Histological Appearances of the Nerves.

Both the anterior and posterior tibial nerves were the seat of perineural fibrous thickening, and the fibrosis extended between the various nerve bundles and between individual nerve fibres which appeared atrophied. In places fat could be demonstrated in the nerve fibres.

While the symptoms and appearances described in this case are identical with thrombo-angiitis obliterans occurring in the young subject, syphilis apparently plays no part as an etiological factor in that disease, and no spirochaetes have been demonstrated (Buerger).¹ In Perla's² series of 41 cases 36 gave a negative Wassermann reaction. The term "thrombo-angiitis obliterans" was first employed in 1908 by Buerger, who gave a detailed description of the disease from an examination of 38 cases, but it has been described under various names—such as pre-senile gangrene, non-syphilitic obliterative endarteritis of the Jews, obliterative endarteritis of the young, and endophlebitis and endarteritis, etc., by many of the earlier writers. Russian, Polish, and Rumanian Jews, it is said, are most generally affected. Perla found 41 cases, all Jews, out of 10,000 cases in the records of the Montefiore Hospital, New York, but states that no conclusion can be drawn from this, as 95 per cent. of all the patients there are Jews. Other authors have reported cases among Turks, Chinese, Koreans, and Japanese. The average age of onset is about 30 years, and all the recorded cases have been males; 10 of Perla's cases were tailors. Buerger found the left leg the first to be affected, but Perla the right leg in the largest number of his cases. All the limbs, however, may be affected. Perla described a case occurring in the aorta and coronary arteries as well as in the peripheral vessels of both legs. The disease in all cases originates in the smaller vessels, such as the dorsalis pedis artery, and ascends to the vessels above. The capillaries of the extremity remain free. Professor C. F. M. Saint of Capetown University informs us that he has seen a considerable number of these cases in South Africa in recent years; in certain cases the disease involved both upper and lower extremities.

The histological appearances of the present case show a condition of thrombo-angiitis obliterans with an associated phlebo-sclerosis or phlebo-thrombo-sclerosis, which would appear, in view of the positive Wassermann reaction and the exclusion of other causes, to be of syphilitic nature. Tuberculosis is reasonably excluded from the absence of tuberculous lesions elsewhere. There was no evidence of a generalized miliary tuberculosis or of a tuberculous lesion in the immediate neighbourhood from which direct infiltration could arise. As has already been stated, no tubercle bacilli were detected in the lesions. Such extensive giant cell formation as was present in our case is uncommon in the smaller arteries in syphilis. Buerger described giant cell formation as occurring in the intima, internal to the elastic lamina, and also in the thrombus, and regarded these cells as probably phagocytes assisting in the process of organization. No giant cells were present in any of Perla's cases. It is possible that some of Buerger's cases were of syphilitic origin, as no Wassermann tests were performed, the disease having been excluded on the ground that no spirochaetes were found.

The condition is distinguished from gangrene due to injury, with resulting thrombosis, and thermal gangrene following prolonged exposure to extreme cold, by the fact that these develop in forty-eight hours. The absence of sugar in the urine excludes diabetic gangrene. In arterio-sclerotic endarteritis obliterans the vasomotor phenomena, blanching and hyperaemia, are infrequent, and gangrene supervenes early and progresses more rapidly. Again, physical manifestations of impaired circulation are few prior to the onset of gangrene. Raynaud's disease is distinguished by its sudden onset with local syncope or regional ischaemia, involving the fingers, more rarely the toes and other parts; by short duration of sensory and vascular manifestations; their intermittent character and absence of arterial occlusion between the attacks.

The changes in the vessel walls in the present case would account for the thrombus formation with all the other related symptoms, gangrene, etc., and the sclerosis of the nerves for the atrophic disturbances. The feature of such cases is the slow progressive thrombus formation, with

periods of remission of symptoms and the comparatively late onset of gangrene.

We have difficulty in accepting Buerger's view of a primary thrombosis with secondary change in the vessel wall. It seems more probable that the toxic agent which has caused the condition set up the changes in the vessel wall primarily and that the thrombosis occurred secondarily. No doubt when existing thrombosis has altered the current of blood in an artery abnormal eddies may precipitate thrombosis in other parts of the vessel where there may be no obvious disease in its walls.

The thrombosis in the present case would appear to have originated in the popliteal artery and to have spread progressively downwards to the anterior and posterior tibial arteries, rather than to have ascended from below.

Perla agrees that luetic endarteritis, leading to occlusion of the peripheral arteries of the extremities, while rare, can only be distinguished from thrombo-angiitis obliterans by the presence of other evidences of syphilis.

REFERENCES.

- ¹ Buerger: *Amer. Journ. Med. Sci.*, 1908, 136, pp. 567-580. ² Perla: *Surg., Gynecol. and Obstet.*, 1925, xlii, p. 21.

LIPIODOL IN PULMONARY DIAGNOSIS: ITS USES AND LIMITATIONS.

(With Special Plate.)

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LIPIODOL, a compound of iodine and oil (poppy seed) introduced as a diagnostic aid by J. Forestier, is non-irritant to the tissues of the body and opaque to the x rays*; when injected into the bronchial tree it will flow to the utmost limit of the ramifications and fill the alveoli, rendering both opaque and clear cut. It might be thought, therefore, that by its use bronchiectatic and emphysematous dilatation would be seen, lung cavities demarcated, the position of lung abscesses determined, the site of a broncho-pleural fistula demonstrated, and the existence of a foreign body in the bronchus or a tumour shown; that we should be able to distinguish between an abscess, an old empyema cavity with a fistulous opening into the lung, and bronchiectasis—a problem which not infrequently confronts us; we might also expect to diagnose with greater ease conditions which are notoriously difficult in the early stages—such, for example, as new growths—and be able to assess the significance of the constant clicking basal râles that from time to time puzzle us. How far this expectation has been realized we shall endeavour to show by the cases described below. We have injected lipiodol in over fifty cases at the City of London Hospital for Diseases of the Heart and Lungs, Victoria Park, and it will be seen that while in some instances information of great value was obtained, in others no help was given; or the information obtained was sometimes of a negative character, by which is meant that the examination with lipiodol having excluded bronchiectasis we are driven to search for other conditions which give rise to a similar clinical syndrome.

Methods of Injection.

Several routes for injecting the lipiodol have been used by different workers: (1) through the crico-thyroid membrane; (2) through the trachea below the isthmus of the thyroid gland; (3) the bronchoscopic route; and (4) the transglottic, by means of a laryngeal syringe; a rubber tube extension is sometimes employed, or a weighted catheter which can be passed into the right or left bronchus at will. We have used the first method almost exclusively.

* See BRITISH MEDICAL JOURNAL, 1923, vol. ii, p. 214.

FIG. 1.—Normal.

FIG. 2.—Normal.

FIG. 3.—Bronchiectasis of upper lobes. Case I.

FIG. 4.—Glove-finger type of bronchiectasis. Case II.

FIG. 5.—Chronic bronchitis and emphysema. Case III.

FIG. 6.—Chronic lung abscess. Case IV.

Technique.

A. Apparatus.—(1) A 20 c.cm. glass syringe. (2) A special needle made by Allen and Hanburys (bluntly bevelled, 3/4 in. in length, No. 15 Birmingham wire gauge), or a small trocar and cannula which has been made for us by the same firm,† with a bore of one millimetre only, which is quite sufficient to permit the passage of the oil; or the curved trocar and cannula used by Dr. Armand Delille, like a minute tracheotomy tube, which can be fastened in position by tapes round the neck. (3) Syringe and needles for novocain and cocaine.

B. Lipiodol.—Temperature raised to 100° F. by immersing the metallic container in hot water. This decreases the viscosity, and allows the oil to flow easily.

C. Patient.—(1) Cocaine idiosyncrasy should be tested beforehand by giving an eighth of a grain of cocaine either subcutaneously or by mouth. (2) No food for three hours before the injection. (3) Morphine for adults (one-sixth of a grain hypodermically); tinct. camph. co. in the case of children is perhaps advisable if cough is troublesome. (4) The patient is propped up by pillows over which the head is extended in order to expose the crico-thyroid region. The operator stands on the right side of the patient. (5) The site is prepared with spirit or ether, and not with iodine, as this is opaque to the x rays.

D. Anaesthesia.—(1) A few minims of 2 per cent. novocain are injected intradermally over the crico-thyroid space (larger quantities may obscure the landmarks). (2) Into the trachea 0.5 c.cm. of a 5 per cent. solution of cocaine is injected, a stouter needle being used to avoid the possibility of the needle breaking should the patient cough. The thyroid cartilage is steadied by the left hand, and the needle inserted through the crico-thyroid membrane. To make sure that the needle is in the larynx air should be drawn into the syringe. The cocaine is then injected slowly, but should the patient cough it must be injected quickly, and the needle rapidly withdrawn.

E. Injection of Lipiodol.—Having filled the syringe the needle is introduced through the crico-thyroid membrane. The piston is then withdrawn, and air should enter freely. This test is essential, and should be repeated during the injection. The position of the patient may now be altered according to the part of the lung to be injected. If this is the right lower lobe the above position is satisfactory, as the lipiodol tends to gravitate into the right bronchus; if the left side, the patient should be gently inclined to the left; if the apex, the patient should be placed more horizontally. After the injection the shoulders can be lowered still more. During the injection the patient is told to breathe deeply through the mouth and to suppress swallowing movements and cough. We have injected between 15 and 20 c.cm. of lipiodol as a rule. The procedure should take about five to ten minutes. After the injection any lipiodol on the skin should be wiped off with ether, a collodion dressing applied, and the patient should be radiographed as quickly as possible, both in the horizontal and vertical positions. The manipulation of the patient should be gentle, as otherwise coughing may be induced and part of the lipiodol may be dislodged before an x-ray picture has been obtained.

Effect on the Patient.

Using, as we have done, a very small amount of cocaine solution there is very little, if any, discomfort. Sometimes there is a feeling of constriction; this is relieved by a sip of water. The injection of the oil appears to cause no discomfort, but the patient may complain occasionally of the taste and smell of the lipiodol. In sensitive subjects the symptoms of iodism may occur. This happened in one of the Victoria Park cases, when a characteristic rash appeared. In another case an attack of asthma seemed to be precipitated. Apart from these we have seen no harmful effects, although over fifty injections have been made.

The Normal.

A knowledge of the normal picture is obviously the first essential. Figs. 1 and 2 we consider normal.

The following are illustrative cases.

CASE I.—Early Bronchiectasis. (Fig. 3.)

A girl, aged 12, who had been treated for two or three years as a case of tuberculosis owing to cough, expectoration, and haemoptysis, and abnormal signs over the right upper lobes; tubercle bacilli, however, were never found in the sputum or the faeces. Lipiodol injection showed the condition to be bronchiectasis.

CASE II.—Gross Bronchiectasis. (Fig. 4.)

A woman, aged 26, when between the ages of 6 and 8 had pneumonia on three occasions. At the age of 9 she was treated in hospital for bronchiectasis. On the present occasion she was admitted complaining of increased cough and sputum since an attack of "congestion of the lungs," eighteen months previously. Her fingers and toes were clubbed. She was expectorating 12 to 20 ounces of offensive sputum in the day. A radiogram showed a large dense shadow at the right hilus, and an opacity above the inner part of the right diaphragm. The bases were fairly clear. Two lipiodol injections were given; Fig. 4 shows the picture after the second. Large masses of lipiodol are seen at both bases, and the gloved finger type of bilateral bronchiectasis revealed.

† Latterly one of us (F. G. C.) has used this trocar and cannula exclusively.

CASE III.—Bronchitis and Emphysema. (Fig. 5.)

A man, aged 29, was severely gassed in 1917, and had since complained of recurrent attacks of bronchitis. The chest was barrel-shaped, and there were signs indicative of bronchitis and emphysema. No tubercle bacilli were found in the sputum. A radiogram showed increased striations at the right base. An injection of 18 c.cm. of lipiodol was given through the crico-thyroid membrane. Fig. 5 shows abrupt terminations of the outline of several bronchi and a peculiar flocculent distribution of lipiodol in the alveoli.

CASE IV.—Chronic Lung Abscess. (Fig. 6.)

A boy, aged 12, was sent by Dr. Trower to Charing Cross Hospital. He had had pneumonia at the age of 6, and since then had always had a cough. Three months before admission he had "influenza," and since this illness the cough had become more troublesome and the sputum had increased and had become offensive. The fingers were clubbed. Anteriorly the right side of the chest was impaired to percussion, and the breath sounds were harsh but distant. Posteriorly similar signs were obtained over a more limited area below the angle of the right scapula. The daily sputum amounted to 10 ounces, and had an exceedingly offensive odour. No tubercle bacilli were found, although repeated examinations were made. A radiogram showed an opacity in the mid-zone and base of the right lung. Towards the outer part of the centre of this shadow there was a circular area of lesser density. Lipiodol was injected. This went almost entirely into the left lung, and showed a normal bronchial and alveolar outline. Bronchoscopy was therefore performed by Mr. Davis, and an attempt made to fill the right bronchial tree with lipiodol. Again it failed, but Fig. 6 shows the substance outlining the bronchi up to the diseased area, but going no further. The injection thus excluded bronchiectasis, but failed to differentiate between pulmonary abscess and empyema with a broncho-pleural fistula. The case, however, seemed to be one urgently demanding operation. This was done by Mr. Clogg, and a large pulmonary abscess cavity was found, which was successfully drained.

CASE V.—Empyema Cavity with Broncho-pleural Fistula.

We were anxious to know if lipiodol would demonstrate a broncho-pleural fistula. A case of old chronic empyema of three years' standing was therefore taken, in which 20 ounces of offensive pus had been coughed up one week before admission to hospital. The lipiodol did not appear, in this case, to enter the old empyema cavity.

CASE VI.—Contracted Left Lung. ? Pressure on Main Bronchus.

A man, aged 49, had had repeated attacks of malaria and bronchitis; he had lost 2 st. in weight. He was admitted with bronchitis and bronchopneumonia, and the heart was displaced to the left. After the acute attack subsided he was left with dullness all over the left side, with bronchial breathing, and absence of adventitious sounds. The heart was in the left axilla. The x-ray picture showed a dense opacity all over the left side, with the right lung invading the left side of the thorax and the heart drawn to the left axilla; it gave no clue to the cause of the condition. The Wassermann test was strongly positive. The diagnosis of pressure on the left main bronchus by aneurysm or gumma suggested itself, and lipiodol was injected in the hope that further light would be thrown on the case. A very interesting picture was obtained. Through the opacity could be seen the denser shadow of the lipiodol; the main bronchus appeared to be immensely enlarged, as though flattened out; the bronchi springing from this were enlarged and blunt-ended; they appeared to be uniformly enlarged, but with no bronchiectatic dilatations, and ended abruptly without any of the usual alveolar arrangement of the lipiodol.

CASE VII.—Diabetes and (?) Neoplasm of Lung.

A man, aged 54, was admitted with diabetes, cough, occasional haemoptysis, and pain over the right side of the chest, which had been present for two months. There was slight clubbing of the fingers and dullness on percussion at the right base and absent breath sounds, but no adventitious sounds. There were no tubercle bacilli in the sputum. The radiogram showed a vague shadow, suggesting a possible growth. Lipiodol, however, freely entered this dull "silent" area and had a normal distribution, thus giving no help in the diagnosis.

CASE VIII.—Bronchiectasis.

A man, aged 53, in 1921 suddenly coughed up half a pint of stinking pus and collapsed. From this he recovered. In 1924 he had a large haemoptysis. In January, 1926, he again coughed up pus and fainted. He was brought to hospital; the chest was explored; a little pus was obtained, and an operation for empyema was performed. No empyema was discovered. A little later lipiodol was injected, and a bilateral bronchiectasis was revealed.

The Positive Findings.

In bronchiectasis we get positive evidence of dilatation of the bronchi. The picture appears to be pathognomonic and unequivocal (Figs. 2 and 3). It is the only positive method of proving the diagnosis. It is well known that, as a rule, the ordinary radiogram gives little help in diagnosing bronchiectasis. Either very little can be seen,

or the shadows thrown are similar to those obtained in many different pathological conditions, or the lesion may come behind the heart shadow. The first two points are demonstrated in Case I. Here the physical signs were like those of chronic tuberculosis, and the radiogram could be interpreted in various ways. Lipiodol injections proved the condition to be bronchiectasis. Frequently constant clicking râles are heard at one or both bases. If these are due to bronchiectasis we believe that proof positive can be obtained by the use of lipiodol.

Lipiodol will flow into a tuberculous cavity and outline it or fill it; but as a rule such cavities are obvious on the ordinary radiogram. It would be of value, however, in differentiating a large superficial tuberculous cavity from a localized pneumothorax. We have avoided injecting tuberculous cases as far as possible owing to unfavourable reactions having been reported.

Limitations.

Is there any other picture obtained after lipiodol injection which can be considered unequivocally pathognomonic? The answer is doubtful. Fig. 5 shows the picture obtained in a case of apparent chronic bronchitis and emphysema, and it is in accordance with the appearance described by the French writers on the subject. Frequently the information obtained is of a negative character. In cases of lung abscess and old empyema cavity it has been our experience that the lipiodol stops short at the periphery of the diseased area. This is shown in Fig. 6 (Case IV). We have seen the same thing in other cases.

Apparently, therefore, it would not help us to distinguish between a superficial non-tuberculous lung cavity and a localized pneumothorax, or between a pulmonary abscess and an old empyema cavity. What is obtained, however, is the knowledge that bronchiectasis does not exist, and this may be of value both in diagnosis and treatment. In Case IV lipiodol was also injected through the drainage tube into the abscess cavity; it outlined the lower part of the cavity, and this was all. None appeared to go through the bronchi.

We have injected lipiodol in cases of new growth of the lung, old empyema cavity, tuberculosis, and other conditions mentioned above, but apart from the filling of a tuberculous cavity no special help was given, nor did we obtain what may be called a pathognomonic picture. By this we do not mean to suggest that the method has failed. With an enlarged experience, both in the number of cases and in interpretation, more knowledge may be obtained. It would seem that a distortion or misplacement of a bronchus ought to be made manifest. All that we say is that, except in the cases mentioned, we have not hitherto obtained any strikingly helpful radiograms. Case VI, however, certainly gave a distinctive picture, but though tending to confirm a tentative diagnosis based on inferential reasoning, it did not give positive evidence of the actual underlying cause of the condition.

Summary.

1. Lipiodol injection will apparently enable us to diagnose and localize bronchiectatic dilatations with certainty: moreover, in many cases it is the only method of proving the diagnosis.
2. It enables us to distinguish bronchiectasis from lung abscess, from empyema with a broncho-pleural fistula, and from tuberculosis.
3. With regard to the diagnosis of lung abscess and empyema with a pleural fistula, the help is of a negative character. The lipiodol does not appear to enter the pulmonary abscess, but stops short of it; nor does it easily flow through the bronchial fistula into an empyema cavity.
4. Tuberculous cavities fill readily, but it has been suggested that injections are undesirable in cases of pulmonary tuberculosis.
5. In our opinion the method described is simple and harmless, giving invaluable help in certain cases, but possessing limitations.

We are indebted to Drs. Leggett, J. V. Sparkes, and Russell Reynolds for the skiagrams, especially to Dr. Sparkes, by whom most of the radiological work was done.

"VOLVULUS NEONATORUM."

BY

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THE following case appears worthy of record, as it is, so far as I know, the first of its kind to be recognized from clinical observation and to be successfully treated by operation. The case was one of the disease which I described in 1923 as "volvulus neonatorum." In this condition the normal rotation of the midgut fails to occur during development. In consequence of this the mesentery fails to acquire its secondary attachment to the posterior abdominal wall, and the entire small intestine and right half of the colon depend as a mass from a narrow pedicle at the origin of the superior mesenteric artery. The condition obviously predisposes to a volvulus of this enormous extent of bowel. The accident usually occurs within a few days of birth—probably as a result of the first peristaltic efforts of the intestine in response to feeding. The volvulus is peculiar in that the third part of the duodenum is acutely obstructed by being tightly twisted round the pedicle while the less fixed colon does not suffer. Since the involved bowel has a free exit below through the colon, it does not become distended, but collapsed. The blood supply is but slightly impaired, causing only a moderate cyanosis of the intestinal coils.

Of the diagnosis I wrote as follows:

"In these cases I think a correct diagnosis is . . . possible . . . The child is apparently normal when born and remains so for some days. Meconium is passed, and if the onset of the volvulus has allowed time, food residue appears in the motions in due course on the third or fourth day. With the onset of volvulus there may be shock, though this was observed in one case only. Vomiting begins early . . . The vomit is soon deeply stained with bile, for the obstruction lies below the duodenal papilla. . . . The upper half of the abdomen becomes distended by the stomach and duodenum, while the lower part becomes recessed from collapse of the intestines. . . . Melaena may or may not be evident."

It was pointed out that the above syndrome defined the condition clearly from all other possible causes of alimentary obstruction of the first few weeks of life. It was suggested "that reduction of the volvulus would be the most hopeful line of treatment. The intestinal mass would have to be delivered and untwisted."

A female infant, aged 8 days, was admitted to the Royal Edinburgh Hospital for Sick Children on May 20th, 1926, having been referred to us by Dr. Sharp of Musselburgh on account of intestinal obstruction. The birth was natural. Abundant meconium passed. Natural light yellow food residue appeared in the motions on the third day, and a normal motion was passed on the morning of the fourth day. The baby took the breast well until the fourth day, when she had a sudden fit of crying, holding the breath, drawing up the legs—apparent abdominal pain. There was no pallor. From this time she refused to suck. She vomited with increasing frequency, at first clear fluid, then yellowish, and latterly dark green flaky material. There had been complete constipation. There was little further pain until the morning of admission, when it seemed to recur and persist. On the morning of admission a small quantity of blood-stained mucus was passed per anum.

Examination.—A well developed infant; the eyes sunken, the mouth dry, the face drawn, and the skin generally lax and folded from rapid dehydration. A severe degree of toxæmia was obviously present. The upper part of the abdomen was prominent from gastric and duodenal dilatation, the lower part was flat. Small quantities of dark green flaky material were regurgitated at intervals of a few minutes. The rectum contained traces of blood-stained mucus.

Provisional Diagnosis.—From the clearly defined sequence of events of the history, and the facts observed on examination, a confident diagnosis of "volvulus neonatorum" secondary to an error of intestinal rotation and fixation was made. It will be noted that this was based on evidence of acute obstruction to the duodenum below the bile papilla and of post-natal origin.

A large continuous subcutaneous infusion of glucose-saline solution was administered, operation being postponed for four hours in order to re-establish the fluid and carbohydrate equilibrium.

Operation.—Ether anaesthesia. Right paramedian incision. The stomach and duodenum were enormously distended with fluid and gas, the pylorus being widely dilated. The distension ended abruptly where the third part of the duodenum crossed in front of the superior mesenteric vessels and was sharply twisted round them in a clockwise direction. In this case the caecum had crossed the mid-line from left to right and was loosely adherent over the right kidney (incomplete or "mal-rotation"). The lowest coil of the ileum with its free mesentery was loosely