EFFECT OF LABOUR ON UMBILICAL CORD ARTERIAL BLOOD (pH) AND GAS VALUES IN TERM HEALTHY INFANTS WITH APGAR SCORE ≥ 7

NEETA SAGAR ● SWARAJ BATRA

SUMMARY

It is traditionally agreed that fetal blood pH above 7.25 is normal and pH of 7.2 or below is abnormal. In labouring patients fetal pH can fall below 7.2 normally in healthy newborns and this is not pathological. There was significant fall in fetal umbilical artery pH and bicarbonate concentration ($p < 0.001$) and significant increase in PCO2 level ($p < 0.05$) with increase in duration of second stage of labour in newborns born vaginally. Anaesthetic technique (spinal, epidural or general) did not affect the umbilical artery acid base status during elective cesarean section.

In labouring patients, cesarean section done under general anaesthesia had better cord blood O2 levels as compared to spinal anaesthesia. There was significant difference in umbilical artery pH and gas values in those born vaginally born by elective ceasaren and born by first stage cesarean. The mean umbilical artery pH of newborns born vaginally in present study was 7.17 ± 0.31. So in labouring patients delivered vaginally fetal pH upto 7.11 (mean ± 2 SD) can be found in healthy fetuses with Apgar score ≥ 7.

INTRODUCTION

Umbilical cord sampling is regarded as "gold standard" in the analysis of biochemical status of fetus. A cord blood gas measurement, obtained at the time of delivery can establish by the presence of a sig-

Dept. of Obs & Gyn Maulana Azad Medical College & Hosp, New Delhi

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nificant degree of metabolic acidosis that hypoxia has occurred. The absence of acidosis can exclude asphyxia in the presence of low apgar score and effectively shift the physician's attention to identification of other possible causes of newborn depression (Johnson et al 1990). These might include maternal drug ingestion, trauma, neonatal manifestaion, congenital anamolies, prenatal fetal insults, and infections.

Acidemia is defined as an umbilical artery pH values less than 7.20 because most studies have used this cut off. However, this traditional level is probably too high, recent studies (Goldaber et al 1991) suggest that this pH cut off should be lower, perhaps as low as less than 7.00 for defining pathological fetal acidemia.

During second stage of labour there is decline in the O_2 supply to the fetus reflected by drop in fetal pH. But the majority of such newborns are vigorous at birth and have no obvious neonatal sequelae, although they have acidemia based on the traditional umbilical arterial blood pH cut off less than 7.20. These new borns could be considered healthy.

It is reported that new born delivered before the onset of labour had significantly higher umbilical cord blood pH values than those born vaginally and those delivered by cesarean section after onset of labour. There is significant fall in umbilical artery pH and bicarbonate with the presence of labour and increased duration of second stage of labour in healthy term neonates. This should be taken into consideration in evaluating neonatal well being by cord blood pH and acid base measurements.

The present study was designed to find out : a) The effect of labour on the normal values of umbilical arterial blood acid base status at birth in healthy term infants and b) The effect of duration of second stage of labour on umbilical arterial acid base status at birth.

MATERIAL AND METHODS

This study included one hundred and twenty five term pregnant patients in the Department of Obstetrics and Gynaecoloy and associated nursery in M.A.M.C. and L.N. Hospital.

1) STUDY DESIGN : The study included

(i) 50 patients posted for elective cesarean section.
(ii) 25 patients of cesarean section done in first stage of labour.
(iii) 50 patients with vaginal deliveries.

2) Detailed history and clinical examination of all the patients was done.

Criteria for entry into this study :-

(i) Singleton term pregnancy.
(ii) Vertex presentaion if delivered vaginally without anaesthesia except for perineal infiltration with 1% lignocaine before episotomy incision.
(iii) No significant medical or obstetric complications such as diabetes mellitus, hypertension, chorioamnionitis, accidental pla cental haemorrhage, fetal growth retardation.
(iv) Spontaneous labour without augmentation with oxytocin.
(v) Normal fetal heart rate.
(vi) No meconium staining of amniotic fluid.

(vii) Apgar score at 1 & 5 minutes greater than or equal to 7, new borns below the apgar score 7 were excluded from the study.

(viii) No significant neonatal complications.

Determination of cord arterial blood acid base status immediately after birth was done in all cases included in this study and duration of second stage of labour was noted in cases delivered vaginally.

3) Cord blood gas analysis :- Immediately following delivery of infant, a segment of umbilical cord was doubly clamped. At least one ml of blood was drawn from umbilical artery into heparinised syringe which was then capped with plastic cover. Blood gas analysis was done within 20 minutes of collection by using automatic pH blood gas analyser (Eschhweiler 2000).

4) A Kruskal-Wallis ANOVA was used to compare cord blood acid base values among study groups.

RESULTS

One hundred and seventy five term pregnant patients met the inclusion criteria during the study period. The mean age was 23.7, 22.8 and 23.8 years in vaginal delivery, elective cesarean and first stage cesarean groups respectively and were comparable. It was found to be statistically insignificant.

Table I gives Indications of cesarean section. The mean duration of first stage of labour in primigravidas was 15.1 hrs and in multigravidas 10.7 hrs. The mean duration of second stage of labour in primigravidas was 50.5 min and in multigravidas 30 min. Independent of parity, mean duration of second stage of labour was 41.7 min (Table II). There was statistically significant difference ($p < 0.05$) in duration of first stage of labour and second stage of labour ($p<0.05$) in primigravidas and multigravidas.

Table III, shows that there was significant fall in cord arterial pH and bicarbonate concentrations and significant increase in PCO2 level with increase in duration of second stage of labour.

There was fall in umbilical cord pH, bicarbonate and PCO2 of patients in whom elective ceasarean section was done under spinal anaesthesia as compared to umbilical blood gas values of patients operated under general anaesthesia but the difference was not significant.

Table IV shows that there was a fall in umbilical arterial PO_2 level of patients in whom first stage cesarean section was done under spinal anaesthesia as compared to patients operated under general anaesthesia and the difference was statistically significant. There was no statistically significant difference in umbilical arterial pH, PCO2 and $pHCO_3$ level on patients operated under spinal anaesthesia or gneneral anaesthesia.

Table I
SHOWING INDICATIONS OF ELECTIVE CESAREAN SECTION AND CESAREAN SECTION IN FIRST STAGE OF LABOUR

S. No.	Indication of cesarean section	Elective cesarean section n = 50	First Stage cesarean section n = 25
1.	Malpresentation	22 (42%)	6 (24%)
	- Breech	12	2
	- Transverse lie	10	2
	- Brow	—	1
	- Face	—	1
2.	Previous two cesarean sections	12 (24%)	2 (8%)
3.	Previous one cesarean section with cephalopelvic disproportion	8 (16%)	2 (8%)
4.	Cephalopelvic disporpotion (CPD)	4 (8%)	4 (16%)
5.	Contracted Pelvis	2 (4%)	1 (4%)
6.	Bad obstetric history	2 (1%)	2 (8%)
7.	Nonprogress of labour	—	8 (32%)

Table V compares the umbilical cord blood pH and blood gas values of those born vaginally, by elective cesarean section and by first stage cesarean section. There was significant diifference in cord blood acid base values between the three study groups. Newborns born vaginally had significantly lower mean pH and bicarbonate concentration than those delivered by cesarean section ($p<0.0001$)).

Table II
SHOWING DISTRIBUTION OF CASES ACCORDING TO THE DURATION OF SECOND STAGE OF LABOUR IN PATIENTS DELIVERED VAGINALLY

S. No.	Duration of 2nd stage of Labour	Primigravida (n = 36)	Multigravida (n = 64)	Total (n = 100)
1.	1.30 min.	8 (22.2%)	28 (43.76%)	36 (36%)
2.	31.60 min	14 (38.8%)	26 (46.62%)	40 (40%)
3.	61.90 min.	14 (38.8%)	10 (15.52%)	24 (24%)
4.	Mean duration in minutes	50.5	30.0	41.72
5.	S.D.	23.237	21.691	

Duration of second stage of labour in primigravida Vs multigravida t = 4.34, P < .05 significant.

Table III
SHOWING UMBILICAL CORD ARTERIAL pH AND GAS VALUES BY DURATION OF SECOND STAGE OF LABOUR IN NEW BORNS BORN VAGINALLY IN THIS STUDY

	Duration of second stage of labour				
Umbilical cord arterial pH and blood gas values	1.30 min n = 36 Mean + S.D.	31.60 min n = 40 Mean + S. D.	61.90 min n = 24 Mean + S.D.	Mean + S.D.	P
pH	7.214+0.028	7.18+035	7.12+0.03	7.17+0.31	<.0001
PO_2 (mmHg)	19.58+4.161	18.75+4.12	19.87+4.03	19.31+3.99	NS
PCO_2 (mmHg)	50.6+2.76	54.77+4.45	56.45+3.02	53.67+3.49	<.05
$PHCO_3$ (mmHg)	23.9+2.28	20.9+3.35	17.66+2.69	21.20+2.80	<.0001

Statistical comparison between the patients delivered vaginally with increasing duration of second stage of labour by Kruskal-Wallis ANOVA.

Table IV

SHOWING UMBILICAL CORD ARTERIAL pH AND BLOOD GAS VALUES IN PATIENTS OF FIRST STAGE CESAREAN SECTION DONE UNDER GENERAL ANAESTHESIA OR SPINAL ANAESTHESIA

	First stage cesarean section (n = 25)			
Umbilical Arterial PH and blood gas values	Spinal Anaesthesia (n = 8) (Mean+S.D.)	General Anaesthesia (n = 17) (Mean+S.D.)	Mean+S.D.	P
pH	7.23+0.016	7.24+0.028	7.23+0.02	NS
PO2 (mmHg)	22.00+2.85	24.90+3.60	22.09+3.36	P<0.05 Significant
PCO2 (mmHg)	48.25+1.035	46.70+2.75	47.19+2.20	NS
PHCO3 (mmHg)	24.55+2.43	25.4+2.78	25.11+2.66	NS

Table V

SHOWING UMBILICAL CORD ARTERIAL pH AND GAS VALUES IN THREE STUDY GROUPS

Umbilical arterial pH and blood gas values	Elective cesarean section (n=50) Mean+S.D.	First stage cesarean section (n=25) Mean+S.D.	Vaginal delivery (n=100) Mean+S.D.	P
PH	7.25+0.24	7.23+0.024	7.17+.031	<.0001
PO_2 (mmHg)	27.1+3.12	22.09+3.36	19.31+3.99	<.0001
PCO_2 (mmHg)	45.38+3.09	47.19+2.20	53.67+3.49	<.0001
$PHCO_3$ (mmHg)	28.1+2.036	25.11+2.66	21.20+2.80	<.0001

Statistical comparison between the patients delivered by Elective Cesarean Section, first stage cesarean section and those born vaginally by Kruskal-Wallis ANOVA. This table shows that difference in umbilical arterial PH and blood gas values in three study groups were highly singificant (p<.0001).

DISCUSSION

The study was designed to examine the effect of labour on the normal values of umbilical cord arterial pH and acid base status at birth. Effects were directed toward selecting healthy new borns as study populations. All infants with low Apgar score (<7), meconuim staining of amniotic fluid, fetal growth retardation, abnormal fetal heart rate tracing, congenital malformation or neonatal complication or use of oxytocin in labour had been excluded.

There was significant fall in cord arterial pH and bicarbonate concentrations and increase in PCO_2 with increasing duration of second stage of labour in new borns born vaginally. During second stage of labour, uterine contractions occur more frequently and are prolonged. During those contractions, there is a marked reduction in pulse pressure (Basell et al, 1980) and hence decrease in pH.

Katz et al in 1987, found that median umbilical artery pH decreased significantly from 7.31 in patients with second stage of labour that lasted < 15 min to a pH of 7.25 in patients with second stage of labour that lasted more than 30 min. Similarly (Woon and Kim (1994)), found in their study that there was significant fall in umbilical arterial pH and bicarbonate concentrations with increased duration of second stage of labour in new borns born vaginally.

There was fall in umbilical cord pH, bicarbonate and PO_2 of patients in whom elective cesarean section was done under spinal anaesthesia as compared to values of patients operated under general anaesthesia but the differenfe was not significant ($p>0.05$). Similarly, Shyken et al (1990), Gregg (1991) and found no significant difference in umbilical arterial pH and blood gas values of patients in whom elective cesarean section was done under either epidural or general anaesthesia.

In our study, there was a fall in umbilical arterial PO2 level of patients in whom first stage ceasarean section was done under spinal anaesthesia as compared to patients operated under general anaesthesia and the difference was statistically significant ($p<0.05$). There was no statistically significant differnce in umbilical arterial pH, PCO2 and PHCO3 level of patients operated under spinal anaesthesia or general anaesthesia. So, in labouring patients with fetal distress general anaesthesia is better choice as compared to spinal anaesthesia. Similarly Shyken et al (1990) they also found significantly lower arterial PO2 values of those delivered under epidural anaesthesia and extended three potential explanations for better cord blood acid base status in new borns delivered under general anaesthesia :

(i) Decreased uterine perfusion from minor degree of maternal venous pooling caused by blockage of sympathetic vasomotor activity during spinal anaesthesia.

(ii) Maternal hyperoxygenation during general anaesthesia.

(iii) Increased induction to delivery interval during epidural anaesthesia.

There was significant differnece in umbilical arterial pH, PO_2, PCO2 and $PHCO_3$ level of patients delivered by elective cesarean, by first stage cesarean and vaginally. Mean umbilical arterial pH of new borns born by elective cesarean was higher (7.25 + 0.24) as compared to first stage cesarean (7.23 + 0.02) and those delivered

vaginally (7.17 + .031). Similarly Carsten and Weber (1987) and found mean arterial pH to be higher in cesarean section groups compared to those born vaginally.

Mean umbilical arterial pH of newborns born vaginally in present study was 7.71 + .031 on the basis of mean and two standard deviation values in our study; pH upto 7.11 can be present in vaginal delivery group in healthy infants with Apgar > 7. This fall in pH is due to mixed umbilical arterial acidemia, (both respiratory and metabolic component) as with decrease in pH, there was increase in PCO_2 and decrease in bicarbonate levels. So, in labouring patients delivered vaginally, pH value upto 7.11 can be found in healthy newborns when apgar score is >7.

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