3RS IMPORTANCE IN PRACTICAL TEACHING: STUDY OF CARDIORESPIRATORY PHYSIOLOGY WITH A NON-INVASIVE TELEMETRIC JACKET

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1 Introduction

One way to achieve 3Rs in practical animal experimental education is to find new tools or protocols compatible with ethical and educational requirements → **Refinement of practical work** aims to train future manipulators in animal experimentation while educating and sensitizing students to new techniques that value animal welfare.

For this purpose, one of the tools used to refine cardiorespiratory monitoring is the telemetric jacket [1] that allows non-invasive and simultaneous monitoring of cardiac and respiratory functions in awake animals. **Expected 3Rs benefits are :**

- ►***Reducing*** *the number of animals used*
- ►***Refining*** *procedures*
- ►*Providing more predictive data [2]*

AIM : To evaluate the feasibility and relevance of a practical teaching protocol, carried out by students, for monitoring physiological adaptation of rats to exercise using a cardiorespiratory connected jacket.

(Fig.1) Picture of an animal equipped with DECRO® connected jacket.

2 Material and methods

Animal model and Measuring tool:

Two Wistar males (360 gr, 14/16 weeks), **reused from a previous study**, were equipped with a non-invasive cardiorespiratory instrumented jacket (DECRO® as visible in Fig.1, Fig.2 and [3]).

Teaching Organization:

→**12 students** *(Background: Professional degree "physiology and pharmacology")* were divided into pairs.
→**Each day a pair had to carry out the exercise protocol** (Fig.3) and to answer a questionnaire to evaluate their experience as experimenters.

(Fig.2) Animal performing a physical exercise protocol on a treadmill.

Analysis:

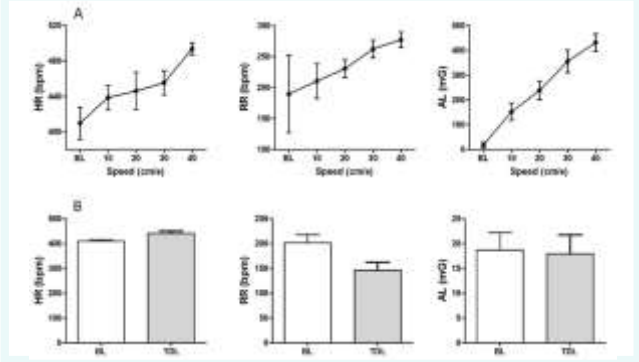
→**Physiological monitoring :**
- Measurements were made during the last 30 seconds of the speed level, during the last 30-second control condition in the cage (Baseline, **BL**) and on the treadmill (**TDL**) before animal manipulation.
- The means and standard error of the mean (SEM) of heart rate (HR, bpm), respiratory rate (RR, bpm), and activity level (AL, mg) were recorded.

→**Practical teaching protocol relevance:**
Perception of the protocol and non-invasive tool was evaluated in questionnaire and answers were summarized in graphical form and analyzed descriptively.

(Fig.3) Exercise protocol chronogram. Exercise consists of a regular speed increase by 10 cm/s every five minutes

3 Results

Physiological monitoring



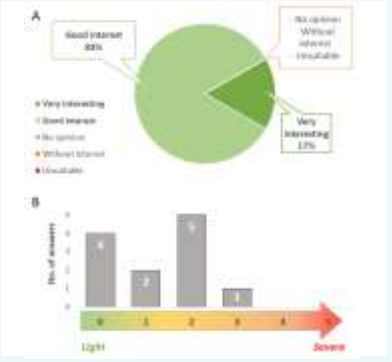
(Fig.4) Monitoring of cardiorespiratory parameters in two rats during performing the exercise protocol.
(A) Parameters evolution during the different speeds of the exercise protocol.
(B) Parameters evolution between the cage (BL) and the animal positioning at rest on the treadmill (TDL).
Heart rate (HR, bpm), respiratory rate (RR, bpm) and activity level (AL, mg) during the 30 seconds of analyzed phases. Mean ±SEM, N = 10 repeated measurement for two rats. One pair result was not analyzed.

The telemetry jacket allowed students to monitor physiological variations in heart and respiratory rates **induced by exercise (Fig.4A) or manipulation (Fig.4B).**

Exercise induced an average increase in **HR and RR** of approximately **4% and 26%,** respectively, between baseline and the last speed level **(Fig. 4A).**

The students were **all able to easily prepare and equip animals** with the telemetric jacket.

Practical teaching protocol relevance



(Fig.5) Results of students' post-experimental questionnaires.
(A) Students' perception of their "in vivo" practical work. The students evaluated the interest of the protocol for their studies.

In questionnaires, **the severity of the procedure was evaluated to light** (average mark of 1.25 ± 0.09 (SD) / 5) which indicated a very good acceptance and perception by the students. **(Fig. 5B)**

High Level of interest and good perception from students. (Fig. 5A et 5B)

The students were made conscious of the impact of the manipulation.

4 Conclusions and discussion

Reduce the number of animals used.

→ Only two "reformed" animals were used for twelve students, animals were reused from one pair to the next.

Refine the practical work procedure.

→ No invasive procedures were required, which contributes to the improvement of animal welfare and the perception of animal experimentation by the students. The procedure to equip the animal has been qualified as “light restraint” by the French ethic comities.

This approach could be replicated on a larger scale (more students) and/or to study different physiological conditions during university practical session.

→ This solution is relevant in several research fields such as physiology, physiopathology and pharmacology and could be used for technical and university degrees.