Prevalence of Upper Respiratory Tract Disorders Detected with a Flexible Videoendoscope in Thoroughbred Racehorses

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ABSTRACT. A total of 350 thoroughbred racehorses found clinically as having coughs or abnormal breath sounds underwent endoscopic examination of the upper respiratory tract at rest. As a result, abnormal endoscopic findings were obtained in all horses, demonstrating that thoroughbred racehorses with a clinical abnormality in the respiratory system necessarily had disorders in the upper respiratory tract. Whereas 11 types of disorder were observed, a combination of three different types of disorder were found in the highest frequencies in 3-, 4- and 5-year-old horses (27.8%, 29.2% and 29.7%, respectively). Among 6-year-olds or older horses, those having only one type of disorder accounted for the greatest proportion (47.6%). The prevalence of pharyngeal lymphoid hyperplasia or abnormalities of the epiglottis decreased with age.—**KEY WORDS:** complication, endoscope, prevalence, thoroughbred racehorse, upper respiratory disorder.

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Since the advent of endoscopes, abnormal findings such as pharyngeal lymphoid hyperplasia (PLH), laryngeal hemiplegia (LH), dorsal displacement of the soft palate (DDSP), epiglottic entrapment (EE), etc. found in the upper respiratory tract in racehorses have occasionally been reported [1, 3, 7, 8, 10, 11, 13]. The widespread use of the flexible videoendoscope in recent years has also facilitated reports of such observations, providing clearer images [6]. But, since most reports focused on the cause of the disease, the diagnostic method and therapeutic procedures, the prevalence of disorders and its relation with age have rarely been described [10, 13]. Furthermore, there have been no reports specifying the severity of disorders, excluding PLH [8], LH [4] and tracheal mucopus (TM) [2], or reports documenting the simultaneous existence of two or more different types of disorder. In Japan, reports of upper respiratory tract disorders in racehorses are rare.

In this connection, we carried out endoscopic examination of the upper respiratory tract in thoroughbred racehorses found clinically as having coughs or abnormal breath sounds to study the actual situation, particularly the prevalence of disorders and their complications.

MATERIALS AND METHODS

Horses: A total of 350 thoroughbred racehorses found clinically as having coughs or abnormal breath sounds were subjected to the study (Table 1).

Endoscopic examination: Each horse underwent endoscopy under restraint with a twitch alone at least 2 hr after the end of exercise to minimize the effects of exercise. After observing the right nasal cavity, nasopharynx, pharyngo-larynx and trachea via the right naris, the left nasal cavity was observed via the left naris. On this occasion, swallowing was induced by touching a certain site of the pharyngo-larynx with the tip of the flexible endoscope to examine for the manifestation of DDSP,

Table 1. Age and number distribution of 350 horses

Age	Sex			Total (n)
	Male	Female	Gelding	
3	94	65	3	162
4	85	43	2	130
5	31	5	1	37
6 or older	17	3	1	21
Total (n)	227	116	7	350

which is likely to be elicited by swallowing. To obtain data helpful in diagnosing LH, the degree of adduction or abduction of the arytenoid cartilage was observed while the nares were temporarily occluded by an assistant. At the same time, a slap test [11], by which the adductive state of the arytenoid cartilage is observed after slapping the thoracic region, was carried out for an auxiliary purpose.

For endoscopic observation, we generally used a flexible videoendoscope (GIF TYPE XQ 200, OLYMPUS, Tokyo), A flexible fiberscope (GIF TYPE XQ 20 long type, OLYMPUS, Tokyo) was also used if necessary. Along with observation on a monitor, the images obtained on the examination were recorded on VHS video tape. The recorded images were closely examined for disorders of the left and right ventral nasal passage, caudal nasal cavity, nasal pharynx, soft palate, pharyngeal recess, pharyngeal openings of the auditory tubes, epiglottis, arytenoid cartilages, vocal folds, laryngeal floor and tracheal lumen.

Assessment of endoscopic findings: PLH [8], LH [4] and TM [2] were assessed according to the criteria described in a previous report.

The degree of PLH was graded according to the criteria

described by Raker and Boles [8]: Grade 0- a few small white follicles over the dorsal pharyngeal wall; Grade 1- mainly small white follicles with occasional larger pink follicles over the dorsal pharyngeal wall and extending laterally to the level of the guttural pouch ostia; Grade 2- pink and white follicles covering the entire dorsal and lateral pharyngeal walls and often also involving the dorsal surface of the soft palate; and Grade 3- large pink, edematous follicles covering all visible mucosa of the pharynx and sometimes including polyps.

The degree of LH was graded according to the criteria described by Hackett *et al.* [4]: Grade 0- synchronous full abduction and adduction of the left and right arytenoid cartilages; Grade 1- asynchronous movement (hesitation, flutter, adductor weakness, etc.) of the left arytenoid cartilage during any phase of respiration. Full abduction of the left arytenoid cartilage (as compared to the right) inducible by nasal occlusion or swallowing; Grade 2- asynchronous movement (hesitation, flutter, adductor weakness, etc.) of the left arytenoid cartilage during any phase of respiration. Full abduction of the left arytenoid cartilage cannot be induced and maintained by nasal occlusion or swallowing; Grade 3- marked asymmetry of the larynx at rest and no substantial movement of the left arytenoid cartilage during any phase of respiration; and Grade 4- laryngeal asynchrony or asymmetry not included in any one of the previous grades.

The degree of TM was graded according to the criteria described by Burrell [2]: Grade 0- not found; Grade 1- isolated globules; Grade 2- a thin continuous stream less than 15 mm wide; and Grade 3- thick continuous stream more than 15 mm wide.

DDSP, abnormalities of the epiglottis (EA), elevation of the soft palate (ELE) and EE were assessed according to the following criteria.

The degree of DDSP was graded according to the following criteria: Grade 0- displacement is not elicited by induced swallowing; Grade 1- displacement is elicited by swallowing, but is restored to the normal position after one subsequent swallowing movement; Grade 2- displacement is elicited by swallowing, but is restored to the normal position after two or more subsequent swallowing movements; Grade 3- displacement occurs easily in no association with swallowing.

The degree of EA was graded according to the criteria: Grade 0- the convex part of the dorsal center and marginal serrated folds in the epiglottis are clear; Grade 1- the convex part of the dorsal center is unclear; Grade 2- the convex part of the dorsal center and marginal serrated folds are unclear; Grade 3- thinning or stunting of the epiglottis is present in addition to grade 2 findings; Grade 4- findings not assignable to grades 0-3.

The degree of ELE was graded according to the following criteria: Grade 0- more than 2/3 of the glottic opening is observable; Grade 1- 1/3 - 1/2 of the glottic opening is unobservable because of the elevated epiglottis; Grade 2- 1/2- 2/3 of the glottic opening is unobservable because of the elevated epiglottis; Grade 3- more than 2/3

of the glottic opening is unobservable because of the elevated epiglottis.

The degree of EE was graded according to the following criteria: Grade 0- not found; Grade 1- the lateral part of the epiglottis alone is covered with the arytenoepiglottic fold; Grade 2- the tip of the epiglottis alone is covered with the arytenoepiglottic fold; Grade 3- almost the entire epiglottis is covered with the arytenoepiglottic fold.

We assessed only the appearance of disorders other than upper respiratory tract disorders.

Statistical analysis: For statistical analysis, the χ^2 -test was used for a comparison of the prevalence of every upper respiratory tract disorder in the various age-groups.

RESULTS

Eleven different types of disorder were observed. All horses were found to have at least one type of disorder. In 3-, 4- and 5-year-old horses, a combination of three types of disorder were most frequent, while in 6-year-old or older horses those having only one type of disorder were predominant. There was a significant difference in the prevalence of disorders between 3-year-old horses and 6-year-old or older horses, between 4-year-old horses and 6-year-old or older horses, and between 5-year-old horses, 6-year-old and older horses (Table 2).

PLH was found in 73.1% of all horses examined, and the prevalence significantly decreased with age (Fig. 1a, Table 3). In 6-year-old or older horses, all PLH disorders found were either grade 0- or 1.

Table 2. Relationship of the number of disorders to age of horses

Age	Total (n)	Number of disorders						p-value ^{a)} (χ^2 test)
		1	2	3	4	5	6	
3	162	16	38	45	39	22	2	A
4	130	14	30	38	29	13	6	B
5	37	8	7	11	8	2	1	C
6 or older	21	10	9	0	2	0	0	ABC

a) Same letter (A, B, C) means that there is significant difference in the number of disorders ($P < 0.01$) among age-groups.

Table 3. Relationship of the prevalence of PLH to age of horses

Age	Total (n)	Grade				p-value ^{a)} (χ^2 test)
		0	1	2	3	
3	162	27	75	43	17	ABC
4	130	30	73	20	7	A DE
5	37	19	16	1	1	B D
6 or older	21	18	3	0	0	C E

a) Same letter (A, B, C, D, E) means that there is significant difference in prevalence of PLH (A: $P < 0.05$, B, C, D, E: $P < 0.01$) among age-groups.

Table 4. Relationship of the prevalence of LH to age of horses

Age	Total (n)	Grade					p-value ^{a)} (χ^2 test)
		0	1	2	3	4	
3	162	67	54	33	8	0	AB
4	130	30	53	36	11	0	A
5	37	10	9	14	3	1	B
6 or older	21	6	8	5	2	0	

a) Same letter (A, B) means that there is significant difference in prevalence of LH ($P < 0.05$) among age-groups.

Fig. 1a. Videoendoscopic view of PLH (Grade 3), demonstrating large pink and edematous follicles covering all visible mucosa of the pharynx.

Fig. 1b. Videoendoscopic view of LH (Grade 3), demonstrating asymmetry of arytenoid cartilages.

Fig. 1c. Videoendoscopic view of TM (Grade 2), demonstrating a thin continuous stream less than 15 mm wide (A).

Fig. 1d. Videoendoscopic view of DDSP (Grade 2), demonstrating ulceration in the free border of the soft palate (A).

LH was found in 67.7% of all horses (Fig. 1b). The prevalence was significantly higher in 4-year-old and 5-year-old horses than in 3-year-old horses. Grade-3 LH was found in 6.9% of all horses, the prevalence being higher in 4-year-old, 5-year-old and 6-year-old or older horses (8.5%, 8.1% and 9.5%, respectively) than in 3-year-old horses (4.9%) (Table 4). Among all horses with LH, the left side was affected in 99.6%, and the right side in 0.4% (grade 4).

TM was found in 36.6% of all horses examined (Fig. 1c). Intratracheal foreign bodies (pasture grass or wood chips) were found in 5.5% (7/128) of these horses with

Table 5. Relationship of the prevalence of TM to age of horses

Age	Total (n)	Grade					p-value ^{a)} (χ^2 test)
		0	1	2	3		
3	162	109	25	13	15		N
4	130	76	29	16	9		N
5	37	20	8	4	5		N
6 or older	21	17	4	0	0		N

a) Same letter (N) means that there is no significant difference in prevalence of TM among age-groups.

Table 6. Relationship of the prevalence of DDSP to age of horses

Age	Total (n)	Grade					p-value ^{a)} (χ^2 test)
		0	1	2	3		
3	162	101	35	16	10		N
4	130	89	28	11	2		N
5	37	25	9	3	0		N
6 or older	21	18	2	1	0		N

a) Same letter (N) means that there is no significant difference in prevalence of DDSP among age-groups.

TM. In the prevalence of TM there was no significant difference among the various age-groups (Table 5).

DDSP was found in 33.4% of all horses. Although the prevalence of grade-2 or -3 DDSP tended to decrease with age, the difference was not statistically significant (Table 6). Horses with grade-3 disorders, accounting for 3.4% of all horses examined, included no individuals 5 years old or older. On the other hand, ulceration of the free border of the soft palate was found in 4.3% (5/117) of horses with DDSP (Fig. 1d).

EA was present in 52.3% of all horses examined. In particular, marked loosening and thinning (grade 3) of the epiglottis were found in 3.1% (Fig. 2a); horses with these findings were likely to develop DDSP not associated with swallowing. Shortening of the epiglottis (grade 4) was found in 2.9%. The prevalence of EA decreased with age, showing a significant difference between 3-year-old and 4-year-old horses and between 3-year-old and 6-year-old or older horses (Table 7).

Of all horses examined, 21.4% had ELE, with 0.3% having grade-3 ELE, in particular (Table 8, Fig. 2b). In the prevalence of ELE there was no significant difference among the various age-groups.

EE was found in 0.6% (grade 3) of all horses examined. A granulating ulcer was present in the arytenoepiglottic fold in one of the horses with EE (Fig. 2c). In the prevalence of EE there was no significant difference among the various age-groups.

Other disorders included rhinitis found in 22.9% of all horses (Fig. 2d), sinusitis in 0.9%, mycosis of the guttural

Table 7. Relationship of the prevalence of EA to age of horses

Age	Total (n)	Grade					p-value ^{a)} (χ^2 test)
		0	1	2	3	4	
3	162	63	66	22	9	2	AB
4	130	65	47	10	2	6	A
5	37	22	11	3	0	1	
6 or older	21	17	3	0	0	1	B

a) Same letter (A, B) means that there is significant difference in prevalence of EA (A: $P < 0.05$, B: $P < 0.01$) among age-groups.

Table 8. Relationship of the prevalence of ELE to age of horses

Age	Total (n)	Grade				p-value ^{a)} (χ^2 test)
		0	1	2	3	
3	162	130	27	5	0	N
4	130	106	14	9	1	N
5	37	25	8	4	0	N
6 or older	21	14	6	1	0	N

a) Same letter (N) means that there is no significant difference in prevalence of ELE among age-groups.

Fig. 2a. Videoendoscopic view of EA (Grade 3), demonstrating marked loosening and thinning of the epiglottis.

Fig. 2b. Videoendoscopic view of ELE (Grade 3), demonstrating marked elevation of the epiglottis.

Fig. 2c. Videoendoscopic view of EE (Grade 3), demonstrating a granulating ulcer in the arytenoepiglottic fold (■).

Fig. 2d. Videoendoscopic view of severe rhinitis.

pouch in 0.3% and ethmoid hematoma in 0.6%. In the prevalence of any of these disorders there was no significant difference among the various age-groups.

DISCUSSION

The present study demonstrated that thoroughbred racehorses with a clinical abnormality in the respiratory system necessarily had at least one type of abnormal endoscopic disorder in the upper respiratory tract. This prevalence was extremely high in comparison with the results reported by Raphael [10], who performed endoscopic examination of the upper respiratory tract of 479 horses and found abnormal findings in 8.6% of them. This is probably because the subjects of our study were restricted to horses clinically showing an abnormality in the respiratory system. The use of a videoendoscope in our study may also have been contributory. Even mild disorders were easy to detect with the videoendoscope, because it allowed observation and recording of data from the CCD as clear images provided via the monitor, unlike the conventional fiberscope which allows a single operator to observe disorders only through the eyepiece. The percentage of horses that had one type of disorder alone was 13.7%, and the other 86.3% had two or more types of disorder; a combination of three types of disorder was most frequent in 3-, 4- and 5-year-old horses. These findings are not consistent with the results of previous reports [10,13] covering a single type of disorder alone. The aforementioned factors may also be involved in this discrepancy. These disorders should be treated properly, with due consideration of their combination.

PLH, which was found in the highest frequency among the horses examined in the present study, is known to be common in young horses. This condition reportedly become less frequent with age [11], and this trend was also noted in our study. This has been explained by the following speculations: the younger the horse is, the weaker the immune response of the pharyngeal mucous membrane may be, and that young horses may not be strong enough to bear the increased physical actions of intense airflow, etc., during training [11]. However, these speculations have not been demonstrated by actual corroborative data, and much still remains to be elucidated.

On the basis of experimental data obtained during treadmill exercise [4, 9], it has been reported that horses having grade-3 LH at rest emit abnormal breath sounds during maximal exercise because the left arytenoid cartilage cannot be opened to the maximum degree, and this affects their performance. In the present study, grade 3 LH was found in 6.9% of all the horses examined. Our finding that LH was significantly more frequent in 4- and 5-year-old horses than in 3-year-old horses was inconsistent with the previously reported finding that LH was more likely to develop in the initial stage of training [11]. Further research is necessary to investigate the degree of its involvement in decreased running capacity and the mechanisms of its development.

Burrell [2] detected TM in about 50% of all horses examined. In our study, the corresponding percentage was 36.6% as a whole, with this condition being relatively frequent among 3-, 4- and 5-year-old horses. Although TM is attributable to inflammation of the lower respiratory tract (e.g., bronchitis), it was difficult for endoscopy to identify the site of the primary disorder.

In the present study, DDSP was found in 33.4% of all horses. Horses with grade 2 or 3 DDSP, accounting for 12.3%, emitted abnormal breath sounds or showed signs of exercise intolerance. This indicates that the assessment criteria used in the present study rather closely reflect the situation during exercise and is useful for examination carried out under resting conditions, but for more accurate judgment, determination of the condition of the upper respiratory tract during exercise and the effects on the cardiorespiratory system may be necessary. On the other hand, endoscopic examination of the upper respiratory tract should be performed on all horses observed to have exercise intolerance, because DDSP is considered to be one of the differential diagnoses for exercise intolerance.

Much remains unclear as to ELE, including its effects on running capacity, and there has been no report documenting its prevalence. This condition was present in 21.4% of all horses examined in the present study, but only horses with grade-2 or -3 ELE, accounting for 5.7%, emitted abnormal breath sounds or showed signs of exercise intolerance. Since subepiglottic cyst [5, 12] was a possible cause of this condition [11], these horses underwent lateral roentgenography, which, however, failed to detect any subepiglottic cyst. In one autopsied case, an anatomical defect was found (unpublished data), suggesting the involvement of a congenital factor. That is, more than one factor has been suggested in relation to the etiology and pathological condition of ELE. Improved methods may therefore be necessary in approaching this issue.

We must acknowledge EA as a discreet clinical condition, because EA has been reported to predispose to DDSP [11]. Nevertheless, apparently no detailed reports on EA have been published to date. We found this condition in about 52.3% of all the horses examined, and we concluded that horses with high grades of EA have a tendency to be afflicted with DDSP.

We could not obtain enough patients with EE to thoroughly deal with the criteria we employed.

The present study demonstrated a correlation among the type and severity of disorders in the upper respiratory tract, the frequency of complication and age in thoroughbred racehorses.

We would like to apply these results in order to make clear the causes of the upper respiratory disorders and the relation between each grade and prognosis, and to continue the pathohistological analysis.

REFERENCES

1. Boles, C. L., Raker, C. W., and Wheat, J. D. 1978. Epiglottic entrapment by arytenoepiglottic folds in the horse. *J. Am. Vet. Med. Assoc.* 172: 338-342.
2. Burrell, M. H. 1985. Endoscopic and virological observations on respiratory disease in a group of young thoroughbred horses in training. *Equine Vet. J.* 17: 99-103.
3. Clarle, A. F., Madelin, T. M., and Allpress, R. G. 1987. The relationship of air hygiene in stables to lower airway disease and pharyngeal lymphoid hyperplasia in two groups of thoroughbred horses. *Equine Vet. J.* 19: 524-530.
4. Hackett, R. P., Ducharme, N. G., and Fubini, S. L. 1991. The reliability of endoscopic examination in assessment of arytenoid cartilage movement in horses Part 1: subjective and objective laryngeal evaluation. *Vet. Surg.* 20: 174-179.
5. Koch, D. B. and Tate, L. P. 1978. Pharyngeal cysts in horses. *J. Am. Vet. Med. Assoc.* 173: 860-862.
6. Morris, E. A. and Seeherman, H. J. 1990. Evaluation of upper respiratory tract function during strenuous exercise in racehorses. *J. Am. Vet. Med. Assoc.* 196: 431-438.
7. Ordidge, R. M. 1977. Epiglottic entrapment in the horse. *Vet. Res.* 100: 365-366.
8. Raker, C. W. and Boles, C. L. 1978. Pharyngeal lymphoid hyperplasia in the horse. *J. Equine Med. Surg.* 2: 202-207.
9. Rakestraw, P. C., Hackett, R. P., Ducharme, N. G., Nielan, G. J., and Erb, H. N. 1991. Arytenoid cartilage movement in resting and exercising horses. *Vet. Surg.* 20: 122-127.
10. Raphael, C. F. 1982. Endoscopic findings in the upper respiratory tract of 479 horses. *J. Am. Vet. Med. Assoc.* 81: 470-473.
11. Robertson, J. T. 1991. Pharynx and larynx. pp. 331-387. In: *Equine Respiratory Disorders* (Beech, J. ed.), Lea & Febiger, Philadelphia.
12. Stick, J. A. and Boles, C. 1980. Subepiglottic cyst in three foals. *J. Am. Vet. Med. Assoc.* 177: 62-64.
13. Sweeney, C. R., Maxson, A. D., and Soma, L. R. 1991. Endoscopic findings in the upper respiratory tract of 678 thoroughbred racehorses. *J. Am. Vet. Med. Assoc.* 198: 1037-1038.