Practical Points of Diagnosis and Treatment in Medicine.

CHEST RADIOGRAMS.¹

By FRANKLIN G. WOOD, M.B., D.M.R.E.

CHEST films cannot be studied satisfactorily without some knowledge of the method of taking the films and the different positions utilized, together with a knowledge of the relations of the various structures of the chest in each radiogram. If the details of the positions are not known, failure of interpretation of the film may occur, and the significance of the appearances shown may not be grasped. In the usual anterior position the patient has the front of his chest in contact with the aluminium holder or cassette which contains the film, whilst the X-ray tube is at a given distance from the centre of the cassette. X-rays in the form of a cone are emitted from the circular window in the tube, and passing through the patient cast a shadow of the heart, lungs, ribs, &c., on the film. In order that this shadow may be clear, there must be no movement and the breath must be held in full inspiration whilst a short exposure is made. The exposure is of variable length according to the output of the apparatus, size of the patient, and so forth, but is generally about one-tenth of a second.

The radiograph positions are named according to the part of the chest which is in contact with the cassette. Thus we have an anterior view when the anterior chest surface is on the plate, or a posterior view when the posterior chest surface is on the plate. In addition, we can have four oblique views and two lateral views. The possible positions are thus: (1) Anterior; (2) posterior; (3) right anterior oblique; (4) left anterior oblique; (5) right posterior oblique; (6) left posterior oblique; (7) right lateral; (8) left lateral.

The posterior oblique positions are seldom utilized. It is always necessary to know whether the film was taken with the patient lying down, standing or sitting, because alteration in the shape of the heart and the breast shadows will occur. Also, the presence of fluid levels in cavities in the lung or pleura can be determined in an erect view, but will be absent in a film taken lying down.

In the anterior radiogram we can see the heart shadow, the right border of which is formed by the right auricle, and the left border, from above downwards, by the aortic arch, pulmonary artery, left auricle and left ventricle. The greatest movement of the heart shadow occurs in the region of the left auricle, so that the outline here is frequently slightly blurred. On each side are the root shadows, made up of blood-vessels, lymph glands, bronchi, &c., and radiating out from the root to the periphery of the lung in all directions is a series of fine lines, the linear striæ which are probably caused by the blood-vessels running with the bronchi, and to some extent by the bronchi themselves.

¹ The substance of a Post-Graduate Lecture, delivered at the Victoria Park Chest Hospital, on November 26, 1931.

The base of the heart is partly obscured by the domes of the diaphragm, and the right ventricle is not seen in outline in any radiographic position.

THE DIAPHRAGM.

The domes of the diaphragm usually form a smooth curve and strike the periphery of the chest at an angle, the costophrenic angle. This is of importance, because it may be obscured by shadows in cases of pleurisy or pleural effusion. The right dome is usually at a higher level than the left, possibly because the liver lies beneath it, and both domes may show a wavy outline due to irregularities of contraction, which are without significance. Elevation of a dome of the diaphragm may occur from paralysis of the phrenic nerve, the result of disease or surgical interference, or be congenital in cases of Petit's eventration, where the left dome may lie as high as the second or third costal space in the nipple line. One side of the diaphragm may even be absent, so that the shadows cast by the air-containing large bowel are seen mingled with the lung field. Hernia of the diaphragm is relatively uncommon, and is seen as a rounded opacity above the diaphragmatic level, often close to the heart shadow. Barium in the stomach passes up into the pouch, when the patient lies down, and reveals the diagnosis.

THE HEART SHADOW.

The appearance of the heart shadow in a film is altered by a number of factors: (1) The distance between the tube and the film; (2) the position of the patient, whether erect or prone; (3) the size, weight and build of the patient; (4) the age of the patient; (5) the position of the film, whether anterior or posterior.

(1) The effect of increasing the distance between the tube and the film is to make the rays approximate more to the parallel, and thus the size and outline of the heart shows less exaggeration with increasing distance. In order to demonstrate this, radiograms of a patient with a heart lesion were taken at tube distances of 2, 4 and 6 ft. respectively. The transverse diameter was measured in each film with the following results:—

Distance		Diameter of heart
2 feet	...	7.1 inches
4 "	...	6.5 "
6 "	...	6.4 "

It will be observed that, whereas when the tube distance was decreased from 6 ft. to 4 ft. the diameter of the heart shadow was increased by 0.1 of an inch; when the tube distance was decreased from 4 ft. to 2 ft., the heart shadow was increased by 0.6 of an inch. This serves to show that there is considerable distortion in a 2 ft. radiogram. In order to get a reasonably undistorted picture of the heart, it is necessary to take a 6 ft. or 7 ft. radiogram.

(2) In a film taken lying down the heart lies with its long axis rather transverse and it appears larger than in an erect picture, in which position the heart seems to rotate slightly, causing a change in outline, and a diminution in the transverse diameter.

(3) The transverse diameter of the heart varies directly with the patient's weight, and attempts have been made to calculate by a formula the correct diameter for a given weight, allowing for sex. It was hoped by this means to calculate exactly from the film whether a heart was enlarged or not. Unfortunately, the build of the subject has

to be considered. The short, stocky patients have hearts larger than their weights would lead one to expect, whilst the long and thin patients have hearts which are smaller than that calculated for their weight.

(4) The size of the heart relative to the chest varies inversely as the patient's age. Thus in infancy it is relatively large, but the discrepancy gradually disappears, so that probably at about 10 years of age the adult proportions are attained. The outline of the heart in young subjects shows well-rounded convex margins, but its appearance tends to alter with advancing age, one of the appearances commonly seen being an elongated enlarged aortic arch, and a heart with a prominent left ventricle—the so-called golf-club heart—calcified plaques may also be present in the aortic arch where it is seen end-on, giving a ring shape.

(5) The heart appears larger in a posterior film because it is nearer the front of the chest, and further away from the film. This causes it to subtend a greater angle.

It will be readily realized that all the above factors make it very difficult to determine precisely whether we are dealing with cardiac enlargement in a border-line case or not. Probably the best method is to gauge the size by the eye. After noting the size of chest, whether large or small, and the type, whether hypersthenic or hyposthenic from the film appearances, it is usually easy to pick out an enlarged heart. A simple measurement, the cardio-thoracic ratio, i.e., the relation of the transverse diameter of the heart to the transverse diameter of the chest, will help to confirm the decision made. The ratio should not be more than 1 to 2.

When an enlarged heart has been diagnosed, it is possible in some cases of valvular disease to get some information from the film as to what valves are involved. Perhaps the skilled cardiologist after his examination with the stethoscope is already in possession of this information, but it is always advantageous to check clinical information with radiological information. The lesions that usually give a typical picture are uncomplicated cases of mitral stenosis, in which the enlarged left auricle can generally be made out projecting from the left border of the heart and frequently also from the right border, aortic disease where the hypertrophied left ventricle is easily seen, and some cases of congenital heart disease which show a small aortic knob and a large bulge in the pulmonary artery area. Where more than one valve is affected the outline is more complex and a typical shadow is not obtained, so that we can only make a generalized X-ray diagnosis of morbus cordis.

Pericarditis with effusion gives an enlarged heart shadow, which is often difficult to distinguish from that of a failing heart, where the heart shadow may be very large indeed. In some cases of pericarditis with adhesions the left border of the heart tends to be in the form of a straight line as far as the apex rather than a curve; in other cases with much fluid, the outline of the heart can be made out inside the dilated pericardial sac.

THE AORTIC ARCH.

The outline of the aortic arch is altered in aortitis and aneurysm, and may be studied in anterior right oblique and lateral views, as well as on screen examination. An aneurysm gives a spherical shadow, which sometimes, but not always, shows expansile pulsation. It is seen to be related to the aorta and may have an irregular border. Great care is necessary to distinguish it from a mediastinal new growth, which in some cases throws a somewhat similar shadow, and exhibits a transmitted impulse

which may be mistaken for an expansile pulsation. A radiogram taken in the right anterior oblique position after a barium swallow gives information as to the size of the arch of the aorta, pulmonary artery and left auricle, for all of these make impressions on the oesophagus, and distort the path of the opaque barium.

THE ROOT SHADOWS.

The root shadows are important in a film since they are the site where enlarged mediastinal glands may be detected, and because they show the earliest evidence of a mediastinal new growth. They always form prominent shadows in city dwellers. Yet if films of subjects who have spent their lives away from the dirty atmosphere of a city are studied, it will be seen that there is surprisingly little difference between the appearance of the root shadows in the two cases. The tracheo-bronchial glands which form part of the shadow are present in greatest numbers around the main right bronchus, especially along its upper border, and consequently glandular enlargement is most easily detected on the right side. In tuberculous enlargement, they are frequently accompanied by some clouding in the neighbouring lung field, due to involvement of the lung parenchyma. Hodgkin's disease, involving the mediastinal glands, gives a nodular opacity on each side, with smooth borders and no accompanying opacity in the lung field. Very dense opacities are seen in most radiograms at the hila, and represent healed and calcified tuberculous lesions.

THE LUNG SEPTA.

The right lung has two and the left lung one septum. The right horizontal secondary fissure passes from the level of the top of the second dorsal spine horizontally forwards to the anterior part of the fourth rib. It is in the line of radiation in the anterior position, and shows in a clear radiogram as a thin line, unless obscured by a rib shadow. In cases of effusion localized in this fissure, a wedge-shaped opacity is visible with its base at the periphery. The oblique or primary fissure, which is present on both sides, starts from the level of the second dorsal spine and runs downwards and forwards to the anterior extremity of rib six. It throws no shadow in an anterior radiogram, as the rays pass it obliquely, but it can be demonstrated in cases of thickened pleura or effusion if an erect anterior picture is taken with the patient leaning backwards in an attitude of extreme lardosis. An effusion will then show as a diamond-shaped opacity. A lateral radiogram shows both septa if thickened, or if an effusion is present between the lobes. The right horizontal septum seems to be a favourite site for an effusion, but the most common place is, of course, in the pleural cavity proper, when an anterior view will show a marginal opacity which obliterates the costophrenic angle and extends up towards the axilla. The heart is displaced towards the opposite side unless fibrosis or adhesions are present. There is little difference in the shadow between an erect and prone picture, except in very early effusion, when adhesions have not formed, and the level of the shadow moves slightly upwards in the prone position.

THE LUNG FIELDS.

The lung fields are divided for purposes of radiographic description into three zones. The upper zone extends from the apex of the lung to rib two, the middle one from rib two to rib four and the lower one from rib four to the base of the lung. They

are traversed by the linear striæ mentioned above, which pass out in all directions from apex to base. Numerous small opacities about the size of a pin's head are seen scattered about the lung fields, caused by blood-vessels seen end on. In addition, denser shadows may be present of the size of a pea or larger. These are caused by a deposit of calcium in a primary healed tuberculous focus. The commonest site is in the tracheo-bronchial glands at the lung roots, but they may also be present in the lung parenchyma, where they form a "Ghon's focus." As the linear striæ pass out they curve in all directions, and the larger ones form curved outlines, which must not be mistaken for a cavity. It is not possible in a short paper to describe all the variations caused in the lung fields by disease, but the mottling of tuberculous disease should be looked for, especially at the apices, and below the clavicles. Early disease may be seen as scattered fine opacities in one of these situations, caused by tubercles in the lung, or as a single area of clouding about the size of a florin, possibly with a clear area in the centre, due to cavity formation. The larger cavities are shown either as irregular areas of lessened density, or as circular air spaces with definite walls. Pulmonary tuberculosis frequently has a definite distribution in the radiogram, which assists the differential diagnosis. It is seen to be located in one or both upper zones and to be spreading down towards the middle or lower zones. Cavities are commonest in this disease, but are present sometimes in other conditions, e.g., in new growth or lung abscess. The typical mottling of tuberculosis has to be distinguished from the coarser mottling of pneumoconiosis and carcinomatosis. In both these diseases the mottling tends to be present in the upper, middle and lower zones.

X-RAY DIAGNOSIS.

Whilst the history, pathology and clinical condition of the patient is essential for making an accurate diagnosis, it is a good plan to make an independent X-ray diagnosis on the film appearance alone. This will either corroborate or correct the original clinical diagnosis and will be of value in ensuring its accuracy.

SOME EMERGENCIES IN MEDICAL PRACTICE.

BY KENNETH PLAYFAIR, M.A., M.B.CANTAB., M.R.C.P.LOND.

Physician to the Royal Waterloo Hospital for Children and Women; Physician to Queen Mary's Hospital for the East End.

STATES of emergency frequently arise in the course of medical practice. The subject is a large one, too large to be covered in any brief article, but I propose to discuss some of those emergencies that arise in the course of, and are due to, cardio-vascular disease.

Any definition of emergency seems hopeless since that which constitutes an emergency on one occasion may, under more favourable conditions, probably not be regarded as such. However, I would venture the following working definition. An emergency in medical practice is a state of unexpected urgency necessitating immediate non-operative treatment, with a view to the alleviation of the patient or the cure of his condition.

It will probably be more correct if we regard as true states of emergency those that