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CLINICAL PRACTICE UPDATE- PAEDIATRIC

# Masks, math, and midazolam: Emergency paediatric sedation monitoring Q&A

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#### **KEYWORDS**

Paediatric; Emergency; Sedation; Pain management; Monitoring; Capnography; Pulse oximetry; Pediatric Summary Internationally, sedation of paediatric patients for short procedures is becoming a common treatment option in a variety of areas outside of the operating theatre. However, there are controversies about sedation/pain management and appropriate monitoring, especially in Emergency Department environments. What needs to be monitored, how often, and why? This article will, from the perspectives of emergency and anaesthesia professionals, review the research detailing what emergency department nurses really want and need to know. © 2007 College of Emergency Nursing Australasia Ltd. Published by Elsevier Ltd. All rights reserved.

"Pain is inevitable... Suffering is optional" M. Kathleen Casey<sup>1</sup>

"Procedural sedation is a safe, effective, and humane way to facilitate appropriate medical care.'  $^{\prime 2}~{\rm IP}^{.279}{\rm I}$ 

The Ramones summarised the desires of many paediatric patients in the emergency department (ED) very nicely with their 1999 song ... "I wanna be sedated!" <sup>3</sup> However, there are controversies about sedation/pain management and appropriate monitoring, especially in the ED environment. What needs to be monitored, how often, and why? This article will, from the perspectives of emergency and anaesthesia professionals, review the research detailing what ED nurses really want and need to know.

Preparations for sedation

What preparations are required prior to sedating a child in the ED?

Think about what is the worst thing a child can do when they are sedated. Stop breathing. This should come as no shock. Unlike people who arrive in respiratory arrest and the aetiology is unclear, we know why these children stopped breathing. Either (a) we gave them too much drug; or (b) we gave the correct amount of the drug, but they did not react the way the book said they were supposed to. So with that in mind, in addition to having nursing and medical staff present and trained to potentially resuscitate the

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Probable causes	Examples of actual reported events
Drug-drug interaction- an event that was likely drug- related and for which a combination of drugs had been administered	"The six-week old infant received Demerol, Phenergan, and Thorazine (Largactil) (Meperidine/Promethazine/Chlorpromazine) for a circum- cision and was found dead six hours later"
Drug overdose - at least 1 drug was administered in a dose> 1.25 times the maximum recommended dose	"The child received 6000 mg of chloral hydrate"
Inadequate monitoring- this could have occurred dur- ing or after the procedure	"The child was not on any monitors"
Inadequateresuscitation-therecordsindicatedthat the individuals involved did not have the basic life support or advanced life support skills or did not appropriately manage the emergency	"The heart rate decreased from 98 to 80, the nurse anesthetist gave oxygen and atropine, the pulse decreased further into the 60's, the nurse anesthetist gave epinephrine, 4 min later the nurse gave nalox- one, 3 min later the nurse gave Antilirium (Physostigmine) 12 min later the ambulance was summoned, 10min later the patient was intu- bated, the ambulance drivers found the child on no monitors, EKG revealed electromechanica ldissociation,the patient was transported from the dental office to a hospital"
Inadequate medical evaluation – lack of evaluation or appreciation of how underlying medical conditions would alter the patient's response to sedative drugs	"A child was transferred from Mexico and received 60 mg/kg of chlo- ral hydrate for a cardiology procedure; respiratory depression and bradycardia were followed by cardiac arrest. Autopsy revealed a ven- tricular septal defect, pulmonary hypertension, and elevated Lanoxin (digoxin) levels"
Premature discharge – the patient developed the problem after leaving a medical facility before meeting recommended discharge criteria	"The child became stridorous and cyanotic on the way back to his hometown"
Inadequate personnel – either the medication was administered at the direction of a physician who then left the facility, or there were inadequate numbers of individuals to monitor the patient and carry out the procedure at the same time	"The physician administered the medication and left the facility leav- ing the care to a technician"
Prescription/transcription error- if patient received incorrect dose either because of a transcription or prescription error (nursing or pharmacy)	"The patient received tablespoons instead of teaspoons"
Inadequate equipment - if an emergency arose and the equipment to handle it was not age – or size – appropriate or not available	"An oxygen outlet was available, butflow meter was not – only room air for the first 10min"
Inadequate recovery procedures – this category included cases where there was not a proper recov- ery period, where no one was observing the patient after the procedure, or if an emergency occurred and the necessary equipment was not available	"If they made nurses stay after SPM, they would all quit" (my <i>personal favorite</i> )
Inadequate understanding of a drug or its pharmaco- dynamics	"The patient was given 175mcg of Fentanyl by IV push; chest wall/glottic rigidity was followed by full cardiac arrest." Naloxone ormuscle relaxant never administered
Prescription given by parent in an unsupervised medi- cal environment	"The mother gave two prescriptions of chloral hydrate at home"
Local anaesthetic overdose – if child received more than the recommended upper limits orf an intravas- cular injection occurred	"A 22.7kg child received 432mg of mepivacaine for a dental proce- dure. Seizures were followed by respiratory and cardiac arrests"
Inadequate fasting for elective procedure Unsupervised administration of a drug by a technician	"The child received a bottle of milk prior to aCT scan" "The drug was administered by a technician; there was no physician or nurse in attendance"

Probable causes and examples of adverse sodation events Table 1

child, certain preparations are needed pre-, during, and post-sedation to 'ward off the evil spirits'. Table 1 lists examples of adverse sedation events and their probable causes.

Adapted from Cote C.J. et al.4

At a mm1mum, the following items are needed and in working order prior to procedural or 'conscious' sedation:

- Suction that works



Figure 1 Range of resuscitation mask sizes. Photo courtesy of Mercury Medical, www.mercurymed.com.

- Oxygen that works
- Appropriate size resuscitation bag with age-appropriate size mask<sup>2,5,7</sup> (Fig. 1)

### What about reversal medications?

Remember there are three goals with procedural sedation. To make the child safely 'asleep,' pain free, and not remembering the nasty things we do in the ED. Opiates, such as morphine or fentanyl are most commonly administered for analgesia, while benzodiazepines such as midazolam provide sedation and amnesia. It is crucial to remember that while opiates do a wonderful job of 'taking away pain,' they do little for sedation and nothing for amnesia. Alternatively, benzodiazepines do not offer any analgesia and therefore they may be sedated, but experiencing pain from the procedure. Therefore, if 'nasty' procedures are being done, in most cases both types of medications should be administered. 2.5.7

Anything you give, you want to be able to take away. As there are two types of medications for sedation, each has their own respective reversal agent. Naloxone (Narcan) is for the 'take away pain' opiates and Flumazenil (Anexate, Romazicon) is for the 'go to sleep' benzodiazepines. Should you have the reversal drugs drawn up into a syringe and sitting at the bedside ready to go? Some hospitals say 'yes,' while others say 'no.' At a minimum, we recommend having the medications unopened at the bedside, especially if your hospital uses the automated drug dispensing devices such as



Figure 2 Traditional pulse oximeter. Photo courtesy of Covidien, www.covidien.com.



Figure 3 New forehead pulse oximeter. Photo courtesy of Covidien, www.covidien.com.

	Minimal sedation (anxiolysis)	Moderate sedation <i>l</i> analgesia 'conscious sedation'	Deep sedation/analgesia	General anaesthesia
Responsiveness	Normal response to verbal stimulation	Purposeful response to verbal or light tactile stimulation	Purposeful response following 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

Table 2 Analgesia and sedation continuum

Adapted from American Society of Anesthesiologists House of Delegates.<sup>11</sup>

Pyxis<sup>®</sup> (Cardinal Health, Dublin, Ohio, USA). If your patient stops breathing, that is not the time to 'argue' with the Pyxis<sup>®</sup> machine! This way if you need them, great – use them. If not, put them back and no one gets charged.<sup>8</sup>

However, taking that idea one step further, remember that when you are stressed (i.e. the child is now apneic), that is not the time to figure medication doses. Therefore, we highly recommend prior to pushing any sedative medication, to figure out the appropriate dose in milligrams (for the chart) and millilitres (how much should you push) for reversal agents. Are the reversal drugs going to work? Yes. Are they instantaneous? No. Even Naloxone intravenously (IV) takes a minute or two to 'kick in.' Therefore, using a bag and a mask until they decide to breathe is highly recommended. Again, why be stressed if you do not need to!<sup>5,7,8</sup>

### Monitoring options: does every child need...

Does every child need pulse oximetry during sedation? Pretty much every protocol I have come across says 'yes'. Everyone has to have a pulse oximetry. That is not the issue. The issue is when does the pulse oximetry need to get put on the patient. Certainly, before the procedure, but if the child is 'possessed' and ripping off their pulse oximetry, chances are their saturations are fine. When the child is mellow enough to allow pulse oximetry to be applied, put on the pulse oximeter. When should the pulse oximetry be removed? Simply, when the child rips off their pulse oximeter, chances are they no longer need the pulse oximeter!<sup>7,10</sup> (Figs. 2 and 3)

Does every child need cardiac monitoring during sedation? Again, some hospitals say yes, while others say no. My feelings are simply summarised with a question. Are you really worried this cute healthy 2-year old is going to go into second degree AV block type II? If so, they really should be on a cardiac monitor, if not, why are you hooking them up to a cardiac monitor? In many cases, it is because the protocol says you should or more commonly, 'to get a heart rate.' However, what do you get as an added bonus to the oxygen saturation on a pulse oximeter? A heart rate! Why this is nice is two-fold. First, remember that the less wires a child has in the ED, the less stressed they are. Secondly, remember that anything you put on, you later have to take off. What does a child remember from a perfectly painless procedure

CT scan) is having three big bandages ripped off their chest. If your protocol says to use them, great, use them,

but many children's hospital protocols say a pulse oximeter in healthy kids with moderate sedation is just fine.<sup>7,8,10</sup>

Does every child need automatic blood pressure monitoring during sedation? Our feelings with this are simply, if you have one, great use it . If not, intermittent regular manual blood pressures are just fine. That is not the issue. The issue is if you have one, how often do you tell it to take a blood pressure? I will give you a choice ... every 5, 10, 15, 25 min – pick one. If you are doing a simple, short procedure with oral/rectal/nasal sedative agents such as a 2 min CT scan, taking a pressure every 15 min is probably just fine. Take a pressure pre-CT scan, take another pressure post-CT scan,



Figure 4 Handheld Sa0<sub>2</sub> /EtC0<sub>2</sub> Monitor. Photo courtesy of Covidien, www.covidien.com.



figure 5 Portable monitors with Sa02 and EtC02 measurements. Photo courtesy of Koninklijke Philips Electronics NV, www.medical.philips.com.

and happily let the child sleep during the procedure. However, if you are 'actively working' at sedating a child (i.e. IV narcotics), every 5 min is appropriate. The fear is that taking a blood pressure will wake the child up and you will have to administer more medications entering into a viscous circle. However, if what you are doing to the child does not wake them up; chances are checking the pressure will not wake them up. Remember that especially with children and IV sedation measures, they 'are deeper than you think' and should be closely monitored accordingly. <sup>2,7,10</sup>

Remember that sedation and analgesia are a continuum ranging from minimal sedation to general anaesthesia. Moderate 'conscious' sedation means they wake up and respond appropriately to commands. Young children do not do what we tell them to do, that is why we are sedating them. When you stop doing what I tell you to do, you are now at deep sedation, and once there, it is not that far to travel into undesired general anaesthesia!<sup>2,6,7,11</sup> Table 2 summarises the analgesia and sedation continuum.

### What about the newer 'toys' (i.e. capnography) monitoring?

Capnography or the measuring of expired end-tidal carbon dioxide ( $EtCO_2$ ) has been the standard of care for verification of endotracheal tube placement for several years. However,

in more recent years, anaesthesia, paediatric, and emergency medicine professionals are highly recommending its use for sedation monitoring. The reasons are simple. If you are cute, healthy, well oxygenated, and then you suddenly stop breathing, how long will it take your pulse oximeter to drop below 90% and the alarm to go 'ding, ding, ding?' In healthy people, it can be several minutes. However, what rises long before that is expired carbon dioxide. Studies have shown that combining pulse oximetry with nasal cannula EtC0<sub>2</sub>monitoring lets you know the patient is running into trouble long before they desaturate, become bradycardic, or arrest. Though not the standard of care yet, the combination of oximetry/EtC0<sub>2</sub> monitoring with handheld or bedside monitoring devices will probably become the standard in the foreseeable future<sup>7</sup>\*<sup>8</sup> (Figs. 4-6).

In summary, though once the exclusive domain of anaesthesic professionals, paediatric sedation is now commonly performed in EDs across the globe.<sup>6,7,12</sup> However, with the goals of having a child 'asleep, pain free, and not remembering,' comes the need for appropriate monitoring. 'When in doubt ... Knock em out' – but do it safely and remember your mask and math with midazolam!

"Emergency nurses have an important role in promot ing patient safety while minimizing anxiety and!or pain for patients undergoing stressful and/or painful procedures in the emergency department. "<sup>6</sup>



Figure 6 Bedside monitor with Sa0<sub>2</sub> and EtCO<sub>2</sub> measurements. Photo courtesy of Koninklijke Philips Electronics NV, www.medical.philips.com.

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