Sedation: Is it getting easier?

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As medicine moves towards less invasive and fast track options, there is a steadily increasing call for the provision of sedation rather than general anaesthesia for diagnostic and therapeutic procedures. This is a result of reduced staffing, funding and in-patient facilities. 12% of in-patient procedures (and 40 –50% of out-patient surgeries) in the USA in 2001 were performed under some form of sedation. Sedation is, however, not a static or easily achieved entity. It lies at a variable distance along the continuum from the awake state to general anaesthesia, depending on the extent of sedation. Patients may move from one level to another with top up doses, or infusions, or with changes in level of stimulus – intra-patient variation. In addition, there is wide inter-patient variation in response to a given dose of a given drug or combination. The levels of sedation as defined in the South African Society of Anaesthesiologists (SASA) practice guidelines are tabulated below but are easier to describe than to achieve.

	Anxiolysis	*Light Sedation* (no opioid)	*Deep Sedation* (or with opioid)	Anaesthesia
Responsiveness	Response to verbal stimuli	Purposeful response to verbal or tactile stimuli	Purposeful response only *after repeated or* painful stimuli	Unrousable
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

Conscious (or light) sedation is a drug-induced state of central nervous system (CNS) depression characterised by rousability in response to verbal or minimal tactile stimuli. Cardio-respiratory homeostasis, airway and protective reflexes are maintained. Its goal is to provide patient comfort and co-operation; optimal operator access; maximum safety, and to facilitate subsequent similar procedures. It is suitable for procedures that require only local anaesthesia or require very short periods of intense analgesia, and for prolonged procedures requiring immobility or occurring in an unfamiliar or uncomfortable environment. Conscious sedation can be produced by a variety of drugs, given in appropriate doses with appropriate patience. The sedation produced may be the primary effect of the chosen agent, e.g. midazolam or propofol or a by-product of its primary effect, e.g. remifentanil. The key phrase in achieving conscious sedation is titration to effect.

The issue of safety is often stressed, and enhanced safety of sedation is a widely held perception amongst non-anaesthetic colleagues and the general public. However, a sober assessment of the data comparing identical procedures performed under general anaesthesia (GA)or sedation tells a very different story. The mortality for gastrointestinal tract (GIT) endoscopy performed under "conscious sedation" ranges from 1:3000 to 1:11000. The major morbidity rate is about 5.3:1000. These figures are about 3 – 9 times greater than the rate for the same procedure under GA. In the 18 month period prior to the production of the local sedation guidelines, there were 14 sedation related deaths reported in SA. Other studies show a similar picture. Airway complications occur in 0.7% of cardiology procedures performed under sedation. In a review of ER sedation, 1% of patients developed major cardio-respiratory complications (and 2.3% of children!). In the same study, a rate of failed sedation of 20% was noted. The authors speculated that acceptance of a higher rate of failed sedation may result in a further decline in the "already acceptable" rate of major complications! How would one obtain informed consent against this scenario? The vast majority of sedation-related morbidity and mortality relates to hypoventilation, airway obstruction and hypoxia (often unrecognised). Is it merely an issue of toxic sedation and safe GA or are other factors at play? There are numerous reasons for these safety observations:

- The use of drug combinations with synergistic effects, producing airway or cardio-respiratory problems
- Overdosing in an attempt to ablate patient responses
- Impatience, leading to excessive dosing
- Drug dosing errors, particularly related to incorrect dilution, especially in the very young and the elderly
- Variable patient responses, especially in the very young, the elderly and the infirm
- Inadequate staff numbers and /or training. SINGLE OPERATOR SEDATION
- Inadequate monitoring
- Inadequate facilities for dealing with emergencies
- PRACTISING UNCONTROLLED ANAESTHESIA!

Not all complications are related to over-sedation although it accounts for the bulk of mortality. Indeed, inadequate sedation, with the attendant cardiovascular (CVS) stress and potential for injury, aspiration and failed procedures, accounts for approximately 54% of all sedation-related morbidity. The SASA sedation guidelines (adult and paediatric) were drafted in an attempt to produce standards of care that would not allow any of these dangerous situations to occur.

As mentioned previously, conscious sedation is easier said than done. The patient can move easily from a level of conscious sedation to deeper levels of sedation and even obtundation.

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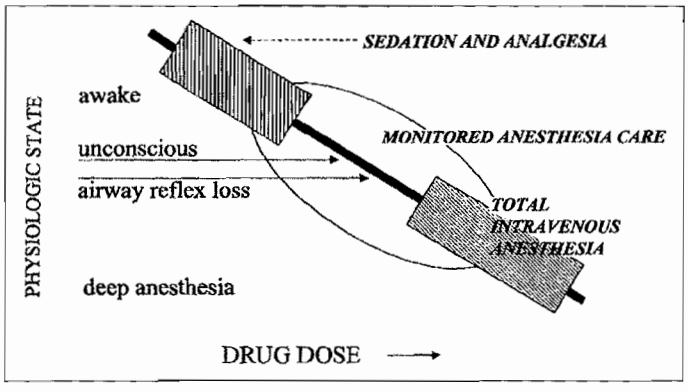
There is no generic approach to every patient for every procedure in every environment. This editorial highlights the following issues:

- Do we know what sedation is and how it works?
- Is it what we (and our patients and surgeons) really want?
- What to do for failed sedation?
- Do we have the ideal agent? Is any agent a panacea?
- What is the best technique for sedation?
- How easy / useful is it to monitor?
- Problem patients – the very young; the elderly; the obese and the infirm
- Sedation outside the theatre or procedure room.

Do we know what sedation is?

The classification of sedation contained in the SASA and ASA guidelines, whilst useful, is impractical. It is unusual for any patient to remain at one level of sedation for the entire duration of a procedure. It may, in fact, be undesirable as the stimulus intensity frequently fluctuates. It also fails to emphasise the analgesic component of sedation. Other terms have therefore replaced these rigid categories and reflect the continuum from anxiolysis to general anaesthesia as well as the importance of the analgesic component. Sedation is perhaps best-termed "sedation-analgesia" or "monitored anaesthesia care" (MAC). These terms allow for the imprecision of sedation but at the same time, demand a practitioner with sufficient skill to deal with the entire continuum of MAC and guidelines identical to those in place for the administration of GA. The spectrum of IV sedation is reflected in the following diagram:



Whilst many sedationists claim to be using conscious sedation, an examination of their actual practice produces the inevitable conclusion that they are, in fact, practising at least deep sedation or even general anaesthesia. Conscious sedation does not ablate all patient responses to all stimuli in all procedures. Likewise, it would require exceptional luck to administer a combination of midazolam, opioid and propofol and maintain a state of mere conscious sedation. There is no problem with moving from a state of conscious sedation to deep sedation or even anaesthesia, provided the sedationist has adequate skills, experience, monitoring and facilities to deal with these.

In a local survey In South Africa in 2001, Dr Robert Raw polled local sedation practice, which demonstrated some interesting facts. Virtually all anaesthesia providers and gastro-enterologists had heard of conscious sedation. 85% of surgeons were also aware of it. Most knew that conscious sedation differed from deep sedation, but only in the anaesthetic group did > 50% know in what way. More than 50% of gastro-enterologists and surgeons were doing their own sedation, usually without supplemental oxygen. About half of these unquestionably practiced deep sedation, the majority without oxygen. Only 50 – 60% of gastro-enterologists always used monitors and oxygen supplementation and 20% never used them. More than a third of single operator-sedationists used the combination of midazolam and an opioid and added propofol for breakthrough discomfort.

These findings raise substantial safety concerns and make the mortality data quite understandable. The importance of practice guidelines and adherence to such guidelines is patently obvious, as is the fact that these require periodic updating.

Is conscious sedation what we want?

There are wide indications for conscious sedation, where it is an optimal approach. These include procedures performed under fully functional loco-regional anaesthesia, lesser degrees of eye surgery and painless diagnostic and therapeutic (DXT) radiological procedures – particularly where co-operation, e.g. breath-holding is required. The huge advantage is the physiological stability and the maintenance of airway patency and control. There are, however, circumstances better suited to deep sedation or general anaesthesia, e.g. procedures with substantially fluctuating levels of stimulus (D&C); procedures where patient resistance may reduce the success of the procedure (endoscopy, reduction of dislocations) and procedures, even painless ones, on pre-adolescent children and patients with cognitive impairment.

The preferred technique, given that it can be employed safely, depends on the surgical procedure, the patient's health and the preference of the patient and operator. In a humane health system, patient preference must always be given priority unless his / her safety is thereby compromised. An example is GIT endoscopy. There is no question that the procedure can be performed awake, merely with topical anaesthesia of the pharynx. This technique is, however, unacceptable to the majority (>80%) of patients and operators. Conscious sedation is regarded as acceptable by 80% of patients and 1/3 of endoscopists. Deep sedation has virtually complete acceptability to both groups. The concern for endoscopists with conscious sedation and endoscopy, particularly colonoscopy, is that patient resistance during insufflation and advancement of the scope reduces the field of vision and results in a 15% reduction in pathology pick up rates, compared with deep sedation and GA. At the same time, deep sedation permits a 55% reduction in procedure time – a time saving that is advantageous for all, and generally compensates for the cost of an anaesthetic presence. The value of the increased safety offered by an appropriately skilled sedationist is, in the words of the MasterCard advert, "priceless."

What to do with failed sedation?

It is in the nature of patients, procedures, and operators, that a proportion of conscious sedation will fail. An uncooperative, combative patient may be the result of inadequate or excessive sedation, or the choice of a sub-optimal sedative approach for a stimulating procedure. The usual approach is to deepen sedation or add agents and, while this may be appropriate in the healthy young patient who requires a higher dose, it may be fatal in patients manifesting hypoxic or hypercarbic confusion from overdose. Where such a patient appears to settle and permit the single operator to continue, this may be because an obtunded, pre-mortem condition has been produced.

The question with failed sedation is whether to:

- Persist and risk patient dissatisfaction or injury and failure of the procedure
- Deepen the sedation and complete the procedure and risk patient morbidity or death
- Call in an dedicated sedationist and proceed with the procedure
- Abandon the procedure and reverse the drugs; reschedule with an anaesthetist to perform sedation.

There really is only one correct answer, namely the final option. The first two are clearly inappropriately risky for patient and practitioner. The third option, whilst popular with the operators, is a minefield for the co-opted anaesthetist. He or she enters the fray (and it is often just that) without knowledge of underlying patient disease status and with minimal tools at his or her disposal to assess whether the patient is under or over-sedated, having not observed the course of the sedation up to that point. It is thus nigh on impossible to assess whether to increase sedation or convert to a GA with intubation. In addition, it is not possible to assess whether the patient has sustained cerebral or other morbidity prior to the call for help. This could lead to medico-legal consequences.

Do we have the ideal agent?

As mentioned, virtually any CNS depressant drug by any route can produce conscious sedation when administered skilfully and in appropriate doses. The range of oral agents includes benzodiazepines, phenothiazines, butyrophenones, ketamine, anti-histamines and chloral hydrate. All are subject to the vagaries of absorption; slow onset; prolonged duration and individual variation in response. Inhalational conscious sedation with N_2O is widely practiced in dental practice and sevoflurane inhalational sedation has been described in eye surgery. Rectal and trans-nasal routes have also been employed for barbiturates, and opioids and benzodiazepines respectively. All of these approaches have been used with success in some patients and circumstances. However, the intravenous (IV) route provides the ideal one in terms of drug onset time and titratability. The ideal drugs would be rapid acting (short distribution half- life), rapidly eliminated, have as wide as possible a therapeutic window and minimal inter-patient variation. Availability of a pharmacological antidote is also an asset.

The drugs in current use that most closely comply with these criteria are midazolam, propofol and the short and medium acting opioids in the fenta class. Dexmedetomidine may well be added to this list in due time and is already registered for ICU sedation (and is a unique type of truly conscious sedation at most doses) after cardiac surgery. The profiles of these drugs are tabulated below.

	Midazolam	*Propofol*	*Fentas*	*Dexmedetomidine*
Onset (min)	3	1 – 2.5	3 - 5	20
Clinical duration	1 - 2 hours	15 – 30 min	< 2 hours	2 hours
Amnesia	Yes	Incomplete	No	Unpredictable
Analgesia	No	No	Yes	Fair
Safety (therapeutic index)	Intermediate	Narrow	Narrow	Intermediate
CVS depression	+	+++	+	++
Respiratory depression	+	+++	+++	-
Antidote	Yes	No	Yes	No
Suitability for conscious sedation	+++	++	+	+++
Depth of sedation	++	+++	+(+)	++
Cost	$	$$	$ - $$$	$$$

Midazolam and dexmedetomidine, as single agents are most likely to produce true conscious sedation. Addition of the other agents or their use as the primary sedatives is likely to yield deep sedation or anaesthesia. It is impossible to prescribe a generic approach to sedation. However, the agents and combinations, are available for every eventuality (and, indeed, every conceivable cocktail has appeared in the literature). It is their intelligent combination, use and monitoring that will yield a successful sedation-analgesia. As mentioned previously, each procedure, patient and operator demands an unique approach and attempts to impose a single solution in every case will lead quickly to the conclusion that sedation does not work!

What is the best technique for sedation?

There are several routes for administration of sedation and doses, combinations and timing of agents must be adjusted accordingly. Confining ourselves to IV sedation, however, several options exist, each with its own pros and cons and protagonists. Whichever is chosen, MAC remains more labour intensive and hands-on than most types of general anaesthesia. This is because of the ease and rapidity of transition to lighter and deeper levels of sedation, and consequent upon the imprecision of the available monitors. Essentially the options are:

1. intermittent physician / nurse controlled bolus technique following an initial LD
2. continuous infusion technique following a loading bolus or infusion
3. target controlled sedation (TCI)
4. patient controlled sedation (PCS)
5. combinations of the above.

An intermittent bolus technique is probably the most frequently employed, particularly in brief procedures requiring no more than a few boluses. Boluses are generally administered based on patient responses and / or changes in the intensity of the procedure. With prolonged surgery, this technique can become excessively tedious and labour intensive. This is not an option with dexmedetomidine because of the excessive haemodynamic effects of clinically effective boluses. Typical subsequent boluses after initial LDs are propofol 0.3 mg/kg, midazolam 0.015 mg/kg, fentanyl 0.4 µg/kg and alfentanil 3 µg/kg. Drugs with shorter durations of clinical effect, e.g. propofol and remifentanil, are better suited to multiple bolus techniques because of a lesser potential for accumulation and delayed recovery. In a study using capnometry to monitor respiratory function, it was shown that 1/3 of anaesthesiologist-administered doses given when the practitioner was blinded to the results, were given during periods of respiratory depression or partial airway obstruction. It appears that dangerous over-sedation is distinctly possible, even with this type of reactive technique.

Continuous infusions are applicable to virtually all commonly used agents. They are particularly indicated where drug boluses are associated with considerable adverse effects e.g. dexmedetomidine and propofol (CVS depression) and remifentanil and other fentas (respiratory depression and N&V). They are more user friendly than intermittent boluses in long surgical procedures. All agents except dexmedetomidine require a gradual or step-wise decline in infusion rate with time to avoid drug accumulation. Infusion

rates must, of course, be adjusted in response to clinically apparent over or under-sedation or in expectation of substantial changes in stimulus intensity. Failure to do this is likely to lead to over-sedation, particularly with long painless procedures.

TCI employs a variety of algorithms and assumptions to construct a variable-rate infusion, designed to produce a constant plasma concentration of sedative agent. It is a more elegant technique than continuous infusion but will only produce a perfect result in the prototype average patient. Some adjustment may still be required based on clinical or neuro-physiological observation. Using propofol by TCI, target plasma levels have been defined at which the typical patient will manifest different levels of sedation:

- lethargic response to spoken name @ 1.3 μg/ml
- response only to loud & repeated name calling @ 1.7 μg/ml
- response only to physical stimuli (prodding / shaking) @ 2 μg/ml
- response only to painful stimuli @ 2.4 μg/ml
- no response @ 2.8 μg/ml.

These figures apply only to propofol for single agent sedation and can be reduced by 25 – 75% when it is part of combination therapy. They also demonstrate the narrow therapeutic window of this agent. A recent study of TCI propofol sedation revealed a 22% rate of over-sedation despite the more scientific pedigree of this technique.

Patient controlled sedation is really a variant of the intermittent bolus technique. Similar doses are programmed as boluses with a 3 – 5 minute lock out period. This technique produces slightly higher patient satisfaction; slightly lower operator satisfaction; 10 – 30% lower drug usage and less potential for over-sedation than physician controlled boluses. It has been used in combination with low dose continuous infusions or TCI (in effect, a kind of background infusion), with no increase in patient satisfaction and a considerable increase in the rate of over-sedation (22% rate of desaturation).

Many clinics operate a differential cost structure for sedation as compared with GA, making sedation a considerably cheaper option. How, precisely, they are able to define the transition from sedation to GA, is unclear. It is not surprising that there is a steadily increasing call for sedation from our surgical colleagues. The cost of disposables and the acquisition cost of the pumps must, however, be considered in continuous infusions, TCI and PCS.

Just as with the drugs available for sedation, there are a sufficient variety of techniques of administration to deal with any sedation challenge. Every patient, procedure and operator will require an individualised approach. Despite developments in administration methods, MAC remains harder work than administering GA!

How easy / useful is monitoring?

There are two basic purposes of monitoring sedated patients:

1. to determine and adjust the level of sedation and analgesia
2. to pre-empt and avoid complications related to over-sedation.

Sedation is a more difficult entity to achieve than GA. Small changes in plasma drug concentrations produce substantial changes in level of sedation. There is real art involved in coaxing a patient into precisely the desired level of sedation! GA merely represents an overdose of sedation in a protected, supported and fully monitored patient. It is extraordinary that untrained personnel will readily take on MAC and yet shy away from the far easier option of GA. There are a host of clinical scoring systems designed to assess the level of sedation analgesia achieved. The results correlate poorly with general vital signs, e.g. BP, heart rate and end tidal CO_2, but somewhat better with neuro-physiological monitors like BIS. Two of the more frequently employed systems are the Ramsay sedation scale and the Observer's Assessment of Alertness / Sedation (OAA/S).

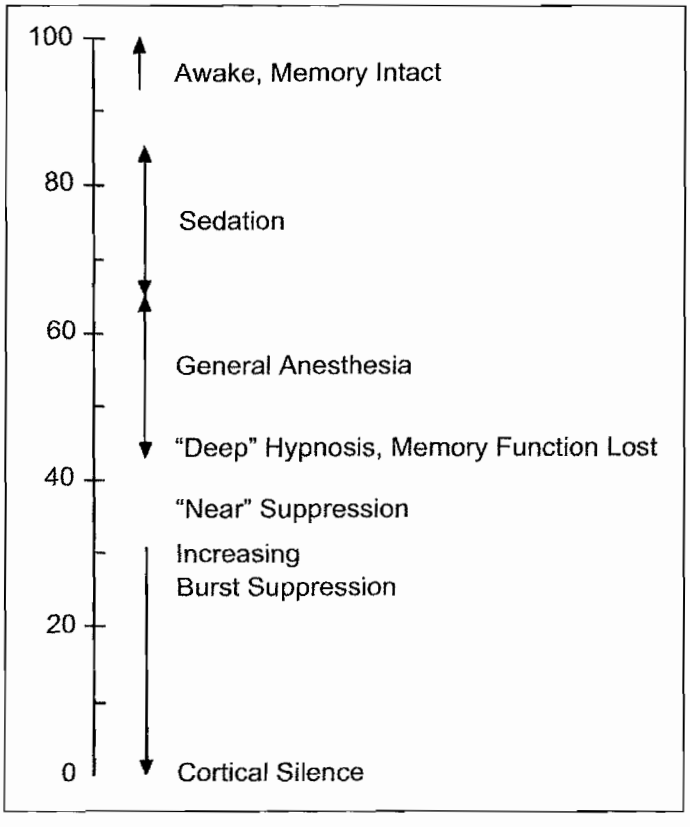
The Ramsay Scale	
Patient awake, anxious, agitated or restless	1
Patient awake, cooperative, orientated and tranquil	2
Patient drowsy with response to commands	3
Patient asleep, brisk response to glabella tap or loud auditory stimulus	4
Patient asleep, sluggish response to stimulus	5
No response to firm nail-bed pressure or other noxious stimuli	6

OAA/S is similar but has values from 1 to 5 only with 1 representing no response to physical stimulation and 5 representing a brisk response to calling the patient's name in a normal tone.

These clinical indices of sedation are adequate in most instances to allow titration of sedation to an appropriate level. The following must be borne in mind though:

- passage from one level to the next is generally abrupt rather than a gradual deepening or lightening unless infinitesimal titration techniques are employed
- there are tiny differences between the levels in terms of plasma concentrations of sedative drugs (except perhaps α2 agonists)
- respiratory depression and airway obstruction can occur with a very slight deepening of sedation

Numerous studies have been carried out in an attempt to correlate clinical sedation, hypnosis, amnesia and analgesia with neuro-physiological indices, e.g. BIS. The findings are daunting with respect to reproducibility; effects of individual agents and agent combinations; the level of surgical stimulus etc. The diagram below shows a generic approach to interpreting BIS readings as far as degree of CNS depression is concerned.



In general, BIS values correlate fairly well to the degree of sedation and scores of 65 – 85 imply adequate sedation. The desired BIS within this range will depend on the intensity of stimulus inherent in the particular procedure, e.g. for upper GI endoscopy, a BIS of 75 – 85 corresponds to a 96% probability of appropriate sedation and corresponds to a Ramsay score of 4 or an OAA/S of 3. Certain provisos exist for the use of BIS as a sedation monitor:

- the relation between BIS and degree of sedation / hypnosis is a fairly reliable one, however
- there is a difference of only 1 BIS unit between awake and lightly sedated and between airway maintenance and loss, i.e. the transition between planes in each patient is a very abrupt one
- the BIS – sedation relationship is most accurate with propofol; less so with midazolam, sevoflurane and dexmedetomidine; and the least accurate with ketamine
- there is no predictable relationship between BIS and analgesia
- the relationship between BIS and amnesia is a partial one but benzodiazepines have an amnestic component that is unrelated to degree of CNS depression. Midazolam produces equivalent amnesia at a BIS of 75 compared with that produced by propofol at a BIS of 60 – 65
- BIS only describes the likelihood of sedation / non-responsiveness in the preceding 15 – 30 seconds. It makes no predictions about what will occur when a stimulus is applied. A patient with a BIS of 75 will awake and be aware if a surgical incision is made in a non-anaesthetic field! However, this is unlikely with the passage of an endoscope in a topicalised pharynx.

The other major component of monitoring involves monitoring of the respiratory system. The vast majority of major and lethal complications of sedation have their origin in respiratory depression and / or airway obstruction. Whilst pulse oximetry is a standard of care – at least as far as all national guidelines are concerned – it is really only an indicator of some forms of hypoxia. Because of the buffering effect of oxygen in the FRC, desaturation may take some time to manifest in a patient with respiratory depression. Apnoea precedes desaturation by an average of 105 seconds in an oxygen-supplemented endoscopy patient. Unfortunately, the shape of the O_2-Hb dissociation curve means that once hypoventilation-related hypoxia manifests, it evolves rapidly into a critical event. This is bad enough in itself, but the inevitable co-existence of hypercarbia with hypoxia in cases of respiratory depression, sets the scene for disaster via cardiac depression; predisposition to arrhythmias and a hyperadrenergic state. The heart is primed for hypoxic arrest and ventricular fibrillation. Since there is no buffer for CO^2, levels rise from the onset of respiratory depression or airway obstruction. Successful monitoring for evolving hypercarbia would therefore serve as an excellent early warning for potential airway and hypoxic complications.

The options for monitoring airway, ventilation and impending hypoxia are:

- Clinical observation that rarely detects the problem before it manifests with desaturation. About 1/3 of sedative doses are, in fact, administered during periods of significant respiratory depression / airway obstruction.
- Oximetry is, by its nature, an insensitive and late monitor. It may be more rapidly responsive and detect earlier respiratory depression in patients not receiving oxygen supplementation. Unfortunately, it remains the first indicator of respiratory depression / obstruction in the vast majority of sedation-related adverse events.
- Transcutaneous capnometry produces an accurate real time indication of arterial CO_2 tension. It is substantially more accurate than clinical observation or oximetry for the early detection of respiratory depression. It remains, however, expensive and fraught with technical limitations and has remained peripheral to the clinical mainstream.
- Capnography is a standard of care in GA. Rapid sidestream analysers can produce fairly accurate waveforms and $ETCO_2$ values when the sampling point is in close proximity to the airway despite potential for dilution with supplementary oxygen and difficulties with positioning. Even with upper GI endoscopy, 57% of all cases of disordered respiration are detected. Accuracy increases when procedures are remote from the airway. At present, it is the best available monitor of respiratory adequacy and early warning system for hypoxia. It adds little to the cost of the procedure and cost-benefit ratio is not in question.

Problem patients - the young

As confirmed by the SASA guidelines, pre-adolescent children are almost never candidates for conscious sedation and rather require deep sedation or general anaesthesia – even for painless procedures. This despite a plethora of suitable drugs and novel administration routes (oral, transnasal, sublingual, rectal). Drugs and doses are available as "Guidelines for sedation – analgesia in children" at www.sasaweb.com. Since they tend to receive deep sedation or GA, they are never candidates for single operator procedures and require a particularly skilled and qualified sedationist to be present at all times. They are, like all sedation recipients, to be prepared in terms of investigation and fasting, as they would be for a GA. As with adults, the combination of agents frequently leads to an uncontrolled level of sedation, usually over-sedation. Deviation from the guidelines poses enormous threats to the safety of the child. The literature, prior to the development of guidelines or where these are disregarded, abounds with case reports of deaths in children related mostly to inadequately supervised deep sedation outside the operating theatre (90% of cases). 78% of deaths were from respiratory causes. From a practical point of view, the transnasal, sublingual and, particularly, IV routes give the most rapid onset and "titratability". IV access can be achieved after skin preparation with an EMLA patch.

There are several problems unique to children that further compound the difficulty of delivering sedation:

- A wide dose range means the potential need for follow up doses, which is difficult using routes other than IV
- Higher incidence of dysphoric reactions to sedation, necessitating conversion to GA
- Many procedures are carried out on children with neurological delays, neurological problems, hyperactivity and failure to co-operate. They are never candidates for conscious sedation

- Many sedation procedures are carried out in awkward environments like the radiology suite where a failed sedation risks injury to the child and costly repetition of investigations
- Children frequently have a series of procedures in close proximity to one another. Tachyphylaxis is a real problem with most agents and bedevils attempts to achieve sedation other than with IV titrations
- Immobility is required for most radiological procedures and the majority of sedated children wriggle
- The time from onset of respiratory depression and airway obstruction to cardio-respiratory arrest in a child is inordinately short because of their reduced FRC and increased oxygen consumption.

Older, cooperative children are better candidates for conscious sedation for painless procedures like radiology and radiotherapy. They often undergo numerous procedures in a short period and soon come to welcome IV sedation over inhalational induction. Case reports suggest that the use of dexmedetomidine infusions (1 µg/kg loading dose over 20 minutes, followed by 0.2 – 0.7 µg/kg/hr) is particularly useful in producing conscious sedation with features of natural sleep; maintenance of the airway and a lack of tachyphylaxis.

But the bottom line is that, at present, successful sedation in children is better termed deep sedation or anaesthesia. To quote Epstein from the 2003 Rovenstine lecture to the ASA *".. not surprisingly, in current practice, nearly all sedation is called conscious sedation, regardless of the depth of the sedation produced. Can painful procedures or non-painful procedures requiring complete immobility (e.g. diagnostic imaging or radiation therapy) be realistically performed in a child who is consciously sedated? We believe the answer is no. The myth of achievability of a state of conscious sedation in which paediatric patients are simultaneously responsive to voice stimulus while remaining immobile in the face of pain is just that – a myth." Cravero and Blike, in their review of paediatric sedation, state that ".. many of the regimens used in emergency departments and ICUs around the country are evolving into recipes for brief general anaesthesia rather than sedation."* This is no problem if they are treated as such.

Problem patients - the elderly

Like children, the elderly pose challenges to the sedationist. They manifest increased sensitivity to sedation and more toxicity and complications. These include CVS toxicity; respiratory and airway impairment; fluid and electrolyte problems and post-operative cognitive dysfunction. Restlessness usually implies excessive depth of sedation with or without hypoxia and hypercarbia. But they are tolerant patients and ideally suited for procedural conscious sedation. The sedationist needs to consider several factors when planning conscious sedation for the elderly:

- Co-morbid conditions
- Chronic medications. Cardiac medications generally increase sensitivity to sedation. CNS acting drugs may reduce it.
- Progressive decline in organ function
- Altered drug kinetics and dynamics.

Some of the relevant organ function abnormalities include:

- CNS – loss of neurones; slowed conduction; susceptibility to sedatives and anti-cholinergics
- CVS – decreased sympathetic compensation and reduced cardiac function
- Respiratory system – changes in lung mechanics leading to lower FRC; airway closure; shunt and hypoxia; increased sensitivity of respiratory control centres to drugs
- Renal – progressive fall in glomerular filtration raten (GFR) without an alteration in U&E until it exceeds 60%
- GIT – reduced hepatic drug clearance and slowed gastric emptying
- Hypothyroidism in 13% of patients (most undiagnosed).

Amongst the pharmacological changes are:

- Slower onset of drugs because of reduced cardiac output and slower circulation
- Higher peak drug concentrations due to reduced cardiac output and reduced first pass elimination
- Prolongation of elimination time (increase Vd of fat soluble drugs and reduced clearance)
- Reduced Vd of water soluble drugs with increased propensity to toxicity
- Greater inter-patient variation in responses – up to 4- fold
- Prolongation of physiological effects of drugs e.g. CVS depression from propofol

The result of the differences in the physiology of the elderly is that we should alter our technique of sedation as follows:

- Drug doses must be reduced by 25 – 75%
  - especially in the over 75s'
  - 50% reduction for propofol, dexmedetomidine and opioids
  - 75% reduction in midazolam
- Top ups should be less frequent and injections slower
- Wait longer for peak effect of drug
- Increased vigilance and monitoring
- Supplemental oxygen mandatory. Airway support often required.

Despite these caveats, the elderly are particularly rewarding patients for procedural sedation. The practice of avoiding admission and performing minor procedures on an outpatient basis has had a considerable beneficial effect on the incidence of post-operative cognitive dysfunction in this group of patients.

Problem patients - other

Patients with morbid obesity and major organ system dysfunction also often require procedures of magnitude suitable for conscious sedation. It is an acceptable and safe technique in many circumstances. Many of the caveats applicable to the elderly are equally relevant here. The following rules, however, apply to conscious sedation in these patients:

1. Even pure conscious sedation requires the presence of a skilled and dedicated sedationist
2. The impact of the patient's physiological impairment on the kinetics of the drugs and of the drugs on the patient's physiology must be considered in advance and a sedation plan individualised

3. The risks of aspiration, and respiratory and cardiovascular depression are increased and mandate standards as befit general anaesthesia (preparation, environment, monitoring and staff)
4. Supplemental oxygen is mandatory
5. Acceptable options are true conscious sedation (midazolam or dexmedetomidine alone), RA +/- conscious sedation, and GA. Deep sedation carries all the risks of GA without the benefit of respiratory control
6. Post-operative care should be meticulous and patients must fulfil all discharge criteria – cognitive, physiological and comfort -wise before discharge. Those who have received pharmacological antagonists must be observed for at least 2 hours prior to discharge.

Sedation outside the operating theatre

More sedation procedures are done outside the theatre environment than within it. Some of these environments pose significant challenges in so far as quality of facilities, access to patients and quality of monitoring is concerned. There is no room to compromise on any of these issues. If the patient is not fit and the procedure not suitable for pure conscious sedation, then the facility must be upgraded to the prescribed standards, or the procedure must be performed in the operating theatre. As mentioned previously, many of these more closely resemble GA than conscious sedation. The dangers of excessive sedation in these environments are well chronicled by the medical protection societies. The recurring theme with non-anaesthetist sedation is under-estimation of the degree of sedation and failure to, or a delay in instituting the monitoring and resuscitative efforts required. Procedural sedation outside the OR is the subject of ongoing turf wars between anaesthesia personnel and other interested parties. Anaesthesiologists are accused of imposing guidelines to force their inclusion in all of these procedures. This is not necessarily the case, but in the words (once again) of Epstein *"many low-incident, high-risk procedures appear routine, as we perform hundreds of these procedures annually ... when everything is all right, does this mean nothing can ever go wrong? There's a cost for maintaining safe practice. It's called knowledge and experience!"* The sedationist does not have to be an anaesthesiologist, but must have equal skill for he or she carries equal responsibility.

Please refer to guidelines for sedation in adults and children which are available at www.sasaweb.com

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