aEEG Monitoring In Newborn Infants - GCNIC -CHW

Practice Guideline ©

DOCUMENT SUMMARY/KEY POINTS

- aEEG provides information about the functional integrity of the brain and can be interpreted immediately.
- The application of the electrodes is undertaken by staff who have been trained in the technique.

Key performance indicators:

- Electrodes remain in situ for at least 4 hours
- Traces are interpreted and reported upon by a member of the aEEG review team
- Procedure documented in patient's medical record

CHANGE SUMMARY

- References updated
- Content condensed and updated for ease of clinician reference
- Trouble shooting table added

This document reflects what is currently regarded as safe practice. However, as in any clinical situation, there may be factors which cannot be covered by a single set of guidelines. This document does not replace the need for the application of clinical judgement to each individual presentation.

Approved by:	SCHN Policy, Procedure and Guideline Committee	
Date Effective:	1st October 2023	**Review Period**: 3 years
Team Leader:	Nurse Educator	**Area/Dept**: Grace Centre for Newborn Care

READ ACKNOWLEDGEMENT

- All clinicians working in GCNIC who utilise the equipment are to read and acknowledge they understand the contents of this document.
- Training and education:
  - Regular in-services are provided and bedside teaching sessions.

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TABLE OF CONTENTS

Background

Amplitude-integrated electroencephalography (aEEG) is a method for continuous monitoring of brain function used in the Grace Centre for Newborn Intensive Care (GCNIC). Two-channel bedside monitoring provides both raw EEG and quantitative measures of EEG trace from the cerebral cortex of each hemisphere. aEEG provides information about the functional integrity of the brain and can be used immediately after admission of the infant to the GCNIC[1].

Indications

aEEG monitoring should be used on the following infants.[2]

- Infant's ≥35/40 and ≤ 44/40 with:
  - Definite or questionable seizures
  - Neonatal encephalopathy (with or without seizures)
  - Unexplained apnoea
  - Brain injury or suspected brain injury
  - Metabolic Disorders
  - Meningoencephalitis

Monitoring should be negotiated with the attending Neonatologist.

Preterm infants (<35 weeks gestation)[3,4]

aEEG monitoring can be used for seizure detection in preterm infants and in cases of large IVH. The trace may be less easy to interpret in preterm infants. Nevertheless, it can provide very useful information and so may be considered in some infants of < 35 weeks' gestation including:

- Clinical or suspected seizures
- Encephalopathy
- Grade 3 or 4 intraventricular haemorrhage

aEEG monitoring of preterm infants should be at the discretion of the attending consultant.

Limitations

aEEG monitoring lacks the sensitivity and specifity of a formal multichannel EEG, certain focal, low amplitude, and very short periods of seizure discharges (<30 sec) can be missed by aEEG. It is a valuable means of continuously monitoring cerebral activity at the bedside. It is recommended for any neonate with suspected seizures or cerebral dysfunction a formal EEG is obtained.

Consent

Nil formal consent required, a thorough explanation to parents must be provided prior to commencing monitoring.

Trace Interpretation

It is recommended that aEEG traces are assessed both visually based on pattern recognition and with consideration of the upper and lower amplitude margins[2]. When interpreting traces revision of the background activity, sleep wake cycling, and seizure recognition is required[5].

There are 3 parameters which should be taken into consideration when interpreting and reporting.

Impedance	• Impedance is measured in Ohms (Ω). <5 Ω is very good, 5-10 is acceptable. • Measure's the electrical signal's conductivity and indicates the contact between the electrode and the scalp. • It is not recommended to make decisions around treatment based on an aEEG trace with high impedance.
Raw EEG data	• This is the raw electrical signal measured directly from the electrodes before it is compressed by the monitor.
Amplitude-integrated EEG (aEEG)	• Is the compressed trace that the monitor makes from the raw-EEG. • By compressing the EEG to 1hr/6cms, the aEEG gives information on cerebral function

Background Pattern

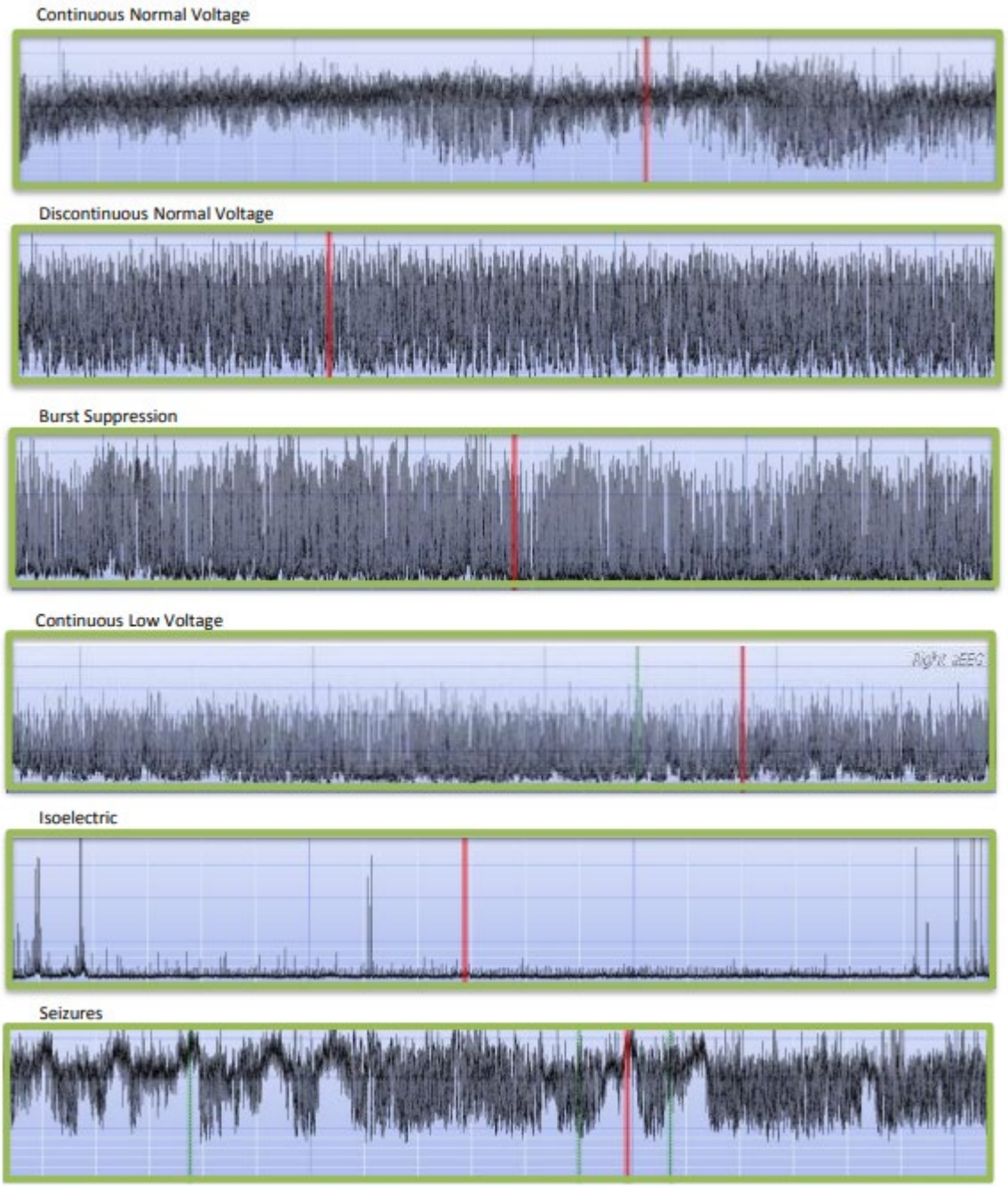
The background pattern describes the dominating type of electro-cortical activity in the aEEG trace. It is classified into five trace patterns which are outlined in the following table:

Burst Suppression

It is important to note Burst suppression can either present in a high- or low-density form:

- Low density BS: more time is spent in a low voltage background activity <25 μV. Presents as a 'wide tooth comb' with longer inter burst interval.
- High Density BS: there is a cluster of spikes with minimal gaps in between them with the upper margin >25 μV. Presents as a 'fine tooth comb' with short inter burst interval.

Summary table aEEG traces

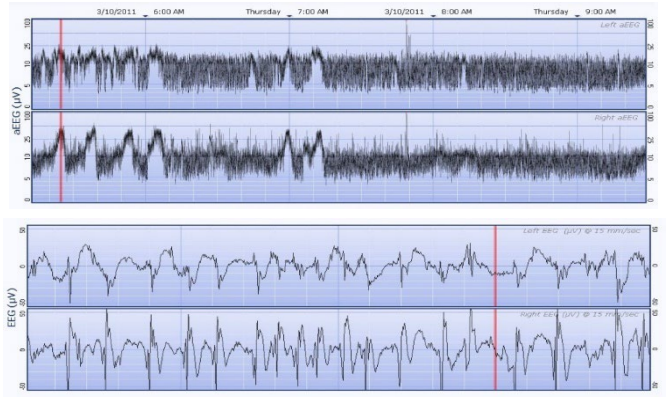
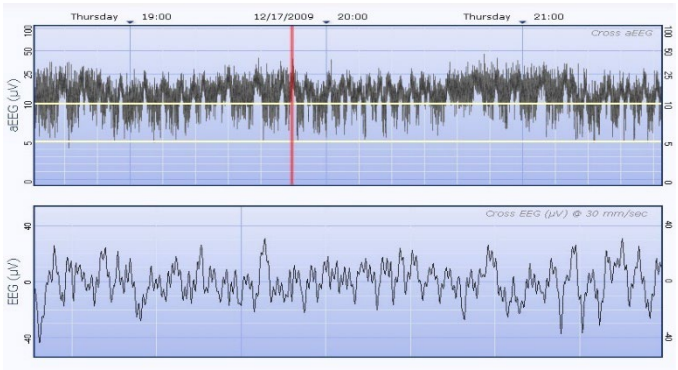
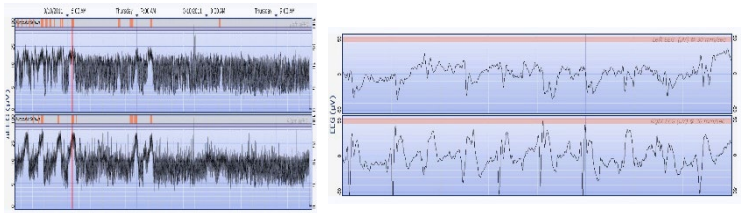


For additional information on aEEG traces and classifications **click here**.

Seizures

Epileptic seizure activity in the aEEG usually is seen as an abrupt rise in the trace. The raw EEG should show seizure activity, with a gradual build-up and then decline in frequency and amplitude of repetitive spikes or sharp-wave or activity with duration of at least 5 to 10 sec.[5] Seizures are classified as single, repetitive or status epilepticus.

Seizure Classification

	Example	Information
Repetitive seizures		Single seizures appearing more frequently than at 30-minute intervals. The example demonstrates repetitive seizures with multiple seizure episodes observed with raises in the baseline of the compressed data and the raw data showing active seizure activity
Status Epilepticus		Continuous unremitting seizures > 30 minutes in duration Often appears as a saw tooth pattern on aEEG
RecogniZe ©[5]		Is automated seizure detection software. It identifies events that may be seizures highlighted on the trace in red or orange. Patterns identified by the software as potential seizures are highlighted with a visual alarm a flashing red highlight on the 'clinical' button. Clinicians should review any RecogniZe alerts.

Gestational Differences

Preterm Infant

Compared with term infants, the background pattern of less mature infants is more discontinuous, there are more frequent 'bursts', and the raw tracing of the EEG signal may show periods of relatively low voltage with sudden but infrequent bursts of high activity.[3,4,6]

Table summarising aEEG features at different gestational/post-conceptual ages:

Gestational age or Post conceptual age (wk)	Dominating Background pattern	SWC	Minimum Amplitude (mcV)	Maximum Amplitude (mcV)	Burst/h
24 through 25	Discontinuous	Imminent/immature	2 to 5	25 to 50 (to 100)	>100
26 through 27	Discontinuous	Imminent/immature	2 to 5	25 to 50 (to 100)	>100
28 through 29	Discontinuous/ Continuous	Imminent/immature + some developed	2 to 5	25 to 30	>100
30 through 31	Continuous/ Discontinuous	Developed	2 to 6	20 to 30	>100
32 through 33	Continuous/ Discontinuous in QS	Developed	2 to 6	20 to 30	>100
34 through 35	Continuous/ Discontinuous in QS	Developed	3 to 7	15 to 25	>100
36 through 37	Continuous/ Discontinuous in QS	Developed	4 to 9	17 to 25	>100
38+	Continuous/ Discontinuous in QS	Developed	>10	15 to 25	>100

Table 2. modified from Hellstrom-Westas et al (2006). QS = Quiet Sleep

Artifact

Interpreting and applying aEEG findings in clinical practice rests heavily on the distinction between artifact and activity[4]. One of the more common signs seen from electrocardiographic artifact is the 'drift of the baseline', with the baseline tracing becomes falsely elevated in the setting of severely suppressed background activity[4].

Tips to insure quality aEEG trace(s)

- Carefully prepare skin and place electrodes according to positioning guide and always check impedance levels
- Review the raw EEG display to evaluate for artifact that may falsely elevate the aEEG baseline and help in positively identifying seizure activity
- Ensure DAB box is placed at foot of bed or away from electrodes to prevent artifact

Common factors that impact the aEEG trace

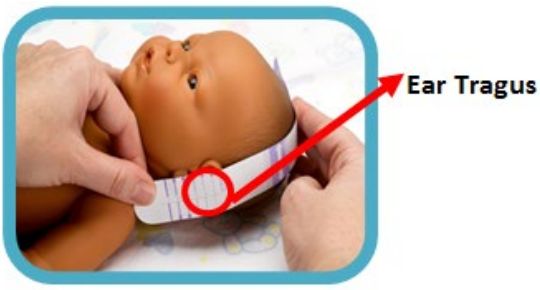
Background pattern appears erratic or extremely elevated	• ECG artifact (lower margin appears elevated) • Handling/patting • Muscle activity/infant movement • High-frequency ventilation • Gasp artifact
Background pattern appears unusually dampened or depressed	• Severe scalp edema • Electrodes placed significantly too close together • Significant sedation

Insertion

Equipment for insertion:

- Positioning tape measure term/preterm
- 4 Needle and 1 Hydrogel electrodes
- Sterile surgical marker pen
- Wrap hat
- KY Jelly (assists to part hair)
- Steri-strips

Insertion technique:



For step by step instructions on how to insert needle electrodes can be found here.

Key Principles

- It is recommended that monitoring stays insitu ideally for a minimum of 4 hours.
- Sucrose 24% is administered prior to electrode placement.

Nursing Care

- Maintenance of sensors and troubleshooting
- Navigation of the monitor interface including admission, marking events, pausing/stopping recording
- Interpretation of the aEEG pattern within scope of role and training
- Notification to MO/NP of evolving background pattern including suspected seizures
- Electrode check including the needle position with cares or after any procedure
- Documentation in the EMR if needles are replaced and each shift the background trace any clinical events

Marking Events

Click on the **markers** tab. Select the relevant preset markers. The marker is inserted at the timeline cursor position (the red vertical line in the aEEG display).

1. To add a marker at a different place, touch the aEEG display to reposition the timeline cursor at the new location.
2. To add a custom marker, touch the custom marker field. Use the on-screen keyboard to type the custom marker Event name, and press **Add**.

Daily Trace Interpretation

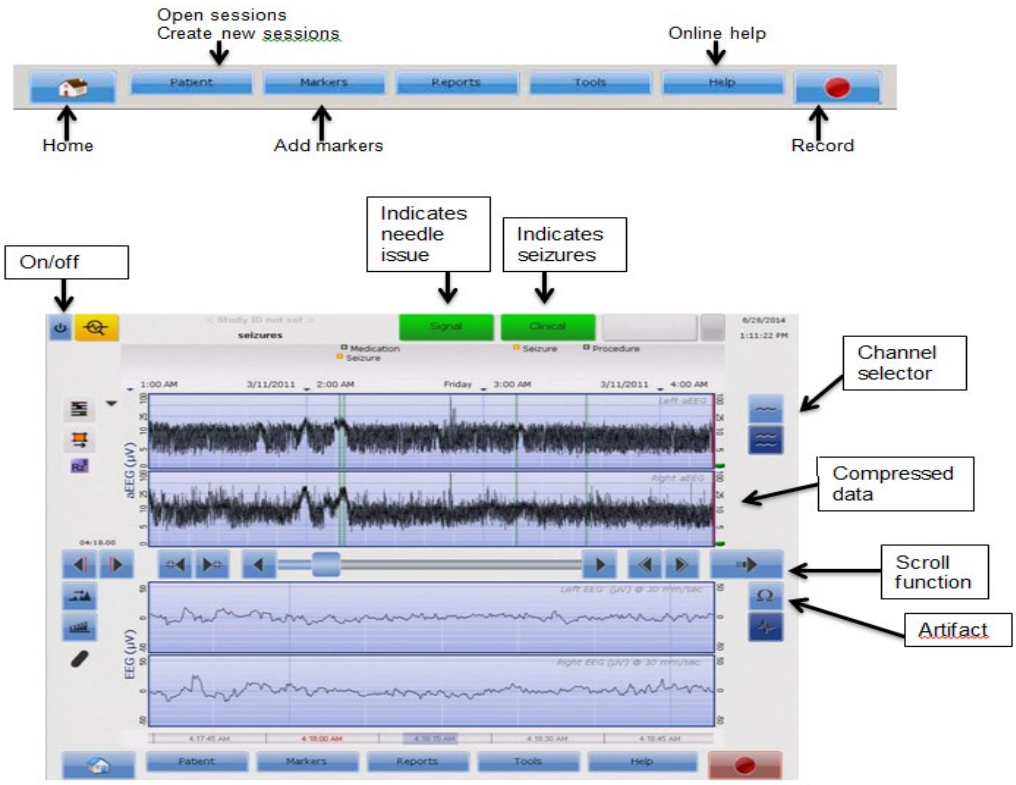
- Daily trace interpretation should be undertaken as part of the ward round.
- When available an aEEG superuser will review the traces and document in the EMR to support clinical staff in recognising common patterns, artifacts, and to review challenging tracings/cases.

Using the monitor

When setting up the monitor:

- Set up the monitor close to the patient and check that the connections are correct.
- Do not place the data acquisition box (DAB) near the infant's head.
- Switch on the power switch and wait for the system to power up to the main display.
- Apply the neonatal sensor set. Use the Electrode impedance view to check impedance levels of the individual sensors.
- Check the impedance levels of the first two sensors before applying the remaining sensors.

Commonly used icons and screen management



Information on how to use the monitor can be found here.

Cleaning

- Monitor and DAB to be wiped down with soft cloth dampened with water and detergent after use.

Issue	Instructions
Impedance (Signal Quality)	• Unstable impedance values, when the number jumps around; this will occur if the electrodes have become dislodged or if the reference sensor is no longer sticking adequately. **Action**: Check all the electrodes • If the impedance is gradually increasing check the reference sensor and also check for artefact for example from a cooling blanket, ventilator or other equipment. Also check that electrodes are not dislodged, loose or only partially stuck.

Reducing Artefact	• Ensure the electrodes are positioned the appropriate distance apart and connected properly with low impedance. **Action**: Free electrode wires from any equipment which may cause movement artefact. • Check nothing is touching the electrodes, such as bedding rubbing against the electrodes when the head moves. • Ensure the DAB is at the either by the side of the babies body or is not resting near their head
Babies with Hair	• After inserting the electrode apply a layer of lubricating gel (KY Jelly) around the electrode. • Apply the lubricating jelly on the hair where you want the steri-strips to secure the electrode. • After the lubricating jelly dries, it creates a surface so the steri-strips can stick to it.

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