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Classification
of
Lung Lesions

William S. Monlux, D.V.M., Ph.D.

The classification of lung lesions according to location is a system that enables one to diagnose lung diseases on gross examination. In most instances it also indicates the probable etiology. The schematic sketches included in this paper show the basic alterations that occur in the lung.

Because of the difficulties associated with the depicting of the changes that occur in the lung as the result of hyperemia and edema, these are not included in the drawings. These two changes are, however, quite easily recognized. The lungs are larger than normal and are not hepatized. The pulmonary vessels are engorged with blood and the lung has a cyanotic color. When the lung is incised, blood flows from the cut surface. White foam is present in the trachea and bronchi. Samples of tissue removed from the lung will float when placed in water.

Hyperemia and edema of the lung may be unilateral or bilateral. Unilateral lesions are usually the result of the influence of gravity on the circulatory system in animals that are recumbent and remain on one side for a long period of time, or in those individuals whose cardiac output is not sufficient to maintain a blood pressure that will overcome the influence of gravity. As a result, blood accumulates in the ventral lung. The condition is usually termed hypostatic congestion.

Hypostatic congestion must be differentiated from postmortem congestion. Postmortem congestion occurs when the blood, under the influence of gravity, accumulates in the lung that is ventral in the dead animal. Postmortem congestion is distinguished from hypostatic congestion by the absence of foam in the trachea and bronchi. Air must be passing through the pulmonary passages and be mixing with the edematous fluid if foam is to be produced. Since respiratory excursions are not occurring in the dead individual, no foam will be present in postmortem congestion.

Bilateral edema and congestion of the lung occurs when the influence of gravity is equal in both lungs. It is associated with cardiac failure, hypoproteinemia, exhaustion, the vascular alterations associated with shock, and the first stage of bronchopneumonia.
Drawing A shows the distribution of the lesion in broncho-pneumonia. It is located in the anteroventral portion or the dependent portion of the lung when the animal stands and moves in a normal position. Because of the influence of gravity on the blood vascular system, passive hyperemia occurs in this portion of the lung if any impairment of circulation is present. Since there is difficulty in maintaining normal blood circulation in the ventral portion of the lung in pulmonary and cardiac diseases, it is in this portion of the lung that pneumonia is most apt to occur because the body defense mechanism is impaired by the passive hyperemia that is present. Lesions in the anteroventral portion of the lung will be found in the pneumonia associated with shipping fever, canine distemper, viral pneumo-enteritis of calves, chronic heart disease, and debilitating diseases in which there is passive hyperemia and edema.

Drawing B reveals the typical lung lesions of hog cholera. A broncho-pneumonia is seen in the anteroventral portion of the lung. In addition, one or more red infarcts may be found in the dorsal portion of the diaphragmatic lobe of the lung. The base of the infarct will protrude above the dorsal border of the lung.

Drawing C depicts the type of lung lesion seen in the pneumonia associated with pleuro-pneumonia-like organisms in swine. The lesion suggests that an inhalation type of bronchitis and pneumonia is present. The infectious material coming down the trachea passes into the bronchi and then, under the influence of gravity, settles into the ventral portions of the lung immediately under the tracheal bifurcation. As a result, the pneumonia involves the entire cardiac lobe, the anteroventral portion of the diaphragmatic lobe, and the posteroventral portion of the apical lobe. Patchy areas of pneumonia may be found in the ventral portion of the lung anterior and posterior to the location described in the preceding sentence if considerable bronchitis is present. The disease spreads through the lung by bronchial extension.

Drawing D represents the lung alteration occurring as the result of pulmonary embolism when the embolus is large. The centripetal force of the blood carries the large embolus into the diaphragmatic lobe of the lung because the blood flow into this lobe is greatest. The embolus will be found in the pulmonary artery approximately at the junction of the posterior and middle thirds of the diaphragmatic lobe. The portion of the lung supplied by the artery is slightly reduced in volume, and the surface shows a slight depression as compared to the surrounding tissue. Infarction of the area does not occur unless the embolus is septic or pneumonia is present.

Drawing E shows a torsion of the right cardiac lobe of the lung of a dog. This lesion is often diagnosed as pneumonia instead of a torsion because the rotation of the lobe is overlooked.

Drawing F reveals the location of the lesions when the pulmonary emboli, such as bacteria or tumor cells, are small. Because of their small size, the centripetal force of the blood is not exerted and the
emboli are distributed throughout the lung.

Drawing G shows the location of the lesions in gangrenous pneumonia as the result of inhalation or medication. The material that pours into the lung enters the ventral portions of the lung below the entrance of the bronchi. As a result, the necrotic areas will be found in the entire cardiac lobe, the anteroventral portion of the diaphragmatic lobe, and the posteroventral portion of the apical lobe.

Drawing H indicates the location of the suppurative or gangrenous pneumonia that results when foreign bodies originating in the reticulum pass through the diaphragm and penetrate the lung.

Drawing I locates the site of the suppurative or gangrenous pneumonia when large septic emboli are carried into the lung by the blood stream.

Drawing J indicates the complication that may result when large septic emboli as shown in drawing I are present in the lung. The exudate from the suppurative or gangrenous lesions in the diaphragmatic lobe enters the bronchi and under the influence of gravity it settles into the ventral portions of the lung producing secondary suppurative or gangrenous lesions.

Drawing K illustrates the type of lesion seen in typical pasteurella pneumonia or in contagious pleuro-pneumonia in horses and cattle. The basic lesion is a broncho-pneumonia as is shown in drawing A. In addition, throughout the area there are multiple foci of necrosis as the result of vascular damage and infarction in the area. If saprophytic organisms are present, gangrene may be the result in these necrotic areas.

Drawing L is an enlargement of a portion of a lung showing the alterations that occur in pasteurella pneumonia or contagious pleuro-pneumonia of cattle and horses. Note the wide interlobular septa and pleura as the result of the exudate that has accumulated in these structures. Distended lymphatics can be seen in both the pleura and the septa. The surface of the lung is covered with a layer of fibrin.

Drawing M shows the type of alterations observed in the lung infected with lungworms of the *Dietycaulbus* and *Metastrongylus* species. The parasites are located in the bronchi of the dorsoposterior portion of the diaphragmatic lobe. Because of bronchial obstruction, bronchitis, and pneumonia, V-shaped areas of alveolar emphysema intermixed with areas of atelectasis and penumonia are present.

Drawing N is a sketch of the posterior border of the diaphragmatic lobe showing the enlargement of the edge of the lung as the result of the alveolar pulmonary emphysema that occurs when lungworms are present as indicated in drawing M.

Drawing O illustrates the location of the lesions in the lungs of animals infected with *Muellerius* and *Aelurostrongylus* species of lungworms. These parasites are found in the pulmonary alveoli and the blood vessels of the lung. They are present throughout the lung but are most numerous in the diaphragmatic lobe.

Drawing P locates the site of the primary lesion of tuberculosis in the lung of the bovine, canine, and feline. It is
found in the mid-dorsal portion of the diaphragmatic lobe.

Drawing Q shows the alterations that occur in pulmonary adenomatosis in cattle, sheep, and horses. The lung is larger than normal, meaty in consistency, and shows extensive areas of both alveolar and pulmonary emphysema. Multiple areas resembling foci of hepatization are scattered throughout the lung. Frequently, a complicating broncho-pneumonia is present in the anteroventral portion of the lung.

Drawing R represents the pulmonary atelectasis that occurs in the ventral portion of the lung when hydrothorax is present. The line between the atelectic and the normal lung is straight and horizontal in the apical lobe but is curved in the diaphragmatic lobe. This curve in the diaphragmatic lobe occurs when considerable fluid is present in the pleural cavity, and because of the buoyancy of the lung, the pulmonary tissue is compressed in a dorsal direction. When the pleural fluid escapes at the time the thoracic cavity is opened at necropsy examination, the pressure on the lung is removed and the lung returns to its normal position.

When the lung is observed at this time, the line between the atelectic and normal lung tissue will curve in a ventral direction.

Drawing S shows a cross section of the atelectic lung described in drawing R.

Drawing T illustrates another alteration of the lung seen in hydrothorax. As the lung floats on the pleural fluid, the dorsal compression of the lung is so great that a crimping of the ventral border of the diaphragmatic lobe occurs. When the fluid pressure is released at necropsy examination, the lung returns to its normal position and the site of the crimp is indicated by a narrow area of atelectasis that extends into the diaphragmatic lobe in a dorsoanterior direction.

BIOLOGICAL WARFARE AND ITS DEFENSE. Some possibilities of biological warfare were discussed. It could be directed against human beings or against food crops or livestock. Dissemination among the human population could be accomplished by sabotaging the food or water, by spreading the infective agents in the air itself with a bomb or aerosol unit, or by contaminating the air of entire buildings via the air-conditioning units.

Possible biological agents that might be put in the food or water are the toxins of Clostridium botulinum and various pathogenic organisms. Diseases that might be spread in the air include: anthrax (by spores), Q-fever, tularemia, brucellosis, glanders, coccidioidomycosis, histoplasmosis, and epidemic typhus.

Protection from air-borne agents could be very effectively accomplished with gas masks or by proper shelters. Sunshine kills many organisms. Food and water should be boiled before use to kill microorganisms and destroy toxins. Vaccination against and treatment of diseases are responsibilities of the medical profession in the event of biological warfare.