Aortic Rupture & Aortopulmonary fistulation in the friesian horse

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lay out Friesian horse project

2008 Prof. Dr. Wim Back
- Dwarfism
- Hydrocephalia
Aortic rupture & Aortopulmonary fistulation in the Friesian horse
Megaesophagus

ROYAL FRIESIAN

Ids Hellinga

Universiteit Utrecht

Universiteit Gent

Dierenkliniek Wolvendaal

Wageningen UR

2 PhD students:
Margreet Ploeg, Utrecht University, Department of Pathology
Véronique Saey, Ghent University, Department of Pathology

12 students of the Utrecht & Ghent University
Aortic rupture in the Friesian horse

People know now where to find us
Case controle
Human aortic rupture?

13th leading cause of death
- abdominal aortic rupture (74% cases) ANEURYSMA
  unhealthy lifestyle
  → inflammation: elastin & collagen degradation
- thoracal aortic rupture (26% cases) OFTEN ANEURYSMA
  genetic factors: Marfan’s, Ehlers Danlos, etc...

Also other species: turkey
Equine aortic rupture?

- **aortic root** rupture or intracardiac rupture causes?

  Copper deficiency,
  long-term degenerative disease with weakening of the aorta
  migration of *strongylus vulgaris* larvae
  high blood pressure
Equine aortic rupture?

- **aortic root** rupture or intracardiac rupture
  - → acute cardiac failure and death
  - → stabilisation, death

- for example: breeding stallions:
  
  (Brown and Taylor, 1987)

  - >15 yrs age
  - hypertension, full action
  - histological no abnormalities
Aortic rupture in the Friesian horse

Friesian horses are predisposed to develop rupture of the aorta near the ligamentum arteriosum to develop a pseudo aneurysm at the level of the rupture to develop a fistula (connection) between the aorta en A. pulmonalis

The estimated prevalence ± 2% (~dwarfism: ± 0,25%)
Aortic rupture in the Friesian horse
Aortic rupture in the Friesian horse
Aortic rupture in the Friesian horse

Research partners: 46 fully illustrated aortic rupture cases: detailed prior history, blood work, diagnostic work-up, protocolized autopsy, histology

Research partners: 40 fully illustrated megaesophagus cases: detailed prior history, blood work, diagnostic work-up, protocolized autopsy, histology

- BEVA 2010: Clinical diagnosis and findings of aortopulmonary fistula in 4 friesian horses. van Loon et al.
- BEVA 2012: Aorto-pulmonary fistulation in the Friesian horse: clinical characterization of 31 cases combined with histopathological features. Lifting a tip of the veil. Margreet Ploeg et al. BEVA Award winner
- Equine veterinary journal 2012: Aortic rupture and aorto-pulmonary fistulation in the Friesian horse: Characterisation of the clinical and gross post mortem findings in 24 cases
- BEVA 2013: transesophageal ultrasound to diagnose aortic rupture in the Friesian horse
Why does it need attention?

- High prevalence (~hydrocephaly 0,25%)
- Horses tend to rupture at a mean age of 4,5 years, most often just after they are broken. However (1-20 years research cases):
  - reproductive career
  - financial point of view
  - emotional point of view
- There is an acute, subacute and chronic form! Some of these horses walk around with this condition for weeks to months before they die
- A lot of these horses die in full action, not rarely while they are being ridden: dangerous situations
- Pre mortem diagnosis is a real challenge because of the distal location of the rupture and the musculature of the friesian horse
- Post mortem diagnoses requires adapted autopsy incisions of the heart, otherwise the zone of the rupture is ruined and the fistulation is overlooked. Also, many cases show no macroscopic abnormalities when the thoracal cavity is openen. Many cases are and have been overlooked without any doubt
- Is there overlap with genetic background of other diseases within the friesian breed? Collagen dysfunction
Typical case history features

- no gender predilection 46 cases
- Mean 4.4 years old (1-20 years)
- 4 out of 46 cases found death without prior symptoms: haemothorax
- Over 1/3th of all cases in days to weeks prior to cardiac failure:
  - recurrent colic
  - coughing/dyspnoe
  - poor performance
  - anorexia
  - depression
  - epistaxis
  - lameness switching from one leg to the other
- Other distinctive features reported 1 to 2 weeks prior to overt cardiac failure:
  - intermittent peripheral oedema
  - fever
  - sustained sinus tachycardia at rest
Typical features clinical examination

- ↑ rectal temperature
- ↑ jugular pulse
- Pale mucous membranes
- Bouncing arterial pulsation
- Peripheral (ventral) oedema
- Cardiac arrhythmias rare
- Murmurs are not necessary pronounced
- Sustained tachycardia at rest (> 56 BPM)
Typical features clinical examination
Pre-mortem diagnosis

✓ Case history: *acute*: dead without prior symptoms, but in several cases
  *subacute to chronic*: recurrent colic, peripheral oedema and
  *sustained tachycardia* for several weeks prior to overt cardiac failure.

✓ Clinical examination: sustained tachycardia, increased rectal temperature,
  peripheral oedema and increased jugular pulse with a bounding arterial pulse.

✓ Blood work: often mild anemia

✓ Radiography: increased diameter thoracic aorta and/or pulmonary artery

✓ Transthoracic ultrasound: *van Loon et al.*: SPECIAL VIEWS
  → right heart and pulmonary artery dilatation, tricuspid regurgitation,
  visualisation of the aortic rupture and fistula always possible but only on
  specific views (esp. left 3\(^{rd}\) and 4\(^{th}\) ICS)

However:
→ in some cases: diagnosis difficult to obtain (esp. due to size of the animal
  and location of the lesion).
→ early screening? Detection of predisposed cases?
Post-mortem diagnosis

- aortic rupture proximal lig. Arteriosum
- some cases also rupture pulmonary trunk & aortopulmonary fistulation
- remark: **classic cardiac autopsy incisions** → missed diagnosis EVJ 2013)
- some cases liver congestion + fibrosis → non-acute
Ultrastructural (microscopic) features aortic wall

COLLAGEN
ELASTIN
Aortic wall 40 cm distal from rupture

- H&E staining
  - significant ↑ collagen degeneration
  - significant ↑ hemorrhage
  - significant ↑ inflammation
  - no significant ↑ mineralization

- v Gieson staining:
  - ↑ waved pattern in ruptured cases

- PSR staining:
  - significant ↓ in amount of collagen
Aortic wall 40 cm distal from rupture

Control

Mineralization

Hemorrhage

Waved collagen fiber pattern
Aortic wall 40 cm distal from rupture
**Genetic background?**

GRANT PROPOSAL PROJECT → GWAS study : genetic test (hydrocephalia & dwarfism)  
→ SEQUENCING: 100% identification of responsible FUNCTIONAL GENE

**LINK BETWEEN TRAITS?**  
**EXTRA BUDGET**

<table>
<thead>
<tr>
<th>Chromosomal location</th>
<th>Description</th>
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<tbody>
<tr>
<td>5q13-q14</td>
<td>Mutatie zorgt voor verandering in een bindweefselproteïn</td>
</tr>
<tr>
<td>3p25-p24</td>
<td>Mutatie in het TGFBR2 gen, zorgt voor verandering van groeifactor</td>
</tr>
<tr>
<td>16p13.3-p12.2</td>
<td>Mutatie in myosine heavy chain 11 gen, belangrijk voor opbouw glad spierweefsel in vaatwand</td>
</tr>
<tr>
<td>19q13.3</td>
<td>Mutatie in FGF21 en HAS1, beide belangrijk voor celgroei en wondhealing</td>
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Human transoesophageal ultrasound

Doctor places TEE probe into mouth and down esophagus

A

B

Echocardiogram

Heart
Ventricles
Atrium

Fr 26Hz
3.0cm
2D
49%
C 50
P 60
Gen
CF
63%
4.1MHz
Wk High
Med

PAT 37.0C
TFF 38.2C
72 bpm

Esophagus

Transoesophageal echocardiography (TEE) probe in esophagus (probe can also be placed in the stomach)

Sound waves create pictures of the heart

Stomach

Patient lies on bed on left side
Human transoesophageal ultrasound

Chronic aortic dissection with thrombus in false lumen

Dissection aortic arch/descendens Shortaxis view 3D ultrasound

Aortic pseudoaneurysm after TEVAR procedure, 3D
Transoesophageal ultrasound Friesian horses

- 2 healthy Friesian horses
- 4 Friesian horses with aortic rupture
- Standing procedure (n=6); under anesthesia (n=3)
- Equipment: 10 mHz linear probe GE with colour flow, Logiq E in opened nasogastric tube, duct tape

TransTracheal wash tube ~ lubricant ventrally
Transoesophageal ultrasound
Friesian horses

STANDING PROCEDURE: Before start:
- Indicate zones of interest:
  → thoracic inlet
  → adult friesians: ± 1.48 nostril ~ site of rupture
- catheter left jugular vein: orientation point for probe
Introduction of probe under endoscopic guidance

Before start:
- treatment digoxin (0.011 mg/kg po BID po)
  furosemide (1.5 mg/kg iv SID)
  flunixin meglumin (ruptured)
- fasted (~ air oesophagus)
- sedation (detomidin; romifidin; ACP)
- nose twitch
Transoesophageal ultrasound
Friesian horses
Procedure under anesthesia

- End stage procedure
- Right lateral decubitus
- Longitudinal opening oesophagus for easy steering
- Left carotid artery catheterisation

One ruptured horse died during catheterisation after 60 min.

3 ruptured horses thorax opened after euthanasia to confirm location.
Transoesophageal ultrasound
Friesian horses

Source: topographic anatomy Popesko
Transoesophageal trajec

Bifurcation jugulair/axillaris/thymus

Subclavian and vertrebral branches and m. longus colli
Transesophageal trajectory
Transoesophageal trajectory
Conclusion

✓ Transoesophageal ultrasound is a very helpful tool to aid in premortem diagnosis of aortic rupture
✓ In view of possible overlap of traits sequencing is necessary to identify the functional responsible gene

Tank you! to all people who helped us!