necessary to study cases occurring in other seasons and at other places in order to settle this point.

Summary

During the 1955 poliomyelitis epidemic 121 cases of clinically typical poliomyelitis were admitted to hospital. In the same period nine cases of encephalitis-like illness were seen. These were investigated by standard virological techniques, and seven were shown to be infected with poliomyelitis virus. The infected cases fell into two groups—those which resembled acute cerebellar ataxia, and those which resembled acute encephalitis. Probably poliomyelitis infection can occasionally manifest itself by symptoms exclusively related to cerebellar or "encephalitic" lesions.

We are grateful to Drs. J. M. Kennedy and T. Colver for permission to publish these cases. We thank Drs. A. J. M. Warrack and L. Wolman for the pathology reports, Dr. J. M. Warboys for the E.E.G. reports, Dr. A. B. Sabin for his valuable discussion, and Professor C. H. Stuart-Harris for criticism of the manuscript.

REFERENCES

- Adler, E., Landau, J., and Rabinowitz, E. (1955). *Confin. neurol. (Basel)*, 15, 154.
 Balducci, D., Zaiman, T. E., and Tyrrell, D. A. J. (1956). *Brit. J. exp. Path.*, 37, 205.
 Barrett, A. M., Gairdner, D., and McFarlan, A. M. (1952). *British Medical Journal*, 1, 1317.
 Berglund, G., Mossberg, H. O., and Rydenstam, B. (1955). *Acta pediat. (Uppsala)*, 44, 254.
 Black, F. L., and Melnick, J. L. (1954). *Yale J. Biol. Med.*, 26, 385.
 Bodian, D. (1952). *Papers and Discussions Presented at 2nd International Poliomyelitis Conference*, p. 61. Lippincott, Philadelphia.
 Huston, A. F., Morwood, J. B., Christofinis, G. J., and Wood, W. (1956). *British Medical Journal*, 2, 629.
 Jennings, G. H., Hamilton-Paterson, J. L., and MacCallum, F. O. (1949). *Ibid.*, 2, 210.
 Kelleher, W. H., Bratton, A. B., and MacCallum, F. O. (1949). *Ibid.*, 2, 213.
 Kraft, L. M., and Melnick, J. L. (1950). *J. exp. Med.*, 92, 483.
 Melnick, J. L. (1955). *Ann. N.Y. Acad. Sci.*, 61, 754.
 Minnesota Poliomyelitis Research Commission (1947). *J. Amer. med. Ass.*, 134, 757.
 Tyrrell, D. A. J., Balducci, D., Snell, B., and Zaiman, T. E. (1957). In preparation.

HABITUAL ABORTION DUE TO INSUFFICIENCY OF THE INTERNAL CERVICAL OS

A PRELIMINARY REPORT OF SEVEN CASES TREATED BY A MODIFIED SHIRODKAR TECHNIQUE

BY

V. B. GREEN-ARMYTAGE, M.D., F.R.C.P.
F.R.C.S., F.R.C.O.G.

AND

J. C. McCLURE BROWNE, F.R.C.S.Ed.
F.R.C.O.G.

From the Institute of Obstetrics and Gynaecology,
Hammersmith Hospital, London

The problem of habitual abortion is fortunately relatively rare. To the woman who suffers from this condition, however, it is a most serious and depressing one. Despite every line of investigation and management, there is still a hard core of patients who habitually abort in the early months of pregnancy.

Aschoff (1906) demonstrated the intimate anatomy of the uterus and cervix, showing that the upper part of the cervical canal and the anatomical internal os were incorporated into the lower segment of the uterus at an early stage of pregnancy (Fig. 1). This was confirmed by F. J. Browne (1950). Danforth (1947), of Chicago, showed that as a result of congenital defect or of trauma by dilators, forceps extraction, or the passage of a large infant, the fibromuscular junction between the anatomi-

cal internal os and the lower uterine segment might be rendered inefficient for its purpose of retaining the growing conceptus *in utero* (Fig. 2). Clinically such a condition may be suspected in patients who, following

FIG. 1.—Showing formation of the lower uterine segment by inclusion of the upper part of the cervical canal in the uterine cavity.

surgical dilatation or amputation of the cervix, or trauma during delivery, subsequently abort repeatedly at a stage in pregnancy which will vary according to the degree of cervical impairment present.

Lash and Lash (1950) drew attention to the incompetent internal os as a factor in habitual abortion, but particularly in relation to anterior defects resulting from obstetrical or gynaecological trauma. They described a method of repair of the anterior defect. Subsequently Rubovits, Cooperman, and Lash (1953) described a means of diagnosis in the non-pregnant state by means of x-ray examination. The symptoms are, of course, present only during pregnancy, and consist of a sudden rupture of the membranes followed by a rapid and relatively painless extrusion of the products of conception. It seems curious, however, that Lash and Lash should describe only an anterior defect, for most gynaecologists would agree that lateral defects in the cervix are far more common. Shirodkar (1955), however, realizing that the defect in the internal os could be, and

FIG. 2.—To show how bag of membranes may descend or herniate if fibromuscular junction is weak or insufficient, with rupture of membranes and/or abortion.

Fig. 2.—To show how bag of membranes may descend or herniate if fibromuscular junction is weak or insufficient, with rupture of membranes and/or abortion.

most frequently was, in a situation other than anterior, described a method of encirclement by means of a fascial strip, forming a "purse-string" around the internal os.

Incompetence of the internal os may be suspected if there is a history of repeated early rupture of the membranes resulting in abortion. The incompetence can be demonstrated in two ways when the patient is not pregnant. First, a special hystrogram can be carried out, using a cannula tipped with an inflatable bulb. This is inserted into the uterine cavity and lipiodol or other radio-opaque substance injected so as to distend the bulb. Then, with gentle traction on the cannula, an x-ray plate is taken in the lateral and antero-posterior positions. This will demonstrate an abnormally patulous internal os (Fig. 3). On the other hand, it may be possible, with the non-pregnant patient anaesthetized and in the lithotomy position, to pass a Hegar dilator of size 4 or larger into the uterine cavity without any

difficulty whatsoever. This we regard as demonstrating that the internal os is indeed deficient.

In a patient already pregnant, however, with a history of repeated abortions, inspection of the cervix through a speculum may show bulging membranes and a gaping cervix, and obviously a clinical diagnosis of threatened abortion is indicated. If there has been no bleeding it is reasonable to suppose that it is the cervix which is at fault.

FIG. 3.—Ballooning of the cervical canal, with a patulous internal os (Case 7).

We have now had seven patients suffering from repeated abortion in whom we have been able to demonstrate by these methods a deficiency in the internal os. They were all treated by a modification of the Shirodkar technique, for one of us had the privilege of watching Mr. Shirodkar perform his operation in Bombay on a patient five months pregnant who had had four abortions and in whom the bulging membranes could be clearly seen high in the dilated cervical canal. Five have now been delivered (three by caesarean section and two *per vias naturales*): two of these are now pregnant again, and the operation has again been performed. The sixth and seventh are not yet pregnant so far as we know. One is living in Ghana, and the other has only recently undergone operation.

The following are details of the seven cases.

Case 1

The patient, a para 0+4, aged 26 and married eight years, was first seen in the infertility clinic on March 18, 1955. There was no clear history of cervical trauma. There had been three miscarriages, the first in September, 1952, at 12 weeks; the second in July, 1953, at 22 weeks; and the third in August, 1954, at 24 weeks.

Clinical examination was essentially negative. A tubal insufflation test was positive and a hystrogram showed that there was a deficiency in the internal cervical os (Fig. 4). On December 16, 1955, she was found to be approximately 10

FIG. 4.—Hystrogram showing a defective internal os. (Case 1.)

weeks pregnant (L.M.P., October 10), and she was admitted immediately for a modified Shirodkar operation. This was carried out, but she aborted the same day. Following her period on March 26, 1956, she again became pregnant, and on May 18 a progesterone implant of 100 mg. (4×25 mg.) was performed. The pregnancy continued until 38 weeks, when, because of her history and a first degree of disproportion, surgical induction of labour was carried out. On introducing the finger through the cervix the nylon suture could be felt as a rigid band lying just deep to the endocervical mucous membrane. It had presumably migrated to that position from the outer aspect of the cervix. The suture was divided with long curved scissors, and immediately the cervix opened widely enough to admit three fingers. The forewaters were ruptured and clear liquor was obtained. Labour pains, however, did not follow, and 27 hours later lower segment caesarean section was carried out. A living male child weighing 5 lb. 7 oz. (2,465 g.) was delivered, and has survived. She is now pregnant again (L.M.P., April 30, 1957) and the operation has been repeated. The pregnancy continues.

Case 2

A para 0+3, aged 34 and married two years, had no history of cervical trauma. In 1954 she had a spontaneous miscarriage at 8 weeks, and in the same year one at 12 weeks. In 1955 another miscarriage occurred, again at 8 weeks. She was first seen at the infertility clinic on October 28, 1955. Clinical examination revealed a small fundal fibroid which was thought to be of no significance. There was no other clinical abnormality. A tubal insufflation test was positive. Examination of the husband's sperms showed no abnormality. The total count was 175,000,000. On November 18 a hysterosalpingogram (Fig. 5) showed incompetence of the internal cervical os, and a temperature chart

FIG. 5.—Hystrogram showing a defective internal os. (Case 2.)

showed that ovulation was indeed occurring. Her last period began on November 4, and on December 16 the Hogben test was positive. There was a slight brown discharge. She was admitted to hospital on January 2, 1956, and a modified Shirodkar operation was performed.

Pregnancy progressed uneventfully until on August 1, when 39 weeks pregnant, the blood pressure had risen from an average level of about 120/80 to 140/90. She was admitted and went into labour at 10 o'clock that night. At 1.30 p.m. the next day she was having fairly good contractions. No dilatation of the cervix could be felt on vaginal examination. The nylon suture was divided posteriorly and the membranes were ruptured. As soon as the stitch was divided the cervix dilated readily to two fingerbreadths. Labour progressed normally and at 2 p.m. on August 3, after a second stage lasting 50 minutes, a living female child weighing 6 lb. 11 oz. (3,030 g.) was delivered with the aid of an episiotomy. The puerperium was normal and the child survived.

On February 11, 1957, the patient was seen again. The last period had begun on December 16, 1956, and a Hogben test on January 8 was positive. She was admitted for the insertion of another pericervical suture. The pregnancy is continuing.

Case 3

This woman, a para 1+4, aged 32, had been married three years. Early in 1953 she underwent an operation in Hong Kong involving amputation of the cervix. In December, 1953, June, 1954, April, 1956, and December, 1955, she had miscarriages at 11 or 12 weeks' gestation. On examination in May, 1956, she was not pregnant. The cervical canal was almost non-existent; its length was approximately 4 mm.

In early May, 1956, a modified Shirodkar operation was performed, using three monofilament nylons, so as to make some real length of cervical canal. Each stitch was placed 0.5 cm. above its predecessor. The patient became pregnant immediately after operation, and went to Indonesia. On March 12, 1957, letters were received from her doctor, P. Rot, and her husband, stating that she had a breech presentation and was going to have a caesarean operation. We later heard that she had been successfully delivered of a living infant by caesarean section.

In this case the repeated abortions were clearly due to a too radical amputation of the cervix.

Case 4

A para 3, aged 31, had been married nine years. Normal deliveries occurred in April, 1949, March, 1951, and May, 1953. Her last menstrual period was August 4, 1956. On December 10 she noticed that her uterus suddenly reduced in size, and on the 14th she suddenly lost 4 to 5 oz. (114 to 142 ml.) of liquor amnii. She was put to bed, and had labour pains for 1½ hours. On December 16, in consultation with Dr. Murray, she was seen in her home. When a speculum was introduced into the vagina a watery discharge could be seen emerging from a cervix which was dilated sufficiently to admit a finger. She was taken to Hammer-smith Hospital, and a modified Shirodkar operation was performed that day. Since then she has proceeded normally. The nylon filament was removed at 39 weeks. She delivered normally at term.

Case 5

One of us (V. B. G.-A.) was asked to see this patient in Cairo in September, 1956. She was aged 25, had been married six years, and had had five abortions but no living child. On examination the cervix admitted a No. 5 Hegar dilator with ease. The operation was performed at the Coptic Hospital, but so far she has not become pregnant.

Case 6

This patient, a para 0+4, aged 25 and married three years, was referred because of repeated miscarriages. Investigation showed that she was ovulating and that her tubes were patent. There was no detectable abnormality in the uterus, except that the cervix was slightly patulous. The

husband's semen was normal. It was possible to pass a No. 4 dilator straight into the uterine cavity without any obstruction by the cervix, although there was no evidence of laceration or other trauma.

On January 3, 1957, a modified Shirodkar operation was carried out. Recovery was entirely normal, and the patient has returned to her home in Ghana. So far there has been no intimation that she is pregnant.

Case 7

A para 0+2, aged 31, had been married four years. There was no clear history of cervical trauma. In 1954 and in May, 1956, she had had miscarriages at 8 weeks, curettage being necessary in both cases. On February 8, 1957, a hystrogram (Fig. 3) showed considerable ballooning of the cervical canal, with widening of the internal os. The last period began on January 20, 1957. On February 13, at operation, a No. 4 Hegar dilator passed with ease into the uterine cavity and a modified Shirodkar operation was performed. A hystrogram (Fig. 6) showed satisfactory reduction in calibre. She is not yet pregnant.

FIG. 6.—Narrowing of cervical canal after modified Shirodkar operation (Case 7). (Compare with Fig. 3, before operation.)

Technique

The technique employed was as follows:

Under thiopentone and gas and oxygen, with the patient in the Trendelenburg position, whether pregnant or not, after passing a catheter the anterior lip of the cervix is grasped by a sponge-holder or single-toothed tenaculum. Then 30–50 ml. of 1% procaine with adrenaline, 1 in 200,000, is first injected submucosally upwards and completely around the cervix. After a few minutes a 1-in. (2.5-cm.) transverse incision is made at the vagino-cervical junction, and then, with blunt scissors, the submucosa and bladder are pushed upwards to expose the region of the histological internal os, which lies about 1½ in. (3.5 cm.) above the external os.

The sponge-holder or tenaculum is now transferred to the posterior lip and a small vertical incision is made at the same site on the posterior surface of the cervix. The submucosa is then deviated to the right and left with blunt scissors so that now the anterior and posterior surfaces of the cervix proper can be clearly seen smooth and white.

With size 7N or 8N nylon threaded on a needle, a bite is taken of the anterior visible cervical surface, and then, using a Moseley hook or a right-angled blunt needle (such as the right and left Macewen hernia needle), this is passed from the posterior incision next to and around the right side of the cervix to emerge at the anterior incision and pick up one free end of nylon and bring it out posteriorly. The procedure is repeated on the left side and the other free end brought out. The ends are then tied together tightly enough to approximate the walls of the endocervical canal at the level of the anatomical internal os. If need be, a second, or even a third, nylon ligature can be passed and secured. The knots are always placed *behind* the cervix to avoid irritation of the bladder. Shirodkar at present prefers to use ½-in. (3-mm.) nylon tape. In future, possibly kangaroo tendon would be even better.

Judging the degree of tautness of approximation of the canal walls is easy in the non-pregnant, for all one need do is to pass a No. 4 Hegar dilator into the cervix and then tighten the nylon sufficiently to prevent the dilator falling out spontaneously, or, if need be, squeezing it out before

knotting. But in the pregnant woman it is another matter ; one must use one's own judgment ; the suture should be tied with very little tension. The two incisions are then closed with catgut in the ordinary way and the patient is sent back to bed. The foot of the bed should be raised for 48 hours or more if the patient is pregnant.

Mode of Delivery

With a history of repeated abortion and with a pregnancy which has reached term after this operative procedure it is tempting to deliver the child by means of caesarean section. Where there is no other obstetric indication, however, it seems reasonable to allow the patient to go into labour and divide the suture, which by this time may be found to lie just deep to the endocervical mucosa. Then, if labour proceeds normally within 48 hours, operative intervention is not indicated. If, however, after division of the suture delivery is not imminent after 48 hours, it seems to us desirable to deliver the patient by caesarean section.

Discussion

Without detailing the underlying causes, Malpas (1938) suggested that after three abortions the chance of spontaneous cure was 27%. Swyer and Daley (1953), however, found that this pessimistic assessment was far too low ; that approximately 50% of such women had a chance of producing a live baby without treatment.

It is, of course, not difficult, in cases where there is a history of habitual abortion, to perform a Lash or Shirodkar type of operation, either before or during pregnancy, and if subsequently the patient carries to term there would be a natural tendency to claim that any successful result was due to the operation itself. In our opinion, success can be attributed to the operation only if a history of repeated early rupture of the membranes is obtained, or if actual incompetence of the internal os can be demonstrated.

It is quite obvious that to amass a series of cases sufficient to produce statistically significant results will take a long time owing to the relative rarity of this cause of habitual abortion. This preliminary communication is published in the hope that it may stimulate other workers in this field to carry out investigation and treatment along similar lines.

Summary

Deficiency of the internal cervical os is an occasional cause of habitual abortion. Such insufficiency may be either congenital or the result of trauma at gynaecological operation or during childbirth or miscarriage. The deficiency may be suspected from the history of repeated early rupture of the membranes followed by abortion, and may be demonstrated in the non-pregnant woman by a special x-ray technique or by the passage of a No. 4 cervical dilator freely into the uterine cavity. During pregnancy it may be confirmed by the observation that the membranes are bulging and that the cervix is partially dilated in the absence of bleeding or obvious uterine contractions.

A method of reinforcement of the inefficient internal os, based on Shirodkar's original technique, is described, and seven cases so treated are listed in detail. Five have now been delivered, and two are not yet pregnant.

ADDENDUM.—Since submitting this paper for publication we have operated on five more patients between the 15th and 20th weeks of pregnancy: none of these have aborted and all have proceeded to term normally.

REFERENCES

- Aschoff, L. (1906). *Z. Geburtsh. Gynäk.*, 58, 328.
 Browne, F. J. (1950). *Proc. roy. Soc. Med.*, 43, 103.
 Danforth, D. N. (1947). *Amer. J. Obstet. Gynec.*, 53, 541.
 Lash, A. F., and Lash, S. R. (1950). *Ibid.*, 59, 68.
 Malpas, P. (1938). *J. Obstet. Gynaec. Brit. Emp.*, 45, 932.
 Rubovits, F. E., Cooperman, N. R., and Lash, A. F. (1953). *Amer. J. Obstet. Gynec.*, 66, 269.
 Shirodkar, V. N. (1955). *Tendances Actuelles en Gynécologie et Obstétrique* p. 545. Librairie de l'Université, Geneva.
 Swyer, G. I. M., and Daley, Dorcen (1953). *British Medical Journal*, 1, 1073.

PHARYNGO-CONJUNCTIVAL FEVER

SCHOOL OUTBREAKS IN ENGLAND DURING THE SUMMER OF 1955 ASSOCIATED WITH ADENOVIRUS TYPES 3, 7, AND 14

BY

E. J. C. KENDALL, M.B., M.R.C.P.
Epsom, Surrey

R. W. RIDDLE, M.B., D.P.H.

H. A. TUCK, M.B.

Shoreham-by-Sea, Sussex

K. S. RODAN, M.D.

Southlands Hospital, Shoreham-by-Sea, Sussex

B. E. ANDREWS, M.R.C.S., Dip.Bact.

AND

J. C. McDONALD, M.D., D.P.H.

*Virus Reference and Epidemiological Research Laboratories,
 London*

In 1954 Parrott and his colleagues reported a small outbreak of eight cases of febrile illness associated with type 3 adenovirus infection among patients and staff of a children's hospital in Washington. The main clinical features were pharyngitis, rhinitis, enlarged cervical lymph nodes, and conjunctival inflammation. Further outbreaks of an apparently identical illness occurring in the general population in the vicinity of Washington in the same year were described in detail by Bell *et al.* (1955). Once again type 3 adenovirus was apparently responsible, and the authors suggested that the disease be named pharyngo-conjunctival fever. Outbreaks of illness with clinical similarities occurred in Toronto in 1955 (Ormsby and Aitchison, 1955). Others had been described earlier by Guthrie and Pessel (1925) in a residential boys' school in New Jersey; by Derrick (1943) in association with a swimming-bath in Brisbane, Australia; and by Cockburn (1953) in Greeley, Colorado. Subsequent tests on paired sera from patients in the Greeley epidemic showed rising titres of neutralizing antibody to type 3 adenovirus (Cockburn *et al.*, 1956).

An epidemic of febrile pharyngitis and conjunctivitis associated with adenovirus type 4 infection occurred in Helsinki in the summer of 1955 (Forssell *et al.*, 1956). In this epidemic, however, some differences in the symptomatology were observed; severe headache, gastro-intestinal symptoms, and stiffness of the neck or back were found in many patients, and sinusitis was a common complication. Meningismus and other unusual signs were also noted by Sobel *et al.* (1956) in an outbreak of pharyngo-conjunctival fever in New Hampshire in 1955, in which there was evidence of type 3 infection. A school outbreak of acute respiratory illness associated with adenovirus type 7 infection occurred in the North of England in 1955 (Tyrrell *et al.*, 1956). Conjunctivitis was seen in a small proportion of the cases.

During the summer of 1955 epidemics of an illness closely resembling that described by Bell *et al.* (1955) occurred in Lancing College and Epsom College, two residential boys' schools in southern England. This report is mainly concerned with an account of observations made in these schools. Later in the summer two of us (B. E. A. and J. C. McD.) assisted in the investigation of five other similar epidemics: four in residential