THE SIGNIFICANCE OF MECONIUM IN FOETAL DISTRESS

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When pregnancy ends with the delivery of an infant that is either dead, dying, or destined to be mentally defective, it is indeed a tragedy. On recognizing the signs of foetal distress, the accoucheur can frequently prevent this unfortunate outcome by timely intervention. No greater test of the obstetrician's judgment and clinical acumen exists, for the wrong decision can too frequently end in disaster.

The criteria for the diagnosis of foetal distress are well known. Various authors have attempted either to minimize or to emphasize the importance and value of certain signs

as indications of foetal distress.[1-4,6,9-11,14-16,18,19,21-27] Of all the signs, the significance of meconium in the liquor amnii associated wi·h vertex presentations is probably the most controversial.[8,13,17,21,23-26]

In this paper I propose (i) to assess whether the recognition of meconium in the liquor amnii in vertex presentations is sufficiently serious to warrant interference, either immediately or at a later stage; (ii) to show what the outcome was in cases where conservatism was practised; and (iii) to suggest a scheme of treatment when meconium is recognized during the course of labour.

METHODS OF STUDY

A study was made of 2,600 consecutive deliveries at the Somerset Hospital, Cape Town, between 1 January 1957 and 31 May 1958. These patients were drawn from the non-White population (mainly from Cape Town). The proportion of Coloured to Bantu admissions was approximately $2\frac{1}{2}$: 1 (1,863 Coloured and 730 Bantu patients). Seven Asian women were delivered in hospital during this period. These patients are a selected group, since only primigravidae, grande-multiparae (over 5 pregnancies), and patients with a poor obstetrical history or with antenatal complications are admitted to the Somerset Hospital for indoor delivery.

In all vertex deliveries the presence of meconium was noted as a routine by the nursing staff. The degree of meconium (light or frank), and the colour (light-green or dark olive-green) was recorded. A more frequent and strict checking of the foetal heart ($\frac{1}{4}$-hourly whenever possible) was started immediately meconium was seen. Unless the delivery was imminent, a member of the medical staff was always informed and a vaginal examination done. In order to check the records of the nursing staff, I personally recorded 44 random cases. Subsequent comparison indicated that they had not failed to observe the presence of meconium in any of these cases. Unless confirmed by the medical staff, a single observation of 'slightly meconium-stained liquor' was not accepted for this series.

INCIDENCE

Meconium was present in association with vertex deliveries in 169 of the 2,600 cases studied. Bearing in mind the selected nature of the patients, this incidence of 6·5% cannot be accepted as representative of all cases. Other authors have quoted figures varying from 3% to 9·6%.[5,21,26] In the 169 cases studied, there were 93 primigravidae and 76 multigravidae, whereas in the overall admissions there was a higher incidence of multigravidae. Patients with the 2 types of meconium, namely, 'light meconium' and 'frank or dark-

green meconium' are referred to throughout the rest of the paper as 'group 1' and 'group 2' respectively. There were 120 patients in group 1 and 49 in group 2.

Perinatal Mortality

Altogether 23 infants were lost during labour and the first week of the puerperium. This represents an incidence of 13·6%. Since these included 8 'dead births' (the foetal hearts not being heard on admission or before the onset of labour), the salvable foetal loss was 9·3%.

The uncorrected perinatal mortality found by other authors was 5·3%[17] and 8%.[12] Besides the 8 babies who were not salvable, there were 10 stillbirths and 5 neonatal deaths. In group 1 (120 cases) 6 infants were lost, an incidence of 5%. The salvable incidence was 3·4%. In group 2 (49 cases) 17 infants were lost, an incidence of 34·7%. The percentage of babies that could have been saved in this group was 25·6% (Table I). *The marked difference in foetal loss in group 2 compared with group 1 serves to emphasize the importance that should be attached to the presence of frank meconium.* This view is confirmed in other publications,[7,8,21] but Walker[25] found a higher loss associated with thin meconium (11·1%) than with thick meconium (7·8%).

Perinatal Mortality in Relation to Method of Delivery

Spontaneous vaginal delivery occurred in 133 cases, an incidence of 78·7%. There were 21 forceps deliveries (12·4%) and 15 Caesarean sections (8·9%).

(i) *Spontaneous vaginal delivery (Table II).* The overall loss for this group was 7·1%, while the loss associated with group 2 was 8 times that of group 1. Of the 3 neonatal deaths in group 1, 2 could have been prevented by earlier intervention. Both mothers had premature rupture of the membranes. One of the cases was associated with toxaemia and postmaturity, the other with a mild accidental haemorrhage and prematurity. Of the 6 salvable babies in group 2, earlier intervention was indicated in 2 cases and could have saved both infants. One case was associated with toxaemia, and thick meconium appeared some time after rupture of the membranes. The cord was found to be wound tightly round the neck at birth. The other case was associated with postmaturity and a mild accidental haemorrhage. Meconium was noticed when the os was 2 fingers dilated. In both cases, no other signs of foetal distress were present and consequently intervention was not considered. Of the 9 babies lost in spontaneous vaginal delivery, it would thus appear that 4 could have been saved by early intervention. In the 5 remaining cases, meconium was noticed too late for intervention to have altered the outcome.

TABLE I. PERINATAL MORTALITY IN RELATION TO PARITY

	Parity	No. of cases	SB	DB	NND	No. lost	Uncorrected loss %	Salvable loss %
Group 1	P	69	—	1	1	2	2·9	1·5
	M	51	1	1	2	4	7·8	6·0
	Total	120	1	2	3	6	5·0	3·4
Group 2	P	24	4	4	1	9	37·5	25·0
	M	25	5	2	1	8	32·0	26·1
	Total	49	9	6	2	17	34·7	25·6
Total		169	10	8	5	23	13·6	9·3

SB=stillbirth, DB=dead birth, NND=neonatal death, P=primipara, M=multipara.

(ii) *Forceps delivery (Table III)*. The overall loss after forceps delivery was 10%. In group 1, forceps were applied for foetal distress *per se* on only 7 occasions; an irregular foetal heart was present each time. Earlier intervention could have prevented the 1 stillbirth, since meconium appeared 15 hours before delivery, the foetal heart becoming faint and irregular 7 hours later. At birth the cord was found to be wound tightly round the neck. In group 2, forceps were applied primarily for foetal distress on 4 occasions; all were associated with an irregular foetal heart rate. The stillbirth in this group could not have been prevented, since the foetal heart sounds disappeared without earlier irregularity 18 hours before delivery, meconium being noticed for the first time 5 hours later. The cord was once again found to be wound tightly round the neck at birth. Of the 2 stillbirths in this section, only 1 could have been prevented by early intervention.

TABLE II. PERINATAL LOSS ASSOCIATED WITH SPONTANEOUS VAGINAL DELIVERY

	Parity	Cases	SB	DB	NND	Corrected loss %
Group 1	P	58	—	1	1	1·8
	M	45	—	1	2	4·6
	Total	103	—	2	3	3·0
Group 2	P	15	1	3	—	8·3
	M	15	4	2	1	38·5
	Total	30	5	5	1	24·0
Total—groups 1 and 2		133	5	7	4	7·1

For key, see Table I.

(iii) *Caesarean section (Table IV)*. The percentage perinatal loss after Caesarean section was almost 3 times that of the series as a whole (26·7% compared with 9·3%). This might lead to the fallacious conclusion that Caesarean section should be employed less frequently. However, many Caesarean sections were undertaken for indications other than foetal distress. In group 1, only 3 sections were performed primarily for foetal distress. All 3 babies were born alive. In group 2, 4 out of the 10 sections were performed primarily for foetal distress; all 4 of these infants survived. In 4 cases where the section was performed for disproportion, there were 2 stillbirths. In both of these meconium appeared long before the sections were done and earlier operation could have saved both these babies. From the above analysis, it is seen that, in the 7 cases where a Caesarean section was undertaken for foetal distress, no infant was lost. If heed had been taken of the frank meconium at an earlier stage, 2 more infants might have survived.

TABLE III. PERINATAL LOSS ASSOCIATED WITH FORCEPS DELIVERY

	Parity	Cases	SB	DB	NND	Corrected loss %
Group 1	P	7	—	—	—	—
	M	5	1	—	—	20·0
	Total	12	1	—	—	8·3
Group 2	P	5	1	1	—	25·0
	M	4	—	—	—	—
	Total	9	1	1	—	12·5
Total—groups 1 and 2		21	2	1	—	10·0

For key, see Table I.

FOETAL LOSS IN RELATION TO THE TIME OF FIRST APPEARANCE OF MECONIUM BEFORE DELIVERY

Table V shows that 10 out of the 15 salvable foetal deaths occurred when meconium was present for 6 or more hours before delivery. Two further Caesarean sections were performed in primigravidae for indications other than foetal distress. The meconium was noticed for the first time at

operation (dilatation less than 3 fingers in both cases) and it can be presumed that delivery might have taken 6 or more hours had a vaginal delivery been possible. The 1 multigravida grouped in the section 'under ½-hour' was admitted with the foetal head on the perineum, and should thus correctly not be grouped in this section, meconium having been present for an undetermined length of time before admission.

OUTCOME IN RELATION TO DILATATION OF CERVICAL OS

For the purpose of investigating the outcome in relation to cervical dilatation, the patients were divided into 3 sections:
1. Those able to be delivered immediately (i.e. os either fully dilated or almost fully dilated).
2. Those where the os was dilated 3 fingers or less.
3. Those where the os was dilated more than 3 fingers, but was not near full dilatation.

Section 1 (67 patients)

Fifty-eight patients were delivered spontaneously per vaginam (Table VI). The remaining 9 were delivered by forceps. Of these, forceps were applied in 5 for foetal distress *per se*. Of the 8 infants lost, only 2 were salvable, a corrected foetal loss of 3·3%. In neither of these patients did meconium appear early enough to indicate intervention. The 5 infants delivered by forceps might well have survived because of the presence of meconium, for it was this sign which drew attention to the fact that something was amiss and called for a closer watch for alterations in the foetal heart rate.

TABLE IV. PERINATAL LOSS ASSOCIATED WITH CAESAREAN SECTION

	Parity	Cases	SB	DB	NND	Corrected loss %
Group 1	P	4	—	—	—	—
	M	1	—	—	—	—
	Total	5	—	—	—	—
Group 2	P	4	2	—	1	75·0
	M	6	1	—	—	16·7
	Total	10	3	—	1	40·0
Total—groups 1 and 2		15	3	—	1	26·7

For key, see Table I.

Section 2 (58 patients)

The foetal loss associated with frank meconium (35·3%) was approximately 7 times as high as that associated with thin meconium (5·1%)—Table VII. Only 5 of the 11 Caesarean sections performed here were primarily for foetal distress. None of these infants was lost. Had a Caesarean section been done earlier in the following case, the baby might have been saved:

A 26-year-old grav. ii, para. i, 40 weeks pregnant by dates, was in labour for 36½ hours. Frank meconium presented with rupture of the membranes 19½ hours before a Caesarean section was performed at 3 fingers dilatation. The foetal heart sounds became irregular 5 hours before and disappeared altogether 3 hours before the Caesarean section, which was eventually undertaken for obstructed labour. The birth weight of the baby was 9 lb. 7 oz.

In the spontaneous vaginal births in this section, 4 of the 5 infants lost could have been saved by early intervention:

(i) A 24-year-old primigravida, 42½ weeks pregnant by dates, with mild toxaemia, was in labour for 37 hours. The membranes ruptured 72 hours before delivery, meconium being present 8 hours before the birth. No antibiotics were given until admission 24 hours before delivery. The baby died after 13 hours. A postmortem examination showed signs of aspiration pneumonia.

(ii) A 22-year-old grav. ii, para. i was at term. The foetal heart sounds disappeared suddenly 20 hours before delivery, after the patient was in labour for 21 hours. When the membranes

TABLE V. FOETAL LOSS IN RELATION TO TIME MECONIUM FIRST NOTICED BEFORE DELIVERY

Group	Parity	Under ½ hour	½ - 1 hr.	1 - 1½ hrs.	1½ - 3 hrs.	3 - 6 hrs.	6 - 12 hrs.	Over 12 hrs.
1	P	—	—	—	—	—	—	1
	M	—	—	—	—	1	1	1
2	P	1	—	—	—	—	1	1
	M	1	—	—	—	—	2	3
1 + 2	Total	2	—	—	—	1	4	6

2 infants were born by Caesarean section, meconium being noticed for first time at section.

TABLE VI. PATIENTS ABLE TO BE DELIVERED IMMEDIATELY. METHOD OF DELIVERY AND PERINATAL MORTALITY

Group	Parity	No. of cases	NVD	LF	MF	HF	CS	SB	DB	NND	Corrected loss %
1	P	29	26	2	1	—	—	—	—	—	—
	M	14	13	1	—	—	—	—	1	—	—
	Total	43	39	3	1	—	—	—	1	—	—
2	P	13	11	1	1	—	—	1	3	—	10
	M	11	8	1	2	—	—	—	2	1	11·1
	Total	24	19	2	3	—	—	1	5	1	10·5
1 + 2	Total	67	58	5	4	—	—	1	6	1	3·3

NVD=normal vaginal delivery, LF=low forceps, MF=mid forceps, HF=high forceps, CS=Caesarean section, SB=stillbirth, DB=dead birth, NND=neonatal death, P=primigravida, M=multigravida.

TABLE VII. DILATATION OF OS 3 FINGERS OR LESS (58 CASES). METHOD OF DELIVERY AND PERINATAL MORTALITY

Group	Parity	No. of cases	NVD	LF	MF	HF	CS	SB	DB	NND	Corrected loss %
1	P	21	14	2	1	1	3	—	1	1	5·0
	M	19	17	—	2	—	—	1	—	—	5·7
	Total	40	31	2	3	1	3	1	1	1	5·1
2	P	6	3	1	—	—	2	1	1	—	16·7
	M	12	6	—	—	—	6	5	—	—	41·7
	Total	18	9	1	—	—	8	6	1	—	35·3
1 + 2	Total	58	40	3	3	1	11	7	2	1	14·3

For key, see Table VI.

TABLE VIII. OS OVER 3 FINGERS DILATED, NOT FULLY DILATED. METHOD OF DELIVERY AND PERINATAL MORTALITY

Group	Parity	No. of cases	NVD	LF	MF	HF	CS	SB	DB	NND	Corrected loss %
1	P	19	18	—	—	—	1	—	—	—	Nil
	M	18	15	—	1	1	1	—	—	2	11·1
	Total	37	33	—	1	1	2	—	—	2	5·4
2	P	5	1	2	—	—	2	2	—	1	60·0
	M	2	1	—	1	—	—	—	—	—	Nil
	Total	7	2	2	1	—	2	2	—	1	42·8
1 + 2	Total	44	35	2	2	1	4	2	—	3	11·3

For key, see Table VI.

ruptured half an hour later, thick meconium was present. The placenta was grossly infarcted. (Had the membranes been ruptured earlier, the presence of meconium might have called for intervention and the infant might have been saved.)

(iii) A 45-year-old grav. ix, para. vii, 41 weeks pregnant by dates, was in labour for 63 hours. Meconium appeared 6 hours before delivery. The foetal heart rate was regular, but the sounds disappeared suddenly 30 minutes before the birth. The cord was wound tightly round the neck.

(iv) A 42-year-old grav. xv, para. xiv, 42 weeks pregnant by dates, was admitted to hospital with a mild accidental haemorrhage. Thick meconium was present with the rupture of the membranes 8½ hours before delivery. The foetal heart rate was regular, but the sounds suddenly disappeared 2½ hours after the membranes ruptured.

Section 3 (44 patients)

The number of patients in group 2 in this section is too small for statistical evaluation, but the overall mortality of 42·8% for this group, compared with 5·4% for group 1, once again illustrates the increased foetal loss associated with the presence of frank meconium (Table VIII). Only 1 of the 5 forceps deliveries in this section was done for foetal distress. Of the 4 Caesarean sections, only one was performed because of the presence of meconium—a grandemultipara with no live children. The baby was born alive. Of the 5 infants lost in this section, meconium appeared too late for intervention in 3 cases, 1 infant had a meningocele incompatible with life, and the fifth infant might have been saved by earlier intervention:

A 35-year-old grav. viii, para. vii, 34 weeks pregnant by dates, was admitted in labour with a mild accidental haemorrhage. Light meconium was noticed 4 hours after the onset of labour, the foetal heart being slightly irregular. The infant was born limp 9 hours later, responding to resuscitation after 30 minutes. Its birth weight was 3 lb. 13 oz., and it died after 5 hours.

CONGENITAL ABNORMALITIES

There were only 4 infants with congenital abnormalities. One was insignificant (extra digits only). The 3 remaining infants were born dead. In 2 of these foetal heart sounds were not heard on admission, the babies being (i) a monster with numerous abnormalities and (ii) a hydrocephalic. The third baby, which was stillborn, had a meningocele incompatible with life.

The peculiarly low incidence of congenital abnormalities in this series (2·4%) is interesting in view of the suggestion made by Leslie[12] that a considerable chance of finding a congenital abnormality existed (the incidence in his series was 6·4%). A conservative attitude with regard to Caesarean section because of the fear of delivering a congenitally abnormal child is not substantiated by the present series.

MANAGEMENT OF CASES WITH MECONIUM

A retrospective analysis of the present series indicated that vertex deliveries associated with meconium should be managed along the following lines:

Once meconium is present, an immediate vaginal examination must be carried out to exclude a prolapse or 'nipping' of the cord. The dilatation of the os is now of major importance and serves as a guide in anticipating roughly how much longer it will be before the infant can be born. The foetal heart must be checked and recorded regularly at quarter-hour intervals.

The case is now assessed, paying particular attention to the following points: (i) Are there any other signs of foetal distress? (ii) Are any of the following associated factors present—toxaemia, postmaturity, disproportion, accidental haemorrhage, elderly primiparity, prolonged labour? (iii) What sort of meconium is present—thin and light-green, or thick, frank, and dark-green? The cases are then divided into 2 groups—(a) light meconium and (b) frank meconium.

Group 1 (Light Meconium)

(i) *Three Fingers or less Dilatation*

(a) No other sign of foetal distress and no associated factors present. These patients generally have a good prognosis and can be left alone while checking the foetal heart carefully.

(b) Other signs of foetal distress are present—a Caesarean section should be done.

(c) In the presence of the associated factors mentioned above, no intervention is recommended at this stage, purely because of the appearance of thin meconium. If, however, any obstetrical abnormalities may require interference at a later stage, then immediate intervention is indicated. *No further trial of labour* should be allowed. If a Caesarean section is not indicated, a forceps delivery should be carried out at full dilatation.

(ii) *Over 3 Fingers Dilated, but not near Full Dilatation*

(a) No other signs of foetal distress and no associated factors present—leave alone while checking the foetal heart carefully.

(b) If other signs of foetal distress are present, a Caesarean section must be done.

(c) Should associated factors be present, conservatism must be tried, with, however, a more frequent reassessment of the case. An unsatisfactory progress of the labour requires a Caesarean section sooner than would normally be necessary in the absence of meconium. Forceps delivery should be carried out at full dilatation.

(iii) *Full Dilatation or Almost Fully Dilated*

(a) If there are no other signs of foetal distress or any associated factors, spontaneous delivery is allowed.

(b) In the presence of other signs of foetal distress or associated factors, a forceps delivery should be carried out as soon as practicable.

Group 2 (Frank Meconium)

(i) *Three Fingers or less Dilatation*

Bearing in mind the high foetal mortality associated with this group, Caesarean section is recommended, *even in the absence of other signs of foetal distress or associated factors.*

(ii) *Over 3 Fingers Dilated, but not near Full Dilatation*

(a) In the absence of any other signs of foetal distress or associated factors, a conservative attitude is justifiable, provided a Caesarean section can be performed at short notice. Delivery by forceps at full dilatation is essential.

(b) In the presence of other signs of foetal distress or any of the associated factors, a Caesarean section should be performed.

(iii) *Full Dilatation or Almost Fully Dilated*

Delivery by forceps is clearly indicated, irrespective of whether additional signs of foetal distress or other associated factors are present.

In addition, it is suggested that a high rupture of the membranes be performed as a diagnostic procedure whenever a trial of labour is anticipated under the following conditions: elderly primipara, postmaturity or toxaemia.

Likewise, in prolonged labour, if the membranes are intact, a diagnostic rupture should be done.

Although oxygen was administered to most of the mothers in this series, its value at the present time is still debatable and does not alter the scheme of treatment in any way.

DISCUSSION

Of all the signs of foetal distress, the significance of meconium in the liquor amnii in vertex presentations is probably the most controversial. In the literature it is generally considered to be associated with a favourable outcome in the absence of any other signs of foetal distress, serving merely as a warning of impending danger. As such it calls for a close watch on the foetal heart. There is general agreement that, if associated with other signs of foetal distress, its significance is increased considerably and the need for intervention seems indicated.[5,10,12,17,20,26]

The present investigation led to the following conclusions: The presence of frank, dark-green meconium was far more significant than that of thin, light-green meconium, the foetal loss in the present series being nearly 8 times as high when associated with frank meconium (25·6%) as compared with thin meconium (3·4%). Other authors report similar findings.[5,13] In elderly primigravidae and in postmaturity, meconium is a serious sign.[21,23,24] In such cases the foetal heart is not a good guide since it frequently stops without any preceding slowing or irregularity, as was often found in the present series.

At least 4 of the infants lost might have been saved had the membranes been ruptured earlier. The tell-tale presence of meconium would have obviated the necessity of relying entirely on the foetal heart for indications of foetal distress.

When meconium is associated with accidental haemorrhage or pre-eclamptic toxaemia, it is also particularly dangerous. This has been the experience of Walker[23] as well. The presence of meconium early in labour is an ominous sign. In most of the cases in which infants were lost in the present series meconium was present for 6 or more hours before delivery. The advisability of allowing a trial of labour to continue in the presence of meconium, particularly frank meconium, is highly debatable.

Probably the most difficult cases to manage are those in which meconium is first noticed fairly late in labour (after the os is 3 fingers dilated). No one can be blamed for hesitating to terminate labour at this late stage by Caesarean section, particularly if everything had been progressing smoothly. Conservatism may be justifiable, but only in the absence of those complicating factors referred to previously. The necessity for a forceps delivery at full dilatation cannot be denied, particularly in the presence of frank meconium. Shortening the second stage can be of extreme importance in preventing further embarrassment of an already hypoxic infant.

No doubt numerous experienced obstetricians could quote the vaginal deliveries which they effected time and again in spite of the presence of meconium and without any undue foetal loss. The present series, although admittedly small when broken down into its numerous sub-divisions, nevertheless clearly shows the increased foetal loss associated with the presence of meconium. As a pilot survey for a much larger series, it can hardly be ignored because of the facts it brings to light. If the scheme of treatment suggested in this paper had been followed, the outcome might have been like this:

In the 169 cases in which meconium was present, an extra 12 Caesarean sections would have been carried out. In addition, 2 Caesarean sections would have been done earlier, and a further 19 forceps deliveries carried out. This added amount of intervention might have saved 8 of the 15 salvable infants who were lost. Whether this less conservative attitude is justified in order to achieve the higher foetal survival rate, is the decision which each obstetrician must make for himself when faced with the problem.

SUMMARY

1. 169 cases, in which meconium was present in association with vertex presentation, are analysed. These occurred among 2,600 consecutive deliveries. This is a pilot survey for a much larger series.

2. The perinatal mortality associated with the presence of meconium is discussed.

3. The diagnostic value and significance of meconium as an indicator of foetal distress in this series is analysed. The outcome of the various cases is discussed in relation to (i) the dilatation of the cervical os at the time when meconium was first diagnosed and (ii) the method of delivery.

4. A markedly increased foetal mortality was found where meconium was present for more than 6 hours before delivery.

5. Throughout, *the presence of thick or frank meconium is shown to be associated with a higher foetal mortality than is the case with thin or light-green meconium staining of the liquor amnii.*

6. There was a surprisingly low incidence of congenital abnormalities in the present series (2·4%). A conservative attitude with regard to Caesarean section because of the fear of delivering a congenitally abnormal child is not justified.

7. A scheme for the treatment of vertex deliveries associated with meconium (this being based on a retrospective analysis of the present series) is outlined. Early Caesarean section, in order to prevent possible foetal loss, is recommended, particularly in the presence of frank meconium. If other signs of foetal distress or certain associated complicating factors are present, early intervention is also indicated. At full dilatation, delivery by forceps is necessary.

REFERENCES

1. Baird, D. (1950): *Combined Text-book of Obstetrics and Gynaecology*, 5th ed., p. 506. Edinburgh: Livingstone.
2. Bartholomew, R. A. (1925): Amer. J. Obstet. Gynec., 10, 89.
3. Baumm, P. (1917): Arch. Gynäk., 107, 353.
4. Claye, A. M. in Holland, E. and Bourne, A. eds. (1955): *British Obstetric and Gynaecological Practice*, p. 138. London: Heinemann.
5. Desmond, M. M., Moore, J., Lindley, J. E. and Brown, C. A. (1957): Obstet. and Gynec., 9, 91.
6. Donald, I. (1959): *Practical Obstetric Problems*, 2nd ed., p. 405. London: Lloyd-Luke.
7. Dumoulin, J. G. and Martin, J. D. (1957): J. Obstet. Gynaec. Brit. Emp., 64, 123.
8. Fitzgerald, T. B. and McFarlane, C. H. (1955): Brit. Med. J., 2, 358.
9. Gibberd, G. F. (1951): *A Short Text-book of Midwifery*, 5th ed., p. 108. London: Churchill.
10. Ginsburg, S. J. (1957): Amer. J. Obstet. Gynec., 74, 264.

11. Greenhill, J. P. (1943): *Principles and Practice of Obstetrics*, 8th ed., p. 270. Philadelphia and London: Saunders.
12. Leslie, D. W. (1959): Brit. Med. J., 2, 612.
13. Lister, U. M. and Buchanan, M. F. G. (1957): J. Obstet. Gynaec. Brit. Emp., 64, 233.
14. Louw, J. T. (1955): S. Afr. Med. J., 29, 160.
15. Lund, C. J. (1940); Amer. J. Obstet. Gynec., 40, 946.
16. *Idem* (1943): *Ibid.*, 45, 636.
17. Macafee, C. H. G. and Bancroft-Livingstone, G. (1958): J. Obstet. Gynaec. Brit. Emp., 65, 7.
18. Mintz, N. (1960): Amer. J. Obstet. Gynec., 79, 224.
19. Moir, J. Chassar *in* Kerr, M. (1956): *Operative Obstetrics*, 6th ed., p. 7. London: Baillière, Tindall and Cox.
20. Prystowsky, H. *quoted by* Paul, W. M. (1957): Obstet. Gynec. Surg., 12, 369.
21. Resnick, L. (1955): S. Afr. Med. J., 29, 857.
22. Theobald, G. W., Kelsey, H. A. and Muirhead, J. M. B. (1956): J. Obstet. Gynaec. Brit. Emp., 63, 641.
23. Walker, J. (1954): *Ibid.*, 162.
24. *Idem* (1959): Amer. J. Obstet. Gynec., 77, 94.
25. Walker, N. (1959): Brit. Med. J., 2, 1221.
26. White, V. T. (1955): Med. J. Aust., 1, 641.
27. Winckel, F. von (1903): *Handbuch der Geburtshulfe*. Wiesbaden: Bergmann