Heart rate variability measured by subcutaneous bio-loggers during one day of transport in fattening lambs

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Heart rate variability (HRV) refers to the variation in time intervals between consecutive heartbeats, and it is an index of the balance between sympathetic ("fight or flight") and parasympathetic ("rest and digest") control of the heart. Stress can significantly affect HRV, and monitoring HRV can be useful to gauge stress levels. The most common and well-tested methods to measure HRV are the Standard Deviation of the N-N intervals (SDNN) and the Root Mean Square of Successive Differences (RMSSD).

The transport of livestock is an animal welfare issue because during transport, animals are exposed to a variety of environmental stressors. Subcutaneous biologgers able to measure HR, together with an appropriate software to calculate both SDNN and RMSSD, could be a useful tool to be applied in transport-stress studies in livestock.

Fourteen 90-day-old lambs were surgically implanted with a subcutaneous temperature (T) and heart rate (HR) bio-logger (DST micro-HRT, Star Oddi, Iceland), programmed to record data at 1-min intervals during a whole day, when lambs were transported in a lorry for 75 min at noon. Data regarding T and HR during the day of transport have been previously presented (Manenti et al., 2024). The Star-Oddi HRT Analyzer software was used to calculate HRV parameters, using raw-electrocardiographic (ECG) data. Since recording raw-ECG data requires a large amount of storage memory, loggers were programmed to record raw-ECG data at alternate times (9 am-8 pm). Thus, the day of transport was divided into seven phases (1: 9-10 am, lambs quiet and undisturbed; 2: 11-11:15 am, lambs being blood and saliva sampled; 3: 11:16-12 am, the h before loading into the lorry; 4: 13-14 pm, lambs being transported; 5: 15-16 pm, one h after transport; 6: 17-18 pm, two h after transport; 7: 19-20 pm, four h after transport. Mean (±S.E.) HR, SDNN and RMSSD were calculated and compared among phases by the T-student test for related samples. While no significant differences were detected between the phases studied for HR, the highest SDNN and RMSSD were recorded during phase 4 (transport) (39.69±8.22 and 49.70±11.16 ms, resp.) and 2 (sampling) (39.28±14.33 and 51.26±18.44 ms, resp.), with significant differences with phases 1, 3, 5 and 7 ($P<0.05$).

In conclusion, these biologgers have proven to be very useful in the study of HRV and its relationship with the transport stress of lambs, revealing higher values during sampling and transport, compared to the phases when the lambs were resting.