The Relationship Between Pulmonary Function Tests and Other Parameters. Results of a Research Project into the Etiology of C.O.P.D. in Horses

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Introduction

The subject defined in the title of this paper will be discussed in combination with provisional results obtained from a research project into the etiology of coughing in horses in riding schools. In the course of this project the reliability of pulmonary function tests appeared to be a problem. In 1981 tracheobronchoscopy became routine in the "Clinic of Large Animal Medicine" in Utrecht, and from that time on the validity of pulmonary function tests has been questioned. The problem is as follows:
It is well-known that the clinical investigation (at rest as well as immediately after exercise) of horses suffering from so-called C.O.P.D. is very often disappointing. Pulmonary function tests were an improvement on previous diagnostic methods and it became evident that many horses without clinical signs of respiratory disease suffered from obstructive lung disease. In those cases in which a post-mortem examination was carried out, the findings were invariably indicative of obstructive lung disease. At that time pulmonary function tests were the last word in veterinary medicine both for veterinarians and owners.
But bronchoscopy brought an end to this euphoria. Every year more horses were found to be suffering from chronic coughing without any other clinical signs and without measurable functional disorders. However, sometimes considerable amounts of mostly purulent exudate in the trachea and bronchi were found. Horses with functional disorders without positive bronchoscopic findings are rare, especially when investigated after exercise. Therefore, one might think that pulmonary function tests are simply not sensitive enough.
Bronchoscopy gives more additional information about patients. Does this mean that C.O.P.D. can be diagnosed in an earlier stage of the disease? Even before the obstructive character of the disease can be demonstrated? Have pulmonary function tests any prognostic value? Are there any other parameters that can give diagnostic information, even before measurable functional problems?

Material and Methods

About 2 years ago an investigation was started into the etiology of coughing in riding schools. Sixteen riding schools were selected throughout the Netherlands using (i) the number of horses (at least 50) and (ii) being a school with or without "coughing problems" as the selection criteria.
At all riding schools, 15 horses were clinically investigated, and lung function tests as well as bronchoscopy were carried out.

Results

Out of the 240 horses examined only 12 had clinical signs of C.O.P.D. Another 19 horses were reported to cough occasionally. That means: 5 % of the horses were clinically abnormal, 7.9 % were suspected, altogether 12.9 %.
The pulmonary function tests were abnormal in 17.9 % of the cases (43 horses), including the clinically diseased animals. Of the 19 coughing horses 11 had abnormal lung function tests.
Bronchoscopic inspection (Table 1) revealed purulent exudate in the tracheas of 80 horses (33.3 %). The difference between the riding schools was striking. The percentages differed from 0 to 79!

		Follic. pharyngitis	Abnormal pulmonary function tests
Riding-school horses 100	without exudate 67	−75	+6
		+25	
	with exudate 33	+62	+51
		−38	

Table 1: Bronchoscopic and functional findings in %

In 50 of these positive horses (62.5 %) a follicular pharyngitis was found, too. This means that in 37.5 % of the horses with symptoms of chronic bronchitis it was not possible to diagnose laryngitis and/or pharyngitis.
Pharyngitis was diagnosed in 25 % (40 cases) of the horses without purulent exudate in the trachea. In the majority of these cases the owner reported that the animals could have been infected some weeks earlier during a horse-show or similar event. All horses which were slaughtered or sold by the owner because of respiratory problems had abnormal function tests, i. e., the maximal intrapleural pressure change was too high. From these data it is concluded that lung function tests are inferior to bronchoscopy. To be clear, such findings were not obtained from patients in the clinic, but from horses in riding schools. Nevertheless, clinical cases have given a similar experience. Maybe the percentage differs a little, but the tendency is similar. The same can be said about pulmonary function tests and clinical investigation.

Discussion

What does this all mean? Is there a need for other lung function tests, for example during exercise?
Using bronchoscopy it appeared to be possible to diagnose pulmonary malfunctions in riding schools. It was, however, necessary to investigate quite a few animals.
But what was happening at these riding schools? The horses were chronically diseased. Bacteriological investigation of the mucus was negative. In acute cases, virological investigation was sometimes positive, but those cases are not included in the numbers presented.

Control of Riding Schools

There was a need for more information about the riding schools in which the horses were housed. During the last two years many parameters were continuously recorded. Below the most striking results are given (brought up to 1-6-'85). (Table 2).

Riding school	% Exudate in airways	CO_2 (vol-%)	NH_3 (vol-%)	Dust (mg/m^3)
8	7	0.05 (0.01 – 0.11)	2.4 (1.0 – 5.0)	1.221 (0.548 – 1.901)
13	0	0.05 (0.02 – 0.10)	2.6 (1.0 – 7.0)	1.480 (0.748 – 2.338)
2	79	0.08 (0.02 – 0.15)	3.6 (1.0 – 6.7)	1.932 (1.803 – 3.628)
9	67	0.07 (0.03 – 0.10)	3.1 (1.0 – 6.2)	1.873 (0.590 – 2.737)

Table 2: Parameters recorded in riding schools during 2 years

In riding schools with the highest percentage of bronchoscopically positive horses, the highest concentrations of ammonia and dust in the air were found. Even more striking is that in each separate school the ammonia and dust concentrations were the highest in those stables where most positive horses were found. This investigation is still being carried out.
As environmental factors are obviously of great importance, we investigated whether dust provokes an allergic disease in those schools. Intradermal tests with a number of known allergens were carried out. The allergens included

Micropolyspora faeni	0.3 mg/ml
Fungi	0.1 %
Thermoactinomyces vulgaris	0.3 mg/ml
Hay dust	0.1 %
Dermatophagoides pteronyssinus (hay dust mite)	100 NE
Dermatophagoides farinae (meal mite)	1 %
Horse danders	0.01 %
Grass pollen	1000 NE
Control:	
Histamine	0.001 %
Buffer solution	100 %
Riding school antigen	0.1 %

Table 3: Allergens used in the intradermal tests

Micropolyspora faeni, hay dust, meal mite and riding school dust (made from each specific riding school).
Histamine and the buffer solution used were controls. The reactions were measured at 30' and 240' (Table 3 + 4).
Again, the results are surprising. To make a long story short: except for histamine all reactions were optimal at 240' which is similar to the type-III reaction in man. Meal mite was intermediate and grass pollen gave no reaction whatsoever. Dust gave the same results, more positive reactions after 240' than after 30'.
From the number of positive reactions in each horse it appeared that in those riding schools with the most bronchoscopically positive horses the highest number of positive intradermal reactions was found. The difference was statistically significant.
In the schools with problems, the percentage of positive reactions after intradermal application of riding school antigen was up to 100, whereas this figure was less than 40 in the schools without problems. Therefore, intradermal sensitivity tests can be used for tracing schools in trouble. For each separate horse this test cannot be used.
Thinking of a type-III reaction as in the condition of farmer's lung in man, precipitating antibodies were checked. In some cases they could be found, namely for Micropolyspora faeni.

Conclusion

It is very likely that ammonia and dust can provoke non-specific bronchial hyperresponsiveness, but a type-III reaction may play a part as well. In the schools with coughing

Table 4: Intradermal sensitivity tests in %

30'	240'	Micro-polysp. faeni	Fungi	Thermo-act. vulg.	Hay dust	Hay dust mite	Meal mite	Horse danders	Grass pollen	Histamine
+	+	2.6	0.4	0.9	15.1	0.9	47.0	0.0	0.4	24.6
+	–	0.0	0.0	0.4	1.3	2.6	0.9	2.2	2.2	72.1
–	+	81.9	18.1	14.2	59.5	2.2	48.3	1.3	3.0	3.3
–	–	15.5	81.5	84.5	24.1	94.4	3.9	96.6	94.4	0

problems a slight increase in the number of eosinophilic cells in peripheral blood was demonstrated. Decreased paO_2-values in horses, even without signs of airway obstruction, was an indication, too.
If a type-III reaction plays a part, negative pulmonary function tests can be accepted because in human medicine in about 45 % of the chronic cases obstruction to airflow is not evident. Pulmonary function tests during exercise are recommended. Exudate in the bronchi is quite normal in the farmer's lung.
Is a type-III reaction being the etiology for chronic coughing in horses the cause of so many negative pulmonary function tests, even in horses with a considerable amount of exudate in trachea and bronchi? Or are these tests not sensitive enough and consequently abnormal in more severe cases only?
Pulmonary function tests are of importance in a clinic, anyhow, both in diagnosing and even more in the evaluation of therapy, but in herd control they are inferior to other parameters.

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