ATYPICAL INTERSTITIAL PNEUMONIA OF CATTLE

D. C. Blood*

Introduction

This disease has been known for many years and under many names, including pulmonary adenomatosis, acute alveolar emphysema and oedema, bovine pulmonary emphysema, "panters", "lungers", bovine asthma, pneumoconiosis and "fog fever". On clinical grounds there are two forms of the disease, the acute and the chronic, but most descriptions are confined to the acute form. It is the purpose of this paper to draw attention to the chronic form of the disease, and to the circumstances in which the disease occurs, in an attempt to point out possible aetiological agents.

The introduction of a new name, atypical interstitial pneumonia, may appear to further confound the nomenclature of the disease but it is suggested because the names listed above do not adequately describe the disease. Pulmonary adenomatosis is already an accepted name for a specific viral disease of sheep; emphysema is a secondary lesion in this disease, as it is in many others; bovine asthma is a much rarer disease and differs markedly from atypical interstitial pneumonia, both clinically and at necropsy; pneumoconiosis is characterized by granulomatous lesions of the lung, quite unlike those of this disease; "lungers", "panters" and "fog fever" have local significance only. Atypical interstitial pneumonia, as a name, is only a degree more specific because no aetiological factor is mentioned. In our present state of lack of knowledge of causes, this is unavoidable.

There appear to be a number of probable causes of atypical interstitial pneumonia, and there are the two clinical forms of the disease, but pathologically there is sufficient similarity between all of these aetiological and clinical forms to justify grouping them as one disease.

Occurrence of the Disease

With two exceptions, all classes, ages and breeds of cattle are affected about equally if run under similar conditions. The exceptions are cattle under three months of age, which do not appear to be susceptible and the case of lungworm sensitivity, to which adults are much the most susceptible. Atypical interstitial pneumonia occurs in cattle on pasture, in feed-lots and in barns. Seasonally, the incidence appears to be highest in the fall amongst cattle at pasture but this statement requires some modification. Both acute and chronic forms occur at all times of the year but the acute form (which often affects more animals at a time) is most common in the pasture period, in our area particularly in August (Table I). In areas where cattle are housed, the chronic form is more common in the winter (8), and perhaps more common in the Channel Islands breeds. In our

*Ontario Veterinary College, Guelph, Ontario.

area, these breeds are much less common than are Holsteins but most outbreaks of the chronic form have been in Jerseys and Guernseys (Table II).

TABLE I

SEASONAL DISTRIBUTION OF OUTBREAKS OF ATYPICAL INTERSTITIAL PNEUMONIA

	Acute	*Chronic*	*Total*	*Totals*
June	–	–	–	
July	1	–	1	Pasture Period 10
August	6	1	7	
September	–	1	1	(8 acute 2 chronic)
October	1	–	1	
November	2	1	3	Barn Period 16
December	2	–	2	
January	2	1	3	
February	–	–	–	
March	–	–	–	(10 acute 6 chronic)
April	2	3	5	
May	2	1	3	
Totals	18	8	26 (52 animals)	

TABLE II

BREED DISTRIBUTION OF OUTBREAKS OF ATYPICAL INTERSTITIAL PNEUMONIA

Breed	*Acute*	*Chronic*	*Total*
Holstein	8	1	9
Jersey	–	4	4
Guernsey	–	2	2
Ayrshire	1	–	1
Angus	3	1	4
Shorthorn	3	–	3
Hereford	2	–	2

There are some differences between the occurrence of the two forms of the disease. In the acute form, the call is often an urgent one: sometimes a number of cows suddenly become affected and, in many instances, a number of deaths may occur in 24 hours. In the chronic form, although several animals may become affected during the course of a week, it is more usual to have sporadic cases, often at intervals of several months, and it may only be with the second or third animal that the veterinarian and the farmer realize that they are confronted by an atypical pneumonia.

The acute form is also commonly associated with a change of pasture. Many veterinarians in mountain areas have observed a high incidence when cattle are brought down to lowland pastures in the fall. Change from one field to another

can have the same effect and the new pasture may be dominated by either legumes or grasses. Turning cattle onto rape or kale, or onto a field where turnips have been pulled and the cattle allowed access to the tops may have the same effect. In all of these instances, the outbreak usually occurs sharply, about ten (seven to twelve) days after the change.

Insufficient has been written about this disease to indicate where it occurs, but the acute form is recorded very commonly in the U.S.A. (1, 2, 3, 4, 5); in Canada, the acute and chronic forms both occur (6, 7); in Switzerland, only the chronic form is recognized (8). In Great Britain, the acute form of the disease, known locally as "fog fever", is common (10, 11, 12, 13, 14).

Clinical Findings

Acute Form: The onset is sudden. Laboured breathing, often with grunting, mouth breathing and frothing at the mouth, is the most obvious sign. There may be associated bloat and diarrhoea and ruminal atony is characteristic of severe cases. Although the animal shows anxiety, there is no apparent toxaemia and moderately affected animals will attempt to eat and drink. Coughing, if it occurs, is not frequent, but there may be a frothy nasal discharge. The temperature is usually about 103° F but varies from 101° to 106° F, the more severely affected animals having higher temperatures. There is a similar variation in the heart rate (80 to 150 per minute) and those with a rate of more than 120 per minute are usually in the terminal stages of the disease.

Auscultation of the lungs may be disappointing if one is not accustomed to listening for consolidation without bronchial involvement. Loud bronchial tones, indicating consolidation but a clear airway, are heard over the ventral parts of the lungs. There may be an absence of breath sounds over the dorsal parts if involvement is severe, but in animals that live for several days the loud friction rubs and dry rales characteristic of interstitial emphysema are signs of diagnostic significance. There may be emphysema under the skin. Death may occur in as short a time as twelve hours, but most fatal cases survive until the second or third day. The average mortality rate is about 30%. Those which survive often have chronic emphysema and are unthrifty.

Chronic Form: In most cases, three or four days elapse after the appearance of signs before the farmer is sufficiently worried to call for veterinary assistance. There is an increase in the rate and depth of respiration, frequent deep coughing, a fall in milk yield and a loss of weight. It is probable that the disease develops for some time before these signs are evident. A secondary bacterial pneumonia often develops and it is probably this, together with embarrassment of heat loss, which causes the usual moderate elevation of temperature to 103° to 104° F. For the same reason, there may be a moderate muco-purulent nasal discharge and toxaemia. The heart rate is usually elevated, the degree depending upon the amount of lung involved.

On auscultation gross abnormality of the pulmonary sounds is evident. There is the grating friction sound of interstitial emphysema over the dorsal part of the chest and loud bronchial tones ventrally, particularly on the right side. To these may be added the moist rales of a purulent broncho-pneumonia.

Complete recovery occurs rarely, if at all. Death may not occur for weeks or months and there may be periods of partial recovery during this time. Most affected animals are disposed of because of ill-health, but death may occur as a result of toxaemia or congestive heart failure.

Clinical Pathology

In this disease there are no clinico-pathological findings which have any diagnostic significance, although bacteriological examination of a nasal swab may indicate the cause of the secondary bronchopneumonia which is so often present.

Necropsy Findings

In both forms, the lungs are enlarged and firm and do not collapse on cutting. In the early stages of acute cases they contain much fluid which is more viscid than usual oedema fluid. The pleura is pale and opaque and appears to be thickened. In very acute cases, the entire lungs are homogeneously affected in this way. Such cases usually have oedema of the larynx. In the more common acute case, the lung has a marbled appearance. Adjacent lobes may be affected with any one of four abnormalities. Areas of normal, pink lung are restricted to the dorsal part of the diaphragmatic lobes. There are areas of pale tissue indicative of alveolar emphysema, areas of a dark pink colour affected by early alveolar exudation, yellow areas in which the alveoli are filled with coagulated protein-rich fluid and dark red areas where epithelialization has occurred. The latter two lesions are firm on palpation and resemble thymus or pancreas. They are more common in the ventral parts of the anterior lobes. In chronic cases, the obvious differences in the age of the lesions suggests that the disease progresses in steps by the periodic involvement of fresh areas of tissue. In all cases there is usually a frothy exudate, sometimes containing flecks of pus in the bronchi and trachea and the mucosa of these passages is markedly hyperaemic.

Histologically, the characteristic findings are an absence of inflammation, except in the case of secondary bacterial invasion, and the presence of an eosinophilic, protein-rich fluid which coagulates in the alveoli, or may subsequently be drawn out into a hyaline membrane. This is more apparent in acute cases, and, if animals live for a few days, there is evidence of epithelialization of the alveolar walls, the interstitial pneumonia which gives the disease its name. In long-standing cases, there is extensive epithelialization and fibrosis. A hyaline degeneration of the walls of small pulmonary arteries is a common finding and is considered to be typical of this disease.

Bacteriological examination of the lungs is often negative, although in cases of long standing in which secondary bacterial pneumonia has developed *Past. multocida*, *P. hemolytica*, *Streptococcus* spp., and *Coryne. pyogenes* may be found.

Diagnosis

The justification for the use of the word "atypical" in the name of the disease is that the reaction of the pulmonary tissue is quite unlike that in any of the

standard forms of pneumonia and there is little or no response to standard treatments for pneumonia. One stumbles onto the diagnosis, particularly of the chronic form, in this way. However, there are some clinical characteristics which set the cases of atypical pneumonia apart from other pneumonias. In the acute form, the very rapid onset of deep, laboured respiration in the absence of signs of toxaemia, and often with no fever, differentiates it from bacterial pneumonias. Pneumonia pasteurellosis (shipping fever) might warrant consideration in the differential diagnosis, especially if the animals have been moved in the preceding two weeks, but in pasteurellosis there is usually only moderate dyspnoea and the signs of toxaemia are marked. The closest resemblance to acute atypical pneumonia can be caused by poisoning with organic phosphatic insecticides. The differential features are the pupillary constriction, mucoid diarrhoea, muscular tremor and stiffness of the limbs in the latter. Infectious bovine rhinotracheitis, "summer snuffles" and malignant catarrhal fever all resemble this disease only slightly.

Enzootic (viral) pneumonia may be difficult to differentiate from either acute or chronic atypical pneumonia, but in our experience it is almost entirely restricted to animals less than six months of age and is a very mild disease in older animals. Cough is usually marked and there is some response to treatment with broad-spectrum antibiotics. When enzootic calf pneumonia is accompanied by a bacterial bronchopneumonia it is virtually impossible to distinguish it from a similarly complicated chronic atypical pneumonia, except on an age basis and the probability that the enzootic pneumonia will affect a number of animals at one time. One tends to choose chronic atypical pneumonia, rather than a chronic bacterial bronchopneumonia, in an adult when the subject is one of the Channel Island breeds, when the disease appears during the housing period and when there is gross change in pulmonary sounds heard on auscultation over most of the lung.

Aetiology and Pathogenesis

A number of specific causes of atypical interstitial pneumonia are known, but in many outbreaks the cause cannot be determined, although suspicious agents are often suggested. The reaction in the lungs is not inflammatory and those transmission studies which have been carried out have been negative (8), suggesting that the disease is not infectious.

It is known that a massive infestation of the lungs by large numbers of lungworm larvae in a sensitized animal can cause an allergic reaction resulting in the development of atypical pneumonia (13). However, in many cases lungworms do not appear to be present. In our own series, a search for lungworm larvae in the pasture, in the faeces of affected and in-contact animals, and in the lungs of animals at necropsy was positive in only one instance. The migration of abnormal parasites, particularly ascarids, has been suggested as a possible cause of the disease but this does not appear to have been observed.

The inhalation of nitrogen dioxide gas is capable of causing atypical interstitial pneumonia in cattle (3) but the natural occurrence of circumstances similar to those which cause "silo-fillers' disease" in man appears to be unlikely amongst cattle. During the stabling period, cattle may be briefly exposed to nitrogen

dioxide gas if large amounts of ensilage are fed. There is a strong correlation between the occurrence of the disease and pasturing on rape or turnip tops or the ingestion of algae (5), but the specific causative agent has not been determined. Rape is an excellent forage crop in northern areas, especially for beef cattle during October and November when the cattle can still run out, but it is associated with a high incidence of not only this disease but also of polioencephalomalacia and haemolytic anaemia. For this reason, the crop has to a large extent gone out of favour. Providing hay in the rape field or access to a field of old grass is a reasonably effective prevention.

Another probable cause of atypical interstitial pneumonia is exposure to moulds, either by inhalation or ingestion. Many mouldy feeds, including cornstalks and sweet potatoes have been implicated by field observers (1, 4). Again, the specific cause is not determined, but the nature of the lesion and the rapidity of development of the acute form of the disease do suggest allergy as the basic mechanism. If this is so, the inhalation or ingestion of allergens such as moulds could cause the disease. Other allergens including hay dust and pollen may also be causative. The high incidence of the disease in early fall, when many legumes and other pasture plants are in flower, and the common occurrence at this time of allergic rhinitis in cattle, suggest that the inhalation of pollen may cause an allergic response of the alveolar epithelium. Also, the tendency for the disease to occur about ten days after the cattle have been moved onto a new pasture suggests that sensitisation may occur initially, and an allergic reaction at a later date. However, in many fall outbreaks the cattle are on pure grass pasture with no flowers visible, and in housed animals pollen inhalation is unlikely, although the inhalation of hay dust is. One relationship which we feel is of importance in stabled animals in Canada is the occurrence of the disease in cattle standing near the hay chute from which hay and bedding are thrown down from the mow to the barn floor. It is not uncommon to have a selective distribution of the disease so that only animals which stand near the chute, and are thus more exposed to the inhalation of the dust, become affected. In barns where measures have been taken to cut down dust, the development of the chronic form of the disease appears to have been reduced.

Other less likely causes of the disease have been suggested, including a nutritional deficiency of phosphorus and *Clostridium perfringens* intoxication (6).

Because of the number and variety of the circumstances in which the disease occurs, it is difficult to suggest a basic underlying cause. Allergy and inhalation of nitrogen dioxide gas appear to be the most likely causes, and it is possible that either may operate under specific sets of circumstances. It is admitted that the particular reaction of the pulmonary parenchyma in atypical interstitial pneumonia is a non-specific reaction to injury and may be caused by exposure to agents other than exogenous allergens or nitrogen dioxide. The possibility that the reaction may be one of irritation by an endogenous allergen, such as the bronchial exudate of a bronchopneumonia, cannot be discarded. It may be that those chronic cases, in which lesions of atypical pneumonia and bronchopneumonia occur concurrently, may be explainable in these terms rather than in terms of secondary bacterial invasion of tissues devitalized by a primary allergic reaction.

That the primary cause in many instances is an allergic reaction is corroborated by the sudden gross outpouring of a protein-rich fluid, often rich in eosinophiles, into the alveoli throughout a large part of the lung, the common occurrence after a change of environment ten days before, and the good response in early acute cases to the administration of adrenaline and antihistamines. The concurrent occurrence of ruminal atony and tympany in some cases is also in accord with an allergic aetiology. The physical occupation of alveolar space by fluid is no doubt the primary cause of the dyspnoea, and the failure to respond to treatment is due to the nature of this fluid and its immovability. Alveolar and interstitial emphysema, and epithelialization and fibrosis of the alveolar walls, follow and confer irreversibility on the lesion.

Treatment

Cases of acute atypical pneumonia must be treated as urgent and, although we have kept no controls, the results achieved by the treatment recommended by Dr. Mackey (2) of a combined double dose of adrenalin and antihistamine appears to have given us excellent results in very early cases. Both are given subcutaneously to avoid excitement which may prove fatal and are repeated at eight-hour intervals as required. I have no experience of the efficiency of hydrochlorothiazide in treatment, but there is one record of a case treated successfully with this preparation (9). Grazing cattle should be removed from the pasture immediately and, if necessary, fed hay in a barn or yard. If an acute outbreak occurs in housed cattle every effort must be made to minimize dust, and, if possible, the hay supply should be changed.

Chronic cases present a much more difficult task. In most instances the animals are not seen, or the diagnosis is not made, until the damage to lung tissue is irreversible. It is therefore wisest in most cases to advise slaughter. If treatment is attempted, a broad-spectrum antibiotic is usually used to treat or prevent concurrent bronchopneumonia. Although it appears to be desirable to remove the hyaline material from the alveoli, parenteral treatment with enzymes, diuretics and corticosteroids appears to exert little of this desired effect, even when continued, together with the antibiotics, for four to seven days.

Control

Control measures depend upon a knowledge of the cause, but in all cases the herd should be removed from the pasture.

The control of lungworm infestation is essential in areas where the infestation occurs. Cattle which have been previously exposed to infestation should not be allowed unlimited access to pasture or stubble fields which are likely to carry very large numbers of larvae, particularly fields which have been heavily manured with barnyard manure. If these areas need be grazed, the cattle should be allowed in for only a short time daily for the first two weeks to desensitize them. If the disease appears, the cattle should be removed immediately. Further cases may occur up to three weeks after the cattle are removed. Trouble may be avoided, when grazing rape, if hay or straw is provided or there is access to a stubble field.

For housed cattle, the feeding of mouldy hay or other feeds and the use of mouldy bedding should be avoided, and every effort should be made to keep down dust. This can be done by wetting the hay, by using a slide from the mow or by hanging a burlap curtain around the chute. Damping the hay will also reduce the amount of dust created by the cattle searching through the hay. Farmers are encouraged to use harvesting techniques which reduce the amount of dust created. Some forage harvesters, for example, tend to crumble legume leaves to powder. If there has been an increase in incidence of the disease in housed cattle in recent years, it may be because of the changes in the composition of pasture and in hay-making methods.

REFERENCES

1. MONLUX, W. S. Pulmonary adenomatosis in Iowa cattle. Iowa Vet. 26:6: 11. 1955.
2. MACKEY, D. R. Acute pulmonary emphysemia in cattle. Southwest Vet. 5: 342. 1952.
3. SEATON, V. A. Pulmonary adenomatosis in Iowa cattle. Amer. J. Vet. Res. 19: 600. 1958.
4. VICKERS, C. L. *et al.* Pulmonary adenomatosis in South Carolina cattle. J. Amer. Vet. Med. Ass. 137: 507. 1960.
5. QUIN, A. H. The syndrome of bovine pulmonary emphysema. Can. Vet. J. 2: 80 (corresp.) 1961.
6. SCHOFIELD, F. W. Acute pulmonary emphysema of cattle. J. Amer. Vet. Med. Ass. 112: 254. 1948.
7. O'DONOGHUE, J. G. Bovine pulmonary emphysema. Can. Vet. J. 1: 482. 1960.
8. FANKHAUSER, R., and LUGINBUHL, H. Chronic interstitial pneumonia and adenomatosis in cattle in the Canton of Uri, Switzerland. Parts 1 and 2. Schweiz. Arch. Tierheilk. 102: 47 and 146. 1960.
9. JOHNSTON, R. W. Treatment of pulmonary oedema in the cow with hydrochlorothiazide. Vet. Rec. 73: 344. 1961.
10. BARKER, J. R. Physiological dysfunctions and metabolic disorders in grazing animals. hypocalcaemia, hypomagnesaemia, hypophosphataemia and fog fever. Rep. Proc. Conf. Grasslands Anim. Hlth. 86. 1948.
11. BEGG, H., and WHITEFORD, W. A. Acute interstitial pulmonary emphysema of bovines. Vet. Rec. 60: 135. 1948.
12. LESLIE, V. J. S. Fog fever. Vet. Rec. 61: 228. 1949.
13. MICHEL, J. F. A contribution to the aetiology of fog fever. Vet. Rec. 66: 381. 1954.
14. MICHEL, J. F., and SHAND, A. A field study of the epidemiology and clinical manifestations of parasitic bronchitis in adult cattle. Vet. Rec. 67: 249. 1955.

VETERINARIANS IN LATIN AMERICA

At present, there are approximately 4,000 veterinarians in Latin America, or 0.2 per 10,000 population. Based on a minimum required ratio of 1.0 per 10,000 population, 35,000 veterinarians would be needed by 1980. In addition to the classical role of the veterinarian with respect to the livestock industry, the recognition of the need for the veterinarian on the public health team has increased the demand for persons of this discipline.

In 1958, there were 26 schools of veterinary medicine located in 14 of the 20 Latin American countries. An average of 20 veterinarians are graduated from each of the schools each year. The curriculum of most schools covers four or five years.

As in other health education fields, veterinary education encounters problems of size and number of schools, high attrition rates, lack of facilities for practical teaching, and the quality and quantity of instruction. The heavy toll exacted by such animal conditions as parasitism, malnutrition, and foot-and-mouth disease is stimulating these countries to improve and expand teaching, research, and practice in veterinary medicine. For instance, the control of foot-and-mouth disease, an achievement for which techniques now exist, could increase the yield of animal protein for human consumption by 25 per cent, thus alleviating in part the burden of human malnutrition.

(*Excerpt from "Facts on Health Problems", July, 1961, a publication of the Pan American Health Organization and the World Health Organization.*)