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Safety and comfort during sedation for diagnostic or therapeutic procedures

診斷或治療過程中實施鎮靜的安全和舒適

Sedation during diagnostic or therapeutic procedures must be safe and comfortable for patients. To achieve this, additional suitably qualified staff must be available throughout the procedure to administer sedation and monitor the patient. Anaesthesiologists possess the necessary knowledge and skills to perform sedation safely but are often unavailable. Non-anaesthesiologists performing sedation should be fully trained in the physiology of sedation, the pharmacology of sedatives and analgesics, the monitoring of patients, and in airway support, ventilatory care, and cardiopulmonary resuscitation. The presence of an anaesthesiologist is desirable when dealing with patients at high-risk of complications. Good sedation practice involves presedation assessment and optimal selection of patients, careful monitoring and support from dedicated staff, and adherence to recovery and discharge criteria.

在診斷或治療過程中對病人施行鎮靜必須安全舒適。為此，在整個鎮靜過程中，必須有額外的具備資格的人員去施行鎮靜及監測病人。麻醉科醫生雖擁有安全施行鎮靜必要的知識技能，但往往缺乏足夠的人手去應付這類工作。非麻醉科醫生在進行鎮靜工作前，應該在鎮靜生理學、鎮靜及止痛劑之藥理學、病人監測、及在氣道處理、通氣護理、心肺復甦等方面受過正式的培訓。在處理高危併發症的病人時應該有麻醉科醫生在場。良好的鎮靜工作涉及鎮靜前評估選擇適當的病人，仔細監測，堅守評估鎮靜後康復的準則，並得到具熱忱員工的支持。

Introduction

Modern medicine often involves minimally invasive interventions for diagnostic or therapeutic purposes. Apart from producing pain and discomfort, such procedures can invoke fear and anxiety reactions. Increased sympathetic activity with tachycardia and hypertension has the potential to precipitate myocardial ischaemia or infarction in susceptible patients. Patients undergoing these interventions often require sedation to enhance procedural safety, comfort, and success. The recent proliferation of these procedures increases the demand for sedation. Sedation carries significant risks to patients, especially when inappropriate techniques are used by inexperienced or untrained personnel. As non-anaesthesiologists are increasingly involved in sedation, it is vital for them to understand safety issues and receive proper training. This article reviews various factors affecting the safety of procedural sedation, including the performance of sedation, monitoring guidelines, and training issues.

Definitions

Sedation involves the use of pharmacological or non-pharmacological means to depress the central nervous system and reflexes so as to reduce patient discomfort without producing unintentional loss of consciousness.[1,2] Anxiolysis, amnesia, analgesia, and immobility are essential requirements in procedural sedation.[3] Conscious sedation is defined as a state of depressed consciousness that allows protective reflexes and the airway to be maintained, and the patient to respond appropriately to physical and verbal stimulation (Table 1).[4] Deep sedation refers to a condition wherein the patient cannot easily be roused but can maintain a patent airway and respond to stimulation.[4]

Key words:
Anesthesia and analgesia; Safety

關鍵詞：
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Table 1. Definition of general anaesthesia and levels of sedation/analgesia[4]

	Minimal sedation (anxiolysis)	Moderate sedation/analgesia ('conscious sedation')	Deep sedation/analgesia	General anaesthesia
Responsiveness	Normal response to verbal stimulation	Purposeful response to verbal or tactile stimulation*	Purposeful response following repeated or painful stimulation*	Unable to rouse even with painful stimulation
Airway	Unaffected	No intervention required	Intervention may be required	Intervention often required
Spontaneous ventilation	Unaffected	Adequate	May be inadequate	Frequently inadequate
Cardiovascular function	Unaffected	Usually maintained	Usually maintained	May be impaired

* Reflex withdrawal from a painful stimulus is NOT considered a purposeful response

The sedation continuum

Although categorised into conscious and deep sedation, sedation refers to a continuum with infinite endpoints (Fig 1).[5] This continuum can be used to satisfy the different levels of sedation and analgesia required by different procedures[6] or patients. The continuum is not drug-specific. Various states from mild sedation to general anaesthesia can be achieved with essentially all sedative agents by increasing the dose.[3] The progression along the continuum towards losing protective reflexes may be subtle, increasing the risks of sedation when performed by inexperienced staff.

Conscious sedation is practised under most circumstances, while deep sedation is an area of controversy. Although the American Academy of Pediatrics guidelines[7] developed by the Section on Anesthesiology allows deep sedation to be carried out without being supervised by anaesthesiologists, British anaesthesiologists consider that deep sedation is difficult to distinguish from general anaesthesia and should be supervised by anaesthesiologists.[8] Proponents of deep sedation without anaesthesiologist supervision cite the higher costs and limited availability of anaesthesiologists,[9,10] and the example of young children requiring magnetic resonance imaging (MRI) examinations[9] to support their argument. However, it must be emphasised that deep sedation is hazardous, and medical personnel competent with airway management, monitoring and resuscitation, that is, anaesthesiologists, should be present or readily accessible in order to protect the safety of the patient.

The sedation continuum*

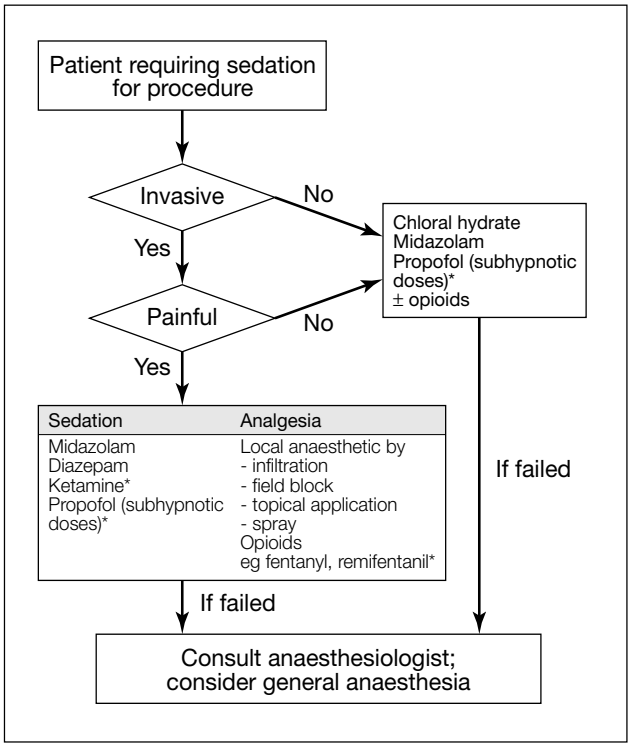
Alert-anxious
Alert-calm (anxiolysis)
Drowsy but clear mentation (sedation)
Eyes open; speech slurred
Eyes closed but answers questions appropriately
Opens eyes to voice; is confused
Oxygen desaturation on room air
Opens eyes to pain; responds purposefully
Eyes closed, moans and withdraws from pain
Moans to pain. Nonspecific motor response to pain
Carbon dioxide retention
Oxygen desaturation on 2 litres oxygen
No response to pain
Bradypnoea—poor gag reflex
Apnoea-hypotension
Death

* Sedation and analgesia refer to a continuum with infinite possible endpoints. The optimal endpoint depends on the procedure to be performed, the amount of pain anticipated, and the patient's anxiety level and cardiopulmonary reserve

Fig 1. The sedation continuum[5]

Sedation and analgesia

Sedation and analgesia are distinct processes. Some patients require primarily sedation, some primarily analgesia provided by opioids or local anaesthetic agents, and some both sedation and analgesia (Fig 2). Painful procedures often require both sedation and analgesia because sedation alone in the presence of pain may cause confusion and



* The presence of an anaesthesiologist is desirable when these drugs are used for sedation

Fig 2. Procedural factors affecting the choice of sedatives
The choice of analgesic and/or sedative drugs and their combination depends on the level of invasiveness, severity of pain anticipated, and duration of the procedure. The recommended route and dosage of individual drugs for paediatric patients is outlined in Table 2

restlessness. Non-painful procedures in uncooperative patients may require sedation only. Drugs and techniques should be selected according to the effect desired, procedural requirements, and individual patients' needs.[5]

Monitored anaesthetic care

Monitored anaesthetic care (MAC) refers to the practice where an anaesthesiologist administers sedation and monitors the patient undergoing a diagnostic or therapeutic procedure.[11] Monitored anaesthetic care includes presedation assessment and optimisation, intrasedation and postsedation care. Throughout the procedure, the anaesthesiologist:

(1) administers sedatives, analgesics, anaesthetic agents, or other medications as necessary to ensure patient safety and comfort;
(2) monitors and evaluates vital functions continuously; and
(3) maintains the patient's airway and manages other clinical problems that may arise.

It is estimated that MAC is practised in 6% to 12% of all in-patient procedures in the United States. In addition, MAC is being increasingly utilised for out-patient surgical procedures (eg cosmetic surgery, cataract surgery, cystoscopy, placement of 'deep' intravenous lines, and vascular shunts).[12] As procedures performed under local anaesthesia with MAC usually have a shorter recovery time compared with procedures undertaken under general or regional anaesthesia, MAC will have an increasingly important place in clinical practice, especially for economic reasons.[13]

Applications of sedation

The application of procedural sedation depends on the patient and the procedure required. Examples include paediatric patients undergoing various examinations or investigations; radiological procedures, such as MRI and interventional radiological procedures; endoscopic procedures; changing of dressings for burns patients; and other miscellaneous procedures such as cardioversion, reduction of fractures, and repair of lacerations.

Although sedation during drainage of peritonsillar abscess[14] and for office-based micro-laparoscopies[15] has been described, the authors consider this practice unsafe for general use. It is important to emphasise that general anaesthesia may be preferable to sedation when the procedure is major or involves significant pain. General anaesthesia is usually required for patients undergoing procedures involving placement in unusual positions for a prolonged period, and for the changing of dressings in a patient with severe burns.

Pharmacology in sedation: safety considerations

The pharmacological profile of drugs commonly used in sedation, together with the suggested reference dose ranges for children are summarised in Table 2. The lower end of the dose range should be used initially to cater for inter-patient differences. Sedative dosage needs to be decreased in the elderly or in sick patients, and in those with organ dysfunction, highlighting the importance of presedation assessment. For non-anaesthesiologists, a stepwise protocol defining the initial, incremental, and maximum dosage of

Table 2. Commonly used drugs for sedation

Drug name	Initial bolus dose (mg/kg)*	Route of administration	Onset time (min)	Duration (min)	Remarks
Midazolam	0.05-0.1 0.1-0.15 0.5-0.75 0.2-0.5 0.25-0.5	Intravenous Intramuscular Oral Intranasal Rectal	2-3 10-20 15-30 10-15 10-20	45-60 60-120 60-90 60 60-90	May cause respiratory depression. Reduce dose in hepatic dysfunction
Diazepam	0.05-0.2	Intravenous	4-6	120-180	May cause respiratory depression
Chloral hydrate	25-100 25-100	Oral Rectal	15-30 15-30	60-120 60-120	May cause vomiting and paradoxical excitation
Fentanyl	0.001-0.005	Intravenous	2-3	20-30	May cause respiratory depression, nausea, and vomiting
Morphine	0.1-0.2 0.1-0.2	Intravenous Intramuscular	4-6 10-20	120-240 240-360	May cause respiratory depression, nausea, and vomiting
Pethidine	0.5-1 0.5-1	Intravenous Intramuscular	5-10 5-10	180-240 180-240	May cause respiratory depression, nausea, and vomiting
Ketamine†	1-1.5 4-5 5-10	Intravenous Intramuscular Oral	1-2 3-5 15-30	40-60 90-150 120-240	Lower dose if given together with midazolam
Propofol†	25-75 μg/kg/min	Intravenous infusion	2-3	10 after discontinuation	May cause transient apnoea and hypotension
Remifentanil†	0.1-0.2 μg/kg/min	Intravenous infusion	3-5	5 after discontinuation	May cause respiratory depression and hypotension

* Dose range for children. Healthy adults require a lower dose. The dose recommended applies only when the patient is given a single drug
† The presence of an anaesthesiologist is desirable when these drugs are used for sedation

fentanyl and midazolam[16] has been found to be safe and effective.

When intravenous access is difficult, other routes can be considered including oral, nasal, or intramuscular routes. As drug absorption will then vary, adequate time must be allowed for the drug to exert full effect before escalating the dose or discharging the patient home. Intramuscular midazolam, ketamine, and pethidine/promethazine combinations have been shown to be effective under expert care.[17]

Chloral hydrate

Chloral hydrate has long been used for paediatric sedation because of its perceived wide therapeutic window.[18] However, it has a long duration of action and residual effects are common. Motor imbalance, gastrointestinal effects, agitation, and restlessness can occur after the patient is discharged home.[19] Use is now restricted to children younger than 3 years for radiological examination.[3]

Midazolam

Midazolam is a short-acting, fast-onset, water-soluble benzodiazepine, with good sedative and anxiolytic actions. Due to its versatility in administration and safety record, it is a very popular sedative. Midazolam lacks analgesic properties and should be combined with opioids such as fentanyl[16] and pethidine[10,20] when analgesia is required in addition to sedation. Desaturation can occur with higher doses, and a dose of 35 μg/kg body weight has been shown to be both safe and effective for gastroscopy.[21] Premedication with midazolam for conscious sedation in colonoscopies has been reported to increase the risk of hypotension and resulted in a significant decrease in oxygen saturation.[22]

Propofol

Propofol is a potent intravenous hypnotic for inducing general anaesthesia. At subhypnotic doses, it is a good sedative and antiemetic. The duration of action is short, with rapid onset of action. As with midazolam, propofol has no analgesic properties and is often combined with short-acting opioids, such as fentanyl, for sedation and analgesia with good results.[23] Propofol is more likely to produce deeper levels of sedation than midazolam.[20] Propofol should be used by anaesthesiologists because the onset of action is fast, and rapid dose escalations can induce a state of general anaesthesia. Airway obstruction, apnoea, and desaturation can then occur.

Ketamine

Ketamine is an anaesthetic agent used extensively by non-anaesthesiologists to provide procedural sedation and analgesia in children during fracture reduction,[24] short painful procedures,[25] and MRI.[26] It can cause neuropsychiatric symptoms in susceptible patients, such as agitation, hallucinations and vivid dreams, elevation of intracranial pressure, and seizures. A study of nine children receiving an inadvertent ketamine overdose showed prolonged sedation in all, with respiratory depression evident in four.[27] Transient laryngospasm (8.2%), emesis (4.1%), apnoea and respiratory depression (0.5%) have also been reported in children receiving normal doses.[28] Personnel skilled in paediatric resuscitation should thus be present to monitor and manage these complications should they arise. Caution should be exercised by non-anaesthesiologists using ketamine for sedation/analgesia because of its potentially life-threatening risks.[29]

Nitrous oxide

Use of nitrous oxide (in concentrations of 30% to 50%) for painful procedures such as dental extractions[30] and laceration repairs[31] has been reported. Although inhalation sedation with nitrous oxide has been considered a safe alternative to general anaesthesia in dental practice,[32] effectiveness is limited and inappropriate use can lead to severe hypoxaemia and the risk of pulmonary aspiration.

Occupational exposure to nitrous oxide may produce adverse effects such as carcinogenicity, mutagenicity, and spontaneous abortion[33,34] as well as major congenital abnormalities in the foetus.[35] Prolonged exposure to nitrous oxide in animals has been noted to affect B12 metabolism and DNA synthesis.[36] The recommended exposure limit for nitrous oxide in Hong Kong is 50 parts per million. In operating theatres with good ventilation and active scavenging, the weighted average of nitrous oxide exposure even during paediatric anaesthesia is well below this limit.[37] In less well-ventilated areas, staff could be exposed to transient high levels of nitrous oxide despite the 8-hour weighted average remaining within the limits.[30,38] These environmental hazards, along with the limited effectiveness, place restrictions on the routine use of nitrous oxide for sedation.

Other drugs

Methohexitone sodium, thiopentone sodium, and etomidate are potent drugs for inducing general anaesthesia. Their use by non-anaesthesiologists is not recommended.

Intravenous methohexitone sodium has been shown to provide effective and short-lasting sedation in children. Complications like myoclonus (10%), hiccoughs (10%), stridor and emergence reaction can occur.[39] Rectal thiopentone has been used for sedation in children undergoing echocardiography[40] or MRI examination.[41] Onset time was approximately 16 minutes and duration of sedation approximately 30 minutes. Desaturation was observed in 10% of patients.[41] The use of intravenous etomidate has been reported for procedural sedation in emergency department patients,[42] with 20% suffering complications such as desaturation, myoclonus, vomiting, bradycardia, and pain on injection.

New techniques

New sedation techniques incorporating new drugs and technology advances have been devised to achieve

appropriate levels of sedation for specific patient groups and procedures. Some of these techniques involve the use of potent anaesthetic drugs and should be used by anaesthesiologists only.

Target-controlled propofol infusion

When a drug is infused intravenously at a rate equal to its rate of elimination from plasma (by metabolism or redistribution), a constant plasma concentration will be maintained. This forms the basis of the target-controlled infusion (TCI) technique. The TCI pump derives all the pharmacokinetic parameters in the mathematical three-compartment model from patient variables such as body weight, sex, and age. After the desired plasma concentration is set, the pump varies the rate of infusion to rapidly achieve and maintain this set concentration. Propofol is commonly chosen for TCI because its infusion rate can be easily titrated to achieve the desired clinical endpoint, and recovery is rapid with minimal residual effects.[43] When the desired level of sedation is not achieved within 3 to 5 minutes, the target concentration can be increased or decreased. This has the potential to prevent oversedation, especially during long procedures.[44]

There are two major issues with regard to the use of TCI. Firstly, the validity of the derived pharmacokinetic parameters for individual patients affects the accuracy of the predicted (target) concentration. Measured plasma concentrations of propofol have tended to be higher than calculated (predicted) concentrations, especially during induction and changes of concentration.[45] Secondly, setting the target plasma concentration for an individual patient is difficult because of wide variability among patients.[46] Consequently, TCI is not a technique that can be used by non-trained personnel. It requires an anaesthesiologist to monitor the patient closely, assess the level of sedation, and adjust the target plasma concentration as necessary. Target-controlled infusion is a good option for anaesthesiologists in MAC, however.[47]

Patient-controlled sedation

Patient-controlled sedation (PCS) allows the patient to control his/her own level of sedation by triggering an infusion pump to deliver a programmed bolus of sedative when needed. Propofol and midazolam are commonly used for PCS.[48] A loading dose may be given by the anaesthesiologist initially to achieve the desired sedation, followed by patient-activated boluses to maintain sedation. A background infusion may also be used, especially for longer procedures, as patients often become restless or fatigued.[49] The ability to control one's own sedation may be anxiolytic and it has been found that many patients actually prefer 'light' sedation.[50] Even in phobic patients, PCS has been shown to use 30% less propofol than the clinician-controlled technique.[51] Patient satisfaction, qualities of sedation, and operative conditions during PCS are comparable with TCI.[52]

When sedatives with a rapid onset of action are used together with a 'lock-out' interval, the patient-controlled approach should be safe, as deeply sedated patients usually cease to press the control button. However, it has been reported that an individual patient who deliberately tries to achieve unconsciousness will have an 11% chance of success.[53]

A variation of PCS with background infusion is to incorporate a patient-controlled element into TCI. A lower initial target concentration is set and the patient is allowed to increase the target propofol concentration in small increments by controlling the handset. Safety measures include a 'lock-out' interval, a maximum permissible target concentration, and a programmed decrement in target concentration after fixed intervals with no demands. One study has shown that 22% of patients developed desaturation requiring supplementary oxygen therapy with such patient-controlled TCI, however.[54]

Remifentanil

Remifentanil is a new, potent, fast-onset, and very short-acting intravenous opioid. It is largely non-cumulative, with a context-sensitive half-life independent of the duration of infusion. Most investigators are in agreement on the short discharge times and stable haemodynamics achieved with remifentanil use.[55-59] However, Litman[55,56] has drawn attention to the high incidence of life-threatening respiratory depression associated with remifentanil use and others have cautioned that careful monitoring of ventilation must be instituted.[59] As a result of its potency and high potential for respiratory depression, remifentanil is not recommended for non-anaesthesiologist use or for office-based sedation where there are no facilities available for respiratory support.

Environment

Sedative sparing effects of music

Conjunctive use of favourable music via a headset has been shown to decrease PCS use in awake patients undergoing procedures performed under regional anaesthesia.[60,61] The intra-operative music chosen by the patient may assist by providing a familiar auditory environment, distracting the patient from upsetting issues during the procedure. The use of headsets also has the advantage of screening out the background noise of the operating theatre.

Quiet environment

Noise can increase anxiety levels[62] and this is an issue in the operating theatre or MRI suite. Stermer et al[63] failed to show the beneficial effect of complete silence versus background music in the endoscopy room, but attempts to reduce noise levels in other areas have been found to be as effective as pharmacological sedation.

Office-based sedation

Sedation is sometimes required for short and minimally painful procedures conducted in the office-based or non-hospital setting. The concerns are essentially the same as those for hospital-care sedation. The sedative and analgesic agents chosen should have a rapid onset and offset of

action to allow early recovery with minimal haemodynamic disturbance or respiratory depression. Patients selected should not have significant co-existing cardiovascular, respiratory, endocrine, or neurological conditions.

Risks of sedation

Sedation results in depression of the central nervous system. Loss of consciousness due to sedation shares the same risks as the use of general anaesthesia.[29] Risks associated with sedation include:

(1) over-sedation, leading to unintentional loss of consciousness;
(2) depression of protective reflexes, predisposing the patient to pulmonary aspiration;
(3) depression of respiration, leading to hypoxaemia, myocardial ischaemia, and arrhythmia;
(4) depression of the cardiovascular system;
(5) use of a wide variety of drugs, and combinations of drugs with the potential for drug interactions—an adverse outcome is more likely when more than two drugs are administered, or when nitrous oxide is combined with other types of drugs[64];
(6) potential for excess dosing to compensate for inadequate analgesia;
(7) individual variations in response to the drugs used, particularly in children, the elderly, and those with pre-existing medical disease. Children aged between 1 and 5 years are at greatest risk, although most have no severe underlying disease[65]; and
(8) risks relating to inadequate skills or experience of the person administering sedation, such as drug errors, inadequate evaluation, inadequate monitoring, or premature discharge.[65]

It is important to note that all sedatives and narcotics can cause problems even when used in recommended doses. All clinical areas employing sedation techniques have reported adverse events.[65]

Complications of sedation

There are abundant case reports describing sedation complications but little hard data on the rate of occurrence of each adverse event. Problems comparing these studies include differences in patient characteristics, the severity of events, level of sedation achieved, type of drug and monitor used, practitioners responsible, and practice guidelines adopted. Complications reported predominantly involve the respiratory system, such as airway obstruction, respiratory depression, apnoea, and hypoxaemia.[65] Other complications reported include cardiac arrest.

In a study of deaths associated with dentistry, the overall mortality rate was 1 in 152 000. One third of deaths occurred in association with local anaesthesia with sedation.[66] The majority of sedation deaths occurred during operator-administered anaesthetics, and the most common precipitating causes included respiratory obstruction, hypoxia, and cardiovascular collapse secondary to arrhythmia.[67]

Inadequate cardiopulmonary resuscitation and a non-hospital setting have been identified as important contributing factors to serious sedation complications (cardiac arrest and poor neurological outcome) in paediatric patients.[68] Patients are at greatest risk of developing complications within 5 to 20 minutes of receiving intravenous medications, and during the postprocedure period, when external stimuli are removed.[69]

Ways to ensure safety during sedation

Staffing

In addition to the doctors and nurses required to perform the procedure itself, there must be additional suitably qualified staff available to administer the sedative drugs and monitor the well-being of the patient throughout the procedure.[70] This is similar to the operating theatre situation, where the presence of an anaesthesiologist ensures that a dedicated doctor is there to manage the patient while the surgeon is occupied with the operation. The practice of a single operator providing sedation as well as performing the procedure should be condemned. The safety of sedation can be ensured only with careful supervision by qualified personnel, who will intervene promptly should the loss of protective reflexes be of issue.[71]

Medical practitioners involved with sedation should have a good knowledge of the physiology/pharmacology of sedation, and be competent in patient monitoring and resuscitation. The anaesthesiologist is the ideal person to sedate and monitor the patient. This specialist is familiar with the necessary equipment and facilities, and possesses the required skills and experience. However, lack of manpower and resources precludes anaesthesiologist provision or supervision of all sedation.

Guidelines and training

In most circumstances, sedation is conducted by non-anaesthesiologists. Nurses may be involved in administering the sedative and monitoring the patient after sedation is prescribed by a medical practitioner. To prevent or manage complications during sedation, the practitioner has to follow certain safe practice guidelines. Various professional bodies and organisations, such as the Hong Kong College of Anaesthesiologists[1] and the Australian and New Zealand College of Anaesthetists,[2] have promulgated guidelines to assist the practitioner in performing sedation safely.

These guidelines outline the general principles of safe practice without providing specific details. Individual departments need to build their own practice guidelines based on these principles to cater for variations in patients, procedures, practitioner skills, and physical setting. The role of doctors and nurses should be clearly delineated. To

reiterate, a qualified nurse, if not a doctor, should be present and dedicated to monitoring the patient throughout the sedation process.

Doctors and nurses involved with sedation should undergo regular recertification of cardiopulmonary resuscitation skills. Protocols for resuscitation such as the Advanced Cardiac Life Support protocol, and for managing complications such as desaturation, should be adopted in areas where sedation is conducted. The staff involved should also receive training in the use of sedative drugs and in appropriate monitoring of patients.

Role of anaesthesiologists

Anaesthesiologists are the most appropriate personnel for the sedation task, especially for specific patients. For patient safety, it is advisable to have an anaesthesiologist present if the patient has:

(1) significant co-existing medical problems;
(2) difficult management problems, eg psychiatric, demented, uncooperative, or claustrophobic patients;
(3) unintended loss of consciousness, airway problems; and
(4) previous history of difficulty in controlling level of sedation, or overdose.[29]

Anaesthesiologists should also be involved in formulating, teaching, and applying clinical practice guidelines on sedation for non-anaesthesiologist colleagues. A commitment from doctors, nurses, and administrators is essential to ensure successful implementation of sedation guidelines, and requires much foresight, continuous monitoring, and clinical audit.[72]

Monitoring

Monitoring during sedation is the key to safe practice. The following procedures are recommended.

(1) Maintain a constant dialogue with the patient during the procedure. This ensures that the patient has not progressed into unintended deep sedation or loss of consciousness.
(2) Complete simple clinical assessments such as patient colour, temperature, blood pressure, and pulse are a basic requirement.[73]
(3) Use non-invasive blood pressure monitors and pulse oximeters to enhance safety during sedation. Early detection and treatment of hypoxaemia is crucial. The use of electronic monitoring equipment should not be considered a substitute for continuous clinical assessment.
(4) Routine supplemental oxygen is recommended to decrease the incidence of desaturation.[33]

The role of bispectral analysis of the electroencephalography signal (obtained through a non-invasive forehead 'lead') in measuring depth of conscious sedation is still unknown, despite initial reports showing a correlation with the traditional sedation scale.[74]

Equipment and facilities

The area where sedation is conducted should be supplied with appropriate equipment and drugs required for cardiopulmonary resuscitation, and airway, ventilatory, and circulatory support. In addition to monitoring equipment, oxygen, adequate suctioning facilities, airway control devices such as endotracheal tubes and laryngoscopes, manual resuscitators, defibrillators, antagonists for benzodiazepines, and opioids should be available. The trolley for performing the procedure must be tiltable. This list is not exhaustive and reference should be made to appropriate guidelines.[1,2]

Drug administration

A key to minimising complications in procedural sedation is slow and careful titration of drugs to the desired effect.[67] Adequate time must be allowed for drugs to exert full effect before giving additional doses.

Presedation evaluation

The medical practitioner responsible for sedating the patient should assess the patient before the procedure. The patient's American Society of Anesthesiologists (ASA) status (Table 3) should be determined for risk stratification. The patient's known medical history allows the practitioner to plan appropriate sedation and monitor strategies. Anaesthesiologists should be involved in sedation of high-risk patients.

Presedation fasting

No evidence-based guidelines are currently available detailing the optimal fasting duration prior to procedural sedation. There is insufficient published data to date to confirm that fasting improves outcome in patients undergoing procedural sedation. However, it is logical to assume that the aspiration risk is lower in a patient with an empty stomach and that some period of preprocedure fasting is desirable. In the absence of hard data, the ASA has recommended 6 hours' fasting for solids and 2 hours' for liquids. In all cases, the urgency of the procedure and the desired depth of sedation should be balanced against the risk associated with inadequate fasting.[75]

Table 3. American Society of Anesthesiologists classification of physical status

Class	Description	Suitability for sedation
1	A normal, healthy patient	Excellent
2	A patient with mild systemic disease, no functional limitations	Generally good
3	A patient with severe systemic disease, definite functional limitation	Intermediate to poor, consider benefits relative to risks
4	A patient with severe incapacitating systemic disease that is a constant threat to life	Poor, benefits rarely outweigh risks
5	A moribund patient not expected to survive 24 hours without the operation	Extremely poor

Recovery care

Vital signs and respiratory status should be monitored until the patient is awake and alert. The patient should be observed until discharge criteria related to conscious state, airway patency, ventilation, and circulation status are met.[4]

Medicolegal aspects

Sedation is an intervention carrying significant risks to the patient. It is necessary to explain all significant risks to the patient and to obtain consent for sedation. It is also important to have another person present during the sedation process to circumvent any potential claims with legal ramifications made by the patient. This is especially important when propofol is used, as sexual delusions can occur in patients during and after propofol administration. The patient may consequently believe he/she was sexually assaulted while under sedation.[76]

Conclusion

Patient safety and comfort constitute the prime priorities in patient management. The provision of sedation carries the risk of potentially life-threatening complications. Adherence to recommended sedation guidelines is therefore mandatory. Choice of agents, techniques, and medical personnel responsible for the proper care of patients should be based on patients' specific needs rather than cost and efficiency alone. To ensure the safety of all patients undergoing sedation, training of staff and provision of support facilities for maximal patient care are also critical.

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