Sleep recording during CPAP

Case 1

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Noninvasive ventilation and sleep unit
Hôpital universitaire Necker
Paris, France
7 year old boy, Mucopolysaccharidosis I

- Diagnosis at 6 months of age on hepatosplenomegaly and typical facial features
- Enzyme replacement therapy
- CPAP for severe OSAS since 4 years of age
Gas exchange on CPAP 8 cmH\textsubscript{2}O
Oxygen desaturations during CPAP, what would you do?

1. Nothing
2. Add oxygen
3. Increase pressure and control
4. Check in-built software
In-built software
Gas exchange during CPAP 9 cmH$_2$O
Case 2
11 year old boy, Wiedemann Beckwith syndrome

- CPAP started during the first year of life for severe OSAS
- CPAP stopped at the age of 4 yrs
- Recurrence of diurnal somnolence: a sleep study showed severe OSAS (IAH 25/h)
How do you start CPAP in this patient?

1. Which ventilator?
2. Which interface?
3. Which pressure?
4. How to monitor therapy?
Our choice

1. Ventilator: The “cheapest” CPAP
2. Interface: nasal mask
3. Pressure: the highest tolerated during adaptation when awake
4. How to monitor: sleep study (PG)
PG during CPAP

Heart rate

SpO₂

Pressure

Flow

Thoracic belt

Abdominal belt

Position

Left side
PG during CPAP
Built-in software

Airflow

Pressure

cmH2O

Leaks

L/min

0,41/sec = 24 L/min

Airflow

Airflow
Gas exchange during CPAP

TcCO₂

SpO₂

Heart rate

23:00 00:00 01:00 02:00 03:00 04:00 05:00 06:00
Leaks without oxygen desaturation or respiratory events, what would you do?

1. Nothing
2. Change interface and control with a sleep study
3. Change interface and control with built-in software
4. Lower pressure in order to avoid excessive leaks
Original Article

Polygraphic respiratory events during sleep in children treated with home continuous positive airway pressure: description and clinical consequences

Alessandro Amaddeo a,b, Valeria Caldarelli c, Marta Fernandez-Bolanos a, Johan Moreau a,d,e, Adriana Ramirez a,f, Sonia Khirani a,g, Brigitte Fauroux a,h,i,*

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Table 4
Occurrence of SomnoNIV respiratory events during CPAF (n = 29).

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Unintentional leaks</th>
<th>Partial or total UAO without decrease in ventilatory drive</th>
<th>Partial or total UAO with decrease in ventilatory drive</th>
<th>Decrease in ventilatory drive</th>
<th>Mixed events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of polygraphies with the event, n (percentage)</td>
<td>12 (41%)</td>
<td>19 (65%)</td>
<td>13 (45%)</td>
<td>12 (41%)</td>
<td>3 (10%)</td>
</tr>
<tr>
<td>Event index/h, median (range)</td>
<td>0.0 (0.0–3.1)</td>
<td>0.4 (0.0–7.9)</td>
<td>0.0 (0.0–4.8)</td>
<td>0.0 (0.0–25.2)</td>
<td>0.0 (0.0–2.0)</td>
</tr>
<tr>
<td>Percentage of time spent with each event, median (range)</td>
<td>0.0 (0.0–42.4)</td>
<td>0.7 (0.0–13.7)</td>
<td>0.0 (0.0–7.4)</td>
<td>0.0 (0.0–5.3)</td>
<td>0.0 (0.0–4.0)</td>
</tr>
</tbody>
</table>
Consequences of respiratory events
Case 3
15 year old boy
Treacher Collins syndrome

- Tracheostomy during the 1st month of life
- Decanulation at the age of 11 months followed by long term CPAP
- CPAP stopped at the age of 13 yrs after mandibular distraction osteogenesis (MDO)
2 years after MDO

- Pubertal spurt: + 15 cm in one year
- Daily somnolence, frequent awakenings, loud snoring, mouth breathing
- Decrease in school performances
- PG: severe OSAS with an AHI of 47/h
How would you start CPAP in this patient?

1. Which ventilator?
2. Which interface?
3. Which pressure?
4. How to monitor therapy?
1. Ventilator: Resmed S9 autoset 10 cmH$_2$O
2. Interface: facial mask (mouth breathing)
3. Pressure: the highest tolerated during adaptation when awake
4. How to monitor: polygraphy
PG during CPAP 10 cmH$_2$O
PG during CPAP 10 cmH₂O
PG during CPAP 10 cmH$_2$O
What would you do?
Gas exchange during CPAP 10 cmH$_2$O
Explanation …?
Analyse Position / Apnées

Durées et nombres des apnées en fonction de la position (sur la période validée)

- Dorsal : 122 min
- Latéral gauche : 322 min
- Latéral droit : 0 min
- Ventral : 0 min

Durée totale (min) : 23 3 1 23 19 1

% temps d’apnée (%): 0 0 0 0 0 0

Durée maximale (s) : 54 27 0 0 18 36

Durée moyenne (s): 0 0 0 0 0 0

Nombre par heure (h) : 78 12 0 0 30 2
PG during CPAP 10 cmH$_2$O

OSAS became positional with CPAP therapy
Images in sleep medicine

Non-positional severe obstructive sleep apnea on polysomnogram became positional OSA with CPAP therapy

Fouzia Siddiqui *, Edgar Osuna, Sudhansu Chokroverty
Persistance of respiratory events during CPAP at 10 cmH₂O: what would you do?

1. Keep the same pressure and recheck in 1 or 2 months
2. Increase CPAP pressure to 12 cmH₂O if tolerated
3. Change for a bilevel ventilation
4. Change for an auto-CPAP
A boy with positional apneas

Correction of all the apneas with an auto-CPAP at 8-12 cmH$_2$O

Other solutions:
- avoid supine position during sleep
- technical tools
Case 4
10 year old boy with ganglioglioma

- Cerebral tumour diagnosed at age 8
- Numerous surgical interventions, hydrocephalus (ventriculo-peritoneal derivation), epilepsy, hypopituitarism (substitutive therapy with L-thyroxine and hydrocortisone)
- Sleep study because of diurnal somnolence
10 year old boy with ganglioglioma
During wakefulness: what do you see?
Polygraphy
Polygraphy
Polygraphy

- Heart rate
- PWA
- Snoring
- SpO₂
- Tracheal sound
- Nasal flue
- Thoracic belt
- Abdominal belt
- Sternal pressure
- Position
AHI 104/h (CAHI 50/h and OAHI 54/h) with mean PtcCO$_2$ 48 mmHg
What’s the best strategy?

1. Oxygen therapy
2. Non invasive ventilation
3. CPAP
4. Nothing, the disease is evolutive
Despite several attempts the child did not tolerate Bilevel ventilation. What is your attitude?

1. Oxygen therapy
2. CPAP
3. Nothing
4. Other?
Assisted servoventilation (ASV)

ASV delivers servo-controlled inspiratory pressure support on top of positive expiratory airway pressure
ASV beyond Cheyne Stokes

BMJ Case Reports

Novel treatment (new drug/intervention; established drug/procedure in new situation)

Chiari malformation and central sleep apnoea: successful therapy with adaptive pressure support servo-ventilation following surgical treatment

Ahmed Fahim, Anthony OC Johnson

Table 1  Sleep studies during the course of investigation and management of the patient

<table>
<thead>
<tr>
<th>Measure</th>
<th>Baseline</th>
<th>Auto SV</th>
<th>Auto SV postoperation</th>
<th>No NIV postoperation</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI</td>
<td>68</td>
<td>0.1</td>
<td>0.1</td>
<td>8.4</td>
</tr>
<tr>
<td>AHI</td>
<td>81</td>
<td>10.5</td>
<td>0.7</td>
<td>22.1</td>
</tr>
<tr>
<td>Total apnoeas</td>
<td>523</td>
<td>1</td>
<td>1</td>
<td>81</td>
</tr>
<tr>
<td>Central</td>
<td>522 (99%)</td>
<td>1 (100%)</td>
<td>1 (100%)</td>
<td>69 (85%)</td>
</tr>
<tr>
<td>Obstructive</td>
<td>1 (0%)</td>
<td>0</td>
<td>0</td>
<td>3 (4%)</td>
</tr>
<tr>
<td>Mixed</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9 (11%)</td>
</tr>
<tr>
<td>Hypopnoeas</td>
<td>103</td>
<td>105</td>
<td>7</td>
<td>132</td>
</tr>
<tr>
<td>Duration mean (max)</td>
<td>23 (46)</td>
<td>16 (48)</td>
<td>14 (18)</td>
<td>17 (59)</td>
</tr>
<tr>
<td>Mean SpO₂</td>
<td>91%</td>
<td>95%</td>
<td>94%</td>
<td>93%</td>
</tr>
<tr>
<td>4% Dip rate</td>
<td>79</td>
<td>35</td>
<td>9.6</td>
<td>39.5</td>
</tr>
</tbody>
</table>

AHI, apnoea hypopnea index; AI, apnoea index; NIV, non-invasive ventilation; SV, servo-ventilation.
ASV beyond Cheyne Stokes

Effectiveness of Adaptive Servo Ventilation in the treatment of hypopcapnic central sleep apnea of various etiologies

Claudio Carnevale\textsuperscript{a,b,d}, Marjolaine Georges\textsuperscript{c}, Claudio Rabec\textsuperscript{c}, Renaud Tamisier\textsuperscript{a,b}, Patrick Levy\textsuperscript{a,b,1}, Jean-Louis Pépin\textsuperscript{a,b,1,*}

Sleep Medicine 12 (2011) 952–958
Our choice

1. Ventilator: Adaptive Servo Ventilator
2. Interface: nasal mask
3. Pressure: EPAP 5-8 and IPAP 0-8 cmH₂O
4. Monitoring: polygraphy
Polygraphy during ASV
Polygraphy during ASV
Gas exchange during ASV

![Graph showing TcCO2, SpO2, and Heart rate over time.](image)
Polygraphy during ASV

- Position
- Body mov.
- Snoring
- Insp.
- Exh.
- Apnea
- Hypop.
- Evt.
- SpO₂
- CPAP Pression
- Leaks
- HR
- Hour

Graphical representation of various parameters over time.
Case 5
2 year old boy, Niemann Pick type A

- Diagnosis at 6 months of age on hepatosplenomegaly and developmental delay
- CPAP for OSAS started at the age of 18 months
Gas exchange during CPAP 8 cmH$_2$O
Nocturnal gas exchange showed persistent desaturations and hypercapnia during CPAP 8 cmH$_2$O. What would you do?

1. Nothing
2. Add oxygen
3. Increase pressure and control with a PG
4. Switch to NIV
Polygraphy during CPAP 10 cmH₂O
Polygraphy during CPAP 10 cmH$_2$O
A PG during CPAP at 10 cmH$_2$O showed persistent respiratory events. What would you do now?

1. Nothing
2. Add oxygen
3. Increase pressure to 12 cmH$_2$O and control with a polygraphy
4. Switch to NIV
How do you start NIV?

1. Which ventilator?
2. Which interface?
3. Which settings?
4. How monitor therapy?
Our choice

1. Ventilator: Respironics Trilogy 100
2. Interface: facial mask (mouth breathing)
3. Settings: S/T AVAPS, IPAP 12/16, EPAP 6, TV 100 mL, slope 2, Insp Trigger 2L/min, Exp trigger 20%, RR 16/min
4. Monitor with a polygraphy
Polygraphy during NIV
Polygraphy during NIV
A PG showed persistent respiratory events. What would you do now?

1. Nothing
2. Increase pressure
3. Add oxygen
4. Increase trigger sensitivity
Our choice

- IPAP 13/17, EPAP 8, TV 130 ml
- RR 22/min, increase trigger sensitivity to 1L/min
Polygraphy during NIV
Polygraphy during NIV
Gas exchange during NIV

NIV started