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THE COMPARATIVE VALUE OF PHYSICAL EXAMINATION AND X-RAY IN THE DIAGNOSIS AND PREVENTION OF PULMONARY TUBERCULOSIS

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AUENBRUGGER and Laënnec were the two men whose genius made possible the physical diagnosis of diseases of the chest. In 1754 Auenbrugger discovered percussion. He had frequently seen his father, who was an innkeeper, tap on wine barrels to determine the amount of wine in them; so he applied the same principle to the chest. He tapped on the chest of a patient and found that it gave a resonance. He then noted that this resonance differed according to whether the lung was normal or infiltrated. This was such a new departure in clinical practice that its importance was not appreciated even by the three able clinicians who filled the Chairs of Medicine in the University of Vienna at that time — Van Swieten, De Haen and Stoll. In fact, Stoll was the only one who mentioned percussion in his writings. Auenbrugger died without knowing that he was to become famous as the originator of physical examination of the chest.

After seven years of practice in percussion, in 1761 Auenbrugger published his findings in "Inventum Novum". Percussion was buried for nearly fifty years after its discovery, until Corvisart, finding Viennese medicine superior to that of Paris, studied the works of the Viennese physicians and found that Stoll in his "Aphorisms" (which Corvisart translated into French) had described a method of directly examining the lungs. Corvisart was impressed with the value of this method and started to use percussion in his clinical work. In 1808 he published his experience in a book of 440 pages, amplifying the modest 95 pages published by Auenbrugger in 1761.

Among Corvisart's associates was Laënnec who was to become one of the most renowned of physicians by inventing the stethoscope and establishing auscultation as a regular procedure in the examination of the chest. Auscultation of the chest had been used to some extent by the Greeks. It was mentioned by Hippocrates, but received no further attention until early in the nineteenth century when Laënnec applied percussion and auscultation to both the heart and lungs. To overcome the difficulties of listening to the apex of the heart by the ear alone, he used a roll of paper, putting one end over the apex area and placing his ear at the other end; and so invented the stethoscope. He then proceeded to classify the sounds that he heard over the lungs.

With Corvisart and Laënnec, the French school of medicine became dominant and for a time physicians traveled from different countries to Paris to learn physical examination of the heart and lungs. Thus French medicine was able to establish physical diagnosis of the chest. However, it had valuable assistance from Skoda of Vienna.

The diagnosis of tuberculosis was for a long time the diagnosis of a far-advanced disease. The nature of the disease was not known. A few investigators had the idea that it was an infection, yet this fact was not established until after physical diagnosis had been made a regular clinical procedure and tuberculosis had begun to be treated clinically.

In 1859 Brehmer established the first permanent sanatorium in the world for the treatment of tuberculosis. He had two great teachers who inspired him to study tuberculosis: Skoda and Rokitansky. Moreover, his interest was stimulated by the fact that he himself had an infection. The treatment of patients as devised by him in his sanatorium was determined by careful physical diagnosis as taught by Skoda, and based on the theory promulgated by

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Rokitansky that the cause of tuberculosis was a heart too small to keep the tissues properly oxygenated. One of the chief factors in treatment consisted of measures for strengthening this inadequate heart. Brehmer's sanatorium was an immediate success. The patients improved as no tuberculous patients had ever before been seen to do. Other institutions soon followed, and physical diagnosis now had new interest for medical men; but early diagnosis was still in the future. Most of the patients who were treated in these early sanatoria suffered from advanced and far-advanced disease.

In 1882 Koch discovered the tubercle bacillus. This presented a challenge to the clinician because tubercle bacilli were sometimes found when percussion and auscultatory changes in the lung were absent or were so slight that the disease was not recognized. But spurred on by the presence of bacilli, clinicians began to struggle to find these early cases.

In 1888 Parrot, a Frenchman, pointed out that when tuberculosis is present in the lung there will also be found infection of the regional lymph glands; and the corollary, that whenever infection is present in the lymph glands a focus will be found in the lung itself. This was an observation regarding primary infection — something entirely unknown at the time. It was not yet recognized that primary infection differed from active disease, and usually took place long before the disease became apparent.

In 1890 Koch discovered tuberculin, which was used for diagnosis. This perplexed clinicians further, for some patients who reacted to tuberculin presented no physical signs of disease or bacilli in the sputum. Physicians accepted the tuberculin reaction as indicating the presence of tuberculosis, but failed to realize that primary infection might be present without causing symptoms and still sensitize the patient to tuberculin; and that a tuberculin reaction simply meant the presence of infection somewhere in the body. Nevertheless, we persisted in our efforts to improve our ability to examine and were rewarded by being able to detect smaller and smaller active lesions.

The key to this riddle was found between 1907 and 1912, with the discovery of local tuberculin tests and tuberculo-allergy; and the understanding of the effect of first infection in producing hypersensitivity of the fixed cells of the body. In 1907 von Pirquet developed the cutaneous tuberculin test; Wolff-Eisner and Calmette, the ophthalmic test; and Mantoux, the intradermal test. This indicated that infection caused widespread sensitization of body cells. These tests were then applied to large segments of the population, particularly children who definitely were not suffering from tuberculosis, and it was found that nearly all children living in cities reacted before they were 14 years of age. It was then realized that a tuberculin reaction meant only that tubercle bacilli had established themselves in the tissues and that it had no significance in determining whether or not the infection had caused disease.

In 1912 Ghon helped to clarify the situation by the publication of studies of primary infection which he had carried on since 1903. He noted that there were two components of the primary infection as mentioned by Parrot, and also that primary infection usually proceeded to quiescence or healing. About this same time Ranke designated the primary infection in the tissues and the lymph gland component the "primary complex", distinguishing it from disease. Then the problems began to clarify and clinicians accepted as fact that any infection with tubercle bacilli might cause a tuberculin reaction. It was further established that the primary complex was not detectable by physical examination unless it metastasized and caused disease.

As a result of the challenges made by the finding of bacilli in the sputum, the use of tuberculin hypodermically and, later, the local tests and the studies of the primary infection by Ghon and Ranke, clinicians were spurred on to a high degree of efficiency in the use of auscultation and percussion in detecting early tuberculosis. Soon after, the x-ray came to the clinician's assistance in differentiating between primary infection and clinical disease.

In 1909 I discovered the reflexes from the lung which show themselves in spasm of the muscles of the shoulder girdle and the crus and central tendon of the diaphragm when tuberculosis of the lung is active, and in atrophy of the same and the skin and subcutaneous tissue above the second rib anteriorly and the spine of the scapula posteriorly when the disease is chronic or healed. I also described the reflexes from the pleura which show in the intercostal tissues and in the skin and subcutaneous tissue immediately overlying them — the intercostal muscles being tense when the disease is active, and degenerated along with other intercostal tissues and the overlying skin and subcutaneous tissue when the disease is chronic or healed. At this same time I discovered the ability to palpate and outline the heart

and structures of different densities in the chest. Thus inspection and palpation were added to percussion and auscultation as direct methods of examining the chest. By a series of studies extending from 1895 to the present time, I have finally shown that the respiratory murmur is caused by the entire respiratory mechanism — everything in it which is capable of causing sound vibrations — instead of the air column impinging upon and dilating the bronchi and air cells, as suggested by Laënnec.

We now have inspection, palpation, percussion, and a new conception of auscultation on which to rely for information on physical examination of the lungs and pleura. With the combined use of all these technics, we are able to make the physical examination a procedure of much greater accuracy than heretofore.

THE PLACE OF X-RAY IN TUBERCULOSIS

As we were beginning to feel fairly secure in making early diagnoses by clinical history, physical examination and examination of the sputum, the x-ray came into use and became a rival of physical examination. Today it has almost displaced physical studies of the patient.

The x-ray was discovered in 1895 by William Roentgen. During the first decade of the twentieth century it was applied successfully in the examination of the chest. Subsequent improvements have greatly increased its accuracy, and it is now used by many physicians as a substitute for accurate physical study of the patient. The x-ray gives a valuable picture of the changes occurring during the course of tuberculosis, but it must be remembered that it is not always the complete picture. X-ray study, too, has its deficiencies and cannot rationally displace the study of the patient by physical methods. Neither physical examination nor the x-ray alone — or even both together — provides a perfect picture of what exists within a chest and the manner in which the patient responds to it. They are supplementary and both should be used in all cases, not only for diagnosis but for study of the patient and guidance in therapy.

PREVENTION OF TUBERCULOSIS

In the program for the prevention of tuberculosis, the x-ray has taken a place that nothing else can fill. Through years of experience with the tuberculin test, coupled with x-raying of reactors in the schools, x-raying of entrants to hospitals and workers in industry, it has finally been shown that mass x-ray screening holds first place in the detection of tuberculosis in the general population. This screening process with the x-ray gives a fairly accurate idea of the amount and relative severity of tuberculosis in a community. In addition, it gives information regarding nontuberculous pathology within the lung such as cancer, bronchiectasis and fungus diseases as well as diseases of the heart.

If patients are left to themselves to consult a physician on the appearance of symptoms which they consider as being caused by tuberculosis, in 80 per cent of cases the disease will be advanced or far-advanced when diagnosed; this is the general situation at present. Many of the more limited lesions are attributed by both patient and physician to conditions other than tuberculosis. On the other hand, in cities with mass x-raying programs as Washington, Minneapolis and St. Paul, about 80 per cent of patients found to have active tuberculosis are suffering from minimal lesions, most of whom are curable and can be restored to usefulness with a minimum expenditure of time and money.

Thus mass x-raying, with the usual follow-up program, gives an overall picture of the infection problems and the therapeutic problems presented by tuberculosis in the community, and must be accepted as the most important method to be used in the prevention of tuberculosis. However, the x-ray alone is not sufficient. Every patient with suspicious x-ray findings must receive careful clinical consideration. So while the x-ray detects the problem, physical examination directs the answer.

Furthermore, only complete study can determine the conditions under which Bacillus Calmette-Guerin vaccination (BCG) may be utilized to the advantage of a community. The use of BCG is limited to those individuals who do not have the protection of a primary infection. It infects with a bacillus so mild that it will not even cause disease in a guinea pig, yet it stimulates the immunity mechanism and produces a degree of protection against natural infection with virulent bacilli. Moreover, its administration is harmless and will not produce foci from which metastases may take place. In the experience of many countries in which millions of vaccinations have been done, not a single person has been reported to have contracted active tuberculosis as a result of the use of BCG, and there has been a great reduction in the incidence of disease as shown by a comparison of vaccinated and unvaccinated groups of patients exposed to equal degrees of infection.

Now for the first time in history we can offer a

complete program for the eradication of tuberculosis in a community:

1. X-ray screening of the population with the small 75 mm. film.
2. A large film of all patients who show suspicious areas on small films.
3. Adequate instruction of all persons who show disease and those who live with them in methods of preventing the spread of infection.
4. Adequate study and treatment of all patients with active disease.
5. Vaccination of all nonreactors who have been exposed.
6. General vaccination of children who do not react to tuberculin, and so are not protected by previous infection.
7. Follow-up of this program at suitable intervals over a generation or until all depots of infection have been found and eliminated.

Thus it can be seen that the x-ray is at the basis of the final program for the prevention of tuberculosis, but that physical examination is necessary to the triumphant result. If prevention had to depend on physical and sputum examination and vaccination of uninfected persons exposed to tuberculosis, the disease could probably be eradicated, but it would take a much longer time and be far more costly in lives and money.

With the present status of roentgenology, the diagnosis and therapy of tuberculosis could be carried on with a minimal use of physical examination, but much information of inestimable value to the patient would be lost. Machines cannot practice medicine. The study of the patient by a well trained clinician is necessary. It must be emphasized that there is a patient who has the disease and that his reactions as an individual are as important, indeed often more important, than the disease itself.

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