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STUDIES ON THE PHYSIOPATHOLOGY OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE IN HORSES. I. CLINICAL SIGNS

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Abstract

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Twenty cases of chronic cough originating in the lung and associated with loss of performance were clinically examined. The physical signs observed were compared with those observed in a control series of 38 clinically normal horses.

Reduced work tolerance, coughing for more than 3 months and abnormal pulmonary sounds (râles) were primary signs of chronic obstructive pulmonary disease (COPD). Forced abdominal expiratory efforts and pumping of the anus were regarded as confirmatory signs.

Neither nasal discharge nor increased marginal distance was found to be a reliable sign of COPD.

The mean respiratory frequency of the COPD subjects, namely 25,4 per minute, was significantly higher than the 16,7 per minute ($P < 0,001$) of the 38 normal subjects.

Résumé

ÉTUDES SUR LA PHYSIOPATHOLOGIE DE LA MALADIE PULMONAIRE OBSTRUCTIVE CHRONIQUE DES CHEVAUX. I. SIGNES CLINIQUES

Vingt cas de toux chronique d'origine pulmonaire, associée avec une perte de performance ont été cliniquement examinés. Les signes physiques observés ont été comparés avec ceux observés dans une série témoin de 38 chevaux cliniquement normaux.

Une tolérance de travail réduite, une toux pendant plus de trois mois et des râles pulmonaires anormaux furent les signes primaires de la maladie pulmonaire obstructive chronique (COPD). Des efforts expiratoires abdominaux et pompage de l'anus ont été considérés comme des signes confirmateurs.

Ni le jetage nasal, ni la distance marginale accrue ne furent pas considérés être des signes certains de COPD.

La fréquence respiratoire moyenne des sujets COPD, à savoir, 25,4 par minute, était significativement plus élevée que celle de 16,7 par minute ($P < 0,001$) des 38 sujets normaux.

Introduction

In a review of chronic pulmonary disease in man, the introductory statement was made: "It doesn't take a doctor to diagnose breathlessness" (Anon., 1972). By analogy, it doesn't take a veterinary practitioner to diagnose "heaves" in horses. The outward signs are apparent to laymen and veterinarians alike. As Gerber (1969) observed, "heaves" is a symptom, not a disease, and should be discarded along with the archaic term "broken wind".

Chronic obstructive pulmonary disease (COPD) has been adopted in much of contemporary medical literature as the most appropriate term to describe a complex range of chronic respiratory disorders originating primarily in the lung (Sasse, 1971). The term is a functional, descriptive one and embraces chronic conditions at all levels of pulmonary airways from bronchi to alveoli. Since the range of chronic conditions includes emphysema, obstructive in this sense means that both flow and diffusion of pulmonary gases within the airways and alveoli of the lung are hindered.

Clinical signs of COPD in horses were recently reviewed by Littlejohn (1979). Although there was agreement that coughing and the forced expiratory effort were typical signs of COPD, there was little unanimity regarding other signs and their significance. As stated by Sasse (1971), "the most divergent findings are noted at lung auscultation". This may be attributed to the wide spectrum of pathological changes which are possible in the lung parenchyma, and to the highly subjective nature of the interpretations thereof.

In their investigations of 88 horses and ponies referred for examination of cardiovascular and respiratory systems, McPherson, Lawson, Murphy, Nicholson, Fraser, Breeze & Pirie (1978) relied on PaO_2 values and on maximum intrathoracic pressure difference (max $\triangle$ Ppl) to diagnose COPD. In the following studies a different approach was used. The diagnosis of COPD was made on purely clinical grounds, i.e. physical examination of the patient and appraisal of its history. The results of physiological or other investigations in COPD subjects were then compared with the results of identical tests in a control group of clinically normal subjects. Since clinical signs were the basis of the comparison and were also correlated with some of the physiopathological values obtained, the clinical methods used and the results obtained form the substance of the first paper in this series.

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Materials and Methods

Subjects

Clinically normal horses and ponies consisted of 18 privately owned and 20 experimental subjects in departmental stables of this Faculty. No signs of pulmonary or cardiac disease were noted at any time during the investigation and all were in some form of productive work. A number of them had minor surgical complaints such as splints, windgalls or sandcracks but, provided that they did not show lameness and were capable of being ridden, they were accepted as clinically normal.

The 20 COPD horses and ponies were clinical cases referred by veterinarians to the Department of Medicine of this Faculty. Although COPD was diagnosed or suspected by the referring veterinarian, they were assigned to the COPD category only after a complete clinical examination. Common factors among COPD subjects were that the owner or rider reported a loss of performance and an intermittent cough for a period of more than 3 months and that the referring veterinarians were unable to attribute the complaint to upper respiratory tract lesions.

Anamnesis

The history of each case was recorded. Points noted were the medical history, the reason for referral, physical signs seen by owner or veterinarian, duration of signs and the work tolerance as judged by the owner.

Physical examination

The physical examination of each case followed a routine similar to those recommended by authorities such as Blood & Henderson (1960) and Boddie (1962).

The sequence adopted by the author was:

(a) Visual examination of posture, habitus, integument and rate and character of respiration. This examination was conducted as unobtrusively as possible while the subject was standing quietly in a loose box. For clinical subjects, the examination was performed the day after arrival at the clinic to allow time for nervousness resulting from transport and change of environment to subside.
(b) Auscultation and percussion of the thorax.
(c) The frequency and nature of cough.
(d) Observation of other physical signs.

The above sequence allowed observations of basic respiratory signs to be made before the subject became stimulated or excited by handling.

Coughing

The occurrence of coughing and its nature were determined both when the subject was resting and, at each pace when working under the saddle at walk, trot and canter over a distance of 400 m.

Auscultation and percussion of the thorax

A Fleischer* stethoscope was used for auscultation. Each intercostal space was auscultated at 3 or more points of the pulmonary area, covering dorsal, central and ventral parts of the lung. The clarity and character of lung sounds were noted.

The cardiac area was auscultated according to the techniques described by Holmes (1968). Heart sounds and murmurs (if present) at mitral, tricuspid and pulmonic areas were recorded.

Percussion of the thorax was performed according to the technique of Steck (1967). This method uses the index or middle finger of one hand as a pleximeter and the index finger of the other hand as a hammer. The pleximeter finger is pressed tightly into the 12th intercostal space, and light percussion is performed at approximately 2 cm intervals down the intercostal space. A change in the quality of the sound produced occurs at the limit of pulmonary resonance. Percussion is thereafter performed firmly down the intercostal space until the faint resonant sound disappears again. This point establishes the limit of thoracic wall resonance. Two points in the 12th intercostal space are thus established. The distance between the 2 points delineated on the thoracic wall was named by Steck (1967) the "Schallgrenz" or marginal distance. This distance is fairly constant in normal quiet horses and measures 40–60 mm. The marginal distance increases with COPD and also with mechanical stimuli such as urination, defecation or recumbency, chemical stimuli of various kinds, and excitement. (Steck, personal communication, 1973).

Other physical signs

Abnormal clinical signs such as nasal discharge or pumping of the anus were observed and recorded.

Statistical methods

Student 't' tests of significance were used (Mather, 1949).

Results

The heart rates and respiratory frequencies of normal and COPD subjects are compared in Table 1. There was no significant difference between the mean heart rates of the normal and COPD subjects. However, the higher mean respiratory frequency of the COPD subjects compared with that of normal horses was highly significant.

Coughing, râles, marginal distance, nasal discharge and pumping of the anus are compared in Table 2. The signs of greatest diagnostic value were reduction of work tolerance, coughing, râles and pumping of the anus. Reduced work tolerance was reported by owners either as increased time over a fixed distance or as respiratory distress when subjected to a normal or decreased work load. The marginal distance as defined by Steck (1967) was not an indicator of COPD, since it was found to be increased in 12 normal subjects. Nasal discharge was noted in only 8 COPD subjects.

All the subjects except 3 coughed while resting, and of these three, 2 coughed during exercise. Of the 17 COPD subjects which coughed at rest, 13 coughed on at least 2 occasions during exercise. All the COPD subjects therefore coughed at rest, during exercise or both, and all but one were considered to have abnormal pulmonary sounds on auscultation.

Râles were noted in all but one of the 20 COPD subjects. There was no uniformity in the nature of the râles; they varied from harsh bronchial sounds to high-pitched squeaks. On 3 occasions, the râles were suggestive of the sound of paper being rapidly crumpled. In 6 subjects, squeaking sounds were heard regularly and bilaterally. In 10 subjects, abnormal sounds were of an intermediate nature with unilateral and/or irregular squeaks. In the remaining case, which did not have abnormal pulmonary sound, coughing during rest and exercise was the only clinical sign; all other signs and endoscopic examination of the upper respiratory tract were negative. However, exercise tolerance was reduced, according to the owner.

TABLE I Mean heart rate and respiratory frequency of normal and COPD subjects

		Normal n=38	COPD n=19	Difference of means	Significance
Heart rate	Mean	39,6	41,0	1,4	t=0,68
	SD±	9,6	11,3	—	P<0,4 (NS)
Respiratory frequency	Mean	16,7	25,4	8,7	t=5,01
	SD±	5,1	8,2	—	P<0,001

* Becton Dickinson & Co., New Jersey

TABLE 2 Work tolerance, coughing, râles, increased marginal distance, nasal discharge and pumping of the anus in normal and COPD subjects

	Normal n=38	COPD 2=20
Work tolerance	Adequate	Reduced
Coughing at rest	0	17
Coughing during exercise	1	13
Râles	0	19
Increased marginal distance	12	16
Nasal discharge	2	8
Pumping of the anus	0	12
Forced abdominal expiratory effort	0	15

Nasal discharge was observed in only 8 of the 20 COPD subjects. In 7 of the 8 subjects, the discharge consisted of serous liquid of a clear watery nature, observed as droplets on the inner border of the external nares and seen as a wet muzzle in the early morning. In 1 subject, muco-purulent floccules were noted in the serous discharge. The origin of the floccules was not determined.

Discussion

Few of the authors whose work was reviewed mentioned heart rate as a diagnostic feature of COPD. Indeed, Gillespie, Tyler & Eberly (1964) recorded mean pulse rates of 50 and 49 per minute for clinically normal and emphysematous horses, respectively. However, the heart rates cited above would be considered somewhat elevated by authorities such as Boddie (1962) and Altmann & Dittmer (1971).

Percivall (1853) gave an exhaustive description of the respiratory signs of broken wind, but neither he nor Fitzwygram (1911) suggested that broken-winded horses had an elevated heart rate. From a physiopathological point of view it might be expected that compensation for inadequate blood oxygenation would be achieved by an increased cardiac output. However, the cardiac output in emphysematous horses is actually decreased (Eberly, Tyler & Gillespie, 1966), so compensation must be achieved by other means.

Hoyt (1963) stated that the heart rate was invariably increased in advanced chronic alveolar emphysema cases. Much depends upon the definition of the term "advanced". Is it meant to indicate "of long standing", "severe" or "terminal"? Since there is no evidence, ethological or physiological, that COPD causes pain even in severe cases, it is pertinent to enquire what may drive the cardiac pacemaker in such cases. According to Guyton (1971), cardiac output is increased in hypoxic states as a result of decreased peripheral resistance caused by local (hypoxic) vasodilatation. If this were the case in the present series of COPD subjects, then one might expect a good inverse correlation between heart rates and arterial oxygen tensions. In the present series of 20 cases, however, this was not the case (Littlejohn, 1978). The relationship of heart rates to PaO_2 values was not significant ($r = 0{,}26$). Factors other than the arterial oxygen tension may therefore have been operating to control the cardiac pacemaker. There is no information available to clarify this point, and all that can be concluded is that in the present series of 20 cases of COPD, the heart rates were not related statistically to the arterial oxygen tensions.

Respiratory frequencies on the other hand were significantly different. The mean of the COPD subjects was 8,7 respiratory cycles per minute faster than that of the normal horses. These findings were at variance with those of other workers (Gillespie *et al*, 1964; Sasse, 1971) who did not detect a significant difference in respiratory rates. However, the mean respiratory frequency of the 11 COPD subjects studied by Gillespie, Tyler & Eberly (1966) was 13 cycles per minute, three more than the mean of 10 cycles per minute recorded for 15 control subjects. Although Gillespie *et al* (1966) did not consider this to be a statistically significant difference, the mean of the COPD subjects was probably significantly higher than that of their control subjects, when tested by the formula used in the present studies. The explanation for the different findings in the present series may be associated with factors such as the composition and physical status of the populations selected, the altitude and the ambient temperature at which observations were made. Although no direct comparisons of the above factors were made, one correlation of interest was that of the respiratory frequency with the $PaCO_2$. In 19 COPD subjects the correlation coefficient 'r' between respiratory rates and $PaCO_2$ values was 0,69 ($t = 3{,}83$, $P<0{,}001$), a result which indicated a close positive relationship between the arterial carbon dioxide tension and the respiratory rate (Littlejohn, 1978). This point is discussed further in a subsequent paper.

The occurrence of a cough concomitant with abnormal pulmonary sounds for 3 months or more and a history of loss of performance in the absence of cardiac and upper respiratory tract abnormalities were accepted in these studies as strong evidence of chronic pulmonary disease. An increase in marginal distance *per se* was not considered to be indicative of a pulmonary condition, because a significant percentage of normal subjects also showed this sign.

Forced abdominal expiratory effort was noted in 15 COPD subjects and pumping of the anus was observed in 12. These were regarded as confirmatory signs of COPD whereas abnormal pulmonary sounds, coughing and reduced work tolerance were regarded as primary signs.

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