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ON THE DIAGNOSIS OF THORACIC AND CARDIAC ANEURYSM BY THE RÖNTGEN RAYS.

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(PLATES IX.—XI.)

OF all the various cases of chest disease to which the Röntgen rays may be applied, for the purpose of diagnosis, and perhaps even prognosis, there are none in which they are found to be of greater value than in the diagnosis of thoracic aneurysm. So much so is this the case, that I think we are justified in going so far as to assert that it is the duty of the physician to make use of this method of examination in all doubtful cases of chest disease, especially if from the signs and symptoms an aneurysm be sus-

pected. At a recent meeting of the Medical Society of London, a discussion was held on the diagnosis and treatment of aneurysm of the aorta. The value of the various signs of an aortic aneurysm, such as, tracheal tugging, diastolic shock, paralysis of the vocal cords, etc., were discussed, but no two speakers were in accord as to the value of these signs. The difficulty sometimes experienced in the diagnosis of aortic aneurysm, especially of the transverse and descending arch, was acknowledged by all. A method, therefore, by which an aneurysm, or rather the shadow thereof, can be actually seen must obviously be of immense value in diagnosis. It will be my endeavour in this paper to establish the value of the Röntgen rays as a means of diagnosis, and perhaps of prognosis, in cases of cardiac and thoracic aneurysm. It will be well, however, at the outset, to give a short description of the apparatus employed. To attempt to obtain a skiagram of the chest that will be really useful in diagnosis, without an efficient coil or tube, is worse than useless, and only brings the whole method into discredit. The coil made use of in taking the accompanying skiagrams is one giving nominally a 12-in. spark, but when worked at high pressure is capable of giving a spark 14 in. in length. The secondary coil has some fifteen miles of wire wound in seventy sections. It is worked by two 4-cell accumulators of 21 ampère-hours capacity, and an electromotive force of 16 volts. The tube must be one of, technically speaking, sufficient hardness or penetrating power. So much for the apparatus.

The next most important points are, the time of exposure and the distance of the tube from the photographic plate. The time of exposure must necessarily depend a good deal on the patient. Age, sex, muscular development, fatness or thinness of the patient, must all be taken into account to obtain a successful result. Young patients and females will require a shorter exposure than adults and males. Very fat or very muscular persons will require a longer exposure than thin and emaciated individuals. As a rule, for thin patients, about one minute fifty seconds will probably be sufficient. For a very muscular patient, three or even four minutes may be required, always provided a 12-in. coil be used. With regard to the height of the tube above the photographic plate, a more stringent rule can be laid down. We must always remember that the nearer the organ to be skiagraphed is to the photographic plate, the sharper will be its shadow and the less its magnification. The further the organ is from the plate, the more blurred is its shadow and the greater is its magnification, the tube remaining immovable. All these points must be duly considered before drawing any conclusions from the picture, especially when working with the screen, in which case the tube must only be a few inches from the wall of the chest.

In taking a skiagram, however, after a certain distance is

passed, the height of the tube becomes a matter of less importance, as the following experiment will show.

Two coins of the same size were placed on the thorax of a skeleton, one on the posterior part of the ribs near the spine, the other on the edge of the sternum which was furthest from the plate. The shadow of the coin on the ribs, that is the one nearest the plate, appeared its natural size, the coin on the sternum was magnified somewhat, its diameter being about $\frac{3}{8}$ in. larger than the other coin. The tube was placed 4 ft. above the plate. With the tube only a few inches from the chest wall, as in a screen examination, the shadow of the coin on the sternum was of course much more magnified, nearly four times.

Allowing, then, for this magnification of the shadow, a good height to work at in chest cases is 4 ft. above the surface of the plate. One word with reference to the photographic plate. Nearly any make of rapid gelatin dry plate will do, only the more rapid the better. A good size for chest work is 10 by 12 in.

I will now pass on to the methods of examining the chest with the X-rays. They may be divided into three principal divisions—

1. Examination by the screen, or radioscopy.
2. Examination by the plate, or radiography.
3. Examination by the stereoscopic method, either by screen or plate.

We may subdivide these again into—

- (a) Examination from the front of chest.
- (b) Examination from the back of chest.
- (c) Examination by the lateral oblique method.

The method generally employed in making a chest examination is as follows:—

The patient lies on a couch in the prone or supine position, with the front or back of the chest resting on the plate, which is protected from breakage by being placed on a board. The tube, in a suitable holder, is placed in position above the chest, with the anticathode at right angles to the plane of plate. I usually employ the anterior method, but of course both may have to be used in examining for an aneurysm. The reason for this I shall return to later on.

If we wish to obtain a stereoscopic view of the chest, the procedure is somewhat different. But this method should always be employed in a case of suspected aneurysm of the aorta. We require a special apparatus, such as that invented by Mr. Mackenzie Davidson. It consists of a stout wooden frame covered with parchment.

An upright rod carries a horizontal graduated bar, on which the tube slides. This horizontal bar can be raised or lowered as desired. The patient rests with the chest on the parchment cover. The plate, enclosed in an opaque envelope, is placed under

the parchment, and kept in position by means of a lever and a screw. The horizontal bar is now placed at the required height above the chest, and the tube brought to the zero point, which is in the middle of the bar. The tube is thus brought vertically over the spine of the patient. The tube is now displaced 30 millimetres to the right of the zero point, and an exposure given of say two minutes. The current is then switched off, the plate removed, and another placed in position, without disturbing the posture of the patient. The tube is now displaced 30 millimetres to the left of the zero point, and another exposure of the same time as the former one is given. We have thus obtained two negatives of the chest, from two different points of view, 60 millimetres apart. When prints are taken from these negatives and placed in a Wheatstone's reflecting stereoscope, a stereoscopic effect is obtained. By this method we obtain the third dimension in space, which must obviously be of great importance in examining a chest for an aneurysm of the aorta. In this way we shall probably be enabled to localise an aneurysm to the part of the vessel from which it originates. The process may seem a complicated one, but is in reality extremely simple. The stereoscopic method can also be applied with the screen, after the very ingenious method of Mr. Mackenzie Davidson.

For the diagnosis of aneurysms of the descending thoracic aorta, the following method, recommended by M. Mignon of Nice, and also practised by Professor Holzrecht of Vienna, may be used, either with screen or plate. This is the lateral oblique method mentioned above. It is a well-known fact to all workers in chest radiography or radioscopy that a strictly lateral view of the chest shows nothing definite, but if a three-quarter view can be obtained, much may be learned of the condition of mediastina by this means. On the screen, by this method, one sees a clear zone of somewhat triangular form bounded as follows:—Below by the convex shadow of the diaphragm, in front by the shadow of the heart, behind by the shadow of the vertebral column, which shadow, of course, includes those of the aorta, vena cava, and œsophagus. M. Mignon proposes to call this clear zone the retro-cardiac triangle. There is another clear triangular space seen in front of the heart shadow corresponding to the anterior mediastinum.

Tumours originating in the anterior mediastinum, or aneurysms in the posterior mediastinum, can occasionally be well seen in this way. Any bulging of the vertical vertebral spinal shadow would indicate an aneurysm springing from the thoracic aorta or an œsophageal tumour, the rarity of the latter, however, making an aneurysm probable. I have tried this method in a few cases. The anterior triangular clear space is seen easily enough, but the shadows in the retro-cardiac triangle are more difficult; but I have seen this retro-cardiac triangle filled up with shadow in a case of enlarged mediastinal glands.

As with the stethoscope it is impossible to say if a murmur be present or not without knowing the normal sounds of the heart, so with the skiagram it is impossible to say if an aneurysm be present or not without a knowledge of the normal shadow of the heart and aorta. It will be well, therefore, to give an illustration of the heart and aortic shadows in a skiagram of a healthy adult (Plate IX. Fig. 1).

The chest is viewed from the front. We see well the shadow of the heart and aorta; the latter shadow may be traced nearly up to the manubrium sterni, where it is lost. The next illustration (Fig. 2) shows a projecting shadow to the left of the aortic arch, which might be easily mistaken for a commencing aneurysm of that vessel.

This shadow is frequently seen in cases in which we have no reason to suspect an aneurysm, and it is probably a normal shadow of the junction of the transverse with descending thoracic aorta. It is accentuated if the tube be placed a little obliquely to the plate. We must therefore be cautious in drawing any inference from this shadow. It is, however, always of small size.

It may be as well to say now a few words with reference to the danger of exposing the patient to the Röntgen rays. That a severe dermatitis may be produced by prolonged or repeated short exposure to the X-rays, is a fact beyond question. I have seen four cases where a bad X-ray burn was so produced; but in each of these the rays were used therapeutically. I have, in an experience of over five years, never seen any injury arise from the exposure necessary for obtaining a skiagram of the chest.

This danger has been completely obviated by the introduction of the large coils now in use, which thus enables us to make the exposure so short that any fear of setting up a dermatitis may be disregarded. I will now give three cases of aneurysm of the aorta which were first discovered by the Röntgen rays:—

CASE 1.—A gentleman, *æt.* 45, was sent to me by my colleague, Dr. Heron, for an X-ray examination of the chest. This gentleman had been seen by three consulting physicians in London. He had been under treatment for intercostal neuralgia. The physical signs were obscure. There was a little tenderness on percussion over the upper dorsal vertebræ. There was no dulness to be made out, no tracheal tugging, pupils equal. No cough, and only slight dyspnoea. But it only required, however, a moment's inspection with the screen to see that this gentleman had a large aneurysm of the thoracic aorta. A skiagram was taken, and the result is shown in Plate IX. Fig. 3.

CASE 2.—The next case was that of a woman, *æt.* 51, whom I admitted to the City of London Hospital for Diseases of the Chest, as long ago as 1897, with the signs of aortic regurgitation. She remained in the hospital eight weeks, and at the end of that time she was discharged considerably improved. She returned to the out-patient room towards the latter part of December of last year, saying she had

been in much the same condition, but the pain in the back, especially between the shoulders, had become much worse. She described this pain as if "a piece of broken glass were being scratched up and down the spine between the shoulders." As an X-ray apparatus had been installed in the hospital since the patient's first admission, I at once examined her chest with the screen, and had no difficulty in diagnosing an aneurysm of the descending thoracic aorta. I immediately looked up the in-patient notes, and found the physician under whose care the patient was placed when in hospital had diagnosed, like myself, aortic obstruction and regurgitation. I found such negative notes as these, "No tracheal tugging," "Cords move well," etc.

Of course it is an open question as to whether the aneurysm existed in 1897; all that can be said is, that at that time, as at this, it gave no physical signs of its presence. I anticipate that when the Röntgen rays come into more general use in the diagnosis of chest disease, aneurysms of the aorta will be discovered much earlier than they are at present. I think we may possibly find that the life of an aortic aneurysm is much longer than is usually supposed. As Sir Richard Douglas Powell very truly says,¹ "the commencement of an aneurysm of the aorta is unmarked by symptoms, and the disease may continue latent up to the time of death." I think, with such a means of diagnosis as the X-rays at our disposal, these cases will become rare. Such a case should go no longer undiagnosed.

The skiagram (Plate X. Fig. 4) was taken in December last, and shows the aneurysm of the thoracic aorta. The chest is viewed from the front.

CASE 3.—A patient, a woman, *æt.* 58, was admitted to the hospital under my colleague, Dr. Clifford Beale. She had been sent up from the country with the diagnosis of laryngeal phthisis. On examination of the larynx, the left vocal cord was found to be paralysed, which of course in itself was a very suspicious sign of an aneurysm. Nevertheless no other symptom or sign of aneurysm existed; it was only on a screen examination that a large aneurysm of the transverse arch was found (Fig. 5). The chest is viewed from the back.

I think the three above cases are almost enough in themselves to establish the usefulness of the rays in the diagnosis of thoracic aneurysm. I will, however, give one more case.

CASE 4.—A man, *æt.* 37, was admitted to St. Bartholomew's Hospital, under the care of Sir William Church. The diagnosis of an interthoracic tumour was made, and the case was sent to the Electrical Department for an X-ray examination of the chest.

The skiagram showed conclusively that there was a large aneurysm of the aorta. The patient is still under treatment.

For the diagnosis of an aneurysm the shadow must be in continuity with the heart or aorta. The shadow cast by an interthoracic new growth is quite different.

The skiagram of an aortic aneurysm (Fig. 6) was kindly lent

¹ Reynolds, "System of Medicine," vol. v. p. 29.

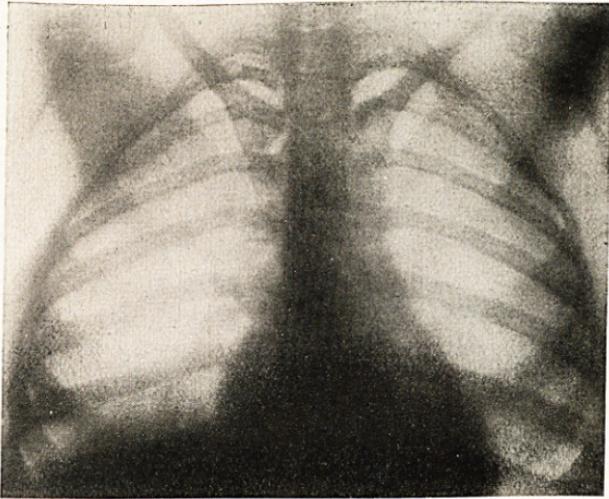


FIG. 1.

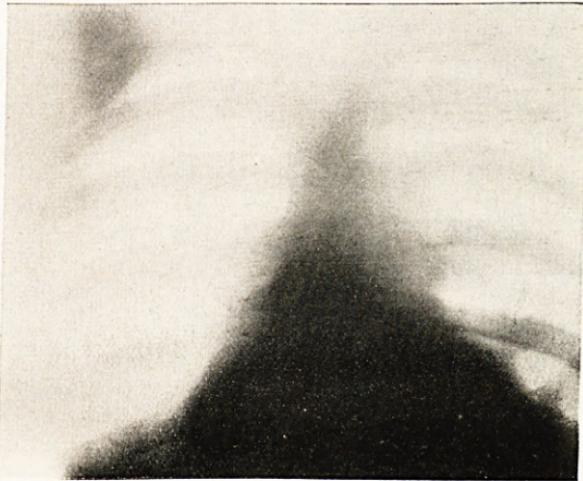


FIG. 2.



FIG. 3.

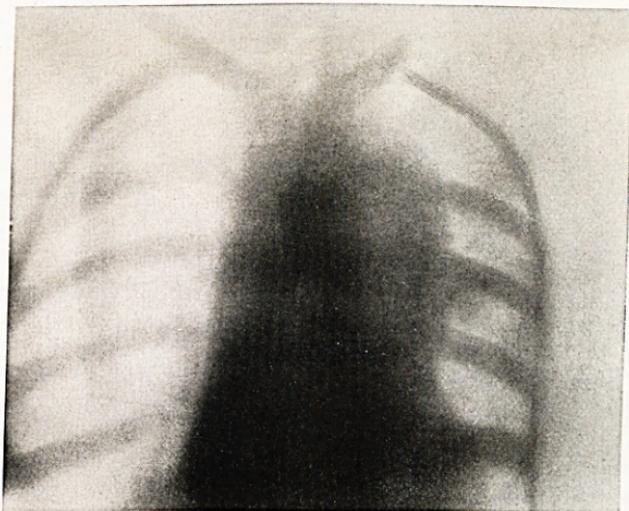


FIG. 4.

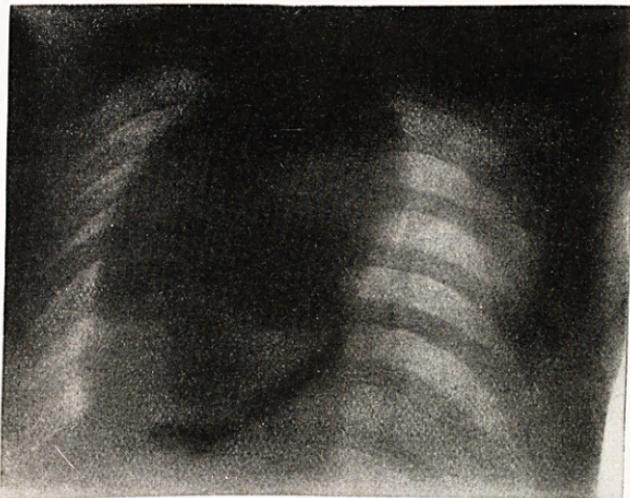


FIG. 5

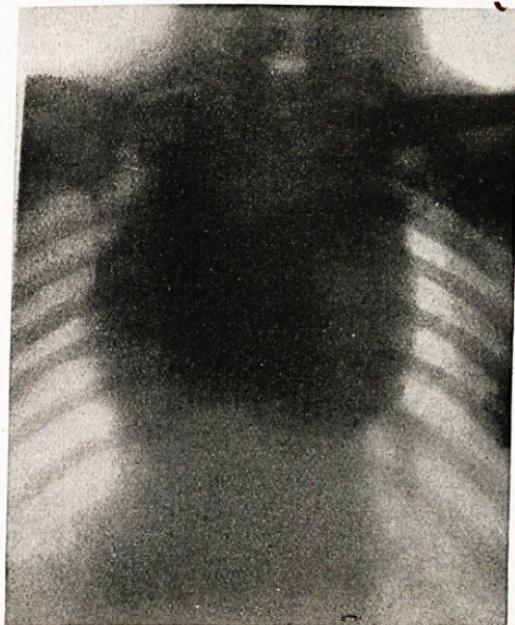


FIG. 6.



FIG. 7.

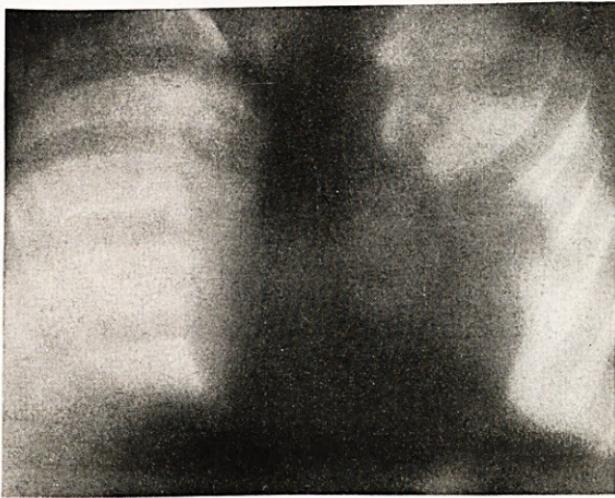


FIG. 8.



FIG. 9.

to me by my friend Mr. Payne, who is in charge of the X-ray department of the Sussex County Hospital.

The difference between the density of the heart shadow and the shadow of the aneurysmal sac is well marked, the latter being much the denser of the two. This is an important point from a prognostic point of view.

We know that fluid blood is almost completely transparent to the rays. The greater the density of the aneurysmal sac, therefore the more abundant the laminated clot in the sac of the aneurysm, because clotted blood is comparatively opaque to the rays, so the density of the shadow has some prognostic value.

Now, a word with reference to the position of the heart in some of these cases. Plate XI. Fig. 7 is from a skiagram of the chest of a gentleman who was seen, I think, by nearly all the consulting physicians in London. The skiagram only shows the sac of the aneurysm. Post-mortem, the heart was found lying nearly transversely in the chest, as if pressed into that position by the superincumbent weight of the sac of the aneurysm. I have noticed on three or four occasions, when examining with the screen, this transverse position of the heart in cases of aneurysm of the aorta.

This position of the heart is, I think, a very important sign of aortic aneurysm, and one not sufficiently insisted upon. For instance, a man, *æt.* 51, came to the out-patient room complaining of pain in the back between the shoulders, and dyspnoea of three months' duration. On examination, he was found to have well-marked signs of aortic regurgitation. There was no pulsation to be felt on the chest wall, no dysphagia, no cough, no cord paralysis, no definite tracheal tugging, the pulse was collapsing but equal on each side. The apex beat was displaced somewhat outwards but not downwards, as one would have expected from the amount of regurgitation, as judged by the pulse. On percussion, the heart was found to be lying almost transversely in the chest. There was also very marked epigastric pulsation. This case, excepting the position of the heart, might have been passed as one of simple aortic regurgitation. On a screen examination, however, the patient was found to have an aneurysm of his aorta. One was induced to look for an aneurysm by this transverse position of the heart.

If space permitted, there are many more cases of aneurysm of the thoracic aorta, which I have examined by the X-rays, which I should like to give, but I must be content.

I will now pass on to a case of probable cardiac aneurysm; I say probable, because the patient is still under observation, and cardiac aneurysms are confessedly of rare occurrence.

CASE 5.—A man, *æt.* 33, came to the out-patient room complaining of dyspnoea and a "cramp-like feeling" in the region of his heart. There was a specific history of fifteen years ago. In the third and

fourth interspaces on the left side, $3\frac{1}{2}$ in. from the mid-sternal lines there was a diffuse area of pulsation, over which a systolic murmur was audible. The aortic and pulmonary second sounds were clear; at the apex there was a systolic murmur following the first sound. The expansion of the left side of the chest was a little less than the right. The breath sounds all over the left side of the chest were a little weak. Numerous crepitations were heard over the left base behind, pupils equal, no tracheal tugging. Both cords moved well. The pulse was 72, regular and equal on each side. The patient was admitted under the care of Dr. Eustace Smith.

Illustrations 8 and 9, Plate XI., are skiagrams of this patient's chest. Fig. 8 was taken on his admission, Fig. 9 one year after. The chest is viewed from the front. There is a projecting shadow from the left base of the heart corresponding in position to the left auricle, and if aneurysms of this chamber of the heart were not so extremely rare—there being, I believe, only a few cases on record—we might suppose that this shadow was produced by an aneurysm of this chamber of the heart. The tumour was seen plainly pulsating with the screen. It is gradually increasing in size, as shown by the second skiagram. The patient is still under treatment.

Much still remains to be done to perfect this means of diagnosis of cardiac and aortic aneurysms, but I hope, in this short paper, I have sufficiently established the diagnostic power of the X-rays, to induce physicians to use them in addition to the other methods of physical examination at their disposal.

All the skiagrams of the chest are viewed from the front, with the exception of Fig. 5, Plate X., in which the chest is viewed from the back.

OSTEOMALACIA.

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(PLATE XII.)

THE main interest attached to the disease known as osteomalacia is doubtless obstetric in character, and apart from the chapters in obstetric works which deal with the causes and varieties of contracted pelvis, our text-books contain little information on the subject. There is, however, a large amount of recent literature dealing with this disease which is of interest from the physician's point of view, and the object of the present paper is to briefly discuss the condition from this standpoint, and to illustrate it by the record of an example of the disease which has been for a long period under observation.