Endocrine and cardiac parameters in parturient mares - Prediction of foaling -

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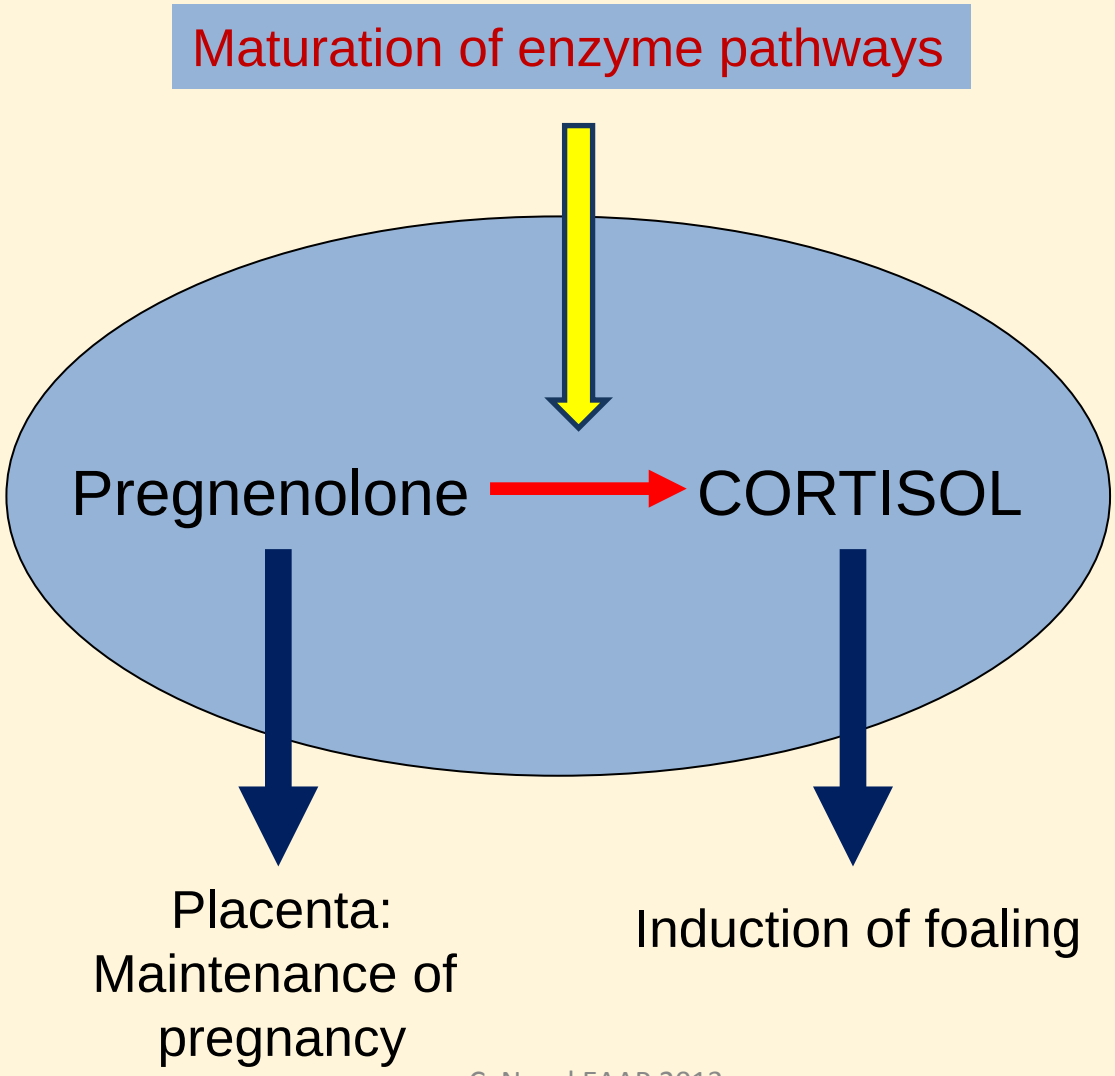
Endocrinology during late gestation

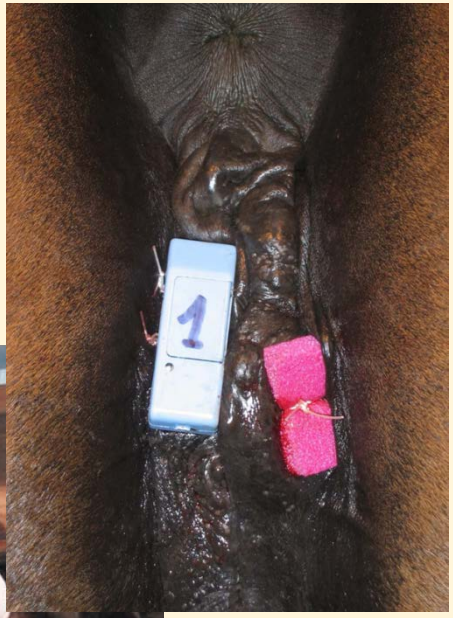
- Physiological induction of parturition in horses different from ruminants and pigs
- No progesterone in late pregnant mares but pregnancy is maintained by 5α-pregnanes
- Precursors for placental progestin production originate from fetal adrenal glands

➢ Fetus essential for maintenance of pregnancy

Endocrinology during late gestation



Prediction of parturition



Parturition and stress responses

- Parturition in horses
  - Short and active expulsive phase
  - Is suggested to be a strenuous and painful process
- Stress response
  - Activation of the sympathetic nervous system and the hypothalamo-pituitary-adrenal axis
- Stress response

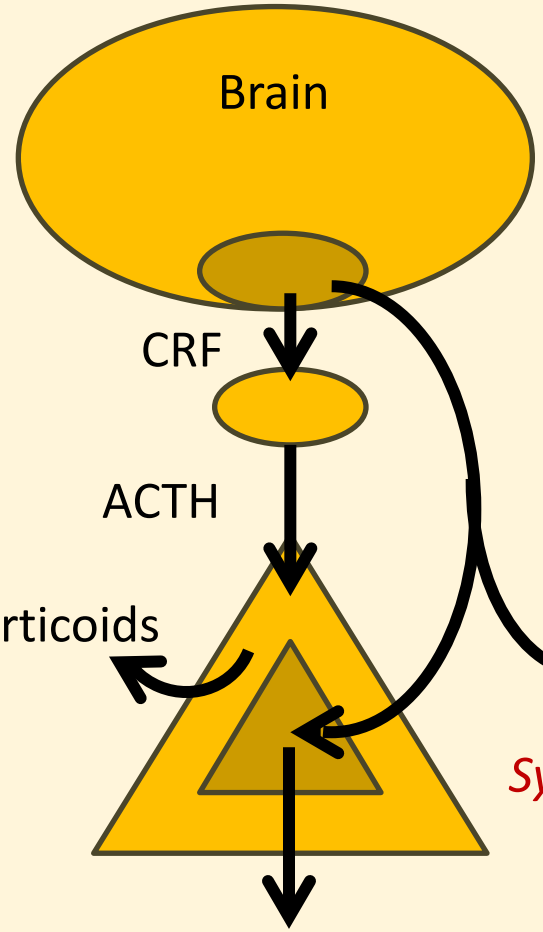
  Stress during parturition ➔ inhibition of labor

  via activation of uterine $ß_2$-receptors

Parturition and stress responses

- Stress response is indicated by
  - Cortisol concentration ↑
  - Heart rate ↑
  - Heart rate variability ↓

Stress responses



Hypothalamus

Anterior pituitary

Adrenal gland

Hypothalamic-pituitary adrenocortical response

Cortisol
(Saliva = non-invasive sampling)

Sympathetic-adrenomedullary response

Heart rate
Heart rate variability

Autonomous nervous system (ANS)

Sympathetic part of ANS

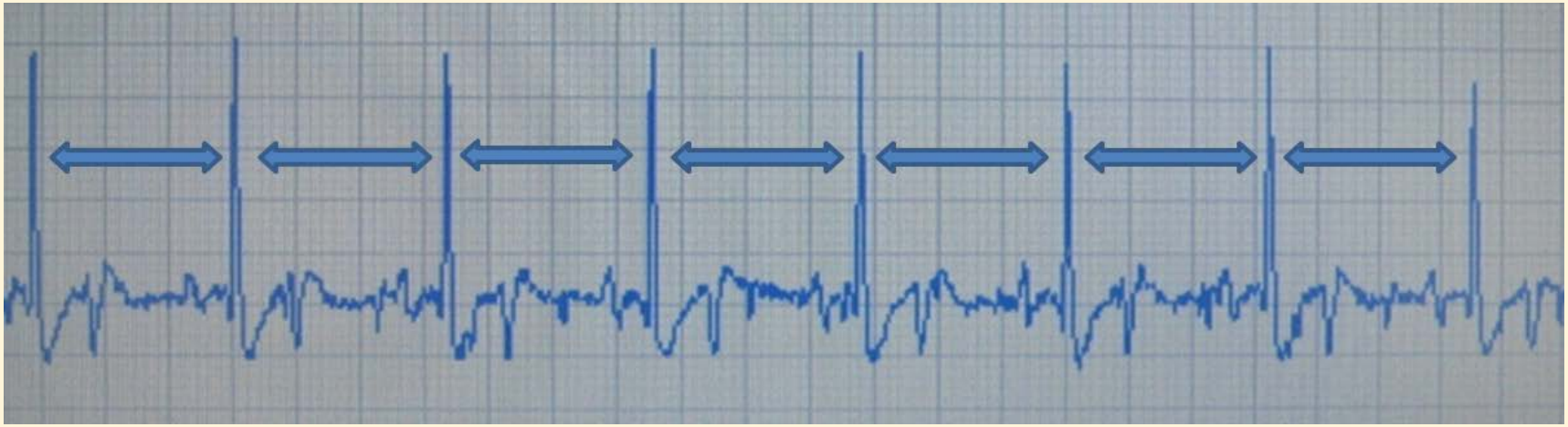
➔ increased activity in response to stressful situations and external challenges ("fight or flight")

Parasympathetic part of ANS

➔ increased activity during times of rest ("rest and digest")

Heart rate variability

- HRV ↓ = Sympathetic dominance
- HRV ↑ = Parasympathetic dominance



- RMSSD = Root mean square of successive RR differences
  Specific for parasympathetic activity

Hypothesis

- Parturition in mares induces a stress response and thus parturition can be predicted by changes in stress parameters
  - Heart rate
  - Heart rate variability
  - Cortisol concentration

Cut-off point: Increase of more than 2 times the standard deviation of respective parameter from mean values of days 5, 4 and 3 before foaling

Material and methods

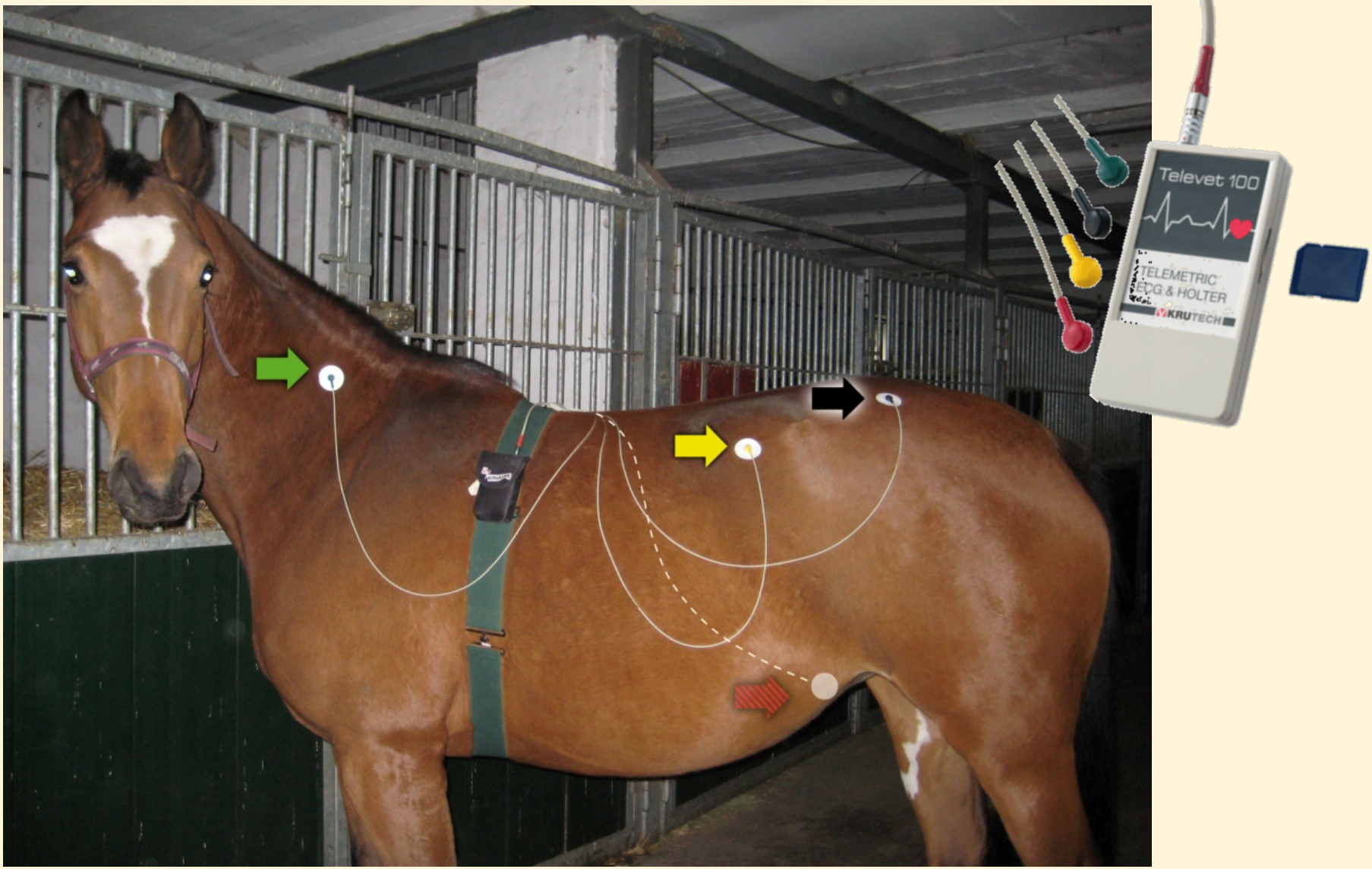
Group 1: Warmblood brood mares (n=24)

- Starting 15 days before calculated day of parturition
- ECG recordings once daily for one hour
- Salivary cortisol 4 x daily (6:00, 12:00, 18:00, 24:00)

Group 2: Warmblood brood mares (n=17)

- From 2 hours before to 2 hours after parturition
- Continuous ECG recordings
- Salivary cortisol at 0, 15, 30, 60, 120 min after foaling

Electrocardiogram



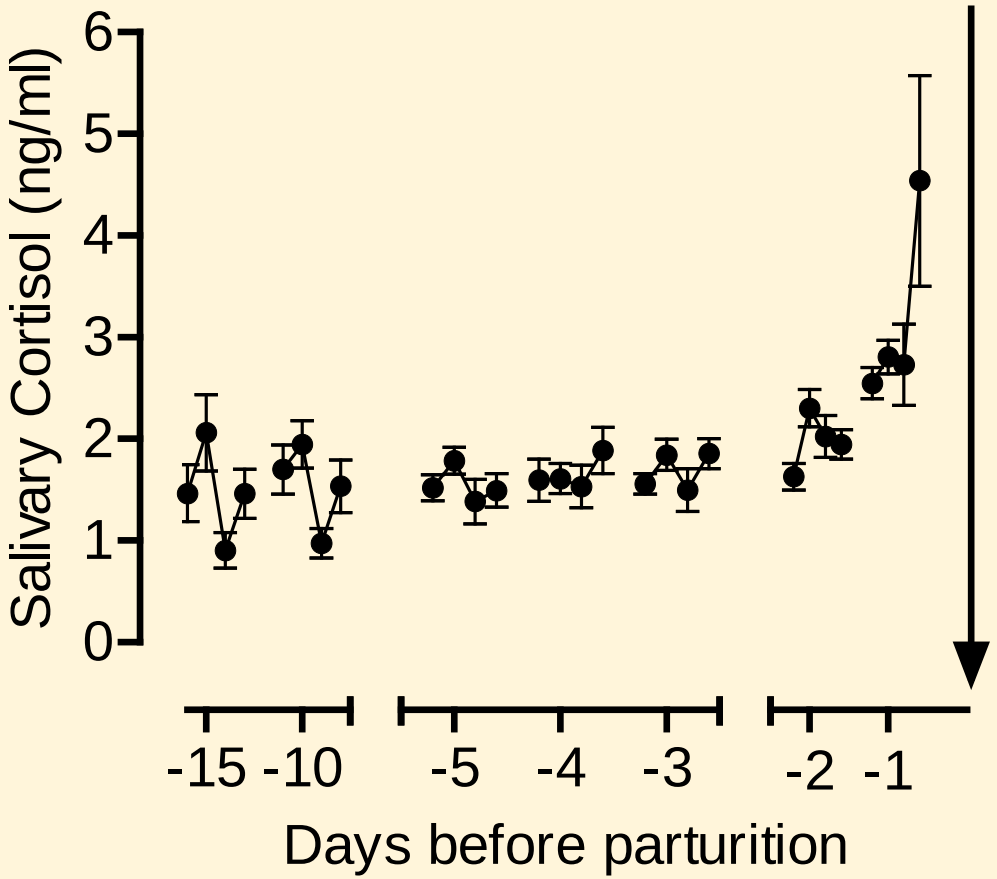
Salivary cortisol

Salivary cortisol

- Non-invasive technique
- Only biological active part of total cortisol concentration
- Need of laboratory equipment

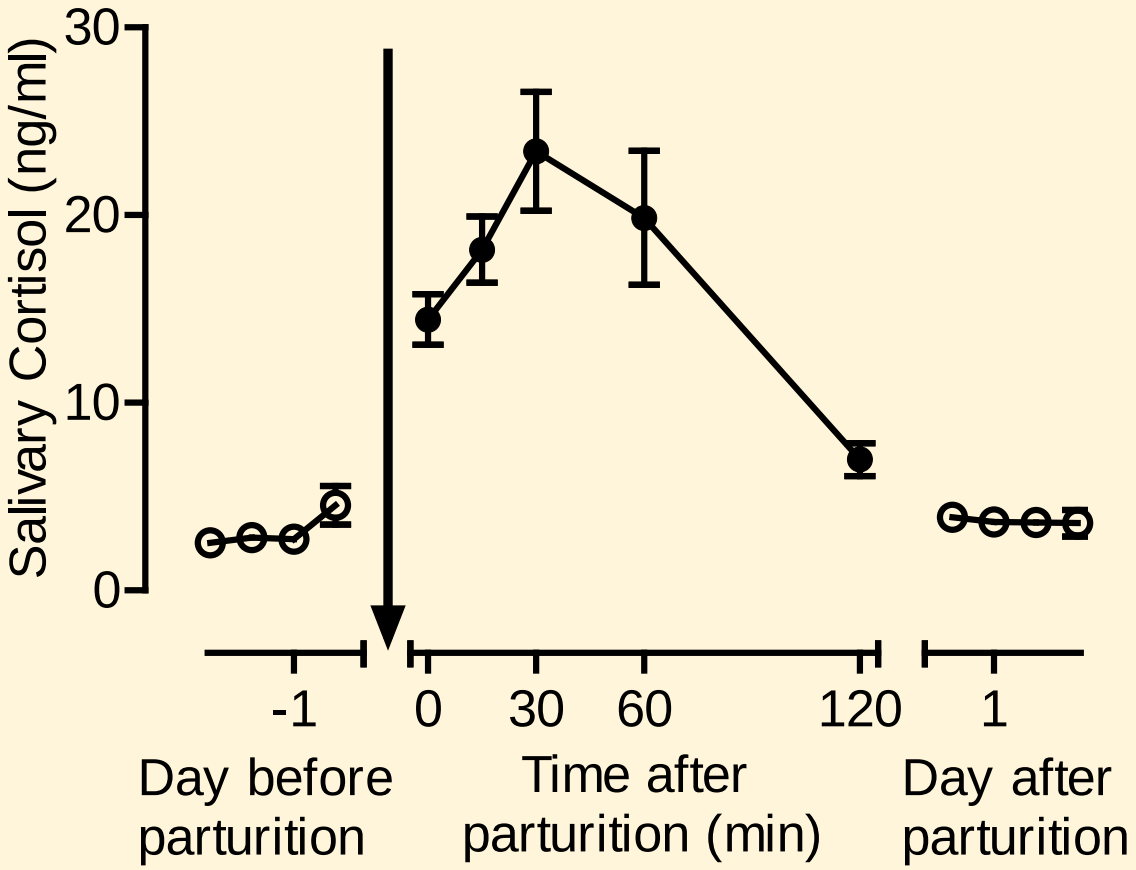
Results

Salivary cortisol



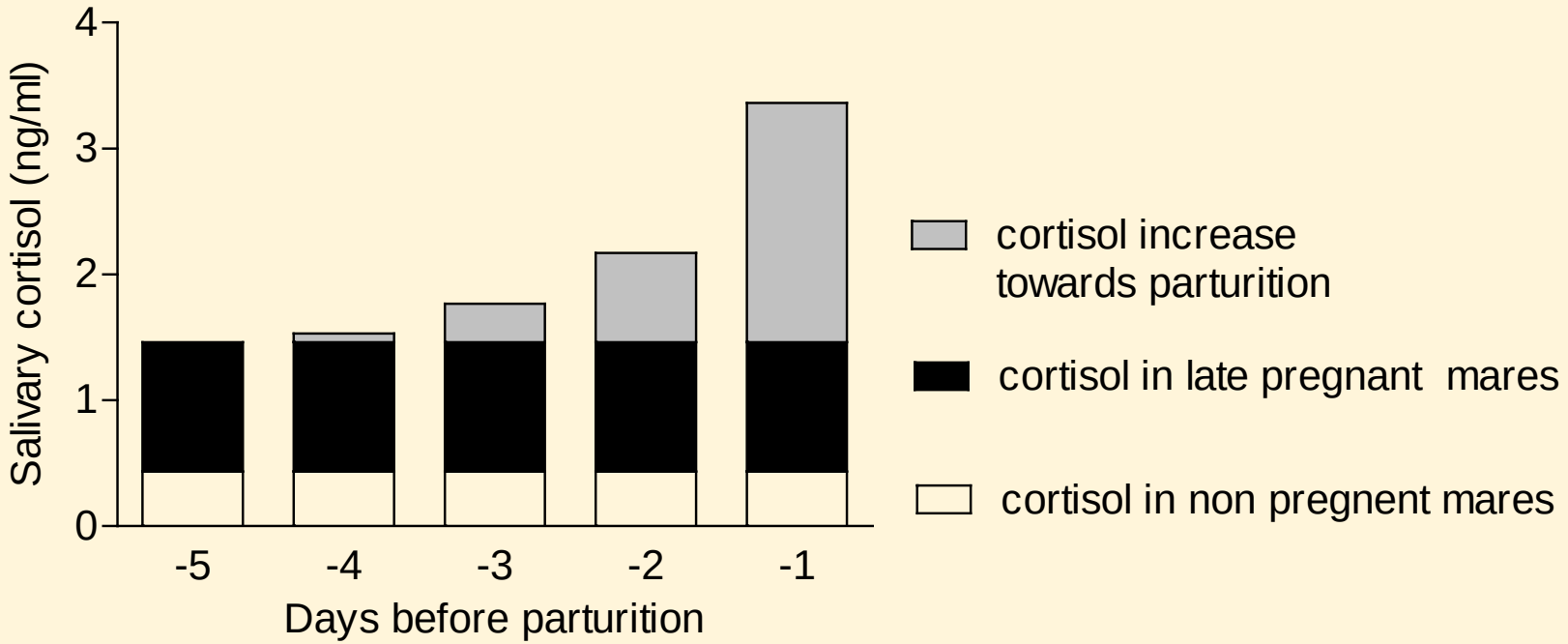
Salivary cortisol concentration in mares from 15 to 1 day before parturition at 6:00, 12:00, 18:00 and 24:00

Salivary cortisol



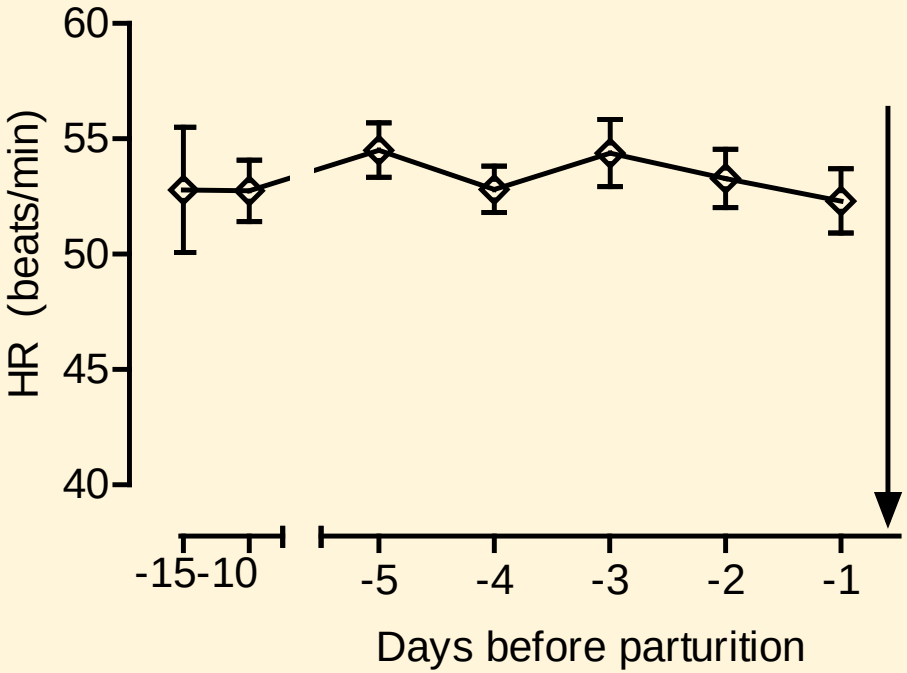
Salivary cortisol concentrations from 1 day before to 1 day after parturition

Salivary cortisol

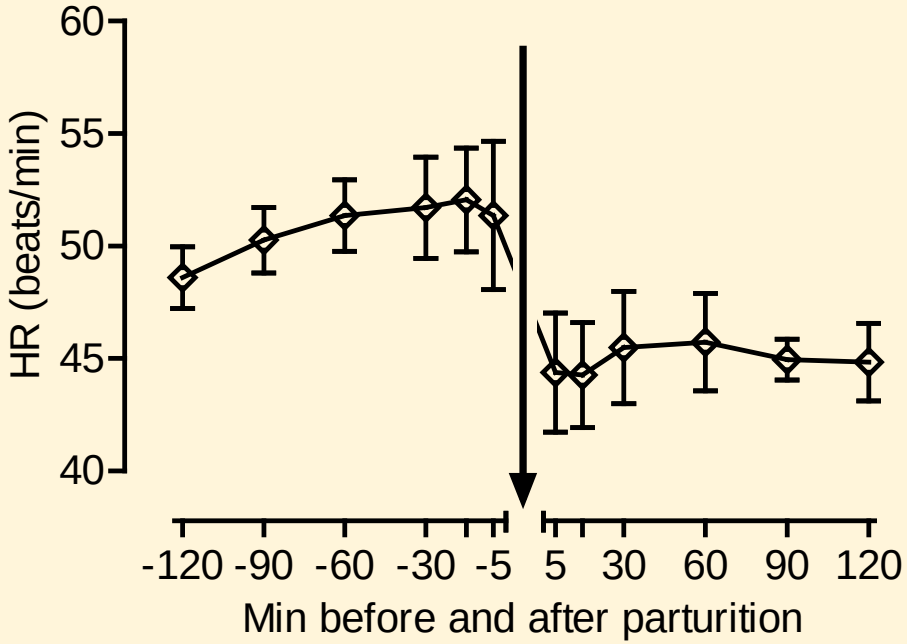


- 80% of mares show an increase in cortisol during the last 24h before parturition (> 2 x SD of basal values)

Heart rate

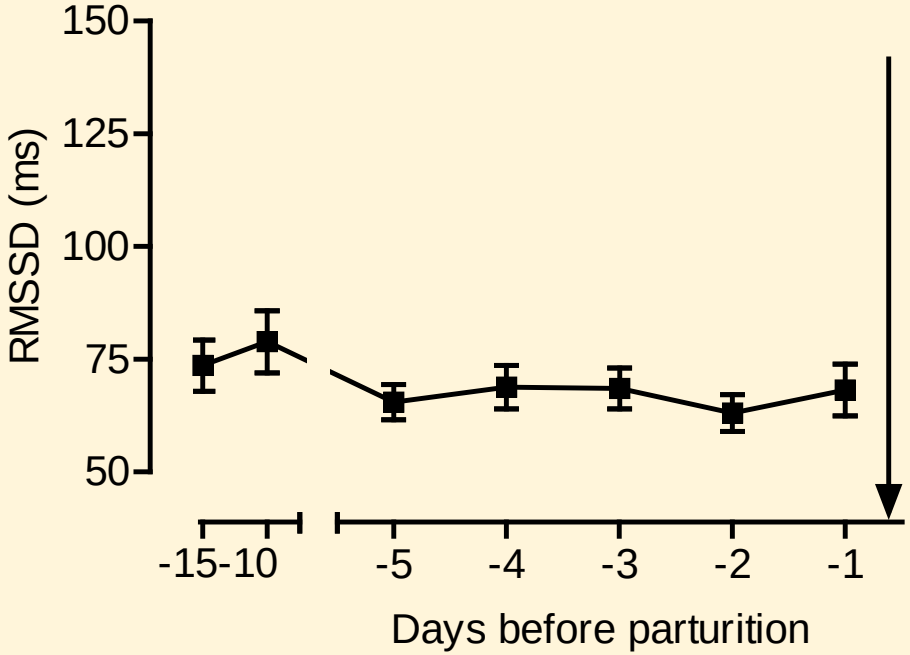


Heart rate from 15 days before to 1 day before parturition

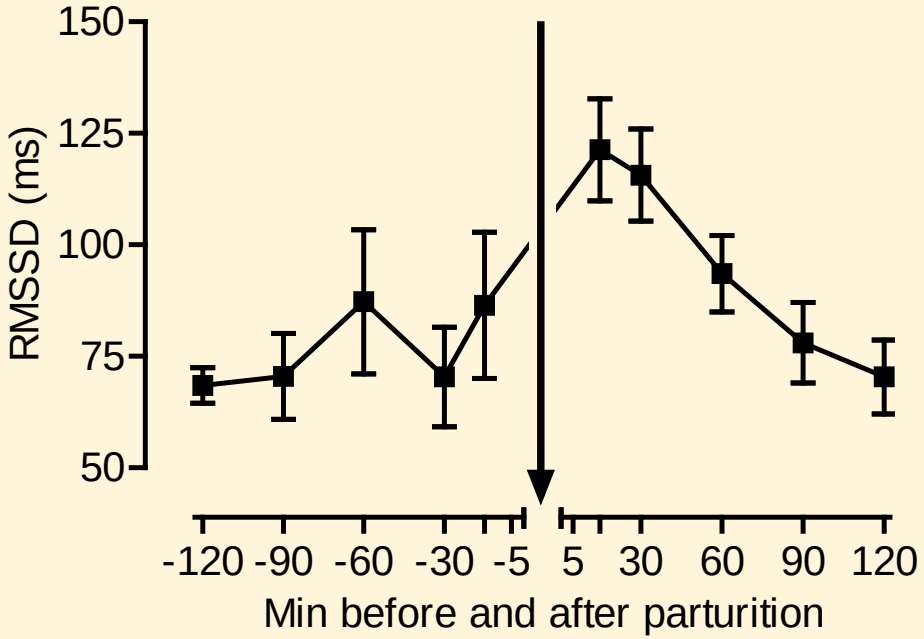


Heart rate from 120 min before to 120 min after parturition

Heart rate variability



HRV variable RMSSD from 15 days before to 1 day before parturition



HRV variable RMSSD from 120 min before to 120 min after parturition

Heart rate and HRV

Heart rate

- Increases during the last month of gestation but no further changes towards foaling
- false positive results with regard to prediction of foaling

HRV

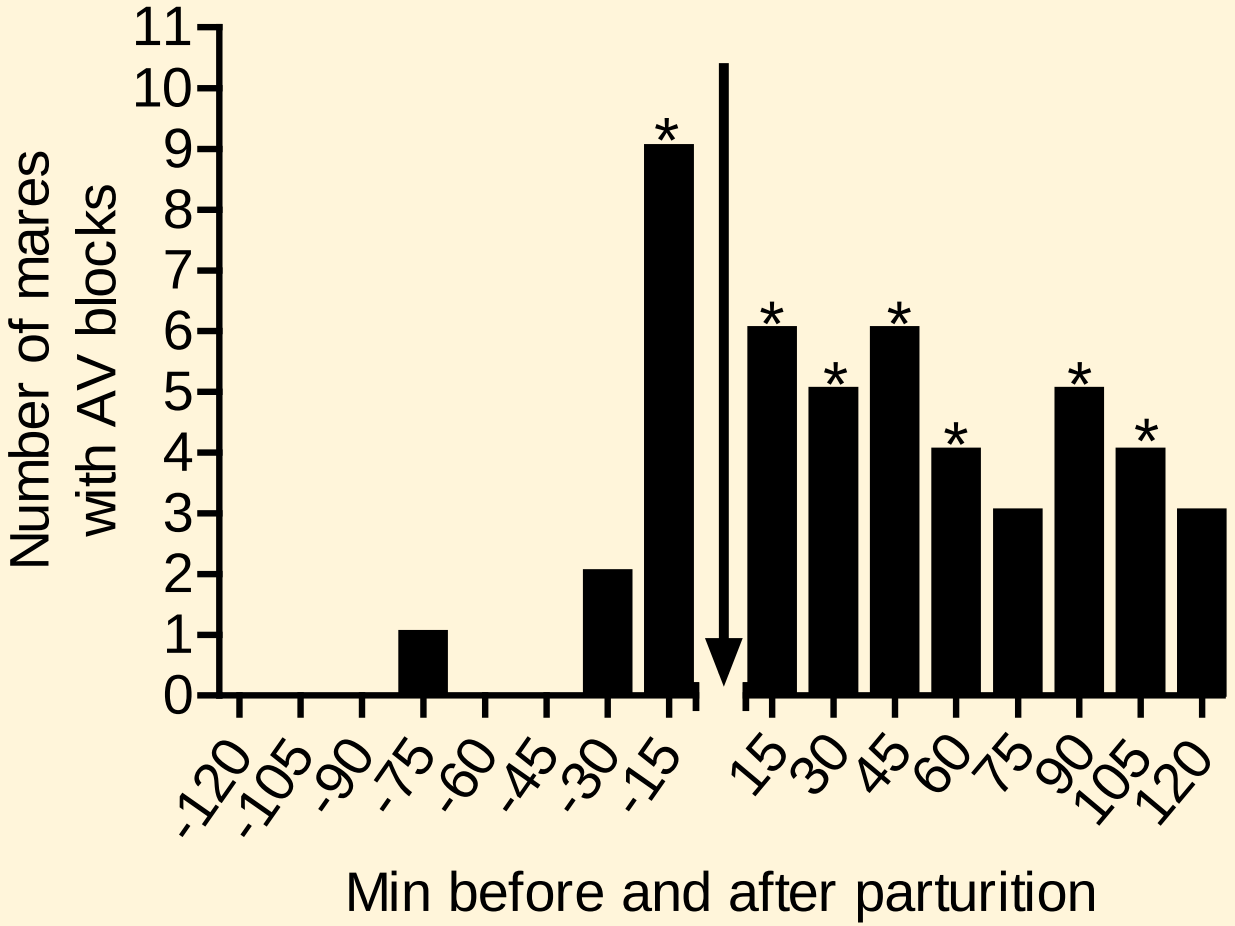
- High individual variations
- Increase in less than 70% of mares during the last 2 h before parturition

Atrioventricular blocks

- Horses have a powerful cardiovascular system and at rest occasionally “skip” one heart beat due to second degree atrioventricular blocks (AV blocks)
- Sign of high parasympathetic tone
- Disappear during exercise, due to increased demands on the cardiovascular system

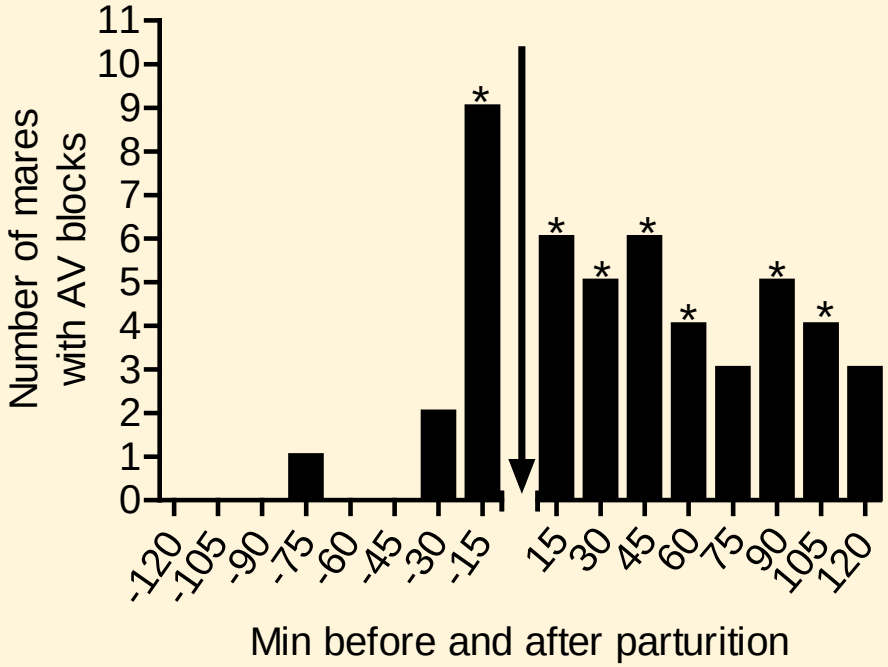
- AV blocks in parturient mares**?**
  - ➔ If parturition is a stressor, no AV blocks are expected

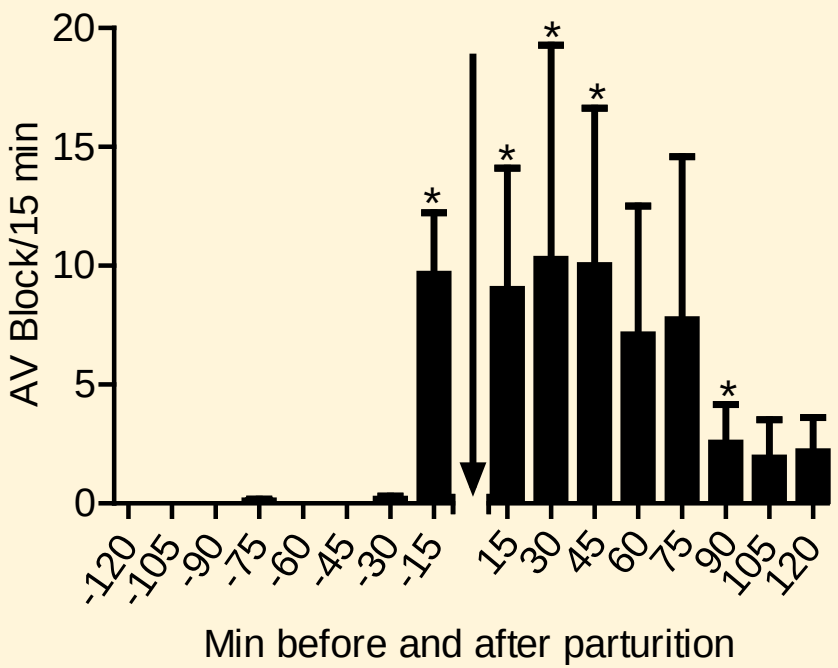
Atrioventricular blocks



Number of AV blocks per mare during 15 min intervals from 120 min before to 120 min after parturition (n=11)

Atrioventricular blocks





Number of AV blocks per mare and number of mares with AV blocks during 15 min intervals from 120 min before to 120 min after parturition (n=11)

Atrioventricular blocks

- No AV blocks in any mare days before parturition
- 9/11 mares showed AV block during 15 min interval before parturition
- Only one mare showed no AV blocks at all

Summary and conclusion

Summary and conclusion

- HR increases during equine gestation because of adaptation of the cardiovascular system to increasing demands of the growing fetus
- Before and during foaling heart rate remains at the same level
- High incidence of AV blocks and high HRV during and after parturition

➔ In horses parturition and the immediate post partum period are dominated by parasympathetic activity

➔ Physiological parturition is no major stressor in horses

Summary and conclusion

- Salivary cortisol increases 1-2 days before parturition
  - Coincides with increase in fetal plasma cortisol (Silver and Fowden 1995)
  - Cortisol in the maternal circulation could in part be of fetal origin
- Maximum cortisol concentration at 30 min after parturition
  - Not directly associated with labor

➔ High level of cortisol during high parasympathetic activity

➔ Rise in cortisol concentration is unlikely a stress response but part of the endocrine pathways initiating parturition

Prediction of parturition

- Heart rate and HRV no reliable parameters
- Detection of AV blocks during normal parturition?
- Cortisol concentration increases >2 ng/ml in up to 80% of mares during the last 24 hours before parturition

Prediction of parturition

Thank you for your attention