NERVUS MONITOR

# Burst Suppression Tutorial

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Reykjavík, Iceland

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# Burst Suppression Monitoring

This document is written as a guide for the ICU staff on how to monitor Burst Suppression (BS) in the patient at risk. It is also meant to be a guide for non medical staff working with the Nervus Monitor and seeking a better understanding of the BS pattern in EEG. **The information in this document is not medical advice.**

This document is based on several sources which are mentioned in the reference section and on The User Manual for Nervus Monitor. It is not expected to replace these sources in any way and we encourage the user to study them further.

Screenshots in the document are from actual recordings of Burst Suppression, done at The University Hospital in Tampere, Finland.

## Introduction to Burst Suppression

### Definition

The BS pattern is a characteristic signal in the EEG. It is recognized by a periodic pattern of low voltage less than 10 μv and a relatively shorter pattern of higher amplitude complexes.

The BS pattern is classified as an EEG abnormality because of its relation to severe encephalopathy. It can be generalized or lateralized. Depending on initial cause, the state can be reversible in some instances. The BS pattern is specially regarded in premature babies.

### Causes

The BS pattern can be seen in different clinical conditions in the ICU:

- Head trauma
- Stroke
- Coma
- Anoxia
- Anaesthesia
- Hypothermia
- Premature babies

Obviously, the BS pattern can only be recognized with EEG!

The underlying condition can in itself be the cause of BS, but those causative effects are, in a way, additive. Hypothermia, for example, can further emphasize the suppression effect of general anesthesia.

## Treatment

As mentioned before, the BS pattern is related to severe encephalopathy and prognosis is almost as severe as in electro cerebral inactivity. However, the state is reversible if caused by anaesthesia and/or narcotics.

In the ICU environment, the patient is under anaesthesia and other medication during the most acute phase (hours-days). BS pattern in the EEG at that stage is therefore not considered to have a prognostic value until after withdrawal of the medication.

The anaesthesia of a patient in acute phase can on one hand be monitored with EEG since interburst interval or bursts per minute can be calculated. Generally, an interburst interval of 30 seconds or less or 2-3 bursts per minute are considered to be "safe" for the patient. On the other hand, the EEG is also a perfect tool for the ICU to monitor recovery from the BS pattern, when medication is withdrawn and the patient is in recovery phase.

Concerning **premature babies,** a discontinuous pattern can be seen in the EEG that is very similar to BS. In the case of a premature baby, this pattern is not necessarily related to severe encephalopathy. Quantification of interburst interval or counting of burst/min gives additional information on maturation of continuous EEG in the conscious premature baby, during stimulation and during sleep. The interburst interval has proven to be a good prognostic parameter: longer interburst intervals (>30 sec) indicating worse prognosis.

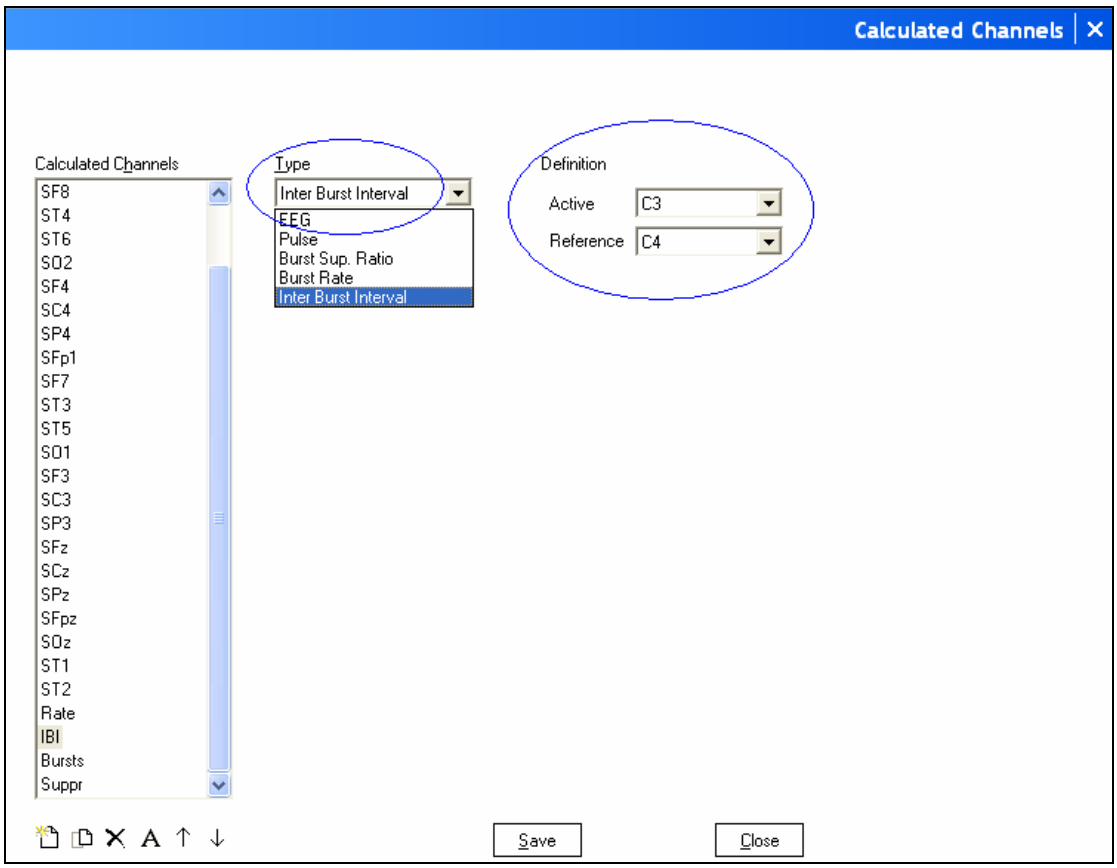
## Monitoring Method

As emphasized before in our tutorials, an EEG monitoring device does not replace a routine EEG recording. A routine EEG should be performed as soon as possible in a patient at risk for BS in the ICU. However the ICU staff can start monitoring the pattern, the bursts per minute (Burst), the interburst interval (IBI) and the burst suppression ratio (Suppr) as soon as the patient is admitted to the ward. Monitoring of BS enables the doctor to monitor anaesthesia more accurately. It also allows him to monitor severity and recovery of brain trauma.

# The Burst Suppression Protocol

The latest version of the Nervus Monitor software has new Burst-Suppression features. These features enable the ICU staff to monitor inter-burst-interval, burst count and suppression/burst ratio "live" and have an overview of how these develop during the period of monitoring.

The Burst Suppression Ratio (Suppr), bursts per minute (Burst) and the Interburst Interval (IBI) can be calculated and shown on the Alert Strip on the screen. Create these as calculated channels in the Calculated Channels Editor, select the type accordingly and define. As burst suppression is by definition a pattern occurring in all channels, it is only necessary to have these features applied to one channel.

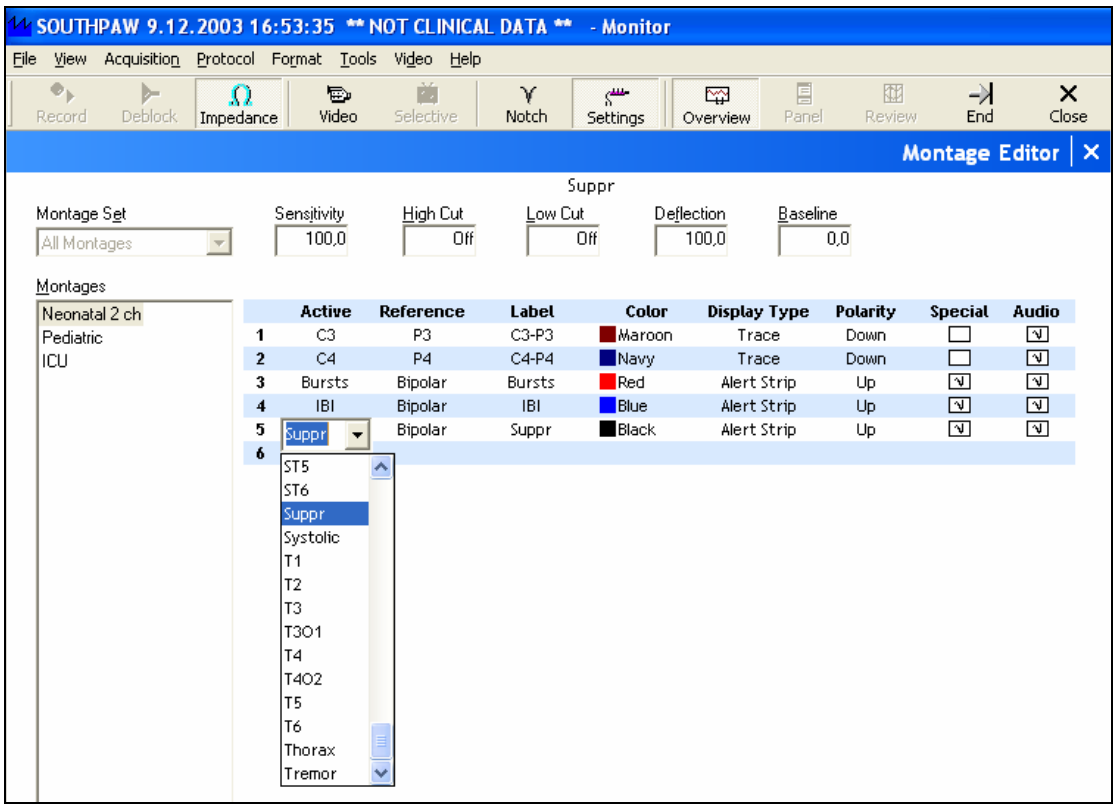


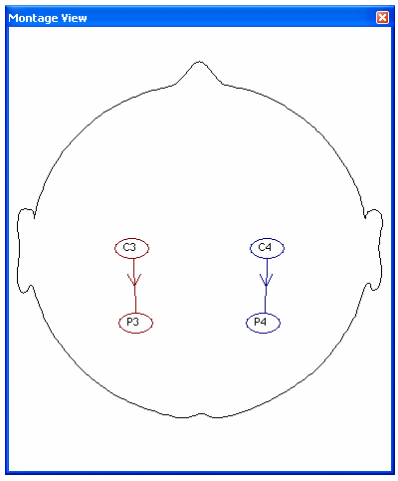

It is important to realize that these features can be shown as "live" figures on the new Alert Strip as well as trends (an overview of how they develop in time).

***Montage:*** Should be as simple as possible so that ICU staff will be comfortable in applying the electrodes and maintain them. A 2 channel (four electrode) montage is recommended: C3-P3 and C4-P4, Reference (placed in the midline) and Neutral (placement does not matter; we recommend a hairless spot like the

ear lobe). To begin with it is recommended to do the recording with a referential montage (C3-ref, P3-ref, C4-ref, P4-ref), to verify the quality of the signal.

In the montage, you also include the new burst suppression features. Bursts refers to the count of bursts per minute, IBI stands for inter-burst-interval and Suppr stands for the percentage (%) of suppression in the EEG for the last minute. The numbers for these features can be displayed in several ways (see the dropdown list under "display type" in the montage editor). We highly recommend that you use the new Alert Strip for this purpose. Also, consider having the numbers displayed in colors for even quicker recognition.



***Trends*:** Add the new Burst Suppression features to trend by choosing Generic as a Trend type and Active sensor accordingly. On the Trend display, remember to adjust the scaling (Burst count approximately 0-10; IBI approximately 0-60 sec; the Suppression ratio is automatically set to 0-100%).

***Events*:** You can create events, duration or non-duration; add them to the Palette and they are ready to use in the recording. Remember to choose size of events: small-medium-large. *Note settings of alarm-events.*

***Amplifier setup*:** check boxes for input 1(C3), 2(P3), 3(C4) and 4(P4) or according to a chosen montage. Reference and neutral have special inputs on the amp. **To ensure high quality recordings, use both reference and neutral.**

## Connecting the electrodes

In most hospitals, ICU doctors and nurses have not yet developed skills to apply electrodes to the patient's head and need detailed training to be able to start immediate recording of EEG. The training of ICU staff should be left to those who have developed such skills, EEG technicians or clinical application specialists. This ensures the safety of the patient and quality of the recording.
*Needle electrodes:* Wipe the skin at the insertion site with antiseptic wipe. The needle is inserted under the skin at an angle of 30°, subdermally. Secure the needle with a tape or gauze with EEG adhesive paste.
*Stick-on electrodes:* For better impedance, shave hair at the attachment site. Rub the skin with EEG scrub, wipe excess scrub away and clean skin with dry cloth before attaching stick-on electrodes (also called hydrogel electrodes).
*Cup-electrodes:* Shaving hair at the attachment site is not necessary but improves signal quality. Rub the skin with EEG scrub, wipe excess scrub away and attach the cup-electrode with EEG conductive paste. Secure the electrode with tape or gauze with adhesive paste.

When the electrodes are connected to the patient's scalp, attach them one by one to the amplifier (input 1 to 4), after connecting ref and neut. Check impedance and start the recording. The impedance check is meaningless if the reference electrode is not connected and remember that the neutral adds quality to the signal.

## Impedance

As with all EEG recordings, getting good electrode impedance is a major challenge in ICU monitoring. Proper electrode application skills are of high importance in this concern as is the continuous impedance check of the Nervus system.

To activate the continuous impedance check, press the impedance button before or just after starting a recording and you will immediately note if impedance is above the set threshold (red). The continuous impedance check notifies the user when impedance is too high by showing a "bad electrode" event on the screen during recording.

Generally, an impedance below 10 kOhms is acceptable in EEG recordings, but the lower the impedance, the better quality of the signal. Relative impedance is also important and it is highly recommended that users put effort into ensuring a good quality signal from all electrodes.

## Concerns

In ICU monitoring, the patient's safety is of course a major concern. The user should keep few things in mind:

**a.** *Patient Safety*: Always keep in mind that the patient's head is attached to the amplifier with the elecrodes. Do not attach the electrodes too heavily due to possible pulling of the amplifier which can cause trauma to a patient's head or skin.

**b.** *Amplifier*: Place the amplifier as close to the patient's head as possible, preferrably in the bed if hygene standards allow (the amplifier can be wiped with a sterilized gauze or wipe, but no acetone or sterilization procedures can be used). Secure the amplifier so it will not pull the electrodes.

**c.** *Electrodes*: Although we want the electrodes to last for hours/days/ weeks, we need to check the patient's scalp for irritation or infection at the site of electrode placement. Replace the electrodes if any sign of irritation or infection is present.

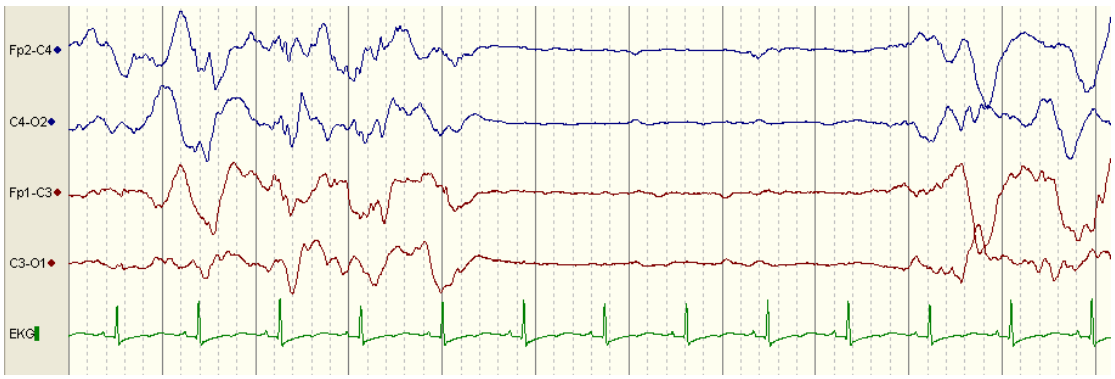
**d.** *Artefacts*: The user should be aware of all possible artefacts in the environment and identify them into the recording with event placement. This adds quality to the recording and makes it easier to analyze.

**e.** *Inform relatives*: As with all caring in the ICU, cooperation with relatives is extremely important (ask the nurses!). The user has to explain the purpose of brain monitoring as well as all other monitoring and care giving procedures.

# What to look for?

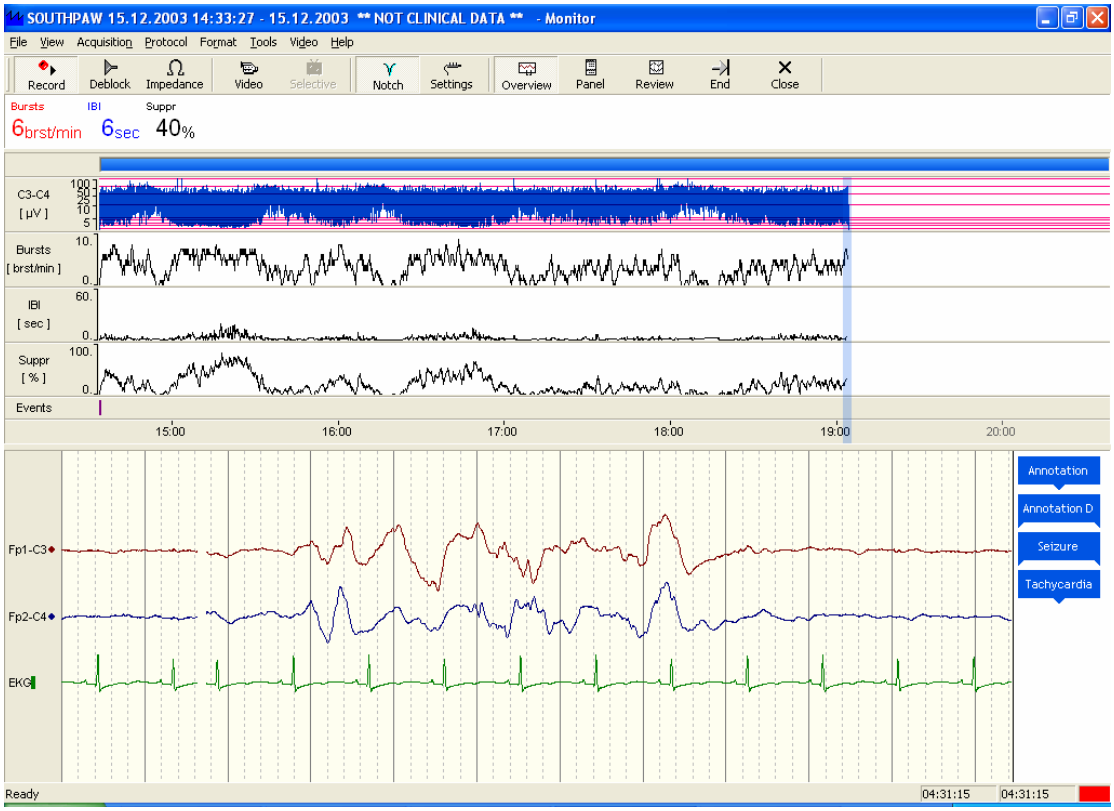
## The EEG

As mentioned before, BS is defined as periodic pattern of low voltage less than 10 μv and a relatively shorter pattern of higher amplitude complexes.




At slower "paper speed" you can even see it more clearly:

## The Burst Suppression Trends




The Burst Suppression Trends give an overview of how the pattern is developing over the period of monitoring. The Alert Strip shows the figures for these features "live".

## Reference


Doyle, P.W. & Matta, B.F.: Burst suppression or isoelectric encephalogram for cerebral protection: evidence from metabolic suppression studies. British Journal of Anaesthesia 83 (4): 580-4 (1999).

Jäntti, V: *EEG monitoring in critical care, practical observations.* Clinical Paper at the Datex-Ohmeda website: www.datex-ohmeda.com.

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***The burst suppression detector in Nervus is based on the following article:***

Sarkela et al. Automatic Analysis and Monitoring of Burst Suppression in Anesthesia, Journal of Clinical Monitoring and Computing, 17:125-134, 2002

Albin, M.S: Textbook of Neuroanesthesia with neurosurgical and neuroscience perspectives. The McGraw-Hill Companies Inc. 1997.

Niedermeyer, E. & Lopes da Silva, F: Electroencephalography. Basic Principles, Clinical Applications, and Related Fields. Lippincott, Williams & Wilkins. Fourth Edition, 1999.

Hellström-Westas, L., De Vries, L.S., Rosén, I.: An Atlas of Amplitude-Integrated EEGs in the Newborn. The Parthenon Publishing Group, 2003.