

# Quality control of various ergospirometric measuring parameters by means of a gas exchange simulating system

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## Introduction

Quality control is significant for valid results in metabolic gas exchange measurements. The inherent variability of human breathing makes it difficult to assess the quality of breath-by-breath (BxB) gas exchange analysis. Several gas exchange simulation systems (GESS) have been developed to simulate gas exchange and to control quality of metabolic measurements (Gore et al. 1997; Prieur et al. 1998). Previous studies mainly focussed on the  $O_2$ -uptake and the  $CO_2$ -output (Keskinen et al. 2002; Kusch et al. 2002). They now aimed to have a closer look onto different primary measuring parameters like expiratory tidal volume ( $V_t$ ) and single breath duration ( $t_b$ ).

## Methods

The GESS was used to simulate different expiratory volumes ( $V_t$ : 0.5-2.9 l), respiratory frequencies ( $f_r$ : 10-60  $b \cdot \text{min}^{-1}$ ), gas fractions ( $O_2$ : 16-18 %;  $CO_2$ : 3-5 %) and  $O_2$ -uptakes ( $\dot{V}O_2$  ca. 0.1-6.0  $l \cdot \text{min}^{-1}$ ). Measurements were obtained by connecting the GESS directly with a portable metabolic cart (Ergospiro 680, zAn, Germany). A position sensor allowed monitoring the stroke volumes of the GESS and these data were used to calculate the simulated gas exchange as in the metabolic cart software. Agreement between GESS expiratory values and metabolic cart readings was evaluated by Passing-Bablok regression analysis and differences were tested by ANOVA.

## Results

Figures 1 – 3: regression plots

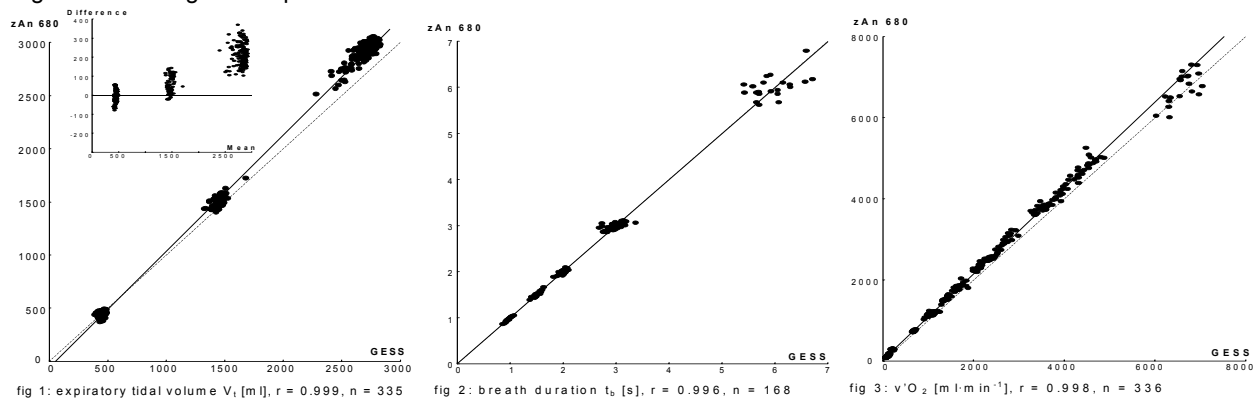


fig 1: expiratory tidal volume  $V_t$  [ml],  $r = 0.999$ ,  $n = 335$

fig 2: breath duration  $t_b$  [s],  $r = 0.996$ ,  $n = 168$

fig 3:  $\dot{V}O_2$  [ $ml \cdot \text{min}^{-1}$ ],  $r = 0.998$ ,  $n = 336$

GESS  $\dot{V}O_2$  and  $\dot{V}CO_2$  values were highly correlated with the cart results ( $r \geq .995$ ). Especially the excellent correlations between breath durations and between expiratory tidal volumes ( $r \geq .996$ ) are responsible for these results. However, somewhat greater deviations were observed for volume flow rates in excess of  $9 l \cdot s^{-1}$ , which were due to an overestimation of  $V_t$  at high ventilatory frequencies ( $f_r > 50 b \cdot \text{min}^{-1}$ ).

## Conclusion

The present testing procedure can be used to assess the validity of BxB devices. We conclude that the portable metabolic cart tested can be considered as a valid instrument for measuring pulmonary BxB gas exchange parameters within a wide physiological range.

## References

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