Limitations of current monitors and new approaches to depth monitoring.

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Anaesthetic depth monitoring is permanently embroiled in controversy. The subject lacks clear definitions as to what is meant by anaesthetic depth and what the purpose of a depth monitor may be. Clearly understood criteria and terminology are required to understand the usefulness and limitations of current depth monitors. Useful criteria include: ability to track the sedative effects of drugs (hypnosis), prevent awareness, prevent connected consciousness, predict movement, and predict cardiovascular responsiveness to surgical stimuli. There is a need for a consensus statement on criteria for defining and assessing depth monitors.

Widespread use of depth monitoring followed the release of the Bispectral Index monitor in 1996. The true strength of this device was the ability to reliably capture the EEG in real time in the electrically noisy operating theatre environment. Anaesthetists would have done well to learn to read the EEG before using it. Instead there has been an over reliance on the single 'depth' number which essentially reflects the decreasing power and complexity of the EEG with the administration of GABA-ergic drugs, volatile anaesthetics and opioids. Limitations of the monitor are numerous: It does not reflect the effects of NMDA antagonists such as ketamine and nitrous oxide, may not be accurate for α2-agonists such as dexmedetomidine and it is not able to predict the likelihood of movement. It has also not been accurately calibrated to reflect the changes in the EEG that occur in old age and is prone to interference from EMG. Similar devices using frontal cortex monitoring to derive a single number suffer from broadly similar limitations (Entropy, Patient State Index, Narcotrend). These depth monitors are, however, useful. They can reduce the chances of awareness and accurately track depth for specific combinations of commonly used anaesthetic drugs such as propofol-remifentanil. In the Intravenous anaesthetic setting they have a safety role in monitoring for delivery of the intravenous anaesthetic.

In response to these limitations there is now a search for improved understanding of the central nervous system effects of anaesthetic drugs, where the important effects occur in the brain and how to assess them. New EEG monitoring modalities include: improved display and visual interpretation of the underlying EEG patterns (eg Sedline™), Fronto-Parietal Communication, Slow Wave Saturation and Alpha-Gamma Phase-Amplitude coupling.

References

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