NIPPV Improves Severe Chronic Lung Disease

A success story of the HAMILTON-C2 nCPAP-PS mode applied on a 6 months old boy with bronchopulmonary dysplasia (BPD)

A former preterm of 29 weeks gestation with chronic lung disease was at risk of urgency intubation while in need of an oxygen concentration of 100% via nasal cannula to achieve a pulse oxymetry saturation of 90%. Born with lung hypoplasia due to premature rupture of the membranes the boy had been on mechanical ventilation for 25 days and on nasal CPAP for 71 days. Actually, at the age of 6 months, he was in permanent tachypnoea and dyspnoea.

It was impossible to re-install nasal CPAP because of the boy's natural movements. The use of sedative drugs was contraindicated due to the side effect of reducing respiratory drive and thus putting the boy at risk of respiratory insufficiency. The challenge was to improve respiratory mechanics in his lungs with highly overinflated basal lung areas and irregularly inflated upper lung areas. Additionally, episodes of airway obstruction had been evident from auscultation. Re-intubation would have carried the risk of prolonged mechanical ventilation, failure to wean and need for tracheostomy and home ventilator therapy.

We decided to install NIPPV for its positive effects on recruitment and airway stabilization. A trial with a conventional system of NIPPV was unsuccessful due to patient-ventilator dyssynchrony. Then we introduced the HAMILTON-C2 ventilator. The HAMILTON-C2 is characterized by a high responsiveness and accuracy of the expiration and inspiration valves and a blower driven flow generation of up to 240 l/min. The biphasic pneumatic concept of the ventilator allowed the child to freely breathe regardless of ventilator induced inspiration or expiration phases.

With the mode nCPAP-PS, the flow sensor is not positioned at the Y-piece rather directly at the exhalation valve. This allows to connect a nasal interface without losing the possibility to synchronize inhalation and exhalation efforts of the patient with the ventilator. Leak is compensated over an ingenious algorithm called IntelliTrig. IntelliTrig detects the present leak and adapt flowtrigger threshold and expiratory trigger sensitivity for a perfect synchronization even in the presence of leaks. Ventilator settings were PEEP 6 cmH_2o, Pinsp 4 cmH_2O, Flow trigger 1.4 l/s, Pramp 25 ms, ETS 10%, Timax 0.7 s.

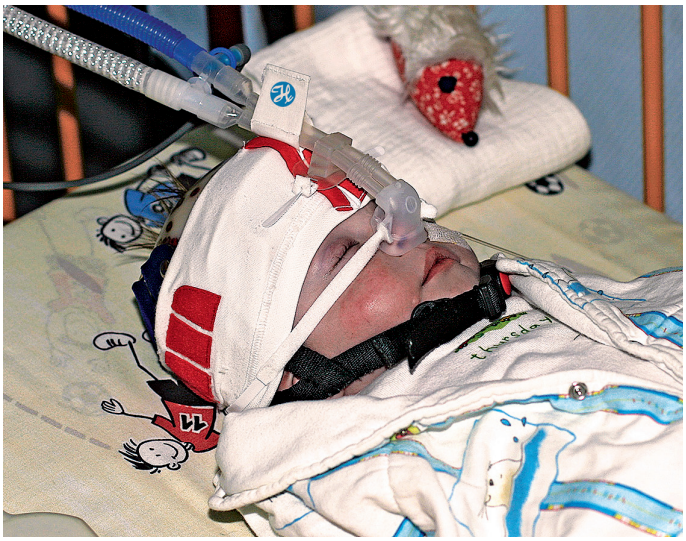

Fig.1: NIPPV therapy via nasal mask with the HAMILTON-C2

In the course of 7 weeks there was a significant clinical improvement with a reduction in oxygen need, decrease in respiratory rate and a decrease in the level of CO_2 (Tab.1). According to the literature on mechanisms of action we think that NIPPV was highly efficient as it improves respiratory drive[1], enhances ventilation uniformity[2], increases functional residual capacity[3], and thus effects lung recruitment.

After this treatment, the boy could be discharged from hospital for the first time in his life on home oxygen therapy via nasal cannula. Since then half a year has passed, no hospital readmission was necessary for this boy.

References

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(2) Deakins KM. Bronchopulmonary dysplasia. Respir Care. 2009 Sep;54(9):1252-62.

(3) Owen LS, Morley CJ, Davis PG. Neonatal nasal intermittent positive pressure ventilation: what do we know in 2007? Arch Dis Child Fetal Neonatal Ed. 2007 Sep;92(5):F414-8.

	day-time FiO_2 (nasal cannula)	night-time FiO_2 (nCPAP-PS)	respiratory rate (nCPAP-PS)	$PaCO_2$ (nCPAP-PS)
start of NIPPV	100 – 80 %	55 – 65 %	64 /min	58 mmHg
after 7 weeks of NIPPV	80 – 60 %	40 – 45 %	50 /min	44 mmHg

Tab.1: Significant reduction of required oxygen, decrease of respiratory rate and normalization of $PaCO_2$ over 7 weeks of NIPPV therapy with the HAMILTON-C2.

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