crisis. The use of the steroids is such common practice to-day that in cases of unexplained coma the possibility of adrenocortical insufficiency due to steroid withdrawal and an accompanying infection should be suspected.

Summary

Loss of consciousness was the presenting manifestation in three patients who while being maintained on long-term steroid therapy developed an acute respiratory infection and concomitantly discontinued their medication.

Prompt recovery occurred after corticosteroid administration, and it is postulated that the loss of consciousness was due to acute adrenal insufficiency occasioned by steroid withdrawal and the stress of infection.

It is suggested that in cases of unexplained coma the possibility of adrenocortical insufficiency due to withdrawal of steroid therapy and a concomitant stress situation should be suspected.

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REFERENCES

- Amatruda, T. T., jun., Hollingsworth, D. R., D'Esopo, N. D., Upton, G. V., and Bondy, P. K. (1960). *J. clin. Endocr.*, **20**, 339.
- Blau, J. N., and Hinton, J. M. (1960). *Lancet*, **1**, 408.
- Brit. med. J.*, 1959, **1**, 1464.
- Capper, R. S., and Moser, R. H. (1960). *Amer. J. med. Sci.*, **239**, 261.
- Caughey, J. E. (1958). In *Modern Trends in Endocrinology*, edited by H. Gardiner-Hill, pp. 132-141. Butterworth, London.
- Engel, G. L., and Margolin, S. G. (1942). *Arch. intern. Med.*, **70**, 236.
- Fraser, C. G., Preuss, F. S., and Bigford, W. D. (1952). *J. Amer. med. Ass.*, **149**, 1542.
- Fredell, E. W., Johnson, H. P., Krupp, M. A., Engleman, E. P., and McGrath, A. K. (1955). *Arch. intern. Med.*, **95**, 411.
- Hoagland, H. (1955). In *Neurochemistry: The Chemical Dynamics of Brain and Nerve*, edited by K. A. C. Elliott, I. H. Page, and J. H. Quastel, pp. 756-784. Thomas, Springfield, Ill.
- Holub, D. A., Jailer, J. W., Kitay, J. I., and Frantz, A. G. (1959). *J. clin. Endocr.*, **19**, 1540.
- Ingle, D. J., and Kendall, E. C. (1937). *Science*, **86**, 245.
- Jacobs, J. H., and Rose, F. C. (1955). *Tubercle (Lond.)*, **36**, 113.
- Lancet*, 1957, **2**, 130.
- Medical Research Council (1956). *Lancet*, **2**, 798.
- O'Donnell, W. M., Fajans, S. S., and Weinbaum, J. G. (1951). *Arch. intern. Med.*, **88**, 28.
- Pearson, R. S. B. (1959). *Postgrad. med. J.*, **35**, 463.
- Salas, R. M., Bennett, W. A., Keating, F. R., jun., and Sprague, R. G. (1953). *J. Amer. med. Ass.*, **152**, 1509.
- Smyth, C. J., Black, R. L., Demartini, F. E., Duff, I. F., Engleman, E. P., Graham, D. C., Montgomery, M. M., Polley, H. F., Rosenberg, E. F., Sacasa, C. F., Steinbrocker, O., Wayne, H., and Wilson, G. M. (1960). *Ann. intern. Med.*, **53**, No. 7, p. 68.
- Soffer, L. J. (1956). *Diseases of the Endocrine Glands*, p. 287. London.
- Stevens, A. E. (1960). *Lancet*, **2**, 234.
- Timiras, P. S., Woodbury, D. M., and Goodman, L. S. (1954). *J. Pharmacol. exp. Ther.*, **112**, 80.
- Williams, R. H. (1955). *Textbook of Endocrinology*, p. 242. Saunders, Philadelphia and London.
- Woodbury, D. M. (1958). *Pharmacol. Rev.*, **10**, 275.

A survey made to study the fate of the radioactive waste discharged into the River Thames from the Atomic Energy Research Establishment at Harwell shows that a significant amount of the caesium-137 so released is absorbed on the river bottom. This effectively reduces the concentration of this radionuclide in London's drinking-water. Enhanced activity on the river bed exists for many miles below the outfall but is not sufficient to raise radiation levels in air significantly above background at any point. (H.M.S.O., price 4s. net.)

MANAGEMENT OF THE SECOND TWIN

BY

R. R. MACDONALD, M.B., Ch.B., M.R.C.O.G.

Senior Registrar and Tutor, Department of Obstetrics and Gynaecology, University of Leeds

Argument continues unabated on whether the second twin is at greater risk than the first. Confusion arises because of conflicting reports from various eminent centres. Bender (1952), of Liverpool, and Potter and Fuller (1949), of Chicago, stated that there was no increased risk for the second twin, and Chassar Moir (1956) wrote that there was no increased stillbirth rate among second twins in Oxford. On the other hand, many authorities reported a second-twin loss up to twice that of the first (Munnell and Taylor, 1946; Corston, 1957). Tow (1959), of Belfast, and Little and Friedman (1958), of New York, found neonatal deaths more than twice as common among second twins.

There is also dispute about the management of the second twin, particularly as to the best delivery interval. Greenhill (1955) advocated waiting an hour before rupturing the membranes in the absence of complications, but in 1960 he reduced this to 15 minutes. A tendency to shorten the delivery interval is seen throughout the current literature except in a report by Danielson (1960), who thought it acceptable to wait two hours.

The present investigation was undertaken to see if there was any increased risk for the second twin, and also to find out the best way of managing the second delivery. A series of 500 consecutive twin deliveries at the Royal Maternity Hospital, Glasgow, from 1953 to 1958 have been analysed (497 patients with twin pregnancies were delivered in the hospital during that time, and the first three cases from 1959 were taken to make up the 500). Every case-sheet was studied individually by me, and the paediatric reports were also consulted where necessary, in order to make the assessment as uniform and accurate as possible.

Incidence and Mortality

A total of 20,369 patients were delivered in the hospital during the same period, giving an incidence of twin deliveries of 1 in 41, a figure which emphasizes the high rate of abnormal cases in the hospital. The vast majority of patients belonged to social classes III to V and approximately 80% were booked.

There was no maternal death in the series and the gross perinatal mortality, including infants born alive before 28 weeks, was 12.5% (cf. 8.3% for the hospital as a whole). This compares with 9.2% (Little and Friedman, 1958), 28.1% (Munnell and Taylor, 1946), 14% (Potter and Fuller, 1949), 11% (Bender, 1952), and 12.3% (Tow, 1959).

Table I shows the stillbirths and neonatal deaths of the first and second twins. For mechanical reasons macerated babies seem more likely to come second, and, in fact, on two occasions in this series the macerated

TABLE I.—Stillbirths and Neonatal Deaths

	First Twin	Second Twin
Fresh stillbirth	13	14
Macerated	15	24
Neonatal	26	33

infant was known to be presenting late in the first stage and yet was delivered after the healthy infant. In any comparison therefore between the twins macerated babies must be excluded, and herein lies one fallacy in the collection of mass figures. Apart from the macerated babies and those delivered by caesarean section, there were 38 first and 46 second twins lost. Only seven first and nine second twins died when the babies were normal and weighed 2,000 g. (4 lb. 6 oz.) or more.

These corrected figures agree very closely with the series of Bender (1952), and would suggest that the hazards for each twin are similar. This, however, is just not so, since closer study shows that some factors, notably prematurity, are shared but that the hazards in labour are much greater for the second twin.

During the course of this study several other interesting points emerged, but these are mentioned only briefly in order to avoid confusing the main issue.

Prematurity

Once again prematurity is clearly demonstrated as the major cause of foetal loss. Guttmacher and Kohl (1958) estimated that 2,000 g. (4 lb. 6 oz.) was the critical birth weight for twins, and this is confirmed here as every first twin born alive weighing 2,000 g. or more survived.

Disregarding abnormal infants, prematurity was a major factor in every neonatal death except two, and the only antenatal factor in more than a third of the cases. The two exceptions were both mature second twins dying from asphyxia and trauma.

Antenatal complications are common but premature labour seems to be precipitated in most cases by the sheer size and weight of the uterine contents. This is emphasized by the increased mortality (21.5% in this series) associated with hydramnios, very largely due to extreme prematurity.

Bed rest is the main protective measure, but there is no general agreement about the best time for resting. Russell (1952), writing from Aberdeen, emphasized the significance of social class and diet and advocated admission at 30 weeks. Anderson (1956) suggested not later than the 32nd week and Tow (1959) 30 to 36 weeks, while Donald (1959) advises 30 to 34 weeks, having practised this for some years with success. Bender (1952) recommended admission at the end of the 33rd week, but said that about half the foetal loss in his series occurred before this time.

Effect of Rest

In the present series 186 patients were admitted for periods ranging from eight days to eight weeks, the average being 3.3 weeks. More than 60% were admitted before 36 weeks, and 84.4% were associated with significant antenatal complications.

Table II shows that the patients who were rested had more mature babies with a lower foetal mortality despite the much higher complication rate. The two groups are not strictly comparable, but the inference is very strong

TABLE II.—*Maturity at Delivery*

	No. of Patients	Less than 36 Weeks	More than 40 Weeks	Foetal Mortality	Antenatal Complications
Rested ..	186	12.9%	37.6%	8.9%	84.4%
Not rested ..	314	35%	14%	14.6%	57.3%

—namely, that judicious bed rest despite complications will reduce prematurity and lower foetal mortality. Twenty-seven patients were admitted for rest before the 31st week, and the foetal mortality in this group was 7.4% compared with 12.5% for the whole series. These numbers, however, are too small, and the point could be proved conclusively, one way or the other, only by a prospective study. This is now being undertaken.

It is estimated that, by resting the remaining patients from 30 to 36 weeks, at least 20 uncomplicated neonatal deaths might have been prevented, but only four if admission were delayed to 33 weeks. Thus to be effective in reducing losses from prematurity, patients must be admitted not later than 30 weeks.

After 36 weeks only one death occurred where prematurity by weight was a major factor. The ideal time for resting is therefore 30 to 36 weeks. In favourable circumstances a few patients might safely be allowed home again after 34 weeks.

Special Indications for Admission

Not every patient carrying twins can be or is willing to be admitted for prolonged rest. Under certain circumstances, however, admission becomes imperative. As Table III shows, primigravid patients are more liable to pre-eclampsia and premature labour, and have a much higher foetal loss than multiparae. Since they are also likely to have fewer domestic cares, every primigravid patient should be admitted at 30 weeks.

TABLE III.—*Pre-eclampsia and Premature Labour*

	Total No.	Pre-eclampsia		Delivered before 36 Weeks	Total Foetal Loss
		Incidence	Foetal Loss		
Primigravidae	129	39.5%	14.7%	34.9%	17.8%
Multiparae ..	371	19.4%	6.3%	23.7%	10.6%

Pre-eclampsia occurred in 24.2% of the patients, with a foetal loss of 9.9% compared with 12.5% for the whole series. The reduced mortality associated with pre-eclampsia has been ascribed by various authors to the fact that it tends to develop only after the risk from prematurity is past. In the present series, however, 68.4% of the pre-eclamptic patients were admitted before 36 weeks, which would suggest that the enforced rest is also beneficial. This view is supported by Eastman (1956).

Marked clinical hydramnios occurred in 8.4% of patients, with a foetal loss of 21.5%. In fact, hydramnios and pre-eclampsia with accidental haemorrhage accounted for most of the deaths between 26 and 31 weeks. Thus increasing girth associated with hydramnios is a strong indication for admission even before 30 weeks.

Anaemia with haemoglobin levels below 60% occurred in 17% of the patients, and severe degrees of anaemia were associated with eight macerated infants. This reflects the state of nutrition in the area and indicates a need for improved antenatal care, and also for admission for rest and treatment in all but the mildest cases.

Eastman (1956) recommended frequent vaginal or rectal examinations in the last three months of twin pregnancy in order to detect the "physiologically incompetent cervix." If effacement or dilatation of the cervix were found he thought that admission to hospital for rest would lower substantially the neonatal mortality.

This method might well be used to make a decision about admission in cases which were otherwise normal.

It is stressed that these are merely relative indications, and every effort should be made to admit all twin pregnancies from 30 to 36 weeks.

Locked Twins

Three sets of locked twins occurred in the series, which suggests that the textbook incidence of 1 in 90,000 deliveries may be something of an underestimate. In each case the presentation was breech-vertex and the aftercoming head of the first was obstructed by the second head in the pelvis. All three first twins died from asphyxia, but the second twins survived. The weights ranged from 3 lb. 11 oz. (1,672 g.) to 5 lb. 1 oz. (2,295 g.). Under deep anaesthesia the second head was pushed out of the pelvis, but with considerable difficulty on one occasion. Delivery of the first child was then completed, and the second removed by internal version and breech extraction. I witnessed two of these cases, and it is difficult to see how such a catastrophe can be prevented unless the attendants are extremely alert.

Method of Delivery and Mortality

The methods of delivery are compared in Table IV, showing the number of babies lost and the total mortality. Macerated infants and those born by caesarean section have been excluded. Breech delivery

TABLE IV.—*Methods of Delivery*

	Twin 1		Twin 2	
	No.	Babies Lost	No.	Babies Lost
Normal delivery ..	306	19	237	18
Assisted breech ..	119	14	148	18
Breech extraction ..	17	2	38	4
Internal version and breech extraction:				
From transverse ..	6	2	14	2
" vertex ..	—	—	22	2
Forceps ..	37	1	26	2
Total spontaneous ..	425	33 (7.8%)	385	36 (9.4%)
" operative ..	60	5 (8.3%)	100	10 (10%)

occurred with 142 first twins and 222 second twins. This would suggest at once that there was an increased risk for the second twin from asphyxia and birth trauma.

Operative Intervention for the Second Twin

On 39 occasions after the first twin had been born spontaneously operative intervention was required for the second. The indications were shoulder or compound presentation, cord prolapse, foetal distress, bleeding, and prolonged delay. Despite these dangers the spontaneous and operative mortalities are similar. Bender (1952) found that the operative delivery of the second was often imperative because of complications, but was not associated with increased risk to the baby. Although he denied any extra hazard for the second twin, in fact he put his finger on the crux of the matter by adding that it might well be that intervention reduced the risk for the second twin.

Hazards of Labour

Anderson (1956) found that there were many more stillbirths among second twins from the hazards of delivery. Table V shows that the numbers are evenly divided in this series, but it is clear that the dangers facing each twin are quite different.

Prolapse of the cord occurred 10 times with the first twin, causing four deaths, and seven times with the second twin without loss. The second child is at an advantage here since it can be extracted immediately the complication occurs. On the other hand, as shown in the previous paragraphs, malpresentation, foetal distress, and potentially traumatic delivery are much more common for the second twin. It is a tribute to the skill and experience of the operators that second-twin mortality is not much higher.

Twice a uniovular placenta was delivered between the babies, and four times the placenta of the first child came away before the second delivery. Such accidents are not rare, since Tow (1959) and Danielson (1960) mention similar cases.

TABLE V.—*Labour Hazard Stillbirths*

Twin 1			
Complication	Cause of Death	No.	
Prolapsed cord ..	Asphyxia	4	
Second-stage delay: low forceps ..	Tentorial tear	1	
Precipitate breech ..	Cerebral haemorrhage	1	
Locked twins ..	Asphyxia	3	
Total ..		9	

Twin 2			
Complication	Method of Delivery	Cause of Death	No.
Compound presentation	Internal version and breech extraction	Tentorial tear	1
		Asphyxia	1
	Mid-forceps "	Tentorial tear	1
Foetal distress	Breech extraction	Atelectasis	1
	Assisted breech	Tentorial tear	1
	Spontaneous vertex	Asphyxia	1
Uterine inertia	Breech extraction	Tentorial tear	1
Placental delivery ..	Assisted breech	Asphyxia	1
Total ..			8

Relative Asphyxia

Reduction of uterine volume after delivery of the first child would seem inevitably to reduce placental oxygenation and hence the reserve of the second child.

A special study was made of birth asphyxia in 140 cases where both babies were delivered spontaneously by the vertex. The infants were divided into three groups according to their respiratory activity at birth: (a) active, crying at once and requiring no resuscitation; (b) mildly asphyxiated but crying within five minutes; and (c) severely asphyxiated, not crying within five minutes or requiring special resuscitative measures. On this basis it was found that 20.7% of second twins fell into a lower category—that is, were more asphyxiated than the corresponding first twin—while only 7.1% of second twins were more active than the first.

Thus even in double spontaneous vertex deliveries the second twin is on average slower to breathe than its fellow. Add to this the higher breech and operative delivery rate and it becomes easier to understand why neonatal deaths occur more often among second twins.

Second-twin Hazards

One is inevitably led to the conclusion that, except in cases of cord prolapse, the second twin is at much greater risk than the first. Breech presentation, breech extraction, compound presentation, and internal version are all more common for the second child. The need for operative intervention is greater, and a general anaesthetic is then usually required. Reduced placental circulation, occasional placental separation, and relative

asphyxia at birth increase the risk for the second twin. The list is formidable, and clearly the decisive factor is the obstetric experience available at delivery.

The next stage in the investigation was to decide the safest method of delivery for the second child.

Delivery Intervals and Second-twin Mortality

Table VI suggests that the safest delivery interval might lie between 10 and 20 minutes. Macerated babies and caesarean sections are again excluded in this table and in the next.

TABLE VI.—*Delivery Intervals and Second-twin Mortality*

Delivery Interval (Minutes)	No. of Patients	Stillbirth	Neonatal Death	Mortality (%)	Operative Rate (%)
10 or less ..	170	4	14	10.6	30.7
11-20 ..	124	2	5	5.6	13.9
21-30 ..	70	3	6	12.9	6.8
31-60 ..	66	4	5	13.6	10.4
Over 60 ..	31	1	2	9.7	56.3

Little and Friedman (1958) reported a gross perinatal loss of 9.2%, which is probably the lowest in the literature. They found the best delivery interval to lie between 2½ and 15 minutes, with a foetal loss of 6.4%, and the greatest loss occurred among babies delivered by internal version and breech extraction within five minutes or more than 25 minutes after the first child. They also made the important observations that there was no excess of very small babies in any group, and that each method of delivery showed a similar mid-interval decrease in death rate.

Percival (1959) recommends that intervention be avoided for at least 30 minutes in the absence of foetal distress or bleeding, since gentleness at delivery is important and a prolonged interval does not increase foetal mortality. It is true that really prolonged delay with simple inertia can be harmless, but the highest death rate occurred in this series between 20 and 60 minutes, and it is estimated that 10 of the 21 deaths after 20 minutes could have been avoided by skilful intervention at an earlier stage.

Tow (1959) concluded that it was expedient, while the cervix was still fully dilated immediately after the first delivery, to rupture the membranes and deliver the second twin from a potentially dangerous situation. The findings from this series and those of Little and Friedman (1958) suggest, however, that there is a safe minimum as well as a safe maximum delivery interval. Analysis of the preventable deaths indicates that the interval should be not less than five minutes and not more than 20 minutes.

Method of Membrane Rupture

Second-twin deliveries have been divided into groups in Table VII according to the indication for membrane rupture, and the results are quite illuminating.

TABLE VII.—*Membrane Rupture in Second-twin Deliveries*

Group No.	Method of Membrane Rupture	No. of Patients	No. of Babies Lost	Mortality (%)
1	Spontaneous ..	116	14	12.1
2	Artificial under general anaesthetic ..	51	1	2
3	" on principle to hasten delivery ..	84	4	4.8
4	Artificial because of complication ..	17	3	17.6
5	" " " delay over 20 minutes ..	43	5	11.6
6	Unknown (probably spontaneous) ..	164	19	12.7

Groups 1 and 6 contain a higher proportion of small and abnormal babies. In group 2 the patients were already under a general anaesthetic, and in each case the membranes were ruptured and operative delivery of the second was completed within 20 minutes of the first. Although this group contains a slightly higher percentage of larger babies, a mortality of 2% (one neonatal death in a 2-lb. (907-g.) baby) confirms that it is reasonably safe to proceed with the second delivery where the patient is already anaesthetized.

Group 3 is the most interesting and consists of 84 patients whose membranes were ruptured within 15 minutes, simply on the principle of hastening delivery. The group contains an average spread of babies from 29 weeks and 3 lb. 2 oz. (1,417 g.) upwards. The mortality was 4.8%, including two preventable deaths—a hasty version and extraction for compound presentation immediately after the first delivery, and a mature neonatal death after foetal distress where delivery was delayed for 40 minutes. Two neonatal deaths—an abnormal infant and a 31-week breech—were classed as unavoidable in this context. This method of membrane rupture actually seemed to improve the chance of a spontaneous delivery since operative intervention was required only half as often as in the whole series. Among 30 babies born between 10 and 20 minutes in this group there were no deaths at all.

In groups 4 and 5 the membranes were ruptured artificially because of foetal distress, bleeding, or delay of more than 20 minutes. There were six preventable deaths and two premature neonatal deaths. The combined mortality was 13.3%, or almost three times that of group 3, although the groups are otherwise comparable. This must provide a very strong argument in favour of early intervention and against the practice of waiting for foetal distress or for an interval of 20 minutes or more.

Second-twin Delivery

The conclusion to be drawn from the last two paragraphs is that the membranes should be ruptured at five minutes and delivery be complete within 20 minutes. If spontaneous delivery has not occurred within 15 minutes, then operative intervention is necessary, since further delay carries an increased risk. Where the head is in the pelvis, forceps can be applied under pudendal block, and where the breech is presenting, gentle breech extraction can be carried out.

There remains the problem of what to do if, after membrane rupture, there is inertia or the head remains high and deflexed. Group 3 (Table VII) is worth further study in this connexion. Among 60 patients whose membranes were ruptured artificially within 10 minutes of the first delivery inertia did not occur. If membrane rupture was delayed to 15 minutes, or over 20 minutes as in group 5, the delivery interval between the twins tended to increase correspondingly. Moreover, when the membranes were ruptured within 10 minutes, operative intervention was required only twice for the second child after a spontaneous first delivery. Thus early membrane rupture was not associated with inertia, and seemed to reduce the risk of complications.

If, however, the head does remain high the alternatives are high forceps or internal version and breech extraction. In group 2 (Table VII), where the patients were already anaesthetized, internal version and breech extraction was carried out 13 times without loss between

5 and 20 minutes after the first delivery. Version and extraction would therefore seem safer than difficult forceps, provided that the manoeuvre is carried out within these time limits. Donald (1961, personal communication) suggests that the application of the ventouse might prove the best solution of all for such cases. The importance of having an anaesthetist and an obstetrician present at every twin delivery is obvious.

Conclusions

The solution to the problem of whether the second twin is at greater risk than the first lies in appreciating that, apart from prematurity, the risks in labour for each twin are quite different. The second twin is in fact at much greater risk, but mortality can be reduced considerably by skilful obstetric management at delivery.

The first twin is more susceptible to cord prolapse because of incomplete dilatation of the cervix, and may suffer cerebral damage in dilating the birth canal. The second is at considerable risk from reduction of placental oxygenation and has a much higher breech and operative delivery rate; it may therefore succumb at birth or in the neonatal period from asphyxia, trauma, or both.

As previous writers have also suggested, prematurity could be reduced by rest from the 30th week or even earlier to the 36th week. This presupposes efficient antenatal care with early diagnosis. Hospital admission would be indicated particularly in primigravid patients and where there were early signs of hydramnios, pre-eclampsia, anaemia, or effacement of the cervix. Total twin mortality can therefore be reduced by the prevention of prematurity, allied with efficient antenatal care.

Twin labour should always be conducted in hospital, where there are special paediatric facilities, and the delivery attended by an anaesthetist and an experienced obstetrician. Gentleness and skill in handling the babies will reduce mortality.

Early rupture of the second sac is not followed by inertia. Indeed, spontaneous delivery is more likely and the risk of complications is reduced.

Immediately after the birth of the first child the lie of the second should be corrected to longitudinal, and five minutes after the first delivery the second presenting part should be pushed into the brim and the forewaters ruptured. If spontaneous delivery does not occur in a further 10 minutes, or if there is any complication, operative delivery is indicated. Delivery should thus be complete within 20 minutes of the birth of the first child.

Summary

A series of 500 consecutive twin deliveries has been studied to define the particular risk facing the second twin.

Prematurity is the major cause of foetal loss, and could be reduced by rest from 30 weeks or earlier to 36 weeks. Particular indications for hospital admission are discussed.

The second twin is at greater risk from asphyxia and trauma, but anaesthetic and skilled obstetric assistance at delivery will reduce mortality.

Early controlled delivery of the second twin is advocated, with membrane rupture at five minutes and delivery complete within 20 minutes.

Professor Ian Donald kindly gave permission for the study of these patients, and provided valued and constructive criticism on the paper.

REFERENCES

- Anderson, W. J. R. (1956). *J. Obstet. Gynaec. Brit. Emp.*, **63**, 205.
 Bender, S. (1952). *Ibid.*, **59**, 510.
 Corston, J. M. (1957). *Obstet. and Gynec.*, **10**, 181.
 Danielson, C. O. (1960). *Acta obstet. gynec. scand.*, **39**, 63.
 Donald, I. (1959). *Practical Obstetric Problems*, 2nd ed. Lloyd-Luke, London.
 Eastman, N. J. (1956). *Williams Obstetrics*, 11th ed. Appleton-Century-Crofts, New York.
 Greenhill, J. P. (1955). *Obstetrics*, 11th ed. Saunders, Philadelphia.
 — (1960). *The Year Book of Obstetrics and Gynecology*, p. 276. Year Book Publishers, Chicago.
 Guttmacher, A. F., and Kohl, S. G. (1958). *Obstet. and Gynec.*, **12**, 528.
 Little, W. A., and Friedman, E. A. (1958). *Obstet. Gynaec. Surv.*, **13**, 611.
 Moir, J. C. (1956). *Munro Kerr's Operative Obstetrics*, 6th ed. Baillière Tindall and Cox, London.
 Munnell, E. W., and Taylor, H. C. (1946). *Amer. J. Obstet. Gynec.*, **52**, 588.
 Percival, R. (1959). In *British Obstetrical Practice*, edited by Sir Eardley Holland, 2nd ed. Heinemann, London.
 Potter, E. L., and Fuller, H. (1949). *Amer. J. Obstet. Gynec.*, **58**, 139.
 Russell, J. K. (1952). *J. Obstet. Gynaec. Brit. Emp.*, **59**, 208.
 Tow, S. H. (1959). *Ibid.*, **66**, 444.

SIDEROSIS IN THE BANTU

A COMPARISON OF INCIDENCE IN MALES AND FEMALES

BY

T. H. BOTHWELL,* M.D., M.R.C.P.

Tutorial Physician, Department of Medicine, University of Witwatersrand, Medical School, Hospital Street, Johannesburg

AND

C. ISAACSON, M.B., D.C.P., D.Path.

Pathologist, South African Institute for Medical Research and Baragwanath Hospital, Johannesburg

The diet of the Bantu in South Africa contains large amounts of iron, most of which is derived from the containers used in the preparation of alcoholic drinks (Walker and Arvidsson, 1953). Although other as yet unidentified factors may be involved, this high iron intake is almost certainly the primary cause of the varying degrees of iron overload so common in adult Bantu. Recent evidence suggests that such iron deposits may have deleterious effects. For example, there is a close correlation between severe hepatic siderosis and portal fibrosis (Higginson *et al.*, 1957; Gillman *et al.*, 1958), and this is especially so with iron concentrations above 2% dry weight (Bothwell and Bradlow, 1960). In addition a small proportion of subjects exhibit clinical and pathological features virtually indistinguishable from those found in idiopathic haemochromatosis (Seftel *et al.*, 1960, 1961; Isaacson *et al.*, 1961).

The present investigation was undertaken to define in more detail the extent of the problem in the Johannesburg area. This was done by estimating chemically the concentration of iron in the livers of several hundred male and female Bantu adults dying in hospital. The results in the two sexes were then correlated with the histological findings.

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