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LETTER TO THE EDITOR

Reponse to 'Estimating the autonomic function from heart rate variability in mechanically ventilated patients after spinal cord injury'

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We thank Drs Castiglioni and Merati for the insightful comments regarding applicability of standardized heart rate variability (HRV) analysis in ventilated spinal cord injury (SCI) patients.[1] The authors noted a possible methodological error in setting our lower limit of the high-frequency band at 0.15 Hz corresponding to 9 breaths min^{-1} in the analysis of ventilated patients, thereby risking that the power of the respiratory oscillation will be associated with the low-frequency power (LFP) and not entirely with the high-frequency power (HFP), resulting in overestimation of the sympathovagal balance.

We agree with the authors that special attention in using the default settings of HRV analysis software should be taken for ventilated patients.

The authors refer to a Medscape article by Amitai *et al.*[2] that states that 8–12 breaths min^{-1} are recommended for patients not requiring hyperventilation.

In our study all mechanically ventilated patients were treated as recommended by the guidelines from the Consortium for Spinal Cord Medicine with an initial breathing rate of 12 min^{-1}.[3] If at a later state the patient's condition permitted assisted ventilation, the respiratory frequency could occasionally be <10 breaths min^{-1} for a shorter period of time.

Among 50 patients, 17 patients were mechanically ventilated (15 C1–C8 and 2 T1–T5).[4] We reviewed this group of patients regarding respiratory frequency throughout their admission in intensive care unit (ICU). Owing to a new data management system, three patients did not have their respiratory rate stored. Median ICU admission time was 25 days (range 5–45 days), but as described in Table 1 in our paper, patients classified as being in ventilator treatment were not necessarily ventilated throughout the entire observation period. Five patients received ventilator treatment during the entire observation period. Among the reviewed patients two had an intermittent respiratory frequency of <9 during one Holter recording and one had an intermittent respiratory frequency of 9 during one Holter recording. All other reviewed patients were ventilated with a least 10 breaths min^{-1}.

When looking at the available spectrogram data of the mechanically ventilated patients, the general pattern of the respiratory peak correlated to a respiratory frequency of 11–12 breaths min^{-1}. The waterfall spectrogram illustrated in Figure 1 in our paper therefore reflects an exception from the general data of the ventilated patients.

The authors state that a respiratory peak between the LFP and HFP bands results in an overestimation of the sympathovagal balance. With regard to the results of our study, we found significantly lower values of LFP and low frequency/high frequency (LF/HF) ratio in C1–T5 SCI patients compared with T6–T12 SCI patients. All the mechanically ventilated patients belong to the C1–T5 group. If we have overestimated the sympathetic response in any of our mechanically ventilated patients, we would expect even lower sympathetic responses from the C1–T5 patients.

To investigate the potential methodological error that ventilator-treated patients might have caused in our study, we recalculated the statistics after excluding the mechanically ventilated patients.

As in our previous results we found significantly lower values of LF/HF ratio in C1–C8 patients compared with T6–T12 patients ($P=0.002$). LFP was significantly lower in C1–C8 patients compared with T1–T5 and T6–T12 patients ($P<0.001$). The difference between C1–C8 and T1–T5, which was not found in our previous results, can be explained by a very limited amount of patients in the group (three patients) after removal of mechanically ventilated patients. No difference between groups was found in HFP.

From a methodological point of view it is difficult to evaluate the contribution from low-frequency mechanical ventilation alone on HRV as such experiments require that patients are evaluated for a period of time both with and without mechanical ventilation, and their general clinical condition during these two situations may be different.

In conclusion, we appreciate the qualified comments by Drs Castiglioni and Merati regarding HRV analysis in mechanically ventilated patients. It is important that future HRV studies regarding mechanically ventilated patients assess whether the respiratory peak is entirely in the HFP band. Regarding the results of our study, only two of our ventilated patients had short periods with a breathing rate of <9 and additionally our analysis without mechanically ventilated patients still showed lower sympathetic activity with higher injury level. Hence, the overall conclusions of the study remain valid.

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