be consulted by those interested. In this place it may be stated that our conclusions are that the fall in blood pressure is of no practical significance. Even in the cases showing the maximum drop the general condition has not given rise to any anxiety. In many cases we have noted that the pressure is quickly restored spontaneously or after the administration of the ether is begun. It is quickly readjusted by the hypodermic injection of 1/2 c.cm. of a solution of ephedrine hydrochloride (50 mg. per c.cm.), and this we utilized commonly during our early experience, although, since recognizing that the condition is clinically unimportant, we are now using drugs less and less. Our findings in these respects are paralleled by those of other workers (for example Dandy).

2. *Depression of Respiration.*—Slowing and reduction in the amplitude of respiration are common, and this effect at first gave us some concern. We have, however, seen no harm arise from it. Where severe, it is at once readjusted by administering carbon dioxide. For this purpose we find it advisable that a cylinder of oxygen containing 5 per cent. CO_2 should always be at hand in the theatre.

A minor disadvantage of avertin is the headache of which a considerable proportion of patients complain on waking from the anaesthetic. It is readily controlled by pyramidon 5 grains (repeated after four hours if necessary, although one dose usually suffices).

CONCLUSIONS

1. Employed in a dosage which does not exceed 0.1 gram per kilo of body weight, avertin is a safe drug. In this dosage it may suffice for minor operative work, but a supplementary inhalation anaesthesia is usually required.

2. Its advantages are: (*a*) ease, comfort, and certainty of induction; (*b*) reduction of post-operative discomfort and sickness; (*c*) reduction of post-operative pulmonary complications.

3. In this series of 1,000 unselected cases there have been no deleterious effects, either immediate or remote.

4. There have been five deaths in the series, and in no instance could the fatal issue be attributed to the avertin.

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SOME SIALOGRAMS

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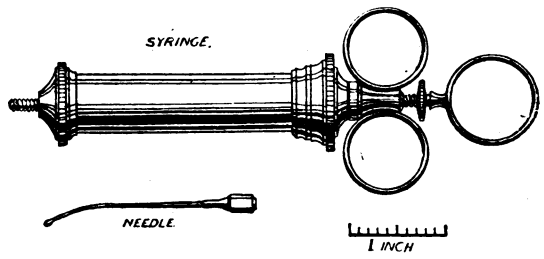
(*With Special Plate*)

Lipiodol radiography has become an extremely useful diagnostic procedure during the last few years. Lipiodol came into its own quite early in the diagnosis of diseases of the chest, tumours of the spinal cord, and sterility. It is an oil containing about 50 per cent. of iodine, and is therefore highly opaque to *x* rays. It is non-toxic, and is only absorbed in small amounts, while the firm nature of its iodine union renders it very unlikely that any patient in whom it is used will develop iodism.

Sialography has been little used because the cases upon which it can throw light are very few; but in a limited number of cases, facts of both diagnostic and pathological interest can be obtained from the study of a sialogram. During the war, sialography was frequently used for the investigation of salivary fistulae. Both parotid and submaxillary glands have easily accessible ducts, so that the technique is not difficult.

TECHNIQUE AND *X*-RAY METHODS

The lipiodol injection is carried out by means of a metal syringe fitted with a plunger, also of metal, as shown in the accompanying sketch. The stem of the plunger is graduated in cubic centimetres, so that the amount of lipiodol injected can be measured. The needle



is a modified lachrymal duct needle made of silver, and has a blunt, slightly bulbous end; it is malleable, and the curve can be adjusted to suit any given case. The needle is fitted to the body of the syringe by a screw attachment. There is therefore no risk of the patient's mouth being coated with lipiodol from the sudden detachment of the needle during the process of injection. With gentle usage no harm can be done to the lining membrane of the salivary duct. The plunger is fitted with a ring for the surgeon's thumb, and the body of the syringe has two rings for the index and middle fingers. The instrument is thus very easily controlled. The usual precautions of warming the syringe, needle, and lipiodol are taken; there is then no difficulty in driving the lipiodol through the rather fine-bore needle. In our hands the syringe has proved eminently satisfactory. Payne[1] has obtained good results by the use of a simple glass syringe.

Parotid Gland.—The injection is performed with the patient sitting facing the surgeon, in a good light. In injecting the right Stenson's duct, the surgeon retracts the right cheek with his left thumb and forefinger, and looks for the orifice of the duct, which is situated opposite the crown of the second upper molar tooth. The opening in most people is slit-like; in some it is situated on a slight papillary elevation. If there is difficulty in finding the orifice, the gland may be made to secrete by giving the patient a slice of lemon, or simple pressure upon the gland may expel a few drops of saliva and enable the opening to be found. The needle of the loaded syringe is brought up to the orifice of the duct and is steadied by the surgeon resting it upon his left thumb. It is slid into the duct for about an inch. The introduction of the needle causes a slight cutting pain, but not sufficiently intense to cause undue discomfort.

The injection is continued gently until the patient experiences a sensation of discomfort in the region of the parotid gland; this indicates that the finer ducts are filled with lipiodol. About 1/2 to 1 c.cm. is used. The needle is quickly but gently withdrawn, and the patient is immediately placed in the recumbent position on the *x*-ray table. One of us (P. R. A.) was able to inject his own Stenson's duct while standing in front of a mirror in a good light. In none of our cases has any untoward complication occurred as a result of injection.

Submaxillary Gland.—The injection is performed in a similar manner. The patient sits with the mouth widely

open and with the tongue pressed firmly upwards against the hard palate behind the upper incisor teeth. The orifices of Wharton's ducts are situated side by side near the fraenum linguae on a well-marked papilla. The needle is introduced as before, but the procedure usually presents more difficulty than in the case of the parotid duct.

X-RAY TECHNIQUE

Parotid Gland.—The patient lies on his side, and the radiographer places the head (as accurately as possible) in the lateral position, so that the two rami of the lower jaw are superimposed. The head is hyperextended so as to open up the space between the jaw and the vertebral column The mouth is opened and is retained in this position by a cork, which is placed between the incisor teeth. With the patient in this position, the greater part of the shadow of the gland is in front of the shadow of the cervical vertebrae.

Submaxillary Gland.—A lateral radiogram is taken here. The patient's mouth is fully opened and the tongue is pressed upwards to the roof of the mouth. There is usually no shadow of bone overlying that of the gland, but in some cases the hyoid shadow may be superimposed.

USES OF SIALOGRAPHY

1. In some cases of chronic parotitis with subacute exacerbation, sialography reveals that one essential feature in the pathology of the disease is a dilatation of the ducts and of the alveoli.

2. A sialogram is of value in helping to decide whether a tumour in the neighbourhood of a salivary gland is derived from the gland tissue or from adjoining structures. In the former case the gland may be largely destroyed and there may be a considerable filling defect on the sialogram, while in the latter case, even though the gland may be somewhat displaced, it will show normal filling.

3. Injection of lipiodol may be of assistance in the localization of calculi.

4. The precise position and track of a salivary fistula, more especially of the parotid gland, can be traced very easily by means of a sialogram.

NORMAL SIALOGRAMS

Parotid Gland.—By the study of the sialograms of the normal parotid glands which we have so far taken, it would appear that Stenson's duct is formed about the middle of the posterior border of the ramus of the lower jaw by the union of two other ducts of slightly smaller diameter; these pass upwards and downwards respectively, and join Stenson's duct at a right angle. During its course across the face it is joined by five or six very small ductules from the socia parotidis and from the anterior lobules of the gland. At the point where it curves forwards in front of the masseter it is often compressed by the anterior border of that muscle, and the shadow of the lipiodol here is considerably attenuated ; the otherwise even course of the duct shows at this point a slight kink. The two intra-glandular ducts run upwards and downwards to the upper and lower poles of the gland respectively, and are joined by numerous smaller collecting ducts. These in turn are formed from an arborization of fine ductules, which are the terminal ducts and alveoli. Nna normal sialogram the alveoli show no dilatation, but are represented by the tiny endings of the smallest ducts. The gland reaches below to the angle of the jaw and above to the neck of the mandible.

Submaxillary Gland.—From Fig. 3, it would appear that the intra-glandular portion of Wharton's duct commences at the lowest point of the gland, one and a half inches below the lower border of the body of the mandible and one and a half inches in front of the angle of the jaw. It passes vertically upwards to a point in the submaxillary fossa, about a quarter of an inch above the lower border of the body of the mandible. At this point the duct turns sharply upwards and forwards to the papilia on the floor of the mouth. The figures given will vary to some extent with slight changes in position of the patient's head during radiography. Both sides of the main duct receive smaller ducts, which are themselves made up of a fine arborization of tiny ductules from the lobules. One rather larger tributary passes downwards and forwards from the posterior part of the floor of the mouth to join Wharton's duct at the angle mentioned.

CASE REPORTS

CASE I.—*Bilateral Chronic Parotitis with Subacute Exacerbations*

History.—M. H., female, aged 16. This patient was first seen in 1927, when she came to hospital complaining of a discharge of pus from the left ear. A few months later there appeared a gradual swelling of the left parotid gland, followed a few weeks afterwards by a similar swelling on the right side. At first the swellings were slight and not painful. In July, 1927, the right parotid gland suddenly became painful, red, and hot, and in a few days' time similar changes occurred in the left gland. There was no rise of temperature and of pulse rate, though the girl felt ill and had no appetite. The swellings remained in this condition for several days, but subsided as a result of treatment by fomentation and hot mouth washes. During the following four years the patient has had both glands persistently larger than normal, with occasional bilateral acute exacerbations, precisely as in the first attack. In some of the acute attacks she noticed an excessive discharge of saliva containing some solid debris ; in others, the saliva was thick and purulent, and of a disagreeable taste and offensive smell. These changes subsided with the passing of the acute attack. There has been no history of a sore throat or of other illness.

Examination.—During the chronic stage both parotid glands are slightly but definitely enlarged. The surface is lobulated throughout, each lobule being an enlarged single alveolus of the gland. The gland is neither hot nor red, nor is it tender. On pressure, clear saliva can be expressed from the gland. During the acute attack the gland is much more enlarged ; it is hot to the touch and tender on pressure, but there is no fluctuation. The surface, which in the chronic stage was lobulated, now becomes quite smooth. On gentle pressure over the gland, saliva containing plugs of pus mixed with epithelial debris can be squeezed out of Stenson's duct in considerable quantity. By this procedure the feeling of tension present in the gland is relieved. At no time has there been any evidence of gross abscess formation, and the condition has resumed its chronic state in from one to three weeks' time. The orifice of Stenson's duct was on some occasions reddened and slightly more prominent than usual, though this was not uniformly the case. The first teeth were healthy, but the second dentition is very unhealthy ; the teeth are deficient in enamel, and several have been broken off near the alveolar margins ; many of the remainder are carious. The throat and tonsils are healthy. The discharge from the ear has subsided in the last three years. General examination of the patient reveals nothing abnormal. The blood count is normal and the Wassermann reaction is negative. A possibility of parotid calculus led to repeated *x*-ray examinations, all of which were negative. A probe could be introduced into either duct without encountering any obstruction. A culture from the debris discharged from the right Stenson's duct yielded on one occasion a staphylococcus. The debris was found to consist of desquamated epithelial cells, pus cells, and much mucus.

Sialogram.—The injection of lipiodol was very easily effected. The gland is moderately enlarged. The lumen of Stenson's duct is considerably wider than normal, and each terminal ramification is very much dilated. The picture is very like that obtained after lipiodol injection into the trachea in a well-marked case of bronchiectasis. The sialogram here seems to indicate that the disease is largely an affection of the ducts. Probably the swelling and oedema of the walls of the

smaller ducts cause some obstruction to the outflow of saliva, with consequent dilatation of the alveoli.

Treatment.—The patient has been given dental treatment. She has had a long course of potassium iodide without result. She has received the greatest benefit from regular massage to both glands; this the patient has done for herself after meals for the past few months.

CASE II.—*Chronic Sialadenitis of the Submaxillary Gland*

History.—A. B., female, aged 29 years. The patient was first seen on admission to hospital, under the care of Mr. Flint, in August, 1931. During childhood she had had recurrent lumps immediately below the lower jaw. These used to appear, remain for a few weeks, and then gradually subside, only to recur again after a variable interval. They were hard in consistency and painful to touch; movements of the jaw also caused great discomfort. At the age of 13 her tonsils were removed, and the lumps did not appear again until 1927, twelve years later. In that year the patient noticed a small tumour on the left side of the neck, just below the lower jaw, which varied in size and became swollen and painful after meals. She also complained of a pricking sensation underneath the tongue, and on several occasions had managed to squeeze out from the floor of the mouth stones which were hard, gritty, and the size of a small pea. A fortnight prior to admission the tumour increased in size. It became very tense and tender, and caused considerable pain both in the neck and in the left ear. At no time throughout the illness had there been any suggestion of involvement of the other salivary glands.

Examination.—On admission to hospital the patient had a large swelling below the lower jaw, which extended from the mid-line anteriorly to the angle of the mandible posteriorly. The skin over it looked tense and glossy. There was marked fetor of the breath. The tumour was of a hard, elastic consistency, and was fairly regular in outline; it bulged upwards into the floor of the mouth on the left side of the frenum linguae. During the acute attack it was tender to the touch. Inside the mouth the opening of Wharton's duct was seen to be ragged and inflamed, and a small, white, flake-like calculus was found adhering to the edge of the opening; this was easily removed. About half an inch posterior to the papillary eminence on which the duct opened, there was a fistulous communication between the duct and the mouth, and from this opalescent saliva was ejected at intervals.

Sialogram.—The needle was inserted through the fistula already described, and was passed backwards along the duct without obstruction. About 1/2 c.cm. of lipiodol was injected; of this a small quantity escaped backwards into the mouth. In the sialogram the duct from the gland to the papilla is quite normal, but its intra-glandular portion shows a marked saccular dilatation. None of the finer ducts are filled with lipiodol, but two subsidiary ducts are visible, and these are both dilated in a similar manner to the main duct. The fact that the dilatation in this case is almost entirely confined to the main duct in its intra-glandular course is in marked contrast with the sialogram of the case of chronic parotitis, in which the finer ducts all show terminal dilatation. Presumably in this case the finer ducts were blocked by debris, which prevented the entry of lipiodol.

Treatment.—Operation performed by Mr. Flint on August 20th, 1931. A curved incision was made below the lower jaw on the left side of the neck, and a flap was turned upwards, with its base at the border of the mandible. The submaxillary gland was very adherent to all the surrounding structures, but was dissected out *in toto*. The wound was closed, a small tube being inserted for drainage. Careful dissection of the gland after removal confirmed the facts noted on the sialogram. The intra-glandular part of the main duct was dilated, and the walls were greatly thickened and almost cartilaginous in consistency. The smaller ducts were apparently unaffected. A bead of muco-pus was squeezed from the cut end of the duct. The patient made an uninterrupted recovery.

CASE III.—*Tuberculous Submaxillary Lymphadenitis*

History.—W. T., male, aged 31 years. The patient was first seen as an out-patient in January, 1931, when he complained of a painful tender lump about three-quarters of an inch in diameter in the right submaxillary region.

Examination.—January, 1931. The swelling was soft, elastic in consistency, and was movable; it was thought to be buried in the substance of the submaxillary salivary gland. There was nothing abnormal to note inside the mouth. It was found impossible to decide with certainty whether the swelling was a tumour of the salivary gland itself or an enlargement of one of the submaxillary lymphatic glands.

On admission to hospital in July, 1931, the tumour occupied the whole of the submaxillary fossa, but did not bulge upwards into the floor of the mouth. It was definitely lobulated, and was adherent to the surrounding structures. It was of varying consistency, and at one point was thought to be fluctuant. No change could be found in Wharton's duct. In July, therefore, the clinical picture was that of tuberculous submaxillary lymphadenitis. To clinch the diagnosis a sialogram was taken.

Sialogram.—The needle was introduced into Wharton's duct without difficulty, and about 1/2 c.cm. of lipiodol was injected. This picture was taken quite early in the series, an ordinary Record syringe and lachrymal sac needle being used. Towards the end of the injection the needle slipped off the syringe, and some lipiodol was squirted into the mouth. This accounts for the dark shadow above the buccal part of Wharton's duct. The photograph shows a perfectly normal submaxillary gland, with a faint shadow of the actual tumour visible immediately anteriorly.

Treatment.—A curved incision below the lower jaw on the right side of the neck was made. A mass of tuberculous lymph glands was found and removed.

This case illustrates the use of sialography in the diagnosis of a swelling of doubtful nature in the neighbourhood of a salivary gland.

CASE IV.—*Acute Parotid Abscess*

History.—A. H., female, aged 45 years. The patient was admitted to hospital in July, 1931, with an acute swelling in the left parotid region, of three days' duration. The illness began with sharp lancinating pains behind the angle of the jaw, and when the patient reached hospital she was suffering intense pain. There had been no discharge into the mouth and no history suggesting the passing of a calculus. She also complained of a numbness of the left side of the face.

Examination.—The contour of the left side of the face was completely obliterated by a large inflammatory swelling in the parotid region, with much surrounding oedema. The left eyelids were so swollen that the eye was quite invisible, in addition to which there was a paresis of the whole of the left side of the face. Nothing abnormal was noted inside the mouth, but there was a purulent discharge from the left ear, which on closer inspection was found to issue from an inflamed area on the anterior wall of the external auditory meatus. The swelling was hot and extremely tender, and gentle pressure over the parotid caused pus to issue from the external meatus in increasing quantities. There was much oedema and swelling in the neck, and this caused some difficulty in breathing.

Treatment.—An incision was made just behind the angle of the jaw on the left side, and a pair of forceps was pushed upwards into the parotid region. A large collection of pus was found and liberated, and a tube was inserted into the abscess cavity. As a result of this treatment the condition rapidly subsided and the facial paresis recovered completely.

When seen a month later the swelling had entirely disappeared, although the parotid region was still tender. There was a slight serous discharge from the incision behind the angle of the jaw, and a muco-purulent discharge from the ear. Inspection of the external auditory meatus showed two polypi on the anterior wall, and pus was seen to be discharging from this point. The polypi were removed, and histological examination proved them to be composed of simple granulation tissue. A sialogram was taken at this stage.

Sialogram.—Stenson's duct appears normal. There is almost complete absence of the contributory ducts owing to destruction of the gland by the acute inflammatory process.

We wish to thank Mr. J. F. Dobson and Mr. E. R. Flint for permission to publish these cases, also Mr. Harrison for his drawing of the syringe, and the members of the *x*-ray staff, who have given invaluable help and advice.

REFERENCE

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L. N. PYRAH & P. R. ALLISON: SOME SIALOGRAMS

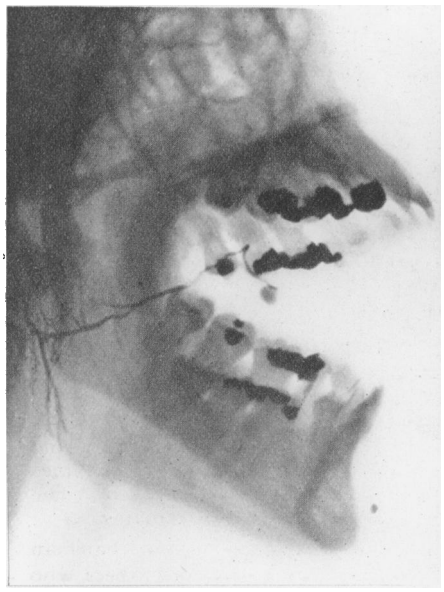

FIG. 1.—Sialogram of normal parotid gland.

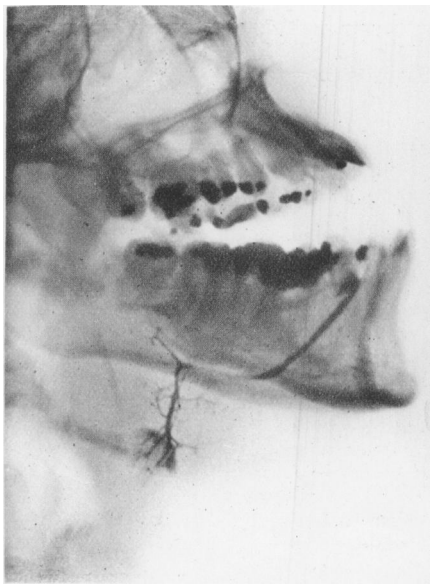

FIG. 2.—Sialogram of normal submaxillary gland.

FIG. 3.—Case I: Chronic parotitis. Bronchiectasis-like dilatation of terminal ducts and alveoli.

FIG. 4.—Case II: Showing saccular dilatation of the intraglandular part of Wharton's duct with deficient filling of finer ducts.

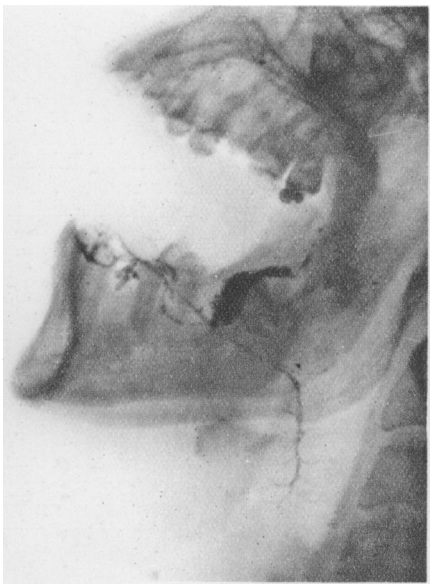

FIG. 5.—Case III: Normal sialogram of right submaxillary gland immediately anterior to which is a faint shadow of a mass of tuberculous lymph glands.

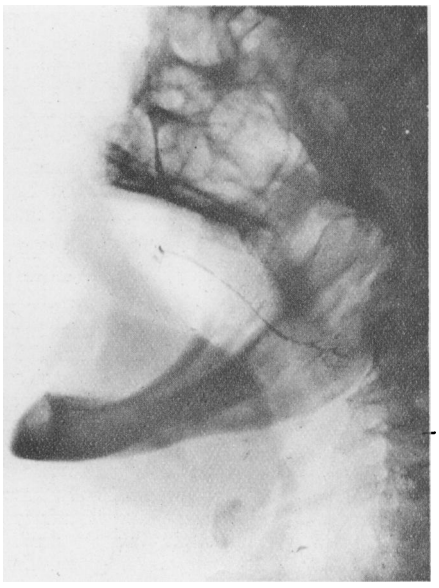

FIG. 6.—Case IV.: Parotid abscess with destruction of the gland. Showing obliteration of all but the main parotid duct.