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Review Article

Anesthesia Options for Pediatric Endoscopy: A Review of Intravenous Sedation and General Anesthesia

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Abstract

Gastrointestinal (GI) endoscopy has emerged as an indispensable tool for the assessment and management of GI disorders. Intravenous (IV) sedation and General Anesthesia (GA) are both employed to alleviate patient discomfort and ensure amnesia during these procedures. Essential aspects of both methods include vigilant monitoring of consciousness levels, pulmonary ventilation, oxygenation and hemodynamics.

While GI endoscopy is generally regarded as safe, there is a potential for complications. This is particularly noteworthy in the context of pediatric patients. Raising awareness of the potential complications linked to sedation during GI endoscopy in children and involving anesthesiologists in their care is pivotal to ensuring safety. Several risk factors for complications were identified, including younger age, higher ASA (American Society of Anesthesiologists) class (indicating more severe health conditions) and the use of IV sedation. Documented adverse events encompassed issues such as inadequate sedation, diminished oxygen saturation, airway blockages, episodes of apnea necessitating bag-mask ventilation, patient agitation, occurrences of bleeding and cases of organ perforation. Statistical analysis revealed that complications were less frequent when GA was used (1.2%) compared to IV sedation (3.7%). Furthermore, IV sedation was found to be independently linked to a 5.3% higher risk of cardiopulmonary complications compared to GA. Consequently, GA can be considered a safer and more efficacious choice in providing comfort and amnesia during GI endoscopy.

Keywords: Gastrointestinal; Endoscopy; Pediatrics; Sedation; General Anesthesia

Introduction

Gastrointestinal (GI) endoscopy has evolved into an indispensable diagnostic and therapeutic tool for gastrointestinal diseases. To ensure patient comfort and amnesia during these procedures, healthcare providers, including anesthetists and non-anesthetists, have employed Intravenous (IV) sedation and General Anesthesia (GA). Recognizing the need for safe sedation practices during GI endoscopy, the American Society of Anesthesiologists (ASA) has released guidelines [1,2].

Conscious sedation has gained widespread acceptance as the primary sedation modality for children undergoing these procedures [3]. Nevertheless, regardless of the specific sedation approach, there is an overall immediate, non-fatal complication rate associated with pediatric GI endoscopy, with 2.3% of cases related to hypoxia [4].

Both the American Academy of Pediatrics Committee on Drugs and The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) have issued guidelines aimed at enhancing safety and reducing risks in pediatric GI endoscopy procedures [5,6]. A noteworthy challenge in this context is that children frequently become agitated and restless, which heightens the risk of complications. General Anesthesia (GA) is acknowledged as a secure and effective method for ensuring patient

comfort and amnesia during these procedures. However, it demands specialized expertise and has sometimes been perceived as less cost-effective [3].

The practice of sedation for pediatric endoscopy exhibits considerable variability. The safety of these procedures can be notably improved by enhancing awareness of the potential complications linked to sedation, incorporating contemporary monitoring methods for identifying these issues and actively engaging anesthesiologists in the care of these pediatric patients, both within and beyond the operating room [7]. Furthermore, The JCAHO has enforced the mandate for providing the same standard of care and monitoring for children, whether they are undergoing sedation or GA for these procedures [6].

Objectives and Goals

The objectives and goals for administering Intravenous (IV) sedation or General Anesthesia (GA) to children during these procedures are as follows:

1. Enhance Comfort and Amnesia: Ensure that children can comfortably undergo otherwise distressing procedures while experiencing amnesia
2. Minimize Movement: Enable children to remain still throughout the procedure, thereby reducing the risk of complications
3. Ensure Safety: Maintain a high standard of safety by offering continuous monitoring and expert care delivered by well-trained healthcare professionals
4. Deliver High-Quality and Cost-Efficient Care: Provide care that is not only of superior quality but is also cost-effective, ensuring that resources are used efficiently
5. Facilitate Prompt Discharge: Promote the early discharge of children from the healthcare facility to their homes, enhancing their overall well-being

Sedation and Anesthesia Guidelines

The American Society of Anesthesiologists Task Force has precisely defined "Sedation and Analgesia" as a state that allows patients to comfortably endure uncomfortable medical procedures while retaining sufficient cardiorespiratory function and the ability to respond purposefully to verbal commands and/or tactile stimuli [1]. This term, "Sedation and Analgesia," is considered more accurate in describing the therapeutic objective than the commonly used but imprecise term "Conscious Sedation".

The primary aim of these guidelines is to enable medical professionals to provide sedation and analgesia to patients while minimizing associated risks. Sedation and analgesia facilitate patients in tolerating unpleasant procedures by alleviating anxiety, discomfort, or pain. In cases involving children and uncooperative adults, it can expedite procedures that are not particularly uncomfortable but necessitate the patient to remain still. However, excessive sedation and analgesia may lead to cardiac or respiratory depression, which must be rapidly identified and managed to prevent the risk of hypoxic brain damage, cardiac arrest, or death. Conversely, inadequate sedation and analgesia can result in patient discomfort or injury due to a lack of cooperation or adverse physiological responses to stress.

The following practice guidelines for the safe conduct of gastrointestinal endoscopic procedures have been recommended by the ASA Task Force, with proven benefits including enhanced patient satisfaction, improved clinical outcomes and reduced adverse events:

1. Pre-procedure Patient Evaluation: This involves a comprehensive patient history, physical examination and laboratory assessments
2. Pre-procedure Patient Preparation: Includes patient counseling and fasting instructions
3. Patient Monitoring: Ensuring continuous monitoring of the patient's level of consciousness, pulmonary ventilation, oxygenation and hemodynamics
4. Real-Time Record-Keeping: Timely recording of monitored parameters, such as the level of consciousness, respiratory function and hemodynamics
5. Dedicated Patient Monitor: Availability of a dedicated staff member responsible for patient monitoring and safety
6. Provider Education and Training: Ensure that sedation and analgesia providers are well-trained
7. Emergency Equipment and Staff: Availability of appropriately sized emergency and airway equipment and well-trained staff

8. Supplemental Oxygen: Use of supplemental oxygen as required
9. Multiple Sedative and Analgesic Agents: Employing various sedative and analgesic agents as needed
10. Titration of Medication: Adjusting the dosage of sedative and analgesic medications to achieve the desired effect
11. Intravenous Medication Administration: Administering sedative and analgesic agents via the intravenous route
12. Reversal Agents: Ensuring the availability of reversal agents such as naloxone and flumazenil
13. Post-procedure Monitoring: Ongoing monitoring during the patient's recovery and post-discharge periods
14. Special Regimens: Tailored approaches for patients with unique medical conditions or characteristics, such as the uncooperative, elderly or pediatric patients, those with significant cardiac, pulmonary, hepatic, renal, or central nervous system diseases, morbid obesity, sleep apnea, pregnant patients, substance abusers, emergency and unprepared patients and those with metabolic and airway challenges

Risk Stratification

In the pre-procedure assessment of children, it is crucial to categorize patients according to the ASA classification. Thakkar, et al., found that younger age groups, higher ASA classes and IV sedation are risk factors for complications. Stratifying patients in this manner can help prevent or mitigate complications associated with the procedure [4,8].

1. ASA Class 1 (Healthy Children) and ASA Class 2 (Mild Systemic Illness): Suitable for IV sedation
2. ASA Class 3 (Severe Systemic Disease): To be evaluated on an individual basis for IV sedation or GA
3. ASA Class 4 (Severe Systemic Disease with a Constant Threat to Life) and ASA Class 5 (Moribund Patients Not Expected to Survive 24 Hours): Considered for GA

Sedation Levels

The American Society of Anesthesiologists has defined various sedation levels [2]:

1. Moderate Sedation/Analgesia (Conscious Sedation): A drug-induced depression of consciousness where patients can respond purposefully to verbal commands and/or light tactile stimulation. No interventions are needed to maintain an open airway and spontaneous ventilation is adequate. Cardiovascular function is usually preserved
2. Deep Sedation/Analgesia: A drug-induced depression of consciousness where patients cannot be easily awakened but respond purposefully to repeated or painful stimulation. Ventilation may be compromised, requiring assistance to maintain a patent airway and spontaneous ventilation might be insufficient. Cardiovascular function is usually maintained
3. General Anesthesia: A drug-induced loss of consciousness where patients cannot be aroused, even by painful stimulation. Maintaining independent ventilatory function is often impaired, necessitating assistance in airway maintenance and potentially positive pressure ventilation. Cardiovascular function might be affected

Monitoring During Sedation and General Anesthesia

Irrespective of whether IV sedation or GA is employed, vigilant monitoring is essential to avoid adverse events that could lead to fatalities. The Joint Commission on Accreditation on Healthcare Organizations (JCAHO) has recommended mandatory uniform monitoring standards for children undergoing these procedures. Monitoring should include:

- Level of Consciousness: Regularly assessing patient responses to commands to gauge their level of consciousness
- Pulmonary Ventilation: Monitoring respiratory function to prevent drug-induced respiratory depression
- Oxygenation: Using oximetry to detect early signs of hypoxemia
- Hemodynamics: Continuous Electrocardiography (ECG) monitoring in patients with specific medical conditions and regular blood pressure assessments before and during the procedure

These monitoring standards are vital in reducing risks and ensuring patient safety

Bispectral Index Monitoring

The Bispectral Index (BIS) monitor measures the hypnotic effects of anesthetic and sedative drugs using a numeric scale. BIS helps gauge the level of anesthesia or sedation. It has been validated for pediatric anesthesia and sedation in breathing children [9,10].

Pulse Oximetry

Pulse oximetry detects oxygen levels but may lag in identifying ventilation issues, especially with supplemental oxygen. It helps in preventing hypoxemia, crucial for patient safety [12].

Capnography

Capnography, especially micro stream capnography, can detect breathing problems earlier than pulse oximetry, aiding in maintaining patient safety [13].

Adverse Events

Adverse events during sedation include inadequate sedation, low oxygen levels, airway blockages and excitement [12]. They can vary in frequency depending on the type of sedation used and patient characteristics [4].

Sedation Regimens for Pediatric Gi Endoscopy

Midazolam: Rapid onset and short duration, administered in 2-3 divided bolus doses (0.05-0.15 mg/kg IV).
Fentanyl: Rapid onset, short duration, administered in 0.5-1.0 microgram/kg bolus doses every 3 minutes.
Remifentanil: Brief duration, administered by continuous infusion (0.1 microgram/kg/minute).
Propofol: Fast onset and variable duration, used for induction (2-3 mg/kg) and maintenance (50-150 microgram/kg/minute).

Conclusion

In GI endoscopy for children, General Anesthesia (GA) is considered safe and effective, especially in regions with limited monitoring capabilities. In developed countries with better monitoring, Intravenous (IV) sedation is a safe alternative.

Conflict of Interest

The author has no conflict of interest to declare.

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