Early Experience on Remote Pressure Sensor Respiratory Plethysmography in Monitored Sedation

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Background and objective: The importance of monitoring the breathing pattern during sedation of children undergoing MRI is indicated in guidelines, but no appropriate MR-compatible devices are available. We report preliminary findings from a technique referred to as Remote Pressure Sensor Respiratory Plethysmography (RPSRP).
Methods: A data acquisition system was developed, enabling measurement of respiratory rate (RR), plethysmogram amplitude (PA), proportion of inspiratory time over cycle time (T_I/T_{TOT}), thoraco-abdominal phase shift (PS) and sigh rate (SR). Correlation between PA and tidal volume was investigated on adult volunteers. Twenty-seven children undergoing sedation were monitored with RPSRP, in addition to SpO_2 and $P_{ET}CO_2$. Differences in monitoring parameters were searched for among three groups: patients that received chloral hydrate only (CS), those that received a supplementation of sodium thiopental (CF), and those that were sedated with sodium thiopental directly (NC). Correlations were searched for among monitoring parameters, and with total dose of thiopental. The long-term behaviour of RR, T_I/T_{TOT} and PS was studied.
Results: PA was found to correlate linearly with tidal volume ($r>0.92$), with a slope varying up to 22%. While 11% of patients did not tolerate the capnometric probe, all of them tolerated RPSRP belts. Sighs and non-respiratory movements of the torso could be distinguished on RPSRP waveforms. No significant inter-group differences were found in $P_{ET}CO_2$, SpO_2, RR and PS. T_I/T_{TOT} was higher in the NC group when compared to the CS group (0.497 ± 0.03 vs. 0.463 ± 0.008, $p=0.02$), the CF group being characterised by intermediate values (0.480 ± 0.008); when compared to the CS group, SR was lower in the CF group (0.04 ± 0.04 vs. 0.14 ± 0.08, $p=0.04$) and in the NC group (0.06 ± 0.05 vs. 0.14 ± 0.08, $p=0.03$). A positive correlation was found between total dose of thiopental and T_I/T_{TOT}, with $r=0.4$ and $p=0.04$. A large baseline variability in PS was found. No long-term trends predictive of patient movements could be identified.
Conclusions: Breathing pattern monitoring is feasible through pneumatic devices, which are well tolerated. The resulting correlation with changes in tidal volume can be better when compared to visual inspection. T_I/T_{TOT} and SR convey information related to the state of the sedated patient. Large-scale studies on the clinical usefulness of breathing pattern monitoring are motivated.