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A NOVEL NON-CONTACT DEVICE THAT IDENTIFIES AND CATEGORISES SLEEP DISORDERED BREATHING IN PATIENTS WITH CHRONIC HEART FAILURE

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Introduction Sleep Disordered Breathing (SDB) is prevalent in patients with chronic heart failure (CHF) and is associated with increased mortality. The current gold standard for making this diagnosis in patients is polysomnography or polygraphy (PSG/PG). This is cumbersome and labour intensive. Repeat studies where there is diagnostic doubt are also difficult and challenging due to such resource constraints. The SleepMinder device is a novel non-contact bedside biomotion sensor that uses an ultra low power radiofrequency transceiver able to detect movement and breathing. We sought to evaluate its accuracy in identifying and quantifying SDB in patients with CHF compared to full in hospital PSG.

Methods 30 adult patients with systolic heart failure had simultaneous overnight in-hospital PSG and SM recordings after consent in the HF clinic. An Apnoea Hypopnoea Index (AHI) algorithm was developed using intelligent feature extraction, vector transformation and pattern recognition techniques, from a training set of 20 patients and tested on the remainder of 10 patients. We aligned the PSG and SM signals using a cross correlation and sliding window system and the SM's Sleep/Wake analysis and integrated movement detector

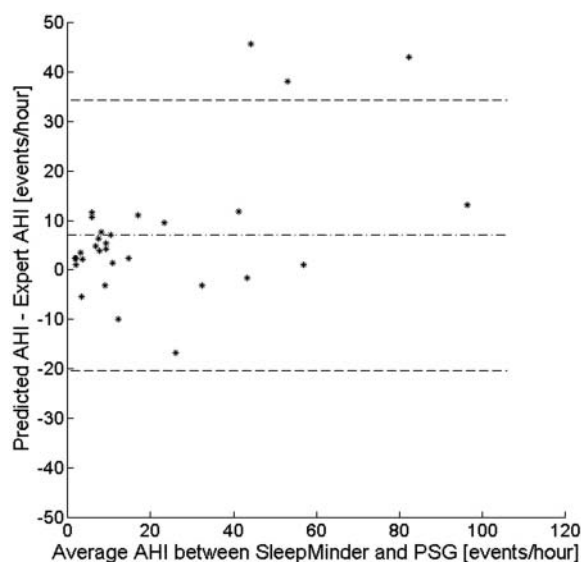


Figure 1 Bland Altman plot showing agreement between the two techniques.

algorithm was employed to determine the SM calculated Total Sleep Time (TST) for the purpose of AHI estimation. The PSG signals were scored by an independent expert scorer using standard criteria.

Results The median age of studied patients was 70.5 years. The mean ejection fraction, and Body Mass Index were $33.6 \pm 6.05\%$, and $29 \pm 5 \text{ kg/m}^2$ respectively. 37% of patients had SDB with an AHI >15 determined by expert PSG scoring. The correlation between SM_{AHI} and PSG_{AHI} was excellent with a co-efficient of 0.95 for the training and 0.84 for the test set. The Bland and Altman plot also showed good agreement across the range of AHI and did not vary by more than 10 events per hour in 70% of patients for all patients (figure 1). Our algorithm had good diagnostic accuracy across the board but performed best with a diagnostic threshold of AHI >15 , which represents clinically significant SDB, with a sensitivity of 91% and a specificity of 90%. The area under receiver operator characteristic curve at this threshold was 0.93.

Conclusions The SleepMinder compares favourably with full in-hospital PSG, detecting every patient with an AHI >15 with a low false positive rate of 9% in a CHF clinic population. Its novel contactless feature makes it convenient to use and patient friendly. We plan

to extend this work to involve a larger study cohort to confirm the diagnostic value of this new tool and are also continuing to explore the unique opportunity this device presents for the longitudinal assessment of nocturnal respiratory patterns and nightly variations of SDB in patients with chronic heart failure.

Table 1 Haemodynamic changes in the overall population

Temperature	Sys. BP (mm Hg)	Dis. BP (mm Hg)	MAP (mm Hg)	SV (ml)	CI (L/min/m ²)	SVR (dn.n/cm ⁵)	HR (bpm)	Dp/dt (mm Hg/s)
Overall population								
19°C	135±28	76±13	96±17	68±23	2.2±0.8	2096±632	63±14	787±340
28°C	120±27	66±9	85±14	70±19	2.3±0.6	1685±456	64±11	704±381
p=	0.05	0.002	0.007	0.23	0.51	0.003	0.75	0.41

Table 2 Haemodynamic changes in the heart failure and control group

Temperature	Sys. BP (mm Hg)	Dis. BP (mm Hg)	MAP (mm Hg)	SV (ml)	CI (L/min/m ²)	SVR (dn.n/cm ⁵)	HR (bpm)	Dp/dt (mm Hg/s)
Heart failure								
19°C	125±23	70±10	88±10	64±25	2.2±0.9	2071±641	65±14	705±300
28°C	111±28	62±8	78±13	66±20	2.2±0.5	1673±465	64±11	603±345
Control								
19°C	157±25	88±12	112±15	76±18	2.4±0.7	2143±672	60±13	951±382
28°C	137±15	75±2	97±4	79±14	2.5±0.7	1707±480	64±13	908±397