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ANALGOSEDATION IN THE EMERGENCY DEPARTMENT: CURRENT GUIDELINES AND CLINICAL PRACTICE COMPREHENSIVE REVIEW

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ABSTRACT

This article discusses the use of procedural sedation and analgesia (PSA) in the Emergency Department (ED), with an emphasis on ensuring patient safety and comfort during brief medical procedures. The aim of this study is to present the principles of sedation use, its organization, indications, monitoring methods, and potential complications, as well as to emphasize the need for standardized management in the ED.

The methodology is based on a review of available guidelines, classifications (including the ASA system), sedation assessment scales, and an analysis of the pharmacological properties of the most commonly used medications, such as ketamine, propofol, midazolam, fentanyl, and etomidate. Data on patient monitoring and the organization of the clinical workflow are also included.

The results indicate that appropriate selection of sedation levels and medications, as well as close monitoring of vital signs, significantly impacts procedural safety. An individualized approach is crucial, especially in high-risk patient groups (children, the elderly, and trauma patients). The use of combination therapy and alternative techniques, such as nerve blocks, can reduce adverse effects.

The conclusions emphasize the need to implement standards, staff training, and protocols in the ED. Properly performed procedural sedation increases treatment effectiveness, minimizes the risk of complications, and improves patient comfort.

KEYWORDS

Emergency Department, Procedural Sedation, Analgesia, Patient Safety, Monitoring, Ketamine, Propofol

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Introduction

Procedural sedation and analgesia are increasingly used in the ED and represent a cornerstone element of contemporary medical practice [1][28][29]. They are most frequently performed at the patient's bedside when urgent action is required. Sedation and analgesia are primarily employed to ensure psychological comfort and improve the overall quality of health of patients who are briefly admitted to the Emergency Department. Procedures and minor interventions involving analgesia and procedural sedation are performed in the Emergency Department every day and during every shift. Sometimes, the use of proper procedural sedation is necessary for the smooth conduct of procedures performed in the Emergency Department. Therefore, the need to implement appropriate standardization and appropriate conditions for conducting procedural sedation in the ED is increasingly evident. The aim of this study is to summarize the current evidence regarding procedural sedation and analgesia in the Emergency Department, with a particular focus on safety, pharmacological strategies, and organizational aspects [1][23].

Methodology

This study was designed as a narrative review aimed at synthesizing current knowledge on procedural sedation and analgesia in the ED. A structured literature search was conducted across electronic databases, including PubMed, Scopus, and Google Scholar.

The search strategy utilized combinations of the following keywords*: procedural sedation, analgesia, emergency department, ketamine, propofol, midazolam, fentanyl, etomidate, monitoring,* and *adverse events*. Priority was given to publications from the last 10–15 years, including clinical guidelines, systematic reviews, and high-quality original studies.

In addition, official recommendations from international organizations in anesthesiology and emergency medicine were included. The selection criteria were based on relevance to the topic, clinical applicability, and methodological quality.

The analysis focused on key aspects of procedural sedation, including pharmacological agents, sedation depth assessment, patient monitoring strategies, risk stratification, and organizational factors influencing safety in the ED setting.

The selection of publications was based on their relevance to the topics, methodological quality, and available usefulness. Both adult and pediatric patient populations were analyzed. The work focused on pharmacological aspects, including the most important consequences, sedation assessment scales, methods for monitoring risks, medical equipment, and possible complications associated with procedural sedation.

Results

Analysis of available data indicates that procedural sedation and analgesia are key components of modern Emergency Department practice, enabling the safe and effective performance of numerous diagnostic and therapeutic procedures. The appropriate selection of sedative and analgesic agents, tailored to individual patient needs and the nature of the procedure, significantly influences procedural success and patient comfort.

The findings indicate that the use of short-acting agents such as propofol, ketamine, etomidate, and midazolam allows for rapid onset and recovery, making them suitable for emergency settings. Combined pharmacological strategies, particularly ketamine-propofol (ketofol), have been shown to enhance sedation quality while minimizing adverse effects.

A vital safety element is the close monitoring of the patient's vital signs, with particular attention to respiratory function. Capnometry shows greater sensitivity in detecting early ventilation disturbances compared to pulse oximetry.

The results of the review also highlight the importance of proper patient qualification, including risk assessment according to the ASA classification, and the necessity of an individualized approach to high-risk groups such as children, the elderly, and trauma patients.

Furthermore, organizational factors such as staff training, adherence to standardized protocols, and availability of appropriate equipment significantly influence the safety and outcomes of procedural sedation.

1. General Definition of Sedation and Analgesia – Key Differences and Characteristics

Sedation refers to the administration of a single drug or a combination of drugs that reduce central nervous system activity. From the patient's perspective, sedation provides relief from anxiety and pain, serving as a form of calming and psychological comfort during procedures accompanied by unpleasant sensations.

The American Society of Anesthesiologists (ASA) has established guidelines for clinicians managing sedation and pain in patients. Four levels of sedation have been defined [2][12]:

1. Minimal (light) sedation – The patient remains responsive to verbal commands, is aware and relaxed, although mild impairment of speech and logical thinking may occur. Cardiovascular and respiratory functions are fully maintained, and no support is typically required.
2. Moderate sedation – Patient consciousness is altered. The patient responds purposefully to stronger auditory or tactile stimuli. Cardiovascular and respiratory systems remain fully functional without the need for support.
3. Deep sedation – The patient is unconscious, in a very deep sleep, and responds only to strong (usually painful) stimuli. Airway management is often required, and respiratory support may occasionally be necessary due to breathing disturbances.
4. General anesthesia – The patient is profoundly unconscious and does not respond even to strong painful stimuli. Airway management and respiratory support are required; the cardiovascular system may also necessitate assistance.

In the ED, the level of sedation should be tailored to the type of procedure, ensuring it is sufficient to safely perform the intervention. Whenever possible, patients should not be sedated more deeply than required. Frequently, sedation is adjusted according to the planned procedure, depending on its complexity and duration.

Sedation may range from very light to levels approaching general anesthesia [29]. In emergency department settings, general anesthesia should be avoided whenever feasible, due to the associated risks to patient health and life. Additionally, bedside procedures are usually brief; lighter sedation ensures that the patient does not remember the intervention, carries fewer risks, and allows faster discharge from the ED.

Table 1. Effects of sedation on physiological functions

Feature	Minimal (light) sedation	Moderate analgosedation	Deep analgosedation	Dissociative sedation	General anesthesia
Reaction to stimuli	Preserved reaction	Purposeful response to a repetitive or painful stimulus	Purposeful response to a repetitive or painful stimulus	No response, even to a painful stimulus	No response, even to a painful stimulus
Airway	Without influence	No action required	Intervention may be necessary	Intervention may be necessary	Action is needed
Spontaneous ventilation	Unaffected	Adequate	May be ineffective	Efficient	Inefficient

Note. Own elaboration based on Marx, J. A., Hockberger, R. S., & Walls, R. M. (Eds.). (2018). Rosen's emergency medicine: Concepts and clinical practice (9th ed.). Elsevier.

The sedation procedure should be performed by a specialist in anesthesiology and intensive care. However, the standard in Western countries is for procedural sedation to be performed by emergency physicians. This practice stems from the lack of clearly defined standards regarding the depth and level of sedation that an emergency physician may safely administer without being an anesthesiologist.

The most appropriate approach in the context of ambiguous guidelines and standards for procedural sedation is to ensure that it is performed by a physician possessing adequate knowledge, skills, and experience in conducting such sedation. Additionally, the physician is required to have knowledge of the medications and methods for securing the airway during these procedures.

The degree of central nervous system depression induced by pharmacological agents can be assessed clinically using specific scales and tools. To objectify the level of sedation, various measurement scales are employed, such as the Modified Wilson Sedation Scale [13][19].

Modified Wilson Sedation Scale:

1. The patient is oriented to time and space, can respond to questions such as their name and location, and may have their eyes closed.
2. The patient is drowsy, opens their eyes on command, and can state their name.
3. The patient responds to moderately intense stimuli (squeezing and pulling the earlobe).
4. The patient does not respond to moderately intense stimuli.

The objective assessment of sedation depth can be performed instrumentally using the following methods:

- frontal muscle electromyography,
- measurement of lower esophageal sphincter tension,
- continuous electroencephalographic (EEG) recording,
- spectral analysis of EEG rhythms,
- bispectral index (BIS),
- analysis of auditory evoked potentials (AEP),
- entropy measurement,

For various reasons, these measurement methods have not been widely adopted in routine clinical sedation practice. Some of these techniques are primarily used to assess the depth of general anesthesia or as measurement tools in scientific research.

2. Indications and Contraindications for Procedural Sedation

Indications:

- reduction of fractures and dislocations,
- electrical cardioversion,
- debridement of large wounds,
- procedures performed under regional anesthesia,
- certain surgical interventions, e.g., cataract removal,

There are no explicitly defined contraindications for the use of procedural sedation. It may be performed in situations of significant anxiety or pain, or when its application facilitates the safe completion of a procedure, provided the patient is appropriately prepared.

Relative contraindications may include:
- age (below 6 months and above 70 years),
- obesity,
- certain comorbidities (ASA classification > III),
- psychiatric disorders,
- signs of "difficult airway", which may complicate airway management and ventilatory support,

3. Assessment of the Patient's General Condition Prior to Sedation

Protocols for monitoring the general condition of patients play a crucial role in ensuring the safe and efficient conduct of procedures performed in the emergency department using PSA. Patients must undergo a pre-sedation assessment and remain continuously monitored throughout the procedure.

The initial step in planning appropriate procedural sedation is taking a thorough patient history. Key information includes the patient's overall health status, drug allergies, chronic medical conditions, ongoing treatments, and the timing and content of their last meal before hospital admission. Accurate patient qualification is essential for procedural safety [1][23].

Assessment of the patient's general condition according to the ASA classification allows determination of their suitability for sedation. Particular attention should be given to patients classified as ASA > III, as these individuals require closer observation and more rigorous monitoring of vital signs [2][11]. Obtaining written informed consent is also essential.

During procedural sedation, the patient should be closely monitored in a suitably equipped and staffed intensive monitoring area [1][24][29]. Vital parameters that should be continuously observed during the procedure include [1][7]:
- blood pressure (BP),
- oxygen saturation (SpO_2),
- respiratory rate (breaths per minute),
- heart rate (beats per minute),
- end-tidal carbon dioxide ($EtCO_2$) levels,

Studies show that capnometry is more effective than pulse oximetry for the rapid detection of respiratory depression and hypoventilation [7][10].

Assessment of airway patency, respiratory rate, and the quality of breathing is essential when preparing a patient for sedation. This evaluation is critical for identifying potential respiratory complications, the need for ventilatory support, or endotracheal intubation. It is also important to check for the presence and position of dental prostheses or other removable oral appliances. Additionally, the patient should be positioned appropriately for the planned procedure, with measures in place to prevent aspiration of gastric contents or sudden deterioration of their general condition.

Teamwork within the emergency department is another critical component. The sedation team should be properly trained and supervised by a physician. During the sedation procedure, two physicians should be present: one responsible for performing sedation, and the other leading the multidisciplinary emergency team, issuing instructions, and overseeing the safe and efficient conduct of the procedure [32].

Pre-procedural preparation for sedation:
- obtain informed consent for analgesia and the procedure,
- patient monitoring: ECG, BP, SpO_2, $EtCO_2$,
- position patient in a semi-recumbent posture,
- pre-oxygenation using a reservoir mask at 15 L/min for at least 3 minutes,
- prepare and select appropriate drugs for analgesia and sedation,
- have antidotes, vasopressors, and muscle relaxants readily available,
- ensure the presence of a second physician and the emergency nursing team,

Airway Equipment (Dedicated Instruments)
- self-inflating bag (Ambu bag) connected to oxygen,
- suction device,
- nasopharyngeal and oropharyngeal tubes,
- laryngoscope,
- endotracheal tubes,
- laryngeal mask airway (LMA),
- bougies and equipment for difficult intubation,

In addition to the above equipment, the workstation must be equipped for continuous monitoring of the patient's vital signs:

1. Pulse oximetry
2. Capnography
3. Blood pressure measurement
4. ECG monitoring
5. Oxygen therapy
6. Availability of suction

Special attention should be given to establishing a patent peripheral intravenous line. Ideally, the patient should have two large-bore peripheral cannulas (>20 G) [1][18][34].

4.Drugs and Pharmacological Agents Used in Procedural Sedation

Pharmacological agents for procedural sedation and analgesia in the emergency department are selected based on several factors. The choice of medication primarily depends on the onset and duration of action of the agent. In addition to single-drug regimens, combination therapy is often employed, selecting drugs according to their intended effect and complementary pharmacodynamic profiles.

This approach is crucial as it influences the quality and speed of sedation, minimizes the risk of complications and adverse effects, and increases the efficiency of the procedure. The most commonly used pharmacological agents include ketamine, propofol, etomidate, midazolam, and fentanyl [19][22].

4.1 Midazolam

Midazolam, a benzodiazepine, exhibits anxiolytic, sedative, and amnestic properties. Compared to propofol, it has a slower onset of action and a longer recovery period, yet remains a safe option in situations requiring pre-procedural anxiety control. It is administered intravenously at doses of 5–10 mg. Onset of action occurs rapidly, within 30–60 seconds, with peak plasma concentrations reached approximately 13 minutes after administration. The total duration of effect ranges from 20 to 80 minutes, with an average duration of 30 minutes. The most common adverse effects include hypotension and respiratory depression [4][19][22]. In the event of such complications, flumazenil should be administered intravenously as an antidote, starting with 0.2 mg over 15 seconds, followed by 0.1 mg after 1 minute. This dose may be repeated every minute up to a total cumulative dose of 1 mg.

4.2 Etomidate

Etomidate is a sedative agent commonly used in combination with an opioid analgesic, such as fentanyl. It is administered intravenously at a dose of 0.2–0.3 mg/kg body weight. It is characterized by rapid onset and relative hemodynamic stability, making it preferred for patients with limited cardiovascular reserve or traumatic brain injury. However, its use may cause transient suppression of the hypothalamic–pituitary–adrenal axis, which should be considered during patient selection [19][22]. Etomidate, usually combined with an opioid analgesic, is typically employed for procedures requiring deep but short-term sedation, such as electrical cardioversion.

4.3 Fentanyl

Fentanyl, a potent opioid analgesic, is administered intravenously at a slow dose of 0.05–0.1 mg. Repeat doses may be given if necessary, but careful titration is essential due to the risk of chest wall rigidity. Onset of action is observed within 2 minutes, with an effect duration of 10–15 minutes. The most common adverse effects include respiratory depression, hypotension, bradycardia, and muscle tremors [4][19]. In case of these complications, naloxone should be administered intravenously at 0.1–0.2–0.4 mg increments, up to a total dose of 1 mg.

4.4 Ketamine

Ketamine, a non-competitive N-methyl-D-aspartate (NMDA) receptor antagonist, induces dissociative anesthesia and is widely used in emergency medicine and anesthesiology due to its combined sedative and analgesic properties [24][31]. Its clinical significance is further enhanced by its hemodynamic profile, as it generally does not cause significant cardiovascular or respiratory depression, unlike many other anesthetic agents. Ketamine can be administered via intravenous, intramuscular, or intranasal routes. Recent studies have highlighted its therapeutic potential in mood disorders [32].

Subanesthetic intravenous doses (typically 0.1–0.5 mg/kg i.v.) have been shown to produce rapid antidepressant and anxiolytic effects, particularly in patients with severe depressive symptoms, suggesting potential applications beyond procedural sedation [35].

Potential adverse effects include central nervous system and ocular complications. Ketamine may increase intracranial pressure (ICP) due to cerebral vasodilation, necessitating caution in patients with elevated ICP, intracranial neoplasms, or other intracranial pathologies. Intraocular pressure may also rise, posing a risk for patients with glaucoma or other ophthalmic conditions. Additionally, ketamine may induce excessive agitation and hallucinations [4][31].

4.5 Propofol

Propofol is one of the most commonly used intravenous anesthetics in clinical practice, suitable for both procedural sedation and general anesthesia [19][25]. Its primary mechanism of action involves modulation of GABA-A receptors, increasing chloride ion influx and hyperpolarizing neuronal membranes. Clinically, this produces dose-dependent loss of consciousness rapidly—after a single induction dose of 2–2.5 mg/kg, full unconsciousness occurs within 30–60 seconds, with recovery typically within 3–5 minutes, making it ideal for short procedures [32].

Propofol's short duration results from rapid hepatic metabolism and renal elimination, which is particularly relevant in elderly patients and those with renal impairment. Although it lacks analgesic effects, its sedative and anxiolytic properties make it widely used in emergency and outpatient procedures [26]

From a safety perspective, propofol is associated with dose-dependent adverse effects, including respiratory depression and hypotension, necessitating close monitoring of vital signs. Special caution is advised for patients with comorbidities such as heart failure, chronic obstructive pulmonary disease, obstructive sleep apnea, or severe obesity, due to an increased risk of hemodynamic and respiratory complications.

Propofol does not inhibit adrenal cortical hormone synthesis at therapeutic doses, which is advantageous for prolonged sedation in intensive care settings. It can be used as monotherapy or in combination with other agents, such as opioids or ketamine, to achieve a synergistic clinical effect while minimizing individual drug doses and reducing complication risk.

Common applications include short procedures, such as joint dislocations (muscle relaxation is advantageous), fracture reduction, electrical cardioversion, and small abscess drainage. It should be avoided in severe cardiac disease, hemodynamic instability, or allergy to soy or eggs.

Combination therapy can improve sedation quality while reducing adverse events compared to monotherapy. One commonly used regimen is ketofol, a combination of ketamine and propofol, which balances hemodynamic effects: ketamine's sympathomimetic properties counteract propofol-induced hypotension, supporting cardiovascular stability [3][6][16][35]. Additionally, propofol may mitigate ketamine-associated adverse effects, such as nausea, vomiting, and dysphoric reactions.

Combining a benzodiazepine with an opioid, typically midazolam and fentanyl, is a standard pediatric sedation strategy. This combination enables deeper, more predictable sedation but prolongs recovery and increases the risk of respiratory depression. Continuous monitoring of vital signs, particularly oxygen saturation and respiratory function, is therefore essential throughout the procedure.

Ketamine–midazolam combinations are considered effective and relatively safe for procedural sedation in pediatric populations. The synergistic analgesic and sedative effects of ketamine, combined with the anxiolytic and amnestic properties of midazolam, allow rapid attainment of controlled sedation during short, painful procedures. This regimen reduces the incidence of agitation, uncontrolled movements, and dissociative phenomena while maintaining relative hemodynamic stability. Target sedation depth is achieved quickly, and recovery remains clinically acceptable.

Pharmacological regimen selection should always consider patient-specific factors, including age, ASA classification, comorbidities, and procedure type. Current guidelines emphasize personalized procedural sedation and analgesia in emergency settings, accounting for drug safety profiles and pharmacokinetic and pharmacodynamic characteristics.

Comparative analysis of commonly used sedatives and analgesics should include onset of action, duration of clinical effect, therapeutic benefits and limitations, potential adverse effects, monitoring requirements, and suitability for specific patient populations.

Table 2. Description of the action of individual drugs used in analgosedation

Drug	Main effect	Initial dose	Onset of action	Benefits	Side effects
Fentanyl	Analgesia	Infusion 0.35-0.5 mcg/kg i.v.	1-2 min	- Short duration of action - Reduces histamine release	- Respiratory depression - Accumulation in adipose tissue during infusion >4 hours
Midazolam	Sedation, amnesia	0.02-0.08 mg/kg i.v.	2-3 min	- Neutral effect on the cardiovascular system - Muscle relaxant - Retrograde amnesia	- Prolonged duration of action - Respiratory depression
Ketamine	Dissociation, sedation, amnesia	0.1-0.5 mg/ kg i.v.	1 min	- Preservation of airway protective reflexes - No respiratory depression	-Hallucinations - Nausea - Increased intraocular pressure - Agitation
Etomidate	Sedation, amnesia	0.1-0.2 mg/kg i.v.	<1min	- Rapid onset of action - Short duration of action - CNS protection	- Respiratory depression - Myoclonus - Adrenal suppression - Nausea
Drug	Main effect	Initial dose	Onset of action	Benefits	Side effects
Propofol	Sedation, amnesia, antiemetic effect	5 µg/kg/min i.v.	<1min	- Rapid onset of action - Short duration of action - CNS protection	- Respiratory depression - Hypotension - Lipid metabolism disorders - Risk of developing PRIS (Propofol Infusion Syndrome) during prolonged infusion

Note. Own elaboration based on Wordliczek, J., Woroń, J., & Serednicki, W. (2015). Analgosedacja i leczenie bólu u dorosłego pacjenta po urazie w warunkach oddziału intensywnej terapii. Anestezjologia i Ratownictwo, 3, 334–344.

Regional anesthesia techniques, particularly peripheral nerve blocks, represent an effective method for pain control without the need for systemic sedation. When performed using ultrasonography or anatomical landmarks, these techniques allow for precise, localized analgesia, providing patient comfort comparable to procedural sedation. The use of nerve blocks simultaneously reduces the requirement for systemic medications, which translates into a lower risk of adverse effects such as respiratory depression, nausea, vomiting, or hemodynamic instability [8][18][22].

A randomized controlled trial conducted in an adult population demonstrated that the use of a supraclavicular nerve block was associated with faster achievement of effective analgesia, a significantly lower incidence of desaturation episodes, and higher satisfaction scores reported by both patients and healthcare

personnel. These findings suggest that regional techniques, when performed by appropriately trained operators, can offer a valuable alternative to procedural sedation, providing shorter recovery times and a lower rate of complications [3][30][35].

5. Monitored Anesthesia Care

Continuous assessment and monitoring of vital parameters during medical procedures constitute a fundamental component of anesthetic practice. In outpatient settings, this obligation applies not only to general anesthesia but also to other interventions, including those performed under local or infiltration anesthesia.

Monitored Anesthesia Care (MAC) encompasses comprehensive measures aimed at ensuring patient safety and comfort throughout the procedure. This includes monitoring respiratory and circulatory function, as well as the administration of sedative and analgesic agents within the framework of procedural sedation. A critical component of this care is the readiness to initiate immediate therapeutic interventions in the event of complications or other intra-procedural adverse events [18][24].

This is particularly important in patients with comorbidities, where the risk of destabilization is increased. In such populations, monitoring should be conducted with heightened vigilance, and the scope of supervision should be tailored to the individual risk profile.

6. Complications and Management

During sedation, patients may experience respiratory disturbances or airway compromise. The clinician performing sedation must anticipate these events and be prepared to provide ventilatory support or active oxygen therapy. Another potential complication is hypotension, or a drop in blood pressure [4,14,36]. Sedated patients may also develop allergic reactions to medications used during sedation. In such cases, appropriate management should be implemented according to the pharmacologic agent involved, along with adjunctive medications as per established algorithms.

Certain drugs, particularly benzodiazepines and ketamine, may induce paradoxical reactions, including hallucinations, psychomotor agitation, and dysphoria. Management of complications involves assessment according to the ABC scale (A – airway patency, B – breathing and its quality, C – circulation), administration of oxygen, and, if necessary, assisted ventilation or administration of reversal agents [18,24].

Other possible adverse effects of procedural sedation include memory disturbances, injection site pain, vomiting, and aspiration episodes. Notably, the incidence of these events is significantly lower compared to general anesthesia, confirming the favorable safety profile of procedural sedation [4].

7. Procedural Sedation in Special Patient Populations

7.1 Pediatric Patients

PSA in pediatric populations requires a distinct clinical approach compared to adults [5][9][17]. This is due to differences in pharmacokinetic and pharmacodynamic parameters, limited cooperation, and heightened emotional reactivity in children during medical interventions, making parental presence important.

For short-term, painful diagnostic and therapeutic procedures, both monotherapy and combination therapy with ketamine, propofol, midazolam, or opioids such as fentanyl are used, typically at lower doses. Ketamine, which induces dissociative anesthesia, preserves spontaneous ventilation and hemodynamic stability, making it one of the preferred agents in this population.

The combination of ketamine and propofol (ketofol) is increasingly utilized, associated with reduced incidence of respiratory depression and shorter time to target sedation depth. Clinical data indicate a low frequency of severe adverse events with this regimen. In recent years, there has been growing interest in less invasive routes of administration for sedative drugs, which may contribute to improved comfort and safety profiles in pediatric procedures [5][9] [27][33][35].

7.2 Elderly Patients

In recent years, significant medical progress and improved socio-economic conditions have led to an increase in average human life expectancy. Elderly patients (especially those over 65) may present symptoms of frailty syndrome [20]. An additional criterion associated with frailty syndrome is the high prevalence of chronic diseases and comorbidities among the elderly. The most important feature resulting from frailty syndrome is the disruption of the psychophysical response following the application of a relatively minor stimulus [8][15].

A serious complication occurring after sedation therapy in the elderly is the manifestation of exogenous syndrome (delirium). As a form of acute central nervous system failure, it is characterized by a sudden onset

and unexpected variability of symptoms. The most common disturbances include disorientation, acute consciousness disorders, cognitive impairment, psychomotor slowing, and sleep disturbances [16].

The presence of peripheral and cerebral vascular diseases in the elderly carries a risk of hemodynamic complications and worsening of autonomic control over cardiac function. In older individuals, progressive atherosclerotic changes impair vascular perfusion, thereby weakening the adaptive capacities of the circulatory and respiratory systems. Therefore, the use of light sedation combined with local anesthesia and analgesic therapy allows for the avoidance of cardiopulmonary depression.

7.3 Trauma Patients

Intravenous procedural sedation is widely used in patients with polytrauma or multi-site injuries. Local anesthesia techniques reduce the opioid requirement during sedation, mitigating adverse effects and shortening hospital stay, thereby improving emergency care outcomes. Critically ill trauma patients often require intensive supportive therapy, including mechanical ventilation, intravenous infusions, vasopressors, and continuous renal replacement therapy (CRRT). Diagnostic and therapeutic procedures in this population necessitate intravenous sedation to control pain, reduce anxiety, and improve patient comfort [35].

A variety of pharmacologic agents are used depending on the patient's clinical status, hemodynamic profile, and procedural requirements. Of particular interest is the combination of ketamine and propofol, increasingly applied in ER. Their complementary pharmacologic effects, particularly on cardiovascular and respiratory systems, enhance procedural utility. Ketamine's properties include potent analgesia, opioid-sparing effects, blood pressure support, modulation of inflammatory responses, minimal immunosuppression, and potential antidepressant effects that may reduce the risk of Post-Traumatic Stress Disorder (PTSD) [16][35].

8. Work Organization and Protocols in the Emergency Department

Procedural sedation and analgesia are integral to ED operations, but their effectiveness and safety heavily depend on non-technical factors such as workflow organization, communication, and team safety culture. In emergency settings, where decisions are often made under time pressure and incomplete information, even optimal pharmacotherapy may fail without proper organizational support.

Teamwork beyond task division is critical. A functional team requires trust, predictability, and awareness of individual competencies. Each member must actively monitor the patient and procedural course to detect abnormalities early, reducing system-related errors [8][23].

Effective information management is also essential. Standardized communication tools, such as brief reports, checklists, and information transfer protocols, help reduce information chaos and improve clarity [1][23]. Logistical aspects, such as equipment placement, drug availability, and ergonomic workstations, are equally important. Minor barriers, such as lack of immediate access to essential equipment, can cause delays and increase team stress.

The human factor, including fatigue, psychological burden, and the pressure of responsibility, cannot be overlooked. High stress levels can affect decision-making ability and increase the risk of errors. Therefore, the need for solutions supporting staff well-being, such as appropriate shift organization, work breaks, and psychological support, is increasingly emphasized.

Simulation-based training is an important element of improving clinical practice. It allows for the practice of rare but potentially dangerous situations without endangering the patient. Through these simulations, it is possible not only to develop technical skills but also to improve communication and cooperation within the team. Regular exercises of this type build operational confidence and prepare personnel for crisis situations.

9. Most Common Errors in Analgosedation Practice in the ED

Procedural sedation and analgesia are routine in modern emergency practice, allowing safe performance of diagnostic and therapeutic procedures while minimizing patient stress, pain, and discomfort. Despite its routine nature, successful sedation requires high-level knowledge, practical skills, and strict adherence to safety protocols.

Errors during sedation can lead to serious complications, including respiratory depression, hypotension, cardiac arrhythmias, and, in extreme cases, life-threatening events. The main sources of errors include poor workflow organization, incomplete patient assessment, inappropriate drug selection, and insufficient monitoring.

Patient Selection

Inadequate patient assessment is a common error. Omitting relevant comorbidities, such as heart failure, chronic lung disease (COPD), obstructive sleep apnea, liver disease, or significant obesity, significantly increases complication risk. Structured risk assessment tools, such as ASA classification and detailed medical history, help anticipate potential complications and select optimal sedation strategies.

Drug Selection and Dosing

Incorrect drug choice or dosing is another major risk factor. Standard sedation protocols, if not tailored to individual needs, may cause respiratory depression, hypotension, tachycardia, or paradoxical reactions. Drugs such as propofol, ketamine, midazolam, fentanyl, and etomidate require careful selection based on clinical status and hemodynamic profile.

Patient Monitoring

Inadequate monitoring represents one of the greatest risks. Continuous observation of vital signs—including respiratory rate, heart rate, oxygen saturation, blood pressure, and capnography—is essential for early detection of deviations and rapid intervention.

Preparation for Emergency Interventions

Many sedation-related complications result from insufficient preparation for emergency interventions. Sudden needs, such as airway obstruction, respiratory depression, or allergic reactions, require ready access to resuscitation equipment, a designated responsible team member, and clear emergency protocols. Standardized protocols, checklists, and regular simulation exercises improve response time and patient safety.

Emergence Phase

The emergence phase is particularly prone to errors. Symptoms such as agitation, nausea, vomiting, hallucinations, or psychomotor excitement may be misinterpreted or untreated, affecting patient comfort and procedural safety.

Recommendations to reduce errors in emergency procedural sedation include:

1. Thorough patient assessment, including comorbidities and clinical status.
2. Individualized drug selection and dosing.
3. Continuous, multi-parameter patient monitoring, including capnography.
4. Full preparation of equipment and emergency procedures.
5. Clearly defined protocols for patient emergence.
6. Regular team training and simulation exercises.

Discussion

Procedural sedation and analgesia are central to modern emergency department practice, enabling safe and effective performance of diverse diagnostic and therapeutic procedures [1][23]. The effectiveness and safety of sedation depend on interrelated factors, including patient assessment, pharmacotherapy optimization, monitoring, and team organization [2][11].

Individualization of sedation is a key consideration. Drug selection should account for patient status, comorbidities, procedure type, and duration. Short-acting agents such as propofol, ketamine, and etomidate are preferred due to rapid onset and predictable recovery [1][18][34]. Combination therapies, particularly ketamine-propofol (ketofol), offer complementary mechanisms that enhance sedation quality while reducing adverse effects, especially regarding hemodynamic and respiratory stability [4][16][31].

Patient monitoring is critical. Standard methods such as pulse oximetry and blood pressure measurement may fail to detect early respiratory compromise [1][7]. Capnography provides more sensitive early detection of hypoventilation and apnea, enabling timely intervention [7][10].

Proper patient selection and risk assessment remain essential. Tools such as ASA classification are useful, particularly in patients with comorbidities [2][12]. High-risk groups—children, elderly, and trauma patients—require particular attention due to less predictable responses to sedatives.

Organizational factors also play a major role. Trained personnel, clear role allocation, and standardized protocols significantly improve patient safety [8][24]. Literature indicates that many adverse events arise not solely from pharmacology but from systemic factors such as poor preparation, communication errors, or inadequate monitoring.

Limitations of available data include heterogeneity in study design, sedation protocols, and outcome measures, complicating direct comparisons. Many studies exclude high-risk patients, limiting generalizability. This highlights the need for further high-quality prospective research to establish standardized sedation protocols.

In conclusion, procedural sedation and analgesia in emergency departments require a comprehensive, multifaceted approach. Ongoing development of standardized protocols, optimization of pharmacologic strategies, and improvement of team organization are key to enhancing patient safety and care quality worldwide.

Conclusions

Procedural sedation and analgesia are essential elements of Emergency Department practice, significantly improving the safety and feasibility of diagnostic and therapeutic procedures [1][2][4][7]. Their effective use requires an individualized approach, appropriate pharmacological selection, and continuous patient monitoring, particularly of respiratory function.

The implementation of standardized protocols, along with proper staff training and organizational support, plays a crucial role in minimizing complications and optimizing clinical outcomes. Further high-quality research is needed to establish more uniform guidelines and improve the safety of procedural sedation, especially in high-risk patient populations.

Conflict of interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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