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BY

WILLIAM OSLER, M. D., M. R. C. P., Lond.,

*Professor of the Institutes of Medicine, McGill University; Physician and Pathologist
to the General Hospital, Montreal.*

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VERMINOUS BRONCHITIS IN DOGS.*

By WILLIAM OSLER, M.D., L.R.C.P. Lond.; Fellow of the Royal Microscopical Society, London; Vice-President of the Montreal Veterinary Medical Association; Professor of Physiology in McGill University, and in the Veterinary College, Montreal.

EARLY in the month of January I was asked by Principal McEachran, F.R.C.V.S., to aid him in the investigation of a disease which had broken out among the pups at the kennels of the Montreal Hunt Club, and which was believed to be of a pneumonic nature. On proceeding to the place we found that the affection was confined almost exclusively to animals under eight months old, and that it had already proved fatal in several instances. At the time of the visit only one pup was ill, presenting symptoms of diminished air space in the chest. In order to ascertain the exact condition of the lungs, one of the pups, which had died a day or two previously, and had meanwhile frozen stiff, was ordered to be sent to the veterinary college for dissection. On the following day it was found at the autopsy that in addition to the pneumonia there were numerous small parasite worms in the trachea and bronchial tubes. Knowing how subject many of the lower animals are to bronchial strongyles, I did not think it very remarkable that they should occur in the dog. On referring, however, to Dr. Cobbold's list of entozoa infesting the dog, I was surprised not to find a bronchial strongyle mentioned, and a further search through the standard works on veterinary medicine and helminthology proving fruitless, I then wrote to the editors of the *Veterinarian* asking for information on the subject. They very kindly replied in a short editorial note in the March number, stating "that" so far as their knowledge extends "no such cases have been placed formally on record," but Dr. Cobbold tells them "that one such instance has been verbally brought under his notice, though not in such a way as to be thoroughly convincing."

* Read before the Montreal Veterinary Medical Association, March 29th.

I shall proceed now to speak of the symptoms and pathology of the disease, then give a description of the parasite itself, and make a few general remarks.

Symptoms.—Only five of the diseased animals were seen during life, and that rather irregularly, on account of the distance of the kennels from the city. However, I have obtained some important details from the keeper, and a case which was brought to the infirmary and kept for some time was made the subject of clinical study.

Among the initial symptoms disinclination for food and exercise, together with an unsteadiness of gait, amounting in some of the cases to a subparalytic condition of the hinder extremities, were the most evident. In fully half of the cases convulsions occurred. There was rarely diarrhœa or any other symptom referable to gastro-intestinal disorder. Cough was not a prominent symptom, being absent in many of the cases. When present, it was short and husky, "not," as the keeper said, "the regular distemper cough." In the case brought to the infirmary the cough was well marked, and was dry and short. The pulse and respirations were increased, and the temperature elevated. Towards the close all food was refused, and even when fed the soup given was commonly vomited. Death took place in most instances quietly, though sometimes during a convulsion, and the keeper noticed that the pups which lasted the longest had the most fits. The duration of the disease ranged from three days to a week, or even ten days. The whole epidemic lasted about seven weeks.

Altogether fifteen couples were attacked, all of which, with the exception of three couples of old dogs, were under eight months old. Of the old dogs three had the disease badly, but only one died. Of the total number affected four and a half couples recovered, so that twenty-one animals were lost. The dogs which recovered are now in their usual health, though not in such good condition as they were before.

With regard to the hygienic surroundings of the animals it may be stated that, at present, the kennels are in an old house which stands by itself on the government property known as Logan's farm, at the east end of the city. It is isolated, being at some distance from any other building, and is situated on an elevated ridge overlooking the Quebec suburbs.

The disease showed itself during a remarkably cold spell; indeed, for the first three weeks of the epidemic, the thermometer was almost constantly below zero. It was first observed in two

or three pups of four couples which were kept by themselves in a separate room, 14 ft. by 8; the floor being covered with straw, which was changed every week. There was a cupboard in the room, and in this the pups slept. This room was on the exposed side of the house, and, according to the keeper, was always very cold. The rest of the animals were kept in tolerably roomy quarters, though at night, with the doors closed, I do not think the ventilation would be sufficient. During the day they had free access to a large yard. The food consisted of porridge and cooked horseflesh, which were given either separately or boiled together. They got nothing else. The oatmeal was of good quality, nor did I find in portions of the food removed from the feeding pans anything which afforded the slightest clue to the origin of the disease.

Pathology.—*Post-mortem* examinations were made in eight cases. The following notes were dictated at the time.

CASE 1.—Autopsy eighteen hours after death. Body that of a well-nourished, half-grown, fox-hound bitch. On opening the thorax the lungs only partially collapse; the lower borders of the lobes are firm to the touch and dark in colour. The vessels in the lower mediastinum look full, and the tissues in that region are blood-stained. Pericardium natural; heart appears of normal size; right auricle filled with dark grumous clots, which extend into the vessels and are here decolourised. Right ventricle distended with dark, semi-coagulated blood; the conus arteriosus is filled with a perfectly decolourised clot, which passes into the pulmonary artery to the third and fourth divisions. The left auricle contains a small coagulum. The left ventricle contains no blood, but the whole cavity is occupied by a firm milk-white thrombus, which is connected through the mitral valve with the one in the auricle, while a prolongation from it extends into the aorta.

Lungs.—After normal, on inverting them, a quantity of dirty brown frothy fluid escapes through the larynx.

The anterior and middle lobes and the anterior half of the posterior lobe of the right lung are solidified, being of a dark reddish-brown colour, and contrasting strongly with the unaffected parts. The pleural surfaces are smooth, and there is no exudation. On section the lung tissue is of a dark red colour, the surface of the section finely granular, and bathed with a quantity of reddish-brown serum. On close inspection it is seen that the air cells are uniformly filled a solid exudation; attempts

at inflation of the affected portions with are unsuccessful. Portions excised sink at once when placed in water. In the left lung the apex of the anterior lobe, the whole of the middle, and the root of one of the posterior lobes, are in the same condition. The portions of the organs not diseased are of a rosy red externally, and on section contain much blood and frothy serum. Between the healthy and diseased parts there is a zone of intense hyperæmia.

Trachea.—On slitting up the windpipe the mucous membrane is found covered with a dark frothy mucus. The membrane looks pale and natural to within an inch of the bifurcation, but at this point it becomes reddened, and uneven from the projection of irregular little masses of a greyish-yellow colour, which on close inspection are found to be localised swellings of the membrane, containing small parasitic worms, the white bodies of which can be seen lying upon and partially imbedded in these elevations. They are most abundant just at the bifurcation, at the lower part of which several have emerged, forming an elevation three or four lines in height. About the orifices of the second divisions these little masses are also seen, and the whole mucous membrane of this region is deeply congested, and somewhat swollen. Very few of the worms are found lying free on the mucous membrane; almost all of them are attached to the masses or buried in them. The smaller tubes, especially those leading to the diseased portions of the lungs, are filled with a dirty brown fluid, and on squeezing any portion of the organ quantities of it can be expelled.

The *bronchial glands* are swollen and enlarged.

The *spleen* appears healthy.

The *left kidney* contains a large amount of blood; otherwise looks natural. Nothing unusual in the right one.

The *stomach* contains a few ounces of dark brown fluid; mucous membrane is pale. Large veins full.

The *duodenum* contains a bile-stained mucus, and on pressing the gall-bladder, bile flows from the papilla biliaria.

Jejunum and *ileum* contain a dirty black material adhering to the mucous membrane.

One *tænia elliptica* and one *ascaris marginata* are found in the jejunum.

Large bowel healthy.

Liver firm, dark red in colour, lobules indistinct, hepatic veins full, gall-bladder contains a small amount of bile. There is a clot in the portal vein.

Brain.—Nothing abnormal about the membranes. Substance of good consistence and apparently healthy.

In the following cases I have condensed the original account.

CASE 2.—A five months' old dog pup, which had been ill a week.

Extensive pneumonic consolidation of the lungs, involving the lower part of the anterior lobe, and scattered patches in the middle lobe on the left side, and half the posterior lobe on the right. On section the solidified parts presented the appearance already described in the preceding case, and the unaffected portions are in a state of engorgement. On slitting up the trachea and bronchial tubes much frothy blood-tinged serum escaped, but no trace of any parasites can be found either in the tubes or parenchyma of the lungs. No ova or young parasites can be found in the blood of the cavities of the heart or of the pulmonary artery.

Abdominal viscera appear healthy, though, owing to the obstruction in the lesser circulation, the blood-vessels are engorged. A few ascarides in the intestine, and one small *tænia elliptica*.

CASE 3.—Dog pup, six months old.

In the left lung there are scattered patches of pneumonia in the anterior lobe, one or two are in the middle lobe, and half a dozen, the size of marbles, closely set together in the upper part of posterior lobe. In the right lung the anterior lobe is solid in an area 3" by 1", extending along the lower free border, and through the whole thickness. Small patches occur here and there over the other lobes. In this instance the inflamed spots are smaller, and not so extensive as in the other cases. On slitting up the trachea the mucous membrane looks healthy to within 2" of the bifurcation, when it becomes swollen, dark red in colour, and thickly scattered over with the elevated granular masses noticed in the first case, attached to and in which numerous small white worms can be seen. A stream of water of considerable force does not wash them away, but shows that each little elevation consists of a nest of the parasites. They extend to the tubes of the second order, and are specially abundant at the bifurcation itself, and about the orifices of the first tubes given off from the main bronchi. The small tubes are filled up with a frothy serum. Two of the worms are found far in the mucus.

Stomach and intestines appear healthy, except the lower portion of the ileum, which is congested.

In this region ten specimens of *dochmius trigonocephalus* occur, and further up in the bowel eight ascarides.

CASE 4.—A six months' old dog pup brought to the infirmary and died the next day.

In the left lung the anterior and middle lobes and the lower free border of the posterior lobe are solidified.

In the right lung the lower three fourths of the anterior and middle lobes, and the lower fourth of the posterior lobe, are in the same condition. Pleural surfaces involved. The posterior half of the windpipe contains upon the mucous membrane of its lower wall about a dozen small red patches, which extend in the axis of the tube; some appearing like linear streaks due to the injection of a few vessels. In all of them the presence of parasites can be determined, though in some of the smaller only one is found. They become more numerous about the bifurcation and in the main bronchi, occupying chiefly the lower wall. The masses are isolated and the mucous membrane between them intensely injected. None are found in the second divisions of the tubes.

Abdominal organs contain a good deal of blood. Mucous membrane of stomach and intestines look healthy. The large bowel contains a quantity of consistent fæces. Six ascarides in the duodenum; six specimens of *dochmius trigonocephalus* in the jejunum, and ten specimens of *tricocephalus affinis* in the cæcum.

Blood of heart and veins examined; nothing abnormal found.

CASE 5.—Seven months' old bitch pup. Considerable emaciation. Scattered areas of pneumonia throughout both lungs; not quite so extensive as in Case 4, but presenting similar characters. From an inch in front of the bifurcation of the trachea to the bronchi of the second order, the whole mucous membrane is transformed into an irregular greyish-yellow granular structure, upon which the bodies of numerous white worms can be plainly seen. Two sizes may be distinguished, one longer and of a more opaque white, which subsequent examination showed to be the female, the other shorter, thinner, and paler. In this case, even about the orifices of the third division of the bronchi, a few nests of the parasite can be seen. In the mucus from the smaller tubes a few of the adult worms occur, and on spreading it out on glass slips, and examining with a low power, a few ova and free embryos are seen.

Blood of heart and veins contain no parasites.

Nothing abnormal in the stomach or intestines, a large specimen of *tænia elliptica* in the latter, also a few ascarides.

CASE 6.—A thin, badly nourished dog pup, six months old.

Lungs present numerous patches of consolidation, involving on the right side the lower half of the anterior lobe, and a large piece of the posterior lobe. On the left side the free borders of the anterior and middle lobes for almost two inches from the margin, and a broad strip along the upper part of the posterior lobe.

Trachea and bronchi healthy; mucous membrane of the tubes in the affected parts congested, but no parasites in the membrane or in the lung tissue.

Stomach and intestines appear natural; a few ascarides in the latter. Nothing abnormal found in the blood.

CASE 7.—Dog pup, seven months old. The autopsy, which was made at the same time as the previous case, reveals a similar condition of the lungs, and an entire absence of any parasites either in the tubes or in the parenchyma of the lungs. Nothing unusual in the abdominal organs. The *tænia elliptica* and five or six ascarides in the jejunum.

CASE 8.—A fine, well-grown dog pup, eight months old. Had been ill a week.

Lungs contain pneumonic areas of considerable extent; in the right involving the entire apex with the dependent border, and a small portion of the posterior lobe near the diaphragm. In the left lung almost the whole of the middle lobe, and the root of the posterior, are specially affected.

On opening the windpipe the discrete elevations above described upon the mucous membrane about the bifurcation are very distinct, and the worms can be seen in them. The appearance is very like that met with in Case 4, and the description need not be repeated. No parasites in the intestines. Nothing abnormal found in the blood.

The general and specific characters of the worm may be defined as follows:

Strongylus canis bronchialis.—A slender nematode helminth, body filiform, the female measuring about one fourth of an inch in length, the male smaller, measuring one sixth to one eighth of an inch; head conical, mouth simple, unprovided with papillæ; tail of female obtuse, anal and generative orifices terminal, opening by a cloaca; ovarian tube containing one row of eggs, which, in the mature species, have developed into slender-coiled embryos; tail of the male somewhat pointed; penis consists of a double spiculum of a yellowish-brown colour; mode of reproduction viviparous.

Only occasionally, as stated above, were the worms found lying

free upon the bronchial membrane; as a rule they lay imbedded in a localised granular swelling of the mucosa, from which portions



FIG. 1.—Head of male worm.



FIG. 2.—Tail of female worm, showing the young embryos.

of them protruded. They could readily be pulled out with a pair of fine forceps, but a stream of water did not wash them away. In several of the cases examined (more especially Case 4) the whole mucous membrane of the affected part appeared rough and irregular, as if ulcerated, and innumerable parasites lay upon and in it. The mature females could easily be distinguished, not only by their larger size, but by the opaque whiteness of their bodies. The majority of the female worms examined were immature, and did not contain developed ova. The males were not nearly so numerous as the females. Forms intermediate between the adult worms and the young embryos (some of which, as already mentioned, existed free in the mucus) were not met with.

The occurrence in the bronchial tubes of the lower animals of nematoid worms belonging to the genus *strongylus* is by no means uncommon. Owing to the irritation caused by their development in the mucous membrane an inflammation of the tubes is produced, hence the affection is known by the names of parasitic or verminous bronchitis, popularly called "husk" or "hoose." It is not altogether unknown in man, but very few instances are on record. Infesting the domestic animals there are three well-recognised species of *strongylus*: the *S. filaria* of the sheep and goats; *S. paradoxus* of the pig, and *S. micrurus* of the calf, more rarely of the horse and ass. In calves and lambs parasitic bronchitis often constitutes a serious and fatal epidemic, so much so that in the latter it goes by the name of *the lamb disease*. So far as I know, no epidemic of the kind has been noticed in Canada. The species I have here described differs in several particulars from either of the above mentioned, and is most probably new to science.

The origin of the epidemic must, I am afraid, like that of so many other diseases, remain obscure. We have absolutely nothing to aid us in forming an opinion on the subject. There had been no change in the locality nor in the food. The straw upon which the dogs slept was of the ordinary kind, and the usual attention had been paid to changing it and also to the general sanitary condition of the place. The disease broke out, too, during a spell of very severe weather, when the food left in the pans froze quickly. The course of the epidemic was short, lasting between six and seven weeks, a sufficient time, however, to destroy almost all the pups in the kennels.

The mode of invasion in parasitic disease of the bronchial tubes has been, and still is, a matter of much dispute, some observers maintaining that "the ova and young parasites taken up with the food, in the first place gain access from the alimentary canal to the circulation;" others hold the view that they pass directly from the mouth to the trachea, or that the ova are inhaled by the breath. The former view is the one most generally entertained, and it is urged in its favour that the presence of the worms has been determined in the cavities of the heart and in the blood-vessels, as well as in the intestines. Now, in the epidemic under consideration I think this view does not meet the case. Supposing the young embryos to have been ingested and to have gained access to the branches of the portal vein, they would then be carried to the right side of the heart, and from thence to the lungs, by the pulmonary artery, the capillaries of which ramify in the lung substance alone, a situation in which the parasites did not occur. To get to the bronchial mucous membrane they must be returned by the pulmonary veins to the left side of the heart, enter the aorta, and pass out by the small bronchial arteries which supply the tubes—an exceedingly round-about and somewhat improbable route. It is to be remembered that young strongyles have been found capable, like many other nematoid worms, of reviving on the application of moisture after a dessication of a month or more, and even after immersion in spirits of wine, and solutions of corrosive sublimate and alum (Williams), so that their chance of survival under adverse circumstances is unusually good. It seems quite as reasonable to suppose that the dried embryos were inhaled with the breath, and, lighting in the mucous membrane, found suitable conditions for development. The position of the parasites about the bifurcation of the trachea, at the angles of division of the main bronchi, and most abundantly in the lower wall of the tubes, just the localities

where small particles would be most likely to lodge, favours an infection through the air rather than by the blood. The negative evidences in the heart and blood-vessels do not go for much either way, as the examination in all the cases was made after the invasion of the parasites, and consequently at a time when they could scarcely be found in the circulation.

It is a somewhat remarkable fact that verminous bronchitis prevailed to a much greater extent, and is more fatal in young animals than in adults. Thus lambs and calves are the chief victims in epidemics of "hoose," whereas it is only occasionally that adult animals succumb to the disease. In lambs the worms are usually found in the bronchial tubes, while in sheep they are more commonly encysted in the lung tissue itself, where they do not appear to cause much irritation. It seems to me that in the anatomical peculiarities of the lungs in young animals we have an explanation of the fatality of the disease among them. If the bronchial tubes of a young animal be compared with those of an adult they are seen to be softer, much less rigid; the mucous membrane is lower, not so thin, nor so closely attached to the tissues beneath. Hence it happens that in inflammation of the tubes from any cause, swelling and tumefaction of the mucous membrane readily occur, and constitute elements of danger which are directly proportionate to the calibre of the tubes attacked. In the cases above reported the swelling of the membrane in the larger tubes was considerable, and, though not sufficient to prevent the access of air, must have interfered greatly with the expulsion of mucus from the smaller tubes, not only by decreasing and narrowing the orifices of exit, but also by destroying, over an important area, the ciliary action so useful for this purpose. The same difference is met with in human practice. Ordinary acute bronchitis in the adult is not at all a dangerous affection, while in young children it is the reverse; and for the very reason that in them the bronchial mucous membrane swells easily, and there is not the same expulsive power to enable them to get rid of the mucus which, in consequence, accumulates, and may cause collapse or inflammation of the lung tissue. In the "lamb disease" death occurs from asphyxia, caused by the collection of mucus in the tubes. I have no records at hand of the state of the lung tissue in these cases, whether it is in a condition of collapse or of inflammation; probably the latter, for I see the expression, verminous pneumonia," used by some authors.

With reference to the pneumonic condition of the lungs of the dogs in this epidemic, it will be remembered that in three of

the *post-mortem* examinations the inflammation of the lungs was found without the occurrence of parasites in the bronchial tubes; the pneumonia being quite as extensive as in the cases accompanied with strongyles. I must confess that this circumstance has puzzled me not a little, and I see no very satisfactory explanation of the fact. It appears natural to refer the diseased condition of the lung substance in the parasite cases to the accumulation of the mucus in the smaller tubes producing collapse of the air cells in certain areas, which subsequently became inflamed—a sequence of events sometimes observed in children. The appearance of the lungs in several of the cases corresponds with this view; for the pneumonia was lobular, affecting small and isolated portions of the lung tissue.
