

Examining the Relationship Between Circadian Temperature Rhythm and Successful Discontinuation of Mechanical Ventilation

Sheena Keding, MSN(c), RN, at the School of Nursing, California State University, Fresno

Research Question

Does the presence of a circadian temperature rhythm have a relationship to the ability to successfully discontinue the mechanical ventilator?

Introduction

Every client who receives mechanical ventilation will require the weaning process and eventually discontinuation of the ventilator. However, removal of mechanical ventilation and subsequent extubation is an invasive intervention that can be extremely challenging and lead to poor outcomes if it is attempted when optimal health is not present (Drouot, Cabello, d'Orho, & Brochard, 2008). The current protocol used to determine when a patient is ready to have the ventilator discontinued includes a Spontaneous Breathing Trial (SBT). However, the use of only the SBT to determine readiness leads to 31.2% of patients failing extubation (Boles et al., 2007). Furthermore, there is a population of patients who struggle with the removal of mechanical ventilation, and it is suggested that 10-50% of patients will experience prolonged ventilation due to difficulty with the discontinuation process (Boles et al., 2007).

Sleep and circadian researchers have suggested there is a relationship to their field of study with medical interventions such as mechanical ventilation. The expressed relationship involves improved patient outcomes if invasive interventions are performed in the presence of optimal health which is evidenced by stable circadian rhythms (Drouot et al., 2008). It has been hypothesized that the presence of circadian rhythms will allow the patient to recover from invasive interventions (Drouot et al., 2008; Hanneman, 2009).

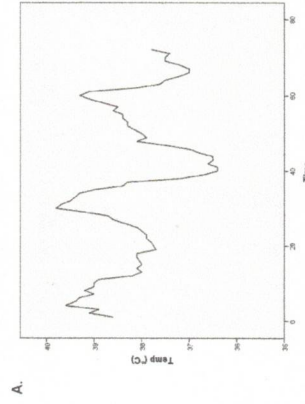
Since additional criteria are needed to support those 31.2%, this study aims to apprehend the impact, if any, that circadian temperature rhythm might have on the process of discontinuing the ventilator.

Method

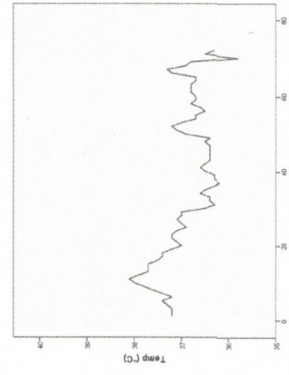
- Retrospective descriptive correlational study
- Mechanically ventilated for > 96 hours
- Excluded female, age > 50 years, age < 20 years, neurologic trauma, burn trauma, and patients with tracheostomy
- Cosinor Analysis done to identify circadian rhythm from temperature data with a threshold of $r^2 > 0.30$ (r^2 is higher then circadian rhythm is present)

Determining Circadian Rhythm Presence

Figure 1 shows a graphical representation of temperature circadian rhythm as determined by a Cosinor Analysis. The value of $r^2 > 0.30$ indicates rhythmic presence.



A.



A. Patient exhibits a circadian temperature rhythm. The corresponding $r^2 = 0.72$. B. Patient does not exhibit circadian temperature rhythm. The corresponding $r^2 = 0.02$.

Results

Table 1 summarizes the presence of a temperature rhythm in relation to success with ventilator discontinuation.

- A total of 29% of 31 patients exhibited a rhythm prior to extubation.
- There was an 89% chance at being successful when rhythm is present, while only a 73% chance of success when lacking a rhythm.

Table 1. Outcomes of Ventilator Discontinuation Among Patients With and Without Circadian Rhythms

Rhythm prior to Discontinuation of the Ventilator	Frequency (n)	Failed Discontinuation (n)	Successful Discontinuation (n)
No Temperature Rhythm	22	6	16
Temperature Rhythm	9	1	8
Total Cases	31	7	24

Table 2 displays the characteristics of the patients in each group. None of the differences were statistically significant.

- The average total time for all patients on a ventilator was 171 hr. Although not statistically significant, the average ventilator time for those with rhythm was greater than for those without by 52 hr.
- The average age for all patients was 40.23 years old. The average age for those exhibiting circadian temperature rhythm was younger than for those who did not exhibit temperature rhythm at that time, by 4.7 years.
- The average total hospitalization time was 28 days. The average hospital days for those with rhythm was almost two times more than for those without rhythm.

Table 2. Characteristics Between Patients With and Without Circadian Temperature Rhythm

Patient Characteristics	Rhythm prior to discontinuation	N	Mean	Std. Deviation	Std. Error Mean
Total time On Ventilator - (hr)	No Rhythm	21	155.64	50.429	11.005
	Rhythm	9	207.72	130.550	43.517
Age	No Rhythm	22	41.59	8.279	1.765
	Rhythm	9	36.89	10.470	3.490
Total Hospitalization (days)	No Rhythm	22	23.00	12.728	2.714
	Rhythm	9	40.22	43.425	14.475

Conclusion

This study was suggestive of the existence of a relationship between the presence of circadian temperature rhythm and successful discontinuation of the mechanical ventilator for patients on a mechanical ventilator >96 hr. There was increased success with the removal of the ventilator in the presence of a circadian temperature rhythm. It is important to note, the lack of rhythm did not indicate failure, rather only decreased chance of success.

Furthermore, for those who exhibited a rhythm at the time of extubation, it was noted their average hospital length of stay and duration of mechanical ventilation was increased. The relationship here may be related to the fact that the patients had more time to adapt to the environment and equipment to develop and display a circadian temperature rhythm. Therefore it is not the rhythm that caused the increase in duration of the discontinuation process, but possibly it was the extended time that allowed for circadian temperature rhythm to develop through adaptation.

References

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Contact Information

Sheena Keding, MSN (c), RN
skeding22@gmail.com