REFINING THE IMPLEMENTATION OF SURGICAL PROTOCOLS: BENEFITS OF NON-INVASIVE CARDIORESPIRATORY MONITORING IN RAT.

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1 Introduction

- Experimental procedures like surgical interventions can induce uncontrolled physiological alterations [1] that need to be assessed and minimized before the study begins [2].
- Live clinical parameters monitoring during surgery can help to:

→ **minimize the impact** of the procedure on animal welfare

→ **improve survival** after surgery

→ **ensure qualitative results** by reducing variability

AIM: To highlight the contribution of non-invasive monitoring with a telemetric jacketed system (Fig.1 [3]) during a carotid denervation surgical procedure to prepare for sensors catheterization.

(Fig.1) Animal equipped with DECRO telemetry jacket. [3]

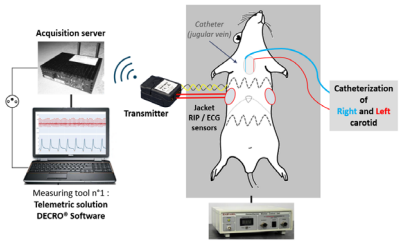
2 Material and methods

Animal model and monitoring tool:

- Ten Wistar males (355 gr, 10 weeks) monitored with DECRO® non-invasive cardiorespiratory instrumented jacket (DECRO® as visible in Fig.1 and Fig.2,[3]).
- Animals anesthetized (2%/2.5% isoflurane).
- Recording of an ECG and Respiratory signal throughout a surgical gesture involving denervation and isolation of the carotid arteries for the catheterization of two cardiac and arterial pressure probes in rats (Fig.2).

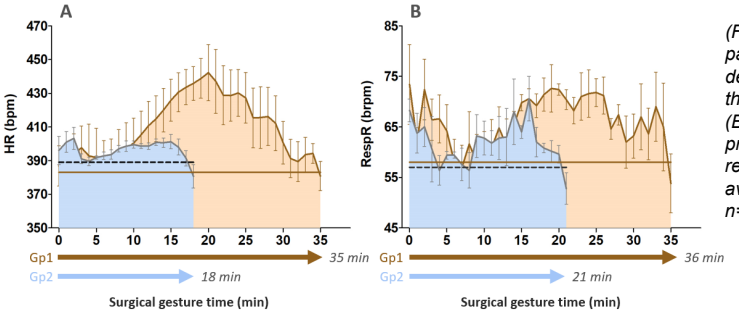
Data analysis :

- Calculation of Heart rate (HR, beats/min) and respiratory rate (RespR, breaths/min)
- Baseline (reference state) was calculated between 0 and 6 min
- For each group, Calculation of Means ± SEM every minute and Air under the curve (AUC)
- Comparison of HR and RespR variations induced by the procedure between initial protocol (Group1 (n=5)) and refined protocol (Group2 (n=5)) during the first 40 min (carotid denervation)



(Fig.2) Experimental setup.

3 Results



(Fig.3) Monitoring of cardiorespiratory parameters of rats during the carotid denervation procedure. Evolution of the heart rate (A) and respiratory rate (B) during the first 40 minutes of the protocol. Heart rate (HR, bpm) and respiratory rate (RespR, brpm) were averaged every minute. Mean ± SEM, n=5/group rats

Observation in group 1

- The stimulation of the vagus (Fig. 3 and Table. 1) nerve during surgery induced an average increase over baseline of **+12% in HR** and **+20% in RespR.**
- Moreover, the execution time of the procedure was 36 minutes.

Original protocol amendments

- An atropine injection (250 µL/kg, IM) to limit the effect of the vagus nerve during the next step of catheterization.
- An ergonomic improvement of the experimental setup.
- An increase of inter-gesture recovery times.

Reduced gesture time and impact in Group 2

- Alert thresholds and signals available in real time allowed manipulator to adjust their surgical gestures in real time.
- Changes in protocol allowed to attenuate these effects of **-83% for HR** and **-63% for RespR** in Group2.
- Surgical procedure and thus its impact has been **reduced by 15 min** between group 1 and group 2. (Table. 1)

	Heart Rate (bpm)			RespR (brpm)		
Group	**1**	**2**		**1**	**2**	
Baseline	383	389	=	58	57	=
Max value	442	403	↘	73	70	=
Area > Baseline	933	159	↘ **-76%**	266	98	↘ **-63%**
End of Peak (min)	35	18	↘ **-49%**	36	21	↘ **-40%**

(Table. 1) AUC results of cardiorespiratory parameters of rats during the first 40 minutes of the surgical protocol containing the carotid denervation procedure.

4 Conclusions and discussion

Benefits of including monitoring tool during this surgery:

→ **highlight the impact of a surgical procedure** and adapt the protocol accordingly;
→ **help the manipulator to reduce his impact** by adjusting his gestures;
→ decrease the time of interventions.

Application of real-time noninvasive monitoring of cardiorespiratory function:

- **Traceability** of performed interventions (recording of surgeries);
- **Follow-up of the surgical training** of the manipulator before the study;
- **Quantification of the quality** of the surgery performed.