Sedation and Analgesia in the Critically Ill

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Severance Hospital Division of Nursing
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Analgesic & Sedative in critical patient
Analgesic

Pain Assessment Tool

Medication

Algorithm
- Firstly used
  - during operation
  - in post-anesthesia care unit (PACU)

- In 1995, the American Board of Intensive Care Medicine published a guideline for analgesic sedative use
  -> recently renewed

• Should be able to select proper medication for the best care

• Stays in the Intensive Care Unit to assess the adverse event or the cumulative effect of medication
Reasons for pain in ICU patients

Acute pain

- Operations
- Immobility
- Diagnostic procedures
- Therapeutic procedures
- Nursing procedures
Pain and its consequences in the ICU

- Long Lasting psychological effects
- Suppressed immune system
- Impaired ventilation: atelectasis, pneumonia
- Severe anxiety delirium
- Morbidity mortality
- Myocardial ischemia
- Increased oxygen demand
- Tachycardia/hypertension
Pain in ICU patients

- Majority ICU patients suffer severe/moderate pain
- 40% are delirious & cannot communicate
- 50% are either physically/emotionally distressed
- 10-20% have no hopes of cure --- end-of-life in ICU
- Balance between pain relief & maintaining alertness
- Multidisciplinary team for multimodal therapies.
Assessment of pain in ICU

- Establishment of pain as 5 vital sign – frequent evaluations
- In cognitive impairment /delirium
  - behavioural (facial-FACS)
  - physiological-BP, HR, RR
- Subjective quantification
  - visual/numeric/graphic scales (W-B faces)
Pain Assessment

* Assessment Tool (Subject Data)

VAS  VNRS
1. VAS (Visual Analog Scale)

No pain at all

The worst pain imaginable
Pain Assessment

2. VNRS  (Verbal Numerical Rating Scale)
## Pain Assessment

### 3. FLACC scale

<table>
<thead>
<tr>
<th>Categories</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face</td>
<td>No particular expression or smile</td>
<td>Occasional grimace or frown, withdrawn, disinterested</td>
<td>Frequent to constant frown, quivering chin, clenched jaw</td>
</tr>
<tr>
<td>Leg</td>
<td>Normal position or relaxed</td>
<td>Uneasy, restless, tense</td>
<td>Kicking or legs drawn up</td>
</tr>
<tr>
<td>Activity</td>
<td>Lying quietly, normal position, moves easily</td>
<td>Squirming, shifting back and forth, tense</td>
<td>Arched, rigid, or jerking</td>
</tr>
<tr>
<td>Cry</td>
<td>No cry (awake or asleep)</td>
<td>Moans or whimpers; occasional complaint</td>
<td>Crying steadily, screams or sobs, frequent complaints</td>
</tr>
<tr>
<td>Consolability</td>
<td>Content, relaxed</td>
<td>Reassured by occasional touching, hugging, or being talked to; distractible</td>
<td>Difficult to console or comfort</td>
</tr>
</tbody>
</table>
Pain Assessment

4. Wong–Baker faces

Table 1: Wong-Baker FACES Pain Rating Scale. Recommended use for persons age 3 years and older.

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>NO HURT</td>
</tr>
<tr>
<td>2</td>
<td>HURTS A LITTLE BIT</td>
</tr>
<tr>
<td>4</td>
<td>HURTS A LITTLE MORE</td>
</tr>
<tr>
<td>6</td>
<td>HURTS EVEN MORE</td>
</tr>
<tr>
<td>8</td>
<td>HURTS A WHOLE LOT</td>
</tr>
<tr>
<td>10</td>
<td>HURTS WORST</td>
</tr>
</tbody>
</table>

Explain to the person that each face is for a person who feels happy because he has no pain (hurt) or sad because he has some or a lot of pain. FACE 0 is very happy because he doesn’t hurt at all. FACE 2 hurts just a little bit. FACE 4 hurts a little more. FACE 6 hurts even more. FACE 8 hurts a whole lot. FACE 10 hurts as much as you can imagine, although you don’t have to be crying to feel this bad. Ask the person to choose the face that best describes how he is feeling.

Brief word instructions: Point to each face using the words to describe the pain intensity. Ask the child to choose face that best describes own pain and record the appropriate number.
Characteristics of Ideal Analgesic

1) Fast acting time
2) Convenient route of consumption
3) Least accumulation of medication in the body
4) Least adverse event occurring in cardiovascular, respiratory, hepatic or renal system
5) Fast awakening time after stopping the medication
6) Low price

Morphine
Fentanyl
Alfentanil
Sufentanil
Remifentanil
ketamine
• has a strong effect in subsidizing pain

• Induces the vascular dilation which causes hypotension eventually

• Causes a delay of sedative condition when in renal failure state
Fentanyl

- Has stronger effect approximately for 100-150 times
- Has fast acting time
- Can be administered to the patient whose hemodynamic is unstable → because it does not increase serum histamine level
- Remifentanil has so short acting time that it is effective when the medication should be stopped for a neurologic test.
Remifentanil vs. other opioids

Minto et al. Anesthesiology, 1997;86:10-23
Ketamine

- Has strong effect as morphine
- Has the least effect in respiratory depression and bowel movement decrease
- Can dilate bronchi
- Interrupts the reabsorption of norepinephrine
  - which activates sympathetic system and eventually increases blood pressure and pulse
Adverse Event

- In respiratory system
  - especially keep close watching self-respiratory failure patient
- In hemodynamics
  - Patients with hypovolemic and symphatocotonia experience hypotension
  - Patients with normal volume can experience hypotension due to reduced level of histamine
- In gastroenteric system
  - Patients experience decreased bowel movement or circulation in stomach
Analgesic & Sedative in critical patient
ICU Sedation of history


1974: Use of sedation scale
1980’s: Continuo infusion with midazolam propofol
1990: Reports of prolonged neuromuscular weakness associated with NMB
1995: First sedation guideline by SCCM -> 2002 revised
2000: Daily interruption
2001: Delirium as important risk factor for poor outcome
2008: Combination of daily awakening and breathing trial
2013: Clinical practice guideline for the management of pain, agitation, and delirium in adult patient in ICU

Importance of analgesics in sedation
Figure 1. Causes and Interactions of Pain, Agitation, and Delirium.

Drugs and other treatments for pain, agitation, and delirium form an “ICU triad” cognitive management analogous to the “triad of anesthesia,” which highlights interactions among hypnotics, analgesics, and muscle relaxants to encourage balanced anesthesia. The “ICU triad” concept highlights that changing one element is unlikely to be as effective as a coordinated approach.
Sedative Care Assessment Tool

Objective monitoring of sedation level:
- EEG
- BIS
- Cerebral State Index

Subjective monitoring of sedation level:
- Ramsay Scale score
- Richmond agitation sedation scale
- VICS
- ATICE
Ramsay Scale

Awake Levels
1. Patient anxious and agitated or restless or both
2. Patient cooperative, orientated and tranquil
3. Patient responds to commands only

Asleep Levels
4. A brisk response to a light glabellar tap or loud auditory stimulus
5. A sluggish response to a light glabellar tap or loud auditory stimulus
6. No response to a light glabellar tap or loud auditory stimulus
# RASS (Richmond Agitation Scale)

<table>
<thead>
<tr>
<th>Score</th>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+4</td>
<td>Combative</td>
<td>Overtly combative or violent, Immediate danger to staff</td>
</tr>
<tr>
<td>+3</td>
<td>Very agitated</td>
<td>Pulls on or removes tube(s) or catheter(s) or exhibits aggressive behavior toward staff</td>
</tr>
<tr>
<td>+2</td>
<td>Agitated</td>
<td>Frequent nonpurposeful movement or patient-ventilator dys-synchrony</td>
</tr>
<tr>
<td>+1</td>
<td>Restless</td>
<td>Anxious or apprehensive but Movements not aggressive or vigorous</td>
</tr>
<tr>
<td>0</td>
<td>Alert and calm</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td>Drowsy</td>
<td>Not fully alert, but has sustained (&gt;10 seconds) awakening, with eye contact, to voice</td>
</tr>
<tr>
<td>-2</td>
<td>Light sedation</td>
<td>Briefly (&lt;10 seconds) awakens with eye contact to voice</td>
</tr>
<tr>
<td>-3</td>
<td>Moderate sedation</td>
<td>Any movement (but no eye contact) to voice</td>
</tr>
<tr>
<td>-4</td>
<td>Deep sedation</td>
<td>No response to voice, but any movement to physical stimulation</td>
</tr>
<tr>
<td>-5</td>
<td>Unarousable</td>
<td>No response to voice or physical stimulation</td>
</tr>
</tbody>
</table>
BIS

Awake
- Responds to normal voice

80
- Responds to loud commands or mild prodding/shaking

60
General Anesthesia
- Low probability of explicit recall
- Unresponsive to verbal stimulus

40
Deep Hypnotic State
- Burst Suppression

20
0
Flat Line EEG

Asymmetry Indicators (ASYM)
4 channel of EEG
Sedation Goal

Sedation Goal: Calm, Comfortable, & Easily Arousable

Ramsay Sedation Scale
2

Richmond Agitation-Sedation Scale
0

Sedation Assessment Scale
4
Characteristics of Ideal Analgesic/Sedative

1) Fast acting time
2) Convenient route of consumption
3) Least accumulation of medication in the body
4) Least adverse events occurring in the cardiovascular, respiratory, hepatic or renal system
5) Fast awakening time after stopping the medication
6) Low price

Diazepam
Lorazepam
Midazolam
Propofol
- Does not have analgesic effect, but have subsidizing effect

- The factor such as age, disease, drug, or alcohol can influence its effect on the body or duration

- The use of benzodiazepine can cause hypotension in hemodynamically unstable patient
1) Midazolam

- has short acting time, good for acutely acting out patients
- remains longer in patients with renal failure or low serum albumin level
- can cause hypotension when it is used with narcotics
- is recommended to be administered with ketamine or fentanyl to hemodynamically unstable patients
2) Lorazepam

- has long acting time, not proper for acute patients
- should be diluted when used continuously
- watch for precipitation
- when used in high dose or for long time, it can cause Acute renal tubule necrosis or lactic acidosis
Benzodiazepine

Side effect

- Respiratory suppression
- Hypotension
- Over-sedation
Propofol

- Is provided in the emulsion type
- Has fast acting time and half-time
  -> neurologic examination is possible when it is stopped
- Decreases intracranial pressure
- Cause dose-dependent hypotension and bradycardia
- Cause pain in the injection site
- Cannot be administered long to infants
How to Administer

Continuous intravenous administration:
- Advantage: helps maintenance of sedative state and patient’s comfort
- Disadvantage: prolongs day of hospitalization in the intensive care unit and ventilation support
  -> (Kollef et al. Chest 1998;114:541-8)

- Causes incorrect results of neurologic examination of consciousness level
  -> examination for checking sedative effect or neurologic loss should be performed often
When administered continuously, sedation should be maintained for a short time

- when used in high dose or for a long time
  -> taper in schedule
  -> change a dose everyday
  -> awaken a patient everyday
- Daily interruption of sedative infusions in critically ill patients undergoing mechanical ventilation.

Sedation Strategies

• Sedation protocols with daily sedation interruptions or maintenance of light levels of sedation

• "Less is more" strategy

• Bedside protocols for titrating sedation and analgesia
• Daily checklists
Summary — Analgesics + Sedatives

- Morphine + midazolam: hemodynamically stable patients
- Fentanyl (alfentanil, sufentanil) or Ketamine + midazolam: hemodynamically unstable patients
Conclusion

- Avoid unnecessary use
- Require tapering schedule to avoid withdrawal symptoms
- Need an algorithm
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<td>Spontaneous awakening trials (SATs)</td>
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</table>
**Presentation 원칙**

**Present Plan List**
1. 오늘의 Sedation Goal
   - Daily Interruption 여부
2. Mechanical Ventilation 여부
   - SBP trial 가능 여부
   - Weaning trial 가능 여부
3. VAP Bundle Check (Head up, PUD, DVT, Daily interruption)
4. BSI Bundle Check
   - Central Venous Catheter 필요 여부
5. 퇴실 가능 여부
6. Antibiotic 사용에 관한 상의 여부

**간호사에 대해 Presentation 할 List**
1. Current Status
2. Chest X-ray Change
3. 오늘의 Intake and Output Target
4. 오늘의 Nutritional Plan (영양팀과 토의된 계획)
5. 오늘의 Sedation Goal
6. 오늘의 Ventilation Plan
7. VAP Bundle Check (Head up, PUD, DVT, Daily interruption)
8. BSI Bundle Check
   - Central Venous Catheter 필요 여부

**Presentation Check List**
1. Age, Gender, Underlying Disease, Current Diagnosis
2. Current Vital Sign (Vasopressor, Inotropics 사용여부)
3. Fluid Balance (Intake and Output)
4. Infection Sign (Fever, Laboratory change)
5. Chest X-ray Change
6. Special Laboratory Change

**간호사 Presentation List**
1. Current Sedation Scale
2. Vasopressor/Inotropics 사용 여부 및 infusion dose
3. Sputum production and color change
4. Tracheostomy site 상태
5. Neurologic Sign Change (Mental, Pupil, Motor 및 이전 상태와 비교)
6. 보호자 주의 사항
7. 배변양상: 설사 횟수, feeding problem

번역결과

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7. 배변양상: 설사 횟수, feeding problem
ABSTRACT

Background: Evidence is growing that less or no-sedation is possible and beneficial for patients during mechanical ventilation.

Aim: To investigate if there was a difference in patient consciousness and nursing workload comparing a group of patients receiving no-sedation with a group of sedated patients with daily wake up, and also to estimate economic consequences of a no-sedation strategy.

Design and methods: Data were collected during a prospective trial of 140 mechanically ventilated patients randomized to either no-sedation or to sedation with daily wake up. From day 1 to 7 in the intensive care unit (ICU), patients were Richmond Agitation and Sedation Scale (RASS) scored, nursing workload was measured with the Nursing Care Recording System (NCR11) and nurse's self-assessment of workload was reported on a Numeric Rating Scale from 1 (low) to 10 (high).

Results: Patients from the no-sedation group had a median RASS score of −0·029 compared with −2 in the sedated group (P < 0·00001). The NCR11 scores were higher in the sedated group compared with the no-sedation group: 19·054 versus 17·05 (P = 0·00001). The nurses self-reported workload was the same in both groups (P = 0·085). Because of a shorter ICU stay and shorter hospital length of stay in the no-sedation group, we estimated that there will be no cost benefit with the use of sedation and a higher patient to nurse ratio.

Conclusion: Patients receiving no-sedation were more awake with a RASS score close to zero, compared with patients receiving sedation and daily wake up. Nurses reported no difference in self-assessed workload between the no-sedation and sedated group of patients.

Relevance to clinical practice: Patients receiving no-sedation are more awake during their stay in ICU. There might be a potential economical saving with the use of a 1:1 nurse-patient ratio and no-sedation compared with sedation and a 1:2 nurse-patient ratio.

Key words: Mechanical ventilation • No-sedation • Nursing workload • RASS • RCT
<table>
<thead>
<tr>
<th>약명</th>
<th>혈청 용량 및 수액</th>
<th>초기 주입 속도 (µg/hr)</th>
<th>Intermittent Bolus Dose</th>
<th>주입용량 범위 (µg/hr)</th>
<th>Dose up</th>
<th>Dose down</th>
<th>주의 사항</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfentanil (2.5mg/5ml/A)</td>
<td>10mg + N/S 100ml</td>
<td>10cc/hr (1,000µg/hr)</td>
<td>1,800-10,800 µg/hr</td>
<td>4cc/hr</td>
<td>4cc/hr</td>
<td>1. ICU 환자에서 analgesics and sedatives 복용 시 공복차가 비약에 2. fentanyl의 1/6-1/10 potency, 1/3 duration 가용 3. brain tumor 환자의 ICP pressure 증가</td>
<td></td>
</tr>
<tr>
<td>Fentanyl (1mg/20ml/A)</td>
<td>1mg + N/S 100ml</td>
<td>5cc/hr (50µg/hr)</td>
<td>25-50 µg IV bolus every 20 min until 3 times</td>
<td>40-500 µg/hr</td>
<td>1. 환자에서 analgesics and sedatives 복용 시 공복차가 비약에 2. fentanyl의 1/6-1/10 potency, 1/3 duration 가용 3. brain tumor 환자의 ICP pressure 증가</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morphine sulphate (5mg/5ml/A)</td>
<td>20mg + N/S 500ml</td>
<td>20cc/hr (800µg/hr)</td>
<td>2-4mg IV bolus or Subcutaneous every 1-2 hr</td>
<td>2-30 mg/hr</td>
<td>1. 환자에서 analgesics and sedatives 복용 시 공복차가 비약에 2. 자주 정책 변경 후에는 권장하지 않음. 필요시 intermittent dose 주의</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remifentanil (1mg/1ml/V)</td>
<td>2mg + N/S 100ml</td>
<td>5cc/hr (100µg/hr)</td>
<td>30-900 µg/hr (5-14 µg/ml)</td>
<td>Dose UP</td>
<td>2cc/hr</td>
<td>Dose down</td>
<td>1. ICU 환자에서 analgesics and sedatives 복용 시 공복차가 비약에 2. 300 µg/mL 이상 복용 시 respiratory depression 주의</td>
</tr>
</tbody>
</table>

1회 주입 비용

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<thead>
<tr>
<th>주입 비용/day</th>
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</thead>
<tbody>
<tr>
<td>$10.69</td>
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<tr>
<td>$47.08</td>
</tr>
<tr>
<td>$15.722</td>
</tr>
<tr>
<td>$20.049</td>
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<tr>
<td>$8.890</td>
</tr>
<tr>
<td>$0.000</td>
</tr>
<tr>
<td>$18.100</td>
</tr>
<tr>
<td>$22.920</td>
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## Guidelines for Usage in ICU (Sedative)

<table>
<thead>
<tr>
<th>약명</th>
<th>혈액 용량 및 수액</th>
<th>초기 주입 속도 (60kg 기준)</th>
<th>Intermittent Dose Dose</th>
<th>주입용량 범위 (μg/kg/min)</th>
<th>Dose up Dose down</th>
<th>주의 사항</th>
<th>주입 비용 (day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ketamine</td>
<td>500mg+ N/S 100ml</td>
<td>3cc/hr</td>
<td>0.1-0.5μg/kg/min</td>
<td>0-2 μg/kg/hr</td>
<td>Dose up : 2cc/hr Dose down : 2cc/hr</td>
<td>1. 혈압 등의 효과하여 신호호소가 사용 시 주의할 필요 2. 신호호소 부작용의 증상, 혈압, 호흡 호흡 지속에서 급여 인장 3. GCS pressure 증가</td>
<td>$ 8,415</td>
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<tr>
<td>Midazolam</td>
<td>60mg+ N/S 100ml</td>
<td>10cc/hr</td>
<td>0.3-1μg/kg/min</td>
<td>0.0-0.3 μg/kg/min</td>
<td>Dose up : 2cc/hr Dose down : 2cc/hr</td>
<td>1. K+ blocker의 같이 사용할 경우 허를 10% (100mg/day) 정도 보존 인장 2. 백내장 시 10% (200mg/day)까지 보존 인장 3. Metabolites 포함이 있는 약물 (Amiodarone, Quinidine, Ivermectin, Praziquantel)</td>
<td>$ 8,832</td>
</tr>
<tr>
<td>Precedex</td>
<td>400mcg+ N/S 100cc</td>
<td>6cc/hr</td>
<td>0.4-0.7μg/kg/hr</td>
<td>0.2-0.7 μg/kg/hr</td>
<td>Dose up : 2cc/hr Dose down : 2cc/hr</td>
<td>Ampicillin B 및 disopyramide의 부작용 부적합</td>
<td>$ 70,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$ 108,000</td>
</tr>
</tbody>
</table>
One step further
One word frees us of all the weight and pain of life: That word is “love”

Thank you for listening