PERSONALIZE ANESTHESIA

Best practice and position statements for brain function monitoring

2004

The Joint Commission

Develop and implement an anesthesia awareness policy that includes effective application of available anesthesia monitoring techniques and timely maintenance of anesthesia equipment.[4]

2006 April

American Society of Anesthesiologists

The ASA members agree with the use of such [brain function] monitors for patients with conditions that may place them at risk, patients requiring smaller doses of general anesthetics and patients undergoing cardiac surgery.[8]

2012

The Joint Commission

Strategies to prevent intraoperative awareness and possible memory deficits after surgery should be developed.

Investigation of EEG techniques is ongoing, but no method has been shown to be uniformly reliable.

In elderly patients with poor pre-existing cognitive reserve, sedation may be a precipitating factor for delirium.

2012 Nov

National Institute for Health care and Excellence (NICE)

Use of EEG-based depth of anaesthesia monitors is recommended as an option during any type of general anaesthesia in patients considered at high risk of adverse events — including those at higher risk of unintended awareness and of excessively deep anaesthesia — and in all patients receiving total intravenous anaesthesia.[9]

2015 Feb

American Geriatrics Society

The anaesthesia practitioner may use processed electroencephalographic (EEG) monitors of anesthetic depth during intravenous sedation or general anesthesia of older patients to reduce postoperative delirium.[10]

2015 Oct

Association of Anaesthetists of Great Britain and Ireland (AAGBI)

Depth of anaesthesia monitoring should begin at induction of anaesthesia and continue at least until surgical and anaesthetic interventions are completed (i.e., up to the point when the patient is to be awakened).

Depth of anaesthesia monitoring is recommended when neuromuscular blockade is used in combination with TIVA.

Depth of anaesthesia monitoring is recommended during transfer of patients who are receiving TIVA and neuromuscular blockade.[11]

2015

Association of periOperative Registered Nurses (AORN)

The perioperative RN should assess and document depth of sedation using an objective scale and may use bispectral index (BIS) monitoring to measure the level of sedation.[12]

2015

Australian and New Zealand College of Anaesthetists (ANZCA)

When clinically indicated, equipment to monitor the anaesthetic effect on the brain should be available for use on patients, especially those at high risk of awareness, during general anaesthesia.[13]

2015

Brazilian Consensus on Anesthetic Depth Monitoring

Using a BIS™ monitor to monitor the depth of anesthesia can help reduce postoperative delirium (POD) and postoperative cognitive dysfunction (POCD). It facilitates anesthetic titration and decreases brain exposure to high doses of anesthetic agents, especially in the elderly.

Compared to monitoring clinical signs and symptoms, using devices to monitor anesthetic depth (i.e., EEG monitoring) is associated with:

Reduced inhaled and intravenous anesthetic consumptions
Reduced anesthetic recovery time

For high-risk patients under balanced general anesthesia, we suggest using brain electrical activity monitors to prevent intraoperative awakening.

We highly recommend using brain electrical activity monitoring for patients under total intravenous anesthesia, which is a risk factor for intraoperative awakening.[14]

2016

American Association of Nurse Anesthetists (AANA)

Level of consciousness monitoring should be considered for patients at risk of unintended awareness during general anesthesia.[15]

2017 Nov

European Society of Anaesthesiology

Monitoring of depth of anaesthesia and avoiding deep anaesthesia are strongly recommended. EEG/EMG-based neuromonitoring is recommended if available. Also, continuous EEG monitoring might help identify pediatric patients who will develop emergence delirium.[16]

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ELECTROENCEPHALOGRAPHY: A BRIEF HISTORY

The evolution of professional society recommendations for the use of processed-EEG for anesthesia monitoring

In 1875, Richard Caton, a British physician and physiologist positioned two electrodes in an animal, and with a galvanometer, recorded electrical signals. With that experiment, the concept of electroencephalography (EEG) was born.

Hans Berger recorded the first human EEG impulses in 1929 and four years later he discovered the alpha waves. This led to more clinical research involving the use of electroencephalography. Epilepsy was the initial focus but research soon expanded to explore the prospects of other applications.

In 1937, Gibbs found that the EEG was sensitive to general anesthetic agents. He postulated that: "A practical application of these observations might be the use of electroencephalogram as a measure of the depth of anesthesia during surgical operations."[1,2] Since then, EEG has been used in the perioperative setting to monitor brain function.

In the 1960s, automated EEG processors were developed,[3] and in 1996, the FDA approved the first electroencephalographic bispectrum monitor for anesthetic management. To help guide practice, different clinical organizations have developed guidance on the topic.

PRACTICE GUIDANCE ON PROCESSED EEG (P-EEG)

2004 — The Joint Commission

In 2004, the Joint Commission published *Sentinel Event Alert, Issue 32: Preventing, and Managing the Impact of, Anesthesia Awareness*. They recommended the development and implementation of an anesthesia awareness policy that included effective application of available anesthesia monitoring techniques and timely maintenance of anesthesia equipment.[4]

This Sentinel Event Alert was retired in 2012, and the Joint Commission updated their guidance to the following resources, with these recommendations and comments:

- Intraoperative Awareness: From Neurobiology to Clinical Practice. Mashour GA et al. *Anesthesiology*. May 2011.5
  - Strategies to prevent intraoperative awareness and possible memory deficits after surgery should be developed.
  - Investigation of EEG techniques to detect and prevent awareness is ongoing, but no uniformly reliable method has been established.
- Prevention of intraoperative awareness in a high-risk surgical population. Avidan MS et al. *New England Journal of Medicine.* August 18, 2011.6
  - In this study, the BIS protocol was not established as superior.
- Delirium: a cognitive cost of the comfort of procedural sedation in elderly patients? Crosby G et al. *Mayo Clinic Proceedings.* January 2010.7
  - In elderly patients with poor pre-existing cognitive reserve, sedation may be a precipitating factor for delirium.

2006: American Society of Anesthesiologists (ASA)

In April 2006, the American Society of Anesthesiologists Task Force on Intraoperative Awareness published their "Practice Advisory for Intraoperative Awareness and Brain Function Monitoring." In it, they advised that brain function monitoring is not routinely indicated for patients undergoing general anesthesia, either to reduce the frequency of intraoperative awareness or to monitor depth of anesthesia. They agree, however, with the use of such monitors for patients with conditions that may place them at risk, patients requiring smaller doses of general anesthetics, and patients undergoing cardiac surgery.

"The decision to use a brain function monitor should be made on a case-by-case basis by the individual practitioner for selected patients (e.g., light anesthesia)."[8]

2012: National Institute for Health and Care Excellence (NICE)

In November 2012, NICE published *Depth of Anaesthesia Monitors – Bispectral Index (BIS), E-Entrophy and Narcotrend-Compact M*. In this publication, they made the following recommendations[9]:

- Use of EEG-based depth of anaesthesia monitoring was recommended as an option during any type of general anaesthesia for patients at high risk of adverse outcomes, including those at higher risk of unintended awareness and of excessively deep anaesthesia. Use of EEG-based depth of anaesthesia monitoring also was recommended for all patients receiving total intravenous anaesthesia.
- The bispectral index (BIS) depth of anaesthesia monitor was recommended as an option in both these types of patients.

2015: American Geriatrics Society (AGS)

AGS makes the following recommendation in their paper, "Postoperative Delirium in Older Adults: Best Practice Statement from the American Society of Geriatrics"[10]:

"The anesthesia practitioner may use processed electroencephalographic monitors of anesthetic depth during intravenous sedation or general anesthesia of older patients to reduce postoperative delirium."

2015: Association of Anaesthetists of Great Britain & Ireland (AAGBI)

In their guidelines, *Recommendations for Standards of Monitoring During Anaesthesia and Recovery 2015*, the AAGBI made several recommendations,[11] including:

- Depth of anesthesia monitoring should begin at induction of anaesthesia and continue at least until surgical and anaesthetic interventions are completed (i.e., up to the point when the patient is to be awakened).
- Depth of anaesthesia monitoring is recommended when neuromuscular blockade is used in combination with total intravenous anaesthesia (TIVA).
- Depth of anaesthesia monitoring is recommended during transfer of patients who are receiving TIVA and neuromuscular blockade.

2015: Association of periOperative Registered Nurses (AORN)

In 2015, AORN published, "Moderate Sedation: Key Takeaways." They recommend:

"The perioperative RN should assess and document depth of sedation using an objective scale and may use bispectral index (BIS) monitoring to measure the level of sedation."[12]

2015: Australian and New Zealand College of Anaesthetists (ANZCA)

ANZCA points out in their 2015 "Guidelines on Monitoring During Anaesthesia" that:

"When clinically indicated, equipment to monitor the anaesthetic effect on the brain should be available for use on patients, especially those at high risk of awareness, during general anaesthesia."[13]

2015: Sociedade Brasileira de Anestesiologia (SBA)

The SBA published a document in 2015 titled "Brazilian consensus on anesthetic depth of monitoring." They recommend the following[14]:

Anesthetic consumption: "The use of devices to monitor anesthetic depth, such as BIS, Entropia, PSA 4000, and CSM, is associated with reduced inhaled and intravenous anesthetic consumptions, as well as reduced anesthetic recovery time, compared to the method of clinical signs and symptoms."

Strength of the SBA's recommendation: Strong
Quality of evidence: Moderate to high

Intraoperative awakening: "To prevent intraoperative awakening, the use of brain electrical activity monitors is suggested for high-risk patients under balanced anesthesia."

Strength of the SBA's recommendation: Weak Quality of evidence: Moderate

"For patients under total intravenous anesthesia, as it is a risk factor for intraoperative awakening, the use of brain electrical activity monitoring is highly recommended."

Strength of the SBA's recommendation: Strong Quality of evidence: High

Morbidity and mortality: "Electrical nervous activity evaluated mostly by the BIS (dis-regarding other possible components, such as suppression rate, spectrogram or both), alone or in combination with other variables such as MAP and CAM percentage, has a weak association with mortality."

Strength of SBA's recommendation: Weak Quality of evidence: Moderate

Postoperative Delirium (POD) and Postoperative Cognitive Dysfunction (POCD): "Monitoring the depth of anesthesia with BIS monitor facilitates anesthetic titration, decreases brain exposure, especially in the elderly, to high doses of the anesthetic agents, and thus can contribute to reduce POD and POCD."

Strength of SBA's recommendation for POD: Strong Quality of evidence for POD: High

Strength of SBA's recommendation for POCD: Weak Quality of evidence: Moderate to high

2016: American Association of Nurse Anesthetists (AANA)

In their publication, *Unintended Awareness During General Anesthesia: Position Statement, Policy and Practice Considerations*, the AANA recommended that level of consciousness monitoring for patients at risk of unintended awareness under general anesthesia be considered.[15]

2017: European Society of Anaesthesiology (ESA)

The ESA recently published a set of guidelines titled "European Society of Anesthesiology Evidence-Based and Consensus-Based Guidelines on Postoperative Delirium."[16]

They gave a strong recommendation to monitor depth of anaesthesia and avoid deep anaesthesia. EEG/EMG-based neuromonitoring is recommended if available. They also stated that continuous EEG monitoring might help identify pediatric patients who will develop emergence delirium.

CONCLUSION(S):

The 2004 Joint Commission *Sentinel Event Alert* was the impetus look at adverse events related to anesthesia administration. This prompted multiple societies around the world to release guidelines formed from the best available evidence during their publication. In recent years, we have seen that, as more evidence is published, more clinical organizations are updating their guidelines and recommendations regarding this important clinical topic. What's more, we can see that their recommendations are growing in strength. The year 2015 was pivotal in EEG monitoring when five societies released practice guidance on EEG monitoring. The two most common clinical issues addressed in those guidelines are:

- Brain function monitoring during sedation and anesthesia
- Postoperative delirium

Each will remain an area of clinical inquiry.

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