USE OF INTRAVENOUS ERGOMETRINE TO PREVENT POST-PARTUM HAEMORRHAGE

BY

J. D. MARTIN, M.D., M.R.C.O.G.

AND

J. G. DUMOULIN, M.B.E., M.D., M.R.C.O.G.

(From the Obstetric Unit, University College Hospital,
London)

"He gently prevails on his patients to try
The magic effects of the ergot of rye."

—TENNYSON.

Sir William Gilliatt (1949) said: "In spite of official statistics, haemorrhage is the most common cause of maternal death. . . . I think it may be said that obstetricians are uneasy in their minds about the management of the third stage and are not satisfied with the method that is usually written and taught." Similarly, Greenhill (1951) asserts that bleeding is the chief cause of maternal death in the United States.

Although the Registrar-General does not publish details of maternal deaths in this country, it is probable that the annual mortality from haemorrhage exceeds 100; Stallworthy (1939) reported it was 365. In Alberta, Canada, during 1936-9 there were 49 deaths due to post-partum haemorrhage in 64,607 deliveries—one death in every 1,318 deliveries (Conn, Vant, and Cantor, 1941). Stabler (1947), writing of the obstetric emergency service in Newcastle-upon-Tyne, states that there were 18 maternal deaths in the 186 flying squad cases of post-partum haemorrhage. In the reports from eight hospitals (Table II) there were 22 deaths associated with haemorrhage in 77,858 hospital deliveries. It would seem a conservative estimate that one in every 5,000 patients delivered in England to-day dies of haemorrhage.

A review of the post-partum haemorrhage rates in University College Hospital over recent years was made from the annual reports, and showed that in the eight years 1942-9, 9% of the total hospital deliveries had a blood loss of 20 oz. (568.2 ml.) (see Table I). There

TABLE I

Year	Total Hospital Deliveries	No. of Cases of Post-partum Haemorrhage*	Blood Transfusion	Manual Removal of Placenta
1949	1,275	104 (8.1%)	12	21
1948	1,210	85 (7%)	20	24
1947	1,233	147 (11.9%)	6	12
1946	1,178	106 (9%)	11	11
1945	1,129	103 (9.1%)	11	10
1944	937	82 (8.9%)	11	7
1943	946	80 (8.5%)	10	17
1942	849	84 (10%)	7	9
	8,757	791 (9%)	88 (1%)	111 (1.3%)

* Measured blood loss of 20 oz. (568.2 ml.) or more.

were two maternal deaths in the post-partum haemorrhage group of 791 cases—one associated with a long labour in a twin pregnancy, and the other showing a phaeochromocytoma at necropsy. The rate for manual removal of the placenta was 1.3% and for blood transfusion 1%.

This high post-partum haemorrhage rate compares unfavourably with that of some hospitals (Table II), but lack of standardization makes comparison difficult. For example, some hospitals take 20 oz. (568.2 ml.) or more as their standard; others take more than 20 oz., more than 600 ml. (21.1 oz.), 500 ml. (17.7 oz.) or more, 1% or more of body weight, etc. (Tritsch and Schneider, 1945; Dieckmann *et al.*, 1947). Theobald (1950) maintains that any bleeding, however slight, which persists after the birth of the child is post-partum haemorrhage. Even more important is the method by which the blood loss is estimated, whether the loss from perineal laceration and episiotomy is included, and the fact that a considerable quantity of liquor amnii may be included, particularly if the uterus fails to contract with the delivery of the baby. Estimates of blood loss based on clinical impression are notoriously inaccurate.

TABLE II

Hospital	Years	No. of Deliveries	No. of Cases of Post-partum Haemorrhage	Blood Transfusion	No. of Manual Removals of Placenta
St. Mary's, Manchester	1943-9	23,125	1,082 (4.7%)	296 (1.3%)	592 (2.6%)
Queen Charlotte's	1942-9	17,985	369 (2%)	104 (0.6%)	175 (1%)
United Oxford	1942-9	12,543	536 (4.3%)	469 (3.7%)	117 (0.9%)
Elsie Inglis, Edinburgh	1946-9	5,530	281 (5.1%)	62 (1.1%)	119 (2.6%)
British, Woolwich	1945-8	5,175	274 (5.2%)	127 (2.5%)	82 (1.6%)
Bromley	1946-9	5,105	304 (6.0%)	143 (2.8%)	76 (1.5%)
Guy's	1942-9	4,465	353 (8.0%)	Complete details not available	39 (0.9%)
St. Thomas's	1946-50	3,930	552 (14%)	61 (1.6%)	63 (1.6%)
		77,858	3,751 (4.8%)	1,262 (1.7%)	1,263 (1.6%)

Conn, Vant, and Cantor (1941) measured the blood loss in 2,000 normal deliveries: the average loss for primiparae was 388 ml. (13.7 oz.), for multiparae it was 280 ml. (10 oz.), and for the series averaged 323 ml. (11.4 oz.). Dieckmann and Daily (1935) gave the average loss in a spontaneous normal delivery as 107 ml. (3.8 oz.), and in a forceps delivery with episiotomy as 342 ml. (12 oz.). Tritsch and Schneider (1945) reported the mean blood loss noted by 20 different observers as ranging from 100 ml. (3.5 oz.) (Adair) to 600 ml. (21.1 oz.) (Tarnier). It is hardly surprising that these authors list the incidence of post-partum haemorrhage as varying between 0% (Vaux and Mitchell) and 13.7% (Adair *et al.*). Vant (1950), in 2,000 control cases, reported a loss of more than 600 ml. (21.1 oz.) in 15.7%.

The difficulty of comparing reports on post-partum haemorrhage is obvious from these figures, and can be further illustrated by the following figures of University College Obstetric Hospital:

1932-9: 87 cases of post-partum haemorrhage in 8,385 hospital deliveries. A rate of 1%.
1942-9: 791 cases in 8,757 deliveries. A rate of 9%.

This apparent ninefold increase in the haemorrhage rate which occurred since 1942 is not easy to explain, but may be associated with a more careful estimate of the blood loss. We have been unable to incriminate any change of technique at this time, and a similar trend is noticeable in the reports from other hospitals.

Ergot and Prevention of Post-partum Haemorrhage

The use of ergot in the prevention of post-partum haemorrhage is as old as the medical history of the drug.

Dr. Bibley, of New York, writing to Dr. Merriman, says : "In no case where it [ergot] has been used, has haemorrhage occurred, and in natural labour when haemorrhage does occur, it has been given with great advantage" (Merriman, 1820). In 1840 Wardleworth wrote : "As a prophylactic ample experience justifies a reliance on its powers in suppressing haemorrhage. . . . We have repeatedly witnessed its good effects when given to women, some 10 or 20 minutes previous to the delivery." Berry Hart (1912) used intramuscular injection of a liquid extract of ergot as a routine. He wrote : "When the child is born, it is a good plan to give a hypodermic of ergot into the patient's upper hip. . . . I advise that it should be given in all cases after the head is born, and that one should not wait for haemorrhage before injecting it." But the indiscriminate use of ergot in the second stage has probably done more harm than good, and such abuse has earned it an evil reputation.

Chassar Moir, working at University College Obstetric Hospital, was the first to extract the oxytocic factor from crude ergot and to name it ergometrine (Chassar Moir, 1932 ; Dudley and Chassar Moir, 1935). Since this description, a number of authors (see Table III) have acclaimed

TABLE III

Author	Dose	Time Given	No. of Cases	Post-partum Haemorrhage Rate	Manual Removal of Placenta Rate
Reich (1939)	0.2 mg. i.v.	With shoulders	154	24.0%	0.3%
Davis and Boynton (1942)	0.2 mg. i.v.	" "	1,020	0.3% (over 500 ml.)	0.8%
Diddle (1942)	0.2 mg. i.v.	" "	1,960	4.0% (over 500 ml.)	0.5%
Roberts (1942)	0.2 mg. i.v.	After birth	400	2.1% (over 600 ml.)	2.5%
O'Connor (1944)	0.2 mg. i.v.	With shoulders	900	1.0% (over 500 ml.)	1.7%
Quigley (1947)	? i.v.	On crowning	430	0.9%	1.4%
Léon (1949)	? i.v.	With shoulders	639	6.5% (500 ml. and over)	1.7%
Vant (1950)	(a few i.v.) 0.2 mg. i.v.	" "	4,204	4.3% (over 600 ml.)	?
Lister (1950)	1 mg. i.v.	On crowning	835	0.5% (20 + oz. 568.2 ml.)	1.6%
Daley (1951)	0.5 mg. i.m.	" "	490	9.2% (20 oz. and over 568.2 ml.)	3.5%
Snaith (1951)	0.125 mg. i.v.	Often after birth of baby	187	2.1% (20 + oz. 568.2 ml.)	6.9%

its merits in the prevention of haemorrhage. Many of them are enthusiastic, and the routine use of ergometrine with the birth of the baby would seem to be an increasingly popular procedure in the United States. In England its use is not so widespread. This may be due to its condemnation by Munro Kerr and Chassar Moir (1949), the equivocal findings of Linton Snaith (1951), and the modest claims of Daley (1951). Yet Lister's (1950) results are striking : using 1 mg. of ergometrine intravenously with the crowning of the head in 835 selected cases, she reduced the haemorrhage rate from 16% to 0.4%. Manual removal was neither more frequent nor more difficult, and the injection produced no ill-effects. She concludes that the routine employment of ergometrine in all cases would probably reduce the incidence of post-partum haemorrhage in hospital practice to at least one-tenth of its present level.

Ergometrine (0.5 mg. intramuscularly) was used at University College Obstetric Hospital by Flew (1947) in 500 cases in 1935. There was no constriction ring and no manual removal in this series, but the results were not impressive enough for the routine to be continued.

Some authors (Grimes *et al.*, 1948 ; Priver *et al.*, 1949) have reported side-effects from using intravenous ergo-

metrine. These include nausea, vomiting, headache, and a slate-coloured cyanosis. We have noticed no such complications.

Present Investigation

At an obstetric staff conference at University College Hospital under the direction of Professor W. C. W. Nixon in April, 1951, it was decided that all cases of vaginal delivery in the hospital should be given intravenous ergometrine (0.5 mg.) with the crowning of the baby's head. The present report deals with the first 1,000 cases so treated, and results are compared with a consecutive series of 1,000 cases taken from the years 1950 and 1951. The comparison is between the conservative and the active treatment of the third stage. All deliveries, except the instrumental ones, were done by medical students under supervision. Blood from vagina and perineum was collected in a kidney dish and measured. Episiotomy under local analgesia was performed if a perineal laceration seemed imminent.

In the "control" group the third stage was conducted in the following manner. Delivery of the baby's shoulders and trunk was not hurried. When the umbilical cord had been cut, the patient's abdomen was uncovered sufficiently for the fundus uteri to be observed. It was not handled.

So long as bleeding was slight the patient was left untouched until signs of separation of the placenta were obvious. Fundal pressure on the contracted uterus was used to assist delivery of the placenta from the vagina. Ergometrine, 0.5 mg., was then given intramuscularly, and bleeding checked by fundal stimulation.

If excessive bleeding occurred before the placenta was delivered or if, after waiting 20 minutes, separation had not taken place, pressure was applied to the contracted fundus uteri and the house-surgeon was called. In the absence of bleeding, preparations for manual removal were started after one hour. The house-surgeon was sometimes allowed to attempt one Credé expression. If there was haemorrhage he gave ergometrine, called the member of the staff on duty, took blood for cross-matching, and prepared for a manual removal.

In the ergometrine series the routine was as follows. Ergometrine, 0.5 mg., was given intravenously by a student with the crowning of the head. The shoulders and body of the baby were delivered slowly. To deliver the placenta a hand was placed on the fundus uteri, which was gently squeezed at the time of the first contraction while traction was applied to the umbilical cord. On completion of the third stage an intramuscular injection of ergometrine, 0.5 mg., was given. If the placenta was retained longer than 15 minutes, or if there was haemorrhage, the house-surgeon was informed.

Results

The control series is made up of 1,090 consecutive vaginal deliveries, of which 101 were forceps deliveries. From this series 36 cases have been excluded for various reasons, chiefly because the data required were incomplete, and three of these had haemorrhages. One of them was a case in which maternal death occurred from haemorrhage following a prolonged labour and forceps delivery. A further 54 cases were excluded because ergometrine was given with the birth of the baby, and all were forceps deliveries. In the remaining 1,000 cases the results were:

Primary post-partum haemorrhage (blood loss of 20 oz. (568.2 ml.) or more)	131 cases (13.1%)
Secondary post-partum haemorrhage (excessive loss in the puerperium)	3 cases (0.3%)
Manual removal of the placenta	11 cases (1.1%)
Blood transfusion	18 cases (1.8%)

Comparative figures in the ergometrine series were:

Primary post-partum haemorrhage	12 cases (1.2%)
Secondary post-partum haemorrhage	8 cases (0.8%)
Manual removal of placenta	30 cases (3.0%)
Blood transfusion	5 cases (0.5%)

This series consists of the first 1,000 cases given ergometrine intravenously, and comes from a group of 1,221

consecutive vaginal deliveries. In 176 (14.4%) ergometrine was not given either because the student failed to get the needle into the vein as the head crowned or because he was not present at delivery. (This failure rate was reduced to 10% in the last 500 cases.) In 42 patients the ergometrine was given intramuscularly, and in three cases the required data were not available. There were 19 primary haemorrhages and 1 secondary haemorrhage in the 221 excluded cases, and this figure includes two concealed accidental haemorrhages in which most of the post-partum loss was clot formed before birth.

A comparison of the blood loss in the two groups is seen in Table IV. The difference in the mean blood loss of the two groups is significant at the 1% level, and the conservation of blood in the ergometrine group is considerable.

TABLE IV

Amount of Blood Loss	% In Control Series	% In Ergometrine Series
0-9 oz. (0-255.7 ml.) ..	64	89.2
10-19 „ (284.1-539.8 ml.) ..	22.9	9.6
20-29 oz. (568.2-823.9 ml.) ..	7.8	0.7
30-39 „ (852.3-1,108 ml.) ..	3.0	0.3
40-49 „ (1,136.4-1,392.1 ml.) ..	1.4	0.2
50 oz. (1,420.5 ml.) and over ..	0.9	—

Post-partum Haemorrhage

The haemorrhage rate of 13.1% in the control series is higher than stated in the annual report of the hospital because deliveries by caesarean section are excluded and all losses of 20 oz. (568.2 ml.) are included.

The time of administration of pethidine and the weight of the baby were studied in the 131 post-partum haemorrhages and the findings compared with 131 random cases. It could not be shown that pethidine administration increased the haemorrhage rate as Barnes (1947) showed in her report from this hospital. Large babies—over 9 lb. (4.1 kg.)—were significantly more frequent, as Reich (1939) reported. Any tendency towards heavy bleeding in forceps deliveries was due to loss from lacerations, although inexpertly administered or prolonged anaesthesia is a well-recognized cause of increased blood loss.

Delayed haemorrhage some hours after delivery (as reported by Lister, 1950) was not a feature of our treated series.

Secondary post-partum haemorrhage occurred in three cases in the control group and in eight in the ergometrine group. All three in the control group and four in the ergometrine group had a retained placental cotyledon. In the remaining four only fragments of placental tissue and decidua were removed at curettage.

Manual Removal

There were 41 cases of manual removal of the placenta in the 2,000 cases—30 in the ergometrine series, and 11 in the control group. The indication for the operation is seen in Table V.

TABLE V

	Manual Removal	
	For Retained Placenta	For Post-partum Haemorrhage
Ergometrine series	23	7
Control series	2	9

In the present series placental retention is increased (statistically significant at the 1% level) by the use of intravenous ergometrine. Out of the group of 23 cases in Table V there were five in which the injection of the ergometrine was given too late, and one breech delivery. In each of these cases the uterus did not contain the foetal body when it contracted—a situation which predisposes to

placental retention. It has been a recent practice of some operators to remove the placenta manually after a forceps delivery if it does not show immediate signs of separation, and this accounts for a further 6 of the 23 cases. The operation performed under such circumstances in a fit patient is safe, and, in our opinion, is not made more difficult by the use of ergometrine. In two cases in the ergometrine series the placenta was incompletely removed, resulting in a primary and a secondary haemorrhage, both avoidable.

Haemoglobin Level and Blood Loss

A haemoglobin estimation by Haldane's method is done on all patients on the fourth or fifth day of the puerperium. The results in the 2,000 cases are given in Table VI.

TABLE VI

Haemoglobin	% In Control Group	% In Ergometrine Group
Below 60%	2.5	1
60-64%	3.6	2.4
65-69%	6.7	5.6
70-74%	12.7	11.7
75-79%	13.8	13.7
80-84%	24	22.7
85-89%	13.1	17.7
90-94%	13.9	15.2
95-99%	4.4	6.1
100-104%	3.9	3.3
105% and above	1.4	0.6

The standard deviations of the two groups are significantly different at the 1% level. The means of the two groups are not significantly different, but blood loss may occur without affecting the haemoglobin level; for the latter is dependent on haemodilution, which occurs in some cases and not in others (Dyson, Plaut, and Vaughan, 1943). The mean haemoglobin in the control group is 82%, and in the ergometrine group 83.4%. This difference, though small, is probably due to the greater blood loss in the first group, as there is a tendency for large blood loss to be associated with a low haemoglobin. This can be seen from the fact

Post-partum haemoglobin in the 2,000 cases of the series compared with that reported by the Medical Research Council (1945) in married women.

that 37.4% of those who lost more than 20 oz. (568.2 ml.) had haemoglobin values below 70% (49 out of 131), while only 9.1% of the remainder were below this value (79 out of 869). Among the ergometrine group those with a haemoglobin under 70% were 58.3% (7 out of 12) of patients with blood loss greater than 20 oz. (568.2 ml.) and 8.5% of the remainder (84 out of 988).

In the Chart the post-partum haemoglobin in the 2,000 cases is compared with that reported by the Medical Research Council (1945) in married women in this country. The numbers have been combined for this purpose, since the difference between the two sets of 1,000 is small compared with the difference between married and puerperal women. This report also stated that in the last trimester of pregnancy 9% of women had haemoglobin values under 70, and 37% had values under 80. The corresponding figures in our post-partum series are 12.8% and 39.3% in the control group, and 9% and 34.4% in the ergometrine group.

Length of Third Stage of Labour

There is no doubt that ergometrine reduces the length of the third stage, as Table VII shows. In the ergometrine series it was less than 20 minutes in 94% of cases.

Davis and Boynton (1942) noted that there was a direct relationship between blood loss and length of the third stage—an observation which is confirmed in our treated cases.

TABLE VII

Length of Third Stage	% In Control Group	% In Ergometrine Group
0-4 minutes	1.5	50.3
5-9	9.0	33.6
10-19	51.5	10.4
20-29	28.0	1.1
30-39	6.4	1.2
40+	3.6	3.4

Discussion

Intravenous ergometrine, if given with the crowning of the foetal head, causes a striking reduction in blood loss in the third stage of labour and a marked lowering of the post-partum haemorrhage rate. It also shortens the length of the third stage. These facts seem indisputable. Those authors who are not wholly in favour of using ergometrine, such as Roberts (1942) and Snaith (1951), admit that the timing of the injection was not accurately made, or else, like Daley (1951), they gave the ergometrine intramuscularly. We consider timing a most important point: intravenous ergometrine acts within a minute of injection, causing a tonic uterine contraction and placental separation while part of the baby still occupies the uterine cavity. Placental expression should be carried out as soon after the birth of the baby as possible. To facilitate this, cord traction is a useful and safe procedure. In a firmly contracted uterus the only danger of cord traction is the theoretical risk of causing acute inversion of the uterus, but, as Picton (1951) points out, before inversion can be initiated uterus and cervix must be relaxed.

In our series there was an increased incidence of manual removal of the placenta when ergometrine was used (3% as compared with 1.1% in the control series). The higher rate of this complication is used by some as an argument against intravenous ergometrine therapy. As we have pointed out, there is a tendency in this hospital towards a more frequent use of this procedure, particularly after instrumental deliveries. Recognition of the value of cord traction would possibly result in fewer manual removals, as might digital exploration of the upper vagina described by Graber (1950), revealing a placenta trapped in the cervix and therefore easily removed without anaesthesia. Smellie (1754) recommended both pulling on the cord and digital exploration to feel the placenta.

It would be wrong to claim that post-partum haemorrhage is eliminated by using ergometrine. The drug has

no effect on bleeding from cervical or vaginal lacerations. Occasionally the uterus fails to contract after 0.5 mg. of intravenous ergometrine, and there are other factors which may cause bleeding, such as an abnormal coagulation mechanism (Reid, 1951).

There is the disadvantage that an assistant must be available to give the injection at the right moment. In hospital this should not be too difficult to arrange. In domiciliary practice it is far less easy. This is a strong argument for teaching midwives the technique of intravenous injection.

We conclude by advocating a more widespread use of this technique, in the belief that it would prevent much puerperal morbidity and some maternal deaths.

Summary

Intravenous ergometrine, 0.5 mg., was given to 1,000 patients in the second stage of labour with the crowning of the foetal head. The results are compared with 1,000 control cases.

The use of ergometrine has shown: (1) A reduction in the primary post-partum haemorrhage rate from 13.1% to 1.2%. This is significant at the 0.1% level. (2) A reduction in the amount of post-partum anaemia. (3) A shortening of the third stage of labour. (4) A significant increase in the rate of manual removal of the placenta from 1.1% to 3%.

We are indebted to Professor W. C. W. Nixon for his help and advice; to the students and midwives who have made this investigation possible; and to Mr. N. W. Please, of the Department of Statistics, University College, London, for his suggestions and the statistical data.

REFERENCES

- Barnes, J. (1947). *British Medical Journal*, **1**, 437.
 Conn, L. C., Vant, J. R., and Cantor, M. M. (1941). *Amer. J. Obstet. Gynec.*, **42**, 768.
 Daley, D. (1951). *J. Obstet. Gynaec. Brit. Emp.*, **58**, 388.
 Davis, M. E., and Boynton, M. W. (1942). *Amer. J. Obstet. Gynec.*, **43**, 775.
 Diddle, A. W. (1942). *Ibid.*, **43**, 450.
 Diekmann, W. J., and Daily, E. F. (1935). *Ibid.*, **30**, 221.
 —, Odell, L. D., Williger, V. M., Seski, A. G., and Pottinger, R. (1947). *Ibid.*, **54**, 415.
 Dudley, H. W., and Moir, J. C. (1935). *British Medical Journal*, **1**, 520.
 Dyson, M., Plaut, G., and Vaughan, J. (1943). *Quart. J. exp. Physiol.*, **32**, 255.
 Flew, J. D. S. (1947). *Proc. roy. Soc. Med.*, **40**, 370.
 Gilliat, Sir William (1949). *Transactions of the 12th Congress of Obstetrics and Gynaecology*, p. 271.
 Graber, E. A. (1950). *Amer. J. Obstet. Gynec.*, **59**, 699.
 Greenhill, J. P. (1951). *Year Book of Obstetrics and Gynecology*, p. 230. Year Book Publ., Chicago.
 Grimes, W. H., Bartholomew, R. A., Colvin, E. D., and Fish, J. S. (1948). *Sh. Med. J.*, **41**, 980.
 Hart, D. B. (1912). *Guide to Midwifery*, 1st ed., p. 220. Rebman Ltd., London.
 Kerr, J. M. M., and Moir, J. C. (1949). *Operative Obstetrics*, pp. 54 and 810. Baillière, Tindall and Cox, London.
 Léon, M. J. (1949). *Gynec. et Obstet.*, **48**, 501.
 Lister, U. M. (1950). *J. Obstet. Gynaec. Brit. Emp.*, **57**, 210.
 Medical Research Council (1945). *Spec. Rep. Ser. med. Res. Coun.*, Lond., No. 252, p. 24. H.M.S.O., London.
 Merriman, S. (1820). *A Synopsis of Difficult Parturition*. J. Callow, London.
 Moir, C. (1932). *British Medical Journal*, **1**, 1022.
 O'Connor, C. T. (1944). *Amer. J. Obstet. Gynec.*, **48**, 683.
 Picton, F. C. R. (1951). *J. Obstet. Gynaec. Brit. Emp.*, **58**, 764.
 Privet, M. S., Harris, J. M., Krohn, L., and Boros, H. H. (1949). *West. J. Surg.*, **57**, 586.
 Quigley, J. K. (1947). *Amer. J. Obstet. Gynec.*, **53**, 271.
 Reich, A. M. (1939). *Ibid.*, **37**, 224.
 Reid, D. E. (1951). *Trans. Int. and 4th Amer. Congr. Obstet. and Gynec.*, p. 765. Mosby, St. Louis.
 Roberts, P. C. (1942). *Amer. J. Obstet. Gynec.*, **43**, 849.
 Smellie, William (1754). *Treatise on the Theories and Practice of Midwifery*, vol. 2, Case 219.
 Snaith, L. (1951). *J. Obstet. Gynaec. Brit. Emp.*, **58**, 633.
 Stabler, F. (1947). *British Medical Journal*, **2**, 878.
 Stallworthy, J. (1939). *Ibid.*, **1**, 153.
 Theobald, G. W. (1950). *Ibid.*, **1**, 659.
 Tritsch, J. E., and Schneider, E. (1945). *Amer. J. Obstet. Gynec.*, **50**, 434.
 Vant, J. R. (1950). *Ibid.*, **60**, 483.
 Wardleworth, T. H. (1840). *Essay on the Parturient Properties of the Secale Cornutum*, p. 54. Simpkin, Marshall, London.