TRADITION AND MODERNITY IN VETERINARY MEDICINE, 2019, vol. 4, No 2(7): 77–80

VARIATION IN TOPOGRAPHY OF PHRENIC NERVS IN A DONKEY

Lyubomir Hristakiev, Bilyana Petkova, Iliana Ruzhanova, Georgi I. Georgiev, Georgi D. Georgiev

University of Forestry, Faculty of Veterinary Medicine, Sofia, Bulgaria
E-mail: b_petkova@ltu.bg

ABSTRACT

The purpose of this report is to describe and document the rare anatomical variation of the right phrenic nerve seen in a male donkey. During routine dissection, a deviation of Nervus phrenicus dexter was detected. The phrenic nerves – left and right, were found to pas more ventral and specially right nerve was dislocated from caval vein plica in additional pleural fold. The physiological changes or clinical complications that may occur as a result of nerve dislocation have been discussed.

Key words: Nervus phrenicus, donkey, variation, diaphragm paralisis.

Introduction

The diaphragm is very important but not indispensable inspiratory muscle and its contraction leads to enlargement of the thoracic cavity in a caudal direction (7). Left and right phrenic nerves provide the motor innervation of the diaphragm. They originate from spinal nerves C4 to C7 and pass through the thorax in a fold formed by the ventral mediastinum. The left nerve joins the diaphragm passing in the caudal mediastinum; the right one runs through the cranial and middle mediastinum and caudally continues within the serous pleural fold (plica vena cavae) along with the caudal vena cava and reaches the right side of the tendinous part of diaphragm (3). Normal topography of the right phrenic nerve in horse is shown on Fig. 1 by Clayton, et al., 2005.

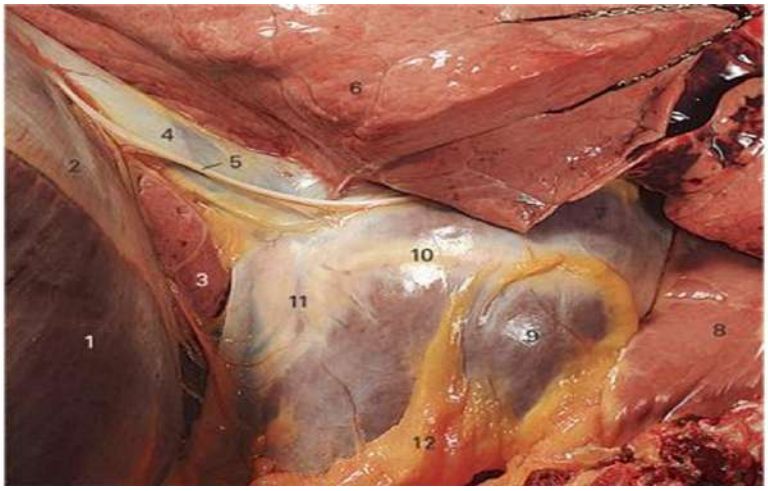

Figure 1: Normal topography of right phrenie nerve, from Clinical Anatomy of the Horse (2005), by Clayton et al.: 1 – Costal part of the diaphragm; 2 – Trndinous center of the diaphragm; 3 – Accessory lobe of the right ling seen throught the delicate caval fold of pleura; 4 – Caudal vena cava (partially drained of blood); 5 – Right phrenie nerve covered by a narrow fold of pleura; 6 – Diaphragmatic surface of the caudal lobe of the right lung; 7 – Right atrium seen throught the pericardium; 8 – Thymus within the cranial mediastinum; 9 – Right ventricle seen trought the pericardium; 10 – Coronary groove seen trought the pericardium; 11 – Subsinuosal interventicular groove seen trought the pericardium; 12 – Fat beneath the pericardial pleura.

Materials and methods

Routine dissection of a 5 years old jack (male donkey) was done. There was no operative scar on the surface of the body as sign of previous surgical treatment. After laparotomy the diaphragm and pericardium surfaces together with blood vessels and innervation were examined. There were no data for physiological disorders during animal life.

Results

During dissection of a male donkey and investigation of thoracic cavity a deviation of the right phrenic nerve was found. Both left and right phrenic nerves were on the side of pericardium attached with connective tissue envelop. The left phrenic nerve was passed on the left side of the pericardium and was reached to diaphragm. The right phrenic nerve in our case was located on the right side of the pericardium and was separated from the caudal caval vein and its fold. It was reached the diaphragm in a proper serous pleural fold, attached to the floor of the thorax. Position of the nerve was also more ventral than normal (Fig. 2 and 3). The lower position for the left phrenic nerve was observed also.

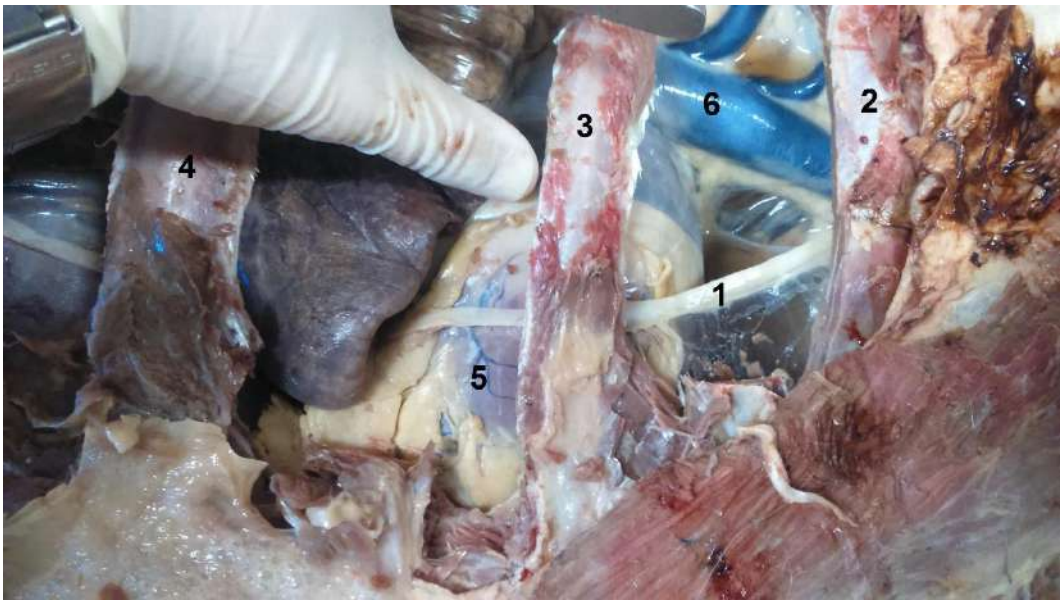

Figure 2: Dissection of a right thoracic wall of a donkey; 1 – right phrenic nerve; 2 – first rib; 3 – third rib; 4 – sixth rib; 5 – hearth and pericardium; 6 – v. cava cranialis.

Discussion

The anatomical variations reported on literature in humans can be classified as: variations in the nerve roots that give rise to the phrenic nerve; variations in its course, as seen in our report; and presence of accessory phrenic nerve. There are few reports in literature about the complications related to the variations of the phrenic nerve, whether on its origin, course or association with an accessory phrenic nerve. However many complications are suggested to happen due to these

variations. The different presence of the phrenic nerve leaves it in a vulnerable position during procedures of punction and catheterism of neighbouring vessels and thoracocentesis (9).

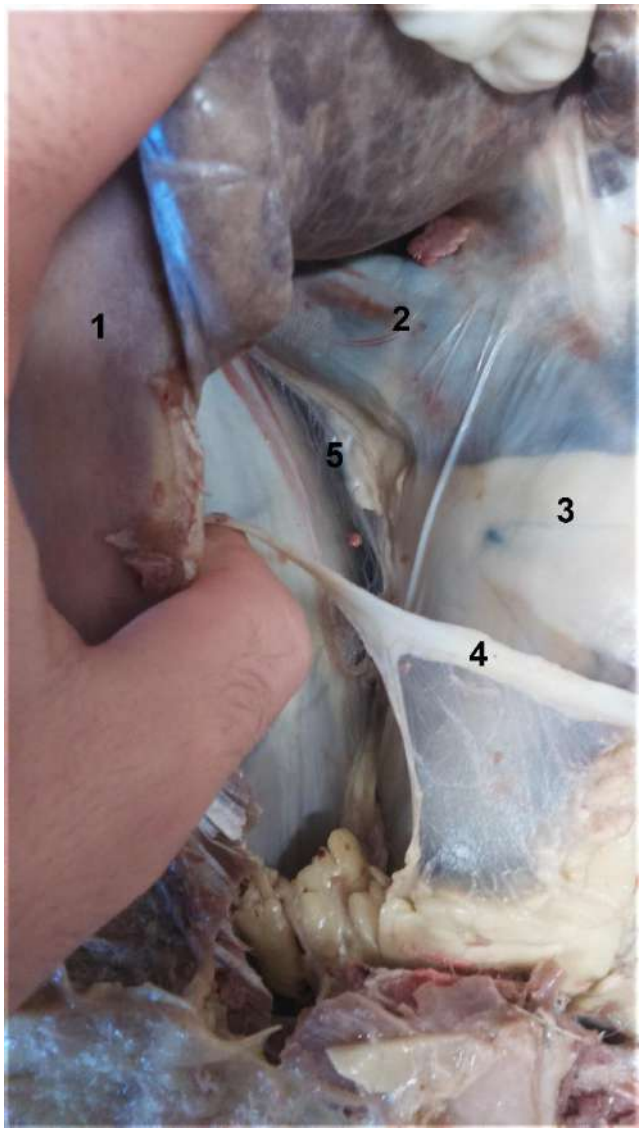

Figure 3: Dissection of a right thoracic wall of a donkey; 1 – sixth rib; 2 – v. cava caudalis; 3 – hearth and pericardium; 4 – right phrenic nerve; 5 – plica venae cavae.

Phrenic nerve impairment can often lead to serious respiratory disorders under various pathological conditions. Central or periphery lesion of phrenic nerve may cause diaphragmatic paralysis. Like Byers et al. (5) described, unilateral diaphragmatic paralysis can be asymptomatic however, animals or humans with bilateral diaphragmatic paralysis typically show signs of respiratory distress and demonstrate a paradoxical abdominal respiratory pattern in which the abdominal musculature contracts inward on inspiration. An increased effort in the struggle to breathe

may fatigue the accessory muscles and lead to ventilatory failure. In our case, unfortunately, we could not reveal the symptoms during donkey's lifetime. Diaphragmatic paralysis is an uncommon, yet underdiagnosed cause of dyspnea. Diaphragmatic paralysis has been described in animals, including a pony, a dog, a llamas, and some cats (1, 4, 5, 6, 8, 10, 11).

Diagnostic imaging used in animals and humans includes radiography, ultrasonography, and fluoroscopy. Ultrasonography has proved as valuable as fluoroscopy in detecting diaphragmatic paralysis in humans, showing 100% sensitivity and 100% specificity in the assessment of abnormalities of diaphragmatic motion (2, 8).

Conclusion

For the first time it was diagnosed a variation of the phrenic nerve position in a donkey but there are no data for breathing disorders during its life. Our suggestion is that this dislocation may cause problems with pericardio- or pleurocentesis related to an unwished injury of the nervus phrenicus, followed by paralysis or hemiparalysis of the diaphragm.

References

1. Amory, H., Lomba, F., Lekeux, P. M., Solal, A. N., Jauniaux, T. P. & Desmecht, D. J. (1994). *Bilateral diaphragmatic paralysis in a pony.* Journal of the American Veterinary Medical Association, Vol. 205: 587–591.
2. Balaji, S., Kunokovsky, P. & Sullivan, I. (1990). *Ultrasound in the diagnosis of diaphragmatic paralysis after operation for congenital heart disease.* British Heart Journal, Vol. 64: 20–22.
3. Barone, R. (1980). *Anatomia Comparata dei Mammiferi Domestici*, Vol. 2. Edizione Italiana a cura di R. Bortolami. Bologna, Ed Agricole. pp. 2, 533–541.
4. Bednice D, Mazan Mr, Kuehn H, Et Al (2002). *Diaphragmatic paralysis due to phrenic nerve degeneration in a llama.* J Vet Intern Med., Vol. 16:603–606.
5. Byers S, Barrington G, Nelson D, Et Al (2011). *Neurological causes of diaphragmatic paralysis in 11 alpacas (Vicugna pacos)*. J Vet Intern Med, Vol. 25:380–385.
6. Clayton, M. Hilary, Peter F. Flood, Diana S. Rosenstein, David Mandeville. (2005) *Clinical Anatomy of the Horse*. Mosby Elsevier first ed., 318 p.
7. Dyce K.M., Sack W. O., Wensing C. J. G. (2010) *Locomotor apparatus.* in: Textbook of veterinary medicine, 52 p.
8. Greene, C. E., Basinger, R. R., Whitfield, J. B. (1988) *Surgical management of bilateral diaphragmatic paralysis in a dog.* Journal of the American Veterinary Medical Association, Vol. 193:1542–1544.
9. Prates Júnior, A. G., Vasques, L. C., Bordoni, L. S. (2015). *Anatomical variations of the phrenic nerve: an actualized review.* J. Morphol. Sci., Vol. 32(1): 53–56.
10. Vignoli, M., M. Toniato, F. Rossi, R. Terragni, M. Manzini, A. Franchi, And L. Pozzi†. (2002). *Transient post-traumatic hemidiaphragmatic paralysis in two cats.* Journal of Small Animal Practice Vol. 43: 312–316.
11. Young, P. N., Gorgacz, E. J. & Barsanti, J. A. (1980) *Respiratory failure associated with diaphragmatic paralysis in a cat.* Journal of the American Animal Hospital Association Vol. 16: 933–936.