Mechanical ventilation Sedation Delirium

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LIST

- Mechanial Ventilation;

auto-PEEP, alveolar recruitment

- PADIS guideline 2018
- Post-Intensive Care syndrome

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Pressure-Targeted Ventilation

Patient-Triggered, Pressure-Limited, Time-Cycled Ventilation





Review Cours

Volume-Targeted Ventilation

Patient-Triggered, Flow-Limited, Volume-Cycled Ventilation





Volume Versus Pressure

	Volume	Pressure
V _T	Constant	Variable
Flow	Set	Variable
Pressure	Variable	Constant
Minute Ventilation	Constant	Variable
Inspiratory Time	Constant	Constant

Society of Critical Care Medicine

Ventilation induced lung injury

	Manifestation	Causes
Barotrauma	Extrapulmonary air, pneumothorax, pneumomediastinum, etc.	Excessive airway pressures, maldistribution of volume, air trapping
Volutrauma	Over-distension injury causing increased permeability of the alveolar capillary membrane	Excessive airway pressures, high VTs
Atelectrauma	Stress and shear injury in alveolar septae, bronchioles, and vessels between adjacent units	Repeated opening and closing of alveoli during tidal ventilation, insufficient PEEP
Biotrauma	Increased concentrations of inflammatory cytokines in alveolar spaces and blood	Over-distension, high airway pressures and volumes, repeated shear stress of alveolar units

Auto-PEEP

- Expiration time동안 expiration이 끝나지 못해 남은 insipiration volume이 폐에 쌓여(air trapping) 폐의 과팽창(dynamic hyperinflation)이 일어나는 것.
- 원인; tachypnea, short expiration time,

increased airway resistance,...

Auto-PEEP

- 영향; TV 감소, hypercapnea, WOB 증가,

Venous return 감소, Cardiac Output 감소, barotrauma,...

- 치료; ventilator circuit disconnect(at BP 저하), PEEP 증가(to overcome the auto-PEEP), RR 감소(by patient sedation),...

Auto-PEEP (PEEP 증가 테크닉)

- 1) 환자의 호흡패턴과 인공호흡기 상태를 면밀히 관찰
 - (esp, PIP and PEEP level)
- 2) 환자와 인공호흡기 상태변화 (esp, PIP)를 면밀히 관찰하면서 PEEP을 1~2cmH2O 증가
- 3) PEEP 증가보다 PIP가 더 증가하면 auto-PEEP이 계속

발생되고 있는 것임.

4) 적절한 PEEP(PIP 유지, stable V/S & ABGA,..) set.

PEEP (effect)

- 1) Retain recruitment of alveoli opened during PPV to improve V/Q and gas exchange. □
- 2) Stabilize alveoli and prevent shear injury.
- 3) Prevent surfactant breakdown from collapse of alveoli at end-expiration.

Alveolar recruitment maenuver

1) 목적(Ix); Alveolar collapse로 인한 Acute lung injury

환자에서 collapse를 제거하여 shunt를 감소

2) Clx; 뇌내압 상승, 급성심허혈, 저혈압(<90mmHg),

심한대사성산증,...(고탄산혈증이 허용되지 않는 경우)















SET

- 7) 전체 단계를 반복 후 6)에서 확인한 PEEP의 바로 위 PEEP으로
- 6) SaO₂가 2%이상 떨어지는 PEEP을 확인
- 5) 30초 간격으로 PEEP을 2cmH₂O 낮추면서 TV 증가
- 4) PEEP 25cmH2O로 낮추면서 TV 2ml/kg로 ventilation start

Alveolar recruitment maenuver

<PIP 30cmH₂O이하로 보면서>

- 3) SaO₂가 90~95%가 유지되는 최소한의 FiO₂ set
- 2) 35~45cmH₂O CPAP mode로 30~45초 유지
- 1) 근이완제 투여(case by case)

(여러가지 방법이 있음)

Alveolar recruitment maenuver

1. 시행 중; Stop if SaO2 ↓ 85% or BP ↓ 10%-20%

below baseline

2. 시행 후

1) Closed suction system 사용

2) Suction 최소화

3) Suction후 ARM 다시 시행(하루 최소 2번은 시행)

4) ARM 전후의 활력징후 확인 필요

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Introduction

- 2018 Pain, Agitation, Delirium, Immobility and Sleep disruption guideline
- Updrade of 2013 PAD guidelines
 - 1) Adding new topics; rehabilitation/mobilization

and sleep disruption

- 2) including patients as collaborators and coauthors
- 3) adding experts from Europe and Australia

Pain

- a protocol-based approach to pain assessment and management.
- specific recommendations regarding the use non-opioid analgesics; a multimodal pain treatment approach is an important strategy to reduce opioid use in hospitalized patients.
- Other recommendations address nondrug approaches to pain management, including massage, music therapy, cold therapy, and relaxation techniques.

Agitation/Sedation

- Light sedation is recommended over deep sedation for most ICU patients.
- Propofol or dexmedetomidine is recommended over benzodiazepines in patients requiring continuous sedation.
- Sedation monitored with BIS compared to subjective scales may improve sedative titration when a sedative scale cannot be used.

Richmond Agitation-Sedation Scale (RASS)

Score	Term	Description
+4	Combative	Overtly combative or violent, immediate danger to staff
+3	Very agitated	Pulls on or removes tubes or catheters, aggressive behavior toward staff
+2	Agitated	Frequent nonpurposeful movement or patient-ventilator dyssynchrony
+1	Restless	Anxious or apprehensive but movements not aggressive or vigorous
0	Alert and calm	
-1	Drowsy	Not fully alert, sustained (>10 seconds) awakening, eye contact to voice
-2	Light sedation	Briefly (<10 seconds) awakens with eye contact to voice
-3	Moderate sedation	Any movement (but no eye contact) to voice
-4	Deep sedation	No response to voice, any movement to physical stimulation
-5	Unarousable	No response to voice or physical stimulation

The Ramsay sedation scale

Clinical score	Patient characteristics
1	Awake; agitated or restless or both
2	Awake; cooperative, oriented, and tranquil
3	Awake but responds to commands only
4	Asleep; brisk response to light glabellar tap or loud auditory stimulus
5	Asleep; sluggish response to light glabellar tap or loud auditory stimulus
6	Asleep; no response to glabellar tap or loud auditory stimulus

Redrawn from Ramsay, MA, Savage, TM, Simpson, BR, Goodwin, R, Br Med J 1974; 2:656.

Delirium

- Approximately 50% frequency in ICU patients.
- Associated with:
 - 1) Threefold increase in 6-month mortality.
 - 2) An extra 5 days on mechanical ventilation.
 - 3) An extra 8-10 days of hospitalization costing on average
- \$ 15,000 per patient.
 - 4) 50% have cognitive impairment at hospital discharge.
 - 5) Long term cognitive impairment in 1 in 3 patients.

Delirium

- Risk factors
 - 1) Modifiable: benzodiazepine use, blood transfusion
- 2) Non-modifiable: greater age, dementia, prior coma, pre-ICU emergency surgery or trauma, and increasing APACHE and ASA score
- Rapidly reversible delirium is associated with outcomes that are simiar to patients who never experience delirium.

Confusion assessment method (CAM) for the diagnosis of delirium*

Feature	Assessment	
1. Acute onset and fluctuating course	Usually obtained from a family member or nurse and shown by positive responses to the following questions:	
	"Is there evidence of an acute change in mental status from the patient's baseline?";	
	"Did the abnormal behavior fluctuate during the day, that is, tend to come and go, or increase and decrease in severity?"	
2. Inattention	Shown by a positive response to the following:	
	"Did the patient have difficulty focusing attention, for example, being easily distractible or having difficulty keeping track of what was being said?"	
3. Disorganized thinking	Shown by a positive response to the following:	
	"Was the patient's thinking disorganized or incoherent, such as rambling or irrelevant conversation, unclear or illogical flow of ideas, or unpredictable switching from subject to subject?"	
4. Altered level of consciousness	Shown by any answer other than "alert" to the following:	
	"Overall, how would you rate this patient's level ofconsciousness?"	
	Normal = alert	
	Hyperalert = vigilant	
	Drowsy, easily aroused = lethargic	
	Difficult to arouse = stupor	
	Unarousable = coma	

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*The diagnosis of delirium requires the presence of features 1 AND 2 plus either 3 OR 4.

Delirium

- multicomponent, nonpharmacologic interventions to reduce modifiable factors for delirium in the ICU.
- Medications, including antipsychotics, are not recommended as a routine strategy to either prevent or treat delirium. (haloperidol, risperidone, dexmedetomidine, ketamin)
- Dexmedetomidine is conditionally recommended for delirium in mechanically ventilated adults when agitation precludes weaning or extubation.

Immobility

- Rehabilitation/mobilization interventions are recommended to reduce ICU-acquired muscle weakness due to immobility.
- Starting and stopping criteria for rehabilitation/mobility are provided.

Sleep Disruption

- Multicomponent protocols are recommended to promote sleep in critically ill adults, including volume control ventilator modes and nocturnal strategies to reduce ICU noise and light.
- Recommendations regarding the use of medications to improve sleep were not able to be made.

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Survival -> Survival + QOL

Paradigm Shift

Introduction

- Critical care medicine advance → survivors of critical illness increased
- Many survivors experience impairment in cognition, mental health, and physical function, known as postintensive care syndrome (PICS).
- The mental health of family members may also be adversely affected, which is termed PICS-Family (PICS-F).

Definition



Figure 1. Postintensive care syndrome (PICS) conceptual diagram. ASD, acute stress disorder; PTSD, posttraumatic stress disorder.

Epidemiology

- 2011년 미국기준 1년에 570만명의 중환자실 입원환자가 발생하고 이중 480만명 정도가 생존퇴원하는데 이중 50% 정도가 PICS로 후유증을 겪고 있다고 보고되고 있습니다.
- Cognitive: 평균 25%정도, 최고 78%까지 보고됨.
- Psychiatric: 1~64%까지 보고됨.
- Physical: 25~64%까지 보고됨.

Risk factors

- 1. Pre-existing factors
 - 1) Neuromuscular disorders
 - 2) Dementia
 - 3) Psychiatric illness
 - 4) Comorbid conditions
- 2. intensive care unit (ICU)-specific factors
 - 1) Mechanical ventilation
 - 2) Acute delirium
 - 3) Sepsis
 - 4) Acute respiratory distress syndrome

Clinical manifestations

• Common symptom: weakness, poor mobility,

poor concentration, fatigue,

anxiety, depressed mood

 many of the signs and symptoms of PICS last for months to years.

Prevention

- Awakening
- Breathing Coordination with daily sedative interruption and ventilator liberation practices
- **D**elirium monitoring and management
- Early ambulation in the ICU
- Functional reconciliation
- **G**ood hand-off communication
- Hand family written information
- light sedation, avoiding hypoglycemia and hypoxemia

Treatment

- Cognitive deficits, Anxiety, Depression, Post traumatic stress disorder; combination of nonpharmacologic and pharmacologic interventions
- Physical dysfunction; multidisciplinary program(exercise, symptom management, mobility aids, environmental adjustments)
- Sexual dysfunction; treating the underlying illness, mental health conditions, and pharmacologic therapies
- Malnutrition; provision of calories(mouth, tube feeding, IV nutrition)

Outcome 1) 중환자실 증후군 (PICS)의 징후와 증상은 중환자실에서 퇴원한 후 처음 6 개월에서 12 개월 사이에 완만하게 향상됩니다. 2) 많은 환자에서 문제가 수년간 지속되기도 합니다. 3) PICS는 종종 일상 업무로의 복귀 및 삶의 질을 저하시킬 뿐만 아니라 이후 몇 년 동안의 사망 위험 증가와 관련이 있습니다. 4) 예방적 또는 치료 적 개입의 효과는 알려지지 않았습니다. 5) PICS 병력이 있는 환자가 다시 중환자실에 입원했을때 PICS의 위험이 증가하는지 여부는 알 수 없습니다.

Post-intensive care syndrome-Family

1. most common problems: sleep deprivation, anxiety,

depression, post posttraumatic stress disorder (PTSD).

- Risk factors: poor communication between staff, being in a decision-making role, lower educational level, having a loved one who died or was close to death
- 3. last for months to years.
- 4. emphasizing frequent and effective communication with family members, as well as open flexible visitation and family presence on rounds.

