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APSF-Endorsed Statement on Revising Recommendations for Patient Monitoring During Anesthesia

by The APSF Committee on Technology
This Statement was authored by the APSF Committee on Technology and approved by the APSF Board of Directors.

The APSF Committee on Technology (COT) has reviewed statements for patient monitoring during anesthesia care published by a sampling of professional organizations from around the world. Since patient safety during anesthesia is independent of location, the Committee believes that the inconsistencies identified between the various statements should be addressed and appropriate revisions encouraged. Specifically, there are gaps between the various statements that have significant patient safety implications.[1,2] The following recommendations for patient monitoring have been reviewed and approved by the APSF Board of Directors.*

The primary goal of this statement is to identify monitoring practices that are not part of existing statements by some professional organizations, but are believed to enhance patient safety. A secondary goal is to foster efforts by professional organizations to harmonize guidelines across all anesthesia professional organizations so that every anesthetized patient can benefit from best monitoring practices.

This statement is not intended to set a monitoring standard. It is based primarily upon expert consensus. The role of expert consensus to setting guidelines that support and enhance clinical practices has been underscored in a recent publication and editorial.[3,4] Indeed, the first standards adopted for patient monitoring were based upon expert consensus and persist to the present day with well accepted impact on reducing anesthesia-related mortality.[5] Furthermore, APSF recognizes that the desired approach to monitoring will ultimately be dictated by available resources and resource-limited locations simply may not be able to comply with these recommendations. However, this statement hopefully will help anesthesia professionals advocate for resources to comply with these recommendations when the resources are available.

BACKGROUND

Patient safety during general anesthesia requires maintaining organ perfusion and oxygenation. Achieving this goal requires that hemodynamics, ventilation, and oxygenation be monitored, and for the most part, existing monitoring statements from all of the professional organizations reviewed by the APSF-COT address this monitoring need.

Ensuring patient safety, however, also requires drug-induced unconsciousness and often, immobility. Delivering the appropriate drug dosage to induce unconsciousness appropriate to the clinical goals is essential for safe care. Drug underdosing can lead to awareness, or allow the patient to move during a critical part of the surgical procedure. Drug overdosing can cause undesired physiologic changes (eg. hypotension) or postoperative residual drug effects (e.g., residual neuromuscular blockade). Statements that address the importance of monitoring drug effectiveness or undesired residual effect are the most glaring gaps between statements by different professional societies. In what follows, the APSF-COT briefly reviews each of these patient safety threats and makes recommendations to promote revision of existing statements.

Specific Recommendations to Enhance Existing Monitoring Statements to Improve Patient Safety

I. AWARENESS PREVENTION—INHALED ANESTHESIA

Patient safety threat: Patients expect to be unconscious during general anesthesia. Awareness and memory of intraoperative events carries significant and well documented patient morbidity.

The use of potent inhaled anesthetics at 0.7 MAC, or greater, is our single best line of defense against awareness in the patient who has been given a neuromuscular blocking agent. This has been well documented.[6-11] Because the International Organization for Standardization (ISO) already requires that anesthesia workstations configured to deliver inhaled agents measure the end-expired concentration of the inhaled anesthetic, the incorporation of this requirement into a revised standard ought to be straightforward and inexpensive, address a major patient safety issue, and help to harmonize with international monitoring standards.

In some patients, it is not possible to maintain an inhaled anesthetic concentration consistent with 0.7 MAC due to hemodynamic compromise, and in those patients, monitoring for the risk of awareness is especially compelling. In those cases, an EEG-based monitor of anesthetic depth should be used to help ensure adequate depth of anesthesia.

PROPOSED MONITORING PRACTICE:

- **Whenever an inhaled agent is administered, its end-expired concentration shall be measured and a low concentration alarm be activated if available.**
- **Whenever a neuromuscular blocking agent is administered during inhalational anesthesia, if 0.7 MAC cannot be maintained, an EEG-based monitor of anesthetic depth should be used and an inadequate anesthetic depth alarm limit set if available.**
- **Exceptions would include procedures (e.g., Neurosurgery) where the technology for EEG-based monitoring cannot be placed or used effectively.**

II. AWARENESS PREVENTION – INTRAVENOUS ANESTHESIA

Patient safety threat: In the patient given a neuromuscular blocking agent, intra-operative awareness has been reported to occur. Indeed, the risk is greater when intravenous agents (most often propofol) rather than inhaled agents are used as the primary anesthetic. Underdosing can be due to technical error or to the inherent pharmacokinetic and pharmacodynamic variability of the drug (and drug combinations) in the population, combined with the inability to

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*Statements can be guidelines, standards or recommendations depending upon the organization issuing the statement.

Specific Monitoring Recommendations to Improve Patient Safety

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continuously and routinely measure drug concentration(s).

An EEG-based monitor of unconsciousness (depth of anesthesia monitor) is required to reduce the likelihood of awareness whenever total intravenous anesthesia is combined with the administration of neuromuscular blocking agents. Anesthetic depth monitors based upon processed EEG analysis are currently the most readily available and well studied devices for assessing intravenous anesthetic effect and the potential for awareness. Various parameters are extracted from the EEG including spectral edge calculation, density and compressed spectral array displays and derived indices like the bispectral and patient state indices. Requiring an EEG-based monitor to provide insight into intravenous drug effect addresses a major patient safety issue, and helps to harmonize international monitoring standards.

PROPOSED MONITORING PRACTICE:

- **Whenever a neuromuscular blocking agent is administered during total intravenous anesthesia, an EEG-based monitor of drug effect is recommended and alarm limits activated when available.**
- **Exceptions would include procedures (e.g., Neurosurgery) where the technology for EEG-based monitoring cannot be placed or used effectively.**

III. POSTOPERATIVE RESIDUAL MUSCLE WEAKNESS

Patient safety threat: Neuromuscular blocking agents exhibit pronounced pharmacokinetic and pharmacodynamic variability. Consequently, whenever neuromuscular blocking agents have been administered, some residual neuromuscular block may be present at the end of the procedure, compromising patient safety (e.g., airway obstruction, aspiration). Quantitative neuromuscular blockade monitoring has well documented advantages over qualititative or subjective monitoring and is the preferred method. APSF believes that any type of neuromuscular blockade monitoring enhances patient safety compared with no monitoring at all when a neuromuscular blocking agent is used.

PROPOSED MONITORING PRACTICE:

Whenever a neuromuscular blocking agent is administered, a neuromuscular block monitor shall be applied and used. Quantitative is preferable to qualitative neuromuscular blockade monitoring.

IV. AIRWAY PRESSURE MONITORING

Patient safety threat: Excessive airway pressure may cause lung barotrauma. Protective lung ventilation has gained considerable attention as a means to minimize lung trauma. Monitoring airway pressure is not consistently recommended by all professional societies. Manufacturing standards require airway pressure monitoring be present in ventilating devices, so it is not a major change for the device manufacturers and consumers to comply with this recommendation. APSF advocates for including it in the statements for patient monitoring for completeness, and to enhance awareness of this important parameter.

PROPOSED MONITORING PRACTICE:

When ventilation is controlled by a mechanical ventilator, there shall be in continuous use a device that is capable of measuring airway pressure. Alarms for detecting disconnection of components of the breathing system and dangerously high pressure shall be available and enabled. The device must give an audible signal when its alarm threshold is exceeded.

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APPENDIX:

Selected Standards of Professional Societies Reviewed for this Statement

Standards for basic anesthetic monitoring. Committee of Origin: Standards and Practice Parameters. Approved by the ASA House of Delegates on October 21, 1986, last amended on October 20, 2010, and last affirmed on October 28, 2015.

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ISO standard 80601-2-13:2011 AMD 1 2015 AMD 2 2018; Medical electrical equipment — Part 2-13: Particular requirements for basic safety and essential performance of an anaesthetic workstation.