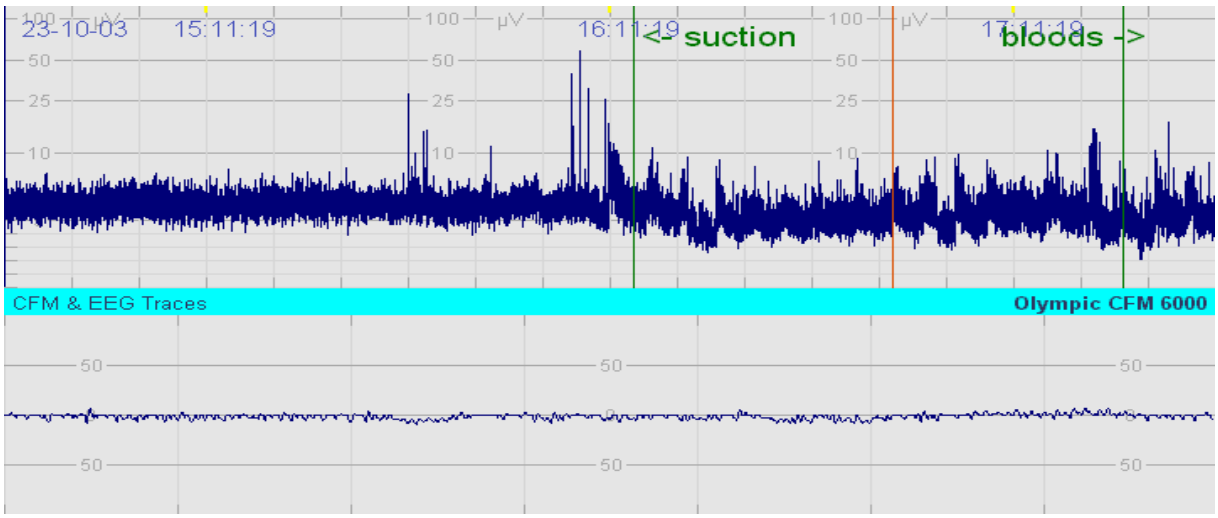
Sample 22: Severely abnormal CFM. EEG shows isoelectric background.



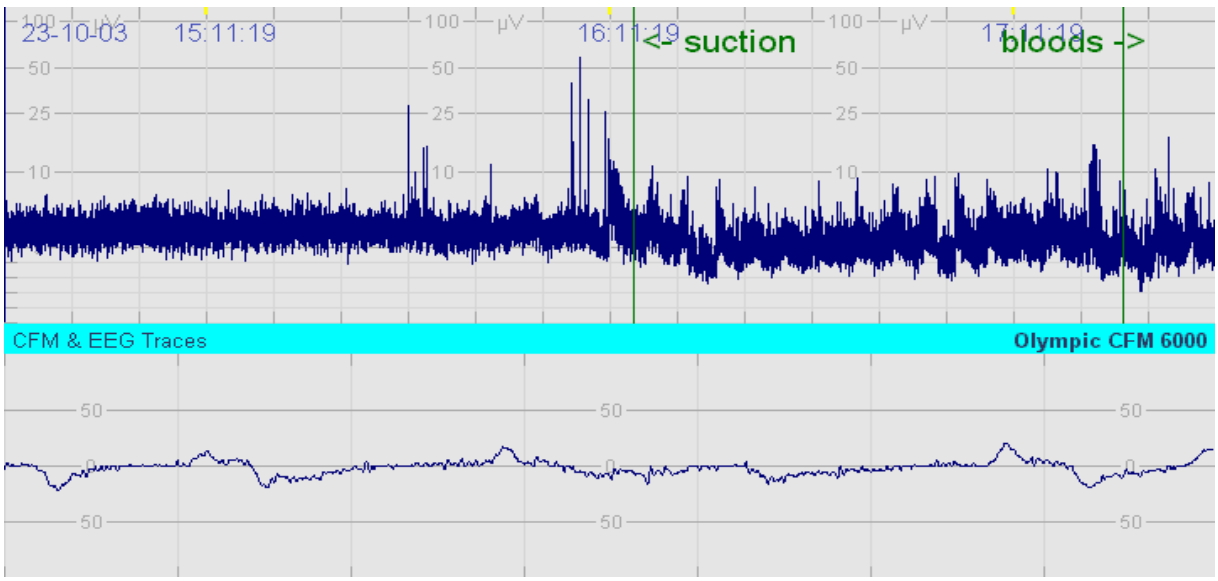
Sample 23: Severely abnormal CFM. Note sudden elevation of CFM trace. The regular waveform on EEG trace could be seizure or arterial pulse artefact.



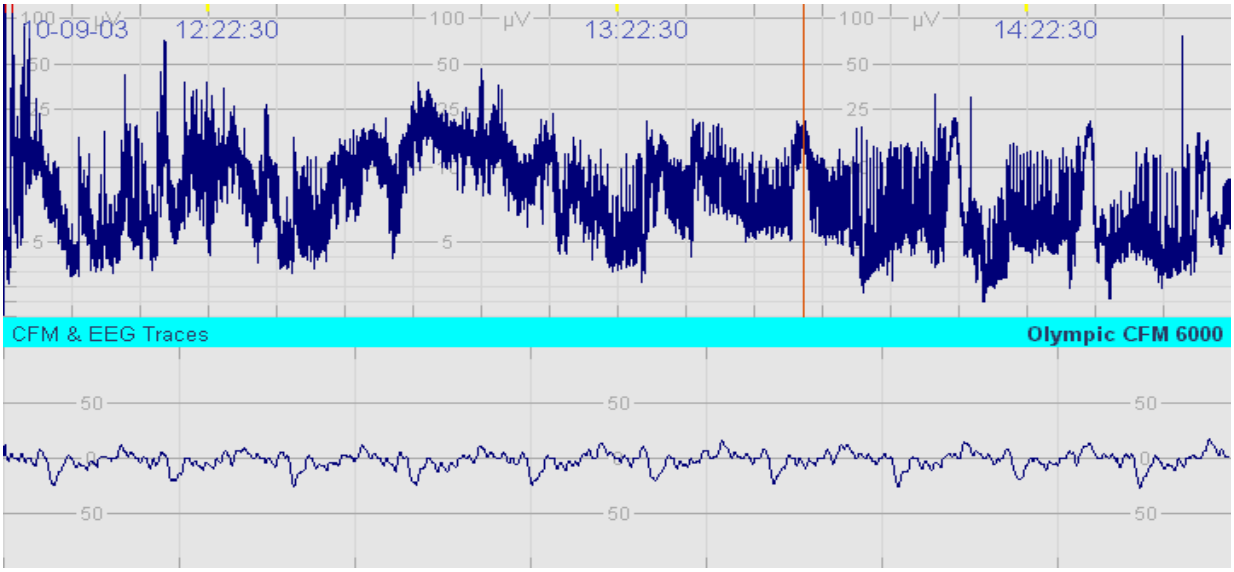
Sample 24: Normal CFM amplitude and frequent seizures. EEG confirms seizure discharge.



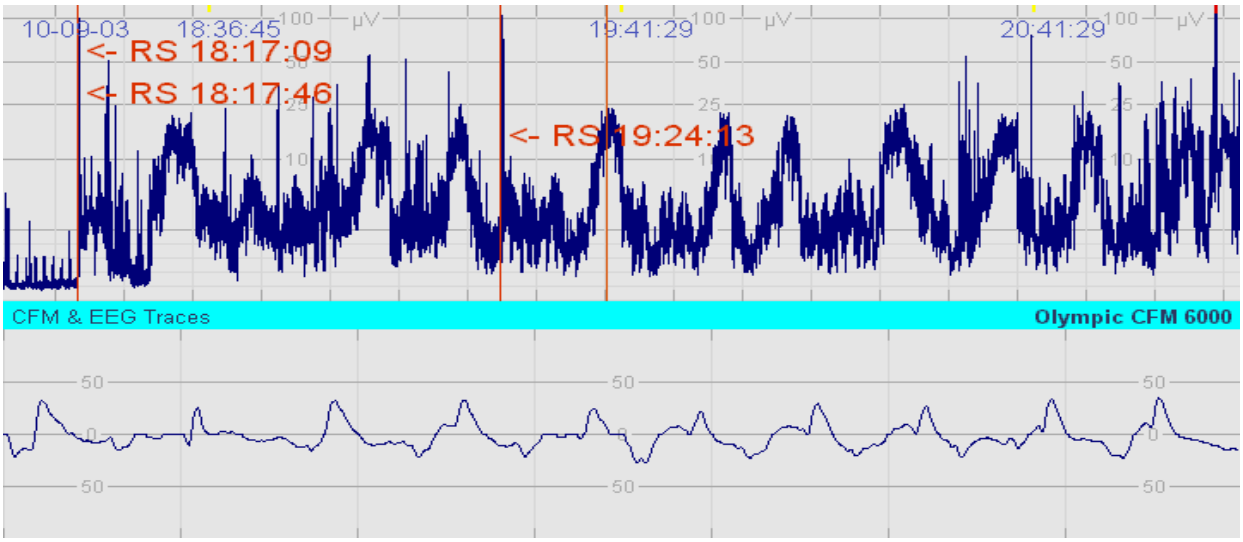
Sample 25: Severely abnormal CFM with isoelectric EEG.
Note ECG artefact falsely elevates lower margin of CFM.



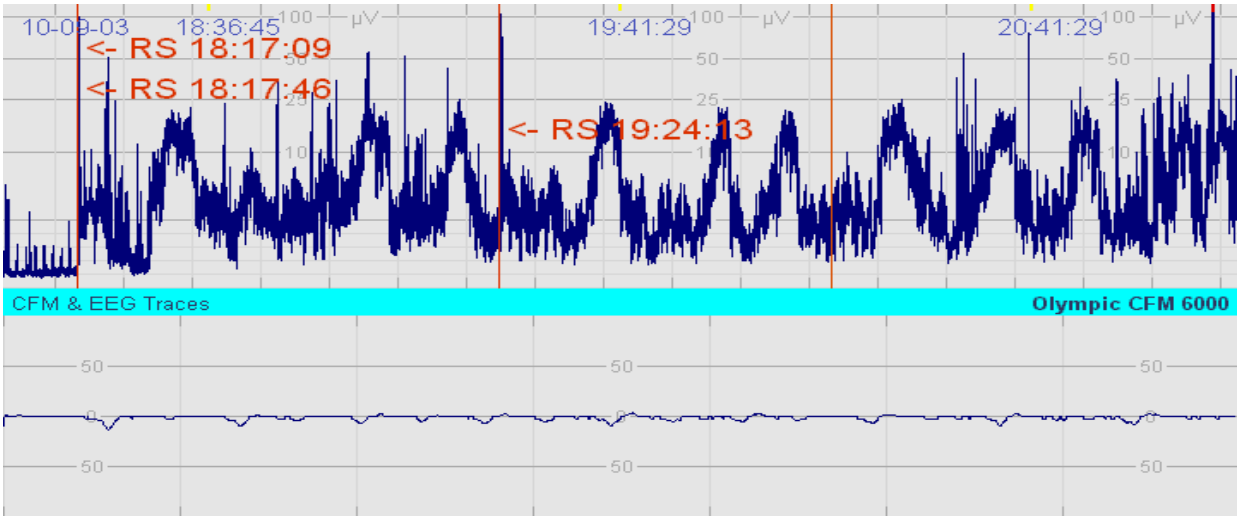
Sample 26: Severely abnormal CFM. Note seizure discharges in part of record confirmed on EEG.



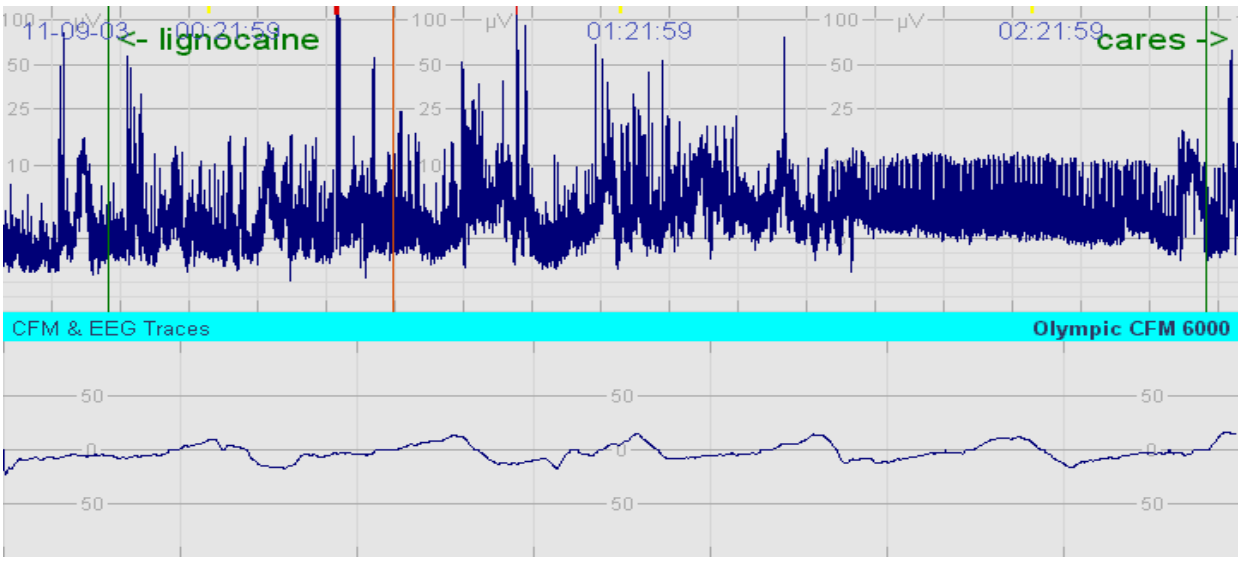
Sample 27: Frequent seizures. CFM amplitude cannot be determined because of frequency of seizures.



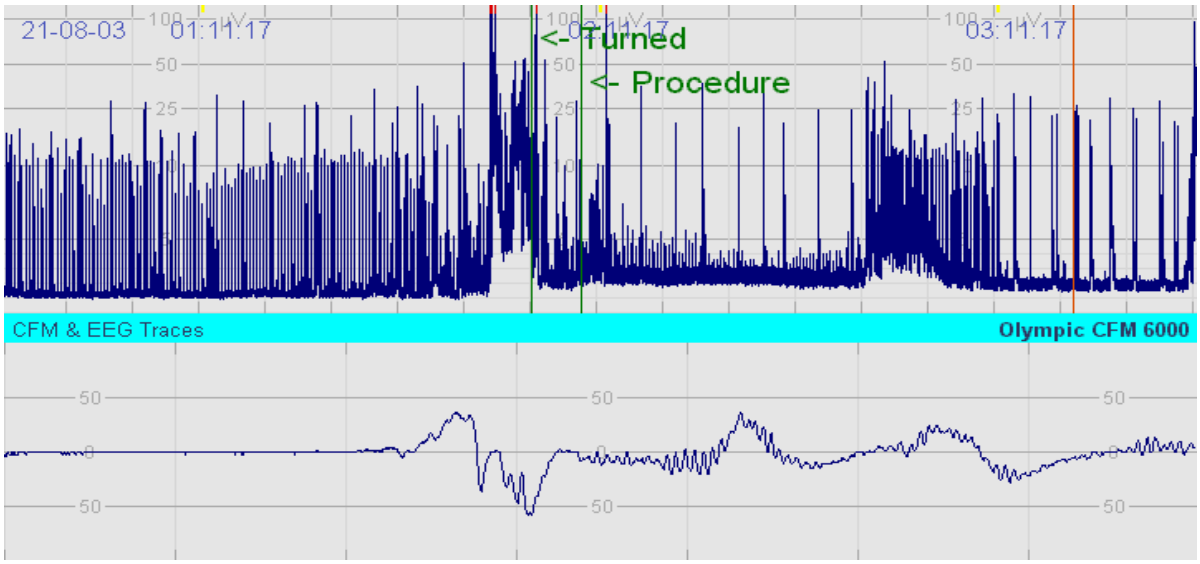
Sample 28: Frequent seizures confirmed by inspecting EEG.



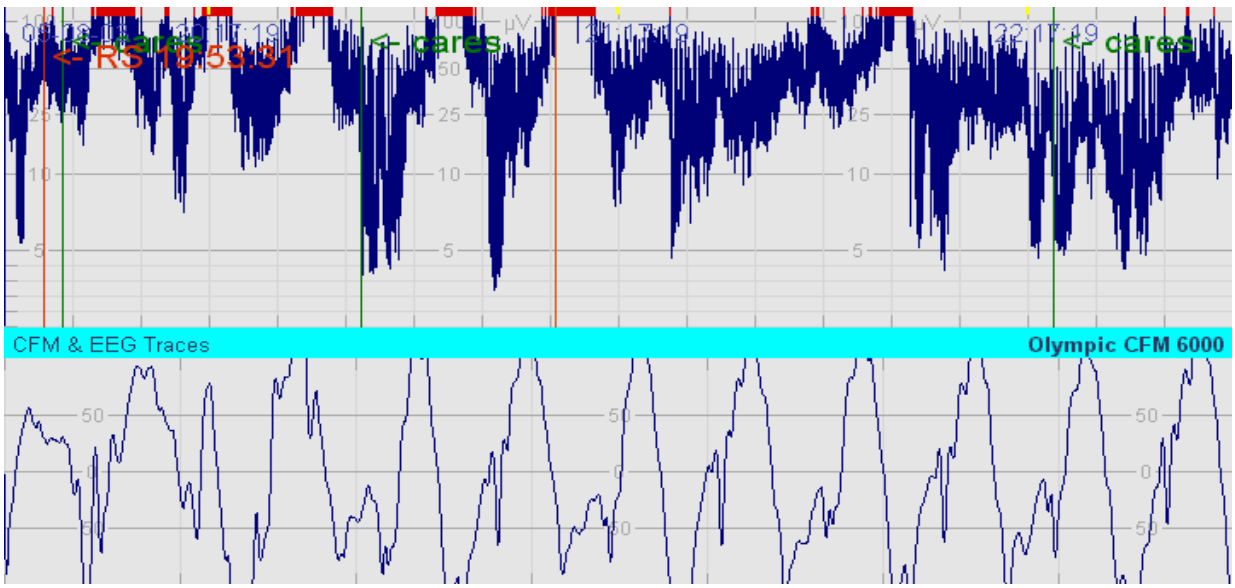
Sample 29: Severely abnormal CFM in between seizures. EEG shows low voltage seizure discharge.



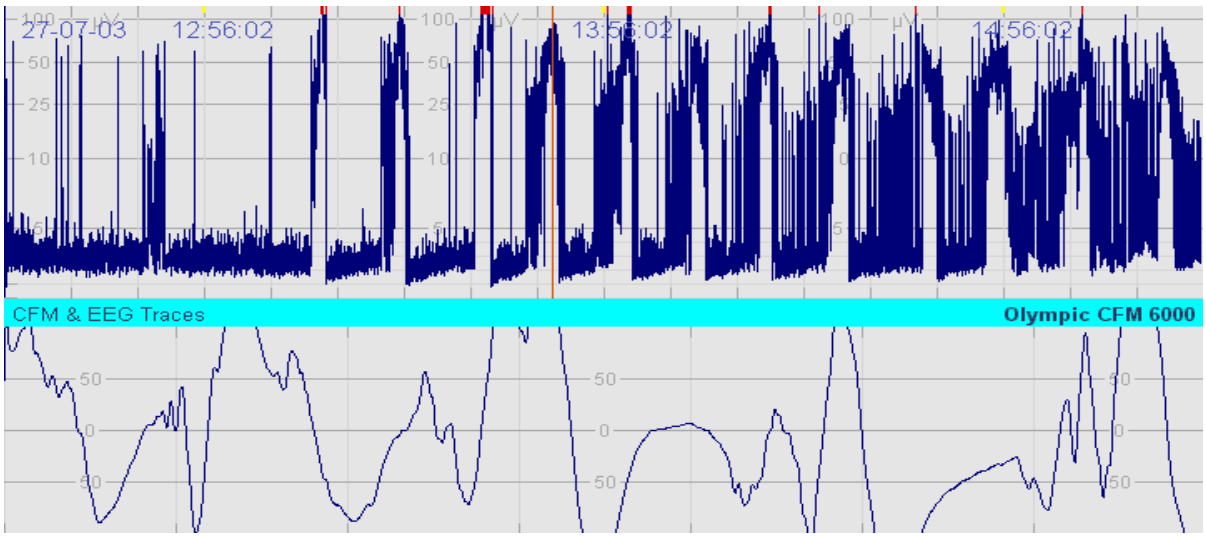
Sample 30: Severely abnormal CFM and seizure discharge.



Sample 31: Severely abnormal CFM and movement artefact.



Sample 32: Frequent high voltage seizure discharges.
CFM amplitude difficult to determine when seizures are frequent.



Sample 33: Severely abnormal CFM and frequent seizure discharge confirmed on EEG.

Notes

Notes

ISRCTN 89547571

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