



PAEDIATRIC PROCEDURAL SEDATION AND ANALGESIA (for Non-anaesthetists)



INTRODUCTION

- Painful procedures are defined as medical procedures that cause short – lived, acute pain
- Procedural pain is one of the most common causes of pain in hospitalized children
- Many children will also experience anxiety and distress before a procedure commonly referred to as anticipatory anxiety
- Pain, anxiety and distress experienced by children during painful procedures can be reduced by using both pharmacological (including sedatives) and non-pharmacological strategies performed before, during and after a procedure



DEFINITIONS

- **Procedural sedation (PS)** : delivery of sedating or dissociative medications to produce a state of depressed consciousness
- **Analgesia** : a loss of sensation to painful stimuli and is defined as having no effect on sensorium (most analgesics however tend to impair a patient's cognition as a side-effect)
- **Procedural sedation and analgesia (PSA)** :
 - provides both sedation and analgesia
 - allows patients to maintain continuous and independent ventilation without a loss of protective reflexes
 - provides effective pain relief in procedures causing severe pain or in high anxiety levels



PROCEDURAL SEDATION AND ANALGESIA (PSA):

The Goals

- 1 Guard the patient's safety and welfare
- 2 Minimise physical discomfort and pain
- 3 Control anxiety, minimise psychological trauma, and maximize the potential for amnesia
- 4 Control behaviour and/or movement to allow the safe completion of the procedure
- 5 Return the patient to a state in which safe discharge from medical supervision is possible

PS OR PSA – WHEN?

- Painless procedures require only sedation without analgesia

Procedure categories	Diagnostic Imaging	Painful Diagnostic	Painful Therapeutic
Sedation/analgesia requirements	Sedation only	Sedation + analgesia	Sedation + analgesia
Examples	<ul style="list-style-type: none"> • CT scan • MRI • Echocardiogram • Electroencephalogram • Hearing tests 	<ul style="list-style-type: none"> • Bone marrow aspiration • Liver, Renal, Skin biopsy • Lumbar puncture • US-guided aspiration, drainage, biopsy and PTC • Sexual assault examination with forensic evidence collection 	<ul style="list-style-type: none"> • Abscess incision and drainage • Chest tube insertion • Complex laceration repair • Foreign body removal • Fracture/ dislocation reduction

INDICATIONS FOR PSA

1. Any painful or unpleasant procedure, even seemingly minor procedures may be traumatic for children
2. Patient immobility is required for a long period of time during procedure
3. Special groups of patients
 - paediatric patient – who may be traumatized by the procedure
 - patient with cognitive impairment - who cannot cooperate



Indications For Various Depths Of Sedation

Mild

- For brief minor procedures to limit motion: Diagnostic imaging like CT scan, ECHO, EEG, Ultrasound

Moderate

- For motion control: Diagnostic imaging
- For painful procedures: STO, Lumbar puncture

Deep

- For complete motion control: MRI
- For painful procedures: Bone marrow aspiration, burn dressings

DEPTH OF SEDATION – A Continuum

Procedure categories	Minimal Sedation (Anxiolysis)	Moderate Sedation/ Analgesia (Conscious Sedation)	Deep Sedation/ Analgesia	General Sedation/ Analgesia
Responsiveness	Normal response to verbal stimulation	Purposeful response to verbal or tactile stimulation	Purposeful response after repeated or painful stimulation	Unarousable 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

APPROACH TO PROCEDURAL PAIN MANAGEMENT

ANTICIPATE pain and distress

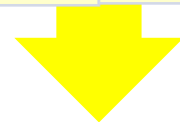
Decrease anxiety before procedures



PREPARE child and caregiver

Provide a sense of mastery of stressful conditions, promote coping behaviours

Encourage active and positive involvement of parents



Combination of pain management strategies

Provide significant pain control

Create a pleasant experience

PERFORMING PSA IN CHILDREN

BEFORE

Preprocedural Assessment

- Select appropriate patient
- Identify risk factors
- Informed consent

Pre-procedural preparation

- Discuss and plan the painful procedure
- Prepare equipment & environment
- Build rapport & gain trust
- Assess procedural experience
- Prepare the child
- Prepare the parents/ caregiver
- Prepare staff

Have a plan B!

DURING

- Adequate personnel
- Close monitoring
- Resuscitation if needed
- Multimodal analgesia
- Troubleshooting

AFTER

- Post-procedural assessment
- Reevaluate procedure
- Reinforce coping behaviour
- Plan the next procedure
- Discharge criteria



BEFORE THE PROCEDURE

1. Select appropriate patients

- ASA I and II - appropriate for Procedural Sedation and Analgesia (PSA)
- ASA III and IV - discuss with an anaesthetist who is familiar with sedation

Class	Description	Examples	Sedation Suitability
I	A normal healthy patient	Unremarkable medical history	Excellent
II	A patient with mild systemic disease (no functional limitation)	Mild asthma, controlled seizure, anaemia, controlled diabetes	Generally good
III	A patient with severe systemic disease (definite functional limitation)	Moderate to severe asthma, poorly controlled seizure, pneumonia	Intermediate to poor; may consider benefits relative to risks
IV	A patient with severe systemic disease that is a constant threat to life	Sepsis, advanced degree of pulmonary, cardiac, renal or hepatic insufficiency	Poor benefits Risks outweigh benefits
V	A moribund patient who is not expected to survive without operation	Severe trauma	Extremely poor

American Society of Anesthesiologists (ASA) Physical Status Classification



Exclusion Criteria for PSA

- Difficult airway syndromes- abnormal facies, mouth, dentition or neck
- Sleep apnoea, stridor, airway obstruction
- Tracheal abnormalities
- Severe cardiorespiratory disease
- Severe obesity
- Raised intracranial pressure
- Severe neurological impairment and/or bulbar dysfunction

** refer to anaesthetists for assessment & sedation

Difficult Airways in Syndromes and Sequences



Down Syndrome



Pierre Robin



Treacher Collins



Klippel-Feil

2. Review the patient

- Identify risk factors
- Anticipate and reduce the sedation adverse events
- Ensure to check for difficult airway especially in syndromic children
- If pre-assessment was done at a different sitting or by a different person
 - Re-evaluate
 - Selection of patient & sedation criteria
 - Relevant clinical (past medical/surgical history, recent illnesses-i.e. URTI, allergies) and drug history/current medications
 - Volume status - dehydration may potentiate hypotensive effect of sedative/analgesia agents
 - Check the consent form
 - Clarify all doubts: about the procedure and pain management plan

Use PSA with caution in these groups of patients

Condition	Reasons for caution
1. Major Illnesses	
<ul style="list-style-type: none">Asthma	Histamine release with morphine Risk of bronchospasm in poorly controlled asthma
<ul style="list-style-type: none">Cardiac disease	Effects of certain sedatives on the haemodynamic status
<ul style="list-style-type: none">Liver and Renal impairment	Increased toxicity or Decreased clearance of drugs
<ul style="list-style-type: none">Prematurity	Increased risk of apnoea Suggest delaying sedation to > 60 weeks post-conception
2. Prior drug use/abuse	
<ul style="list-style-type: none">Prior narcotics or benzodiazepines use	May develop tolerance to standard doses

3. Pre-procedural preparation

- Explanation and Consent
 - Risks, benefits and potential side effect
 - Informed consent for both procedure and PSA
- Patient's preparation
 - Provide written instructions for pre-procedural preparation (if non-emergency)
- Fasting protocol
 - IV access is compulsory
- Equipment
 - SOAPME (**S**uction, **O**xygen, **A**irway, **P**harmacy, **M**onitors, **E**xtra equipment)
- Availability of trained personnel

Solid or Liquid Food	Duration of Fast
Clear liquids	2 hours
Breast milk	4 hours
Infant formula	6 hours
Solids	6 to 8 hours

**Pre-procedure Fasting Guidelines
According to the American Academy
of Paediatrics**

Monitoring and resuscitation equipment mandatory

- Procedural sedation is best conducted in a monitored environment
- All sedated patients **MUST** be monitored for BP, PR, RR, SpO₂ and ECG
- Resuscitation trolley and airway equipment available
- O₂ supply must be checked, ready and nearby



4. Prepare the Child

- Provide honest information and educate about the procedure in a developmentally appropriate language
- Explore together options to minimise pain and distress:
 - what you can do? (e.g. EMLA, hypnosis)
 - what the child can do? (e.g. favourite toy for comfort, positions of comfort, having a parent around)
 - what would the child like?
- Address their fears and concerns



5. Prepare the Parent/ caregiver

- Parental behaviours may affect their child's level of distress, thus encourage 'coping promoting behaviours'
- Provide adequate information on the procedure and what to expect
- Allowed to acknowledge a child's pain but avoid using terms/words which are found not to be helpful
- Identify appropriate and assign parents' role:
 - Holding the child in a comfort position
 - Helping in active distractions e.g. blowing bubbles, reading a story book
 - Helping in breathing exercises

How can parents help? - Distraction

- Distraction is one of the non-pharmacological methods which is particularly useful for managing procedural pain
- Distraction can be performed by anyone including parents and does not require training
- Various types of distractors can be used



Toys



Electronic gadgets



Story books



Movies/cartoon



Blowing spinners



Blowing bubbles



Stress balls



Hidden pictures

Examples of distractors

Comfort Positioning - “Hugging hold”

- All children should NOT be restrained during painful procedures
- They should be placed in positions of comfort which is also sometimes known as ‘hugging hold’.



Back to front bear hug



Front to front bear hug



Frog hold



Side support hold

Provide comfort, security and sense of control & close physical contact for the child
Adults provide positive assistance, not negative restraint

6. Prepare the Healthcare Team

- Know the procedure specifics:
 - What will be done?
 - How long it is anticipated to take?
 - Severity of pain anticipated?
- Prepare drugs, check dose per body weight
- If sedation is expected, check monitoring equipment
- Appoint personnel to monitor and document vital signs
- Be able to handle any emergencies or complications which arise during the procedure
- Be in constant communication with child and caregiver



Personnel required for PSA

- Minimum personnel required for PSA is 3:
 1. One to perform the procedure
 2. One to administers PSA
 3. One nurse/assistant to prepare equipment, assists & monitor patient

PSA administrators should be competent in:

- a. Paediatric airway management and resuscitation
- b. Have knowledge and competency in PSA
 - Patient selection and preparation
 - Patient monitoring
 - Pharmacology of PSA drugs including its side effect
- c. Trained to recognise and manage the potential airway complications, resuscitation and all other potential complications of PSA

Nurses/Assisting PSA should be:

- a. Assist in airway management and resuscitation
- b. Assist in preparing the patient, medication and resuscitation equipment
- c. Handle monitoring and documentation



DURING THE PROCEDURE

1. Monitoring is crucial

- Ensure regular monitoring of BP, PR, RR, continuous SPO₂ , ECG monitor
- Document vital signs
- Assess depth of sedation before and post procedure
- If pain is not well controlled during the procedure, ask the health care provider performing the procedure to stop
- Evaluate the need for additional medication



2. Choosing the right drugs

- Choice of PSA drug/s depends on the complexity of procedure, patient factors and health care expertise
- Examples of drug combinations for PSA (refer local institutional guidelines) include:
 - Morphine+ midazolam (procedural burn pain)
 - Ketamine + midazolam/ fentanyl (painful procedures < 30 minutes)
 - Chloral hydrate (painless procedures < 30 minutes)
- Painful procedures require medications or a combination of medications that have BOTH analgesic and sedative effects i.e. midazolam alone for a painful procedure is inadequate as it does not have any analgesic properties

Existing PSA practices & safety issues

Combinations of chloral hydrate, benzodiazepines (e.g. midazolam), long-acting opioids (e.g. morphine) and antihistaminic (e.g. promethazine)

- have been traditionally used for many decades as a sedative and analgesic cocktail for paediatric patients in Malaysia
- however, this practice lacks pharmacological research
- various safety issues arose from this practice including:
 - airway obstruction
 - respiratory depression
 - cardiovascular collapse
 - secondary morbidity and mortality

Existing PSA practices & safety issues

- Reasons for safety issues with this combination of drugs:
 - i. Long-acting drugs
 - Morphine has peak effect in 10-15 min but duration of action is 2-4 hours thus has a delayed sedation effect even after procedure.
 - Morphine is no longer preferred for short painless/painful procedures.
 - ii. Overdosing
 - iii. Drug interaction (in particularly when 3 or more drugs were used)
 - iv. Unpredictability of the drug effect and duration of drug action

Ketamine

- A dissociative anaesthetic with a profound analgesic, amnesic, sedative and immobilisation effect
- Has little interference with respiration and airway reflexes, hence makes good sedative choice for short painful procedure

Contraindications

- True allergy although documented, is rare. Treat in accordance with usual management for allergy/anaphylaxis

Ketamine

Relative contraindications

Discuss with specialists experienced in procedural sedation if any of the following are present:

- **Infants <3 months (higher risk of airway complications)**
- Current significant respiratory illness, e.g. asthma, respiratory tract infection
- Known difficult airway, history of previous airway surgery or congenital anomaly
- Intraoral procedures or potential intraoral bleeding such as tongue lacerations and dental procedures
- Cardiovascular disease where increased HR and workload are contraindicated, e.g. ischaemic heart disease, cardiac failure, hypertension, Wolff-Parkinson-White syndrome
- Procedures that will stimulate the posterior pharynx
- Glaucoma or acute globe injury
- Porphyria
- Thyroid disease
- Bowel obstruction
- Psychosis
- Increased intracranial pressure
- Concurrent respiratory infection

Drugs used for procedural sedation and analgesia in children

Drug i8	Paediatric Dose	Comments
Midazolam	<ul style="list-style-type: none"> IV: 0.05 - 0.1 mg/kg IV 3 min before procedure; not to exceed a total cumulative dose of 0.4 mg/kg or 6mg (if used as sole agent) IM: 0.1-0.2 mg/kg IM 30-45 min before procedure PO: 0.25-0.5 mg/kg PO 30-45 min before procedure Intranasal: 0.2-0.6 mg/kg/dose inhaled intranasally 10 min before procedure 	<ul style="list-style-type: none"> Provides amnesia, mild anxiolysis, and sedation but NO analgesia For painful procedures, an analgesic agent (eg, ketamine, fentanyl) should be co-administered Reduce dose by 30-50% if combined with chloral hydrate or opioid analgesic (e.g. fentanyl); younger children (i.e. < 5 y) may require higher doses up to 0.6 mg/kg/dose Common adverse effects: Respiratory depression and apnoea, especially when combined with opioid medications (eg, fentanyl); paradoxical reactions including hyperactivity, aggressive behaviour, and inconsolable crying
Ketamine	<ul style="list-style-type: none"> IV: 0.5-1 mg/kg loading dose; 0.25-0.5 mg/kg IV q10-15min; administer slowly, rate not to exceed 0.5 mg/kg/min IM: 2-5 mg/kg/dose 	<ul style="list-style-type: none"> Provides excellent sedation and analgesia; elicits dissociative state; increases bronchial and salivary secretions; increases heart rate, blood pressure, and intracranial pressure Emergence hallucinations observed in older children (>15 years) and adults Pharmacologic effects NOT reversible

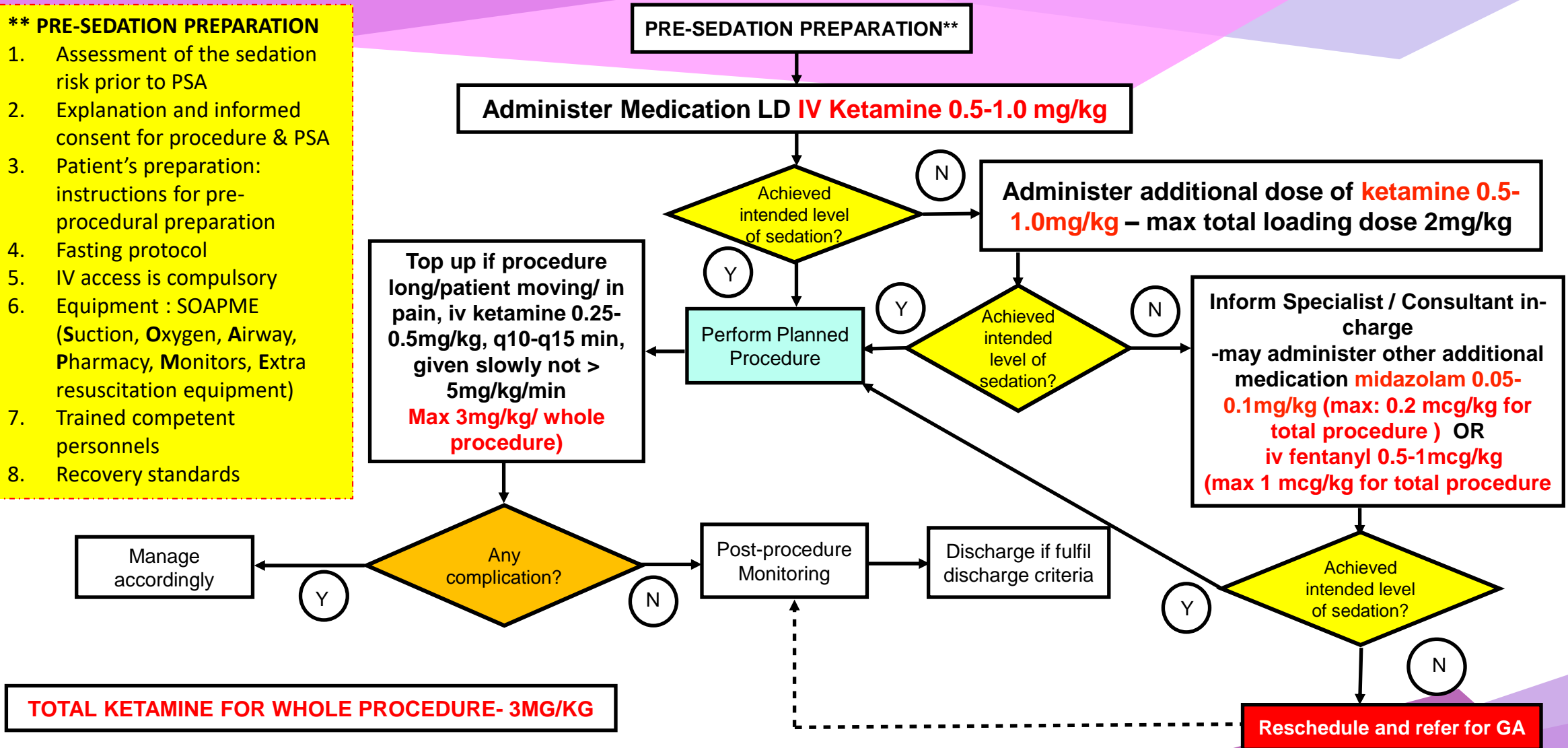
Drugs used for procedural sedation and analgesia in children

Drug	Paediatric Dose	Comments
Fentanyl	<ul style="list-style-type: none"> 0.5 - 1 mcg/kg/dose IV 	<ul style="list-style-type: none"> Provides analgesia for painful procedures; increased risk of respiratory depression when combined with sedatives (reduce sedative and fentanyl dose by 30-50% if used in combination) Chest wall rigidity associated with rapid IV push
Chloral hydrate	<ul style="list-style-type: none"> Neonates : 25 – 50 mg/kg/dose PO max once without repeat, administer 30 min before procedure Children : 50mg/kg/dose (max dose 1000mg) 30 – 45 minutes prior to procedure, may repeat after 30 minutes with 25 to 50mg/kg/dose; Max dose per procedure 100mg/kg or 2000mg/procedure (children) 	<ul style="list-style-type: none"> More effective in < 2 years old or 15kg Most successful if used for short painless procedure, no analgesic effect Unpredictable effect; paradoxical hyperactivity may occur; may cause nausea and vomiting; decrease dose if combined with opioid analgesic (e.g. fentanyl); deaths and permanent neurologic injury from respiratory compromise have been reported, particularly in those with risk factors (e.g. ASA class III, Leigh encephalopathy, tonsillar and adenoidal hypertrophy, obstructive sleep apnoea); active metabolite has prolonged half-life Renal or liver impairment – no dosage adjustment provided Contraindicated in patients with severe renal or liver impairment

PSA for PAINFUL PROCEDURE (<30 mins) in children >3 months

** PRE-SEDATION PREPARATION

1. Assessment of the sedation risk prior to PSA
2. Explanation and informed consent for procedure & PSA
3. Patient's preparation: instructions for pre-procedural preparation
4. Fasting protocol
5. IV access is compulsory
6. Equipment : SOAPME (Suction, Oxygen, Airway, Pharmacy, Monitors, Extra resuscitation equipment)
7. Trained competent personnels
8. Recovery standards



*Routine use of iv midazolam or iv atropine with iv ketamine is no longer indicated



The role of local anaesthetics in PSA

Local anaesthetics are adjuvant to PSA and should be implemented along with PSA whenever possible

EMLA: eutectic mixture of lidocaine + prilocaine



Apply EMLA on **intact site** for **45- 60 minutes** before any procedure done

LOCAL ANAESTHETIC INFILTRATION

Drug	Onset	Duration	Max dose (mg/kg) / (ml/kg)
Lignocaine 1% = 10mg /ml	2 min	15-60 min	4mg/kg (0.4ml/kg)
Lignocaine 2% =20mg /ml	2 min	15-60 min	4mg/kg (0.2ml/kg)
Bupivacaine (Marcain) 0.5% =5mg/ml	10-15 min	3 -12 hours	2mg/kg (0.4ml/kg)
Bupivacaine (Marcain) 0.5% =5mg/ml +adrenaline	10-15 min	4 -12 hours	2.5mg/kg (0.5ml/kg)

Assessment of pain and sedation during the PSA

Conscious level

Physiological status



- During the procedure, target pain score of < 4
 - If awake – FLACC, FACES or Numerical scale (MOH Pain Ruler)
 - If sedated – combination of FLACC and COMFORT-B

Pain score : FLACC

Category	Scoring		
	0	1	2
Face	No particular expression or smile	Occasional grimace or frown, withdrawn, disinterested	Frequent to constant quivering chin, clenched jaw
Legs	Normal position or relaxed	Uneasy, restless, tense	Kicking or legs drawn up
Activity	Lying quietly, normal position, moves easily	Squirming, shifting back and forth, tense	Arched, rigid or jerking
Cry	No cry (awake or sleep)	Moans or whimpers; occasional complaint	Crying steadily, screams or sobs, frequent complaints
Consolability	Content, relaxed	Reassured by occasional touching, hugging or being talked to, distractable	Difficult to console

This is behavioural observer rated pain scale

- Observe for 2 to 5 min or longer (if asleep minimum 5 minutes)
- Observe body and legs uncovered
- Reposition patient (if possible, when asleep) or observe activity
- Assess body for tenseness and tone (if asleep, touch to assess tone)
- Each category is scored 0-2, giving a total of 10

Sedation score : Comfort-B scale

Alertness	• Deeply asleep (eyes closed, no response to changes in the environment)	<input type="checkbox"/> 1
	• Lightly asleep (eyes mostly closed, occasional responses)	<input type="checkbox"/> 2
	• Drowsy (child closes his or her eyes frequently, less responsive to the environment)	<input type="checkbox"/> 3
	• Awake and alert (child responsive to the environment)	<input type="checkbox"/> 4
	• Awake and hyperalert (exaggerated responses to environmental stimuli)	<input type="checkbox"/> 5
Calmness–Agitation	• Calm (child appears serene and tranquil)	<input type="checkbox"/> 1
	• Slightly anxious (child shows slight anxiety)	<input type="checkbox"/> 2
	• Anxious (child appears agitated but remains in control)	<input type="checkbox"/> 3
	• Very anxious (child appears very agitated, just able to control)	<input type="checkbox"/> 4
	• Panicky (child appears severely distressed, with loss of control)	<input type="checkbox"/> 5
Respiratory response (score only in mechanically ventilated children)	• No spontaneous respiration	<input type="checkbox"/> 1
	• Spontaneous and ventilator respiration	<input type="checkbox"/> 2
	• Restlessness or resistance to ventilator	<input type="checkbox"/> 3
	• Active breathing against ventilator or regular coughing	<input type="checkbox"/> 4
	• Fighting against ventilator	<input type="checkbox"/> 5
Crying (score only in children breathing spontaneously)	• Quiet breathing, no crying sounds	<input type="checkbox"/> 1
	• Occasional sobbing or moaning	<input type="checkbox"/> 2
	• Whining (monotone)	<input type="checkbox"/> 3
	• Crying	<input type="checkbox"/> 4
	• Screaming or shrieking	<input type="checkbox"/> 5
Physical movement	• No movement	<input type="checkbox"/> 1
	• Occasional (3 or fewer) slight movements	<input type="checkbox"/> 2
	• Frequent (more than 3) slight movements	<input type="checkbox"/> 3
	• Vigorous movements limited to extremities	<input type="checkbox"/> 4
	• Vigorous movements including torso and head	<input type="checkbox"/> 5
Muscle tone	• Muscles totally relaxed, no muscle tone	<input type="checkbox"/> 1
	• Reduced muscle tone, less resistance than normal	<input type="checkbox"/> 2
	• Normal muscle tone	<input type="checkbox"/> 3
	• Increased muscle tone and flexion of fingers and toes	<input type="checkbox"/> 4
	• Extreme muscle rigidity and flexion of fingers and toes	<input type="checkbox"/> 5
Facial tension	• Facial muscles totally relaxed	<input type="checkbox"/> 1
	• Normal facial tone	<input type="checkbox"/> 2
	• Tension evident in some facial muscles (not sustained)	<input type="checkbox"/> 3
	• Tension evident throughout facial muscles (sustained)	<input type="checkbox"/> 4
	• Facial muscles contorted and grimacing	<input type="checkbox"/> 5
Total Score		
VAS (Visual Analogue Scale) Put a mark on the line below to indicate how much pain you think the child has at this very moment.		
no pain ----- worst pain		VAS Score

Procedure to use Comfort-B:

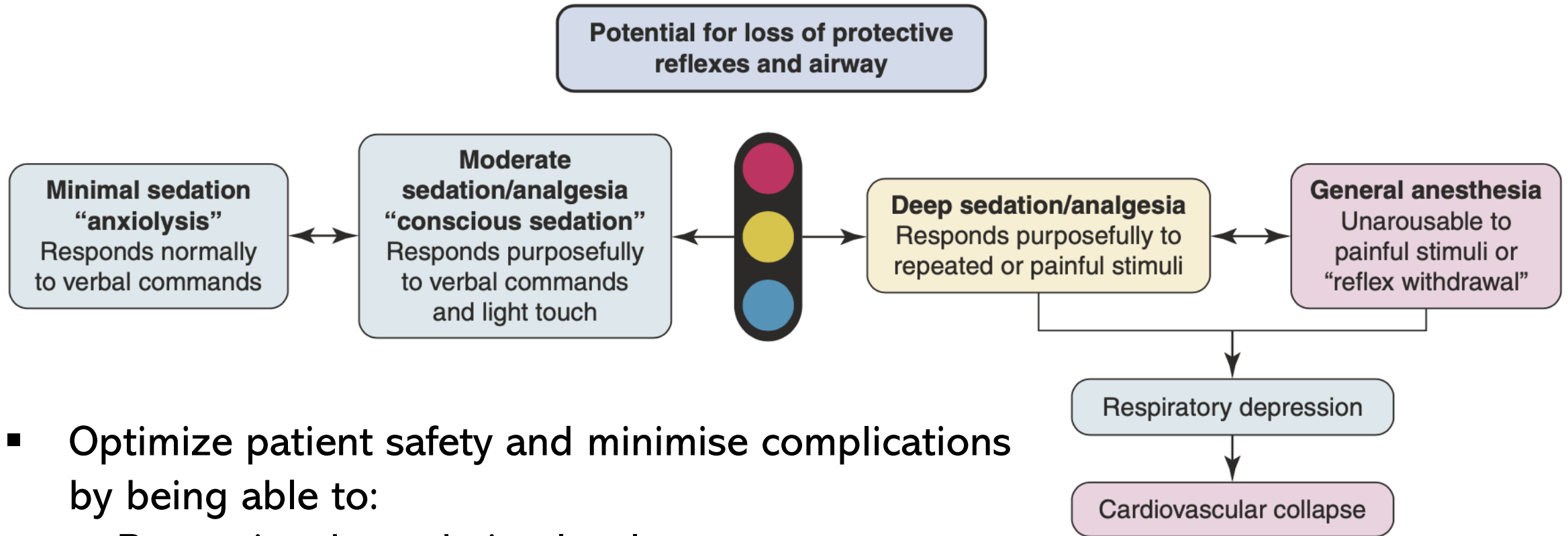
- Observe the child from a position with full view of face and body for a full 2 minutes
- Conclude observation by gentle touch on patient's arm or leg to determine muscle tension
- Then document pain intensity on VAS provided on the ruler

Scores:

- 6-10 → oversedation
- 11-23 → moderately/adequate sedated
- 24-30 → under sedation



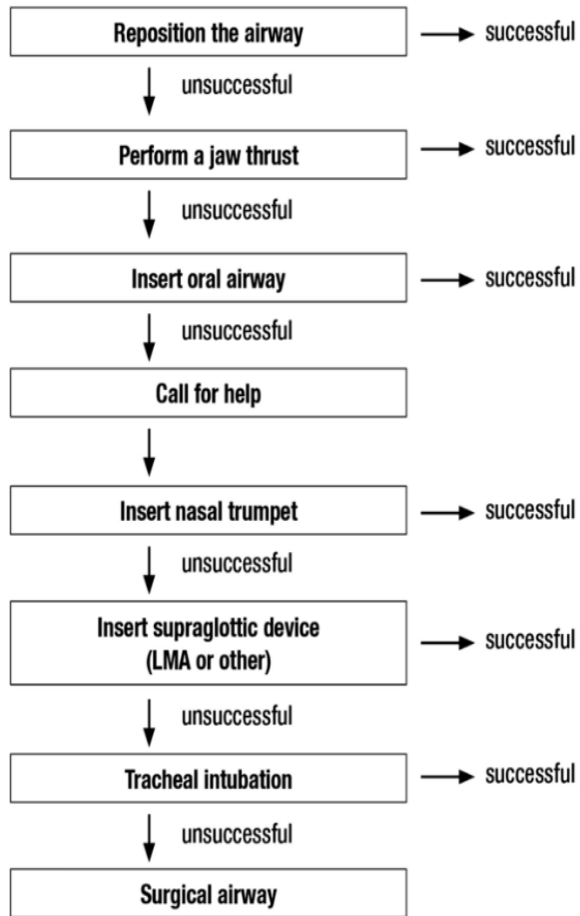
Safe Sedation : Understanding the Concept of “Rescue”



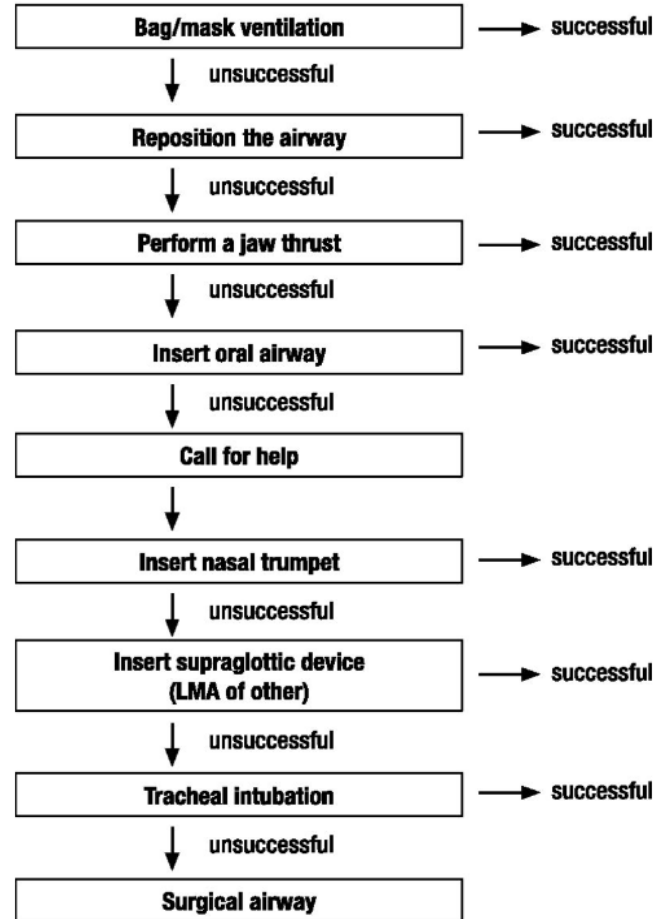
- Optimize patient safety and minimise complications by being able to:
 - Recognise the sedation level
 - Rescue patient from all potential complications

Airway Rescue Therapy

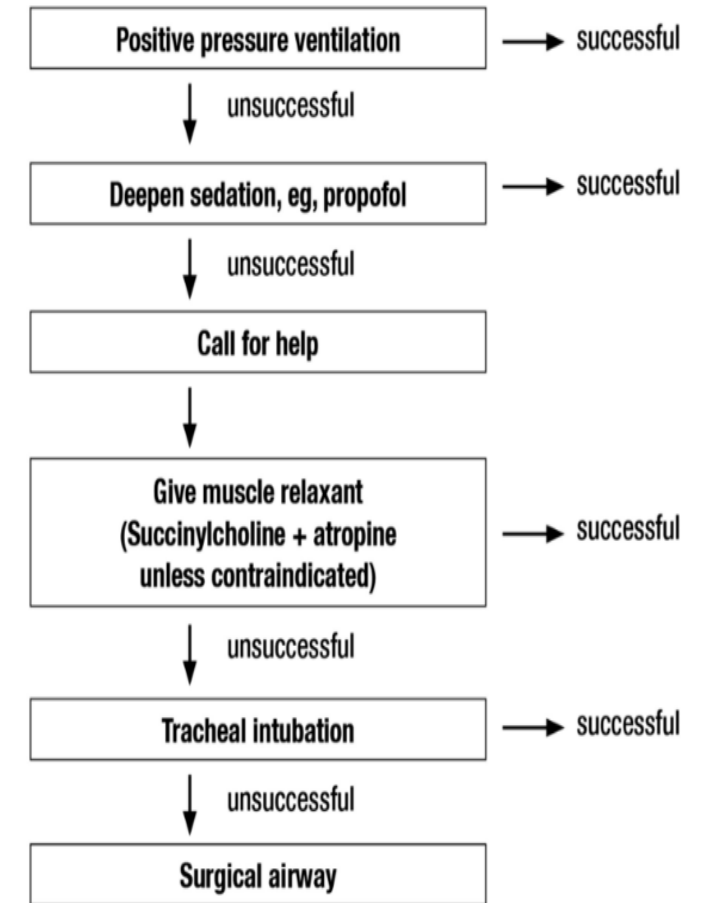
Suggested Management of Airway Obstructions



Suggested Management of Apnea



Suggested Management of Laryngospasm





AFTER THE PROCEDURE

1. Continue monitoring the patient

- Complications from sedation such as respiratory depression are most likely to occur within 5 to 10 minutes after administration of IV medication and immediately after the procedure when the pain stimuli associated with the procedure are removed
- Continue to monitor the patient until patient is fully recovered
 - Airway patency
 - Breathing patterns
 - Level of sedation & pain
 - HR, RR, BP and SpO₂
 - ECG monitoring

2. Document the procedure and PSA

- Document the procedure (Performed by, Assisted by, Observed by)
- Drugs given, time and dose
- Vital signs pre, during and post procedure
- Time patient fully conscious, talking, walking
- Any complication/s



3. Provide a Comfort Plan post procedure

- Pain may be present post procedure
- Use multimodal (pharmacologic and non-pharmacologic) treatment for pain control
- Plan should include instructions on post procedure home care
- Patient must be reviewed by a medical officer before discharge
- Patients can be discharged if:
 - Return to pre-procedural level of orientation and consciousness
 - Tolerate drinking without emesis





THANK YOU



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