PAPERS AND ORIGINALS

Influence on Clinical Practice of Routine Intra-partum Fetal Monitoring

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British Medical Journal, 1975, 3, 341-343

Summary

An attempt has been made to monitor by continuous fetal heart rate recording all women admitted in labour. Altogether 85% of the 1070 patients delivered at one hospital were monitored in 1973 and 92% in 1974. Perinatal mortality fell significantly from levels in preceding years to 15·8 and 11·7 per 1000 births, respectively, in 1973 and 1974. The fall was primarily due to the elimination of intra-partum stillbirths and a significant reduction in neonatal mortality. The incidence of caesarean sections also fell from 9·7% in 1973 to 5·8% in 1974. All patients should be monitored because it is impossible to predict reliably intra-partum fetal distress from maternal "high-risk" factors present before the onset of labour.

Introduction

Experience with high-risk patients has shown that continuous fetal heart rate (F.H.R.) monitoring combined, when necessary, with fetal pH measurement, is a reliable system for the early detection of intra-partum fetal asphyxia and prevention of stillbirth.[1] Quilligan[2] in a large survey observed that the incidence of intra-partum stillbirth was about three times less in a high-risk group of patients who were monitored than the expected rate in an unmonitored group. It seemed, therefore, that a relatively simple system for monitoring the fetus was available which was safer than the traditional fetal stethoscope. These studies showed that though perinatal mortality was significantly reduced in the monitored high-risk group the unmonitored "normal" group had a significant perinatal mortality (3·7 per 1000 deliveries in the "normal" unmonitored group compared with 1·5 per 1000 in the high-risk monitored group[2]). Thus, it seemed logical to try to monitor all patients as soon as they were admitted in labour in an attempt to reduce the effects of intra-partum asphyxia still further. Similar attempts have been made in some units but the number of patients actually monitored was less than half those available,[3 4] chiefly because of the staff's unfamiliarity with or resistance to new techniques.

Our objective was to monitor as many patients as possible over two years (1973-4) and to determine the effect on clinical practice by comparing results during these years with those of previous years.

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Patients and Methods

In 1972 our policy was to monitor only high-risk patients and those who developed clinical evidence of fetal distress during labour—about 20% of all patients delivered. In 1973 we decided to monitor all patients who were induced or admitted in labour.

In 1973 1070 women delivered 1078 babies. All patients were seen by a member of the resident medical staff on admission to the labour ward. If the cervix was closed external monitoring, either by microphone or ultrasound, was used. Once an endoscope could be inserted through the cervix the membranes were ruptured and a Hon clip or a spiral electrode attached to the presenting part of the fetus regardless of the presentation. If the F.H.R. trace was normal no further action was taken, but if an abnormal trace was recorded a fetal blood sample was collected for pH measurement.

One Sonicaid FM-2 and two Hewlett-Packard cardiotocographs were available during 1973-4. The frequency and duration of the uterine contractions were recorded by external tocography or, occasionally, internally by means of a fluid-filled intrauterine catheter attached to the strain gauge supplied with the monitor.

Complications of pregnancy were defined as pre-eclamptic toxaemia, hypertension, an age of 35 years or greater, grand multiparity, poor obstetric history, diabetes, rhesus sensitization, gestation of less than 36 weeks or more than 42 weeks, multiple pregnancy, breech, fetal growth retardation or low urinary oestrogen output, oligohydramnios, ante-partum haemorrhage, previous caesarean section, and recurrent urinary tract infections in pregnancy. Of the 251 patients with a "complicated" pregnancy 197 had one complication, 41 had two, and 13 had three or more.

Fetal Heart Rate Traces.—The terminology of Beard *et al.*[1] was used to describe the changes in the continuous F.H.R. traces. As a result of the correlation found in that study between changes in the continuous F.H.R. and the presence or absence of fetal acidosis the

following patterns were considered to be abnormal: uncomplicated baseline tachycardia, variable decelerations with both normal and abnormal baselines, loss of beat-to-beat variation, and late decelerations with either normal or abnormal baseline. Every trace obtained in 1973 was studied and classified by one of us (P.T.E.) without knowledge of the clinical history of the patient.

Results

Of the 1070 patients delivered during 1973 911 (85%) were monitored; 739 (81%) had an electrode applied to the fetus and 172 (19%) had the F.H.R. recorded by external ultrasound or phonocardiography. Traces in 806 patients were considered to be of sufficient duration and clarity for analysis. Altogether 145 patients had abnormal or suspicious traces and they were all among the 158 patients who had their fetal pH measured; this indicated a reasonable degree of uniformity in interpretation of the traces between the residents and ourselves. Forty-five patients had a fetal pH of 7·25 or less.

Fig. 1 shows the distribution of F.H.R. patterns among the 806 patients. Of the 555 patients in the uncomplicated group 88 (16%) had suspicious or abnormal traces compared with 54 (22%) of the 251 in the complicated group. Though those with complicated pregnancies tended to have a higher incidence of suspicious or abnormal traces than the uncomplicated group the difference was not significant.

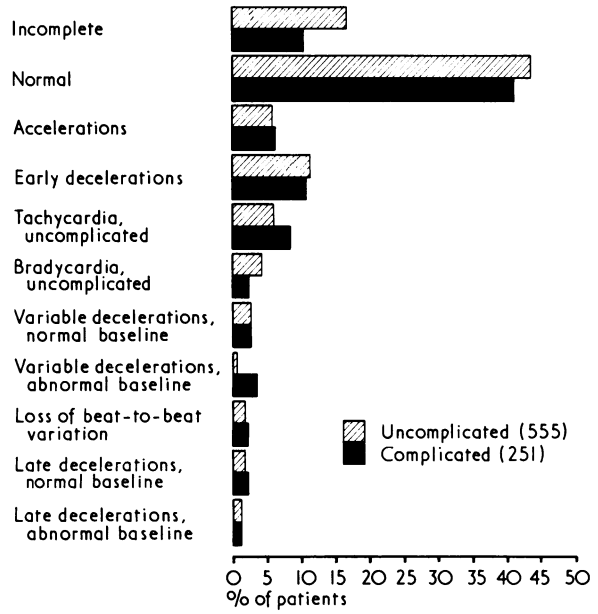

FIG. 1—Distribution of F.H.R. pattern according to whether pregnancy was "complicated" or not.

Further evidence that "high risk" factors do not reliably distinguish fetuses that develop intra-partum asphyxia from those that are unaffected by labour is also shown by the acid base values. Fetal acidosis was found in 18 out of 251 patients with a complicated pregnancy (7%) compared with 27 out of 555 patients with uncomplicated pregnancies (5%); this difference was not statistically significant.

Fig. 2 shows the distribution of fetal pH values when acidosis was present according to the stage of labour when the fetal blood sample was collected and the type of delivery. Thirty-three fetal blood samples were collected in the first stage of labour, 19 of these patients being delivered by caesarean section for fetal distress and 14 being allowed to progress to a vaginal delivery. The major factor which determined whether labour should be allowed to progress to a vaginal delivery was the severity of the acidosis. In general a caesarean section was done if the pH was persistently less than 7·23, but the type of F.H.R. trace and the timing of the sample in relation to the likely time to full dilatation also played a part in the decision. A persistently abnormal F.H.R. trace, even if the acidosis was 7·23-7·25, was a reason for caesarean section unless the patient was near the second stage, in which case the labour was allowed to continue provided that the F.H.R. pattern or fetal pH did not deteriorate. Unfortunately, we could not determine to what extent maternal acidosis contributed to

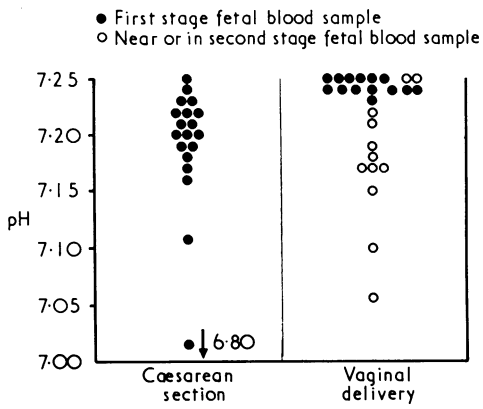

FIG. 2—Distribution of pH values of blood samples from individual fetuses with abnormal F.H.R. trace and pH of 7·25 or less.

the low pH values because maternal pH was not measured. We assumed that several cases of second stage fetal acidosis were of maternal (estimated to be 10%[5]) rather than hypoxic origin.

Type of Delivery.—Table I shows the types of delivery in 1972-4. The incidence of spontaneous vaginal or forceps delivery did not change significantly, but the number of caesarean sections fell significantly from 9·7% in 1973 to 5·8% in 1974 (χ^2=11·08; P<0·01). This fall could be attributed to a reduction in the number of operations done during labour (χ^2=9·89; P<0·02). The number of elective caesarean sections performed did not change significantly.

TABLE I—*Types of Delivery from 1972 to 1974. Results are Numbers (%) of Patients*

	1972	1973	1974
Spontaneous vaginal delivery (including breech)	729 (73·6)	712 (65·1)	741 (72·4)
Forceps/Ventouse	174 (17·6)	262 (24·3)	224 (21·9)
Caesarean sections:	88 (8·9)	104 (9·7)	59 (5·8)
Intra-partum	55 (5·6)	66 (6·1)	34 (3·3)
Elective	33 (3·3)	38 (3·5)	25 (2·4)

Perinatal Mortality for 1968-74 is shown in table II. Perinatal mortality fell significantly in 1973 and 1974, which may be attributed to a reduction in intra-partum stillbirths and first-week neonatal deaths from 1973, when total monitoring was used. Over the same period there was no obvious change in ante-partum deaths. When the number of perinatal deaths from 1968 to 1972 is compared with those in 1973-4, when total monitoring was introduced, a significant reduction in the proportion of intra-partum stillbirths (z=2·57; P=0·003) and first-week neonatal deaths (z=2·84; P=0·0025) was seen. The major factor contributing to the improvement in perinatal mortality was monitoring of the premature fetus (table III). This improvement was evident during both the intra-partum and neonatal periods.

TABLE II—*Perinatal Mortality 1968-74 related to Time of Death*

	1968	69	70	71	72	73	74
Total births	1282	1254	965	1105	991	1078	1024
Total perinatal deaths	29	30	19	26	29	17	12
Perinatal mortality rate (per 1000 births)	22·6	23·9	20·0	23·5	29·3	15·8	11·7
Ante-partum stillbirths	12	8	7	9	8	12	7
Intra-partum stillbirths	6	6	3	4	7	1	0
First-week neonatal deaths	11	16	9	13	14	4	5

TABLE III—*Actual Numbers of Perinatal Deaths (Intra-partum Stillbirths (I.P.S.) and Neonatal Deaths (N.N.D.)) Relative to Probable Cause*

	1972		1973		1974	
	I.P.S.	N.N.D.	I.P.S.	N.N.D.	I.P.S.	N.N.D.
Congenital abnormalities	3	1		1		2
Premature with or without intra-partum asphyxia	4	11		2		3
Mature with intra-partum asphyxia		2	1	1		

Discussion

The major improvement during the two years of total monitoring can be seen in the perinatal mortality. The figures correspond closely with those of Tipton and Lewis[6] from Watford Hospital, who monitored 75% of their patients in 1974 and reported an annual perinatal mortality rate of 22·2, 16·9, and 10·6 per 1000 births in 1972, 1973, and 1974 respectively. In our study the virtual disappearance of intra-partum stillbirths was not unexpected since the combined use of F.H.R. and pH monitoring have not resulted in any false negative results[7] while a normal F.H.R. and pH have been shown to be reliable indications that the fetus is in good condition. What is more difficult to explain, but nonetheless gratifying, is the reduction in the incidence of first-week deaths, particularly among premature babies. Hobel[8] indirectly pre-empted this result when he showed that neonatal mortality and morbidity were much lower among premature babies who had maintained a normal continuous F.H.R. trace and pH. Apart from a single case in which the pH was 6·80 we saw no case of intra-partum fetal acidosis below 7·10. This contrasts with the findings of Beard *et al.*,[9] who used the changes in the ausculated F.H.R. as an indication for fetal pH measurement and found a much higher incidence of severe fetal acidosis. Clearly, the detection of fetal asphyxia at an earlier stage of the process, particularly among premature babies, is a major contributory factor in reducing the number of first-week neonatal deaths. Though we could not assess the effect of monitoring on the incidence of morbidity among neonates there seemed to have been a definite improvement. To what extent these improvements can be ascribed to monitoring is difficult to say for it is likely that the more ready use of oxytocin to augment labour, the introduction of partograms, and the use of the lecithin: sphingomyelin ratio to determine fetal pulmonary maturity have all played a part. Induction of labour, however, remained at 25-28% in 1972-4 in this unit and was unlikely to have been a major contributory factor in reducing perinatal mortality in our study, as was suggested by Tipton and Lewis[6] in their study.

A criticism of monitoring is that it may cause more caesarean sections to be performed. Undoubtedly the use of continuous F.H.R. alone without checking the fetal pH does show this effect because of the much higher incidence of F.H.R. trace abnormalities than cases of fetal acidosis. It could be argued that damaging fetal hypoxia may precede the appearance of acidosis, thus justifying earlier delivery by caesarean section, but the increased morbidity among babies of mothers delivered by caesarean section,[10] let alone the disadvantage to the mother, is evidence of the danger of this argument. In 1972 and 1973 the caesarean section rate in this unit was above 9%, which was higher than the rate in other studies,[6 7] and it was not until 1974 that it fell to 5·7%; this rate has persisted. The reason for this change is not clear but reliance on pH as an indicator of asphyxia probably increased among staff rather more slowly than the acceptance of the monitor as a clinical tool. With this increased confidence came less of a tendency to deliver the patient prematurely if the F.H.R. trace was abnormal but the fetal pH normal.

The organization for monitoring so many patients was less formidable than expected. Late in 1972 it was established that all patients should be examined vaginally on admission in labour and an electrode attached to the fetal scalp. New residents were trained by their seniors in the monitoring techniques, the measurement of blood pH, and the interpretation of F.H.R. traces. Midwives on the permanent staff learned to interpret F.H.R. patterns as readily as the residents but problems arose when temporary or agency staff were employed. The placing of a simple demonstration board of F.H.R. patterns on the labour ward largely overcame this potentially dangerous problem. Three monitors were enough for about 1000 patients, and a close liaison with our medical physics department ensured that breakdowns were dealt with without having to send the monitors away for repair.

The assessment of the value of any new technique is always complicated by the difficulty of controlling the many variables that may influence the final outcome. Changes in clinical policies, such as induction, and in the composition of the obstetric population may be powerful influences on perinatal mortality which are independent of monitoring. Nevertheless, our results are encouraging, suggesting as they do that total monitoring by improved surveillance added to the safety of the fetus during labour; the reduction in fetal mortality is a strong argument in support of this view. Until recently it has been argued that the cost of introducing monitoring as a routine practice could not be justified in Britain. But as the whole objective of pregnancy is to produce a healthy baby the cost of equipping obstetric units throughout Britain with monitors seems small in comparison with the benefit that is likely to result from such a policy.

We thank all the medical and nursing staff on the obstetric unit without whose ready acceptance of new procedures this study would not have been possible; Mr. G. D. Pinker for allowing us to include all patients under his care in the study; Miss E. Belsey of the department of community medicine at St. Thomas's Hospital Medical School for statistical help; and Miss C. A. Knight for doing the drawings and reading the manuscript.

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