Monitoring of equine sick patients

Assessment of autonomic nervous system activity through HRV, with emphasis on stress, pain, and inflammation

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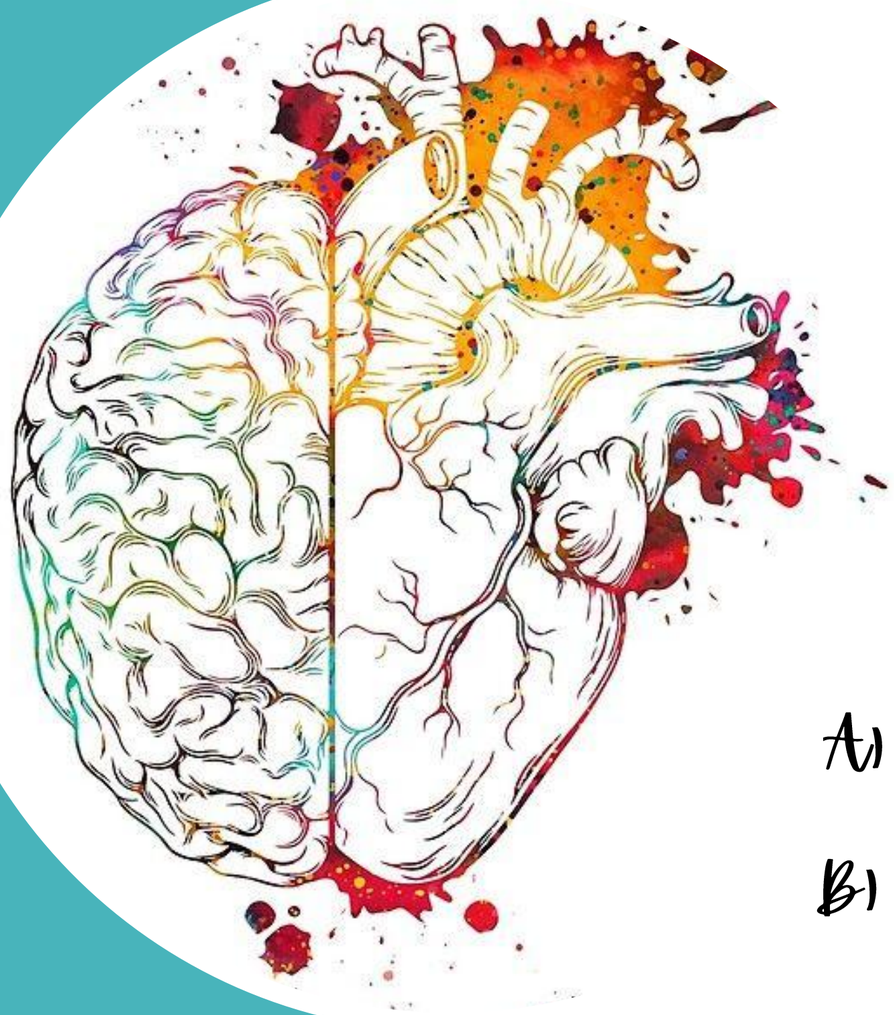
Introduction



1. Heart Rate Variability (HRV) is a non-invasive method to assess autonomic nervous system balance

2. In human medicine, HRV has gained relevance for assessing prognosis in several clinical conditions (for example SIRS and SEPSI)

The questions are:

A) How does HRV change according to the clinical condition in equine adult and foals?

B) Does HRV have prognostic value in relation to different clinical conditions, such as Hypoxic-Ischemic Encephalopathy (HIE), SIRS or sepsis?

Purpose:

monitor HRV changes in relation to clinical status and outcome in hospitalized equine adult and foal

1 **RR interval recording in foals and mares**

2 **Collecting Additional Clinical Data**
Signalment, anamnesis, diagnosis, and SIRS status collected for each patient

3 **HRV analysis by upload of RR interval recording in Kubios ® Software**

SIVE+

Abstract

1st

Heart Rate Variability in foals affected by Hypoxic Ischemic Encephalopathy at various degree of severity

In human neonates, HRV patterns differ according to the clinical severity of hypoxic-ischemic encephalopathy (HIE) and correlate with brain lesions and adverse outcomes, becoming evident as early as 24 hours after birth

Hypotesis:

A) Foals with more severe neurological and clinical presentations show reduced autonomic nervous system (ANS) activity

B) Foals with worst prognosis have lower ANS activity

Methods:

Level I

Level II

Level III

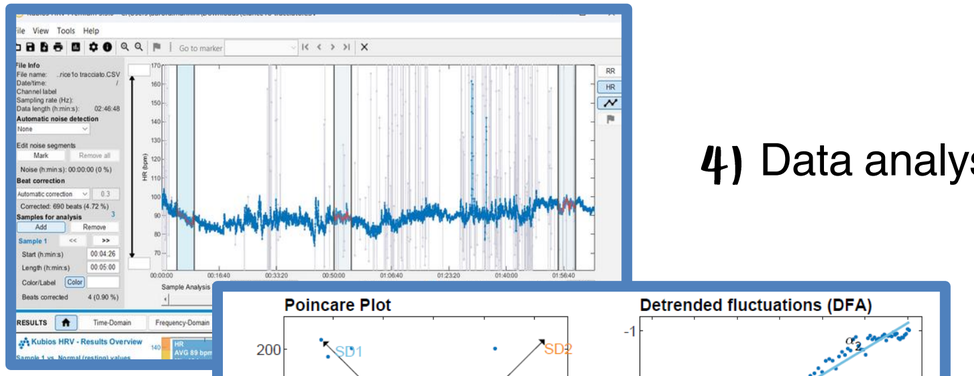
1) Inclusion criteria:
   1. Foals <48h of age
   2. Diagnosis of HIE
   3. Normal ECG recordings

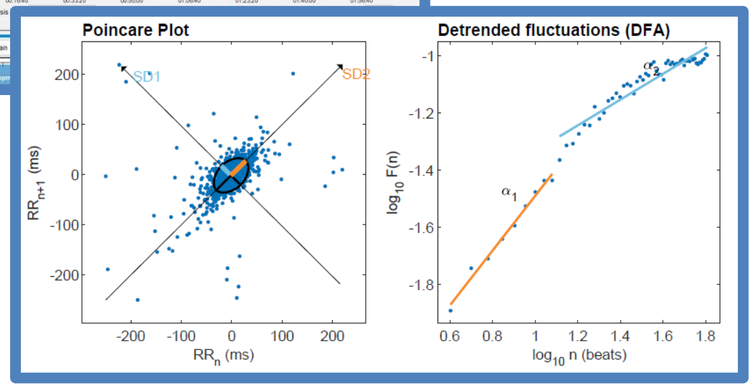
2) Grouping:
   - Level I: mild cases (minimal monitoring)
   - Level II: moderate cases (intensive monitoring)
   - Level III: critical cases (advanced management and intensive support)

   ❖ Survival
   ❖ Non-survival

3) RR interval recordings (Polar ®) of 2h duration→ 2 time point
   - T24
   - T24-48

Methods:





4) Data analysis: Each recording → 3 x 5-minute resting segments → Kubios® software

5) HRV variables considered:

- MeanHR, MeanRR
- SDNN, RMSSD
- LF, HF, LF/HF ratio
- SD1, SD2, SD2/SD1
- DFA α1 and DFA α2

Parasympathetic tone

Sympathetic tone

ANS balance

6) Statistical approach: differences in HRV variables comparing:

1. Level of care (Kruskal-Wallis)
   - For each time point (T_{24}) and ($T_{24\text{-}48}$)
   - Variation between age ($\Delta T: T_{24\text{-}48} - T_{24}$)
2. Outcome (Mann Whitney-U test)
   - For each time point (T_{24}) and ($T_{24\text{-}48}$)
   - Variation between age ($\Delta T: T_{24\text{-}48} - T_{24}$)

7) Only for outcome → Logistic regression and ROC curve

- Each time point (T_{24}) and ($T_{24\text{-}48}$)
- Variation between age ($\Delta T: T_{24\text{-}48} - T_{24}$)

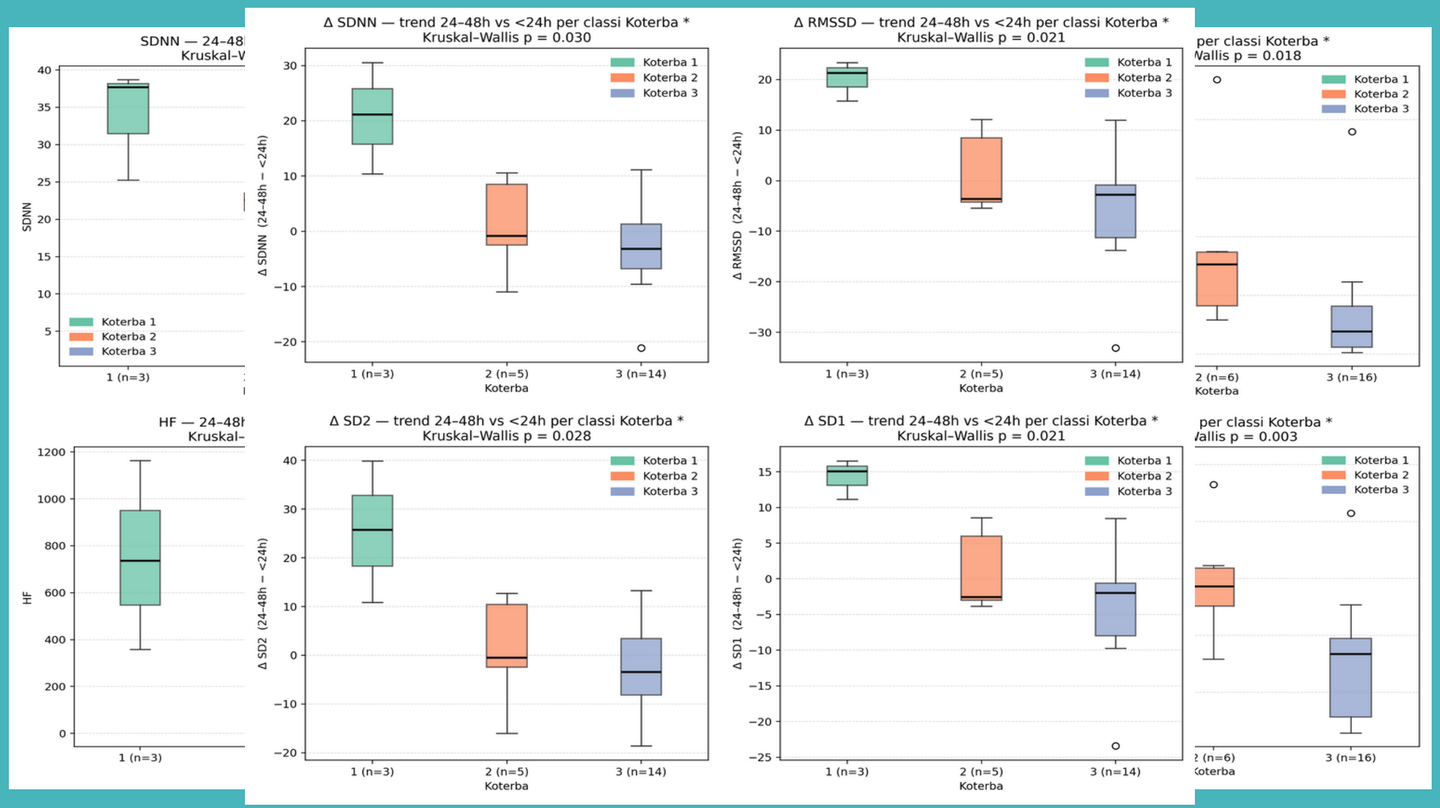
Results:

	<24h		24-48h	
	k	p	k	p
MeanHR	2.966192	0.226934	1.009231	0.603738
MeanRR	2.966192	0.226934	1.009231	0.603738
SDNN	1.610066	0.447073	11.17654	0.003741
RMSSD	0.412536	0.813615	9.047692	0.010847
LF	4.761254	0.092493	10.55808	0.005097
HF	1.974739	0.372555	8.016923	0.018161
LF_HF	0.773599	0.679227	5.081154	0.078821
SD1	0.412536	0.813615	9.047692	0.010847
SD2	2.928205	0.231285	11.64462	0.002961
SD2_SD1	2.699525	0.259302	1.236923	0.538773
alfa_1	5.350807	0.068879	3.498462	0.173908
alfa_2	1.175309	0.555629	2.173462	0.337317

Delta	KW_stat	KW_p
Δ_age_MeanHR	4.077696	0.130179
Δ_age_MeanRR	4.610728	0.099732
Δ_age_SDNN	7.005647	0.030112
Δ_age_RMSSD	7.750198	0.020752
Δ_age_LF	1.434218	0.488162
Δ_age_HF	6.066064	0.048169
Δ_age_LF_HF	3.664822	0.160027
Δ_age_SD1	7.750198	0.020752
Δ_age_SD2	7.134049	0.02824
Δ_age_SD2_SD1	1.480294	0.477044
Δ_age_alfa_1	1.362281	0.506039
Δ_age_alfa_2	5.074534	0.079082

1) Thirty foals met the inclusion criteria

2) **Level of care**:
   - T_{24}: no differences between groups
   - $T_{24\text{-}48}$: less critical foals showed ↑ parasympathetic tone and overall ANS activity
   - **ΔT** : general ↓ ANS activity in critically ill foals compared to less severe cases



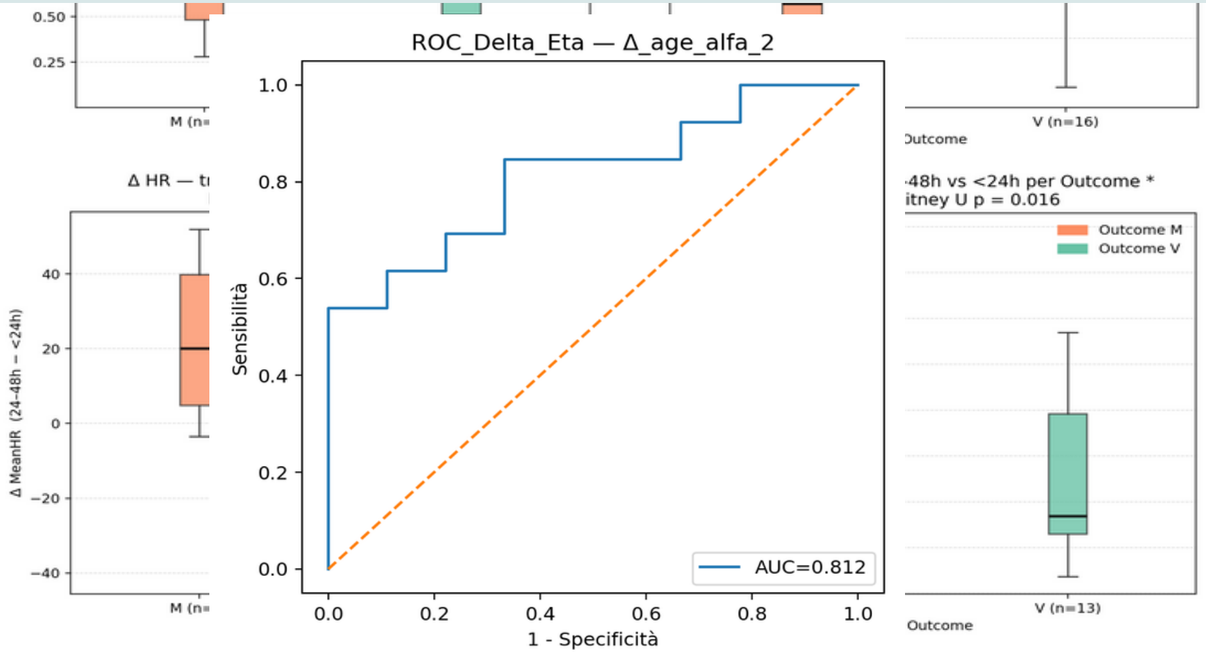
Results:

	<24h		24-48h	
	U	p	U	p
MeanHR	48	0.06487	92	0.427311
MeanRR	121	0.06487	62	0.427311
SDNN	84	1	100	0.218039
RMSSD	88	0.877731	62	0.427311
LF	57	0.16617	52	0.179839
HF	80	0.837472	81	0.84805
LF_HF	64	0.305061	115	0.040079
SD1	88	0.877731	74	0.89114
SD2	72	0.538301	40	0.045696
SD2_SD1	63	0.281515	42	0.058932
alfa_1	51	0.090587	42	0.058932
alfa_2	50	0.081231	43	0.066661

Delta	MW_U	MW_p
Δ_age_MeanHR	90	0.038441
Δ_age_MeanRR	27	0.038441
Δ_age_SDNN	39	0.204518
Δ_age_RMSSD	36	0.141801
Δ_age_LF	56	0.893754
Δ_age_HF	29	0.052799
Δ_age_LF_HF	88	0.052799
Δ_age_SD1	36	0.141801
Δ_age_SD2	37	0.160814
Δ_age_SD2_SD1	83	0.109007
Δ_age_alfa_1	80	0.160814
Δ_age_alfa_2	95	0.016216

3) **Outcome:**
   - T_{24}: no differences between outcomes
   - T_{24-48} : non-survival foals show SNA imbalance
   - **ΔT** : non-survival foals presented ↑HR and ↑ ANS imbalance

4) **Univariate logistic regression and ROC:**
   - T_{24}: several variables show good prognostic ability: HR, DFA α1 and α2
   - T_{24-48}: LF/HF, RMSSD, SDNN, HF, SD1, and SD2
   - **ΔT** :
     ↓ HR,↑ RMSSD, HF, and SD1 → survivors,
     ↑LF/HF, SD2/SD1 and DFA α2 → non-survivors



2nd

Can HRV be used to predict postpartum complications in mares?

Possible postpartum complications in mares:

- Hemorrhage, trauma to the caudal part of the urogenital tract
- Metritis
- GE issue (like colic)

In physiological peri-partum period: high parasympathetic tone

Hypotesis:

Postpartum complications may alter the HRV pattern in mares leading to a suppression of parasympathetic activity

Methods:

1) After foaling: RR interval recordings (Polar ®) of 12h duration
2) Post-partum: physiological (P) or complicated (C)
3) Data analysis: Each recording → 5-minute interpolated by 1 min→ avarenge across 12h → Kubios® software
4) Statistical approach: Mann Whitney U-test → differences in HRV variables comparing P vs C

Preliminary results:

14 mares included:

- 8 with physiological post-partum
- 6 with post-partum complications (trauma of the urogenital (UG) tract (2), constipation (1) and combined GI + UG (3))

No statistically significant differences P vs C

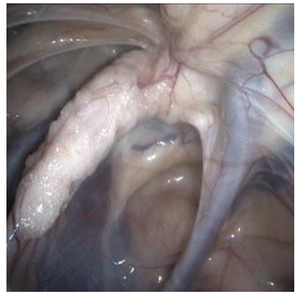
→ Parasympathetic suppression was not observed despite the presence of infection or pain

Future step:

Increase number of cases

Include a wider range of pathological conditions to strengthen statistical analysis

Pubblications:



Contents lists available at ScienceDirect

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Case Report

Headshaking associated with a unique presentation of guttural pouches infection and otitis media in a Quarter Horse stallion: diagnosis, medical treatment and outcome

G. Forni [a], N. Ellero [b,*], A. Mannini [b], L. Scacco [c], F. Freccero [b]

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antibiotics

MDPI

Article

A Laboratory Protocol for Routine Therapeutic Drug Monitoring of Beta-Lactams Antimicrobials in Horses and Dogs

Anisa Bardhi [1], Aliai Lanci [1], Aurora Mannini [1], Carolina Castagnetti [1] and Andrea Barbarossa [1,2,*]

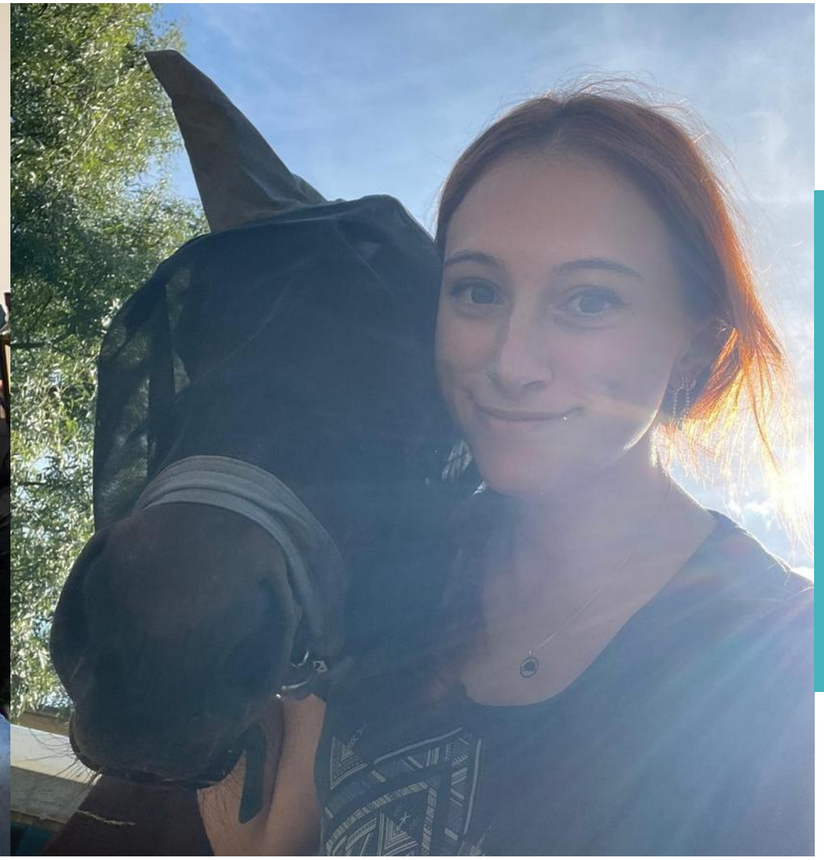
Next Steps:

A) Continue collecting data on sick foals and analyze the effect of SIRS and sepsis on HRV and prognosis

B) Continue collecting and analyze mares' recordings to explore the effect of postpartum diseases on HRV

C) Present them at the SIVE Congress (January 2026) and publish the data already analyzed

D) Plan the research period abroad



Thank you for your attention!