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# 입면기 중추성 수면무호흡

조양제

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# Sleep-onset Central Sleep Apnea

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Sleep-onset central sleep apnea is not uncommon phenomenon, and is usually regarded as a normal sleep pattern. Dysrhytymic breathing is frequently seen at sleep onset. Any process that leads to frequent sleep-wake transitions over the course of the night (such as insomnia) may increase the number of central apneas. Although the exact mechanism is still unclear, rapid loss of the wakefulness drive to breathe and unstable carbon dioxide set point results in central apnea/hypopnea leading to hypercapnia which induces subsequent hyperventilation secondary to arousals. If the following hypocapnia cross the apnea threshold, then central sleep apnea resumes. In this brief review, I will address the underlying physiology influencing sleep-onset central sleep apnea and its clinical implications.

**Key Words:** Central sleep apnea, Sleep transition, Dysrhythmic breathing, Mechanism

## 서 론

(central sleep apnea)

(respiratory drive)

, .

50%

(central sleep apnea syndrome) .[1]

, ,

.[1-3]

, ,

.

(sleep-onset central sleep apnea)

(sleep transition period)

, ,

, .[1,4-6]

.

## 본 론

### 중추성 수면무호흡의 분류, 역학

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,

40%

.[10,11]

,

. -

(obesity-hypoventilation syndrome; Pickwickian syndrome)

, 10~38%

,

.[12]

,

5% .[1]

## 입면기 중추성 수면무호흡의 기전

### 1. 호흡의 대사성 조절기전

(chemoreceptor)

(medulla) $CO_2$ ( $H^+$

) , carotid body

$PaO_2$ $PaCO_2$ .

. $PaO_2$ $PaCO_2$

. , $PaO_2$

$PaCO_2$ ( )

.

(negative feedback)

. ,

,

$PaCO_2$

$PaCO_2$ ,

(eupnic) ,

. ,

(

) $PaCO_2$

(prolonged hyperventilation)

$PaCO_2$

.[4,5,13,14]

### 2. 비대사성 호흡 조절기전 및 영향인자(modulating factor)

. 'wakefulness drive to ventilation'

, $PaCO_2$

(apnea threshold)

. muscle spindle

Golgi tendon organ

,

(behavioral influence), , ,

.

,

.[5,15]

, , , , .[6]

, ,

,

.[16]

,

,

.

12 testosterone

,

.[17]

.

$PaCO_2$

.

,[18]

,

.[19]

(central hypoventilation)

.[6] ,

- ,

, , 60 ,

$PaCO_2$ 38 mmHg .[8]

,[10,11]

,

,

.[6]

### 3. 중추성 수면무호흡의 단계별 기전

1) 수면으로의 이행

'wakefulness drive'

'behavioral influence' .

.

($PaO_2$ $PaCO_2$

)

.[20] ,

,

/

.[5]

2) 무호흡 역치

'wakefulness drive' 'beh-

avioral influence'

, $PaCO_2$

. $PaCO_2$

, .

$PaCO_2$ 2~6

mmHg ,

$PaCO_2$ .[21]

3) 수면에 따른 화학수용체 민감도의 변화

, $PaO_2$

$PaCO_2$

, .[20]

$PaCO_2$

, 3~8 mmHg $PaCO_2$ .

$PaCO_2$

$CO_2$ set point ,

$CO_2$ set point 3~8 mmHg .[22]

,

( $CO_2$ set point)

.[5]

4) 수면 중 각성에 따른 변화

.

.

.

/ ,

(arousal threshold)

.[5]

5) 각성 역치

( ,

, / , )

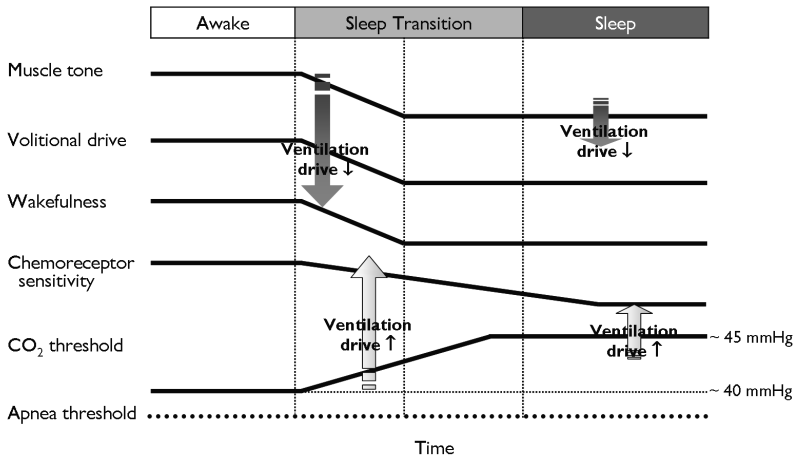


**Figure 1.** Time-dependent changes of various ventilation controlling factors according to the sleep status leading to sleep-onset central sleep apnea. When falling a sleep, the factors promoting ventilation drive (muscle tone, volitional drive, wakefulness drive, etc.) rapidly diminishes while chemoreceptor sensitivity slowly decreases and $CO_2$ threshold (or set point) slowly increases (up to around 45 mmHg). This difference make it possible that initial hypoventilation by loss of wakefulness promotes relative hypercapnia above the $CO_2$threshold, thus induce arousal and hyperventilation. Then subsequent hyperventilation-induced hypocapnia below the apnea threshold brings central hypopnea/apnea leading to hypercapnia again, provoking recurrent cycle of arousal and following hyperventilation. The sleep becomes deepened with time and the new higher $CO_2$ threshold is established, making the ventilation control stablein contrast to the fragile respiratory control during the sleep transition period.

. , .

, $PaCO_2$

.

.

[23]

(Figure 1).

6) 각성에 따른 호흡반응

. .

(eupnic $CO_2$ set point) $CO_2$ set point(~ 45 . $PaCO_2$

mmHg) $CO_2$ set point(~ 40 mmHg) $PaO_2$ , (

$PaCO_2$ $CO_2$ set point )

.[5,6,24] .

$CO_2$ $PaCO_2$

set point ( ) .

. $PaCO_2$

,

.

## 4. 입면기 중추성 수면무호흡의 기전

,

.

/

[25]

,

.

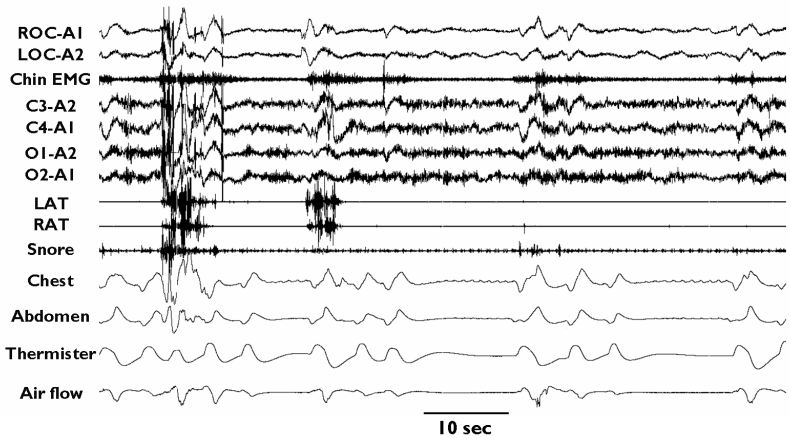


**Figure 2.** An example of sleep-onset central sleep apnea. After a brief arousal, complete cessation of airflow by nasal thermister without detectable movement of chest wall or abdomen (respiratory effort) repeats itself, thus making the respiratory control unstable. Small deflection in chest wall represents cardiac pulsations.

, , .

$PaCO_2$

, ,

$PaCO_2$ . 10 90%

,

. ( ) ,

입면기 중추성 수면무호흡의 임상 양상, 의의 .[6]

(Figure 2).

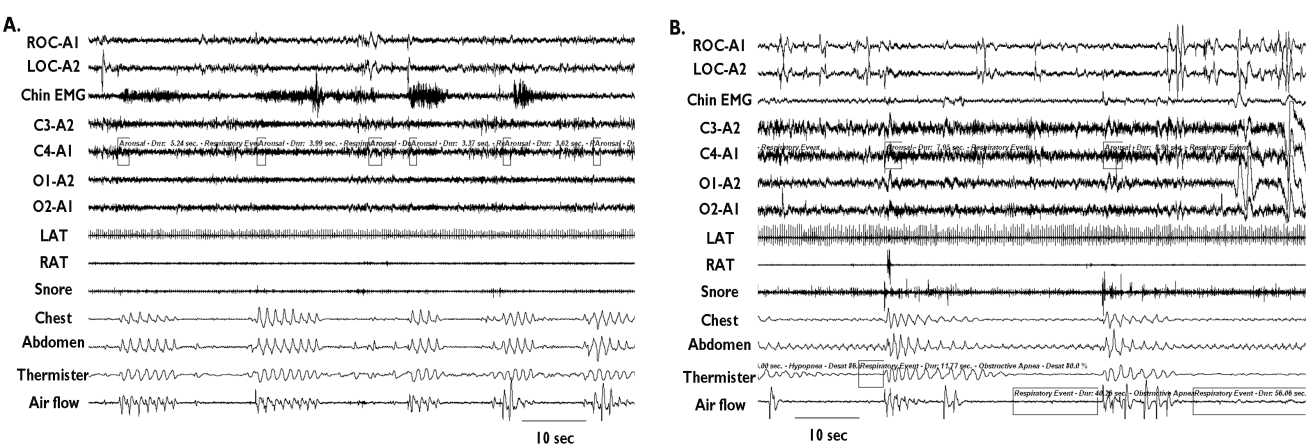


**Figure 3.** An example of exaggerate case of sleep-onset central sleep apnea, making a correct diagnosis difficult. Prolonged period of cyclic pattern of central sleep apnea during the sleep transition, mimicking the diagnosis of idiopathic central sleep apnea (A). During the REM sleep, prominent obstructive sleep apnea and hypopnea were disclosed, suggesting the diagnosis of obstructive sleep apnea (B). The patient was successfully treated with CPAP and hypnotics.

.

. , ,

,

(Figure 3).

,

[6].

,

,

( ) [1,6].

,

[1].

.

## 결 론

, .

, $PaO_2$ $PaCO_2$

, ,

.

.

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