years, resection of part of astragaloid head; resection. Very useful foot.

(c¹) Os calcis, a half dozen fresh cases with obliterated heel and loss of lateral motion of foot, operated by my method of putting in a spindle over the top of the os calcis between tendo achillis and tibia, using this as a grip to break up and reduce the impacted fracture, then holding it in corrected position, and hammering it laterally, the foot on a sand-bag, so as to secure reimpaction.

(d¹) Os calcis, extreme valgus, neck of os calcis sawed, heel displaced in and forward. United, improved.

(e¹) Several cases of removal of spurs in various sites resulting from os calcis fracture.

The range of remediable conditions is large, and with good x-rays, first rate aseptic conditions, skilled assistance and experienced operator, results are attainable that make this already a fruitful field though still in the early stages of cultivation and development. And on the x-ray and its intelligent use much — most — of its development must depend.

THE USE OF TUBERCULIN AS A DIAGNOSTIC AGENT IN PULMONARY TUBERCULOSIS.*

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In doubtful cases of pulmonary tuberculosis the diagnosis must often rest on the presence of slight impairments of resonance, slight changes in breathing and a few râles. Well-trained men frequently disagree as to the presence or absence of slight impairments of resonance. The continued presence of râles at one apex usually means tuberculosis, yet this is by no means invariable. Koch¹ states that 15% of cases of catarrh of the apex did not react to tuberculin, and the subsequent histories of all that could be followed did not prove them to be tuberculosis clinically. Lord² has reported cases of influenza which bore a perfect resemblance to tuberculosis clinically but which did not react to tuberculin. Some of these cases had a family history of tuberculosis, suffered from fever and hemoptysis and yet on autopsy the lungs were free from tuberculosis. Boggs³ has also reported cases of influenza infection which simulated tuberculosis.

At the Rhode Island State Sanatorium we have found it necessary to give the tuberculin test in 2% of moderately advanced cases, in 31% of incipient cases and in 5% of all cases. At the Adirondack Cottage Sanatorium⁴ the test is given in 2% of moderately advanced cases, in 26% of incipient cases and in 14% of all cases. At the Massachusetts State Sanatorium the test is found necessary in "less than one sixth of incipient cases."⁵

In many of the cases tested in sanatoriums the physicians feel that the chances are greatly in favor of tuberculosis being present, but that there

is nevertheless a slight room for doubt and that in the interest of both patients and institutions this doubt should be removed or reduced to the minimum.

Some of the cases so tested do not react and are discharged as non-tuberculous. This happens in 3% of the cases tested at the Rhode Island Sanatorium and in 6% of those tested at the Adirondack Cottage Sanatorium. Wilkinson⁶ cites Weicker, who in one year tested and refused 48 non-tuberculous patients who had been diagnosed by good examiners as early cases.

It would doubtless be necessary to test even a larger percentage of incipient cases were they not subjected to delay in diagnosis, during which time the appearance of bacilli in the sputum removes all doubt. At the Rhode Island State Sanatorium 38% of the incipient cases having bacilli in the sputum have been subjected to delays in diagnosis averaging six months.

If sanatorium physicians need the tuberculin test in 15% to 30% of their incipient cases, some of which have been subjected to delay, what must be expected of the general practitioner who sees the disease at its onset? The sanatorium physician necessarily receives only those patients whose histories have been reviewed by others and in whom the presumption of tuberculosis is strong, while the general practitioner sees many kinds of infections of the respiratory tract, the majority of which are not tuberculous. That keenness for searching out incipient cases which is necessary for their recognition many times results in suspicion of tuberculosis in non-tuberculous individuals, and general practitioners can ill afford to run the risk of diagnosing tuberculosis in patients who are free from this disease.

I know that the fear of making this mistake has been the cause of disastrous delays in many instances. If physicians with special training in tuberculosis were given the task of detecting all the cases of incipient tuberculosis in the community within a reasonable time after the clinical onset, say, within two months, I believe that the number of tuberculin tests would be at least 20% of the number of incipient cases found.

As examples of puzzling cases doubtless more or less typical of those which appear to family physicians all over the country, I cite the following. Symptoms and signs relevant to the diagnosis which are not given were absent. Cases 3 and 4 were the only ones having hemorrhages. All cases having sputum were repeatedly examined and found negative. Koch's old tuberculin was used subcutaneously for testing. None of the cases failing to react to the test had a temperature over 99, and all reacting had a rise of 2° or more.

CASE I. Female aged twenty-three. No history of infection. Slight cough and expectoration for three months. Loss of six pounds in weight, pleuritic pain in the right side. Maximum evening temperature 99.2 to 99.8. Few crackles and friction sounds in the right axilla. Reaction negative to 5 and 10 mgm. of tuberculin.

CASE II. Female aged twenty-seven. Family history negative. Severe cough and slight expectoration

* Read before the American Climatological Association in Boston, June 10, 1908.

beginning as a coryza one month previously. Slight soreness in right side. No loss of weight. Maximum temperature 99. Interrupted respiration and suspicion of fine râles at the fourth rib on right side. Reaction positive to 5 mgm. tuberculin. Pain and unmistakable râles over suspected area during fever reaction.

CASE III. Female aged twenty-six. Family history negative. Severe hemorrhage one year previously, patient claiming that the blood was neither coughed nor vomited. Loss of 12 pounds in weight. Slight cough with no expectoration for one month. Stomach symptoms suggestive of gastric ulcer. Maximum evening temperature 98.4. Examination of the lungs negative. No reaction to 2, 5 and 8 mgm. of tuberculin, the last dose being repeated.

CASE IV. Female aged sixteen. One sister tuberculous. Slight cough and no expectoration. No loss of weight. Slight hemorrhage four days previously, at which time patient both coughed and vomited. The stomach symptoms suggestive of gastric ulcer. Maximum evening temperature 98.4. Few crackles at right apex. Positive reaction to 5 mgm. of tuberculin. Pain and increase of râles at the right apex during the reaction.

CASE V. Male aged sixty-two. Family history negative. Severe cough and moderate expectoration for three months. Exposure to infection. Loss of 40 pounds in weight. Loss of appetite. Maximum evening temperature 98.4. Examination of the lungs negative. No reaction to 5 and 10 mgm. of tuberculin.

CASE VI. Male aged twenty-eight. Family history negative. Slight cough and expectoration for four months. Slight pleuritic pain in left side. Maximum evening temperature 99.2. No loss of weight. Examination of the lungs negative. Reaction positive to 5 mgm. of tuberculin.

CASE VII. Male aged twenty-five. Family history negative. Severe cough for one year. Scant expectoration, loss of 14 pounds in weight. Maximum evening temperature 99.6. Examination of the lungs: Questionable dullness at left apex. Uvula long. Reaction negative to 5 and 10 mgm. of tuberculin. Cough relieved by amputation of the uvula.

CASE VIII. Male aged twenty-five. Three sisters died of tuberculosis. Slight cough, no expectoration. Loss of 3 pounds in weight. Maximum evening temperature 98.6. Examination of the lungs: Questionable dullness at both apices. Reaction positive to 10 mgm. of tuberculin.

Of these 8 patients, 4 reacted and 4 did not react to the tuberculin test. The subsequent histories of 6 of these patients have been followed for periods averaging two years and have so far confirmed the diagnosis obtained by testing.

The degree of accuracy of the tuberculin test is largely determined by autopsy. Autopsies on persons who have been injected with tuberculin are rarely reported, and as the following cases serve to illustrate the limitations of the test, they are briefly recorded. These patients were given subcutaneous injections of tuberculin at the Danvers Insane Hospital by Dr. James D. Madison⁷ in the years 1900, 1901 and 1902. The writer examined many of these patients at about the time of the test. There was no selection of cases because of suspected tuberculosis, all patients receiving the test unless their condition rendered it undesirable. The autopsies were performed by the hospital pathologists and members of the hospital staff, to whom I am indebted

for these records. Unfortunately, no special effort was made to search for tuberculosis outside of the cranium, thorax and abdomen.

CASE I. E. S. Female aged thirty-eight. Diagnosis of mental condition, primary dementia. Examination of the lungs showed wavy breathing and few râles at left apex. Positive reaction to 4 mgm. of tuberculin. Patient died one year and seven months after injection. Autopsy: Left pleural cavity contains about 10 oz. of fluid. Right lung is free. Pneumonia of both lungs. No evidence of tuberculosis in the lungs. No effort was made to determine the cause of the pleuritic infection.

CASE II. N. G. Female aged thirty-one. Diagnosis of mental disease, general paralysis. Examination of the lungs: Cogwheel respiration over the left upper front. Reaction positive to 4 mgm. tuberculin. Patient died two years and two months after the test. Autopsy: Few adhesions of the pleura on each side. Left lung shows a small area of partial consolidation posteriorly with a little bronchitis and thrombus of a medium-sized vessel in the lower lobe. No evidence of tuberculosis in the lungs.

CASE III. E. M. Female aged eighty-two. Diagnosis of mental condition, senile dementia. Examination of the lungs negative. Reaction positive to 10 mgm. of tuberculin. Patient died six years and six months after the test. Autopsy: The right lung was gangrenous and the right pleural cavity contained about 300 cc. of reddish-brown purulent fluid having an offensive odor. There was an area of commencing abscess formation around the right kidney. No evidence of tuberculosis found in the thorax or abdomen.

CASE IV. M. S. Female aged sixty-four. Diagnosis of mental condition, post-paralytic dementia. Examination of the lungs negative. A positive reaction to 4 mgm. of tuberculin. Patient died twelve months later. Autopsy: The left lung was adherent to the chest wall by numerous adhesions easily broken up. There was a large contracted area deeply pigmented at the left apex. No sections of this scar tissue were made.

CASE V. M. H. Female aged sixty-four. Diagnosis of mental condition, primary dementia. Examination of the lungs: A few fine crackles at both bases. Reaction positive to 4 mgm. of tuberculin. Patient died in two years and five months after injection. Autopsy: In the left pleura are numerous old fibrous adhesions. The visceral pleura is much thickened. There is an old scar at the left apex and a rather large scar about the middle of the upper lobe.

CASE VI. A. D. Female aged forty. Diagnosis of mental condition, chronic delusional insanity. Examination of the lungs: Prolonged expiration at the right apex. Reaction positive to 4 mgm. Patient died two years and ten months after the test. Autopsy: A few old fibrous adhesions in the right pleura and a small edematous patch in the right pleura at the apex. Right apex shows a small cavity 3 cm. across, containing foul greenish detritus. Pneumonia of the upper lobe of the right lung; gray hepatization. Pneumonia of left lung. Sections of the walls of this cavity did not show evidence of tuberculosis.

CASE VII. M. E. Female aged fifty-three. Diagnosis of mental condition, organic dementia. Examination of the lungs: Nothing of importance found; reaction positive to 4 mgm. of tuberculin. Patient died two years and five months after the test. Autopsy: Both lungs normal save slight hypostatic congestion. Peribronchial lymph node enlarged to 3 cm. by 2 cm. contains many caseous foci in which a few giant cells are found. Sarcoma of the brain.

CASE VIII. A. B. Female aged fifty. Diagnosis of mental condition, primary dementia. Examination of the lungs negative. A positive reaction to 6 mgm. Patient died twelve months later. Autopsy: Right pleura free. Left pleura adherent over entire lung. In the upper lobe of the left lung a small area was found studded with miliary tubercles.

CASE IX. J. C. Female aged fifty-seven. Diagnosis of mental condition, imbecile. Examination of the lungs: "Signs of emphysema." Reaction negative to 4 and 7 mgm. of tuberculin. Patient died seven years after the test. Autopsy: Each lung is bound down by a slight adhesion near the apex. Slight edema of the bases. A calcified nodule at the apex. No other signs of tuberculosis.

CASE X. S. G. Female aged sixty. Diagnosis of mental condition, post-paralytic dementia. Examination of the lungs showed a few fine râles scattered over the chest. Four and 7 mgm. of tuberculin given. Reaction negative. Autopsy: Old firm adhesions at left apex. Left apex has an old fibrous puckering. Right lung has similar adhesions at the apex and the lower lobe shows a moderate degree of edema. Mesenteric glands not enlarged.

CASE XI. I. V. Female aged sixty-seven. Diagnosis of mental condition, alcoholic dementia. Examination of the lungs: Moist râles over both bases. Reaction negative to 4 and 7 mgm. of tuberculin. Patient died a few months after the test. Autopsy: Right pleural sac contains 500 ccm. fluid. Left pleura adherent over nearly entire surface. Lungs collapsed. No consolidation. Hydropericardium. Left ventricle hypertrophied, aortic and mitral valves somewhat thickened, but not rigid; weight 417 gm.

CASE XII. A. K. Female aged sixty-two. Diagnosis of mental condition, recurrent insanity. Examination of the lungs negative. Reaction negative to 4 and 7 mgm. of tuberculin. Patient died four years and eleven months after the test. Autopsy: Apices free from adhesion and cicatrices. Some adhesions of the right pleura. Bronchial lymph nodes normal. Bronchopneumonia of the lower and posterior parts of both lungs. No signs of destructive lesions.

CASE XIII. D. G. Female aged seventy-seven. Diagnosis of mental condition, senile dementia. Examination of the lungs: Crepitant râles heard over the lower lobes of both lungs. Reaction negative to 4 mgm. of tuberculin. Patient died three years after the test. Autopsy: Lungs, hypostatic congestion and a few tiny areas of pneumonia. Peribronchial lymph nodes and larger bronchi normal. Lymphatics normal. No evidence of tuberculosis found.

CASE XIV. A. M. Female aged forty-three. Diagnosis of mental condition, general paralysis. Examination of the lungs: Nothing of importance. Reaction negative to 4 and 7 mgm. of tuberculin. Patient died two years and one month after the test. Autopsy: Acute bronchitis with slight bronchopneumonia of left lung. Lymphatic system apparently normal. No evidence of tuberculosis found.

Of the 8 cases giving positive reactions, Cases IV, V and VIII showed either active or healed tuberculosis in the lungs. Case VII showed a tuberculous peribronchial lymph node; Cases II and VI had old pleuritic adhesions but no other sign of tuberculosis in the thorax. Case I had a pleuritic effusion in conjunction with double pneumonia, the presumption being against the pleuritic lesion being tuberculous. In Case III the pleuritic lesion apparently was a secondary infection from gangrenous lung. This case well illustrates the

fact that if the tuberculin test be given to persons having no signs or symptoms of pulmonary tuberculosis in some of those reacting positively no evidence of tuberculosis in the thorax or abdomen will be found. Persons who have no signs or symptoms of tuberculosis should not be given the test as it is not only of no clinical value but it confuses the physician and unnecessarily alarms the patient.

Of the 6 cases giving negative reactions 2 had healed lesions at the apices, 2 had pleuritic adhesions without evidence of tuberculosis in the lungs and 2 showed no evidence of tuberculosis in either pleura or lungs. In the cases reacting positively in which tuberculous lesions were found the possibility that the infection occurred after the test cannot be absolutely excluded, but from the character of the lesions it is most unlikely.

In the cases giving negative reactions in which no tuberculosis was found, the autopsies were not sufficiently complete to exclude the possibility of tuberculosis in the lymph nodes, nasal passages, middle ears and organs outside of the cranium, thorax and abdomen, where tuberculosis occasionally occurs. Cases IX and X show that healed tuberculous lesions may not react to doses of 4 and 7 mgm. of tuberculin. Possibly they would have reacted had Koch's¹ injunction to give 10 mgm. twice been followed.

Some observers have claimed that diseases other than tuberculosis, notably syphilis,^{8,9} and influenza,¹⁰ give positive reactions, but these claims are not substantiated by autopsies showing the absence of tuberculosis in these cases.

That a positive reaction to the tuberculin test judiciously given proves the presence of tuberculosis somewhere in the body in the overwhelming majority of cases is supported by evidence too strong to be overthrown by the unusual results of a few observers.

The following is an example of the numerous proofs of the accuracy of the tuberculin test as applied to cattle. "In the work of the Pennsylvania State Live Stock Sanitary Board,"¹¹ covering about 4,400 post-mortem examinations of reacting cattle, the lesions of tuberculosis have been found in all but 8 animals that have reacted in a way that was deemed characteristic. We are not, however, justified in saying that tubercular lesions did not exist in these animals, because every portion of the carcass could not be examined. It can only be said that they were not found."

The well-established fact that some patients with healed lesions and other patients with advanced disease fail to react does not count against the practical value of the test, as it is not needed in these cases.

In a series of doubtful cases in which the tuberculin test is given, in some patients negative reactions will indicate the absence of active tuberculous lesions beyond a reasonable doubt. In a considerable proportion of the suspected patients giving positive reactions, local reactions in the lungs will remove all doubt. I have found local reactions in the lung in 20% of patients who

reacted positively. Hamman and Wolman¹² also report local reactions in 20% of patients who reacted positively.

In patients having healed pulmonary lesions or lesions outside the lung in addition to influenza or some other non-tuberculous infection of the respiratory tract, a tuberculin reaction may be misleading. But it should be borne in mind that we have no method of diagnosis which may not in some cases be misleading. In patients critically ill with non-tuberculous pneumonia in addition to pulmonary tuberculosis, the finding of tubercle bacilli in the sputum may be misleading. Such cases have been reported by Janeway,¹³ and I have seen cases of this kind.

The practical value of the tuberculin test in suspected cases is shown by Meyer,¹⁴ who found tubercle bacilli in the sputum of 18 out of 28 doubtful cases some time after positive reactions had been obtained. Of 29 suspected cases giving positive reactions when tested by France,¹⁵ all showed active tuberculous lesions at autopsy, and in 5 suspected cases giving negative reactions no tuberculous lesions were found at autopsy.

The dangers attending the subcutaneous injection of tuberculin deserve careful consideration.

Madison quotes Ewald¹⁶ as reporting 2 deaths from hemoptysis. One case received 1 mgm. and a second case several injections up to 10 mgm. Heron¹⁷ reported a case in which death occurred twenty-seven hours after the injection of $\frac{1}{2}$ mgm., but as the patient did not react he thinks tuberculin was not the cause of death. Brown¹⁸ reports 10 hemorrhages occurring after the injection of tuberculin therapeutically, which may quite possibly have been coincidences.

A search of the literature shows that reports of cases in which death or permanent harm have followed the injection of tuberculin for diagnostic purposes are extremely rare. There could be no certainty that many unfavorable cases had not been reported, and in order to collect evidence on this point, and to obtain information from a large number of observers using tuberculin for diagnostic purposes in pulmonary tuberculosis, letters were sent to the superintendents and physicians in charge of 500 hospitals, comprising all general hospitals of over 75 beds in the United States, making inquiries as to whether or not the tuberculin test had been given, by what method, if any, and asking for a statement of bad results.

In three replies were statements that "rather severe reactions" had been experienced, and one case of swollen arm was reported, but as no serious symptoms or permanent harm resulted these could hardly be classed as bad results. One physician had seen "one or two cases out of a great number where symptoms were exaggerated after the test, but he was not sure they were due to tuberculin." One physician has seen bad results in 2 cases in which overdoses had been given by mistake, but this could not properly be charged to tuberculin. Of 60 replies received from hospitals in which the subcutaneous method had been used, 57, or 95%, had experienced no unfavorable

results. Three, or 5%, reported the bad results given below.

CASE I. A case of Addison's disease died fifty hours after one subcutaneous injection of $7\frac{1}{2}$ mgm. of tuberculin. The patient had been "very sick" some time before the injection, but patient's temperature had never been over 100 and was normal at the time of the injection. Temperature reaction over 105.

CASE II. A case of Addison's disease died forty-eight hours after a subcutaneous injection of 10 mgm. of tuberculin. This case was very feeble at the time of the injection.

CASE III. A case of pneumonia of the right upper lobe which did not entirely clear up in three weeks. The injection of $\frac{3}{4}$ mgm. of old tuberculin gave no reaction and one week later $\frac{3}{4}$ mgm. was given. Temperature reaction 104 and death in eight weeks. Autopsy showed miliary tuberculosis of the lungs, intestines, right kidney and commencing tuberculosis of the meninges.

Case I and II have been elsewhere reported in the literature.^{10,20} They illustrate the risk of giving initial doses above 2 mgm. Had Koch's¹ injunction to begin with $\frac{1}{10}$ mgm. in feeble patients been followed these two unfortunate results might quite possibly have been avoided. Hawes and Floyd quote Ross, of Toronto, as having had fatal results in 2 cases of Addison's disease. In view of these experiences tuberculin should be given in Addison's disease only with extreme caution if at all. That there is reason for suspecting that the unfavorable outcome in Case III was due to the tuberculin may be readily granted. It must also be conceded that inasmuch as cases of acute miliary tuberculosis are frequently developing among tuberculous patients to whom it is not given, tuberculin may sometimes be held responsible for the development of conditions which were inevitable at the time of its administration. Frazier and Biggs²¹ report a case whose temperature was taken a few days in preparation for the tuberculin test who developed paraplegia the day before the injection was to have been given. One patient to whom I decided not to administer tuberculin therapeutically, died of hemorrhage two days after he would have received the dose had I decided differently. It is comparatively easy to collect thousands of cases tested by different observers without injury except for the temporary illness which constitutes the reaction. Tinker,²² Wood,²³ Dunham,⁵ White,²⁴ Rolpke,²⁵ Sears,²⁶ Otis,⁸ Hawes and Floyd²⁰ have altogether reported 1,200 tests without bad results in any case. Koch¹ reported 3,000 diagnostic injections in which he "had never seen any disadvantageous effects of tuberculin when it was used in the way I have described."

Hundreds of thousands of cattle are tested yearly without injury to animals being reported. In Denmark, where tuberculous cattle are segregated and kept, Bang²⁷ states that several herds, comprising many hundreds of cattle, were still living two to four years after reacting positively, and that generalized tuberculosis did not develop more frequently among these tested cattle than among others.

Of 397 patients who were given subcutaneous

injections by Madison⁷ at the Danvers Insane Hospital, which I traced for periods varying from several months to eight years, no patient developed general tuberculosis. Of 50 patients tested by the subcutaneous methods at the Rhode Island Sanatorium no ill effects have resulted with the exception of a swelled arm in one patient who refused to be injected in the back.

The dangers which should be kept constantly in mind in giving tuberculin as noted by many observers are:

1. The temptation to give a large initial dose in order to lessen the number of injections in a given case. Patients in poor condition should not be given over $\frac{1}{10}$ mgm. at the first injection. Patients in good general condition with maximum temperature under 99° F. may be given 1 or 2 mgm.

2. The administration of an initial dose of tuberculin when the temperature is above 99° F.

3. Carelessness in not considering a rise of a fraction of a degree or more Fahrenheit after the first injection and not regulating the size of the second dose accordingly. If such rise occurs the same dose should be repeated and not increased. I have known of alarming reactions and unwarranted prejudice against tuberculin to result from a violation of this rule.

4. In addition to the overdoses given by mistake reported above, I have known of one other case in which an overdose was given because of a mistake in preparing the solution. This work should be done by a reliable pharmacist rather than the practitioner or hospital interne.

The replies from 225 hospitals received in response to circular letters above referred to showed that 51, or 22.6%, claimed not to admit cases of pulmonary tuberculosis, and 84, or 37.3%, did not use the tuberculin test in any form. Ninety hospitals, or 40%, used the tuberculin test. Of 60 hospitals using the subcutaneous method, 12 were using it in out-patient departments. Of 74 hospitals using the ophthalmo-tuberculin test, 23 were using it in the out-patient departments. Of 32 hospitals using Von Pirquet's cutaneous reaction, 7 were using it in the out-patient departments.

It may well be doubted whether any hospital of 75 beds or over can escape admitting cases of incipient tuberculosis who are treated for other diseases which cause more immediate suffering.

Tuberculous patients are prone to disregard the slight symptoms of early tuberculosis. Of 505 cases admitted to the Rhode Island Sanatorium, 219, or 43.3%, delayed consulting physicians for their lung symptoms for a period averaging 6.4 months, and some of these patients had in the meantime been under treatment for other diseases in general hospitals.

General hospitals which attempt to exclude pulmonary tuberculosis can render valuable assistance to the anti-tuberculosis movement by diagnosing these early cases by means of tuberculin when necessary and thus set a standard for the early diagnosis of tuberculosis in the communities in which they are located.

The simplicity of application and absence of constitutional symptoms attending the ophthalmo-tuberculin test and Von Pirquet's cutaneous test are obvious advantages. Should they prove as accurate and as safe as the subcutaneous method, the use of the latter will doubtless become infrequent. I have seen too few cases to express an opinion as to their accuracy, especially as I have seen no autopsies. In 2 of my suspected cases which were entirely negative to the ophthalmo-tuberculin test, typical tuberculin reactions followed the subcutaneous injection of 5 mgm. One of these cases also showed a decided cutaneous reaction. One case which failed to react to the cutaneous test* also reacted positively to 5 mgm. by subcutaneous injection.

It will take years for the accuracy and safety of the cutaneous and ophthalmic tests to be as sufficiently verified by autopsies and clinical work as is the subcutaneous test to-day, and in the meantime suspected cases giving negative reactions to these tests should subsequently be given the subcutaneous test unless the general condition of the patient or an inability to record his temperature prevent the application of the last-named method.

The local reactions in the lung which frequently follow the subcutaneous injection give this method a distinct advantage in accuracy over its rivals.

The circular letters from the hospitals above referred to showed that of 74 hospitals using the ophthalmo-tuberculin test 61, or 85%, had experienced no bad results.

One physician reported: "In my own case recently a postponed ophthalmic test might have been confused by an infection of pink eye that would otherwise have given me a bad scare with no means of proving an error." From this case it would seem that the ophthalmo-tuberculin reaction is of doubtful value during epidemics of pink eye.

Thirteen hospitals reported the unfavorable results given below:

Five, "Severe reactions."

One, "One case suppurative conjunctivitis due possibly to previous chronic conjunctivitis."

One, "Two cases of severe conjunctivitis."

Three, Conjunctivitis lasting several weeks.

Three, Ulceration of the cornea.

Six of these eleven hospitals reported that no history of previous disease of the conjunctiva or cornea could be obtained in the unfavorable cases. This included 2 of the cases of corneal ulceration. These bad results from the ophthalmic test show that great caution is required in the selection of cases for this method and that great care should be exercised in the technic. Patients who have conjunctivitis or who have ever had disease of the iris or cornea should not be given this test. For patients in hospital wards, or for patients whose temperatures can be watched in their homes, the subcutaneous test is much to be preferred. One hospital reported several severe reactions from the cutaneous test.

* A 25% solution of old tuberculin was used.

In order to ascertain the extent to which medical students are being taught the needs of the tuberculin test and its practical application, circular letters were sent to all the medical colleges in the United States asking the following questions:

1. Are your students taught that pulmonary tuberculosis may occasionally be present when no signs of the disease can be detected on physical examination by an expert?

2. Are your students taught that if there is continued doubt as to the presence or absence of pulmonary tuberculosis after careful study of a case, that the tuberculin test should be resorted to?

3. Is the tuberculin reaction (by subcutaneous injection) in doubtful cases of pulmonary tuberculosis demonstrated to your students?

4. Is Calmette's ophthalmo-tuberculin test demonstrated to your students?

5. Is Von Pirquet's tuberculin skin reaction demonstrated to your students?

Eighty-one replies were received from medical colleges in 26 states. Of these, 78, or 96.1%, answered the first question in the affirmative. Seventy-one, or 87.6%, advised their students to resort to the tuberculin test in case there was "continued doubt," etc., and 10, or 12.3%, did not advise its use. Sixty-two, or 76.5%, demonstrated the tuberculin test in some form. Fifty-one, or 62.9%, gave demonstrations of the test by subcutaneous injection, and 29, or 37%, did not do so. Fifty-seven medical colleges, or 70.3%, were demonstrating the ophthalmo-tuberculin test to their students and 30, or 37%, were demonstrating the cutaneous reaction.

One prominent university answered, "Yes, but not sufficiently," to all five questions; another prominent university answered that the demonstrations were given in sections and that some students might not see them. Many regretted that it was not more thoroughly done. One reply stated that the test was unsafe, and another that sputum examinations were sufficient for diagnosis.

Medical colleges should make special efforts not only to have their students trained in physical diagnosis, but to have them impressed with the fact that in spite of all the training in physical diagnosis thus far given, and all the agitation concerning tuberculosis during the past ten years, a comparatively small proportion of tuberculous patients are diagnosed in the incipient stage of the disease. If our medical students are not thoroughly trained in the use of a diagnostic agent found necessary in the detection of doubtful cases; by Koch,¹ Turban,²⁸ Heron,¹⁷ Trudeau,²⁹ Osler³⁰ and a host of careful clinicians, it must be expected that a large proportion of these doubtful cases which develop sooner or later in every community will continue to drift into the advanced stages before a positive diagnosis is made.

SUMMARY.

1. The tuberculin test is at present necessary for the prompt diagnosis of many suspected cases of pulmonary tuberculosis.

2. Of 8 cases reacting positively, in which the subcutaneous test was given as a routine without reference to symptoms of tuberculosis, at least one had no tuberculosis in the thorax or abdomen.

3. Of 6 patients reacting negatively to 4 and 7 mgm., 2 had healed lesions in the lungs.

4. The tuberculin test should be given only to patients who have symptoms or signs of tuberculosis. If given to other persons a positive reaction has no clinical value because of the uncertainty as to the location of the lesions and the probability of healed lesions reacting.

5. In the great majority of doubtful cases of pulmonary tuberculosis the subcutaneous test will give a correct diagnosis.

6. If given judiciously in small initial doses the subcutaneous test is safe; it should be given in Addison's disease with extreme caution or not at all.

7. Of 225 hospitals in the United States having 75 beds or over, 40% have used tuberculin in the diagnosis of pulmonary tuberculosis, 26.6% have used the subcutaneous method, 32.8% have used the ophthalmic method, 14.2% have used the cutaneous method.

8. The accuracy of the ophthalmic and cutaneous tuberculin tests is yet to be proven and cases reacting negatively to these tests should be tested by the subcutaneous method, unless the last-named method is contra-indicated. Cases suitable for the subcutaneous test should receive it in preference to the ophthalmic test because of its greater safety.

9. Of 81 medical colleges in the United States, 87.6% advise that the tuberculin test be given as a last resort in suspected cases of pulmonary tuberculosis, 76.5% have demonstrated the tuberculin test to their students, 62.9% have demonstrated the test by subcutaneous injection, 70.3% have demonstrated the ophthalmic test, 37% have demonstrated the cutaneous test.

10. All medical students should be thoroughly trained in the use of the three methods of applying the tuberculin test.

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