scopical examination of the urine, and radiological examination of the entire urinary tract, at least every three months.

Summary

1. The incidence of 19.1 per cent. of urinary tract complications is reported in a series of 162 children who were undergoing prolonged recumbent treatment.
2. Attention is drawn to the latency or absence of symptoms and signs in these cases.
3. Factors conducive to calculous disease, or pyogenic infection, of the urinary tract in recumbent patients are considered. The most important factors appear to be defective renal drainage, due to rigidly enforced dorsal posturization, and chronic focal sepsis.
4. Brief allusion is made to certain aspects of diagnosis and prognosis, and a plea is made for the early detection of urological abnormalities.

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A POSSIBLE RESERVOIR HOST OF *TRYPANOSOMA RHODESIENSE*

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The question of the identity of the two polymorphic trypanosomes found in man and ruminants in Eastern Africa has ever been a vexed one. The German school, led by Kleine, maintains that the human strain *T. rhodesiense* is distinct as a species from *T. brucei*, whereas it seems to be generally accepted by British workers that the former is merely a variant of the latter, which, for reasons imperfectly understood, has developed qualities making it pathogenic to man. Thus Duke (1923) believes that the epidemic of trypanosomiasis which broke out in the neighbourhood of Mwanza, Tanganyika Territory, was due in the first place to an infection with *T. brucei*, which became pathogenic to a population the stamina of which had been sapped by famine and the physique undermined by hookworm.

If the supposition of Kleine and his co-workers is correct and the human trypanosome is indeed specific to man, the existence of a true reservoir host must be postulated. If the identity of the two trypanosomes is accepted then, according to the views of Wenyon (1926), the animal strain, having once gained a footing, is more easily passed on to other men. (For, although in the first instance its virulence is light, it is later increased, presumably after many passages, in the same way as the virulence of *T. gambiense* can be increased by passage through a series of rats.) On the other hand, Duke has advanced the hypothesis that not only the polymorphic trypanosomes *T. gambiense*, *T. brucei*, and *T. rhodesiense*, but also the monomorphic trypanosomes *T. evansi*, *T. equinum*, and *T. equiperdum*, may be simply physiological variants of the one species, *T. brucei*.

If a human reservoir exists it is to be expected that he would be in every way comparable to the carrier of such conditions as enteric fever or diphtheria, being himself unaffected by the parasites in his body. Efforts have been made to find such an individual. For instance, in Nyasaland, consequent on the epidemic of sleeping sickness which broke out there in 1908, a search for human reservoir hosts was made in 1916 by Dr. J. B. Davey. He examined the blood of many adult natives living in the area that had been proclaimed, and injected

the blood of a hundred others into monkeys, utilizing as many as fifty-six of the animals, with a view to demonstrating the existence of occult infections, but without result. It is believed by the writers that a human reservoir host has been discovered, and the following are the preliminary details of the case.

Clinical Details

An adult male native, aged about 30, was admitted to the native hospital at Fort Johnston, Nyasaland, on June 16th, 1935, suffering from urinary schistosomiasis. During the investigation of his case examination of the faeces revealed a heavy infection with ankylostomiasis, and, in addition, polymorphic trypanosomes were found in his blood. These latter parasites were later identified as *T. rhodesiense* by their pathogenicity to rats and by the development of posterior nuclear forms in these animals.

The native has now been under observation for over six months, and, apart from an improvement in his general health as a result of the successful treatment of

hookworm and bilharzia, his condition remains the same as on admission. Further than a positive formol-gel reaction tested against a control the patient shows no sign or symptom of trypanosomiasis. His course has, in general, been afebrile, for only twice has a rise of temperature been noted, and on these occasions he experienced no discomfort whatever. He has been content to remain in hospital, where he is housed and fed, and where he helps in the routine work of the wards. In his spare moments he weaves mats for the hospital, the intricate nature of this work indicating that his muscular co-ordination remains unimpaired.

During his stay in the hospital the patient's blood has been examined at weekly intervals with the object of defining the parasite rate, and of demonstrating what relation, if any, this bears to the temperature. Once every month the condition of the cerebro-spinal fluid and of lymph obtained by gland puncture has been investigated, but without result. As will be seen from the chart depicting it, the trypanosome rate has varied

widely. On the two occasions on which the patient had a rise of temperature the rate rose and fell in conformity with it, while during the afebrile periods the rate changed from week to week without apparent cause. The trypanosomes have therefore not as yet produced recognizable evidence of their presence. That they are virulent parasites, however, is proved by the following experimental results:

1. In the case of a dog subinoculated hypodermically from the patient, trypanosomes appeared in the peripheral blood eight days later, the animal succumbing with a very heavy infection on the thirty-first day.

2. A second dog, subinoculated hypodermically from the patient on one of the two occasions on which he had a rise of temperature accompanied by a rise in the trypanosome rate, developed trypanosomes in the peripheral blood on the fifteenth day, and died on the thirty-first.

3. Direct transmission of the trypanosome to a third dog was effected through the agency of a muscid fly, *M. sorbens* Wied. The insect was fed on the blood of the patient and then transferred to a small fresh incision on the ear of the animal, in the blood of which the trypanosomes showed up thirty-five days later, death taking place on the forty-eighth day.

4. A rat, subinoculated intraperitoneally from the patient, showed trypanosomes in the peripheral blood eight days later, posterior nuclear forms being discovered on the tenth.

5. Cyclical development took place in a bred *G. morsitans* that was fed on the patient two days after its emergence; the parasites, metacyclic forms, were found in enormous numbers in its salivary glands on the twentieth day.

6. In the case of a rat bitten by one of the flies which had fed on a dog subinoculated from the patient, and in which cyclical development had taken place, the parasites were found for the first time forty-four days later, and the animal duly succumbed to the infection.

Deductions

From a consideration of this case it will be apparent that the patient is either passing through a latent stage in the course of active trypanosomiasis or else is a carrier of the disease. Whilst irregularity in degree and duration of symptoms is characteristic of the two recognized types of sleeping sickness, infection with *T. rhodesiense* is marked by the frequency of its febrile periods, the pronounced glandular enlargements, and a more rapid course to a fatal termination as compared with the *gambiense* form. It is generally stated in textbooks that in the former condition death takes place within a year, but it would appear from a study of the sleeping sickness diaries of this Protectorate, in which details of many cases are given, that the average period is far shorter. In those cases in which it was possible to obtain an approximate date of a visit to a fly area, or a date when symptoms first became apparent, the longest period of survival was four months and the shortest one month.

Since the patient has so long remained entirely able-bodied, and since he resides in an area infested by *G. morsitans*, it is quite evident that any flies which might have bitten him could well have passed on the infection to others, and that in this way could have been started an epidemic comparable to those which have been traceable to one infected person. At the moment there would appear to be no danger of such an epidemic, for, following the recognition of a possible carrier, an extensive search was made for sleeping sickness among the natives in the neighbourhood of the village from which the patient came, so far without result. The history of the first outbreak of sleeping sickness in Nyasaland is in this respect particularly instructive.

Appearance of the Disease in Nyasaland

It would appear from the sleeping sickness diaries that until 1907 the disease was unknown in the country, for in the diary for that year information was given as to what was believed to be the southern limit of the disease. It was stated to be a line passing from Mvua on the western shore of Tanganyika more or less due west to the Portuguese boundary. The diary records that "precautionary measures to be taken against the spread of the disease shall include restriction of the movements of natives . . . these measures are being enforced at the Government Medical Post at Karonga (the most northerly administrative centre of the Protectorate), particularly against Swahili traders who are engaged in illicit traffic in rubber and ivory with the natives of the Congo Free State."

In 1908 it is noted that Dr. J. B. Davey, a medical officer engaged in sleeping sickness investigations, diagnosed, as a result of gland palpation and puncture, one case of trypanosomiasis (the first to be found in the Protectorate) near Nkata Bay, towards the north end of the lake, in a native who had accompanied a European as a personal servant to Tanganyika and the Congo. The native had returned home by steamer by way of Capetown. Dr. Davey stated that the patient was apparently in good health, with glands not greatly enlarged, that he was unable to find parasites in the blood, that they were scanty in the glands, and that the native had been back in his village, in a fly-free area, for one year, during which time he had made no complaint of ill-health.

This patient was removed and segregated near Dowa, about 130 miles south. His removal in a condition comparable to that of the native who is the subject of this communication seems to have been responsible for the epidemic of sleeping sickness which followed. The journey was made by steamer from Nkata Bay to Domira Bay, where the medical officer, who had just completed a survey for *G. morsitans* and reported it as widespread, although he had seen no human trypanosomiasis, accompanied the patient from Domira Bay to Dowa (October, 1908). This officer could not have appreciated the risk he ran of becoming directly infected through the agency of this species of tsetse, for, according to current rumour, he omitted to shield the patient against the flies by means of a mosquito net. His own infection followed and took a rapid course, his death ensuing within three months from the time of diagnosis.

In the meantime a search for cases of sleeping sickness in the *morsitans* areas of the country had been going forward, and by September 30th, 1909, five other cases had been discovered. The investigations in Central Angoniland (the region traversed by the above officer and his patient) were commenced in April, 1909, and 20,189 natives were palpated for enlarged glands, gland puncture and blood examination being undertaken in all doubtful cases. It was not until October of the following year that a focus of the disease was discovered in the area. Nine cases in all were brought to light by the end of that month, when the writer of the diary, the late Dr. H. H. Hearsey, formerly principal medical officer of the Protectorate, suggests the hypothesis that the first case ". . . probably infected during his journey from Tanganyika down the Congo, was the source from which the agent of transmission concerned in the outbreak derived its infectivity." In this connexion he drew attention to the very significant fact that ". . . among the villages from which some of the cases appear to have derived their infection a heavy mortality has, it is stated by local natives, occurred during the past eighteen months from a disease presenting symptoms

similar to those of the cases now under medical care." This mortality must have commenced subsequent to the journey of the first case and his medical attendant.

Thereafter the epidemic assumed greater proportions, so that up to October 12th, 1911, sixty-six cases had been reported, up to September 30th, 1912, ninety-three, and at the end of that year the total was 108. In 1913 the figures rose to 153, whilst at the end of 1915 there had been 240. Thereafter the epidemic seems to have died out gradually.

A parallel instance of an epidemic directly traceable to a human carrier is afforded in an unpublished report written in 1910 by a German, Dr. Woolf, dealing with sleeping sickness along the valley of the Rovuma River in Tanganyika Territory. Early in 1910 a native, Mnyao by name, was found ill with symptoms suggestive of trypanosomiasis, a diagnosis which was later confirmed. He had come from his village at the junction of the Upper Rovuma and Sawasaru Rivers. Following the discovery of this patient numerous cases of the same disease occurred along the route on which, it was definitely ascertained, the native had travelled. In 1911 a segregation camp was established at Sawasaru to deal with the outbreak, and between 1911 and 1913 seventy-two cases were isolated. From this area the disease spread northward, and in 1917 it had reached the hinterland of Kilwa.

Conclusions

This case may well afford an affirmative answer to the question: Can *T. brucei*, occurring in areas where human trypanosomiasis is unknown, infect man? Its impor-

tance lies in the fact that the spread of sleeping sickness is, in all probability, mainly due to the movements of human carriers of a strain of trypanosome which, while not immediately pathogenic, may become so after more than one passage through man.

It emphasizes the need for examination of the whole population when sleeping sickness arises apparently *de novo*. The investigation should include the examination of the blood of even the apparently healthy and of material obtained by puncture of the lymph glands.

Summary

1. The modern theories on the epidemiology of trypanosomiasis are reviewed.
2. The existence of a reservoir host in man is emphasized.
3. The case of such an individual is presented.
4. The spread of sleeping sickness through the agency of a human host is described.
5. The results which would follow the liberation of the case under reference are suggested.
6. The location of the reservoir host is made the crucial point in the investigation of future outbreaks of this disease.

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ASSOCIATION OF *B. COLI* INFECTION AND RHEUMATOID ARTHRITIS

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The causation of rheumatoid arthritis remains obscure. It is generally agreed that the disease is an infective or toxic condition, but in spite of much experimental work no specific organism has been definitely demonstrated to be the causal factor. Many hold the view that it is possibly a streptococcal manifestation, while a minority of foreign workers would ascribe the condition to the presence of the tubercle bacillus. In support of the streptococcal theory is the fact that improvement is sometimes seen when the foci of suspicion, such as the teeth or tonsils or sinuses, are treated. Very frequently, however, in the majority of cases no diseased focus can be found, or even if one is present its removal generally leads to no marked improvement in the arthritic condition.

The various investigations of a case of rheumatoid arthritis are only possible in a nursing home or hospital, and in the course of the investigations of the cases that have been under our care we have found that nine out of twenty-four cases of rheumatoid arthritis have had an unsuspected bacilluria. *B. coli* was the organism isolated in eight cases, and a streptococcus was present in one. None of these patients, except the streptococcal one, complained of any urinary symptoms whatever, and it is interesting to note that the usual routine ward examination of the urine, which is carefully carried out in our cases, revealed no abnormality. It was only when

catheter specimens were taken and sent to the laboratory that the bacilluria was discovered, and in the table at the end the findings are clearly detailed.

Treatment

All these cases were treated with alkalis—usually potassium citrate—in doses up to 200 grains daily, or with sodium mandelate and ammonium chloride, following the usual technique in such cases. The latter treatment gave rise to heartburn and dyspepsia, and was less well tolerated than the alkali treatment, but in the cases in which it was used it proved very efficacious. The technique adopted was to give 40 grains of sodium mandelate three times a day, together with 10 grains of ammonium chloride, separately. The urine was tested to be acid to methyl orange, and the dose of ammonium chloride carefully regulated thereby. The course lasted from ten to fifteen days. The patients themselves stated that they felt better whilst on alkali treatment.

Gold therapy and colon washouts were also used, the technique followed being that described in the *Practitioner* of June, 1935. The preparations of gold used were either oleosanocrysin or solganol B oleosum. The latter preparation has a higher gold content than the oleosanocrysin. The doses were 0.05, 0.1, 0.1, 0.2, 0.2, 0.3, 0.3 of a gram, given at weekly intervals, intramuscularly. Colonic washouts of normal saline solution were also used once or twice weekly. All the cases except one were definitely improved on discharge, and they were all typical cases of multiple rheumatoid arthritis, affecting hands, knees, and feet.

Discussion

The administration of alkalis in arthritis generally was an early form of therapy, and it is possible that the presence of bacilluria is more frequent than is thought. Other authors have drawn attention to this fact: Roderer and Grafin in the *Monde Médical* in 1934 stated that *B. coli* infection, or infection of intestinal origin,