

## Correlation of Intra Partum External Cardiotocography and Umbilical Cord Acid-Base Status in Diagnosing Fetal Asphyxia

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**OBJECTIVE** - To detect fetal asphyxia in meconium stained amniotic fluid (MSAF) by FHR pattern during intrapartum external cardiotocography and umbilical cord blood acid-base status at delivery. **METHODS** - One hundred and thirty four women in labour comprising three groups viz those with clear liquor (n = 49), thin MSAF (n=37) and thick MSAF (n = 48) participated in this prospective cross-sectional comparative study from January 1999 to June 2000. Intra partum external cardiotocography, umbilical artery acid-base status at delivery and Apgar scores at one and five minutes were recorded in all cases. The results were analysed using Chi-square and ANOVA tests. **RESULTS** - The number of FHR decelerations were higher in the thick MSAF group (83.33%) and variable decelerations were the most common (p = 0.0003) when compared to those in thin and clear liquor group. There was increased incidence of acidosis (54%) in thick MSAF group when compared to that in clear liquor (30.6%) and thin MSAF (27%) groups (p = 0.05). The sensitivity of low Apgar scores to detect acidosis was poor. There was significant neonatal morbidity (p = 0.001) in the neonates with thick MSAF. **CONCLUSION** - Thick MSAF is significantly associated with fetal hypoxia as evidenced by higher decelerations, low apgar scores and fetal acidosis.

**Key words** - Intrapartum external cardiotocography, fetal acidosis, thick meconium stained liquor

### Introduction

Prevention and treatment of fetal asphyxia is one of the main aims of perinatal care. The diagnosis of asphyxia at birth is often based solely on Apgar score. However, a low Apgar score has proved to be a poor means of diagnosing asphyxia<sup>1</sup>. It is recommended that the term 'fetal distress' should be replaced by 'non-reassuring fetal status' and asphyxia should be reserved for the clinical context of 'damaging hypoxia and metabolic acidosis'. Hence, the objective and scientific means of diagnosing fetal asphyxia at delivery is umbilical cord acid base status. Meconium stained amniotic fluid (MSAF) occurs in 12-20% of all deliveries<sup>2</sup> and it is still controversial whether it can be regarded as a marker of fetal asphyxia. The Perinatal Mortality Rate (PNMR) is as high as 60/1000 births when MSAF is observed<sup>3</sup>.

Most often it is the obstetrician who is blamed for the delivery of an asphyxiated neonate. In the present day of consumer protection act, the perinatologists are often confronted with the questions regarding the occurrence and prevention of fetal asphyxia. Umbilical cord acidemia is the most sensitive indicator<sup>4</sup> of birth asphyxia and recognition of this will improve the identification of the newborn at risk for cerebral palsy<sup>5</sup>.

The correlation of intrapartum FHR patterns, umbilical cord blood pH at delivery, Apgar score and the neonatal outcome in MSAF, in thin meconium and in clear liquor may throw some light in predicting and diagnosing fetal asphyxia.

### Material and Methods

Women with a singleton term pregnancy with the fetus in cephalic presentation formed the pool from which the cases and controls were selected. Patients in labour with thick and thin meconium formed the study groups and matching pregnancies with clear liquor formed the control group. Women with non-cephalic presentation, multiple pregnancies, preterm labour and major congenital anomalies were excluded from the study. Following spontaneous or artificial rupture of membranes the colour of amniotic fluid was noted. All patients were then subjected to continuous external electronic fetal monitoring (EFM) using Corometrics 157 fetal monitor. In cases of meconium stained liquor, fetal monitoring was continued till delivery. In women with clear liquor, EFM was performed for a minimum period of half-an-hour and continued till delivery if FHR abnormalities were noted during this period. The FHR patterns were interpreted as per the 1995 guidelines of ACOG<sup>6</sup>. Following delivery of the baby, the umbilical cord was immediately clamped and a segment of 10-30 cm. in length was isolated after filling up the core vessels by milking it. Cord arterial blood was collected in preheparinised syringe and analysed immediately using blood gas analyser (CBA) CORNING 280 BLOOD GAS SYSTEM. The Apgar Score of the

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neonates were assessed at 1 and 5 minutes. The neonatal morbidity among them was noted. The data was analysed using chi-square and ANOVA tests.

### Results

The mean age was comparable in all the three groups. Though 75% were nulliparous in thick Meconium group it was not statistically significant. The incidence of operative vaginal delivery was markedly increased in

thick MSAF group ( $P < 0.05$ ) though there was no statistically significant increase in the rate of cesarean section (Table I). In thick MSAF group 17 neonates had low Apgar score at 1 min. and 15 needed endotracheal intubation and compared to only one in clear liquor group. The incidence of respiratory distress was also higher with thick MSAF group. Three neonates had developed meconium aspiration syndrome (MAS) of which two showed evidence of acidosis (66.67%).

**Table I : Patient Characteristics, Mode of Delivery, Neonatal Outcome**

Characteristic	Clear liquor (n=49)	Thin MSAF (n=37)	Thick MSAF (n=48)	Significance
Mean age (Yr ± SD)	22.69 (3.2)	23.37 (4.7)	24.12 (3.7)	NS
Nullipara	30 (61.22%)	20 (54.05%)	36 (75%)	NS
Booked cases	42 (85.7%)	24 (64.9%)	42 (87.5%)	$P < 0.05$
Spontaneous vaginal delivery	36 (73.47%)	26 (70.27%)	18 (37.5%)	$P < 0.0005$
Operative vaginal delivery	9 (18.37%)	8 (21.62)	21 (43.75%)	$P < 0.05$
LSCS	4 (8.16%)	3 (8.11%)	9 (18.75%)	NS
1' Apgar ≤ 6	5 (10.2%)	4 (10.81%)	17 (35.42%)	$P < 0.002$
Endotracheal intubation	1 (2.04%)	-	15 (31.25%)	-
NICU Admission	2 (4.08%)	5 (13.51%)	14 (29.17%)	$P < 0.002$
Respiratory distress	4 (8.16%)	5 (13.51%)	17 (35.42%)	$P < 0.001$
Convulsions	1(2.04)	1 (2.70%)	4 (8.33%)	NS
MAS	-	-	3 (6.25%)	

The FHR patterns were abnormal in 83% of fetuses with thick MSAF. The incidence of decelerations was statistically significant ( $p < 0.003$ ) as is shown in Table II.

From Table III it is evident that the mean  $PCO_2$  and bicarbonate levels were not statistically different in the three groups. But the incidence of acidosis was high viz., 54.17% ( $P < 0.05$ ) in thick MSAF.

**Table II : Patient Characteristics, Mode of Delivery, Neonatal Outcome**

Characteristic	Clear liquor (n=49)	Thin MSAF (n=37)	Thick MSAF (n=48)	P value
Normal	24 (48.98%)	13 (35.14%)	8 (16.67%)	0.003
Early decelerations	6 (12.24%)	16 (43.24%)	8 (16.67%)	0.001
Variable decelerations	3 (6.12%)	2 (5.41%)	19 (39.58%)	0.0003
Late decelerations	7 (14.29%)	3 (8.11%)	8 (16.67%)	NS
Combined decelerations	9 (18.37%)	3 (8.11%)	5 (10.42%)	NS
All decelerations	25 (51.02%)	24 (64.86%)	40 (83.33%)	0.003

**Table III : Patient Characteristics, Mode of Delivery, Neonatal Outcome**

Characteristic	Clear liquor (n=49)	Thin MSAF (n=37)	Thick MSAF (n=48)	Significance
$PCO_2$	60.402 (12.96)	58.29 (9.64)	60.22 (11.81)	NS
$HCO_3$	24.04 (2.77)	23.75 (2.85)	22.66 (3.59)	NS
PH <7.2	15 (30.61%)	10 (27.03%)	26 (54.17%)	$P < 0.05$

### Correlation of decelerations, acidosis and low Apgar scores :

In the absence of decelerations only few neonates had evidence of acidosis and low Apgar scores in clear liquor and thin meconium groups while 62.5% neonates with thick MSAF exhibited acidosis and 37.5% had of low apgar scores (Table IV). This is because the degree of hypoxia and the duration of hypoxia are not measurable and also each fetus has its own potential for adaptation towards the stressful event. Hence one cannot find good correlation between the FHR pattern, acidosis and apgar scores. The important finding here is that five fetuses out of eight with acidosis did not show any ominous FHR pattern despite the presence of acidosis; they only exhibited hypoxia in the form of thick meconium stained liquor. This finding is in favour of the importance of thick MSAF as a marker of fetal asphyxia.

The sensitivity of normal FHR pattern to detect normal fetal pH was 59% in clear liquor and 45% in thin MSAF as compared to 14% in thick MSAF. A normal cardiotocogram was highly predictive of normal pH in clear liquor and thin MSAF but not in fetuses with thick MSAF. The sensitivity of all decelerations combined to detect acidosis and low Apgar scores was high (80%) in thick MSAF but the positive predictive value was low. The sensitivity of low Apgar scores to detect acidosis was poor. However, specificity and positive predictive values were high among babies born with clear liquor and thin MSAF but comparatively low among babies born with thick MSAF.

### Discussion

An association between the passage of meconium and reduced umbilical vein blood oxygen saturation was found by Walker in 1954<sup>10</sup>. However others hypothesised that it can be a normal physiological

Tabel IV : Correlation of Decelerations, Acidosis and Low Apgar Scores

Characteristic	Clear Liquor (n=49)		Thin MSAF (n=37)		Thick MSAF (n + 48)	
	Dec. + (n=25)	Dec. - (n=24)	Dec. + (n=24)	Dec. - (n=13)	Dec. + (n=40)	Dec. - (n=8)
pH ≤ 7.2	11 (44%)	4 (16.67%)	9 (37.5%)	1 (7.69%)	21 (52.5%)	5 (62.5%)
pH > 7.2	14 (56%)	20 (83.33%)	15 (62.5%)	12 (92.31%)	19 (47.5%)	3 (37.5%)
Apgar < 6	5 (20%)	-	4 (16.67%)	-	14 (35%)	3 (37.5%)
Apgar > 6	20 (80%)	24 (100%)	20 (83.33%)	13 (100%)	26 (65%)	5 (62.5%)

Dec. + = Presence of Decelerations    Dec. - = No Decelerations

phenomenon in mature and postmature fetuses<sup>11</sup>. In 1992, Katz and Bowes<sup>4</sup> reviewed the literature on MSAF and found evidence to support the other hypothesis that it is not the inhaled meconium which produces the primary pathological condition of MSAF but associated fetal asphyxia.

Meconium in the amniotic fluid initiates the vasoconstriction of umbilical cord blood vessels and placental blood vessels which leads to ischaemic hypoxic cerebral palsy<sup>12</sup>.

Krebs et al<sup>13</sup> found reduced oscillatory amplitude, decreased incidence of acceleration and late decelerations to be significantly more common when there is thick MSAF. In our study, the incidence of

variable decelerations was found to be significantly increased in thick MSAF ( $P < 0.003$ ).

The presence of thick meconium is often associated with increased incidence of operative deliveries. Sambarey and Shinde<sup>14</sup> report the highest rate of 38.5% of operative vaginal deliveries and 41.5% of cesarean section where as Yeomans et al<sup>15</sup> show only 8% operative vaginal deliveries and 17% cesarean section. In our study 43.75 had operative vaginal deliveries and 18.75% cesarean section.

When FHR patterns were correlated with acidosis, the sensitivity of FHR decelerations for detecting fetal acidosis was low which is in agreement with the study of Yeomans et al<sup>15</sup> and Mitchell et al<sup>16</sup>. In the thick

meconium group, we noted acidosis in 62.5% of fetuses in the absence of decelerations.

When an hypoxic stress is present, cardiovascular adaptation and the ability to buffer hydroxonium ions can preserve normal acid base status for as long as 90-

100 min. This may explain the reason why only 54% of the neonates showed acidosis in the thick meconium group and also the increased incidence of early decelerations (43.24%) in thin meconium group. The effect of hypoxia is depicted in Fig.1.

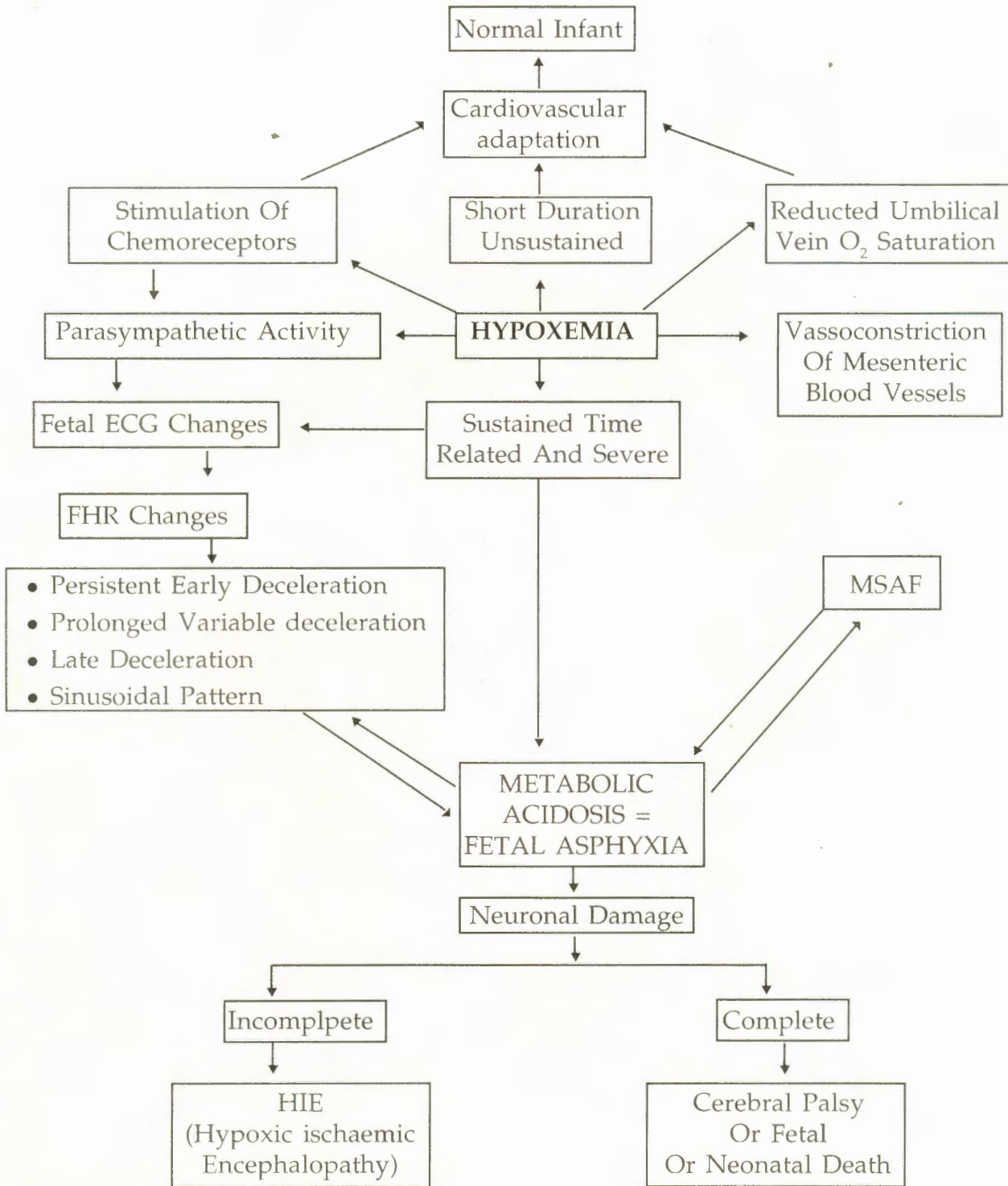


Fig 1 : Effect of Hypoxia

In the thick meconium group the correlation between Apgar scores and acidosis is poor which is in agreement with the studies of Steer et al<sup>1</sup> and Mitchell et al<sup>2</sup>. Fetal acidosis significantly increases the short term as well as long term consequences. Low et al<sup>3</sup> found a 14% incidence of major deficit in motor or cognitive development and 27% incidence minor deficit in neonates with metabolic acidosis when followed upto one year of age.

Yeomans et al<sup>4</sup> concluded that the presence of MSAF at term correlates poorly with the acid base status of the fetus. Steer et al<sup>1</sup> concluded that an abnormal cardiotocogram in the presence of meconium significantly increases the risk of fetal acidosis. Mitchell et al<sup>2</sup> found a significant correlation in 53% of infants with moderately thick meconium and arterial pH < 7.25. The study by Nathan et al<sup>3</sup> also found increased incidence of severe acidosis in meconium group when compared to clear liquor group. In the present study, 54% of infants with thick meconium had pH < 7.2 as compared to 27% with thin meconium and 31% with clear liquor. This is in agreement with the findings of Mitchell et al<sup>2</sup>.

The neonatal morbidity was high in thick MSAF. The same is reported by Yeomans et al<sup>4</sup> and Nathan et al<sup>3</sup>. The prognosis with thin MSAF was almost similar to that with clear liquor and this is in agreement with other studies<sup>1,2,3</sup>.

Thus, significantly higher number of neonates with thick MSAF have hypoxia as evidenced by the higher incidence of decelerations, low Apgar scores and fetal acidosis.

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