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Respiratory pathologies in small ruminants and factors contributing to their outbreak

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Abstract

Pneumopathy embraces all diseases relating to the lungs. However, this name is more often used to refer to a lung infection. There are several types of lung disease: infectious, interstitial, inhalation and hypersensitivity. It should be noted that pneumopathies of infectious origin are the most frequent. Indeed, a pneumopathy designates an inflammation of the lungs and more generally the respiratory system. It can be of various origins, viral for example, but most of the time, it is bacteria (*pasteurella*, *streptococcus*, *pneumococcus*, *mycoplasma*, etc.) that are involved. Globally, pneumonia remains the dominant pathology in small ruminants in sub-Saharan Africa. They generally evolve during the dry- cold and rainy season causing many mortalities. Although small ruminants contribute a lot to the national economy in African countries, their development is hampered by various infectious factors such as peste des petits ruminants, pasteurellosis, *mycoplasma*, etc. Apart from these factors there are also the non-infectious factors, namely climate change, stress, the farming method and the production system. In fact, small ruminants could contribute more to the well-being of pastoralists if they do not pay a heavy price for pathologies. The presence of respiratory pathology, where infectious agents are strongly involved, is reported all over Africa, but very little quantified assessment is made about its prevalence and even less about its economic impact. The objective of this manuscript is to summarize from bibliographic references the different respiratory pathologies of small ruminants, the factors contributing to their appearance, the different pathogens involved, their diagnosis, treatment and prophylaxis.

Keywords: Pneumopathies; Small ruminants; Peste des petits ruminants; Pasteurellosis; Mycoplasmosis; Heartwater

1. Introduction

One of the main income-generating activities for rural populations in Africa is the breeding of short-cycle animals in general and small ruminants in particular. The role of this breeding in reducing the deficit in animal proteins is important. However, the development of this breeding is hampered by diseases including respiratory pathologies.

In sub-Saharan Africa, where the animal protein deficit is remarkable, the breeding of small ruminants occupies an important place in the animal production system in this region. It can be noted that sheep and goats represent 22% in Mali [1] and 60.6% in Chad [2] of the national herd. Therefore, they are important resources not only for the economics of livestock products, but also for all of these countries. These animals have an ability to produce meat, milk and other products, even under particularly difficult ecological conditions. This gives them special importance in the life of traditional breeders and peasants. Subsistence is the primary objective of small ruminant breeding in Africa; meat and milk are consumed on their own, and surplus males are either sold for cash inflows or kept in herds as broodstock [1].

Although small ruminants contribute a lot to the national economy in some African countries, their development is hampered by various constraints such as infectious and parasitic diseases. These include, among others, peste des petits

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ruminants, pasteurellosis, *mycoplasma*, sheep and goat pox, tuberculosis, contagious ecthyma, dictyoculosis, strongyliasis, etc. Note that respiratory pathologies are a major concern in the agro-pastoral system. Several infectious and non-infectious factors contribute to this. These are viral and bacterial infections, the farming system and ecological (climatic) factors. Small ruminants could contribute more to the betterment of pastoralists if they do not pay a heavy price for pathologies [3]. The results of an ecopathological survey of goats in the dry-cool season, carried out in Chad, showed that the respiratory pathology covers most of the symptoms encountered [4].

Based on bibliographic data, this manuscript summarizes the various factors contributing to the outbreak of respiratory pathologies (pneumopathies) in small ruminants, pathogens implicated in these pathologies, diagnosis, treatment and prophylaxis.

2. Factors contributing to the onset of respiratory pathologies in small ruminants

According to Lefevre [5], specific pneumopathies due to a single infectious agent are rare with the exception of smallpox. In contrast, pneumonia with multiple aetiology is by far the main cause of death from infectious disease. For Le jan et al. [6], this notion of multifactorial pathology does not stop only with infectious agents. The living conditions, the production system and the farming method play a very important role.

1.1. Diversity of pathogens implicated in respiratory infections in small ruminants

Globally, pneumopathies represent pulmonary infectious diseases with multiple etiology including viruses, bacteria and parasites. If certain diseases such as mycoplasmosis and pasteurellosis are very often studied or researched as well identified pathologies with an univocal exclusively bacterial etiology, in the field, we are unfortunately often in the presence of multiple etiologic syndrome and not well identified diseases from a clinical and post-mortem point of view. In West Africa, sero-epidemiological surveys have revealed the existence of the main viruses and bacteria involved in respiratory pathology. These are peste des petits ruminants, adenovirus, Blue Tongue, contagious ecthyma, goat and sheep pox, *para-influenza*-3, infectious *rhinotracheitis* of cattle. (IBR), pasteurellosis, *streptococci*, *staphylococci* and *mycoplasma* [7].

Most of the etiological knowledge accumulated on respiratory syndrome is reflected by serological surveys, sanitary and zootechnical monitoring carried out in Mauritania [6], in Mali [8], in Nigeria [9], in Senegal [10], in Cameroon [11] and in Chad [4].

1.1.1. Infectious agents (viruses and / or bacteria)

Regarding the infectious agents involved in respiratory pathologies in small ruminants, we must think about the peste des petits ruminants, the *mycoplasmosis-pasteurellosis* complex, *adenovirus*, the *para influenza* virus- 3 (PI-3) the virus of Infectious bovine rhinotracheitis (IBR) and pulmonary *adenomatosis*. Apart from these infectious agents, we must not lose sight of the parasitic agents, which are among others respiratory *strongylosis*, *dictyocaulosis* and *protostrongylidosis*, to name but a few.

Viral agents

Peste des petits ruminants (PPR)

Peste des petits ruminants (PPR) or enteric complex is an infectious, virulent, serious, highly contagious and rapidly progressive disease which affects small domestic and wild ruminants. It is caused by a virus from the Paramyxoviridae family and the *morbillivirus* genus. Given its social and economic impact, PPR is currently targeted by international organizations (OIE-FAO) for global eradication by 2030. This virus can also infect cattle, buffaloes, camels, pigs, antelopes and deer. Several wild ruminants have been infected most often experimentally, but goats and sheep are the usual targets in natural infection. PPR virus is related to rinderpest virus, distemper in dogs and wild carnivores and the *morbillivirus* in aquatic animals, which is sometimes the cause of confusion between peste des petits ruminants and rinderpest caused by the bovipestic virus. After 3 to 10 days of incubation, the animals are physically slaughtered, their body temperature is elevated [12; 13; 14; 15].

Blue Tongue

Blue Tongue is a viral disease of ruminants, caused by a virus of the Reoviridae family transmitted by arthropods (*culicoides*), resulting in edemas, hemorrhages and especially a blue tongue characteristic of the disease hence the name Blue Tongue in English. The disease is important in sheep and deer with high morbidity and mortality. It is inconsistent in goats, cattle, wild ruminants. Blue tongue does not affect humans [16]. Blue Tongue is one of the first diseases to be

shown to have viral origin at the start of the 20th century in South Africa [17]. Death often occurs usually as a result of pneumonia following false swallowing.

Sheep pox

Sheep pox is a highly contagious, virulent infectious disease specific to sheep caused by a virus of the poxviridae family. This disease is characterized by a high fever and the appearance of pustules on the skin and mucous membranes. Inflammatory nodular lesions are also seen in the first airways and lung parenchyma, and sometimes in the abomasum. Known since ancient times, it is the deadliest animal smallpox, described in detail [18].

Goat pox

Goat pox is a highly contagious viral disease of small ruminants. Characteristic symptoms are generalized skin lesions. The infectious agent is a virus of the poxviridae family and of the genus *Capripoxvirus*. It is very tough and can survive for up to six months in dried scabs. The disease is usually spread by direct contact between animals. The infectious agent is found in the nasal and eye secretions through which it is eliminated. Nodules and scabs also contain large amounts of virus particles.

Some authors such as Davies [19], Davies and Otema [20], Kitching et al. [21], Hadjer et al. [22] state that goat pox affects all small ruminants, while others believe that goat pox is strictly specific to goats [23; 24; 25; 26]. However, no absolute specificity of a strain isolated in Chad could be observed experimentally, as had been observed in studies of the outbreaks [26; 27].

Lentivirus

The lentivirus called *Maedi-Visna* virus causes respiratory infection and naturally affects only sheep. *Maedi-Visna* virus was discovered by Icelanders in the early 1950s although symptoms of the disease had previously been described in South Africa, the United States and France. The Icelandic term "visna" means wasting encountered in the nervous form and the term "maedi" means "dyspnea and breathing difficulties" associated with the respiratory form [28].

Achour [29] describes *Maedi* as a chronic and progressive interstitial pneumonia that causes in animals and deteriorates their general condition and to lose weight, although the appetite is preserved. It mainly occurs during the lambing and lactation periods in females over 3 years old. Sick animals are reluctant to move and stay away from the herd. Polypnea quickly sets in and turns into dyspnea after exertion. In most cases, animals die within 5 to 8 months in an advanced state of cachexia [29].

Para influenza type 3

Para influenza virus type 3 (PI-3) is an enveloped RNA virus that frequently infects sheep in many countries around the world. The virus is spread from animal to animal through aerosols. Symptoms include a runny nose, cough, polypnea, decreased appetite, listlessness, and fever. The main microscopic features of the infection are bronchiolitis and interstitial pneumonia. Another hallmark of this infection is the presence of acidophilic cytoplasmic inclusions in the epithelial cells of the bronchioles and alveoli approximately 6 days after infection.

Infectious bovine rhinotracheitis (IBR)

Infectious Bovine Rhinotracheitis (IBR) is a disease found everywhere and is caused by bovine *herpes virus* type 1 (BHV-1). It is an infectious disease affecting mainly cattle, which results in damage to the upper respiratory tract, but can eventually take the form of encephalitis in calves, conjunctivitis, abortions and metritis. IBR is not transmissible to human. The most commonly observed form is the respiratory form. It appears 2 to 4 days after the animal is infected. The main signs are a high fever (> 40 °), depression and a serous then mucopurulent nasal discharge. Ulcerations of the nasal mucosa and secondary bacterial infections may develop. In the absence of complications, the disappearance of clinical signs usually occurs 15 days after infection [30].

Tumors

A tumor or neoplasm is a newly formed mass of tissue, resulting from the excessive and uncontrolled multiplication of cells. A tumor can develop in a benign or malignant manner from a clinical and pathological point of view. The agents involved are numerous, including chemical substances, physical agents and biological agents. Primary and secondary lung tumors are very rare in small ruminants. The main tumor described in small ruminants is pulmonary *adenomatosis*.

Adenomatosis

Ovine pulmonary *adenomatosis*, also known as ovine pulmonary *adenocarcinoma*, *Jaagsiekte* (in Afrikaans) meaning shortness of breath disease, is a contagious tumor of the lungs of sheep and to a lesser extent of goats. It is the most common lung tumor in sheep. It is reported in many countries around the world. Australia and New Zealand are free from it, and it has been eradicated from Iceland [31]. A beta retrovirus called *Jaagsieke* sheep *Retrovirus* is the causative agent of this tumor. Alveolar epithelial cells (type 2 pneumocytes) and Clara cells in the bronchi are the target cells infected with this virus.

1.1.2. Bacterial agents

In the second pathological entity, bacteria (Pasteurelles and *mycoplasma*), are considered to be the essential etiological agents apart from any primary viral disease [32; 33; 34].

Pasteurellosis

During acute septicemia, acute pneumonia in adults very often results in dyspnea, sometimes hemorrhagic discharge. These terms *pasteurellosis* denote any primary or secondary infection by a bacterium belonging to species attached to the genus *Pasteurella*. These are geographically widespread infections with very broad host specificity. About 20 species are currently recognized. In adult sheep and goats, respiratory *pasteurellosis* or *enzootic pneumonia* caused by *Pasteurella haemolytica* is known in lambs and kids, *pasteurellosis* caused by P. *haemolytica* and P. *trehalosi* develops as sepsis or generalized fatal. A few rare times *Pasteurella multocida* has been implicated. When animals are affected, sometimes the sudden death of all the young herds is the premonitory sign that catches the clinician's attention and it is hemorrhagic *septicemia*. The lungs are dotted with hemorrhagic, heavy and edematous foci, characterizing the stage of red hepatization. The acute forms are characterized by fever, accelerated breathing, even dyspnea accompanied by throwing and lacrimation. In these forms, the lungs are red - blackish, necrotic in places. The more slowly evolving forms give rise to areas of gray pneumonia and atelectasis, clearly visible on autopsy. Lefevre [5], reports that Doutre and Perreau [33] demonstrated that in Senegal healthy sheep were normally carriers, in the sinuses, of *Pasteurella haemolytica* or *Pasteurella multocida*, germs which invade the lungs following a reduction in defenses, local areas of the animal (trachea, bronchi) due to viral infection. This explains the secondary nature of bacterial and *mycoplasma* infections leading to pneumonia.

Salmonellosis

Bacteria of the genus *Salmonella* cause infectious diseases affecting human and many animal species. *Salmonella* infections are mainly manifested by septicemia, pneumonia, enteritis or abortions. The genus *Salmonella*, family of Enterobacteriaceae, currently comprises five subspecies according to biochemical characters and more than 2000 serological types.

Contagious caprine pleuropneumonia

Contagious caprine pleuropneumonia is a contagious infectious disease affecting only goats and caused by *Mycoplasma capricolum subsp*. Capripneumoniae [35]. This disease is mainly found in Africa and Asia. In acute infection, morbidity is very high and herd mortality can reach 80%. Mainly respiratory symptoms are observed including cough with high fever. In an enzootic area, the clinical symptoms are not very specific. Pathological changes are localized in the thorax. Thus, lesions localized to the lungs and pleura are characteristic and often affect only one of the lungs. We can see pulmonary lobes entirely transformed into purulent abscess, a consequence of secondary bacterial infections, as well as adhesions between the lungs and the costal pleura [35]. In superacute cases, at necropsy, hepatization of the lung and a grainy cut surface may be observed; overt pleurisy with deposits of fibrin on the lung and a large amount of exudate in the chest cavity are typical signs of the disease. In acute and / or chronic cases, adhesions between the lung and the chest wall may be observed, as well as abscesses in the affected lung, which are due to secondary bacterial superinfections. The competition ELISA test makes it possible to detect specific antibodies and can also be used for the epidemiological monitoring of herds [35].

Contagious agalactia

Contagious agalactia of small ruminants is a syndrome grouping together breast, joint and eye damage, to which is sometimes added respiratory damage. Mycoplasma agalactia is the first agent historically described, but *Mycoplasma mycoïdes supp. mycoïdes* (large colony) and *Mycoplasma capricolum subsp.capricolum* are responsible for similar clinical signs. Under certain conditions, *Mycoplasma putrefaciens* can cause similar conditions [40]. The characteristic lesion observed in the lungs is bronchopneumonia when affected by *M. capricolum subsp. Capricolum*.

Caseous lymphadenitis

Caseous lymphadenitis in sheep and goats is characterized by the appearance of pyogranulomas mainly localized to lymph nodes and lungs. This chronic bacterial disease is difficult to distinguish from other causes of abscess in small ruminants. It is caused by a gram-positive *bacillus, Corynebacterium pseudotuberculosis*. Granulomatous lesions are formed by central necrosis.

Cowdriosis

Heartwater disease is a virulent infectious disease inoculable, non-contagious in the strict sense of the word. It affects ruminants (large and small), domestic and wild. It is caused by a rickettsia, *Ehrlichia ruminantium*, transmitted by ticks of the genus *Amblyomma*. The Sudano-Sahelian zone experienced the disease between 1970 and 1982, following successive periods of drought throughout Africa. Cowdriosis is the first known animal rickettsiosis. It is described for the first time on sheep and goats and incriminates the tick *Amblyomma hebraeum*. [36]. Sub-Saharan Africa and nearby islands are affected by heartwater. The symptoms consist of general impairment, nervous and digestive disorders associated with exudative pericarditis, very high morbidity and mortality. Muscle infiltration by macrophages is also observed, but exceptionally interstitial hemorrhages. The lung is normal or congested in acute cases, often distended with serous fluid. Sometimes very severe edema and emphysema would lead to death by asphyxiation. The smooth, shiny pleura may bleed. Sometimes petechiae and hemorrhages can be observed on the tracheal mucosa. The microscopic lesions are discrete and essentially consist of rickettsial clusters in the endothelial cells. Histological sections give much less consistent results than smears of tissue on slides [37].

Tuberculosis

Tuberculosis in small ruminants is caused by *Mycobacterium bovis* and more rarely by *M. avium or M. tuberculosis*. It is rare in these two species and has an exceptional character in sheep. Cattle with tuberculosis are the main source of *M. bovis*. The latter is transmitted from cattle to human in two main ways: through the air (aerosols) and through the digestive system (consumption of infected raw milk). People with *M. bovis* pulmonary tuberculosis become sources of infection in others. Symptoms and lesions are characteristic like those of tuberculosis in cattle with a predominance of pulmonary lesions with or without pleural, hepatic and peritoneal lesions. Depending on their appearance, we can distinguish localized and well-defined lesions, tubercles and extensive and poorly delimited lesions, tuberculous infiltrations and effusions. Tubers vary in appearance depending on their stage of development. First, they are pinhead-sized granulations, then they become larger with a center occupied by a yellowish-white substance, the caseum, then they become caseocalcary, then encysted and fibrous. The infiltrations are poorly delimited lesions of an exudative nature, extended to an entire territory or an organ (especially in the lungs). The effusions are observed in the serous cavities (pleurisy, pericarditis, peritonitis). The most representative basic microscopic lesion considered specific is the tuberculous follicle. This is formed by a homogeneous necrotic center called caseum, a first crown of epithelioid cells associated or not with multi-nucleated giant cells, Langhans cells and a second purely lymphocyte crown. The evolution of this lesion can occur in the direction of calcification of the caseum, with peripheral fibrosis. The influence of the age of the animals is evident, as the majority of cases come from animals weakened by successive gestations and lactations.

1.1.3. Parasitic agents

Strongylosis

Respiratory strongyloses are a group of parasitic diseases caused by the presence of *Strongylida* nematodes in the respiratory system of ruminants. These nematodes capable of causing this disease belong to three families: Syngamidae, Dictyocaulidae and Protostrongylidae [38].

Dictyocaulosis

Dictyocaulus filaria, the parasite responsible for this disease in small ruminants, belongs to the Dictyocaulidae family. Dictyocaulosis develops in two forms: chronic bronchial syndrome and acute pulmonary syndrome [39].

Protostrongylidosis

Berrag [41] taken up by Dakkak [39] asserted that although having a very important economic impact, protostrongylidosis attract little attention from breeders and clinicians. Protostrongylidosis in small ruminants are caused by nematodes of the Protostrongylidae family. According to Chartier [38], this family includes many species of parasites of small ruminants, among which we can cite:

- *Protostrongylus rufescens*, a reddish worm 15 to 35 mm in length, which localizes in the bronchioles;

- *Mullerius capillaris*, a worm measuring 12 to 25 mm in length, which localizes in the pulmonary alveoli;
- *Cystocaulus ocreatus*, which measures 20 to 50 mm in length, and is localized in the fine bronchioles. These species are very widespread and are frequently found in small ruminants.

Respiratory signs caused by these parasites are dominated by dyspnea and chronic cough associated with profuse bilateral discharge. Lung lesions are very characteristic. They consist of foci of gray pneumonia and lumpy lesions [39].

Gray pneumonia lesions are foci of chronic bronchopneumonia observed on the diaphragmatic lobes. They appear as protruding patches 1 to 6 cm in diameter and 0.5 to 4 cm deep, grayish-white or grayish-yellow in color, and firm in consistency. From these lesions it is possible to extract *P. rufescens* and *C. ocreatus* and, occasionally, *M. capillaris*. Gray pneumonia lesions are foci of chronic bronchopneumonia observed on the diaphragmatic lobes. They appear as protruding patches 1 to 6 cm in diameter and 0.5 to 4 cm deep, grayish-white or grayish-yellow in color, and firm in consistency. From these lesions it is possible to extract *P. rufescens and C. ocreatus* and, occasionally, *M. capillaris.*

The nodules are 1 to 3 cm in diameter and have a "lead grain" appearance. These nodules are scattered throughout the lung parenchyma, but are particularly concentrated in the basilar regions. Examination of these nodules reveals the presence of *M. capillaris* and, much more rarely, *C. ocreatus*. According to Dakkak [39], there are three types of nodular lesions:

- Type A lesions that appear as red-purple dots, uncalcified, soft to the touch, measuring 1 to 3 mm in diameter and slightly protruding on the surface of the pleura where they resemble petechiae or bruises in the lung parenchyma. It is possible to extract 4th instar larvae.
- Type B lesions, which are nodules 1 to 3 mm in diameter, reddish to yellowish in color, protruding from the surface of the pleura and qualified as "pseudo-tuberculous nodules"; their coalescence leads to the formation of granulomas. The central part is often calcified, which makes them rough to the touch. These lesions usually contain a male or a female, sometimes a pair of *M. Capillaris*.
- Type C lesions appear as yellow-grayish, irregularly shaped, protruding spots that extend from the subpleural region to deep into the lung mass of the diaphragmatic lobes. From these lesions, it is possible to isolate adult worms (M. Capillaris and, more rarely, C. Ocreatus), eggs and first instar larvae.

Syngamidae

Mammomonogamus nasicola, a nematode of the Syngamidae family, is also the cause of respiratory strongylosis in small ruminants. It is localized in the airways of these animals and especially at the bronchial crossroads [38]. Symptoms appear in two different forms: a common form and a paroxysmal form. The common form results in typical chronic bronchitis with coughing, throwing, dyspnea and sometimes transient suffocation (*Dictyocaulus* infestation). These signs are usually very subtle in the case of *Mammomonogamus*.

during a massive infestation by *Mammomonogamus*, there is then a real asphyxiation of the animal, because the worms and the mucus obstruct the larynx-pharynx junction, and death occurs quickly within 1 or 2 hours in sheep;

During re-infestation of adult subjects with *Dictyocaulu*s. Lesions of the common form relate to the tracheobronchial tree in the case of *Mammomonogamus* and *Dictyocaulus*, and to the lungs in the case of *Protostrongylus*. In the first case, the worms are found in foamy, whitish mucus. There may be pulmonary emphysema. In the second case, there are raised foci of pneumonia on the organ in the form of nodules and gray or white patches. The location of these lesions varies depending on the parasite and the host.

Hydatidosis

Hydatidosis, hydatid disease, hydatid cyst disease, hydatid echinococcosis or larval echinococcosis is a disease caused by a carnivorous cestode called *Echinococcus granulosus* belonging to the family Téniidae. Mammals become infected by swallowing an echinococcal tapeworm egg with food. Dogs that feed on parasitized viscera at slaughterhouses and wild canids play a major role in contamination. The disease is transmitted to humans either through direct contact with dogs or through ingestion of poorly prepared parasitized meat. Symptoms in animals are usually very subtle. When they are noticeable, they depend on the location of the cysts. If the cysts are located in the lungs, the signs are those of chronic bronchopneumonia. Often, when there are complications, the damage to the affected organ turns into an abscess. On examination of the organ, one or more hard bumps, with a whitish outline, are seen more or less on the surface of the organ. If the vesicles are numerous, the affected organ takes on a multilobed appearance. If you puncture a cyst with the

tip of a knife, a fluid comes out under pressure. Examination of a little hydatid fluid under a microscope reveals the germinal elements (*acephalocysts*), proligerous capsules and scolices. [38].

1.1.4. Non-infectious factors

Several factors contribute to the outbreak of respiratory pathologies. Apart from viral, bacterial and parasitic infections, the farming system and ecological (climatic) factors also play their part in this respiratory pathology.

1.1.5. Ecological (climatic) factors

Observations made by Traoré [3] show that most of the pathological problems in kids are observed during the dry season. On the other hand, the breeding method and pasteurellosis completely dominate the pathological picture in the cold season.

Breeding method

In agreement with Traoré [3], pneumopathies and diseases with a pulmonary component alone constitute more than 50% of the causes of death in kids. These are followed by causes of death of non-infectious origin (18%). Multiple births (twins, triplets) are the contributing factors, since the causes of mortality are more frequently encountered

1.2. Diagnosis

Clinically, the diagnosis of pneumonia can be made from the clinical signs observed in animals. However, only the laboratory can confirm or deny the diagnosis.

Regarding laboratory diagnosis, we can seek to establish the infectious agents involved. For viral infectious agents, the germs are tested directly in the blood, lungs and swabs of nasal or oropharyngeal mucous membranes by the method of molecular biology (PCR). In the case of bacterial agents, after gram staining, bacteria are observed under a microscope. Apart from PCR, the serological test is also applied in the case of certain causative agents by using the ELISA test for example for PPR and mycoplasmosis. But the results of these serological tests are much more inconsistent.

2. Treatment and prophylaxis

The treatment of lung disease is with fairly broad spectrum antibiotics, which will help kill bacteria. In parallel with taking samples after autopsy for isolation of the germ in question and antibiogram, the very rapid implementation of antibiotic and anti-inflammatory treatment is essential to limit losses (mortality and morbidity). In addition to this, these treatments must be accompanied by a program of disinfection and decontamination of the premises. It may be necessary to check the ventilation of the premises in the case of intensive breeding.

Regarding medical prophylaxis, there are vaccines against peste des petits ruminants and contagious caprine pleuropneumonia, which are produced from attenuated strains that are completely harmless to animals. The prophylaxis methods can intervene at the level of infectious and non-infectious factors, vaccination is possible against PPR; on the other hand, against pasteurellosis, it seems doomed to failure because of the antigenic diversity encountered and the lack of knowledge of the immunological relationships between the different serotypes. With regard to non-infectious factors, an eco-pathological investigation is necessary to highlight the risk factors on which preventive action is possible. There are also vaccines against sheep and goat pox, which are produced from inactivated germs (inactivated vaccines).

3. Conclusion

In the agro-pastoral system, pneumonia is the cause of death in small ruminants during the dry-cold and rainy season. They are due to several infectious, parasitic and non-infectious factors.

The first entity of respiratory pathology is often due to the primary action of viruses (peste des petits ruminants, whether or not associated with other viruses such as Para influenza-3 and adenoviruses), which can be complicated by secondary bacterial infections.

Whatever its origin, the clinical manifestations of the respiratory pathology observed in small ruminants are fever accompanied by congestion of the mucous membranes, weight loss, decreased appetite, dyspnea, respiratory

difficulties, dyspnea and decreased production for adult females. We can observe coughing, sneezing, throwing in these animals. Symptoms can be very subtle, especially in young animals.

The application of sanitary measures combined with treatment with antibiotics as well as with mass vaccination campaigns against infectious agents can contribute to the reduction of death rates in small ruminants.

Compliance with ethical standards

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Disclosure of conflict of interest

By this we declare that there is not conflict of interest.

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