

Evaluation of jacketed telemetry in rats for cardiorespiratory phenotyping at exercise



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Introduction

Challenge of cardiorespiratory function through physical exercise is relevant in several situations

Reveal / study phenotypes

Training

Rehabilitation

- Available monitoring tools (implanted telemetry, metabolic chamber) remain challenging to use in the context of exercise.
- Jacketed telemetry systems for small laboratory animals have been developed, allowing non-invasive cardiorespiratory monitoring of : ECG Respiratory, Activity [1,2] variables and potentially cardiac output [3]



Fig.1: Animal wearing the DECRO jacket during an exercise on the treadmill

AIM : Is it possible to use the DECRO telemetry device to monitor cardiorespiratory adaptation at exercise ?

Methods

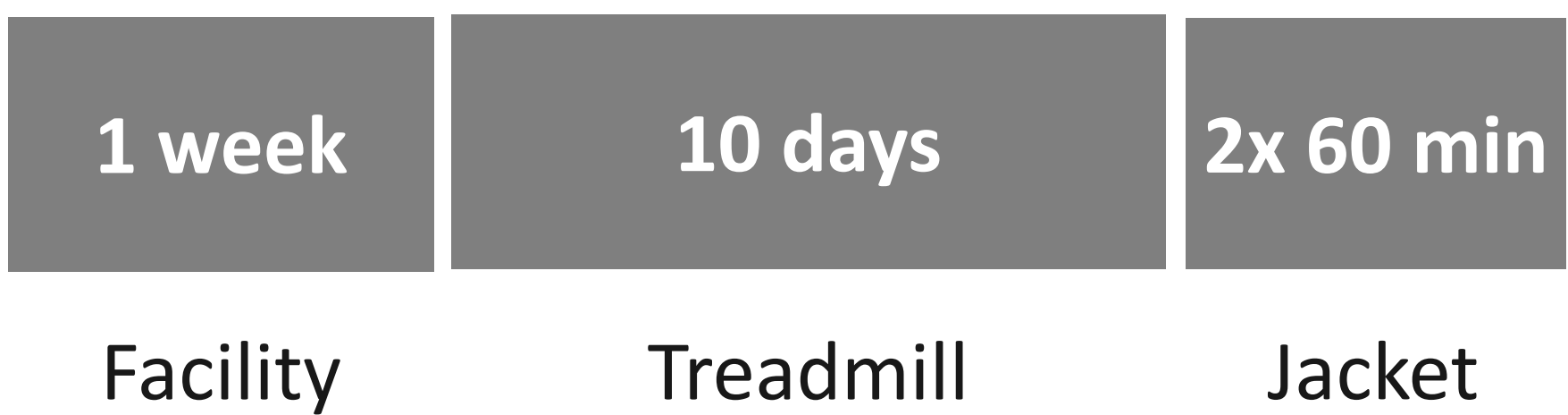
Animal model :

- 9 Untrained Male Wistar rats (332 +/- 15 gr, 10 weeks)
- Sequential habituation to the setup

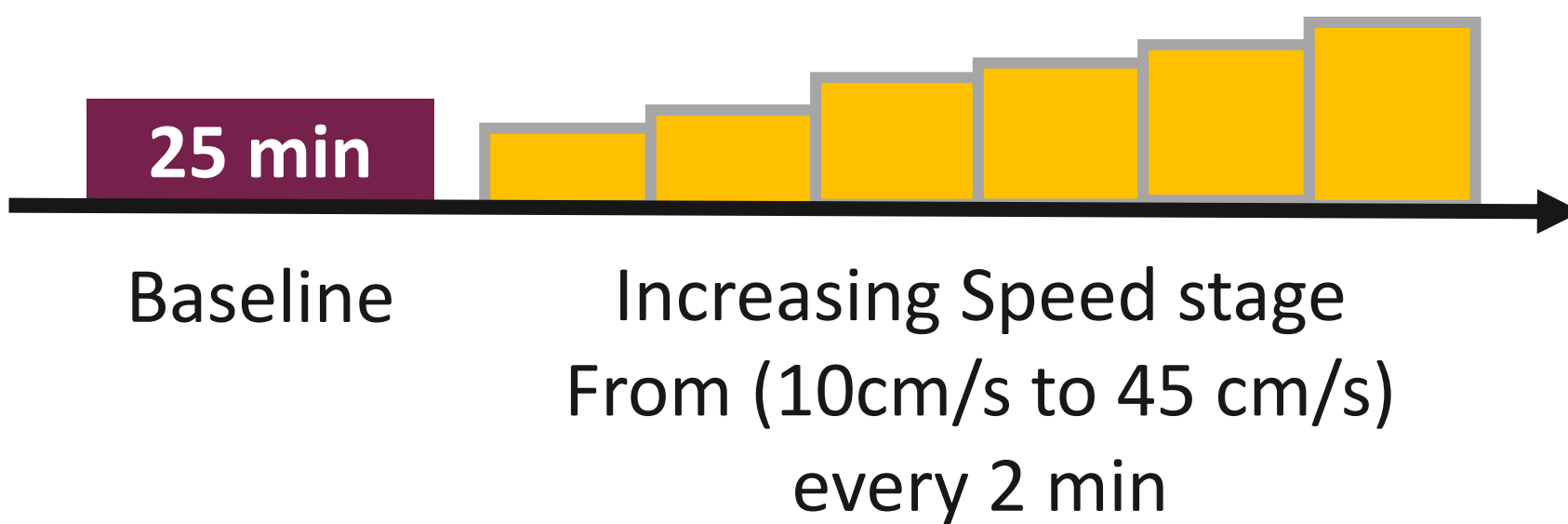
Analyse :

- Heart Rate (HR), Minute Volume (MV) and Locomotor Activity (AL) recorded during an incremental speed protocol
- Average values baseline and during the last 30s of each speed level
- Comparison between baseline and running using RM ANOVA + post hoc tests

Habituation protocol



Exercise protocol



Results

Jacket acceptance & Signal quality

- All the animals were capable to **running on the treadmill equipped with the jacket**
- All jackets and electrodes remained in place during the protocol
- 9 animals managed to run up to 35 cm/sec speed | 5 animals up to 45 cm/sec speed**
- Quality of signals recorded OK for analysis and movement induced artifacts or baseline wandering in ECG are correctly managed

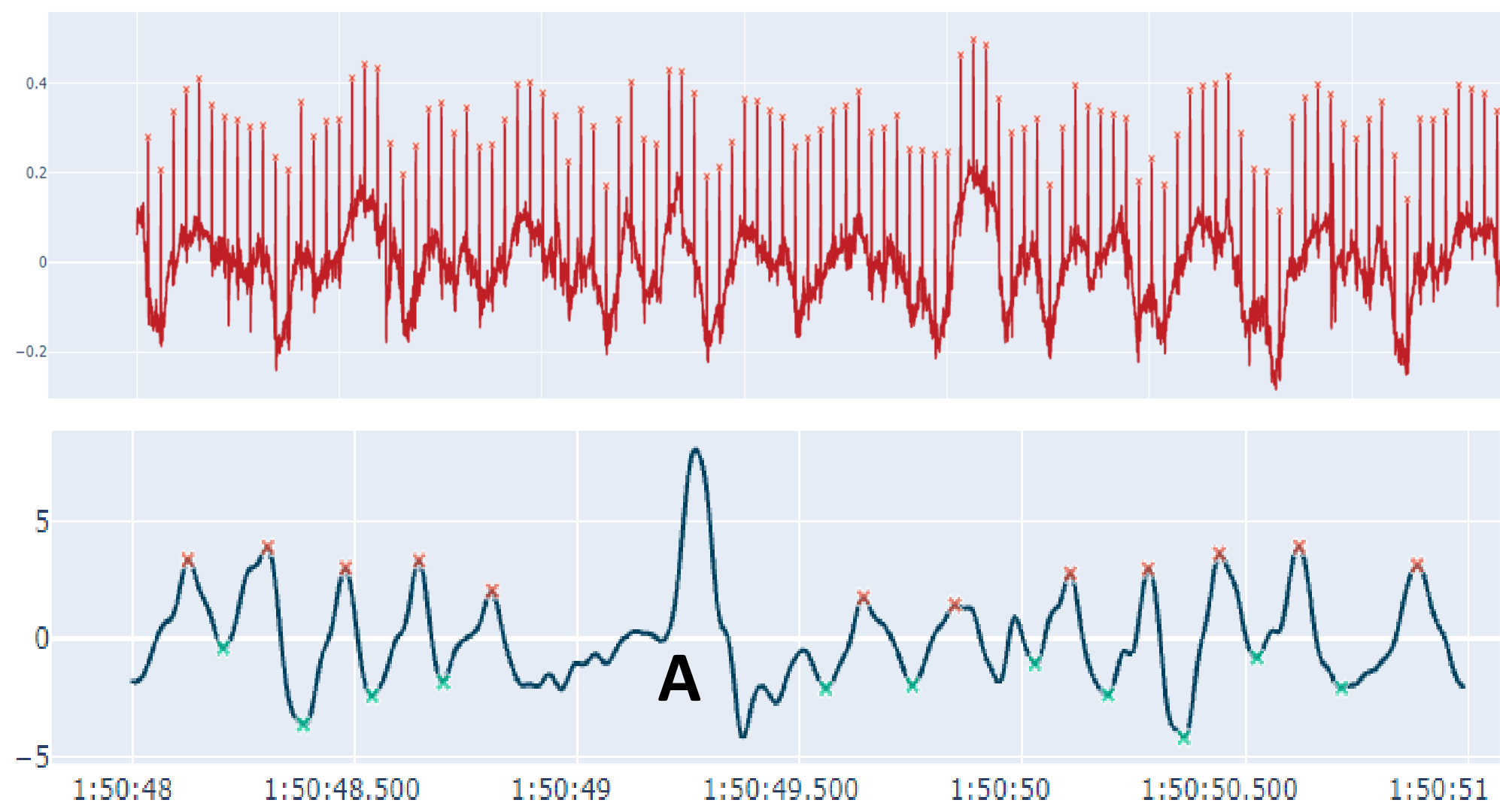


Fig 2: Example of ECG (upper graph) and Respiratory signal (bottom graph) while running at 30cm/s. Movement Artifacts (A).

99% average ECG score at exercise for all the animals = all the signal was used

38% average RIP score at exercise for all the animals = Enough respiratory cycles to calculate an average from a statistical standpoint

Individual response to exercise

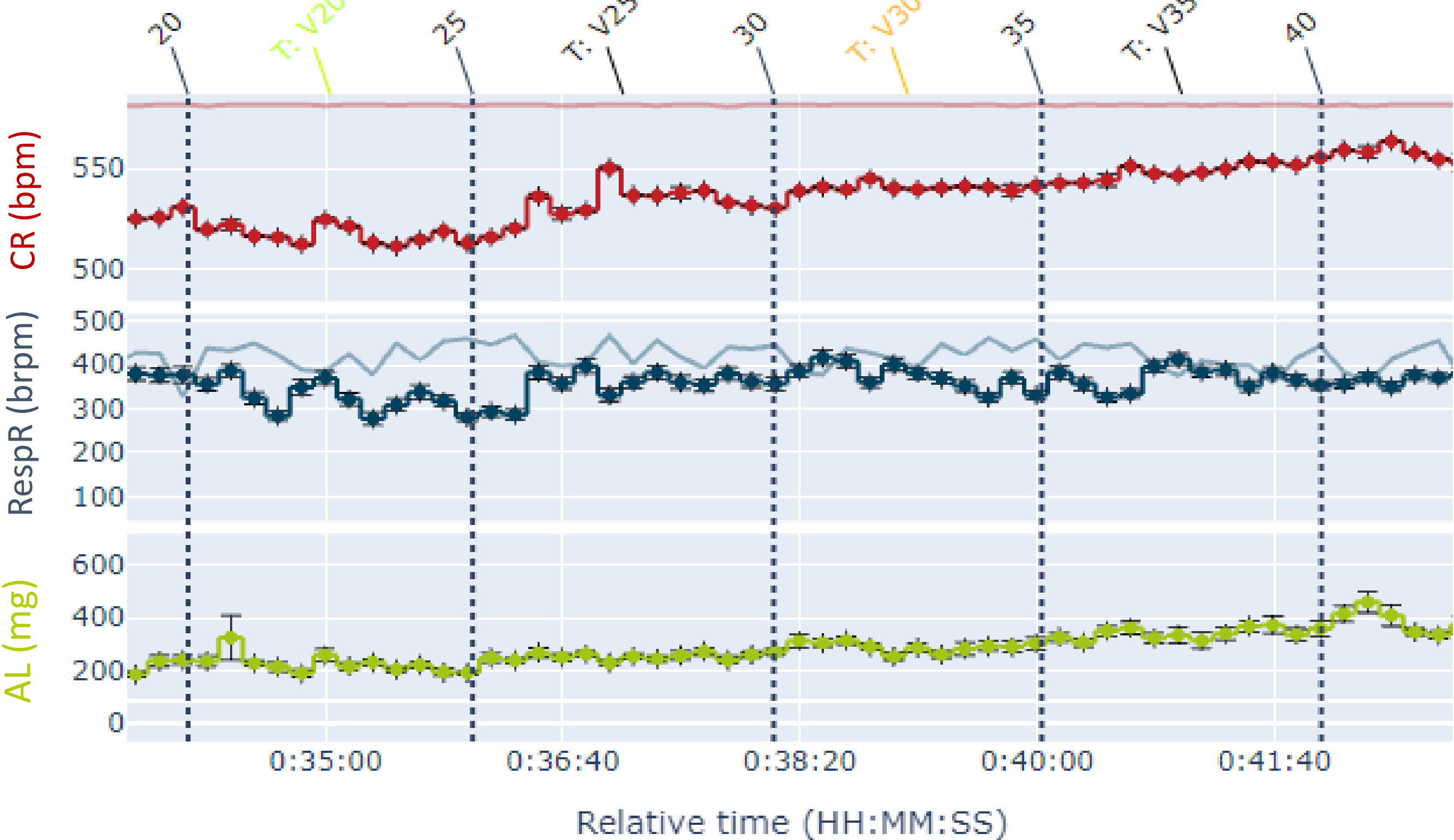


Fig 3: Typical time course of heart rate, respiratory rate and activity for a animal (average +sem every 10s) showing a progressive increasing adaptation with respect to the speed (indicated with 20, 25, 30, 35 40 markers on the top)

Adaptation to exercise

- The device allows to **control the actual level of exercise** realized by each animal using activity level (AL) parameter
- Significant **increase in Heart Rate and Minute Volume**
- Progressive increase with respect to the speed of the treadmill

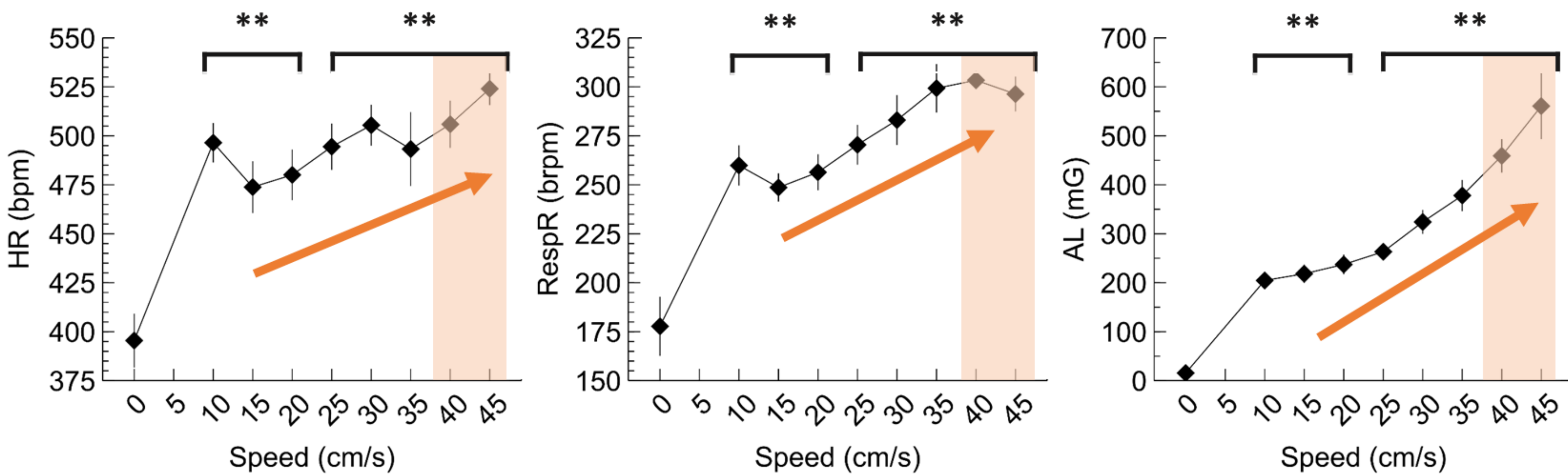


Fig 4: Typical time course of heart rate, respiratory rate and activity for (average +sem every 10s) (n=9,n=5 blue box), average +/- sem for each speed, (** p< 0.01, *** = P< 0.001).

Conclusion

- Rats can run with the jacket on a treadmill and complete a standard exercise protocol
- ECG and respiratory monitoring possible such though conditions as exercise
- Expected physiological adaptation to the exercise challenge is observed



References :

- [1] Fares, et al (2022). "Non Invasive Jacketed Telemetry in Socially-Housed Rats for a Combined Assessment of Respiratory System, Electrocardiogram and Activity Using the Decro System." Journal of Pharmacological and Toxicological Methods 2022 : 107195. <https://doi.org/10.1016/j.vascn.2022.107195>.
- [2] Fares, et al (2023). "Simultaneous Assessment of Central Nervous and Respiratory Systems Using Jacketed Telemetry in Socially-Housed Rats: Application of the '3Rs' Principles in Core Battery Safety Pharmacology Studies." Journal of Pharmacological and Toxicological Methods 121 : 107268. <https://doi.org/10.1016/j.vascn.2023.107268>.
- [3] Fontecave-Jallon et al (2018). "Inductive Plethysmography in Rats: Towards a New Standard for Longitudinal Non-Invasive Cardiac Output Monitoring in Preclinical Studies." Physiological Measurement 39, no. 9 (September 24, 2018): 095006. <https://doi.org/10.1088/1361-6579/aad7ec>.

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