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Original article

The occurrence of dynamic structural disorders in the pharynx and larynx, at rest and during exercise, in horses diagnosed with mild and moderate Equine Asthma (Inflammatory Airway Disease)

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Abstract

The goal of the present study was to establish the occurrence of structural disorders in the larynx and pharynx during treadmill exercise tests in horses diagnosed with Equine Asthma (EA).

Investigation was performed in 29 horses, patients of the Equine Clinic of the Warsaw University of Life Sciences in Poland, admitted with poor exercise performance.

Upper and lower airway examinations were performed in all patients revealing both mild to moderate Equine Asthma (13 horses), and no lower airway abnormalities (16 animals).

In the group of horses with EA, 11 did not have structural disorders of the pharynx and larynx at rest. During exercise two horses were free of abnormalities, while 11 had structural disorders, eight of them solely in the pharynx, two in the larynx, and one in both the pharynx and larynx.

In the non- asthmatic group, 11 horses had no structural disorders during resting endoscopy. Endoscopy performed during exercise revealed disorders of the larynx in 10 horses, of the pharynx in three horses, and in both the larynx and pharynx in the remaining three horses.

In conclusion: horses with diagnosed EA frequently have disorders of the pharynx during treadmill exercise tests, while without EA, often have disorders of the larynx.

Endoscopy of upper airways during exercise testing is a valuable tool in the diagnosis of poor performance in horses with lower airway inflammatory disease.

Key words: horse, treadmill endoscopy, upper airway dynamic disorders, Equine Asthma

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Introduction

In horses with a genetic predisposition, equine asthma is induced by exposure to organic dust and other noxious agents like ammonia or endotoxins, which are generally found in the stable environment. In some cases infectious agents might also be involved. Mild and moderate asthma can affect horses of any age. Symptoms include a persistent cough lasting more than 3 weeks, mucopurulent discharge, and poor exercise performance. On endoscopic evaluation an increased amount of mucus in the trachea and mild thickening of the carina is observed. An increased number of neutrophils, eosionophils and mast cells can also be found in BALF (bronchoalveolar lavage fluid) (Couëtil et al. 2016). Asthma, especially manifesting as impaired exercise tolerance, should be differentiated from conditions of the upper respiratory tract (mostly larynx and pharynx), cardiovascular or musculoskeletal diseases (Lane et al. 2009). Signs of systemic infection (elevated body temperature, lethargy etc.) and respiratory distress at rest are usual exclusion criteria for mild and moderate asthma (Couëtil et al. 2016).

Courouce-Malblanc et al. (2010) investigated a relationship between dorsal displacement of the soft palate (DDSP) and lower airway inflammation in French trotters and discussed possible precedence of the symptoms. They concluded their study by posting a question – might DDSP be the reason for lower airways inflammation or might lower airways inflammation cause DDSP?

The aim of the present study was to analyze the relationship between equine asthma and upper respiratory tract disorders at rest and during exercise.

Materials and Methods

Animals

This research was conducted on 29 equine patients at the Warsaw University of Life Sciences (SGGW). The horses were between 3 and 10 years of age, of various breeds, gender, and use. Thirteen of them were sport horses, 9 were racehorses, and 7 were used solely for recreation. The horses were referred to the hospital with reduced exercise capacity and/or impaired respiratory function. Upon general and detailed clinical examination, which included cardiologic, orthopaedic, endoscopic, and cytological assessment, 13 horses were diagnosed with mild to moderate asthma (previously named IAD). In the remaining 16 patients no abnormalities in lower airways were observed.

In all 29 horses cardiovascular and musculoskeletal diseases were excluded upon initial EKG and orthopaedic examination. All horses met the qualification criteria for a high-speed treadmill exercise test.

Clinical examination

Once the horses were qualified with the exercise test we proceeded with a thorough clinical examination including assessment of body temperature, respiratory rate, heart and pulse rates, loudness of breathing and nasal discharge, palpation of superficial lymph nodes, bilateral auscultation of the heart and lungs, auscultation and palpation of the larynx and trachea, and verified presence of dyspnoea or spontaneous and elicited cough.

Electrocardiographic examination was performed in concordance with generally accepted methods using a Televet 100 KRUUSE ECG system.

On brief orthopedic examination we assessed the horses while they were walking, trotting, and cantering along with a physical examination of limbs with flexion tests.

Endoscopic examination

Endoscopic examination of the respiratory tract was performed with an Olympus GIF-100 videoendoscope: 0.9 cm in diameter and 100 cm long for the upper respiratory tract and Olympus CF: 1.3 cm in diameter and 140 cm long for the lower respiratory tract. For examinations of the upper respiratory tract, horses were not given any sedation. Endoscopic examinations of the lower respiratory tract required sedation with intravenous administration of xylazine 0.3-0.5 mg/kg b.w. and butorphanol 0.01-0.05 mg/kg b.w. Before collecting broncho-alveolar lavage fluid, we locally administered 0.2% lidocaine solution at the site of the tracheal bifurcation and the main bronchi through the working channel of the endoscope.

Endoscopic evaluation of the pharynx and larynx

Evaluation of the pharynx and larynx were carried out based on analysis of video recordings of endoscopic examinations performed at rest and during the exercise stress tests. Morphologic evaluation of the throat and larynx revealed several types of disorders, which have been listen in Table 1 (Figs. 1, 2).

Table 1. Types of structural changes in the pharynx and larynx detected via endoscopic examination during the exercise test on the high-speed treadmill. W/g Lane et al 2006.

	Types of structural disorders in the pharynx
1	Normal structure of the throat (Fig 1a)
2	Dorsally Displaced Soft Palate (DDSP) (Fig 1e)
3	Instability of the Soft Palate (IP) (Fig 1b)
4	Rostral instability of the soft palate (RISP) (Fig 1f)
5	Palatopharyngeal arch collapse (PPAC) (Fig 1d)
6	Pharyngeal Wall Collapse (PWC) (Fig 1c)
	Types of changes in the larynx
1	Normal structure of the larynx (Fig 2a)
2	Left-sided laryngeal paralysis (LRN) At rest: I°, II°, III°, IV° (LRN) during the exercise test: A, B, C (Fig 2c,d)
3	Unilateral collapse of the arytenoid cartilage (AC)
4	Bilateral collapse of the arytenoid cartilage (BAC)
5	Deviation of the aryepiglottic folds (ADAEF) (Fig 2b)
6	Dorsal Displacement of the Epiglottis (DDE) (Fig 2e)
7	Bilateral Vocal-fold Collapse (BVC)
8	Vocal fold collapse (VC)

Explanaton: * The evaluation of left-sided laryngeal paralysis was performed at rest using a simplified four grade scale, while a three grade scale was used during the exercise test (Bakarzai i Dixon 2011).
Four grade scale.
I – All movements of the arytenoid cartilage are symmetric and synchronous, the arytenoid cartilages are fully abducted and remain in this position for a longer time.
II – The movements of the arytenoid cartilage are not synchronous and/or the larynx is not symmetrical all the time; arytenoid can be abducted and can stay in this position for longer time.
III – The movements of the arytenoid cartilage are not symmetrical and not synchronous, Abductuion of left arytenoid cartilage is not possible.
IV – The complete lack of mobility of the left arytenoid cartilage and vocal fold.
Three grade scale assessment of the arytenoid cartilages during exercise:
A. Fully abducted arytenoid cartilages during inspiration.
B. Partial abduction of arytenoid cartilages. Position of arytenoids between resting position and full abduction.
C. Abduction less then resting position including collapse into the contralateral half of the rima glottidis during inspiration.

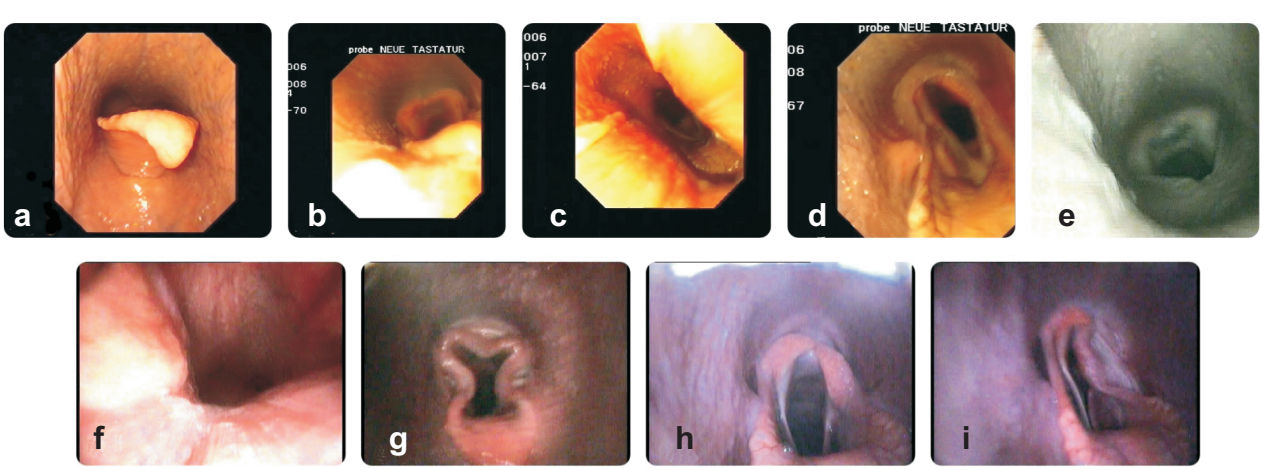

Fig. 1. Dynamic disorders of larynx and pharynx during treadmill exercise test: a – dorsal displacment of epiglottis, b – instability of soft palate, distal part, c – collapse of pharynx, d – lowering of palatopharygeal arch, e – dorsal displacment of soft palate, f – instabilty of soft palate, rostral part, g – axial deviation of aryepiglotic folds, h – Laryngeal hemiplegia grade B, I – Laryngeal hemiplegia grade C.

Table 2. Parameters of the exercise test for horses of varying use based on the maximum heart rate during exercise and the ability to keep the horse at the front of the HAICO 4000 treadmill. Values expressed in arithmetic means ± SD.

Use of horses	Number of horses (n)	Heart rate BPM	Parameters of the exercise test		
			angle of incline (%)	duration of exercise (min)	speed (m/s)
Race	10	198 ± 2.0	4.6 ± 0.1	5.4 ± 0.3	12.5 ± 0.1
Sport	10	190 ± 2.0	3.0 ± 0.2	5.2 ± 0.2	11.3 ± 1.0
Recreation	10	184 ± 1.8	2.8 ± 0.4	4.1 ± 0.1	8.0 ± 0.5

Evaluation of left-sided laryngeal paralysis was based on a 4-grade scale at rest and a 3-grade scale during exercise (Bakarzai and Dixon 2011) (Table 1).

Endoscopic evaluation of the lower respiratory tract

Clinical examination of the lower respiratory tract was performed 30 minutes after the stress test. In this evaluation, the accumulation of mucopurulent fluid in the distal $^3/_4$ trachea was determined based on a 6-grade scale (Bartner et al 2006, Allen et al 2007, Wysocka and Kluciński 2014). Discharge accumulation in the area of the tracheal bifurcation and main bronchi was assessed with a progressive 4-grade scale based on methods developed by Wysocka (Wysocka and Kluciński 2014).

The degree of tracheal bifurcation thickening was calculated with digital image processing software (GIMP ink 2.6), which calculated the ratio of main right bronchus lumen diameter to the thickness of the tracheal bifurcation at the middle of its height (Wysocka and Kluciński 2014).

BALF samples were taken with a silicone catheter (Bivona), 240 ml of warm saline was instilled into the bronchus and gently withdrawn.

The cytological composition of tracheal and broncho-alveolar fluid was determined according to universally accepted methods (Derksen et al 1989, Kluciński et al 1994, Wysocka and Kluciński 2015). The samples were stored in sterile tubes and transported to the lab within 2 hours. Tracheal aspirate (TA) and BALF were centrifuged for 9 minutes at 1500 rev/min. The precipitate was suspended in 0.5 ml of saline and the number of cells was counted. Slides were made from the precipitate and then stained using the May-Grunwald Giemsa method. The percentages of different cell-types were evaluated under 100x magnification in both samples. The percentages of cells were estimated to the number of 200 cells.

Tracheal aspirate samples were cultured according to standardized methods. All tracheal aspirate samples were submitted for microbiological culture. BALF was analysed for cytology. Samples from tracheal aspirate were cultured using standard microbiological methods.

Exercise Test

The exercise test was carried out at the Equine Clinic in the Department of Clinical Sciences at the Faculty of Veterinary Medicine. The test was conducted using a HAICO 4000 high-speed treadmill. The design of this test was modelled on the exercise test performed at The Center for Equine Sports Medicine at the University of Bristol. This test is also used in routine daily diagnostics (Wysocka 2006). The exercise test parameters, i.e. incline angle, duration time, running speed, duration time to running speed ratio, were developed in previous clinical studies by measuring the maximum heart rate during exercise and by assessing the ability of a horse to maintain position at the front of the treadmill (Table 2). The heart rates at rest and during exercise were measured using the POLAR 800i pulsometer and the TELEVET 100 KRUUSE telemetric ECG.

Before participating in the exercise test horses were trained and conditioned equally in walking, trotting and cantering on the treadmill, in order to perform during the test (Wysocka 2006).

Endoscopic examinations of the upper respiratory tract were conducted during the exercise test.

Statistical Calculations

Statistical calculations were performed using the Chi square test and the Fischer's exact test.

Table 3. Values of clinical, endoscopic, and cytologic parameters at rest, in horses with reduced exercise capacity. Values expressed in arithmetic means ± SD.

Horses with poor performance (n=29)		
Parameters	Horses with diagnosed IAD (n=13)	Horses undiagnosed as IAD (n=16)
Body temperature (C°)	37.5 ± 0.5	37.4 ± 0.6
Breaths/min	11 ± 3	10 ± 2
Heart rate BPM	34 ± 4	38 ± 2
Degree of accumulation of tracheal secretions on the scale of 6°	1° (n=9) 2° (n=4)	0° (n=16)
Degree of accumulation of secretions on the scale of 4°	0° (n=11) 1° (n=2)	0° (n=16)
Index of tracheal bifurcation thickening	6.70 ± 0.5[a]	11.0 ± 0.7
Percentage of neutrophils in BAL (%)	36.68 ± 3.12[a]	9.2 ± 2.8
Percentage of eosinophils in BAL(%)	3.205 ± 1.00	0

Explanation: [a] – statistically significant value compared to a grup of horses with undiagnosed IAD ($p<0.05$), n = number of animals.

Table 4. The presence of structural disorders in the pharynx and larynx at rest and during controlled exercise testing in individual horses diagnosed with IAD.

Horses	The structural disorders of the pharynx or larynx	
	during rest	during exercise test
1	none	none
2	none	none
3	none	Instability of soft palate, axial deviation of aryepiglotic folds
4	none	Pharyngeal wall collapse
5	none	Left sided laryngeal hemiplegia grade B, dorsal displacment of soft palate
6	Dorsal displacment of soft palate	Dorsla displacment of soft palate
7	none	Instability of soft palate
8	Left sided hemiplegia grade IV	Left sided hemiplegia grade C, collapse of left arytenoid cartilage
9	none	Pharyngeal wall collapse
10	none	Pharyngeal wall collapse
11	none	Instability of rostral part of soft palate, instability of soft palate
12	none	Pharyngeal wall collapse, instabilty of soft palate
13	none	Instability of rostral part of soft palate

Results

Clinical and laboratory parameters of patients with exercise intolerance

Upon clinical examination of 29 horses with reduced exercise capacity, body temperatures, respiratory rates, and heart rates were all within normal reference ranges (Table 3). No cardiovascular or musculoskeletal disorders were observed.

In the 13 horses diagnosed with mild to moderate asthma, endoscopic examination confirmed the accumulation of mucopurulent secretions in the distal $^3/_4$ trachea, significantly greater oedema of the tracheal bifurcation, and a higher percentage of neutrophils and eosinophils in bronchoalveolar washings when compared to the remaining 16 patients without any lower airways abnormalities (Table 3). Six of the horses with mild to moderate asthma were used for racing, 6 were used as sport horses, and 1 was used for recreation. In the remaining group of 16 patients, 7 horses were used for sport, 6 were used for recreation, and 3 were used for racing.

Table 5. The presence of structural disorders in the pharynx and larynx at rest and during controlled exercise testing in individual horses with undiagnosed IAD.

Horses	The structural disorders of pharynx and larynx	
	during rest	during exercise test
1	Left sided laryngeal palysis grade IV	Left sided laryngeal paralysis grade C
2	none	Left sided laryngeal hemiplegia grade B, left sided arytenoid cartilage collapse, axial deviation of aryepiglottic folds
3	none	Instability of soft plate, bilateral vocal fold collapse, left sided arytenoid cartilage collapse
4	none	Bilateral vocal fold collapse
5	none	Dorsal displacment of soft palate
6	none	Axial deviation of aryepiglottic folds
7	none	Instability of soft palate
8	none	Rostral displacment of palatopharyngeal arch, left sided laryngeal hemiplegia grade B, left sided arytenoid cartilage collapse
9	none	Instability of rostral part of soft palate
10	none	Pharyngeal wall collapse
11	Left sided laryngeal hemiplegia grade IV	Left sided hemiplegia grade C, left sided arytenoid cartilage collapse, bilateral vocal folds collapse
12	Left sided laryngeal hemiplegia grade III	Left sided laryngeal hemiplegia grade B
13	Left sided laryngeal hemiplegia grade IV	Left sided laryngeal hemiplegia grade C, bilateral vocal fold collapse, left sided arytenoid cartilage collapse
14	Left sided laryngeal hemiplegia grade IV	Left sided laryngeal hemiplegia grade C, left sided arytenoid cartilage collapse
15	none	Left sided laryngeal hemiplegia grade B
16	none	Axial deviation of aryepiglotic folds

Table 6. Number of types of structural disorders in the pharynx at rest and during controlled exercise testing in horses qualified in each group.

Types of structural disorders in the pharynx	Number of disorders in horses with diagnosed IAD		Number of disorders in horses with undiagnosed IAD	
	at rest	during exercise test	at rest	during exercise test
Dorsal displacment of soft palate	1	2	0	1
Instability of soft palate	0	4	0	3
Pharyngeal walll collapse	0	5	0	1
Instabilty of rostral part of soft palate	0	3	0	1
Rostral displacment of palatopharygeal arch	0	0	0	1
Number of all disorders	1	14[a]	0	7

Explenation: [a] – diffrences statisticaly important in number of structural disorders during exercise test in horses with diagnosed IAD in comparsion to horses with undiagnosed IDA ($p<0,05$).

Endoscopic evaluation of pharynx and larynx at rest and during controlled exercise test in equine patients

Endoscopic evaluation showed that 11 out of 13 horses diagnosed with mild to moderate asthma did not have any morphological disorders in pharynx or larynx at rest. However during the exercise test, only 2 of the horses showed no structural disorders of pharynx or larynx. The remaining 11 had dynamic structural disorders of the pharynx or larynx visible during exercise. Pharynx disorders were present in eight of these animals, larynx disorders in two, and both pharynx and larynx disorders in one horse (Table 4).

In the group of 16 patients without lower airways abnormalities, 11 patients had no structural disorder

Table 7. Number of types of structural disorders in the larynx at rest and during exercise testing in horses qualified for each group.

Types of structural disorders in the larynx	Number of disorders in horses with IAD		Number of disorders in horses with undiagnosed IAD	
	at rest	during exercise test	at rest	during exercise test
Left sided laryngeal paralysis				
I° A			0	0
II° B	0	1	0	3
III°	0	0	1	1
IV° C	1		4	3
Axial deviation of aryepiglottic folds	0	1	0	3
Bilateral vocal folds collapse	0	0	0	0
Dorsal displacment of epiglottis	0	0	0	1
Left sided arytenid cartilage collapse	0	1	0	5
Bilateral vocal fold collapse	0	0	0	4
Number of all disorders	1	4*	5	20[a]

Explanation: [a] – significant differences in the number of structural changes during the exercise test in horses with undiagnosed IAD ($p<0.05$) between horses diagnosed with IAD during the exercise test on a point scale (Bakarzai and Dixon 2011).

Table 8. Number of horses with IAD and undiagnosed IAD in which there were structural changes in the pharynx and larynx, during rest and during controlled exercise testing.

Number of disorders	Number of orses with diagnosed IAD		Number of horses without lower respiratory disease	
	at rest	during exercise	at rest	during exercise
In the pharynx	1	8(72.8%)[a]	0	3 (18.8%)
In the larynx	1	1 (9.1%)[a]	5	11 (68.8)%
In the pharynx and larynx	0	2 (18.1)	0	2 (12.4%)

Explanation: [a] – statistically significant differences between the number of horses with structural changes in the pharynx and larynx, with diagnosed IAD and undiagnosed IAD ($p<0.05$).

of the pharynx or larynx at rest. The remaining 5 horses had IIIrd and IVth degree left-sided laryngeal paralysis at rest. Moreover during the exercise test we observed structural disorders in all horses belonging to this group. Three horses had pharynx abnormalities, ten patients had larynx abnormalities, and in the remaining three had changes of visible in both the pharynx and larynx (Table 5).

Based on this research, we determined that horses diagnosed with asthma exhibit an increased number of structural changes of the pharynx during the exercise test when compared to the number of structural disorders visible in horses without any lower airways abnormalities (Table 6). The most common dynamic changes recognized in horses diagnosed with mild to moderate asthma were soft palate instability and pharyngeal wall collapse (photo 1 b,c).

In horses diagnosed with mild to moderate asthma, structural disorders in the region of the larynx occurred sporadically when compared to the recognized structural disorders in horses without lower airways abnormalities (Table 7). In horses without lower airways abnormalities most structural changes could be classified as grade B and C left-sided laryngeal paralysis (dynamic grading system of laryngeal function) (photo 2 a,b). A comparative analysis of the two investigated groups revealed that horses with mild to moderate asthma have a significantly higher number of dynamic pharyngeal disorders when compared to horses without EA (Table 8) In horses without lower airways abnormalities, disorders of the larynx are more frequent than in horses affected by mild to moderate asthma ($p=0.039$).

Discussion

In 13 horses diagnosed with mild to moderate asthma 6 were used for racing, another 6 for sport, and 1 horse was used for recreation. Our results confirm previous findings (Wood et al. 2005), which showed that mild to moderate asthma (former IAD)

occurs more often in performance horses than in those used for recreation.

One examination, which can help to find a correlation between diseases of the lower respiratory tract and the resting and dynamic disorders of the upper respiratory tract, particularly in the region of the pharynx and larynx, is the endoscopic examinations at rest and, after preliminary conditioning, on the high-speed treadmill.

Values of the exercise test parameters, such as the angle of incline, exercise duration, speed, and the ratio of exercise duration to speed were determined individually for horses depending on their different use. These parameters have been used at the clinic for the past 10 years when conducting exercise tests for patients of varying use (Wysocka 2006).

Despite continuous improvement and implementation of new diagnostic methods, including portable dynamic endoscopes, the high-speed treadmill exercise test remains a highly efficient tool for diagnosing dynamic disorders in the pharynx and larynx (Franklin et al. 2010, Van Erck 2011).

Testing horses on a high-speed treadmill ensures standardization and reproducibility of exercise within groups of horses with the same usability. The intensity of exercise is more comparable to a race as opposed to training. Horse can be observed more efficiently while at work, which can facilitate a diagnosis, especially a dynamic disorder of the pharynx and larynx. Additionally, it is possible to determine various parameters of clinical and laboratory tests, for example, exercise blood gas test, or exercise echocardiography.

It should be underlined that high-speed treadmill tests are safe for horses (authors unpublished data, Franklin et al 2010).

Undoubtedly, one of drawbacks of exercise testing on a high-speed treadmill is that the horse must be transported to a clinic, which has the suitable equipment and trained personnel. Additionally, exercise testing is time-consuming due to the time period needed for conditioning. It is also impossible to take into account the relationship between the horse and rider, which can affect the appearance of dynamic changes during natural exercise by flexing neck of the horse etc. (Franklin et al. 2010, Van Erk et al. 2011).

This study demonstrated that only 24% of the horses in both groups at rest exhibited disorders, primarily in the larynx (6 animals) and pharynx (1 patient), which remained during the exercise test. In most cases, the disorders of the pharynx and larynx which were observed at rest, did not carry over into the dynamic picture of the pharynx and larynx, which is in accordance with research conducted by Lane et al 2006.

In horses with left-sided laryngeal paralysis, which is visible at rest, in horses with fourth degree laryngeal paralysis, collapse of the larynx during exercise can be predicted (grade C); this is not true in the case of grade II and III (Rakestraw et al. 1991).

During the exercise tests, 93% of tested horses exhibited dynamic disorders in the pharynx and larynx. Statistical analysis of this data shows that over 60% of horses with mild to moderate asthma experience dynamic changes in the throat and 15% experience dynamic changes in both the pharynx and the larynx. In contrast to this, the group of horses without lower airways disease primarily exhibited dynamic abnormalities of the larynx. Of the 16 horses, 11 individuals i.e. almost 69% had such disorders during exercise. In the following 5, there were disorders in the larynx and pharynx (Table 8).

Out of the 5 assessed dynamic disorders in the pharynx of horses with Equine Asthma, the most common disorders were instability of the soft palate, collapsing walls of the pharynx, and rostral instability of soft palate, which were not observed with such intensity in the second group of horses. Disorders related to the dynamic displacement of the soft palate (instability and displacement of the soft palate) are more common in horses with mild to moderate asthma (former IAD), which was described by Courouce – Malblanc et al. 2010. Dynamic abnormalities of the larynx in horses with mild to moderate asthma presented 5 times less frequently than in horses without lower airways disease. The most frequently diagnosed disorders during the exercise test (in horses with undiagnosed lower airways disease) were varying degrees of left-sided laryngeal paralysis, unilateral collapse of the arytenoid cartilage and bilateral collapse of the vocal folds. This is perhaps due to the fact that mild asthma occurs more frequently in young race and sport horses, which account for a large part of the population. Additionally, displacement of the soft palate also occurs more frequently in young horses, yet disorders of the larynx (vocal fold collapse) are more commonly found in older horses (Lane et al. 2006). Allen 2006 similarly describes that the occurrence of mild to moderate asthma (former IAD) is positively correlated with young age in horses that run on racetracks.

Further investigations are needed to conclude if the dynamic disorders of the pharynx are an initiating factor of lower airway inflammation, as horses with dorsal displacement of the soft palate are more prone to food aspiration, or if the disorders of the pharynx are secondary to increased inspiratory negative pressure, observed typically in cases of lower airway inflammation.

In conclusion, performing an exercise test is an important clinical evaluation, which can reveal

dynamic structural disorders in the pharynx and larynx. Studies have shown that horses diagnosed with mild to moderate asthma have concurrent lesions not only in the lower respiratory tract, but also dynamic structural disorders in the pharynx. The most common disorders are instability of the soft palate and collapse of the walls of the pharynx.

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