Studies on The Pathology of Scours and Pneumonia in Young Calves

Thesis

Submitted to the

RAJENDRA AGRICULTURAL UNIVERSITY, BIHAR

in partial fulfilment of the requirements

for the degree of

MASTER OF SCIENCE (VETERINARY)

By

Uma Prasad Sinha

B. V. Sc. & A. H.

Post Graduate Department of Pathology

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Dated, the 21st October, 1976.

This is to certify that the work embodied in this Thesis entitled "STUDIES ON THE PATHOLOGY OF SCOURS AND PNEUMONIA IN YOUNG CALVES" is the bonafide work of Shri Uma Prasad Sinha and was carried out under my guidance and supervision.

(C.D.N. SINGH).

C E R T I F I C A T E

Certified that the research work incorporated in this THESIS has not been published in part or in full in any other journal.

Uma Pd. Sinha
21.10.76

(UMA PRASAD SINHA).

The work embodied in this Thesis was carried out in the Department of Pathology, Bihar Veterinary College, Patna, under Junior Fellowship awarded by the Rajendra Agricultural University, Bihar. The author is grateful to the Vice-Chancellor for the financial help.

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Uma Pd. Sinha 21.10.76.

(UMA PRASAD SINHA).

DEDICATED

TO

MY

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INTRODUCTION

At present, population explosion of mankind has lead to food shortage in the world. Malnutrition and starvation are the most serious problems in certain countries. Protein (a vital nutrient) and other ingredients of human foods are mostly obtained from animal sources. Acute shortage of animal protein has lead to great emphasis on production of better quality and quantity of animal products such as milk fat and meat etc.

Pathologic involvement of digestive and respiratory system is amongst serious problems, responsible for causing great economical loss and casualty in young livestock population. Respiratory diseases occur as primary condition or as terminal complication associated with digestive disturbances. Undoubtedly, huge deaths in calves due to pneumonia or combined attack of pneumonia and enteritis are themselves the great loss to dairy industry; but morbidity in survivors of these diseases further causes serious setback to dairy industry.

The solution of the problem lies initially in improving the quality of livestock and in protection against various diseases and disorders prevalent in the livestock farms.

Stress of long duration would be necessary to produce a depletion of general immunological defence. However, research on epidemiology of common cold in human, Lidwell et al (1965)

demonstrated a significant correlation between the incidence of colds and the mean daily temperature and humidity four days prior to the onset of symptoms. They also suggested that the influencing stresses need only be of short duration. Perhaps, therefore, stress exerts its most important effects on the epithelial surfaces, particularly those of the respiratory and intestinal tracts. Rapid change of temperature and humidity could adversely depress the metabolism of epithelia and associated immunologically competent tissue to such an extent that production of surface active antibodies resembling IgA of human could be insufficient to repel the infective challenge. Stress of various types in relation to respiratory syndrome in field condition and experimentally infected animals have been intensively studied in recent years by many workers.

Survey of diseases of respiratory and digestive tract especially scours and pneumonia were conducted on the basis of pathological data obtainable from autopsy records of the Pathology Department and Government Cattle Farm, Patna. It has now been realised that the lungs react differently to different etiological factors. Viruses produce conditions which are quite different from those produced by bacteria. By studying the alteration in lung architecture and also pattern of the lesion produced, it is possible to group the disease under different pathological headings.

The problem of calf mortality in calves due to several etiological factors deserves immediate attention for

successful operation of various plan and developmental schemes. Damage to livestock industries due to losses from mortality in calves cannot be underestimated. The success of dairy industries lies in reducing calf mortality and proper care in feeding of calves which are the nuclei of livestock farms. The problem of research work on etiology and pathology of various calves diseases is very much complex and vast one. It was not possible to make detailed investigation into causes and pathology of all diseases of calf mortality, in the present research programme and such it was considered to find out the exact position with reference to etiology and pathology of pneumonia and white scours to achieve correct picture of these diseases for effective control and treatment. Minett (1946) pointed out that there does not exist any large scale precise estimate of calf mortality among young cattle stock of India. Dhanda and Khera (1956) also observed that although losses from mortality in calves are known to be very serious in India, very little systematic work has been done to obviate them.

It has been aimed to throw some light on the various pathological conditions, which are deleterious to livestock and also menace the livestock enterprise by studying gross and microscopic changes in the lungs and intestinal tissue of cow calves. Attempts have also been made to isolate bacteria from affected lungs and intestines and transmission experiment was also conducted to correlate the pathological findings with the etiological factors. The present study may guide the veterinarians to adopt correct remedial measures in undertaking the treatment of above conditions in calves.

REVIEW OF LITERATURE

S C O U R S

White scours is an extremely serious disease in calves and many of them die from its attack during their 1st week of life. Even many of them die during first 12 hours after birth. White or clay coloured and sour smelling faeces is most characteristic finding in calf scours.

Diarrhoea or Scours in calves is an etiologically complex condition. Although different factors are considered to be causal or predisposing agents, however, information on rationalising the role of pathogenecity of either Escherichia coli or a virus is available in literature. ARIO like virus and Escherichia coli have been isolated from diarrhoeic calves. Diarrhoea in neonates is a serious element and this has been of great concern for economic reasons. Calf diarrhoea or calf sources is produced by infection, faulty environmental and managemental conditions. The colostrum provides immunity to the neonates and great importance has been attached to specific immunoglobulin class IgG, IgM and IgA. Organisms like Escherichia coli are frequently isolated from diarrhoeic cases.

Minett (1946) with drew conclusion that pneumonia was responsible for 58.4% of deaths and intestinal trouble for 19.5% of deaths and this difference was found to be highly

significant.

Blaxter et al (1953) suggested that intestinal tract failure is associated with scours in calves and bacteria should play secondary role by multiplying in the unabsorbed material present in the gut.

Wood (1955) found that out of 153 calves examined at autopsy in course of three years experiments, organisms of coli aerogenes group were found in 141 cases. Pleurisy and peritonitis were observed in 39 calves and congestive changes were present in jejunum and ileum.

Kesler et al (1956) while making studies on scour in calves observed that there was no difference in incidence of scours between pail and nipple fed calves.

Smith (1958) found that quality and quantity of diets given after the colostrum feeding period are unfortunately predisposing causes of scouring.

Dhanda et al (1959) observed that early deaths in calves were only due to pneumonia and diarrhoea.

Jensen (1903) and Lamount and Kerr (1939) considered calf scours as commonest disease of calf in 1st few days of life.

Shirlaw (1959) conducted survey in 33 farms and main cause of loss in farms was due to coli bacillosis, pneumonia and anaplasmosis.

According to Jubb and Kennedy (1963), it is by no

means unusual for the morbidity and mortality to be hundred per cent among calves in E. coli infection.

Sonsson and Swalin (1968) observed that gastro-enteritis and pneumonia were commonly present in dead calves and percentage of these two conditions were 27% and 23% respectively. They found Pasteurella multocida to be commonest bacteria isolated from sick calves.

Singh et al (1971) described pathological changes in calves under one year of age. Pneumoenteritis and calf scours were 40 per cent and 15.38 per cent respectively in the affected calves in their studies.

Damodaran and Sundararaj (1974) carried out survey of calf mortality in Madras State. They analysed the different causes of calf mortality from death records of 2835 calves. Disorders of respiratory system and digestive systems were noticedin 29.9. and 7.5% cases respectively.

Morin et al (1976) reported 100 per cent morbidity and mortality rate in acute neonatal calf diarrhoea, and isolated Escherichia coli, Salmonella either alone or in combination, several viruses such as Nebraska NCD viruses (reo-like and corona-like) bovine viral diarrhoea virus, adenoviruses and enteroviruses etc. They recently reported that Coccidia of genus Cryptosporidium was found in intestinal tract of a calf with neonatal diarrhoea.

Fisher et al (1976) carried out investigation into

calves suffering from neonatal calf diarrhoea in order to study body fluid dynamics and immunological aspects of diarrhoeic syndromes in neonatal calves. They recorded higher initial haematocrit in diarrhoeic dying calves.

PNEUMONIA

Disorders of trachea, bronchi, lungs proper, pleura and mediastinum are diseases of lower respiratory system. In the lower respiratory system, pulmonary calcification pneumoconiasis etc. are the degenerations where as pneumonia and pleurisy are inflammations. Inflammations of structures of lower respiratory system are many and varied for purposes of review. These can be classified into - tracheobronchitis, pneumonia, pulmonary abscess and pleurisy etc.

Pneumonia is not a single disease but actually a collection of disease processes initiated by a variety of factors. It can be classified according to the (1) causative agent as, tuberculous, viral etc. (2) anatomical distribution of the lesions as, lobar, lobular, bronchial, interstitial etc. (3) gross appearance as, haemorrhagic, fibrinous, purulent etc. (4) clinical course as, typical, atypical etc. (5) duration of course as, acute or chronic (6) route of entrance of the organisms as, haematogenous, aerogenous and (7) relation to other disorder as, post traumatic, terminal etc.

Pneumonia can be ideally classified on the basis of

etiological agents. However, a combination of above listed (1 to 7) is quite satisfactory. Accordingly, the following pneumonic condition may be considered such as, lobular pneumonia bronchopneumonia, terminal pneumonia, aspiratory pneumonia, interstitial pneumonia, viral pneumonia, verminous pneumonia and fungal pneumonia.

Omar (1966) suggested an excellent system of classification of pneumonia based on the predominant histological lesions. Characteristic alterations to divide pneumonia into various kinds were exudative and proliferative changes. Pneumonia caused by viruses in animals was a separate entity.

In present study, Omar's classification has been followed for the shake of review of literature, and classifications of pneumonia as given by him are as follows :

(1) Exudative pneumonia :

(a) Catarrhal, and/or purulent (C. pyogenes as important causative agent).

(b) Fibrinous (Pasteurella sp. as important causative agent).

(c) Embolic pneumonia (accompanied with septicaemic state).

(2) Proliferative pneumonia (Atypical):

(a) (i) Epithelializing pneumonia.

(ii) Giant cell pneumonia (dealt in viral type).

(b) Cuffing pneumonia.

(c) Granulomatous pneumonia.

(3) Specific virus pneumonia:

(a) Due to infectious bovine rhinotracheitis (IBR) virus.

(b) Due to adenovirus.

(c) Due to parainfluenza - 3 virus.

(d) Pneumonia due to Psittacosis - lymphogranuloma venerum (PLV) organisms.

1. Exudative pneumonia :

Smith (1921) grouped cases of bronchopneumonia into acute, chronic and intermediate types. In young calves, it was associated with B. actinoides, B. pyogenes, B. bovisepticus and staphylococci, streptococci in the later stage.

Carpenter and Gillman (1921) described three types of pneumonia in calves such as, congestive, catarrhal and purulent forms. The congestion started from the anterior lobe and spread posteriorly in congestive pneumonia. The lesions described for catarrhal form were dependant on the type and duration of infection. In purulent form one or more lobes were seen with tiny abscesses ranging from 1 mm to 1 cm in diameter and pleuritis was often seen in the last two forms. They isolated micrococci such as, C. pyogenes, E. coli and Streptococci.

Schmid (1933) studied an outbreak of calf pneumonia and recovered C. pyogenes from internal organs of most of cases.

Sairlaw (1935) found areas of hepatization in middle and anterior lobes of lungs in calves and serofibrinous exudate in pleural sac. Histological picture of acute cases is similar to acute form of pasteurellosis. Large number of lymphoid nodule formation was seen around the bronchioles in chronic cases.

Smith (1935) found that Brucella abortus was causative or predisposing factor for secondary bacterial infection in pnumonia of foetus and calves.

Lovell and Hughs (1935) observed 12 per cent of cases of consolidated lungs with areas of necrosis and suppuration and recovered C. pyogenes from these calves. In 5 per cent of cases, Haemolytic coccobacillus was isolated.

Thorp and Hallman (1939) studied 40 cases of acute pneumonia in calves with serofibrinous exudate in the alveoli. Extensive consolidation superimposed on chronic bronchopneumonia and lesions of abscess formation and necrosis were important lesions. Streptococci, Bact. communior, and Staphylococcus aureus were isolated from 26 cases of pneumonic lungs.

Lovell (1939) reported lesions of pneumonia along with white scours in calves and isolated haemolytic coccobacillary organisms, C. pyogenes and Brucella abortus.

Sanders (1939) studied enzootic form of bronchopneumonia in calves and isolated B. coli and Staphylococci, Pasteurella sp. from lung lesions.

Shigley and Thorp (1943) studied bronchopneumonia, pleuritis and abscesses in apical, cardiac and parts of diaphragmatic lobes in calves.

Blakemore (1945) isolated organisms resembling Bacillus actinoides from two outbreaks of calf pneumonia, and induced pneumonic lesions in susceptible calves on intranasal inoculation.

Jennings and Glover (1952) found lesions of suppurative bronchopneumonia in enzootic pneumonia of calves and C. pyogenes was isolated.

Carter (1956a) induced pneumonia in calves by intranasal injection with young culture of Past. haemolytica.

Carter and Rowsell (1958) studied outbreaks of enzootic calf pneumonia having bronchitis infiltrated with fibrin cellular debris and polymorphs and isolated Past. multocida from the lung.

2. Proliferative pneumonia :

Jarrett (1954-56) stated two types of pneumonia in calves namely epithelializing and cuffing pneumonia. Epithelializing pneumonia was characterised by widespread cuboidal epithelialization, and giant cell formation as salient features.

Runnel et al (1960) stated that majority of interstitial pneumonias are caused by viruses.

Van Rensburg and Every (1961) described enzootic pneumonia in calves prevalent in wet summer months in calves of 1-4 months age.

Chemical agents as the cause of interstitial pneumonia have been supported by Omar (1966).

Jubb and Kennedy (1963) described interstitial pneumonia as a condition in which the alveolar septa is affected. Though some exudate may be found in alveoli, by far most of the changes (proliferative) are found in alveolar septa.

Cole (1970) found 13 outbreaks of calf pneumonia and noted that parts of the lungs were slightly congested. Histological lesions of mild peribronchial cuffing and lymphoid infiltration of the bronchiolar submucosa were noticed. Evidence of recent alveolar involvement was the presence of pseudoepithelialization, free alveolar macrophages and other inflammatory cells.

3. Specific virus pneumonia :

This group of pneumonia is gaining more attention in the recent years.

Abnanti et al (1960) recovered 15 PI-3 virus from 7 outbreaks of respiratory diseases in calves and adult cattle and 3 from the nasal secretions of normal calves.

Vardaman et al (1962) studied the response of calves

to PI-3, Past. haemolytica and Past. multocida. Heddleston et al (1962) studied that Past. haemolytica, Past. multocida and PI-3 were capable of transmission by contact under field condition from calves with shipping fever to the susceptible.

Nikolaev and Nikolaeva (1964) isolated and studied cytopathogenic agent from calves with respiratory diseases. Acidophilic, cytoplasmic inclusion bodies in the cylindrical cells of bronchial mucosa were observed.

Blanco Loizelier (1966)associated the disease complex involving respiratory and/or digestive system with PI-3 virus.

Stevenson (1967) studied pathology of pneumonia in intensively reared calves. Morphologically, two distinct types of pneumonia were observed in 9 cases of which 6 had lesions resembling inclusion body pneumonias which were thought to be due to PI-3 virus.

Infections bovine rhinotracheitis (IBR) virus :

Madin et al (1956) isolated an infectious agent (IBR) from nasal washings and scrapings and subsequently the virus was isolated from lungs, nasal discharge and faeces of calves with respiratory illness.

Blanco Loizelier (1966) studied pathogenesis associated with pneumoenteritis and pointed out IBR as one of the causative factors.

Mohanty et al (1969) found in an experimental study involving both intratracheal and intranasal inoculations with some tissue culture of IBR virus that affected animals showed clinical signs of pneumonia. Those given orally and nasally and controls remained clinically normal. All the male calves of 6-8 week old were used. Calves with clinical signs had pneumonic lesions both macroscopically and microscopically.

Adenovirus :

According to Aldasy et al (1965) high incidence of pneumoenteritis has been observed in Hungary calves (2 weeks to 4 months). 78 strains of adenoviruses were isolated. Adenovirus is suggested to be primary cause of pneumoenteritis.

According to Omar (1966), 17.6 per cent of 125 outbreaks showed pneumonia characterised by proliferative and necrotizing bronchiolitis and by the presence of inclusions. He classed them as adenovirus type pneumonia.

Reoviruses :

Lamont et al (1966a, b) reported development of lesions of pneumonia without clinical manifestation in colostrum deprived calves. The lesions described were proliferative reaction with minimal exudation. Peribronchiolar and perivascular lymphoid hyperplasia were noticed.

Phillip (1970) described 20-25 per cent of calf

respiratory disease outbreaks which were diagnosed to be due to reoviruses.

Psittacosis lymphogranuloma venerum (PLV) group of organisms :

Omori et al (1960) reported PLV organisms associated with encephalomylitis and pointed out that they also produced respiratory and intestinal syndromes in cattle.

White (1965) observed extensive and consolidation of apical and cardiac lobes and a tracheobronchitis with copious mucopurulent exudate in experimentally affected calves. Elementary bodies were demonstrated in smears from respiratory tract.

Pulmonary mycosis :

Eggert and Rombery (1960) reported pulmonary aspergillosis in a calf. Aspergillus fumigatus was isolated from infected lungs showing lesions very similar to miliary tuberculosis.

Tuberculosis :

Naik (1932) described lesions in both lungs and mediastinal or bronchial lymph nodes of the buffaloes.

Singh and Prasad (1971) reported high incidence of tuberculosis in Tharparkar cattle and observed well marked lymphocytosis in the tuberculin positive cattle.

MATERIALS AND METHODS

The present research was conducted on twenty young sick cow calves. Half of them were suffering from scours whereas rest of sick calves were affected with pneumonia. The calves belonged to Tharparkar and nondescript breeds of cattle. Daily temperatures and symptoms of sick calves were recorded. After death of these calves, post mortem examination was soon conducted. Twenty five lungs were also collected from slaughter houses for studying pneumonic changes.

Reproduction :

Twenty four healthy white mices were selected and divided into two groups on the basis of random assortment. Each group comprised of twelve mices.

Group - I :

Lung specimens of a dead calf presumptively diagnosed to be a case of Pasteurellosis were collected in sterilised Petridish and was kept in freezing chamber of a refrigerator. Some pieces of the lung were pooled in mortar and macerated in ten ml normal saline solution with pestle. The whole was filtered with simple filter paper.

The filtrate was ready. 0.2 ml of the filtrate was inoculated intraperitoneally into six healthy mices of 1st group with sterilised glass syringe and six other healthy mices of 1st group were inoculated only 0.2 ml of saline solution. Temperature and symptoms were recorded before inoculation and after inoculation of the filtrate of lungs, at four hours interval. After death of these mices, pieces of lungs, intestine, kidneys, liver, spleen and brain were collected in ten per cent formalin saline for histopathology.

The pieces of lungs of dead mices were kept in sterilised petridishes in freezing chamber of refrigerator for further use. By above method ten ml filtrate of lungs of the mices had been prepared. 0.2 ml of filtrate was inoculated intraperitonially in each of 6 mices of 2nd group and six healthy mices were given only saline solution and kept as controls. These mices were kept under observation and symptoms and temperature were recorded. After death of the infected mices pieces of lungs, intestine, liver, kidneys, spleen and brain were collected and kept in ten per cent formalin saline for histopathological studies.

Statistical study :

Data obtained from post mortem records and mortality figures were statistically analysed. The incidence of scours and pneumonia in relation to different age groups were

evaluated. In order to confirm an evaluate studies on the incidence, pathological changes and importance of the scours and pneumonia, other diseases occurring under natural conditions were also carried out.

Haematological studies in all calves affected with pneumonia and scours were carried out. Blood samples were collected in vials containing Wintrobe's antigoagulant for estimating certain blood values such as (a) Total erythrocytic count (b) Haemoglobin percentage, (c) Packed Cell volume (PCV) percentage (d) Total leucocytic count and (e) Differential leucocytic count.

Total erythrocytic count :

Double Neubaur's counting chamber was used for total erythrocyte and leucocyte counts. Hayem's solution was used for R.B.C. count according to Oscar W. Schalm (1961).

Haemoglobin determination :

Haemoglobin percentage was obtained by Sahli-Haden Haemoglobinometer following the direction for its use.

Packed cell volume :

This test was done with the help of Wintrobe's Haematocrit method within an hour of collection of oxalated blood.

Clean Wintrobe's Haematocrit tubes with a uniform 3 mm bore and a double 10 cm scale caliberation with milimeter divisions were used. The scale on the left was read from top to bottom while the scale on the right was in reverse. Tubes were filled with oxalated blood upto 0 mark on the left hand scale and were allowed to stand vertically.

The Wintrobe's tubes were afterwards centrifuged to determine the Packed cell volume at the speed of 300 pm for 50 minutes and then for 20 minutes. The results were recorded as the number of ml of cell per 100 ml of blood. Speed and time of centrifugation were not changed in any case.

Total leucocyte count :

The standard techniques were followed as described by Schalm (1961) in Veterinary Haematology.

Differential leucocyte count :

Properly spread uniform blood films were made on polished and absolutely clean slides. The smears thus made were stained by Leishman's staining technique. Two hundred leucocytes were counted in each slide following the "battlement" system (1 mm down, 1 mm across and 1 mm above).

Post mortem examination :

When the calves died due to scours or pneumonia, a

thorough post mortem examination was conducted. First, the calves were examined externally. Colour of external mucous membrane of the body was noted. The carcasses were opened and various parts of the body starting from subcutaneous tissue and muscle to visceral organs were examined. The shape, size, colour and consistency of the lesions in organs were noted.

Similar post mortem technique were adopted in experimental mices too died due to infection.

Isolation procedure :

To illustrate the bacterial flora associated with the pathological condition, the materials from the representative lesions were first studied in smears stained appropriately. Thereafter, in interesting cases plated in suitable media, colony characters were studied after incubating for a desired period. In a pneumonic case, the virulence and pathogenecity of the infected materials were tested to confirm the aetiological significance. The following media were used in this study :

(i) Nutrient agar - incubated at 37°C for 24 hours to 36 hours.

(ii) Blood agar - incubated at 37°C for 24 hours to 36 hours.

Histopathology :

Pieces of organs which showed the macroscopic lesions were collected in 10 per cent formalin for histopathological examination. After fixation for a few days, the small pieces of tissues were washed in running tap water for 20 hours, dehydrated in ascending grades of prepared alcohol, cleared in benzene and blocks in paraffin were prepared. Sections were cut at 5 micron to 6 micron in thickness and stained by Haematoxylen and Eosin (Lillie, 1954) and studied under microscope.

Sections of lungs were also stained by Macchiavello's technique for detecting viral inclusion bodies.

Macchiavello's technique (modified) :

Paraffin sections were brought to water. The sections stained in 0.25 per cent aqueous basic fuchsin for 30 minutes.

These were differentiated rapidly (about 3 seconds) in 0.5 per cent citric acid and washed in water.

These were further dehydrated, cleared and mounted in D.P.X.

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OBSERVATIONS

INCIDENCE OF WHITE SCOURS AND PNEUMONIA IN YOUNG STOCK OF CATTLE IN BIHAR VETERINARY COLLEGE HOSPITAL, GOVERNMENT CATTLE FARM, PATNA AND OTHER MATERIALS.

In the present study, pertinent materials taken into investigation could be divided into three main parts viz. (1) materials belonging to Tharparkar calves of Government Cattle Farm, Patna (G.C.F., Patna), (2) materials collected from Bihar Veterinary College Hospital (B.V.C.H.) autopsy cases and (3) other category of materials including lungs and other tissues from animals killed or dead in district of Patna.

The composition of Government Cattle Farm, Patna and Bihar Veterinary College Hospital materials in calves affected with pneumonia and scours etc. are given in Table 1.

TABLE 1.

Composition of G.C.F. and B.V.C.H. materials

Enteritis or gastro-enteritis	Number autop-sied.	Pneumonia	Scours	Tuber-culosis	Other with P and/or GI lesions	Other condi-tions
15	276	113	Nil	2	94	52

P = Pulmonary. GI = Gastrointestinal.

Table 1, depicts the distribution of the available data of the Government Cattle Farm, Patna and Bihar Veterinary

College, Hospital over a period of 20 years along with various other pulmonary or gastrointestinal maladies observed post mortem. Pneumonic cases occupied the highest prevalence among the different disease diagnosed in autopsy cases.

TABLE 2.

Incidence of pneumonia in different age groups of Tharparkar and nondescript calves

Total number of cases	Number autopsied	Age group of calves	Diagnosis
113	41	Below the age of one month.	Pneumonia
	19	Between the age of one month to six months.	Pneumonia
	53	Above the age of six months	Pneumonia

Incidence of pneumonia among different age groups of calves is shown in Table 2. The incidence of pneumonia in the calves of above six months of the age is higher than that in other age groups.

TABLE 3.

Incidence of white scours in different age groups of Tharparkar and nondescript calves.

Cases examined.	No.of white scours	Number autopsied	Age group of calves	Diagnosis
200	15	3(TC)	0 - one week	Scours
		1	One - two weeks	Scours
		4	Two - three weeks	Scours
		4	Three - four weeks	Scours
		3	Four - five weeks	Scours
		0	Five - six weeks	Scours
		0	Six - eight weeks	Scours

TC = Tharparkar calf.

Incidence of calf scours among different age groups of calves is shown in Table 3. The incidence of scours was seen in the calves between 0 - one month of age.

TABLE 4.

Seasonal distribution of pneumonia in Tharparka and nondescript calves.

Number auto-psied	Number of cases of pneumonia	MONTHS											
		1	2	3	4	5	6	7	8	9	10	11	12
276	113	23	16	6	5	5	6	5	8	3	15	9	12

Table 4 and Graph I indicate seasonal distribution of incidence of pneumonia among young calves. Its incidence was quite high during the winter season (October to February).

Some specific diseases:

Cases of navel-ill, foot-and-mouth disease and immature amphistomiasis causing severe mortality in cow calves were noticed in available data on Government Cattle Farm, Patna and Bihar Veterinary College Hospital materials. These were 2 case of foot- and-mouth disease, 22 of immature amphistomiasis and 43 cases of navel-ill in calves.

TABLE 5.

Table showing the results of clinical and pathological changes in ten cow calves suffering from scours.

Calf no.	Age	Sex	Breed	Clinical signs	Period of clinical signs present	E. coli Isolation	Pathological changes
1.	20 days old.	Male	Nondescript.	Temperature on 1st day - 104°F. Clay coloured faecal material, colic pain and grinding of teeth. Temperature on 3rd day 99°F.	3 days	+	Liver reddened and swollen. Lungs congested. Mucous membrane of duodenum reddened and swollen.
2.	6 days old.	Male	Tharparkar.	Temperature 101.5°F. Anorexia with slight diarrhoea.	4 days	+	Mucosa of duodenum slightly reddened.
3.	8 days old.	Male	Nondescript.	Temperature 104°F. Dull appearance. Slight diarrhoea. Swelling in navel region.	4 days		Duodenal mucosa congested. Poorly clotted blood in umbilical vein.
4.	1 day old	Male	Tharparkar.	Temperature 99°F. Visible mucous membrane pale, heart beat irregular and slow at coma stage.	8 hours	+	Intestine, congestion in mucous membrane, vicid slimy mucoid material.
5.	1 month	Male	*Tharparkar.	Temperature 101°F. Calf was emaciated, potbellied and anal region plastered with loose faeces.	12 days	+	-
6.	One and half month old.	Female	*Tharparkar.	Temperature 102°F. Pasty diarrhoea, straining during defaecation.	7 days	+	-

TABLE 5 Cont'd.

Calf no.	Age	Sex	Breed	Clinical signs	Period of clinical signs present	*E. coli* Isolation	Pathological changes
7.	28 days old.	Female	Nondescript.	Temperature 104°F. Watery diarrhoea with blood tinged. Swelling at navel region.	4 days	+	Excess of blood tinged mucoid material in the intestinal lumen. Haemorrhagic enteritis clotted blood in umbilical vein.
8	25 days old	Male	Nondescript	Temperature 101°F. Pulse was 92 per mt. Appetite good, bright demeanour.	3 days		-
9	4 days	Male	Tharparkar.	Temperature 105°F. Watery faeces mixed with blood, frequent defaecation,	2 days	+	Lungs congested. Kidneys swollen with more intense colour. Hyperemia of intestinal mucous membrane. Intestinal contents mixed with mucoid materials.
10.	2 months old.	Male	Tharparkar	Temperature 100.5°F. Slight abomasal dilatation. Depraved appetite. Soft faeces.	10 days	+	Reddened areas in the apical lobes of the lung. Few fibrinous strands in the peritoneal cavity. The mucosae of urinary bladder slightly congested.

* = Survivor.

Pathological findings in calf scours :

Of the ten calves suffering from white scours, 7 died of this disease. The results of clinical and pathological findings are given in Table 5.

Symptoms :

After 4 to 5 hours of calving, one calf was suffering from very acute or peracute variety of scours. It was found to be extremely dull and depressed. The temperature was subnormal (99°F), conjunctiva of the eyes were pale. Heart beat was slow and irregular and slight convulsive movements were noticed.

Two calves were suffering from enteric form of scours. The temperature was 104° to 105°F. The faeces were watery, pasty, yellow in colour and occasionally tinged with blood. There was frequent loose defaecation and faecal material had sour odour. Pulse rate was thirty two per minute.There was pain and straining during defaecation.

Four other scours cases in calves were in poor nutritional condition. These were also dull and depressed. Slight swelling in the navel region was noticed in two of these calves. Temperature was 104°F. They were suffering from acute diarrhoea and were passing watery faecal material. The diarrhoeic materials were whitish and frothy in nature. Eye balls were shrunken and the conjunctivae of the eyes were pale.

They had rough body coat and there was hide-bound condition with unusual prominence of bony eminences. Lameness was not noticed in any of these calves. There were three survivers in the case of scours in the present study. The temperature and pulse rates recorded in them were of normal values. Abdomen was moderately distended in one calf. Appetite was depraved of in affected calves.

Macroscopic appearance :

The carcasses of the dead calves were in poor nutritional condition. The eye balls were slightly shrunken in their shockets. Dry, whitish faecal material of somewhat pasty in consistency was clinging to the skin just around the anal rim. On removal of skin of the calves, the muscles were found to be dry and sticky to touch. There were reddened areas in the apical lobes of the lungs. Interlobular septa of the lung was slightly emphasied due to infiltration of serous fluid. In one calf there was a few fibrines in the peritoneal cavity clinging to liver and a loop of gut. The bile in the gall bladder was thick and some what ropy in nature. The liver of one calf was swollen and reddened. The mucosae of urinary bladder were slightly congested in one calf. There was poorly clotted blood in the umbilical veins of two calves.

Stomach contained excessive amount of partially clotted milk with pungent smell in few cases. The intestinal contents were like vicid slimmy slippery materials and blood

tinged in some cases. There was slight redness and swelling in mucosae of stomach in three calves. In the calves investigated, there were macroscopic lesions characterised by redness, haemorrhage and swelling of mucous membrane in duodenum and ileum (Fig. 1). However, no macroscopic lesions in gastro-intestinal tract were noticed in one calve. No lesions were noticed in the form of pus or fibrinous materials in the joints. There were no gross changes in the brains.

Microscopic appearance :

In haematoxylin and eosin stained sections of intestine, there were areas of focal haemorrhage and degenerative change in lamina propria and surface epithelium (Fig. 2 and 3). At places there was complete loss of villi and the epithelial cells lining the crypts of Lieberkuhn had pyknotic nuclei and had desquamated to form clumps in lumen. In some of these calves, the epithelial cells lining the villi were showing pyknosis and karyorrhexis of nuclei. The blood vessels just below muscularis mucosa were engorged with blood. There was slight infiltration of lymphocytes in lamina propria in few cases.

There was congestion and consolidation in lung parenchyma. Pink stained material erythrocytes and mononuclear cells were seen in the alveoli and also in some bronchioles.

The cells in hepatic cords were swollen and even

marked individualisation was noticed in the cells around central veins. The blood vessels in the portal vein were hyperamic.

Cells lining the tubules of kidneys were swollen, granular and had filled up almost the tubules.

Bacteriological examination :

Bacteriological examination of intestinal contents of the dead calves revealed E. coli (Escherichia coli) in almost all the calves.

Haematology :

Results of examination of blood from seven calves are presented in Table 9. There was significant increase in R.B.C. count and Packed cell volume (PCV). There were no other marked changes in the blood value of sick calves.

Pathological findings in pneumonia :

Ten calves showing clinical symptoms of pneumonia were selected in the present studies. Some of them were Tharparkar calves of the Government Cattle Farm, Patna. Pneumonic cases detected in local nondescript stock of cattle were also included in the present investigation. The results of clinical and pathological examinations are given in Table 6.

TABLE 6.

Showing the results of clinical and pathological changes in ten cow calves suffering from pneumonia.

Calf no.	Age	Sex	Breed	Clinical signs	Period of clinical sign present.	Bacteria present	Pathological changes in lungs
1.	9 months old.	Male	Nondescript.	Temperature 106°F. Rapid shallow respiration. Painful cough.	3 days	Corynebacterium sp.	Fibrinous exudate in the bronchioles. Lobular congestion.
2.	1 year old.	Male	-do-	-do-	4 days	-do-	Gelatinous exudation in the interlobular septa. Congestion in brain.
3.	9 months old.	Female	Tharparkar.	Temperature 105°F. Frequent, dry, hacking coughs.	2 days	-do-	Firm, dark grey lungs.
4.	1 month	Male	Nondescript.	Temperature 103°F. Presence of dyspnoea.	5 days	Staphylococcus sp.	Gelations exudation in the interlobular septa.
5.	15 days	Male	Tharparkar.	Temperature 106°F. Rapid shallow respiration.	3 days	-do-	-do-
6.	4 months	Male	-do-	Temperature 105.5°F. Depression, anorexia and dyspnoea with coughing and slight mucopurulent nasal discharge.	2 days	Pasteurella sp.	Hepatization of apical and cardiac lobes. Accumulation of serofibrinous exudate in the interlobular spaces.

TABLE 6. Cont'd.

Calf no.	Age	Sex	Breed	Clinical signs	Period of clinical sign present	Bacteria present	Pathological changes in lungs.
7.	1 year old	Male	Nondescript.	Temperature 102°F. Chronic cough.	15 days	Mycobacterium tuberculosis	There were small caseous nodules in the lung parenchyma. Kidneys were hyperemic.
8.	2 months old.	Female	-do-	Temperature 103°F. Rapid shallow respiration.	7 days	Streptococcus sp.	Gelatine exudation in the interlobular septa.
9.	25 days old.	Male	-do-	Temperature 105°F. There was dyspnoea.	3 days	-	-do-
10.	5 months	Female	Tharpar-	Temperature 106°F. Frequent coughing. Presence of mild diarrhoea.	7 days	-	Granular appearance under the pleura and on cut surface of lungs.

Symptoms :

The affected calves were in poor nutritional condition and their body coats were rough. They were dull and depressed. Some of these calves were found to discharge thin watery mucoid material from the nostrils. Dry and greyish white material found clinging to the nares. Their body temperature was elevated to 105°F. The calves were off fed and suffered respiratory distress. In one case, the temperature was 104°F and there was profuse nasal discharge and salivation with no consipicuous swelling in throat region.

Bronchopneumonia :

Thirty five lung specimens studied under present investigation (8 lungs) showed pathological changes of bronchopneumonia (Table 8).

Macroscopic appearance :

There were patchy red firm areas in lobules of the lungs. These lobules were moderately swollen and raised above the level of adjacent normal lobules in the lungs. There was frothy greyish white material in trachea and bronchi (Fig. 4). In some affected lungs of the calves, there were also firm depressed areas below the level of the surrounding parenchyma. Areas of patchy redness and firmness were mostly marked in antero ventral portions of the lungs. The interlobular septa were thickened and infiltrated with dirty grey fluid. Of these

10 calves examined, pasteurellosis was found in only one case. Slightly dirty serous fluid in subcutaneous tissue of throat and neck region was noticed in this calf. There was several subepicardial and endocardial petechiae in the heart. Spleen was almost normal. The mucous membrane of abomasum and small intestine was swollen and has slightly reddened areas. The lungs show patchy distribution of reddened and firm areas in the lobules. Frothy material in trachea and bronchi was also noticed.

Microscopic appearance :

In Haematoxylin and eosin stained lungs, there were well marked consolidated areas in the lung parenchyma. In some specimens, the lining of the bronchial epithelium had desquamated to lie into the bronchi and were filled with pink stained exudate containing a few inflammatory mononuclear cells (Fig.5). There was also slight increase of round cells in the peribronchial connective tissue in two cases.

The interlobular septa of the lungs were distended with serofibrinous exudate in 3 cases (Fig. 6). Alveoli contained fibrinous threads.

In the smears made from lungs of 10 cases, gram positive pleomorphic rods were detected in 3 cases. When plated on agar plates, they produced dew drops like minute colonies which became opaque on aging of the culture. The morphology of the organism was suggestive of Corynebacterium

species. In two cases, the smears revealed gram positive sherical organisms arranged in clumps like bunches of grapes or in clusters. On agar plates, the colonies were round, smooth glistening, opaque, low convex and amorphous. Their edges were entire golden in colour and butyrous in consistency. In one case, chain of gram positive spherical organisms were recovered. When plated on agar they produced small smooth, finely granular and glistening dew drop like colonies. In one case, bipolar organisms resembling Pasteurella sp. were found in impression smears made from the diseased lungs. These organisms were isolated on agar plates. The colonies were round, flat, fluorescent, whitish opaque, smooth and moist.

Proliferative pneumonia :

Interstitial pneumonia : Of the thirty five specimens of lungs, 12 cases revealed features of interstitial pneumonia (Table 8).

Macroscopic appearance :

When thorax was opened, lungs were enlarged and did not collapse. The lungs were greyish white in colour and firm in consistency (Fig. 7). There were emphysematous areas close to the consolidated patches in both lungs. Slightly blood tinged fluid escaped from the cut surfaces of four lungs. The brains were congested and hyperemic in two cases.

Microscopic appearance :

In Haematoxylin and eosin stained sections of the lungs in 7 cases, the most conspicuous lesions were thickening of interlobular septa due to proliferation and infiltrations of round cells (Fig. 8). The bronchi and bronchioles were empty and there was slight increase in round cells in the peribronchioles spaces in two cases. Lymphatic nodules consisting of lymphocytes were seen at a few places in the lungs of the calves (Fig. 9).

Hyperemia, perineural and perivascular oedema were seen in sections of brain.

Bacteria :

Bacteria isolated from these lungs were mostly reresembling Corynebacterium sp. In some cases staphylo and strepto were also present.

Pulmonary tuberculosis :

Out of 35 lung specimens, pulmonary tuberculosis was observed in one calf.

Macroscopic appearance:

Calcified nodules encased by capsule of fibrous tissue were present. There were areas of congestion and emphysema in close proximity of these lesions. Distinct nodules bulging over the surface of the lungs gave an uneven nodular

appearance to the organ. The nodules were compact and solid. When cut, there was calcified and cheese like material in them.

The kidneys were hyperemic.

Microscopic appearance :

In Haematoxylin and eosin stained sections of lungs replacement of the normal architecture of the lung parenchyma by caseous and calcified materials were observed (Fig. 10).The lining of bronchioles in contact with these lesions was desquamated and moderate lymphocytic infiltrations in lamina propria were noticed. The nodule from within outwards consisted areas of calcification surrounded by a wide zone of caseation. Epithelial cells, lymphocytes and giant cells were visible outside the zone of caseation (Fig. 11). Cells lining the tubules are swollen granular and had almost filled the tubular lumen.

Smears from tuberculous lesions stained appropriately with acid fast method showed acid fast bacilli.

Hyperemia :

Out of 35 specimens, six cases showed characteristic lesions of hyperemia.

Macroscopic appearance :

Lesions were mostly observed in the anteroventral portions of the apical and cardiac lobes. These areas were swollen and dark red in colour and when cut, blood with frothy

material escaped.

Microscopic appearance :

In haematoxylin and eosin stained sections of the lungs, the alveolar capillaries were engorged with blood. A few red cells were seen in the alveolar spaces with pink stained material. The interalveolar septa appeared thickened due to distended capillaries. Oedematous fluid were present in few alveoli.

Oedema :

Of thirty five specimens of lung four cases revealed lesions of oedema.

Macroscopic appearance:

The lungs were pale, voluminous, heavy, doughy and showed pitting on pressure. When cut surface were squeezed, frothy material oozed out. Fluid was also found in the pleural cavity.

Microscopic appearance :

In haematoxylin and eosin stained sections of lungs there was interstitial oedema infiltrating and distending the alveolar septa. Pink stained fluid with a few mononuclear cells were present in the alveolar spaces. Pink stained exudate with inflammatory cells were also present in the alveolar septa.

Emphysema :

Out of thirty specimens, two cases showed emphysematous changes dominantly over the parenchyma.

Macroscopic appearance :

The lesions were focal in nature. The focal changes were of diffused character involving nearly the whole lungs. The focal changes were mostly noticed in the ventral borders of the diaphragmatic lobes of the lungs. The emphysematous areas were well above the level of the normal parenchyma. These areas were paler than normal.

Microscopic appearance :

In haematoxylin and eosin stained sections of the lungs greatly enlarged alveoli and alveolar ducts were present, at several places in the lung parenchyma (Fig. 12). Alveolar walls at places were ruptured forming giant alveoli. The alveolar septa were thin and blood less and torn. The torn ends had bulb like swellings.

Haematology :

There was marked decrease in normal value of haemoglobin percentage and red cell count per cmm. There was a slight increase in percentage of neutrophils and eosinophils in the blood picture of the pneumonic cases (Table 10).

TABLE 7.

Showing recovery of etiological agents in the lung specimens.

Number of cases examined	Conditions of lung	Etiological agents recovered in smears and/or isolated
35	Bronchopneumonia	Corynebacterium sp. Staphylococci sp. Streptococci sp. Pasteurella sp.
	Pulmonary tuberculosis	Mycobacterium tuberculosis
	Interstitial pneumonia	Staphylococci sp. Corynebacterium sp. Staphylococci sp.
	Oedema	-
	Emphysema	Corynebacterium sp.
	Hyperemia	-

TABLE 8.

Incidence of bronchopneumonia and interstitial pneumonia in calves.

Number autopsied	Age group	Broncho-pneumonia	Interstitial pneumonia	Per cent of pneumonia
35	Under three months of age.	8	-	22.8
	Above three months of age.	-	12	34.2

EXPERIMENTAL PATHOLOGY OF PASTEURELLOSIS IN MICE

Symptoms :

The mices were dull and depressed. Shivering of body coat and sneezing were noticed. There was presence of dyspnoea after 10 hours of inoculation. Body temperature was 101°F.

However, body temperature of the 2nd group of experimental mices was 102°F.

Macroscopic appearance :

There were pin point haemorrhages in the subepicardium and subendocardium of heart. There were petechiae in the heart. Marked hyperemia and congestion were present in the lungs. Dark blood was present on the cut surfaces of anteroventral surface of lungs. Liver was pale and swollen and soft in consistency. There was redness and haemorrhages in mucous membrane of the small intestine. Slightly blood tinged material was present in the intestine. There was hyperemia in brain. Kidneys were pale and pulpy.

Microscopic appearance :

In haematoxylin and eosin sections of lungs, bronchioles were empty and alveolar walls were thickened due to infiltration of round cells and neutrophils (Fig. 13). At

places, alveoli contained exudate consisting of mostly erythrocytes (Fig. 14). There were areas of focal haemorrhages.

Intestine :

Surface epithelium showed necrotic changes. Cells lining the villi were desquamated (Fig. 15). Cells lining the crypts of Lieberkuhn were desquamated and pyknotic. Blood vessels were also hyperemic.

Heart :

There was fragmentation of muscle fibers and loss of striation in them. Areas of focal haemorrhages were present in muscle fibers (Fig. 16).

Liver :

There was marked degenerative changes in cells of the hepatic cords. The central veins and portal vessels were severely hyperemic.

Kidneys :

There were focal haemorrhage in the kidneys. The cells lining the tubules were very much swollen and highly granular. At places, cells lining the tubules were desquamated.

Brain :

Few focal haemorrhage were found in haematoxylin and eosin section of brain of mices (Fig. 17). There was hyperemia, increase in number of glia cells. Presence of a few lymphocytes around the blood vessels in two mices were seen.

TABLE 9.

Blood values of normal cow calves and calves suffering from white scours.

No. of calves	R.B.C. (million/ cmm Mean ± S.E.	W.B.C. (thousand/ cmm Mean ± S.E.	Haemoglobin g/100 ml Mean ± S.E.	PCV per cent Mean±S.E.	Neutrophils per cent Mean±S.E.	Eosinophis per cent Mean±S.E.	Basophils per cent Mean±S.E.	Monocytes per cent Mean±S.E.	Lymphocytes per cent Mean±S.E.
				NORMAL CALVES					
7	7.834 ±0.166	8.428 ±0.261	10.47 ± 0.263	30.857 ± 0.508	42.714 ± 1.016	2.857 ±0.769	0	2.285 ±0.606	52.142 ±0.911
				DISEASED CALVES					
7	8.77 ±0.254	8.471 ±0.173	10.157 ± 0.299	36.857 ± 0.213	42.142 ± 0.737	4.142 ±0.508	0	2.714 ±0.544	51.00 ±0.872

The above table shows that there was marked increased in packed cell volumeand red cell count in the cases of white scours.

TABLE 10.

Blood values of normal calves and calves suffering from pneumonia.

No. of calves	R.B.C. (million/ cmm Mean ± S.E.	W.B.C. (thousand/ cmm Mean ±S.E.	Haemoglobin (g/100 ml) Mean ± S.E.	Neutrophils per cent Mean ± S.E.	Eosinophil per cent Mean ± S.E.	Basophils per cent Mean ± S.E.	Monocytes per cent Mean ± S.E.	Lymphocytes per cent Mean ± S.E.
			NORMAL CALVES					
10	6.714 ±0.175	8.451 ±0.193	10.21 ± 0.147	29.40 ±1.104	2.90 ±0.276	0	3.70 ±0.366	64.0 ± 1.437
			DISEASED CALVES					
10	4.718 ±0.191	4.64 ±0.423	7.22 ±0.181	51.10 ± 1.149	4.50 ±0.401	0	2.20 ±0.537	42.40 ± 1.097

The above table shows that there was a marked decrease in the normal value of haemoglobin percentage and red cell count per cmm. There was marked increase in the percentage of neutrophils and eosinophils.

DISCUSSION

STATISTICAL ANALYSIS OF CASES OF SCOURS AND PNEUMONIA IN CALVES IN THE PERIOD 1956-1975.

As already stated under introduction the studies on white scours and pneumonia in calves have been divided into (1) statistical analysis of available data on these diseases; (2) etiological investigation and (3) pathological observations in the diseased animals. In this chapter the statistical analysis of pathological data has been incorporated. White scours and pneumonia in calves are very much queer and complex problems from epizootiological, etiological and pathological angles due to multiplicity of several involved factors. The environmental aspect has got a very important role in incidence of pneumonia and scours in calves, by creating favourable situations which alter or exalt the pathogenic capacity of causative agents.

Analysis of data obtained from Government Cattle Farm, Patna and Bihar Veterinary College Hospital and materials on diarrhoeic calves showed a total of fifteen cases of calves with lesions of only enteritis or gastroenteritis during the entire observation period of twenty years from 1956 to 1975 among 276 dead calves. It thus appears that no case of white scours was clinically diagnosed in the Government Cattle Farm materials although these deaths in calves were due to enteritis

or gastroenteritis, pneumonia, pneumoenteritis syndrome etc. Survey of incidence of white scours in farms and private cattle sheds does not indicate as a serious problem for the calf mortality in calves under 2-3 months of age. But, however, there are some reports of deaths in calves from diarrhoeic condition. Attempts were made to obtain statistical figure on clinical illness of white scours from different district hospitals and local cattle sheds and Government Cattle Farms, Bihar and statistics, so obtained were not exact absolutely and positively reliable because of lack of systematic recording of the disease in details of the sick animals.

It appears from Table 1 that enteritis or gastroenteritis was noticed in calves just below the age of two months. Of the 276 calves died of different causes with symptoms of diarrhoea, lesions of enteritis or gastroenteritis could be observed only in fifteen cases (15 cases) and there was no recorded case of clinical diagnosis of white scours in calves. Percentage of deaths due to enteritis or gastroenteritis in calves under two months of age with no other concomitant lesions of pneumonia was 5.43%. According to Jubb and Kennedy (1963) it is by no means unusual for the morbidity and mortality to be hundred per cent (100%) among calves in E. coli infection. They also pointed out that once a strain of E. coli (Escherichia coli) has established in a herd, predisposing factors such as inadequate housing, errors in dietary management in form of overfeeding or insufficient intake of colostrum and vitamins

become unnecessary and infected young animals may die before such factors have time to operate. When compared with other diseases causing death of calves, white scours does not appears to serious problem in Tharparkar calves and the disease seems to be well controled in the herd as revealed from pathological data. Constant watch was kept over entire period of one year from 1975 to 1976 to detect white scours in cow calves but only three cases of scours could be obtained from Government Cattle Farm, Patna and on bacteriological investigation, E. coli were obtained from duodenum of the dead animals. Even the attempts to detect scours in local nondescript breed of cattle could not yield high figures of mortality from calf scours. Detailed light on the role of predisposing factors such as exposure to extremes of weather and faulty feeding in form of colostrum etc. could not be thrown in the present studies because of paucity of clinically and etiologically established cases of white scours in this State. Fifteen cases of deaths in young animals under two months of age with symptoms of diarrhoea and lesions of enteritis and gastroenteritis did not occur in any particular month of year and were unevenly distributed overall seasons and so effects of season on incidence of such diseases could not be statistically concluded. E. coli in fact was found in three Tharparkar calves revealing lesions of gastroenteritis. Enteritis due to E. coli were found in seven isolated cases of scours in nondescript breed of cattle in cow sheds. Diarrhoea was found to be seven per cent in calves in Government Cattle Farm,

Patna and village cattle population. Thus, it seems that the disease is not a much serious problem as pneumonia in calves. It was not possible to investigate into all private cattle sheds and Government Farms in Bihar due to time bound research programme and lack of funds. Studies were thus, confined to a few cattle sheds, villages and Government Farms.

The main pathological changes noticed in dead calves were dryness and sticky characters of the muscles and excess of blood tinged or mucoid materials in the intestinal tract. Microscopically, petechiation, congestion and degenerative changes in the epithelial cells of villi could be observed in the affected calves. Slight degeneration in the epithelial cells lining the villi has been described by Morni et al (1976) in calves with some strains of E. coli. Absence of inclusion bodies in the sections of intestine, lung and brain stained by Macchiavello's method seems to indicate absence of viral infections with propensity of forming inclusions.

The most significant features observed in haematological studies of the cases of white scours were that there was marked increase in packed cell volume (36.8 ± 0.213) and red cell count (8.77 ±0.254). The author is not aware of any published information on haematological changes in scours in calves in India. Haemoconcentration appears to have caused high increase in red cell count from dehydration, consequent passing of loose pasty faecal excreta. Fisher et al (1976) has also observed that initial haematocrit was higher in diarrhoeic dying

calves (47.4 ± 7.4) than diarrhoeic surviving calves (31.6±4.2).

Minett (1946) withdrew conclusion that pneumonia was responsible for 58.4% of deaths and intestinal trouble for 19.5% of deaths and this difference was found to be highly significant. He further observed that in all above instances the death rate in winter was significantly higher than in summer and the great bulk of deaths occurred during 1st two months of life. In my present studies, mortality in calves due to gastroenteritis or enteritis mostly occurred within two to three months of age after birth. Unfortunately no report on bacteriological investigation on such cases could be available in G.C.F. materials to establish the etiological cause of death.

Dhanda and Khera (1956) observed that diarrhoeic affection and pneumonia are responsible for early calves death.

In my present studies, pneumonia in calves was found to take a great toll of life of young calves. Among the different killers for calves which came to be known and prevalent in the Government Cattle Farm, Patna and other local breeds, pneumonia was found to be most important calf disease for causing losses in cattle farms or sheds. In the present studies 40.94 per cent of deaths in calves in some or other form were as a result of pneumonia. It is clearly evident from Table 2 that losses in calves under one month of age is highest. The present investigation shows that occurrence of pneumonia in calves above the age of six months was recorded to be 24.1 per cent. Thus, it emerges from above findings that pneumonia causes

21.7 per cent and 24.1 per cent of deaths in calves in Bihar under six months of age and above the age of six months respectively. 32.7 per cent of deaths in calves was noticed due to concomitant incidence of pneumonia and enteritis in cow calves. Pneumonia and enteritis were, thus, found to be quite common disease and both of these conditions were manifested together in the same calves. It is very difficult to say whether early pneumonia was the first disease to appear in calves or it was only terminal lesion or secondary complication of enteritis in calves suffering from mixed condition of pneumonia and enteritis. The present discussion on pneumonia in calves revealed it to be a disease of older calves as also reported by Jensen (1903) and Lamount and Kerr (1939). Majority of pneumonic cases occur in winter season. Thus, it becomes greatly imperative for owner's of calves to maintain great vigilance and care especially in the winter months in order to protect young cattle livestock against pneumonia. Epidemiology of pneumonia in calves has almost rather a seasonal incidence. The incidence of pulmonary form of pasteurellosis has some seasonal occurrence because most of the cases of pasteurellosis are reported to be in the period May - August and almost every year deaths in calves commence during the early or late rain and lasts for a few weeks. The outbreak of pasteurellosis in Government Cattle Farm, Patna has been seen in the period June - July and the sporadic cases also occur during these months. It appears that rains or transition of one kind season into another probably reduced the resistance

of the calves. It cannot be even definitely said whether there was spontaneous outbreak of this disease in susceptible calves or the infection was carried to farm through some external agencies. There are several etiological factors responsible for pneumonia in calves. There was no incidence of hydatid cysts in young calves under the age of one year and that age seems to be responsible for deciding the occurrence of this parasitic conditions in the bovines.

An analysis of the composition of Government Cattle Farm materials shows high incidence of pneumonia in comparison to tuberculosis and parasitic enteritis. Tuberculosis was found in only two calves (0.7%) under one year of age whereas incidence of tuberculosis in cattle above the age of two years was highest. Singh and Prasad (1971) reported high incidence of tuberculosis in older cattle. Lesions in the lungs of calf were usually caseation and calcified nodules similar to that described by Naik (1932).

The histopathological changes observed in pneumonia were characterised by exudative changes in alveoli, bronchi and bronchioles and thus exudative pneumonia was the commonest type in young calves. The main organisms found in pneumonias were Streptococci sp., Staphylococci sp., Pasteurella sp. and Corynebacterium sp.

In the calves above the age of three months, interstitial pneumonia had the highest incidence (34.2%) and the lesions were mostly proliferative changes confined to the

alveolar septa and peribronchioler spaces. Alveoli were almost empty. In the present studies, changes such as thickening of alveolar septa and infiltration of lymphocytes in alveolar walls were dominant lesions seen microscopically.

Attempts were made to detect inclusion bodies or evidences of viral pneumonia (calf pneumonia or enzootic pneumonia) specially in calf in the age group of one to six months. But no case with characteristic lesions of viral pneumonia could be detected in my present studies. Jubb and Kennedy (1963) reported calf pneumonia was most prevalent in this group of calves. Calf pneumonia is often complicated with diarrhoea. Jubb and Kennedy (loc. cit.) observed that interstitial pneumonia could be found in coli bacillosis, leptospirosis and parasitic infestation due to migratry larvae at some stage of disease. Five cases of interstitial pneumonia showed exudate in alveolar spaces and thickening of alveolar septa due to infiltration of round cells and it appears that these cases are only due to conversion of interstitial pneumonia into exudative pneumonia.

Hyperemia in six cases and oedema in four cases were found in lungs of calves in the present investigation. Hyperemia in 3 cow calves seems to have developed from congestive heart failure because cardiac muscle fibers showed loss of striation and fragmentations in haematoxylin and eosin stain sections. Emphysema was found in two lungs of calves investigated. The focal lesions were present in the lung having areas of

consolidation and also around the tuberculous nodules as compensatory emphysema.

Pasteurellosis was produced in twelve mices and the lesions noticed in them were mostly degenerative and haemorrhagic in brain and exudative in alveoli of the lungs. Most of the mices died in acute stage of pneumonia and the haemorrhagic exudate consisting of mostly red cells could be found in alveoli. There was no exudate in bronchi or bronchioles which was most significant lesion of pasteurellosis in mices. Petechiation and focal haemorrhage in lung, heart and brain were very conspicuous changes. It is very difficult to explain the reason for absence of exudate in bronchi and bronchioles but occurrence of haemorrhagic exudate in alveoli, focal haemorrhages in muscle fibers of heart and brain indicate severe damage in capillaries resulting in emigration of mostly erythrocytes and formation of exudate outside the vessels. Increase glia cells of brain of mices were also seen and there was also some perivascular cuffing in brain of two mices. In present studies, histopatholigcal changes such as haemorrhage, degeneration and exudate in alveoli and almost negative exudative reaction are the most significant lesions of pasteurellosis in dead mices. It appears from available literature there is no reference on histopathological changes in mices.

Haematological studies were carried out in ten typical cases of pneumonia before death of sick calves. The most important changes were fall in haemoglobin percentage and

rise in percentage of neutrophils and eosinophils. Mostly the calves, in the present investigation, were in state of debility and anaemia as evidenced by fall in haemoglobin percentage. They were very susceptible to adverse effects of incliment weather and developed pneumonia mostly characterised by rising percentage of neutrophils. Alveolar and bronchial exudate was very commonly observed in such cases.

From the foregoing it is clearly seen that deaths in cow calves were mostly due to pneumonia and calf scours. Thus, these two diseases appear to remain main problems deserving timely control measures to check the losses from mortality in young cow calves under the age group of two months. At times, food-and-mouth disease, amphistomiasis and navel-ill are some other specific diseases causing deaths in calves in this State.

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S U M M A R Y

Pathologic changes in white scours and different respiratory diseases of cow calves in Bihar have been described.

Pneumonic cases had the highest prevalence in comparison to white scours and other diseases diagnosed. The incidence of pneumonia was very high in the young calves in winter season.

Degenerative changes in villi and lamina propria of small intestine were noticed in scours in cow calves. Haematological studies were carried out in cases of scours. Increased packed cell volume and red cell count were alterations in the blood values.

Exudative pneumonia was most common observation in calves under three months of age, whereas interstitial pneumonia had highest incidence above the age of three months. Pathologic changes in lungs of dead calves did not indicate any viral infection. The main haematological findings in pneumonic calves were decreased in haemoglobin percentage and increased percentage of neutrophil.

Pneumonic changes, petechiation in different organs and enteritis were the main pathologic changes in mices infected with pasteurellosis. Absence of exudation in the bronchi and bronchioles was not worthy findings in infected mices.

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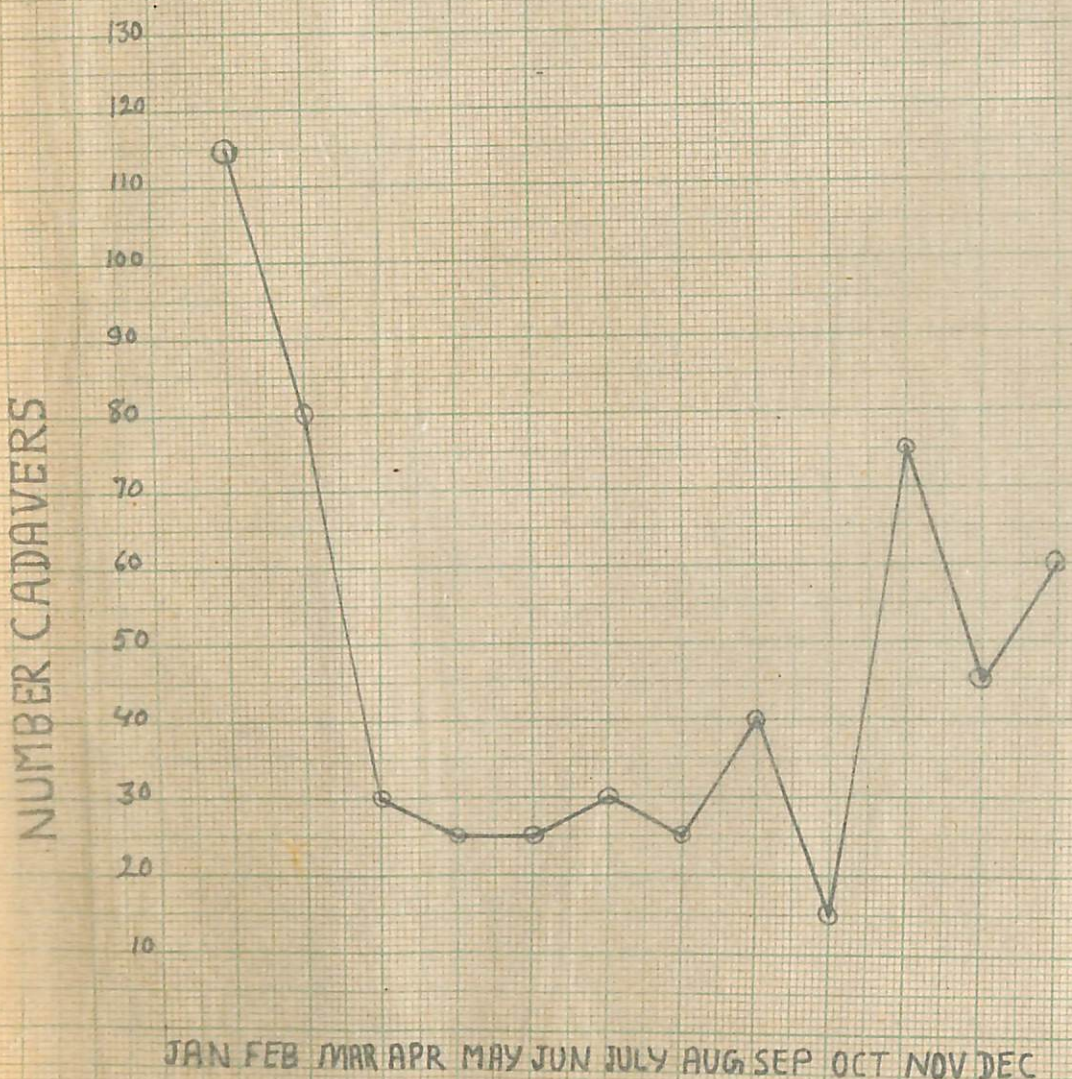
GRAPH SHOWING
SEASONAL DISTRIBUTION OF PNEUMONIC LESION AT-AUTOPSY
IN CALVES

SCALE
1 CASE = 5 SMALL Sq.



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