A Computerized Method Adapted for Pulmonary Function Testing in Unsedated Horses

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It has been suggested that accurate pulmonary function (PF) investigation in unsedated animals requires measurement of many different parameters, measurement of these PF values on many different breathing cycles and selection of the measured breathing cycles which should be preceded and followed by artifact-free cycles.
It is well known that measurement of these PF values, using a manual method, is a very laborious procedure. On the other hand, the available computerized methods presented disadvantages such as measurement of only a few parameters, no selection of the measured breathing cycles and requirements for expensive hardware.
Therefore, our purpose was to design a software program which was reliable, complete, fast and flexible, and could be run using a common personal computer.
Three different programs were written. The first one is used for measurement of the mechanical values of breathing. It is divided into different subprograms like calibration, off-line data, measurements and printing.
Calibration can be performed for different full scale pressures and for different Fleisch pneumotachograph heads. The Lilly head can also be used. Selection of the pressure range and the Fleisch head must be done before each measurement. If not, the last selected values are used.
The off-line data, which are needed for printing the final report, may be introduced before or after PF measurements. These data include mainly information about the patient's condition and blood gas values.
The subprogram for PF measurements is divided into different parts: (i) on-line screen display of the flow, volume and intrapleural pressure (Ppl) curves, (ii) direct selection of the breathing cycles which should be investigated and (iii) PF measurements within 1 sec. (respiratory frequency, inspiratory time/total time of the breathing cycle, tidal volume, minute volume, mean inspiratory and expiratory airflows, maximal inspiratory and expiratory airflows, the lowest Ppl during inspiration, the highest Ppl during expiration, Ppl at the functional residual capacity (FRC) level, maximal change in Ppl, dynamic lung compliance, total pulmonary resistance, viscous work of breathing and power of breathing). These values may be refused, stored in memory and/or printed.
The printing subprogram allows partial or global printing of off-line data, mean on-line data and selected curves and loops. It is therefore possible to see the breathing cycles which were selected, pressure/volume loops and compliance lines on the final report.
The reliability and reproducibility of the measurements done by the computerized method were checked by 2 experiments. Firstly, in 5 ponies, PF values were simultaneously measured on the same 5 breathing cycles for each animal both by the manual and the computerized methods. The values calculated by the computer did not differ significantly (student test for paired data) from those measured, using a rapid writing polygraph.
Secondly, reproducibility of the measurements was investigated, using our artificial lung-thorax unit, which is able to generate identical breathing cycles. The variability of the measured values was smaller for the computerized method than for the manual one, especially for data like dynamic lung compliance which need a high level of precision.
The second program can be used with a helium closed circuit and an helium analyzer for measurement of FRC. There are different subprograms for calibration, measurements and printing. It is also possible to print the helium dilution curve on the final report which should be useful for the study of ventilatory asynchronism.
The third program can be used with rapid oxygen (O_2) and carbon dioxide (CO_2) analyzers and with an airflow analyzer. The following data may be measured: expiratory mixed tensions for O_2 and CO_2, end-tidal tension for O_2 and CO_2, O_2 intake, CO_2 production, respiratory quotient, ventilatory equivalent for O_2 and CO_2, oxygen pulse, dead space volume and alveolar ventilation. Off-line data, on-line data and O_2 and CO_2 curves may also be printed.
In conclusion, it can be said that although the reliability and reproducibility of this software have been demonstrated, it is always useful to print some breathing cycles on the final report.
Indeed, the computerized method, although more precise and much faster than the manual one, is still a more "blind" technique. This disadvantage doesn't occur when the program allows printing of both the mean measured values and the selected curves and loops.

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