THE USES OF LIPIODOL IN GYNÆCOLOGICAL PRACTICE.

By LESLIE WILLIAMS, M.D., M.S., F.R.C.S., F.R.C.O.G.
(*Obstetric Surgeon to Out-Patients, St. Mary's Hospital.*)

When Rubin, in 1920, published his article on "Non-operative determination of patency of Fallopian tubes in sterility" in the Journal of the American Medical Association, the diagnostic equipment of the gynæcologist received an extremely valuable addition. His method of per-uterine inflation with oxygen and the production of an artificial pneumo-peritoneum was modified and improved step by step, so that in the course of a few years the relatively compact apparatus, as exemplified by the widely used Provis's modification of Currier's apparatus, became almost a standard part of the equipment of a gynæcological operating theatre. And carbon dioxide replaced oxygen or air as the gas used for insufflation since it is more rapidly absorbed from the peritoneal cavity than either of the other two.

Shortly after Rubin's original observations various workers turned their attention to the possibility of demonstrating radiologically the patency or otherwise of the Fallopian tubes by means of injection via the uterine cavity of radio-opaque substances. This investigation had in fact been suggested as long ago as 1914 by H. Cary (*American J. Obst. and Gynæc.*) and was performed in 1915 by Rubin. But there was no general adoption of the method—on the contrary it was rapidly abandoned because the substances employed—bismuth paste, argyrol, sodium bromide, etc.—were of uncertain value from the photographic point of view, and, worse, they were occasionally highly toxic. However, in 1923 lipiodol* (a preparation containing iodine in poppy-seed oil) was put on the market and in this substance we have something which is radiographically suitable and, at the same time, nearly safe. Since its first application to the pelvic organs by Heuser in 1924 it has been very widely used in the investigation of cases of sterility. Its place in the diagnosis of other gynæcological conditions has not been so clearly established but it has been used to demonstrate cases of sub-mucous fibroids, carcinoma of the uterine body, etc., and some further remarks on this subject will be made later in this article.

The method of tubal insufflation was at first a purely diagnostic measure but it was soon realised that it, and the methods evolved from it, possessed features of prognostic significance and of therapeutic value. For example, if tubes resisted the passage of gas until a pressure of, say, 150 mm. Hg. was reached and then permitted a free flow, it was quite reasonable to suppose that some minor obstruction had been overcome and that (providing the husband was fertile) the occurrence of conception in the course of the next few months was a distinct possibility. It is highly probable that in cases of partial obstruction a greater degree of patency may be established by insufflation with gas or with some radio-opaque substance under reasonable pressure. In some cases even of complete obstruction it has almost certainly happened that, following such treatment, tubal patency has been re-established in a few cases by the breakdown of adhesions, the straightening out of a kink or the expulsion of a plug of mucus. It is safe to say that after either method of investigation of a case of sterility the fairly frequent occurrence of a conception rapidly following, is strong presumptive evidence of its value as a therapeutic measure.

The Choice between Infection of Gas or Lipiodol.

There grew up a kind of rivalry between the two methods of investigating tubal patency—insufflation with carbon dioxide on the one hand and lipiodol injection plus X-rays on the other. It will be convenient here to consider the

*Its British counterpart neo-hydriol (viscous) seems equally suitable for gynæcological cases.

various points favouring one or other line of treatment. In the first place gas insufflation is simpler and less expensive. Secondly, carbon dioxide is absorbed in a few hours. Lipiodol, in contrast, often remains for months or even years in the peritoneal cavity or the tubal lumen. It also occasionally acts as a foreign body and produces a foreign body reaction in the tissues. For instance, several cases of peritoneal inflammation and a few of resulting pelvic abscess have been reported. Worse, there have been very occasional cases of oil embolus. But, generally speaking, the objection to lipiodol is its occasional failure to get absorbed from the pelvic peritoneal cavity with the resulting disadvantages above mentioned.

So far then it all seems to favour gas insufflation rather than lipiodol and X-ray. But in favour of the latter is the fact that if the tubes are blocked this may be demonstrable by gas injection, but one will have no idea where the block is. Lipiodol, on the other hand, will clearly demonstrate the state of both tubes and the site of the obstruction. From this information one can reason whether or not any attempt at salpingostomy is a justifiable proposition. Again, with gas insufflation, the free passage of gas can occur with one patent tube and one blocked one and no information will have been received as to the presence of blockage on the one side. The condition, however, would have been revealed by the alternative method of investigation. To maintain that the diagnosis of patency of one tube and of closure of the other can be made by listening through the abdominal wall to the sounds caused by the escaping gas is misleading. For the information thus obtained is apocryphal.

To sum up one may conclude that, as the *first* step in the investigation of a case, opinion generally favours gas insufflation rather than lipiodol injection. The possible dangers of the latter method render it unsuitable for the routine investigation of tubal obstruction. But once obstruction has been diagnosed its further investigation by lipiodol injection should follow automatically.

In an attempt to get more detailed information about the state of the tubes by insufflation with gas and thereby further to eliminate the use of lipiodol, King (J. Obst. and Gyn. Brit. Emp., 1936) described his method of taking a kymographic record of the pressure changes occurring during the course of a tubal insufflation with gas. From his tracings and from certain symptoms produced during the operation, he claimed to be able to diagnose such things as patency of one tube with occlusion of the other, tubal spasm, tubal stenosis, the site of tubal obstruction, the occasional production of tubal pneumo-salpinx in the course of an insufflation, etc. Of the above, tubal stenosis may be missed even by lipiodol injection and X-ray, in which investigation it may wrongly appear as normal patency. From the tracings reproduced in King's article and from the arguments which he brings forward a good case is made out for this method of investigation. But it must be admitted that in actual practice the method is not of great value. The apparatus is clumsy and requires too much space; it is too complicated for easy manipulation, it is not a simple business to get the beautiful and clearly interpreted tracings which King can produce. Furthermore, the waves of uterine contractions confuse the picture of the waves of tubal origin on which stress is laid. The method must then be regarded as unsuitable for general use and certainly unsuitable for the investigation of cases which may be scattered about in different nursing homes, etc. It will therefore be agreed by most people that if tubal block be found by gas insufflation with some simple apparatus, there is no practical alternative to lipiodol injection and X-ray in the attempt to get further information.

But the advocates of lipiodol will not be satisfied with this. It has already been mentioned that the methods under consideration are of value, not only in

the diagnosis of the cause of sterility in any given case, but also in its treatment. And it is claimed that lipiodol is of greater therapeutic value than is carbon dioxide. If we take the latter first: Rubin reports that pregnancy occurred in 17.5 per cent. of his cases insufflated for sterility. Of these cases 42.2 per cent. of the pregnancies started within two months of the insufflation from which it may reasonably be inferred that the insufflation was a real factor in the occurrence of the conception.

And now for the results with lipiodol: Green-Armytage (Medical Press and Circular, 1939) claims "not less than 25 per cent." success if the lipiodol injection is carried out within a week of the cessation of a menstrual period. In a private communication dated February, 1940, he goes further and states that he has "definite evidence that at least 45 per cent. of the patients who have been treated by lipiodolograms therapeutically, have become pregnant." Be it noted that this does not refer to all cases investigated but to cases treated therapeutically. Even so these figures represent most gratifying results. Moore-White (B.M.J., Jan., 1939) similarly states that 35.5 per cent. of her series of 62 women became pregnant following lipiodol injection.

But there are clearly many possibilities of error in such statistics. To get really parallel series of cases in which the fertility of the husband is known, the percentage of pelvic abnormalities in the women similar in the two groups, the time of conception after the two operations fairly comparable, etc., offers so many difficulties that one must be hesitant about accepting as final the statistical evidence so far available. But it may be reasonably accepted that both methods of treatment do favour the occurrence of pregnancy and that in all probability lipiodol is superior to carbon dioxide from this point of view.

Technique.

It is not proposed in this article to deal with the types of apparatus used for insufflation of the Fallopian tubes with carbon dioxide. Provis's modification of Curriers apparatus is so widely in use and so generally satisfactory that we need look no further for a simple and not too expensive equipment.

But the various forms of apparatus used for lipiodol injection need more detailed consideration and various points in the technique of the operation can conveniently be discussed in this section.

It is also desirable here to emphasise that no operative procedure should be undertaken for sterility in any woman until the male partner has been proved to be fertile according to the modern standards of fertility. Furthermore, to minimise the risk of disseminating fragments of endometrium and so causing endometriosis, any such operation should be undertaken *in the few days following a menstrual period*. For at this time the endometrium is in its thinnest and least active phase. The performance of the operation at this time is also the most favourable for conception.

The syringe. This must be of good make with the piston accurately fitting the barrel. Its capacity should be 20 c.c. The average quantity of lipiodol used at a Fallopian tube test is 10 to 15 c.cs. Often a few more c.cs. are required and it is most inconvenient to have to stop in the middle of the injection to fill up the syringe with that thick heavy liquid, lipiodol. Besides, the withdrawal of the syringe would give another opportunity for the lipiodol to leak back out of the uterus.

The expulsion of the fluid from the syringe can be obtained by the usual finger pressure. But this is hard labour. And, working in the dark, one has very little idea how much has been injected. It is therefore much better to have a piston which is driven home by a screw turning movement, each turn or each half-turn advancing the piston just so much as to force out 1 c.c. of the lipiodol. In this way the fingers are not strained and one can tell without the necessity for having to switch on a torch exactly how much fluid has been forced out of the syringe. Again, the piston thus moved by a screw facilitates filling the syringe—the lipiodol can be sucked in by an unscrewing movement. In the case of syringes of the ordinary pattern the easiest way to fill up is to withdraw the piston altogether and to pour in the lipiodol. Attempts to suck in that very heavy, thick liquid, even through a wide bore filling tube are unnecessary work.

The uterine pipe. This is a tube of about the diameter of an ordinary uterine sound. It is usually made of steel but it is advantageous in many respects to have it made of aluminium which is not radio opaque. In addition the Volsellum or other form of cervical clamp (*vide infra*) may be made of this metal and thus the picture of the lipiodol entering the uterus and tubes is not confused by the shadow cast by radio opaque instruments. Nevertheless such a shadow is not a very serious handicap and many workers continue to use instruments of the more usual stainless steel, etc. The pipe must fit accurately—preferably with a bayonet fixing—on to the syringe. It should be open at its uterine end terminally and by lateral openings near the tip. It should have a slight curve about two inches from the tip similar to the bend on a sound. At about the same point there should surround the pipe, a metal or, preferably, rubber “acorn” or “olive” which, jammed against the external os, prevents leak back of the lipiodol. It is advisable to have a second pipe with only about one inch of pipe projecting beyond the “olive” and so able to enter the uterus. For in the cases under investigation for sterility one meets at times a real case of a small, underdeveloped uterus. Such an organ would easily be perforated by a pipe, of which, say, two inches was able to pass the external os.

Perhaps the short nosed pipe is in most ways the best and safest. If this be adopted then one can have a complete equipment with two pipes, one the size of a No. 4 uterine dilator (4 mm. diameter) and a second one—for cases of “one child sterility”—with a diameter of 5 mm.

The anæsthetic. On the whole an anæsthetic is probably undesirable. But it becomes a necessity for very nervous women and for those who are intolerant of any vaginal manipulations or who are unable to keep still. It is possible with the anæsthetised patient to inject the lipiodol under such pressure that a Fallopian tube may be burst or the uterine musculature ploughed up. Such an accident can be avoided by observation on the pressure used, by means of an attached manometer. But many continue to use simpler apparatus and while such simple instruments are used the danger remains.

It is safer therefore to deal with the conscious patient; but a somewhat sensitive woman may be given, instead of an anæsthetic, an injection of Omnopon gr. 1/3 and Hyoscine gr. 1/150 half-an-hour before the operation is to be performed.

The volsellum. It is often the use of this that causes the pain, though in many cases the cervix is insensitive. One or two ordinary volsellum forceps may be used to hold the anterior lip of the cervix and to keep the cervical lips jammed against the “olive” on the uterine pipe. The writer prefers a heavier and bigger instrument, one jaw of which goes in front of the cervix and one behind so that when it is clamped on to the cervix, this is not only held, but its canal is squeezed around the uterine

pipe thus assisting in keeping the lipiodol from leaking back. But the ordinary grasp on the anterior lip of the cervix by one or two standard pattern volsellum forceps is quite adequate.

Perhaps the best apparatus of all for holding the cervix consists of two moveable jaws made of aluminium which are tightened around the cervix by a sliding ring through which runs the uterine pipe. But we have not seen this piece of apparatus used in this country.

The manometer. This may be regarded as optional. In many ways it is desirable in that observations on the pressure at which the lipiodol is injected should prevent the adverse results already mentioned. It should be regarded as an essential part of the equipment if the lipiodol be injected with the patient under an anæsthetic and in an operating theatre. With this technique the cervix is closed by a clamp after the injection and the patient then wheeled to the radiological department. By this method there is no check on the progress of the injection by observation of the happenings as revealed by X-rays and the fluorescent screen. Nor are the patient's sensations a warning that undue stretching is occurring somewhere. Consequently there is the danger of using too great pressure. But with the technique shortly to be described this risk is minimised and the manometer may perhaps be regarded as unnecessary. Besides, the manometer is apt to get out of order rather easily and then it gives an erroneous reading of the pressure used.

The combination of instruments. This is a beautifully made but expensive set of apparatus. It consists of a syringe with a screw-propelled piston and a uterine pipe which is connected by a T-junction to a manometer. On the pipe is also a link or a clamp which holds the volsellum grasping the cervix. The position giving adequate counter-pressure being secured, the pipe and the volsellum are fixed by the clamp in their proper positions. Thus the operator's hands are freed. It is described as "*Pièces spéciales pour hystero-salpingographie*" by the makers, Messrs. Collin & Cie, 6, rue de l'Ecole-de-Médecine, Paris. In many ways its use simplifies the technique but most gynecologists will continue to use simpler and less expensive apparatus.

Technique of the Operation.

From what has already been said, the writer's preference in the matter of how the actual injection should be made and observed has largely been revealed. A brief summary should therefore now suffice.

The patient is first given an injection of Omnopon gr. 1/3 and Hyoscine gr. 1/150. Atropin gr. 1/100 may perhaps be added in the hope of abolishing tubal spasm. Half-an hour later, a preliminary X-ray is taken so as to avoid confusing peritoneal lipiodol spill with a calcified gland. She is then placed in the Sims or in the left lateral position on the X-ray couch. A Sims speculum is passed and the anterior lip of the cervix grasped with a volsellum. Previous bimanual examination will have given evidence of the position of the uterus and of its approximate size. Confirmation of this is now sought by the gentle passage of a uterine sound. The uterine pipe is next made to enter the uterus by following the same track as that previously taken by the sound. The "olive" on the pipe is jammed against the external os which is held by counter-traction with the volsellum and the cervical canal thus made watertight. Alternatively the whole cervix is grasped and squeezed on to the pipe by a large size volsellum. The Sims speculum is removed and the patient rolled on to her back. When the fluorescent screen and the X-ray tube are adjusted to give a view of the pelvis the loaded lipiodol syringe is fitted to the uterine pipe, the room darkened and when dark adaptation is secured, the injection is commenced. If all goes well the lipiodol can be observed filling the uterine cavity, perhaps making its way along the tube and spilling into the

peritoneal cavity. At this point a film should be exposed. The great practical difficulty, particularly if the cervix has been torn as in a case of "one child sterility," is to prevent the lipiodol leaking back past the "olive" and obscuring the picture. If this has been avoided and if some 10 c.cs. or even 15 c.cs. have been injected, the injection can be stopped even if visualisation has not been satisfactory. A further film may now be exposed and may show the peritoneal spill which is the final demonstration of tubal patency. In any case the investigation is complete for the time being and the instruments are removed. But it is advisable to have still one more X-ray film taken 24 hours after the injection has been made. In some cases the peritoneal spill is not revealed by the immediate filming but is demonstrated quite clearly at this time. But before this film is exposed the vagina should be well swabbed out to remove lipiodol that has leaked out of the uterus.

Decisions based upon the Radiological Findings.

In cases where tubal patency is revealed and providing the husband is fertile, it only remains to wait and see if the therapeutic value of the injection will be shown by the occurrence of conception.

If there be tubal block which is fimbrial in position this will be shown by the club-shaped shadows of tubes dilated by the injection and by the absence of peritoneal spill. In such cases, providing that there is no other bar to conception, it may be permissible to perform laparotomy and to attempt to restore tubal patency by bi-lateral salpingostomy. The operation is not a very successful one. In only about 10 per cent. of the cases does conception follow. But it is worth doing occasionally providing that the position has been clearly explained to the patient and her husband.

If the tubal block is isthmal it is the almost universal opinion that any attempt at repair is not justified. If laparotomy be done and even if distal portions of the tubes be found patent, the excision of the diseased parts and the implantation of the healthy parts is so rarely followed by conception as to make the operation a mere surgical adventure without any genuine expectation of success. An occasional triumph may tempt one to persevere but when it is remembered that one living baby results for every 22.5 salpingostomy operations (De Lee and Greenhill Year-book, 1938), that this includes all salpingostomies, and that of all salpingostomies the one just mentioned is the least favourable, it will surely be realised that the adverse opinion expressed can hardly be controverted.

Indications for Hystero-Salpingography other than Sterility.

It will be readily agreed that lipiodol injection and hystero-salpingography should be a routine procedure to be performed, say, three months after salpingostomy or tubal implantation. More information will be received from this investigation than could follow mere tubal insufflation with carbon dioxide.

In the same way it is an obvious precaution to adopt with the object of maintaining or securing tubal patency in the remaining tube after one tube has had to be removed on account of a tubal gestation. But many would prefer insufflation with carbon dioxide for this case.

Other uses have been suggested and in May, 1939, Davis read a paper at the Royal Society of Medicine describing many uses to which an investigation of this type could be put. He pointed out that the technique of hystero-graphy was difficult—that considerable expenditure of time and money was entailed—that large experience was required before any radiographic appearances could be reliably interpreted. Nevertheless he reaches the conclusion that this method of

demonstrating the shape and capacity of the uterine cavity together with the interpretation of the variations from the normal shadow as cast in cases of intra-uterine abnormality, has its place in the gynæcological investigation of selected cases. He instances carcinoma of the uterine body as a case in point. This disease gives a fairly characteristic hystero-graphic shadow. Diagnosis by this method would eliminate the risk of dissemination of cancer cells by the operation of diagnostic curettage. But he also points out that the radiological appearances in extreme cases of endometrial hyperplasia may closely simulate those of carcinoma. Another example of the possible use of hystero-graphy is in the diagnosis of the presence and position of small retained fragments of a pregnancy. Such fragments can often be clearly demonstrated by this technique. Hystero-graphy has also been advocated prior to the proposed performance of myomectomy for fibroids. The shadow may outline the fibroid giving valuable evidence as to its exact position. And perhaps, more important, it may show how the anatomical position of the Fallopian tubes has been altered from the normal by the presence of the fibroid. Forewarned as to the presence of such an abnormality the operator may succeed in avoiding damage to such tubes which otherwise would have been in grave danger of being rendered functionally useless.

Hystero-graphy therefore appears to have a definite value in certain selected gynæcological cases. Its routine employment in the investigation of the majority of uterine abnormalities has nothing to commend it, nor should it be employed in the investigation of a doubtful case of ectopic gestation. Here the dangers outweigh the value of any information that may be gained.

Finally there may be mentioned a contrast method by which, in particular, the thickness of the uterine wall may be revealed. In this a pneumo-peritoneum is first produced by insufflation of air or carbon dioxide and then the cavity of the uterus is filled with lipiodol. An interesting hobby but hardly one of wide appeal or of great value!