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CULDOSCOPY—WITH SPECIAL REFERENCE TO ITS VALUE IN THE INVESTIGATION OF INFERTILITY

D. K. QUINLAN, M.B., B.CH., DIP. O. & G. (RAND), F.C.O.G. (S.A.), M.R.C.O.G., *Gynaecologist*, AND G. SHER, M.B., CH.B., M.MED. (ANAES.) (PRET.), F.F.A.C.S. (S.A.), *Anaesthetist, Durban*

In gynaecological practice it is generally possible to make an accurate diagnosis by conscientious history-taking and by careful examination. This is often not the case in the infertile woman, where, when the husband's semenalysis is normal, no cause for infertility can be found in about 60% of cases by the usual methods of investigation. Culdoscopic investigation of the pelvic organs has, therefore, come to occupy a place of importance among gynaecological diagnostic procedures, and by its use the positive findings in the infertile woman can be increased by approximately 25%. Exclusion of pelvic disease is also an important feature of its use, thereby avoiding unnecessary surgery.

Culdoscopy is an adjuvant in the diagnosis of organic or functional disturbance in infertility, but it is not infallible. Ancillary investigations such as curettage, hysterography, tubal patency tests and various laboratory procedures can help to elucidate some of the more obscure pathologies, but even these can be inconclusive, as with culdoscopy. Thus 38% negative and 28% positive tubal insufflation results are erroneous or misleading; also when salpingography suggests occluded tubes there is at least a 15% chance of finding it wrong, and conversely where tubes are patent to tubal insufflation and salpingography, their physiology may be disturbed by unsuspected peritubal pathology.

Culdoscopy can verify or exclude suspected tubal pathology found at salpingography and, therefore, aid in the decision whether reparative tubal surgery should be attempted. Where salpingography shows unequivocal tubal damage culdoscopy can help in the assessment of the peritubal state and decide whether subsequent plastic repair will be worth while. Conversely where tubal anatomy appears to be normal on salpingography, culdoscopy will show if peritubal adhesions are present and whether the most useful procedure of salpingolysis should be performed.

The culdoscope is invaluable in the diagnosis or exclusion of polycystic ovarian disease and the Stein-Leventhal ovary. A conclusive diagnosis can be made and the decision taken on whether wedge resection of the ovary should be performed, thereby avoiding much unnecessary and wanton surgery on normal ovaries.

Laparotomy is the ultimate result when the diagnosis is not proven, but the frequent use of this especially when there is a small chance of finding an abnormality requiring surgical treatment is to be deplored. Even if its past dangers to life and physical health have been decreased by modern surgical and anaesthetic techniques, there remain the psychological trauma and false hopes. Many women are on the fringe of surgical invalidism due to an exploratory incision into the abdominal wall.

As with any endoscopic procedure it requires considerable time and experience to become a well-trained observer. Enthusiasm for culdoscopy must be tempered with discipline and it must not be abused or allowed to become a gynaecological 'gimmick'. Some attempt to rationalize their aversion by saying that if it is justifiable to look inside the pelvis, it is justifiable to have a proper look by laparotomy. Others less certain of their ground are deterred by what appear to be technical difficulties and dangers. There remain a few that have such faith in their fingertips that they regard culdoscopy as a confession of lack of clinical skill; these should take note from the experience of the old physicians who resisted the introduction of radiography and electrocardiography on the grounds that such methods could indicate no more than did percussion and auscultation. There is no doubt that with experience culdoscopy is valuable, simple and safe, provided its limitations are borne in mind.

TECHNIQUE OF CULDOSCOPY

Preparation and Positioning of Patient

The patient is admitted to hospital on the night preceding culdoscopy. The genitalia are shaved and a cleansing enema is given.

The correct knee-chest position is an absolute necessity for satisfactory culdoscopy. Over a 3½-year period other positions have been tried and have proved unsatisfactory. Coelioscopy *per abdomen* with the patient in the Trendelenburg position as described by Palmer[1] has been tried, but is not as successful as the knee-chest position in viewing the adnexa, normally situated at the back of the uterus. The uterus and the adnexa fall back onto the culdoscope even if the Trendelenburg position is adopted. The lithotomy position as suggested by Doyle[2] has also been tried without success.

The knee-chest position results in a shift of the abdominal contents causing a negative pressure in the pelvis. The intestines are carried into the upper abdomen while the uterus and bladder fall forward, giving a clear view of the posterior aspect of the uterus and adnexa.

The patient is wheeled into the operating theatre on a mobile trolley. She is anaesthetized and intubated on the trolley. A Clover's crutch is used to fix the flexed attitude of the thighs with the strap passing over the shoulder and around the neck (Fig. 1). The vulva and vagina are swabbed and the bladder is catheterized. A pelvic examination is carried out to check the position of the uterus, its mobility and any possible mass in the pouch of Douglas. The operating table is prepared and the patient is rolled over from the mobile trolley into the knee-chest position on the operating table. The knee-chest position is not very steep and the thighs are not too sharply flexed on the

trunk. The abdomen is left free from any pressure. The operating table may be put into slight Trendelenburg position to increase the effect of the knee-chest position if required (Fig. 2).

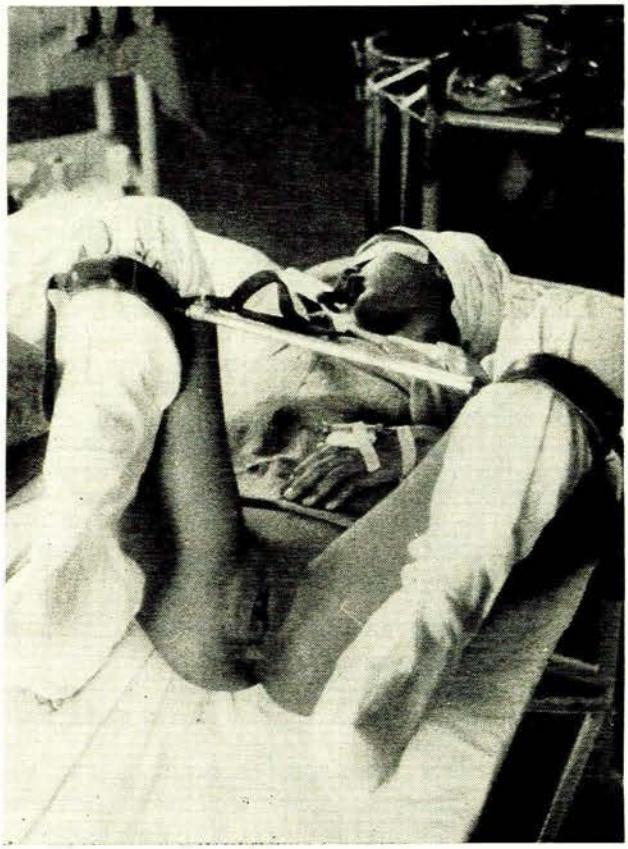

Fig. 1. Clover's crutch in position. The patient is still on the mobile trolley.

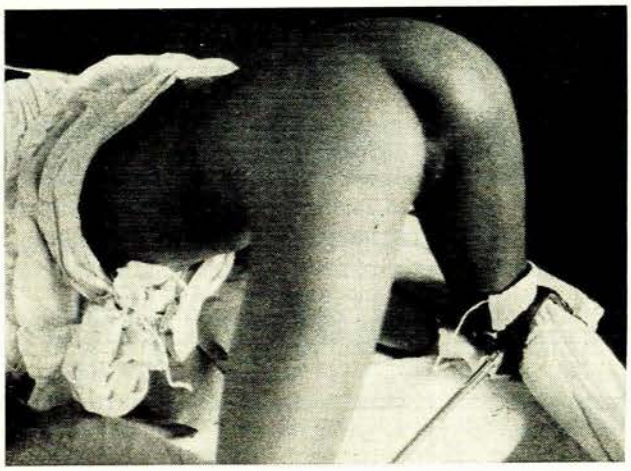

Fig. 2. Patient in knee-chest position on the operating table. Note that the inclination of the trunk is not very steep, the thighs are not very sharply flexed on the trunk and the abdomen is free from pressure of the pillow and table.

Anaesthetic Technique

Local and regional analgesia was found to be unsatisfactory for culdoscopy. General anaesthesia is desirable and is safe if correctly applied. Endotracheal intubation is essential to obtain a clear airway and adequate oxygenation. This is carried out with a cuffed latex armoured tube to prevent kinking. Muscular relaxation is essential.

Anaesthetic considerations before and during culdoscopy. The technique used is based on the maintenance of an open airway and vein throughout the procedure, with maximum muscular relaxation and carbon dioxide elimination.

The patient is examined the night before the procedure and sedated with 50 mg. of hydroxyzine, 150 mg. of secobarbital and 50 mg. of prallobarbital (Vesperax). Atropine sulphate, 0·6 mg. and pethidine hydrochloride, 100 mg., is given by intramuscular injection 45 minutes before induction. All patients receive 350 - 500 mg. of 2½% thiopentone as an induction agent, and this is administered together with 0·6 mg. of atropine sulphate and 10 - 20 mg. of gallamine in the same syringe. The patient is then ventilated with 3 l. of oxygen and 5 l. of nitrous oxide and 0·5% halothane. Succinylcholine, 20 - 30 mg., is given by intravenous injection and endotracheal intubation performed. The cuff of the endotracheal tube is inflated and the tube is calibrated and fixed in position by gauze bandages; this is connected to the anaesthetic circuit and ventilation is controlled throughout the procedure.

It was noticed that no patients exhibited muscular fasciculations before paralysis after succinylcholine was administered with the thiopentone. The pulse rate and blood pressure is recorded before and during the procedure, and on no occasion was any marked change noted. Care is taken to avoid eye damage.

Before placing the patient in the knee-chest position, the anaesthetic circuit is disconnected from the endotracheal tube. At least 3 assistants are required to move the patient and extreme care and gentleness is maintained throughout. A thick pillow is placed under the upper part of the chest to avoid excessive extension of the neck and weight bearing on the trachea, and cervical discs and ligaments. Caution in placing this pillow is essential to prevent interference with breathing and venous channels of the thorax and abdomen. No variations have been noted in the pulse rate and blood pressure after placing the patient in the knee-chest position. The circuit is reconnected and anaesthesia is continued with nitrous oxide, oxygen and halothane; further increments of succinylcholine are given as required. Controlled ventilation is necessary.

No variation of pulse rate, blood pressure or patient's colour have been noted after the introduction of carbon dioxide or air into the peritoneal cavity.

After completion of the procedure the patient is turned onto her back on the mobile trolley with great care. Mouth and oro-pharyngeal suction is carried out; often a fair amount of gastric secretion is present, indicating the necessity for the use of a cuffed endotracheal tube. The endotracheal tube is deflated and extracted during expiration. Spontaneous breathing was present in all cases at this stage.

Some peri-orbital ecchymoses and oedema with suffusion of the conjunctivae was noted in all patients. This disappeared rapidly and is of no consequence. No ill-effects from the anaesthetic were noted in any of the patients. Shoulder-tip and epigastric pain of varying degree was complained of by most patients, as a result of residual carbon dioxide or air in the peritoneal cavity.

The above anaesthetic technique has been found to be satisfactory in all patients. The reason for using atropine sulphate at the time of induction of anaesthesia is to avoid possible excessive vagal stimulation from the overextension of the neck and also from the introduction of cold carbon dioxide or air into the peritoneal cavity. Gallamine is used to avoid postanaesthetic muscular pain from succinylcholine fasciculations, which added to the shoulder-tip pain from the intraperitoneal air or carbon dioxide, can be most trying to the patient. No patient exhibited postoperative hiccup.

Great care and gentleness must be used in positioning the unconscious and paralysed patients in order to avoid obstructing the airway and possible skeletal injury or damage to the cervical cord and brachial plexus.

In addition to the knee-chest position, total paralysis is essential if an adequate view of the pelvis is to be obtained.

Exploratory Technique

The instruments used have been the Decker culdoscope and latterly the Stortz fibrescope, with illumination from a cold light fountain.

The patient is prepared for operation. It is essential to place the telescope in hot water to keep the lens at body temperature and prevent clouding on introduction into the pelvis.

The perineum is retracted with a large Sims' speculum. The posterior lip of the cervix is grasped with a vulsellum forceps and pulled firmly downwards and forwards to put tension on the posterior vaginal wall and overlying peritoneum.

The 'ballooning sign' is looked for; this is due to the changes in intra-abdominal pressure resulting from the knee-chest position. The posterior vaginal fornix distends cephelad between the uterosacral ligaments. The outline of the uterosacral ligaments may be seen and felt between the mucosa. The depression between them marks the site for puncture.

Before puncture with the trocar is made, a further test is carried out. The area is punctured with a small-bladed scalpel and air can be heard entering the peritoneal cavity. The introduction of carbon dioxide into the peritoneal cavity has been abandoned as it is unnecessary and carries possible dangers.

Keeping tension on the cervix, the trocar and cannula is plunged through the posterior fornix in the correctly selected area. With a single sharp jab the trocar and surrounding cannula is introduced. The direction of the trocar must be aimed at the posterior aspect of the uterus at an angle of 45° to the horizontal. If this is followed there is no danger of injuring the rectum.

The trocar is withdrawn and the telescope is placed into position and illuminated (Fig. 3). The operator can now recognize the back of the uterus, the ovaries and outer ends of the fallopian tubes.

If tubal patency tests are to be carried out special screw cannulas or a plastic No. 16 Foley 5 ml. catheter can be inserted through the cervix and the bulb is inflated after insertion. A dye—10 ml. of 0·4% indigo carmine—is then introduced. The passage of dye along the tubes and dripping from the ostia can be observed through the telescope.

At the conclusion of culdoscopy and without changing the patient's position, dilatation and curettage can be performed so that ovarian and endometrial pictures can be compared. When the culdoscope is withdrawn, the puncture hole is sutured with a single chromic catgut suture to prevent any bleeding from the vaginal edges.

The patient is returned to the mobile trolley and the Clover's crutch removed. The patient can normally be discharged on the day following culdoscopy.

DANGERS AND COMPLICATIONS

As with any other procedure, patients must be carefully selected for the success and safety of culdoscopy.

Vaginitis and any acute inflammatory condition of the genital tract is a contraindication, as is any fixed mass in the pouch of Douglas. Many workers state that a retroverted uterus contraindicates the procedure, but this has never been the source of any difficulty. Even fixed retroverted uteri shift forward in the knee-chest position and make culdoscopy possible. However, in inexperienced hands this should be regarded as a contraindication.

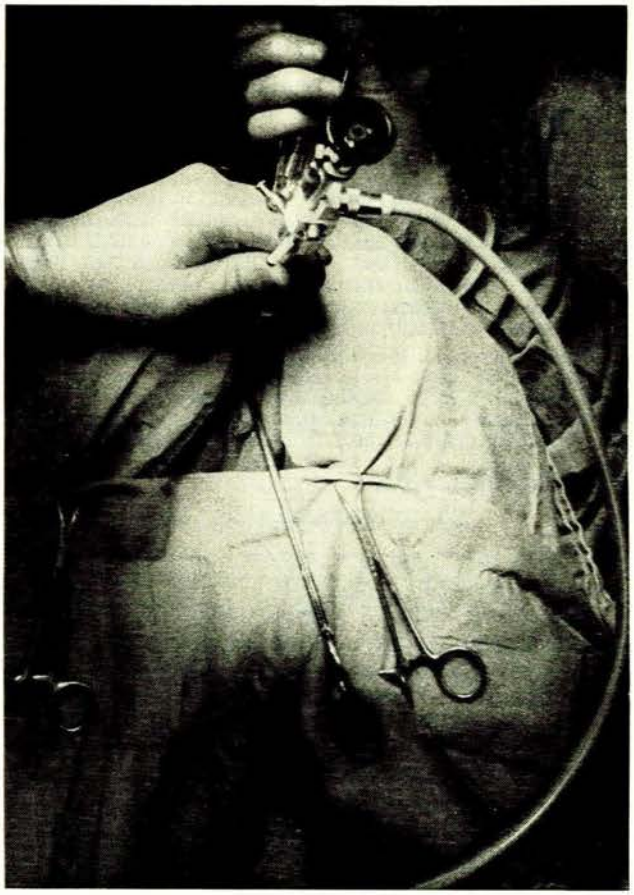

Fig. 3. The patient has been draped. The Sims' speculum is shown retracting the perineum upwards. A vulsellum forceps is seen attached to the posterior lip of the cervix; it is being pulled forwards and downwards. The culdoscope is seen in position with the cable from the cold-light fountain attached.

Perforation of the rectum is a distinct possibility, but if the precaution of plunging the trocar through at an angle of 45° is carried out there is very little danger.

Ecchymoses and oedema of the eyelids with suffusion of the conjunctivae is frequently seen but has never led to any serious consequences.

Epigastric and shoulder-tip pain is found in nearly all patients and may be troublesome but is relieved by analgesics. It disappears in nearly all cases after 48 hours. No difference has been found in this symptom whether carbon dioxide or air has been introduced into the peritoneal cavity.

Intraperitoneal haemorrhage has never been a problem. In those cases operated upon immediately following culdoscopy there has been a small amount of blood in the pouch of Douglas but never of any serious consequence.

Cardiac Arrest

During the 3½-year period that culdoscopy has been done, 1 case of cardiac arrest has occurred. This must be blamed entirely on the technique used at that stage. Carbon dioxide was introduced under pressure into the peritoneal cavity through the pouch of Douglas by means of a pneumoperitoneal needle. The space between the posterior vaginal wall and peritoneum covering the pouch of Douglas is filled with loose vascular cellular tissue which will develop a negative pressure in the knee-chest position and therefore accommodate a large volume of gas.

In this case, the end of the pneumoperitoneal needle was not in the peritoneal cavity but in this potential space. A large volume of carbon dioxide was introduced here with rapid absorption into the blood stream. A condition similar to carbon dioxide retention with acidosis was produced, with subsequent cardiac arrest. Once the cardiac arrest was recognized its cause was quite obvious as the carbon dioxide was not flowing freely as it does when entering the peritoneal cavity. Immediate corrective procedures were carried out with success and the patient survived without incident.

Since this episode, the introduction of carbon dioxide has been abandoned and air is allowed to enter the peritoneal cavity through a large opening, avoiding entrance under pressure and thereby minimizing the possibility of air embolism. It has been found that there is no disadvantage in the postoperative course of the patient where air has been used as opposed to carbon dioxide.

LIMITATIONS OF CULDOSCOPY

Culdoscopy is not infallible and its limitations have been minimized. In terms of economy and disability to the patient it is clearly superior to laparotomy.

When penetration fails, laparotomy will show that in 3 out of 4 cases there was pelvic pathology present which could explain the cause of failure of penetration of the cul-de-sac—it is not only the failure to penetrate, but also the failure to visualize the adnexa once penetration has occurred. This is a very important limitation of culdoscopy especially pertaining to tubal pathology. The fallopian tube may be clearly seen on one side, but no matter how the uterus is manipulated the opposite tube may sometimes not be seen. Visualization of the ovaries is usually far easier. In 417 culdoscopies performed by Kelly and Rock,[3] 84·8% were successful and 15·2% failed. Noyes[4] found that in 109 patients successfully examined by culdoscopy all the organs were seen in 56 (Table I).

TABLE I. FAILURE TO VISUALIZE TUBES AND OVARIES AFTER SUCCESSFUL CULDOSCOPY[4]

Results	*No. of patients*
One tube not seen	21
One ovary not seen	6
One tube and ovary not seen	8
Two tubes not seen	9
Two ovaries not seen	0
Three adnexal organs not seen	5
No adnexal organs seen	4
Puncture failed	21
All organs visualized	56

Ovaries were seen more often than tubes

CULDOSCOPY IN THE DIAGNOSIS OF INFERTILITY

Culdoscopy is not part of the diagnostic routine in infertility, but has special indications. It is indicated in long-standing infertility where the usual diagnostic tests have failed to find a cause. One of its most useful indications is in suspected peritubal disease not shown by salpingography. Ovarian conditions resulting in ovulatory failure can be diagnosed by direct visualization of the organs.

Kelly and Rock[3] found that culdoscopy showed the cause for sterility by revealing unexpected pathology in 34·1% of patients who were considered normal on routine testing. The chances of pregnancy appear to be doubled if the culdoscope-screened patient with pathology undergoes proper surgery.

Tubal Pathology

1. Culdoscopy in Previous Tubal Disease and Before Contemplated Reparative Surgery

The most frequent and important cause for female sterility is occlusion of the tubal lumen. This can be produced by pathological conditions within the lumen itself or in the tubal wall. Adhesions surrounding the tube which distort it or pressure from without by a tumour mass may also be responsible. These conditions vary from agglutination of the fimbrial end and mucosal folds, to adhesions surrounding the tube and extensive disease with hopeless tubal stricture.

Culdoscopy is, therefore, useful in choosing constructive reparative procedures and also in preventing useless surgery.

The results of salpingography may be completely fallacious. Apparent normality of the tubes may be seen with patency and free spill of the dye. No further steps are, therefore, taken to help the patient. At subsequent culdoscopy and proven by laparotomy, the tubes are found bound and immobile by adhesions with their fimbriated ends fixed in a position remote from the ovary. Also a hydrosalpinx may appear to be operable on the salpingogram picture, yet on culdoscopy the tube and ovary is completely surrounded by dense adhesions making surgery impractical. It is plausible to assume that approximation of the fimbria and ovary are necessary for efficient transfer of ova to the tube. The transfer may be delayed or rendered impossible by adhesions about the ovary that prevent its contact with the fimbria of the tube. The ovaries may be fixed to the back of the broad ligament or uterus and lose their normal mobility, thereby preventing the delivery of the ovum close to the fimbriated end of the tube. It has frequently been observed both at culdoscopy and subsequent laparotomy that the ovaries are surrounded by dense postinflammatory adhesions preventing the release of the ovum from the ovary and migration of the ovum to the fimbriated end of the tube is thereby prevented. This condition may also prevent rupture of the follicle-forming follicular cysts, so frequently seen in this type of ovarian condition. The mechanism of ovulation and ovum transfer followed by tubal reception and transportation is dependent upon normal structures capable of normal physiological response. Free-acting, well-developed fimbria are necessary for the arrest and transfer of the ovulated mass. Salpingography will not show this type of abnormal condition.

Peristaltic contractions of the tube appear to be responsible for dispersion of the sperms throughout their length but this may be rendered ineffective by peritubal adhesions that bind and immobilize the tube.

In the experience of Meigs,[5] operations for cornual block are more successful than blockage at the abdominal ostium. Cornual block can be recognized by salpingography, but this type of examination does not indicate the state of the remainder of the tube. Telescopic visualization is the only method other than laparotomy.

Case 1. Mrs. B.M., aged 25 years, had been married for 2 years and never used contraception. Five years previously she gave birth to an illegitimate child, followed by severe postpartum uterine infection. Husband—normal semenalysis. Ovulating on premenstrual curettage. A salpingogram (Fig. 4)

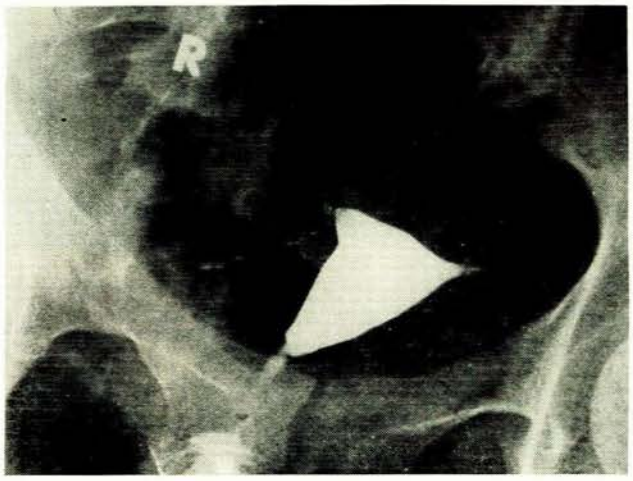

Fig. 4. Normal uterine cavity. Partial filling of right tube; no spill noted. Left tube filled for only a few millimetres.

showed a normal uterine cavity, partial filling of the right tube and no spill; the left tube spilled for a few millimetres beyond the uterine cornu; delayed film showed no spill. The conclusion was bilateral tubal occlusion with the right tube possibly favourable for salpingostomy.

Culdoscopy was performed before any contemplated surgery. The procedure was carried out without incident and the uterine fundus was clearly seen. The right ovary and tube were identified, and there were marked surrounding peritubal and ovarian adhesions, responsible for binding the tube and ovary to the back of the broad ligament. The tubal wall was markedly thickened and the fimbrial end completely clubbed and destroyed. The left tube and ovary were surrounded by adhesions and there was gross tubal thickening. Indigo carmine was injected through the cervix into the uterine cavity. The left tube did not fill, but the dye could be seen through the wall of the right tube; there was no spill. The conclusion was that reparative surgery was not justified as there was almost complete destruction of the left tube and gross intramural fibrosis of the left tube as well as extensive peritubal pathology.

Case 2. Mrs. J.C., aged 30 years, had been married 5 years, and had a septic abortion before marriage. She was ovulating normally and the husband's semenalysis was normal. Salpingography showed bilateral hydrosalpinges. Culdoscopy was easily performed and the fundus of the uterus was identified: dense adhesions surrounded the right tube and ovary with the fimbrial end of the tube completely occluded; the left tube and ovary presented a similar picture; there was no spill of dye. The peritubal and peri-ovarian state was such that operation was not advised.

The patient insisted that some surgical attempt be made to correct the condition. Laparotomy was therefore performed and the uterus was found to be fixed in third-degree retroversion (in spite of this, culdoscopy was performed with no difficulty). The adnexa were fixed in the pouch of Douglas and surrounded by adhesions, confirming the culdoscopy findings. An attempt was made at reparative surgery, but this was unsuccessful. Subsequent tubal insufflation indicated complete tubal occlusion.

Case 3. Mrs. A.W., aged 29 years, had been married 9 years and never used contraceptives. Bilateral wedge resection of the ovaries was done 7 years previously because of irregular menses. Septic abortion had been performed 4 years before marriage. Normal ovulation; semenalysis on husband normal. Because of a history suggestive of tubal involvement, salpingography was dispensed with and culdoscopy done instead. The uterine fundus was identified and both adnexa easily seen. Hydrosalpinx of the left tube was noted and marked peritubal adhesions binding the tube to the ovary. On the right side marked peritubal adhesions were present, and there was immobility of the tube but no hydrosalpinx. Indigo carmine was inserted through the cervix, and there was no spill on the left side, but the hydrosalpinx was distended by the dye when pressure was exerted on the injecting syringe. Free spill was seen on the right side. It was decided that a left-sided salpingostomy and bilateral salpingolysis would be beneficial. The culdoscopy findings were confirmed at operation. Reparative surgery and a ventrisuspension was carried out.

Case 4. Mrs. J.B., aged 26 years, had been married 4 years, and had a septic abortion before marriage. She had been trying to conceive for 2 years. Normal ovulation; husband's semenalysis normal. A salpingogram showed a normal uterine cavity. Spill was noted from the left tube but on the image-intensifier it appeared to be fixed in position. The right tube was occluded at its cornual end. Culdoscopy was carried out to ascertain whether or not the left tube was surrounded by adhesions impairing its mobility; if this was confirmed, salpingolysis would be performed. Both ovaries were seen to be completely free from adhesions—the right tube was completely occluded, no dye issuing from the fimbrial end; the left tube was patent and free from adhesions. Surgery was withheld. The patient conceived 15 months later and is now 20 weeks pregnant.

2. *Tubal Disease Following Previous Ovarian Surgery*

Through the use of the culdoscope it is revealing to see the extent of peritubal damage occurring after ovarian surgery. Damage has been noted following the removal of ovarian cysts, as well as after the removal of physiological follicular cysts at the time of appendicectomy. Unnecessary wedge resection of ovaries has resulted in a similar picture. The majority of these operations were done in women during the second decade, before marriage. In all of these cases the salpingogram was normal and no obvious cause for infertility could be found. Culdoscopy showed the cause in the form of peritubal and peri-ovarian adhesions with subsequent interference in tubal physiology or tubal damage.

A plea is made to those who open the abdomen of young women for right iliac fossa pain, not to interfere with normal ovaries by puncturing or excising innocent follicular cysts, which if left alone will disappear spontaneously. The criteria for operating upon young women with right iliac fossa pain should be strict. Unnecessary surgery in young women should be avoided at all costs, since even a midline scar can be harmful to their future fertility.

Case 1. Mrs. S.C., aged 25 years, had been married 7 years, and trying to conceive for 6 years. Husband—normal semenalysis. Patient's appendix removed at 15 years of age. Two years after marriage she developed dyspareunia, and was told it was due to adhesions. A laparotomy was performed for this. One year later she was informed she had an ovarian cyst and this was removed at a further operation. One year after this, investigations for infertility were carried out and tubes found to be patent on insufflation and at salpingography. Normal ovu-

lation. Two years later salpingogram repeated (Fig. 5), showing a normal uterine cavity, tubal filling and spill on both sides. Peritubal pathology was suspected and culdoscopy was performed.

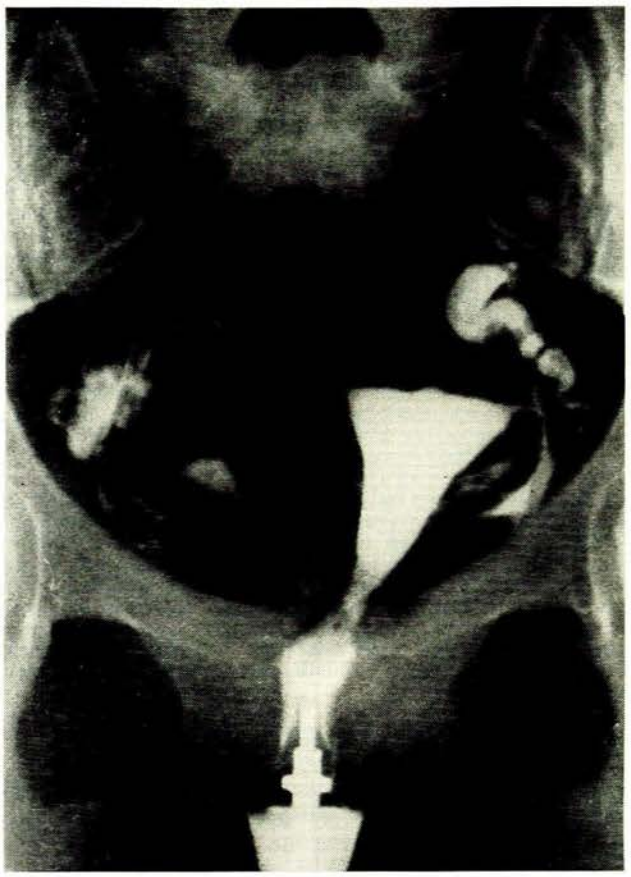

Fig. 5. Bilateral tubal filling and spill is seen.

The right tube was seen coming off the uterine cornu and it could be followed throughout its course to the fimbria; peritubal adhesions were binding the tube to the ovary; free tubal spill was present. The left tube was fixed and adherent to the back of the uterus by dense adhesions; tubal spill was present. Laparotomy was proceeded with and the above findings confirmed. Bilateral salpingolysis and ventrisuspension were performed. The patient conceived 1 year later and gave birth to a male baby weighing 8 lb. 9 oz.

Case 2. Mrs. P. J., aged 29 years, had been married 10 years. Normal ovulation; husband—normal semenalysis. Appendix removed 1 year before marriage. Five years later, bilateral ovarian cyst removed because of lower abdominal pain. A salpingogram showed a normal uterine cavity; both cornua were visualized and there was free tubal spill on both sides. Culdoscopy was performed. Both adnexal regions were clearly visualized and marked adhesions seen on both sides. Indigo carmine was seen issuing from both tubes. At laparotomy the findings were confirmed. Salpingolysis and ventrisuspension was performed. Conception has not occurred after 18 months.

3. *Sterility Following Previous Ectopic Pregnancy*

Culdoscopy has shown that the incidence of peritubal pathology is considerable on the normal side after surgery for ectopic pregnancy. Salpingography frequently shows a normal picture.

Case 1. Mrs. H.W., aged 34 years, married 12 years. Normal ovulation. Husband—normal semenalysis. Ectopic pregnancy in 1956, partial salpingectomy on right side. Salpingogram (Fig. 6) showed a normal uterine cavity. The left tube was outlined and spill seen; a small aggregation of dye was noted at the

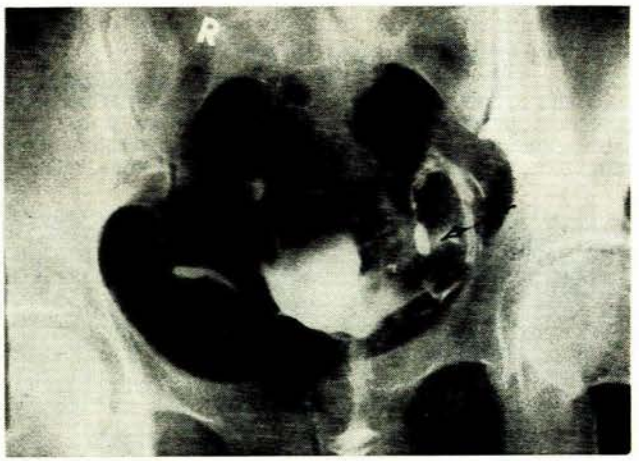

Fig. 6. The left tube is outlined in its full length, there is aggregation of dye at the fimbrial end but spill is present. A 1-hour delay film showed that contrast medium was trapped in this area. The right tube is outlined but is occluded at the ampullary region as a result of partial salpingectomy for an ectopic pregnancy.

fimbrial end suggesting a hydrosalpinx. The right tube had been removed 1 cm. from its origin. At culdoscopy the stump of the right tube was seen; it was not patent and there were marked adhesions surrounding it. The left tube was fixed to the ovary and the back of the uterus by dense adhesions. At operation the tube was freed and separated from the ovary. The left tube was left untouched. Two years after the operation conception has not occurred.

4. *Previous Sterilization Requiring Reparative Surgery*

Case report. Mrs. H.M., para 2, aged 32 years, had been married 9 years. She had been sterilized 5 years previously because of a psychological disturbance. The method of sterilization could not be ascertained. The patient was now very anxious to have another child and requested surgery to rectify the sterilization. Salpingogram (Fig. 7) showed a normal

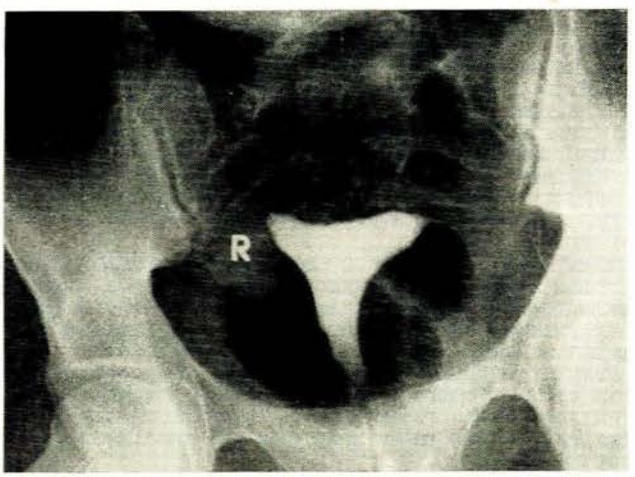

Fig. 7. Normal uterine cavity. Absence of tubal filling on both sides.

uterine cavity and there was absence of tubal filling on both sides. Culdoscopy was performed before any contemplated plastic tubal surgery; this showed a complete absence of both

fallopian tubes. The method of sterilization here had been bilateral total salpingectomy.

This case clearly indicates the importance of assessing the tubal state before contemplating operations to re-establish continuity after sterilization.

5. Tubal Tuberculosis

Only 75% of tubal tuberculosis is reflected in the endometrium obtained at curettage, making a positive diagnosis difficult in suspected cases. Salpingography may show occluded tubes, or a normal picture. Culdoscopy is invaluable in these cases to make or to exclude a positive diagnosis of tubal tuberculosis. The typical infolding of the fimbria can be clearly recognized. Scattered tubercles can be seen on the serosal surface of the tubes.

Case report. Mrs. Z.A., para 0, aged 25 years, had been married 6 years. She presented because of irregular menses and infertility. Husband—normal semenalysis. She had pulmonary tuberculosis, treated 5 years ago, which was said to be cured. Endometrial curettings showed evidence of ovulation, but no sign of tuberculosis. Culture and guinea-pig inoculations were negative for tuberculosis. Salpingogram showed patent tubes on both sides. Culdoscopy: the right ovary was seen and a corpus luteum was present. There were scattered tubercles along the serosa of both tubes. The right tube showed infolding of the fimbria, typical of tubal tuberculosis, but the tube was patent. The left ovary was normal and the left tube was attenuated and fibrotic. Tubercles were seen on the serosal surface. The picture was typical of bilateral tubal tuberculosis. Surgery was avoided. The patient was put onto antituberculous treatment for 2 years. Conception did not occur.

Endometriosis

The ability of culdoscopy to diagnose endometriosis is well substantiated. In younger women to whom childbearing is vital, endometriosis may play an important role. The condition has been quoted as being present in 20% of gynaecological laparotomies. Therefore, the necessity of diagnosing it in infertility and its treatment in its early stages is important in young women. In these women early pregnancy must be advised. Culdoscopy should be used when there is a history of pain, dysmenorrhoea and dyspareunia associated with infertility.

Congenital Uterine Abnormalities

Culdoscopy is a useful ancillary examination to hysterography in suspected uterine abnormalities. In the case described below, the hysterogram suggested a unicornuate uterus, but on culdoscopy it was seen to be bicornuate with one well-developed horn and the other rudimentary; both tubes and ovaries were seen.

Case report. Mrs. A.V., aged 30 years, had been married 7 years. Conception occurred immediately after marriage, but this ended in spontaneous abortion at 6 weeks. Two further pregnancies ended in abortions at 8 weeks. In 1960, a pregnancy went to term ending in an intra-uterine death. For the next 4 years attempts at conception were unsuccessful. The husband's semenalysis was normal. Hysterosalpingogram (Fig. 8) showed that the dye flowed freely into the uterine body and the uterus was seen to be unicornuate in type. The right horn which was visualized was loculated and there was free tubal spill on this side. Culdoscopy: the uterine horn on the right side was clearly visualized and indigo carmine could be seen flowing from the tube. On the left side, a rudimentary horn with fallopian tube could be clearly seen. Both ovaries were visualized and normal. A corpus luteum was seen in the left ovary. The patient conceived 4 months later and is now 24 weeks pregnant; there is no evidence of any developing cervical incompetence.

OVARIAN FACTORS IN INFERTILITY

Ovarian abnormalities may play an important role in infertile patients presenting with obesity and varying degrees of virilism. These may range from mild hirsutism or acne to menstrual irregularities, hypomenorrhoea, oligomenorrhoea and complete amenorrhoea. In these patients it is possible to observe the ovaries through the culdoscope. One may see normal ovaries with signs of recent ovulation, polycystic ovaries with a bluish non-thickened capsule and the typical enlarged ovary with a smooth, white, thickened tunica, characteristic of the Stein-Leventhal syndrome. In this condition the ovary can be observed through all its phases of development from the polycystic ovary to the enlarged 'ivory' gonad.

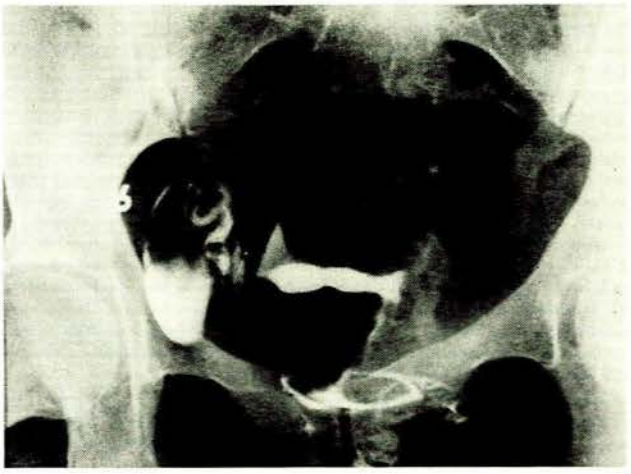

Fig. 8. Loculated atavistic type of uterine horn on right side, with free tubal spill.

A. Normal Ovary

A proportion of infertile patients present with any one or all of the abnormalities of obesity, varying degrees of hirsutism and menstrual irregularities. The mistaken diagnosis of anovulation may be made in a large number of these women, when in fact ovulation is occurring normally and there is another cause for the infertility. Culdoscopy is invaluable here for direct visualization of the ovaries. The above conditions occur in young women, the hirsutism being constitutional in type with normal suprarenal and ovarian function. The obesity probably results from abnormal hypothalamic function. This is frequently associated with irregular menses. Simple weight reduction cures most of these patients and successful pregnancy ensues. Ovarian surgery is never indicated. In the adolescent patient, the syndrome is self-limiting and wedge resection of the ovaries must be avoided at all costs.

It is obvious that those who do frequent ovarian wedge resections on these patients in whom the mistaken diagnosis of Stein-Leventhal syndrome has been made, will achieve excellent results. The reason being that there has never been any ovarian pathology and had the ovaries been left alone the patient would have reverted to normality in any event.

Case 1. Mrs. L.B., aged 30 years, had been married 5 years. No contraception was ever used and there had been attempts

at conception since marriage. Husband—normal semenalysis. Salpingogram normal. Increasing oligomenorrhoea and fairly marked hirsutism. Normal 17-ketosteroids, protein-bound iodine and glucose-tolerance tests. Endometrial biopsy did not confirm ovulation, and temperature did not show the biphasic pattern. The possibility of Stein-Leventhal syndrome was strongly considered. Culdoscopy was performed as well as curettage: the left ovary was normal in size, the capsule was smooth, but normal in colour, there were many small follicular cysts present. The right ovary showed a degenerating corpus luteum. The endometrial pattern was secretory. The patient was left alone and no treatment was instituted. The cervix was observed for the normal ovulatory changes in subsequent cycles and normal postcoital tests were obtained. She conceived after 6 months and was delivered of an 8 lb. boy by forceps. She is now pregnant for the second time. By seeing definite signs of ovulation through the culdoscope, possible laparotomy with a view to wedge resection of the ovaries was avoided.

Case 2. Mrs. J., aged 33 years, had been married 10 years. She had one child aged 8 years, and was well until 5 years previously. Formerly regular menses became markedly irregular. This was followed by periods of amenorrhoea, the longest being for 9 months. A curettage was advised and on the result of this, wedge resection of the ovaries was suggested. Nothing was done for a further year and the menstrual pattern continued as above. One year ago she was reinvestigated: protein-bound iodine 5·8 μg./100 ml.; serum cholesterol 240 mg./100 ml.; 17-ketosteroids 4·4 mg. per 24 hours. Urinary 24-hr. FSH positive at 6 m.u., negative at 12 m.u. Plasma cortisol 15 μg./100 ml. (normal range 6 - 23 μg./100 ml.). Culdoscopy: both ovaries were seen to be normal in size. The capsule of either ovary was not thickened. No signs of ovulation or tuberculosis were seen. The endometrium was proliferative in type. No further treatment was given and after 6 months the cycles became regular. She has now conceived and is 18 weeks pregnant.

Case 3. Mrs. L.C., aged 25 years, married 2 years. The menarche occurred at 13 years, and menses were regular at that time. Soon after marriage menstruation suddenly ceased and when seen she had not menstruated for 9 months. Weight-gain had been excessive since marriage. No hirsutism. Thyroid and suprarenal tests were normal. There was no diabetes. Culdoscopy and curettage was performed: the uterus was normal, both fallopian tubes were seen to be normal, and the right ovary was normal in size with a normal capsule. A large corpus luteum was seen in the left ovary; ovulation was occurring. Thick secretory endometrial curettings were obtained. A weight-reducing diet was started, and this was successful. Menstruation commenced normally and continued to be regular. The origin of the menstrual abnormality was in all probability hypothalamic.

Case 4. Mrs. J.B., aged 30 years, married 6 years. Menarche occurred at 12 years, and menses had been irregular for the past 7 years. Conception had not occurred although it had been attempted for 6 years. Husband—normal semenalysis. Normal salpingogram. Increasing hypomenorrhoea and oligomenorrhoea. Long periods of amenorrhoea, the longest being for 1 year. Definite hirsutism present. On vaginal examination both ovaries palpable, but not grossly enlarged. Withdrawal bleed followed after administration of progesterone. X-ray of the pituitary fossa was normal. Chromosome count—normal female. Normal glucose-tolerance test. Protein-bound iodine 6·8 μg./100 ml.; serum cholesterol 274 mg./100 ml.; 17-ketosteroids 6·2 mg. per 24 hours; 17-hydroxycorticoids 10·6 mg./100 ml. Urinary 24-hour FSH negative at 6 m.u. A similar result was obtained on a repeat test. Culdoscopy: left ovary polycystic and capsule not thickened; right ovary showed a fresh corpus luteum. Curettage showed secretory endometrium. Her temperature was charted and this showed normal biphasic pattern of ovulation. She has been menstruating normally since then, but conception has not occurred to date.

B. Polycystic Ovary

Through culdoscopy it has been possible to observe the common polycystic picture of the ovary associated with anovulation. It would appear that this picture occurs in any condition leading to ovulatory failure. The causes of this may be hypothalamic, often associated with obesity; thyroid malfunction; suprarenal abnormalities or primary ovarian abnormalities as in the initial stages of the Stein-Leventhal syndrome. The ovary may vary in size, but is usually slightly enlarged with the capsule only slightly thickened and smooth; the colour is bluish. Multiple small cysts are visible through the capsule.

The ovary appears to be the target organ in the above conditions and the appearance is quite distinct from the grossly enlarged organ with smooth thickened capsule seen in the fully developed Stein-Leventhal syndrome. The pituitary gland, thyroid gland and suprarenal gland have all been blamed in the aetiology of this syndrome. It is therefore possible that if abnormal function of the glands, leading to the polycystic ovary, is severe enough and persists for long enough, the end-result may be the enlarged, sclerotic Stein-Leventhal ovary. Wedge resection is, therefore, not the treatment of choice in all ovaries of this type. Disease of the other endocrine glands must first be excluded and if ovarian surgery is carried out where such abnormalities exist, failure is inevitable.

The end-result of the common ovarian abnormality is reflected in the endometrium, resulting in irregular menses and a proliferative endometrial pattern.

Jones and Jones[6] have described the ovarian picture in Cushing's syndrome, congenital adrenal hyperplasia, postnatal and postpuerperal adrenogenital syndrome; these are obviously secondary to suprarenal changes. In infants the ovaries showed no recognizable change from normal. There were abundant primordial follicles. The ovary in older untreated patients became increasingly abnormal. In teenage individuals there were also primordial, developing and antrum follicles, but no sign of recent or previous ovulation. In the adult, the ovarian cortex consisted entirely of stroma and in one of the ovaries examined there were a few structures suggesting very old corpora albicantia in spite of the absence of a history of any menstrual bleeding. The severity of ovarian changes was proportional to the severity of the adrenal disease and also to the length of time the patient remained untreated. In patients showing a lesser degree of the abnormality some luteinization of primordial follicles could be found. It is interesting that in these cases sections of the adrenal showed some normal fasciculata.

The ovarian changes may be summarized by stating that in infants, children and adolescents there seems to be normal follicular development to the antrum stage, but no evidence of ovulation. This would account for the polycystic type of ovary found with a moderately thickened capsule and as the severity of the suprarenal disease increases and age of the untreated patient advances there is less and less follicular activity resulting in disappearance of primordial follicles with increasing fibrosis of the ovarian cortex. This could be the stage of the more advanced picture simulating the true Stein-Leventhal ovary. However, the picture cannot be as complete as is shown microscopically because cortisone therapy even in adults results in ovulation and menstruation after 4 - 6 months of treatment. Gold and Borushek,[7] in investigating

these problems, state that their experience is that bilateral polycystic ovaries are present in about half of the patients with suprarenal dysfunction and that in the true adrenogenital syndrome, the ovaries would appear to be indistinguishable from those observed in the Stein-Leventhal syndrome, both macroscopically and histologically.

Therefore, in considering women presenting with obesity, mild virilism and irregular menses, culdoscopy may show normal ovulating ovaries, polycystic ovaries with no ovulation or the various phases of the Stein-Leventhal ovary.

C. Stein-Leventhal Syndrome

Visualization of the ovaries, without resorting to laparotomy, in suspected cases of Stein-Leventhal syndrome is invaluable if only to help in the decision whether or not wedge resection should be undertaken. Also the odd case of excessive bleeding may be due to the early granulosal-thecal dominant phase of the Stein-Leventhal syndrome as described by Ingersoll and McDermott ;[8] here the ovary can be recognized at culdoscopy and a successful wedge resection decided upon with dramatic results.

In the Stein-Leventhal syndrome the assistance to be gained by hormonal assay estimations has been disappointing and direct observation of the ovaries is essential in making a correct diagnosis.

With regard to the ovarian pathology, most authors recognized a single type of ovary concerned with this syndrome, the enlarged multicystic type with pearly-white thickened tunica containing possibly partially developed Graafian follicles. Shippel,[9] however, describes 6 ovarian phases from granulosal dominance to thecal dominance and correlates this with the clinical menstrual picture and endometrial histology. The main ovarian phases can be recognized at culdoscopy, and easily correlated with the menstrual pattern and subsequent treatment, therefore, dictated. In the early imbalance phase with granulosal dominance, one frequently finds the type of hypoplastic polycystic ovary with a typical smooth and slightly thickened bluish-white capsule with multiple granulosal follicular cysts producing an abundance of oestrogen, leading to periods of amenorrhoea followed by bouts of severe menorrhagia. In these cases the endometrium shows active cystic glandular hyperplasia ; no secretory pattern is ever present. In the intermediate imbalance phase, with greater thecal dominance, the ovaries exhibit a more markedly sclerotic picture with a thicker and smoother capsule which is white in appearance ; the ovary is larger and cirrhotic. Oligomenorrhoea is present and blood loss is less. The endometrium shows a proliferative pattern or the atrophic phase of cystic glandular hyperplasia. In the late imbalance phase with complete thecal dominance, the ovaries may show either the typical large sclerotic picture with smooth thickened capsule, or less commonly the atrophic type with similar capsular changes to the former. There is complete amenorrhoea and the endometrium shows the typical and complete atrophic form of cystic glandular hyperplasia.

Wedge resection of the ovaries is required in all of these cases. The earlier imbalance phases can be watched as advocated by Bailey.[10] He states that the decision to operate is based on the consideration of the clinical aspect and examination, together with the complete plan to prolong hormonal and general treatment. There is no harm in waiting to see what effect this will have. However, in those cases of the early imbalance phase, surgery may be necessary to control intractable bleeding.

Case 1. Early imbalance phase. Miss M.P., aged 20 years. Menarche occurred at 12 years and menses were irregular from commencement. Oligomenorrhoea and bouts of amenorrhoea followed by menorrhagia had been present for the past 3 years. Periods of menorrhagia were becoming worse and were completely incapacitating, necessitating blood transfusion because of the associated anaemia. There was marked acne and moderate hirsutism present. Moderate obesity. Normal gynaecological examination. Endometrial histology—hyperplastic proliferative pattern. 17-ketosteroids 2·4 mg./100 ml.; 17-hydroxycorticoids 2·6 mg./100 ml. Thyroid function and glucose-tolerance test normal. Complete failure of prolonged hormonal cyclical therapy. Culdoscopy: bilateral ovarian enlargement with bluish-white thickened capsule with multiple cystic follicles. Diagnosis of early imbalance phase of Stein-Leventhal syndrome was made, and bilateral wedge resection performed. Histology of ovaries confirmed the diagnosis. Excessive menses stopped and the patient is now menstruating regularly and normally.

Case 2. Intermediate imbalance phase. Mrs. A.G., aged 26 years, had been married 8 years. Menarche occurred at 14 years. She had not become pregnant although no contraceptives had been used. Markedly obese with irregular menses and increasing bouts of amenorrhoea lasting up to 6 months. Normal gynaecological findings. Thyroid tests normal, suprarenal tests normal. There was a proliferative endometrial pattern. Fairly marked and increasing hirsutism was noted. Culdoscopy: both ovaries enlarged with thickened and white capsule, some cystic follicles visible. There were no signs of ovulation. Diagnosis of Stein-Leventhal syndrome was made. Bilateral wedge resection of ovaries was performed and the clinical diagnosis of intermediate imbalance phase was confirmed by histology. Normal menses followed operation but there has been no pregnancy to date.

Case 3. Late imbalance phase. Mrs. E. P., aged 30 years, married 12 years. Menarche occurred at 11 years. Para 1—10 years previously. Markedly irregular menses with increasing oligomenorrhoea and amenorrhoea associated with deepening of voice and marked hirsutism. The present examination was preceded by amenorrhoea for 1 year. On gynaecological examination both ovaries were easily palpable. Thyroid and suprarenal function tests were normal. Culdoscopy: both ovaries were visualized and found to be 3 times normal size, capsule smooth and glistening with an ivory appearance, some small blue cysts. Endometrial picture—atrophic cystic glandular hyperplasia. The diagnosis of the late imbalance phase of the Stein-Leventhal syndrome was made. Bilateral wedge resection of the ovaries was carried out and histology confirmed the diagnosis. Normal menstruation followed, but no conception has occurred.

D. Other Ovarian Causes of Amenorrhoea

Ovarian dysgenesis of varying degree causing infertility and amenorrhoea can be recognized through the culdoscope.

With the advent of the new methods of stimulating ovulation by human chorionic gonadotrophin and Chlomiphene, it is important to be able to see the ovary before embarking on expensive treatment to see if it will be responsive or not, the FSH levels having been estimated first. The response to treatment can also be recorded.

Culdoscopy should, therefore, be used in all cases of unexplained amenorrhoea. Jeffcoate[11] quotes a case where an arrhenoblastoma was found with normally palpable ovaries and the patient's only complaint was secondary amenorrhoea.

Case 1. Mrs. M.M., aged 26 years, married 9 years. There had been no pregnancies although no contraception was used.

Menarche occurred at 12 years; regular cycle 5/28, normal bleeding. Married at 17 years and stopped menstruating after a pyrexial illness, the exact nature of which was not known. Withdrawal bleeds brought about with hormonal treatment on several occasions. Never fully investigated.

General examination showed no abnormality. Normal secondary sex characteristics. Height 5 ft. 6 in. Weight 150 lb. Poor hair distribution in axillae and in the genital area. Thyroid function normal. Normal glucose-tolerance test. 17-ketosteroids 6 mg./100 ml.; 17-hydroxycorticoids 12·8 mg./100 ml. FSH positive at 48 m.u., indicating low pituitary inhibition by oestrogen. Maturation index 0/60/40. Chromosome count—normal female. Endometrial histology—atrophic endometrium. Withdrawal bleed on giving oestrogen, but none on giving progesterone. Culdoscopy: pelvis clearly seen; uterus small; both ovaries seen to be extremely atrophic and fibrotic, measuring approximately 1 cm. in length. The diagnosis of secondary amenorrhoea following ovarian atrophy possibly as a result of a pyrexial disease was made. The case was completely unsuitable for stimulation by human chorionic gonadotrophin. The prognosis was completely hopeless.

Case 2. Mrs. H.K., aged 24 years, married 3 years. Primary amenorrhoea. At 16 years of age she was treated and withdrawal bleeds were brought about by giving oestrogen. General examination normal. Poor secondary sex development. Low cornification index. Chromosome count normal for female. Thyroid function and glucose-tolerance test normal. 17-ketosteroids 4·5 mg./100 ml.; 17-hydroxycorticoids normal; protein-bound iodine 7·7 mg./100 ml. X-ray of the sella turcica normal. Three independent FSH 24-hour urines were negative at 6 m.u., indicating that the pituitary was not producing follicular-stimulating hormone. The endometrial picture was atrophic and there was no evidence of tuberculosis. Culdoscopy: small uterus; both ovaries seen to be slightly smaller than normal, but completely inactive. Regarded as being a suitable case for ovarian stimulation with human chorionic gonadotrophin. This was carried out monthly for 3 months and ovulation was induced. In spite of the husband having a normal semenalysis, pregnancy did not occur.

Four cases have been seen where, on the cessation of oral contraceptives after prolonged use, long periods of amenorrhoea ensued. Culdoscopy was performed on one of these women, and the ovaries were found to be inactive but not polycystic.

THE CULDOSCOPE AS A RESEARCH TOOL

Any theory or practice that advances our knowledge concerning amenorrhoea, hirsutism or infertility is most welcome. Through culdoscopy, it is possible to study the ovarian picture in the various phases of thyroid and suprarenal disease. The ovarian changes in the different phases of the Stein-Leventhal syndrome can be observed. It has been interesting to note in the above conditions how similar the ovarian appearances are to the ovary at full-term pregnancy.

At culdoscopy it is possible to take ovarian biopsy specimens for histological examination and to aspirate fluid from cysts for biochemical analysis.

It would be interesting to follow through the culdoscope, the ovarian changes regressing back to normality of patients with suprarenal hyperplasia being treated on cortisone, or to follow the ovarian changes that occur in the ovaries after wedge resection in the Stein-Leventhal syndrome.

Normal ovarian and fallopian tube physiology has been studied at the time of ovulation. The changing picture of the tubal fimbria and increase in fluid surrounding the ovary at this time has been observed. Very recent ovulatory changes in the corpus luteum have been seen.

SUMMARY

The use of culdoscopy in the investigation of infertility is discussed. A description of the anaesthetic technique, method of culdoscopy, dangers and complications is given. The limitations of culdoscopy are recognized, but by its use much useless and unnecessary tubal and ovarian surgery is avoided. Culdoscopy has illustrated the frequency of tubal damage following ovarian surgery in young women. The selection of patients for reparative tubal surgery can be made more accurately.

Ovarian physiology can be studied and the development of polycystic ovarian disease can be followed. It is apparent that the polycystic ovarian picture can be caused by a number of factors, such as thyroid malfunction, adrenal disease and primary ovarian pathology. A more accurate diagnosis of the Stein-Leventhal syndrome can be made by looking at the ovary before contemplating surgery. This will avoid a large number of unnecessary ovarian wedge resections. The research possibilities of culdoscopy are discussed.

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