Monitoring the respiratory rate recovery time in children with asthma

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RATIONALE

Pediatric asthma is one of the most common chronic diseases in childhood. Symptoms, such as chest tightness, shortness of breath, coughing and wheezing, make it difficult for asthmatic children to keep up with their peers during sports and play. Healthy children recover quickly to baseline heart and respiratory rate after exercise. This physiological mechanism enables them to perform their typical frequent but short bursts of intense activity. In children with exercise induced bronchoconstriction the recovery of respiratory rate after exercise may be slower, as bronchoconstriction compromises ventilation. Therefore, this research focused on assessing the respiratory rate recovery time (RRRT) of asthmatic children in both the home setting and during the controlled setting of the exercise challenge test (ECT).

POPULATION

- 32 children with controlled asthma
- 27 children with non-controlled asthma
- 30 healthy children
- No ICD/pacemaker
- No co-morbid diseases

METHODS

All children underwent an exercise challenge test (ECT) according to ATS guidelines and participated in the WEARCON home-monitoring trial for 2 weeks. ECG was recorded during the ECT and for 2 days and nights at home. Pediatric asthma control was assessed by the pediatrician.

Figure 2: Faros eMotion 360° wearable ECG device.

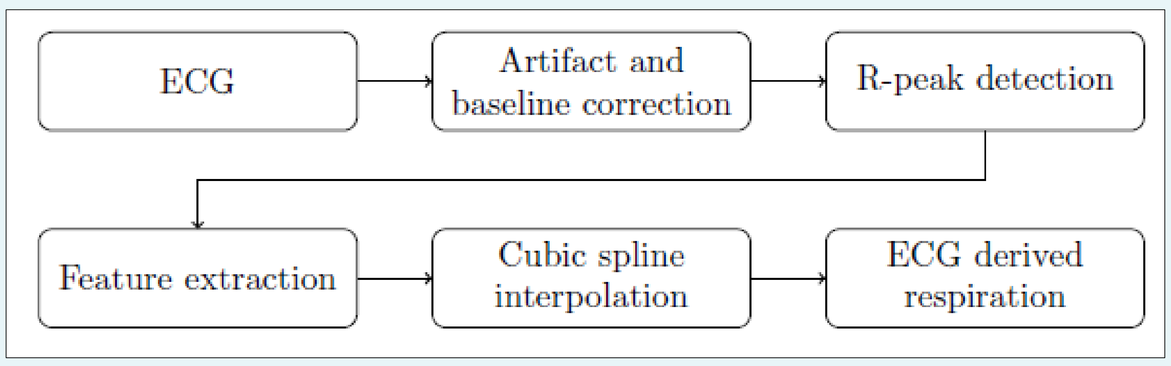

Figure 1: Schematic overview of the analysis of the raw ECG signal to the ECG derived respiratory signal from which the respiratory rate recovery time could be derived.

RESULTS

Table 1 shows the primary ECG outcome parameters. A fair correlation between the RRRT at home and during the ECT was found (pearson R = 0.45). Combining the RRRT with other WEARCON home-monitoring parameters (wake up time, FEV_1 variation and salbutamol use) resulted in a multiple binary logistic regression model with R^2 0.89 to differentiate controlled and non controlled asthma. The odds ratio of the RRRT is 1.138, indicating the risk of uncontrolled asthma is increased 13.8% with every one second the RRRT is prolonged.

	Control	Non-control	Healthy
Nighttime HR	72 (±14)	79 (±16)	71 (±9)
Nighttime RR	15.6 (±1.6)	17.5 (±2.5)[1,2]	15.2 (±2.2)
HRRT – home (s)	34 (±24)	64 (±42)[1,2]	28 (±10)
RRRT – home (s)	23 (±14)	61 (±42)[1,2]	16 (±7)
HRRT – ECT (s)	117 (±70)	133 (±55)	98 (±37)
RRRT – ECT (s)	80 (±49)	181 (±150)[1,2]	64 (±31)

Table 1: ECG derived outcome parameters: mean (±SD)

[1] P<=0.05 compared to healthy, [2] P<=0.05 compared to controlled asthma.

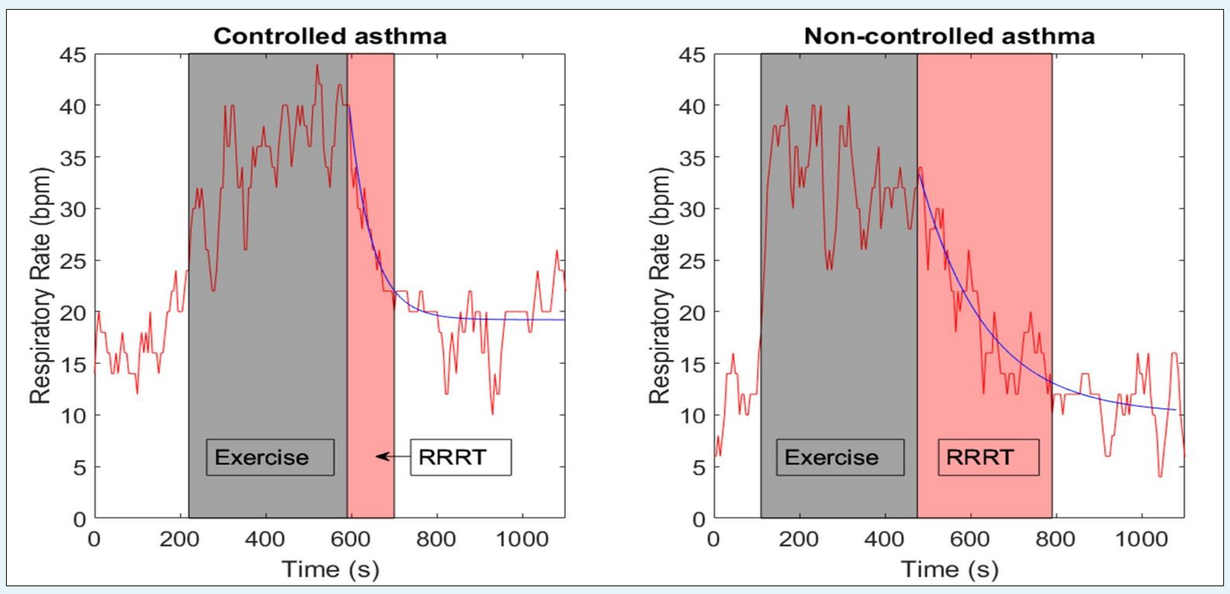

Figure 3: Example of the respiratory rate of a controlled (-9.8% FEV1) and a non-controlled (-39.2% FEV1) asthmatic child. An exponential fit of the respiratory recovery is indicated by the blue line.

CONCLUSION

This study suggests that the respiratory rate recovery time is a viable method for differentiating controlled and non-controlled asthma.

Wearable home-monitoring of the RRRT may provide the pediatrician with information to anticipate on worsening of asthma control.

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