STUDIES IN BLOOD COMPOSITION OF ANIMALS UNDER PATHOLOGICAL CONDITIONS

I. Broncho-pneumonia in cows

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INTRODUCTION

According to Myers (4) and others the development of severe pneumococcus pneumonia in human subjects often entails a more or less pronounced impairment of renal function, apparently secondary to the pneumonia. At the time of the crisis some increase in the non-protein nitrogen of the blood was found, due chiefly to a rise in the undetermined fraction. When the urea nitrogen exceeds 20 mgm. there is generally some creatinine retention. Recently McIntosh and Reiman (5) found that serious impairment of kidney function during lobar pneumonia was not encountered. Berger and Petschacher (1) and others showed also that in man there is in pneumonia a marked rise in the globulin fraction of the blood serum. In broncho-pneumonia most patients show a decrease in the blood chlorides before the crisis.

It seemed of value to find out what changes take place in the chemical composition of the blood in bovine pneumonia due to bipolar organisms (*B. bovisepticus*).

MATERIAL AND PROCEDURE

Eight cows, isolated from a herd on account of more or less high temperature and clinical symptoms of pneumonia of various degrees of severity, were bled from the jugular vein (40 cc.) and the blood plasma (oxalated) analyzed for glucose (Folin and Wu's method), chlorine (Whitehorn's method), non-protein nitrogen (Folin and Wu's method), uric acid (Benedict's method), creatinine (Folin and

TABLE 1

Number	Date of introduction into herd	Date first symptoms were noted	Temperature	Symptoms	Termination
	1927	*1927*	°C.		
5	October 5	October 10	Normal	Atypical case, emaciation, inappetence, diminution in milk, slight lung involvement	Quarantine, 31 days
6	September 9	October 28	40 for 3 days, then relapse, after 7 days, 40–40.1 for 2 days	Typical case, dyspnea, bronchial breathing, inappetence, diminution in milk	Recovered, sick 29 days
7	October 7	October 25	41	Typical case, dyspnea, bronchial breathing, inappetence, diarrhea, diminution in milk	Recovered, sick 36 days
8	Native	November 8	40.3	Atypical, continual coughing, diminution in milk, emaciation, crepitant râles, constipation	November 25, slaughtered
9	October 5	November 3	39.3	Typical case, dyspnea, emaciation, constipation, lessened milk secretions, bronchial breathing	Recovered, sick 21 days
10	July 8	October 20	40.4	Typical case, dyspnea, crepitant râles, mucous membranes pale, rapid pulse, diminution in milk	October 27, sold to butcher. Carcass condemned. Autopsy: lobular pneumonia, fatty degeneration of liver
11	October 5	November 15	40.1–40.5 for 3 days	Atypical case, mild form of pneumonia	Recovered, sick 9 days
12	October 15	November 15	39	Atypical case, mild form of pneumonia	Recovered, sick 9 days

Wu's method), cholesterol (Bloor's method), and albumin, globulin and fibrin (Wu and Ling's method (8)). Control analyses were carried out on the blood plasma of four normal cows.

TABLE 2

Blood constituents in normal and pneumonia cows

(Figures per 100 cc. of blood plasma)

Date	Number	Diagnosis	Glucose	Chlorine	Non-protein nitrogen	Uric acid	Creatinine	Cholesterol	Albumin	Globulin	Fibrin
			mgm.	*mgm.*	*mgm.*	*mgm.*	*mgm.*	*mgm.*	*gm.*	*gm.*	*gm.*
October 25	1		66.6	386	23.12		1.43	133.2	3.49		
November 7	2	Normal	62.4	368	20.69		1.36	144.3	3.49	2.36	0.274
November 7	3		71.6	388	22.22		1.30	88.2	3.34	2.82	0.226
November 7	4		70.8	386	17.65		1.25	100.9	3.72	3.96	0.251
October 31	5		71.2	338	52.14		2.34	73.2	2.33	4.64	0.411
November 6	5		62.5	356	26.50		1.36	82.5	2.26	5.14	0.411
November 30	5		69.0	334	30.04	1.87	1.90	83.2	2.56	6.56	0.377
October 31	6		64.3	358	20.70			89.0	2.84	3.70	0.452
November 10	6		57.1	346	28.90		1.20	88.2	3.07	3.46	0.502
November 17	6		55.3	326	33.40		1.16	100.2	3.34	3.18	0.411
November 30	6		55.3	364	20.72	1.82	1.25	125.0	3.72	4.30	0.361
October 31	7		59.0	334	19.20		1.25	78.2	2.40	3.82	0.502
November 10	7		57.1	346	25.00		1.02	75.0	2.40	3.22	0.411
November 17	7		54.0	388	30.00		1.16	94.6	3.27	3.74	0.452
November 7	8	Pneumonia	57.5	364	21.43		1.20	150.0	2.40	3.22	0.452
November 10	8		62.5	344	24.00		0.94	150.0	2.40	4.16	0.502
November 17	8		64.3	359	26.65		1.14	150.0	3.18	4.18	0.479
October 17	9		58.4	353	28.56		1.20	136.0	3.36	4.52	0.476
October 30	9		54.1	382	17.15	1.58	1.20	107.0	3.72	4.04	0.452
October 25	10		83.4	388	24.00		1.36		2.33		
November 17	11		57.1	365	30.25		1.25	88.8	3.65	3.26	0.502
November 17	12		58.4	350	20.06		1.07	115.3	3.49	3.42	0.565

The clinical data concerning the eight pneumonia cows are summarized in table 1.

A bacteriological examination of the blood and urine of cow 5 was made by Dr. F. S. Jones of this department. The blood culture was negative. He found in the urine albumin, leucocytes, epithelial cells and bacilli in large numbers. Cow 8 was slaughtered and autopsied by Dr. Jones and the junior author. The autopsy showed pleuritis and diffuse chronic pneumonia. The presence of *Bacillus bovisepticus* was established by direct culture of bits of lung tissue.

RESULTS

The results are summarized in table 2.

As can be seen from the table, cases 5, 6, 7, 8, and 9 show deviation from normal in the amount of chlorine, non-protein nitrogen, and protein fractions. The globulin is high. Cow 5 shows on October 31 a high non-protein nitrogen and creatinine. In cow 6 the cholesterol went up. In cows 11 and 12 (mild cases) the globulin was normal. In pneumonia the fibrin also is usually increased.

DISCUSSION

Chlorine. Pneumonia in the cow is evidently associated with a drop in the plasma chlorine, as it is in human beings. The rise in the plasma chlorine seems to be associated with the process of recovery. In cow 8 there was no complete recovery and the chlorine remained below normal. Cow 9 recovered completely and the chlorine reached a normal level also. Cow 5 did not recover up to November 30 and her plasma chlorine was low. Cow 6 recovered. Her chlorine content was, on November 30, normal also. The data reported by Winterstein (7) for normal cattle serum are 369.8 mgm. per cent.

Non-protein nitrogen. This blood constituent is higher when the process in the lungs is not completely healed, and reaches a normal level during recovery. The high non-protein nitrogen in cow 5 (on October 31) is a symptom of a secondary involvement of the kidneys, as confirmed by the analysis of the urine. The high creatinine content of the blood plasma of the same cow on October 31 is an additional diagnostic sign. Winterstein (7) reports for cattle 14 mgm. per cent as normal figures for non-protein nitrogen of blood serum and 1.62 for creatinine. Scheunert and Pelchrzim's (6) figures are

23.8 to 39.4 mgm. per cent for non-protein nitrogen and 1.5 to 1.8 mgm. per cent for creatinine in normal cattle.

Plasma proteins. The high globulin is evident in the presented cases 5, 6, 7, 8, and 9 of pneumonia cows. It is not possible to say definitely what caused this rise in the early stage of the disease—the process in the lungs or a certain stage of starvation due to diminshed appetite. Keese (3) showed that in horses starvation of 16 to 45 hours causes a considerable rise in the globulin fraction of the blood serum, the latter being sometimes 80 per cent of the total protein content of the serum, while in normal horse serum the globulin fraction is only 50 per cent of the total serum proteins. As our pneumonia cows showed a normal appetite during the time when the temperature went down, it is evident that the high blood serum globulin, found at this time, was due to pneumonia.

A calculation of the relative proportions of globulin nitrogen and albumin nitrogen to the total nitrogen, performed by Howe (2), gives for virgin heifers 49 per cent of the total serum protein as globulin and 51 per cent as albumin; for the pregnant heifers Howe's figures are 51 per cent of total globulin nitrogen and 49 per cent of albumin nitrogen. Our figures for serum globulin are seen to rise much above our normal figures and also those of Howe.

SUMMARY AND CONCLUSIONS

1. Pneumonia in the cow causes a drop in the blood plasma chlorine and a rise in the globulin and fibrin fractions. High non-protein nitrogen and creatinine is a sympton of secondary kidney involvement.

2. In pneumonia cows chemical analysis of blood furnishes valuable data for diagnostic and prognostic purposes.

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