Introduction:
Critical illness may result in muscle weakness and decreased cardiopulmonary fitness. To avoid this, mobilization is started in the early stage of intensive care unit admission. Cardiopulmonary exercise testing can be used for diagnostic purposes. An accepted method of interpreting exercise data is by presenting them as 9-panel plots, as proposed by Wasserman [1], and analysing them systematically. We set out to explore whether gas exchange data obtained during exercise in intubated, critically ill patients could be analysed as standard 9-panel plots.

Methods:
Mechanically ventilated patients recovering from critical illness were subjected to an incremental exercise protocol using a bedside cycle ergometer (MOTOmed). Respiratory gases were analysed with a Cosmed Quark, applied to an endotracheal tube. Blood gases were sampled from arterial catheters. Data were analysed using MS Excel.

Results:
Exercise data of seven patients were analysed individually, providing insight in their respiratory physiology. The cumulative data are shown in Figure 1. Basal metabolic rate was increased in 6/7 patients. Median oxygen uptake (VO\(_2\)) increased from 408 to 489 ml/min during unloaded cycling, corresponding to an intrinsic workload of 10 W. Median maximum extrinsic workload during loaded cycling was 7 W, resulting in a median peak VO\(_2\) of 34.3 % of predicted VO\(_2\)\(_\text{max}\). This was accompanied by an increase in CO\(_2\) production, respiratory minute volume and heart rate. Three patients passed the anaerobic threshold.
Median fractional dead space at rest was 44%, decreasing to 42% during exercise, accompanied by a similar decrease in arterial-end tidal PCO\(_2\) difference, and improved respiratory efficiency for O\(_2\) and CO\(_2\). Median arterio-alveolar oxygen difference was 9.9 kPa, decreasing to 7.2 during exercise.

Conclusion:
This research demonstrated the feasibility of standard 9-panel plots to present and analyse exercise data in mechanically ventilated, critically ill patients.

References:


Image:
Figure 1: Exercise data of seven ventilated patients