Feasibility of Overnight Transcutaneous CO2 Monitoring in the Home Setting

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Introduction

The PNAVD supports adult and pediatric patients requiring chronic invasive or non-invasive home mechanical ventilation with equipment and home follow-up visits. We have recently integrated the use of home overnight transcutaneous CO2 (TcCO2) monitoring.

Objectives

- To validate the feasibility of home overnight TcCO2 monitoring,
- To identify the specific diagnoses where this test was requested,
- To evaluate the related human resources costs

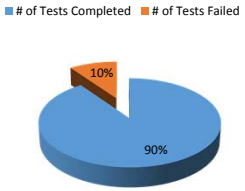
Methods

- A retrospective chart review was completed using the PNAVD administrative database on TcCO2 tests performed between May 2016 and May 2017.
- Protocol for home TcCO2 monitoring:
- The Sentec Digital Monitoring System (Sentec AG) monitor was delivered to the patient's home by the PNAVD respiratory therapist (RT), transported in a protective case within a temperature-controlled compartment.
- Instruction on use of the monitor was given to the patient or caregiver.
- Calibration of the Sentec Monitor:
  - A first calibration of the device was done by the RT,
  - A second was done by the caregiver or patient just before installation and overnight recording,
  - A third at the end of the test in the morning for calculation of signal drift.

Results

- During the study period, 51 tests were requested due to suspicion of residual hypoventilation for 42 ventilated patients (30 adult, 12 pediatric).
- Five studies failed:
  - 1 due to a defective measurement membrane;
  - 3 incorrect installations;
  - 1 was not completed as the patient was hospitalized.
- Repeated tests were successfully done in these patients and in 3 patients as follow-up or post changes to ventilator settings.

Figure 1: Breakdown of patient's tests



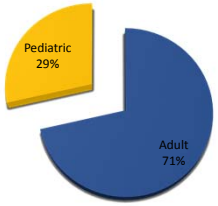
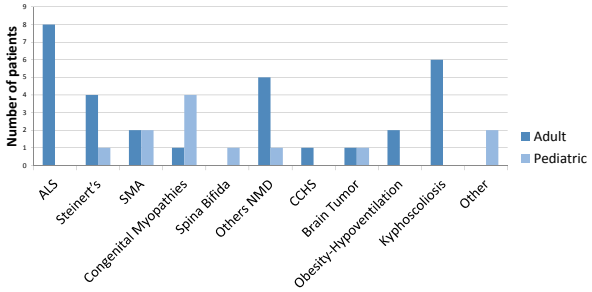


Figure 2: Breakdown of patient's tested

Results – Diagnosis and age

- The adult patients' average age was 53 years (range 22 – 89, SD 18).
- The pediatric patients' average age was 9 years (range 3 – 16, SD 6).

Figure 3: Diagnoses of patients tested

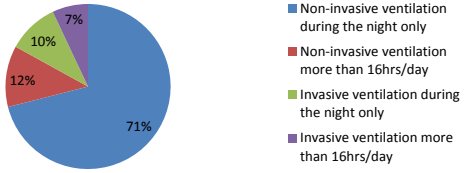


Others (NMD): Limb Girdle, Multiple Sclerosis, Myasthenia gravis, Ataxia, Becker, Coffin-siris Syndrome
Other: Meier-Gorlin Syndrome and bronchopulmonary dysplasia

Results – Type of ventilation

- The Patients' types of ventilation are listed in Figure 4,
- 33% of the patients tested had oxygen with their ventilation:
  - Adult 19%
  - Pediatric: 14%.

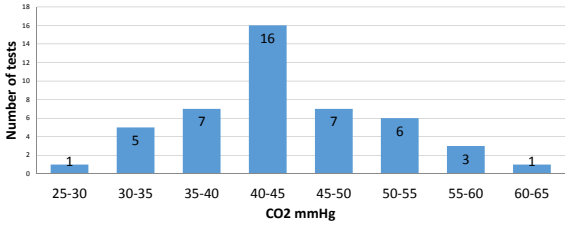
Figure 4: Type and hours of ventilation



Results – CO2 levels

- Of the 46 completed tests:
  - 16 (35%) showed a mean CO2 ≥ 45 mmHg;
  - 10 (22%) showed a mean CO2 level > 50 mmHg;
  - 11 (24%) showed CO2 values ≥ 55 mmHg > 10 min.

Figure 5: Mean CO2 level per test



- Of the 3 repeated tests:
  - 1 patient decreased the mean CO2 from 56,8 to 46,7mmHg post changes to ventilator setting;
  - 1 patient increased the mean CO2 from 29,1 to 33, 1mmHg post changes to ventilator setting to decrease hyperventilation;
  - 1 patient did a follow up to validate the CO2 value without oxygen, Mean CO2 with oxygen: 38,2, without oxygen 35,6mmHg.

Results – Cost

- Comparison of the cost of performing overnight Transcutaneous CO2 monitoring for 51 tests (not including monitor-related costs):

In the home care setting:
- Travel cost to deliver and recover the monitor: $3015.16 (average $59.12 and 68.7 km /study);
- Human resources cost; RT time travel and download of data: $6120 (average $120 /study).
- Total (CAD): $9 135,00

During in - centre polysomnography (PSG)* :
- Human resources costs,: $315 for the recording technician and $100 for scoring ($415 /study).
- Total (CAD): $21 165,00

*This does not include the cost of any staff required to help transfer patients from wheelchair to bed, when needed, nor the cost of travel incurred by the patient.

Conclusion

- In conclusion, it is feasible to utilize the Sentec TcCO2 monitor at home in selected ventilated patients with various diagnoses. In the population tested, few studies failed, and residual sleep hypoventilation was detected in a significant number. Home overnight TcCO2 monitoring is more cost effective than TcCO2 recording as part of PSG in hospital.

Acknowledgements

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