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Comparative Tuberculosis

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EFFORTS directed against bovine tuberculosis have resulted in a reduction of specimens submitted for examination for tuberculosis. The infrequency of such specimens has made it harder to demonstrate to students fresh specimens of tuberculosis. Fresh specimens are always more interesting than preserved specimens, and it is desirable to have as many fresh specimens as possible.

The eradication of bovine tuberculosis has also made more interesting the rarer forms that occur in other species of lower animals. Specimens have been submitted to our school during the past year from a dog, parrot, goat, and sheep, all of which proved to be tuberculosis and were very interesting specimens.

The dog was presented for postmortem examination. It had a history of having been sick for the last few months. The owner of this dog had been a tuberculous patient for the last few years. The dog was a three year old female fox terrier. The chief feature at postmortem examination was one pint of purulent fluid found in the pleural cavity and a nodule the size of a pea found in the posterior lobe of the right lung. The nodule had a necrotic center and smears from this nodule showed many acid fast bacilli. A suspension was made from the lung nodule and this was injected into two guinea pigs and one rabbit. It was felt that this might be a human type infection. It is well known that human type infection is quite virulent for guinea pigs, but only slightly virulent, if at all, for rabbits. The bovine type is quite virulent for both guinea pigs and rabbits. The guinea pigs were injected subcutaneously, the usual method, while the rabbit was injected intraperitoneally. One guinea pig died in about two months and the other in about three months, both with generalized tuberculosis involving the liver, spleen, and lungs. The rabbit which was injected intraperitoneally was killed three months after injection and did not show any lesions of tuberculosis. This indicated a human type of infection.

**Parrot**

A parrot was brought to the Small Animal Clinic because of several swellings on the face and around the eyes. The parrot had been kept in a dark basement for some time, and it was during this time that the swellings developed. One of the nodules the size of a hazelnut was squeezed and yellowish white dry pus material was pressed out. Smears of this material showed many acid fast organisms, and a diagnosis of tuberculosis was made.

Ten days later the parrot was returned for further treatment. Destruction was advised and the parrot was chloroformed. At necropsy a swelling the size of a hazelnut was found on each side of the head below the eye and one the size of a marble between the right eye and the beak. A nodule the size of a small marble was found on the left thigh. Each swelling was well circumscribed and covered with skin. No alterations were found in the internal organs. The nodules contained cheesy material and smears showed many acid fast organisms.

**Inoculations**

An emulsion was made and injected into two guinea pigs and one chicken. One guinea pig died after a few days before lesions of tuberculosis could develop. The other guinea pig died with tubercular lesions in the inguinal lymph glands on the site of the injection and in the liver, spleen and lungs. Many acid fast organisms were found on the smears. The chicken reacted to mammalian tuberculin but not to avian tuberculin. It was killed.
and no lesions of tuberculosis could be found. It is believed that this was tuberculosis due to the human type.

The lungs from two goats were submitted to our laboratory for examination for tuberculosis. The left lung of one and the right lung of the other showed extensive consolidation with areas of cheesy and partly calcareous material. Some parts of the lungs showed encapsulated areas up to the size of a peach filled with thick grayish white pus. The bronchial lymph glands were enlarged and filled with cheesy material which was partly calcified. Smears of this material showed many acid fast organisms. The lungs from two goats were submitted to our laboratory for examination for tuberculosis. The left lung of one and the right lung of the other showed extensive consolidation with areas of cheesy and partly calcareous material. Some parts of the lungs showed encapsulated areas up to the size of a peach filled with thick grayish white pus. The bronchial lymph glands were enlarged and filled with cheesy material which was partly calcified. Smears of this material showed many acid fast organisms.

Fourteen Goats

The specimens were from a lot of 14 goats on one farm. The lot consisted of 1 male and 13 females. Twelve of the females were positive to the intradermal test with tuberculin. All were killed and all showed lesions characteristic of tuberculosis. Five showed generalized tuberculosis with lesions in the lungs, bronchial lymph glands and mesenteric lymph glands. The other seven showed lesions in the lungs and bronchial lymph glands.

A suspension was prepared from the lungs and injected into two rabbits intravenously, but both rabbits died immediately, because the material was old and too toxic for intravenous injection. Two guinea pigs were injected intraperitoneally. Both guinea pigs died of generalized tuberculosis about six weeks following the injection. Material was collected from the spleen of one guinea pig, made into a suspension, and injected intravenously into a rabbit. This rabbit died about one month later with lesions of tuberculosis in the lungs, spleen and kidneys. Many acid fast organisms were found. The result of animal inoculation placed this in the bovine type.

Ovine Specimens

Federal inspectors submitted the internal organs from a sheep with a request for an opinion as to whether or not it was tuberculosis. The specimens consisted of heart, lungs, liver, spleen, kidneys and a small portion of the diaphragm. The lesions in the lungs were large areas of calcification; while dotted between the large lesions were many small pinhead sized lesions, very firm and fibrous. The liver showed large calcified areas. The spleen showed many small fibrous nodules. The kidneys showed many small lesions that were quite firm. The small portion of the diaphragm was covered with many nodules and had the appearance of pearly disease. The lesions were old, judged by the large and extensive areas of calcification. An exhaustive search was made for acid fast bacilli without success. It was believed, however, that it was tuberculosis. Sheep tuberculosis is extremely rare, and since our museum did not contain any specimens of sheep tuberculosis typing tests were started.

A suspension was prepared from the lymph glands and spleen and injected into two rabbits, two guinea pigs and one chicken. The two rabbits were injected intravenously, the two guinea pigs subcutaneously and the chicken intravenously. Most of the cases of sheep tuberculosis so far typed have been due to the avian type. One and one half months after injection the chicken was tested with avian tuberculin and reacted. However, at this time one guinea pig was lame with a swollen lymph gland near the point of injection and was killed. Creamy pus was found containing some semi-solid material, and smears showed acid fast bacilli. The spleen contained many small nodules, and there were areas of necrosis in the liver. Microscopic sections of the spleen and liver were typical of tuberculosis.

Inoculation Results

Two months after injection the remaining guinea pig, the two rabbits and the chicken were tested intradermally using mammalian tuberculin at one site and avian tuberculin at another site of injection. The guinea pig, one rabbit and the chicken reacted to mammalian tuberculin but not to avian tuberculin. The other rabbit died during the tuberculin test from being in the stage of infection in which it was hypersensitive to tuberculin. This rabbit at necropsy showed the lungs filled with various sized nodules,
from pinpoint to pinhead size, with hardly any normal lung tissue remaining. The spleen was about five times normal size with numerous small nodules up to \(\frac{1}{2}\) cm. in diameter. The liver was studded with grayish white nodules. The parietal pleura was covered with numerous nodules. Acid fast organisms were found in all places.

Two and one-half months after injection the remaining rabbit died with extensive lesions in the lungs, liver, spleen and parietal pleura typical of tuberculosis. At this time the remaining guinea pig and the chicken were tested with mammalian and avian tuberculin, using different sites for the injection of each. The guinea pig died shortly after the injection of tuberculin from being hypersensitive, and at necropsy showed extensive lesions of tuberculosis in the regional lymph glands, lungs, liver and spleen. A pure culture of tubercle bacilli was isolated from the spleen. The chicken did not react at this time to either tuberculin and was killed. The spleen contained many small tubercles from a pinpoint to a pinhead in size and acid fast organisms were found. A suspension was made from the spleen of this chicken and injected into two guinea pigs, two rabbits and two chickens. The two guinea pigs were injected subcutaneously, one rabbit intraperitoneally, one rabbit and the chickens intravenously.

**Intradermal Test Applied**

Five weeks after injection each was tested intradermally with mammalian and avian tuberculin using a different site for each tuberculin. Each reacted to mammalian tuberculin but none to avian tuberculin. One week following this tuberculin test, one guinea pig died. At necropsy, it showed the regional lymph gland swollen to about three times its normal size and acid fast organisms were demonstrated in the gland. The rabbit injected intravenously died two months after injection and showed lesions characteristic of tuberculosis in the lungs, liver, spleen and kidneys.

About two and one half months after injection the remaining guinea pig, the remaining rabbit and the two chickens were again tested with mammalian and avian tuberculin using different sites for each injection.

The guinea pig, the rabbit and one chicken reacted to mammalian tuberculin, but not to avian, while the second chicken was negative to tests with each tuberculin. The guinea pig died shortly after the tuberculin test and showed tuberculosis of the regional lymph gland, lungs and spleen. The chicken that reacted was killed, but no lesions of tuberculosis could be found, and no acid fast bacilli could be demonstrated. Four months after injection the remaining rabbit and the remaining chicken were again tested. The rabbit reacted to mammalian tuberculin but not to avian, and the chicken was negative to each tuberculin. Each was killed, the rabbit showing several lesions in the liver, kidneys and peritoneum, while in the chicken, no lesions could be found. These tests indicated that this tuberculosis was due to the bovine type, because it produced generalized tuberculosis in guinea pigs and rabbits and not in chickens.

**Pure Cultures**

Pure cultures of this strain had been isolated from a guinea pig injected with the sheep material, and likewise from a guinea pig injected with the chicken spleen material. These were further tested for pathogenicity. A strain of tubercle bacilli is bovine, when 0.01 milligram of pure culture, injected intravenously into rabbits, causes death within two months with massive infection. A strain is avian, when one milligram of pure culture, injected intravenously into rabbits, causes death within two to four weeks, without gross lesions, but with large numbers of bacilli in the spleen. A strain is avian, when one milligram of pure culture, injected intravenously into chickens, causes death with tuberculosis; but is bovine, when no tuberculosis is produced.

One milligram of pure culture isolated from the guinea pig that had been injected with the sheep material, was injected into one rabbit intravenously, (Continued on Page 128)
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0.01 milligram was injected into each of two rabbits intravenously, and 0.1 milligram was injected intravenously into one chicken. All of the rabbits succumbed to generalized tuberculosis within two months and no tuberculosis was found in the chicken.

A similar test was made with the pure culture isolated from the guinea pig that had succumbed to tuberculosis from the injection of material from the spleen of the chicken that showed lesions of tuberculosis when injected with material from the sheep. One milligram of this pure culture was injected intravenously into one rabbit. 0.1 milligram was injected intravenously into each of two rabbits. 0.01 milligram was injected intravenously into one rabbit. One milligram was injected intravenously into one chicken, and 0.1 milligram was injected intravenously into another chicken. The rabbits in this test all died of extensive tuberculosis within two months and the chickens remained well. Two months after injection the chickens were tested intradermally with mammalian tuberculin at one site and avian tuberculin at another site. Each chicken reacted to mammalian tuberculin but not to avian tuberculin. Following this test the chickens were killed but no lesions of tuberculosis could be found. This further proves that this strain is the bovine type.

Sheep Tuberculosis

The evidence obtained shows that this is a case of sheep tuberculosis of the bovine type. Tuberculosis in the sheep is very rare. Van Es, in his book on "Animal Hygiene" states, "sheep tuberculosis is as rare as rare can be." Calmette in his book, "Tubercle Bacillus Infection and Tuberculosis in Man and Animals," states, "tuberculosis is relatively rare in sheep." Harshfeld and Roderick in an article entitled "Avian Tuberculosis of Sheep," in the A. V. M. A. Jour., 1934, state, "tuberculosis of sheep is exceedingly rare, so that a case is primarily a pathological curiosity." The report of the Chief of the Bureau of Animal Industry of the United States Department of Agriculture for 1937, shows a total of 17,663,158 sheep inspected of which 22 were condemned for tuberculosis. Sixteen cases of tuberculosis of sheep were examined in the laboratory of which fifteen showed acid fast bacilli, and animal inoculations indicate that all were of the avian type.

Most of the cases of sheep tuberculosis so far typed have been avian. The strain here reported is certainly not avian, because it did not produce the kind of tuberculosis in chickens that the avian type produces, and it produced generalized tuberculosis in guinea pigs which the avian type does not do. The marked pathogenicity of this strain for guinea pigs and rabbits with the widespread lesions of tuberculosis produced in both, indicates that it is bovine.

This case also presents evidence that a bovine type may survive for a time when passed from a sheep to a chicken. The chicken that became affected in this case reacted once to avian tuberculin, but on later tests with both avian tuberculin and mammalian tuberculin reacted only to the mammalian tuberculin. This chicken was killed and showed slight lesions of tuberculosis in the spleen. It could not be transferred further to chickens, but was transferred from this chicken spleen to guinea pigs and rabbits. It produced the same lesions on such transfer as it did originally from the material directly from the sheep. This indicates that the strain was not altered in its pathogenicity but that a chicken that was especially susceptible was encountered in the first transfer.

This case is interesting because of the rarity of tuberculosis in the sheep, particularly of the bovine type, and the unusual pathogenicity of the bovine type in one chicken.

“The Relation Between Veterinary Medicine and Electrical Engineering” was the subject of a lecture by Dr. E. A. Benbrook, head of veterinary pathology, at the AIEE meeting April 5 in Engineering Assembly.