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How Much of a Role Birth Asphyxia and Chronic Antenatal Hypoxia Disorders have in the Genesis of Cerebral Palsy?

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Material & Methods: For this large-scale prospective study, proper documentation of all events in the antenatal, natal and postnatal period, a detail, stringent protocol was prepared and distributed to 49 Govt. & Z.P. health institutes. The protocol was filled in for each antenatal mother by the doctor of antenatal clinic and who is attending the delivery. The same was collected back to us by above-mentioned institutes on a fixed date of every month, at the time of monthly review meeting.

Keywords: *cerebral palsy, birth asphyxia, chronic antenatal hypoxic disorders.*

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How Much of a Role Birth Asphyxia and Chronic Antenatal Hypoxia Disorders have in the Genesis of Cerebral Palsy?

Large Prospective Study of 31,804 Antenatal Mothers Followed up till Delivery and 30,080 Live Births Observed in Sindhudurg District

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Results: 246 children were identified as cerebral palsy in 30,080 live births at the end of 3rd serial examination. Only 33% (82/246) victims of Cerebral palsy had birth asphyxia the presumed cause of their cerebral palsy.

Of this 82 cerebral palsy children, 26% (64/246) were of quadriplegic cerebral palsy and 7% (18/246) non-quadriplegic which was attributable to the birth asphyxia. Congenital disorders explained about one third of quadriplegic cerebral palsy. Birth asphyxia was not a significant antecedent of non quadriplegic cerebral palsy.

Conclusion: 33% (82/246) victims of Cerebral palsy had birth asphyxia the presumed cause of their cerebral palsy. There was 20% (48/246) quiet a significant association of cerebral palsy with chronic antenatal hypoxic disorders.

The overall incidence of cerebral palsy for Sindhudurg Dist. amount to 8.1 per thousand live births over a period of 1998 to 2000.

Keywords: cerebral palsy, birth asphyxia, chronic antenatal hypoxic disorders.

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I. Introduction

William John Little in 1862, an Orthopaedic Surgeon presented a group of Children with tonal and developmental abnormalities, which he described as spastic rigidity.(1) Many of these children had a history of prolonged labour, preterm delivery. Because of frequency of these perinatal problems, Little postulated that the motor defects resulted directly from difficulties in the birth process. This opinion was widely held for over a century.

Yet there were early critics, chief among them Sigmund Freud, who speculated that, perinatal difficulties were the result of pre exisisting abnormalities in the foetus rather than the cause of cerebral palsy.(2)

This study was undertaken to identify and quantitate the major causes of cerebral palsy. The analysis were based on specific disorders that might damage a child's brain.(3) The most widely discussed of these disorders is birth asphyxia, with some people claiming that it is a frequent and others could be misleading because it is possible that such disorders are being missed or that insufficient cases have been analysed to find a correlation between them and cerebral palsy.(4) The first goal of the present study was to determine how much of a role birth asphyxia has in the genesis of cerebral palsy. A second goal was to quantitate the roles of chronic antenatal hypoxia disorders, congenital disorders, hypoglycemia, oxytocin, toxaemia of pregnancy, mal presentations and other prenatal factors as causes of cerebral palsy.(5)

II. Material & Methods

38 Primary health centers, 9 Rural hospitals and one Cottage hospital including District hospital are under the technical control of District Civil surgeon. For this large scale prospective study, proper documentation of all events in the antenatal, natal and post natal period, a detail, stringent protocol was prepared and distributed to 49 Govt. Rural, Sub District Hospitals & Primary Health Centers. The protocol was filled in for each antenatal mother by the doctors of ante

natal clinic and who is attending the delivery. The same was collected back to us by above mentioned institutes on a fixed date of every month, at the time of monthly review meeting at District head quarter with district Civil Surgeon. Thus from 1st Feb 1998 to 31st Jan 2000, a prospective study of 31,804 antenatal mothers were followed up till delivery and 30,080 live births were observed in Sindhudurg district. The total number of live births for the above mentioned period was 32366 as per the vital statistics department of District Health Officer, Sindhudurg, thus un accounting the total live births of 2286, which include deliveries in small dispensaries, other nursing homes of outside the districts and home deliveries. All the children born were seen and examined at every six months intervals to identify cerebral palsy by a systematic and uniform record keeping system. The last neurological examination in the study was conducted in February 2002. Data received from above mentioned institute enlisted for investigation, which became available for analysis in March 2002. Data for antenatal mothers and intranatal mothers compiled by the respective doctors in the stringent protocols updated, we are fairly confident that the protocol data accurately reflect the Cerebral palsy pattern in Sindhudurg district. 1065 children could not be analysed because the mothers delivered at different hospitals other than above mentioned institutes.

III. Results

Analysis were undertaken in a prospective study of 31,804 ante natal mothers who delivered from 1st Feb 1998 to 31st Jan 2000.. 246 children were identified as cerebral palsy in 30,080 live births at the end of 3rd serial examination.

Table 1 : Various etiological factors and their relative importance / incidence

Sr. No.	Factor	No	Incidence	Relative Risk
1	Prematurity	148/246	60.2%	54.4
2	Low birth weight	136/246	55.3%	52.2
3	Low Apgar score & abnormal foetal heart rate	86/246	34.9%	10.7
4	IUGR on USG	82/246	33%	15.1
5	History of spontaneous abortion & stillbirth	68/246	27.06%	5.7
6	Toxaemia of pregnancy	44/246	17.9%	8.1
7	Forceps application	42/246	17%	42.2
8	Muconium stained liquor	36/246	14.7%	1.2
9	Malpresentation	34/246	13.9%	8.6
10	Oxytocin drip during labour	26/246	10.7%	2.5
11	Unusually long or short interval between pregnancy	26/246	10.6 %	1.9
12	Caesarian section	16/246	6.5%	0.78
13	History of taking thyroid / oestrogen hormones	16/246	6.5%	43.5
14	Vaccum application	12/246	4.9%	29.6
15	Post maturity	12/246	4.9%	1.6
16	Bleeding during 1st , 2nd, 3rd, trimester of pregnancy	8/246	3.3%	1.3

The following positive antenatal, intranatal findings noticed are suggestive of quite a significant association of cerebral palsy with chronic antenatal hypoxia disorders.

60.2% (148/246) were born prematurely before 32 weeks of pregnancy. 55.3% (136/246) were low birth weight babies (below 2500 grams). Low Apgar scores & abnormal foetal heart rate during labour were present in 34.9% (86/246). Evidence of IUGR on USG was diagnosed in 33% (82/246). History of spontaneous abortion and still births were detected in 27.6% (68/246). Toxaemia of pregnancy was noted in 17.9% (44/246) ante natal mothers. Forceps were applied during deliveries in 17% (42/246). Muconium stained liquor during labour was seen in 14.7% (36/246). Mal presentations were seen in 13.9% (34/246). Oxytocin drip was started during labour in 10.6% (26/246). An unusually long or short interval between the pregnancy was seen in ante natal mothers cerebral palsy children 10.6% (26/246). Caesarean section was performed in

6.5% (16/246) in pregnant women. Ante natal mothers with history of taking thyroid hormones and oestrogen in 6.5% (16/246) were noted. Vacuum was applied during delivery in 4.9% (12/246) ante natal mothers. Post maturity was visualised in 4.9% (12/246). Bleeding during 1st 2nd & 3rd trimester of pregnancy was seen in 3.3%(8/246).

Thus 33% (82/246) victims of Cerebral palsy had birth asphyxia the presumed cause of their cerebral palsy. Of this 26% (64/246) were cases of quadriplegic cerebral palsy and 7% (18/246) non quadriplegic, which was attributable to the birth asphyxia. There was quiet a significant association of cerebral palsy with chronic antenatal hypoxic disorders.. Congenital disorders explained about one third of quadriplegic cerebral palsy. Birth asphyxia was not a significant antecedent of non quadriplegic cerebral palsy.

Finally the findings of the present study under score the importance of making accurate measurements and observations on neonates to avoid mistakes attributing non asphyxial cerebral palsy to birth asphyxia. The overall incidence of cerebral palsy for Sindhudurg Dist. amount to 8.1 per thousand live births over a period of 1998 to 2000.

IV. Discussion

Most studies that have attempted to determine if birth asphyxia is a cause of cerebral palsy, have used low Apgar scores and foetal distress to identify asphyxia. Low Apgar scores and foetal distress are often non hypoxic in origin, so their use as indicators of birth asphyxia could misattribute some non asphyxial cerebral palsy to asphyxia.[6] We explored this possibility by seeing how many victims of cerebral palsy who had low Apgar scores had a non asphyxial disorder as the basis for their cerebral palsy.

During the past two decades, dramatic changes in obstetrical and perinatal care have included the increasing availability of foetal heart monitoring and foetal ultrasonography, the establishment of neonatal intensive care units, and the implementation of policies to encourage the regionalization of care and the transport of mothers carrying high-risk foetuses before delivery. If the occurrence of cerebral palsy reflected sub optimal obstetrical care,[6] then its prevalence would be expected to decline in response to these remarkable improvements in care, but it has not done so.[8]

In an attempt to evaluate the relative contribution of all pregnancy-related factors, some epidemiologists have created analytic models that evaluate later events (for example, those occurring during the delivery)[9] in the light of earlier events (characteristics of the mother before pregnancy, first-trimester events, and so on).[10] , in the victims of cerebral palsy, characteristic consequences of birth asphyxia were more often the result of non-asphyxial disorders.[11] These included muconium in the amniotic fluid, low 10 minute Apgar scores.

Another perspective is gained by looking at the relative risks of various risk factors for cerebral palsy. Birth asphyxia had the highest relative risk for quadriplegic cerebral palsy. However, the low frequency of birth asphyxia in the population as a whole (82 of 30804) gave birth asphyxia a much smaller role as a cause of quadriplegic cerebral palsy.

Difference in distribution of factors related to cerebral palsy is highly significant. Since these factors are not mutually exclusive i.e. same case of cerebral palsy can have more than one factor hence chi square test won't make any sense really.

Factor / Disease	cerebral palsy +	cerebral palsy --	
LBW +	a 136	b X	a + b
Normal born wt	c 110	d Y	c + d
	a + c 246	b+d 29834	A+b+c+d 30080

$$\text{Relative risk} = \frac{\text{Incidence of disease in exposed group}}{\text{Incidence of disease in nonexposed group}} = \frac{\frac{a}{a+b}}{\frac{c}{c+d}}$$

a) Interpretation of Relative risk

If RR = 1, Then it means no risk

If RR = > 1, means more risk

In this study the highest relative risk is for Prematurity. The risk of cerebral palsy is 54.4 times more in premature babies than those born with normal birth weight i.e. premature babies are 54.4 times at an added risk of cerebral palsy than normal babies.

The second important risk factors in descending order are low birth weight (RR = 52.2), history of taking thyroid / oestrgen hormones (RR = 43.5) and Foreceps application (RR=42.2)

In this study of all 16 factors only for caesarian section value of Relative risk is < 1 i.e. 0.78 (it indicates protective effiect) i.e. Babies delivered by caesarian section have less risk of cerebral palsy than other babies.

Table 2

Sr. No.	O	E	$(O-F)^2/E$
1	136	49.5	151.1
2	148	49.5	196.0
3	26	49.5	11.1
4	68	49.5	6.9
5	34	49.5	4.8
6	12	49.5	28.4
7	86	49.5	26.9
8	36	49.5	3.6
9	16	49.5	22.6
10	8	49.5	34.7
11	44	49.5	0.6
12	82	49.5	21.3
13	42	49.5	1.1
14	12	49.5	28.4
15	16	49.5	22.6
16	26	49.5	11.1
			571.2

$$EX = 792 \times = \frac{E}{X} = 49.5 \quad X^2 = 571.2,\ df = 15\ p<0.001$$

b) Difference is highly significant statistically

A child whose mother has long intervals between menses appears to be at increased risk for cerebral palsy.[12] The risk is increased if there has been an unusually short interval (less than three months) or an unusually long interval (more than three years) since the previous pregnancy. [13] In addition, mothers of children with cerebral palsy are more likely than other mothers to have a history of spontaneous abortion and stillbirth. These findings indicate that maternal menstrual and obstetrical factors convey information about the risk of cerebral palsy.

Twins are more likely than singletons to have antenatal peri ventricular leukomalacia[14] and cerebral palsy. [15] Some of the increased risk of cerebral palsy among twins probably results from their gestational age and intrauterine growth retardation. In one study, an increase in the cesarean-section rate in the delivery of twins was not associated with a reduction in the prevalence of cerebral palsy. [16]

The greater concordance for cerebral palsy among monozygotic than dizygotic twins also suggests a genetic basis, but it is compatible with placental problems that are unique to monozygotic twins as well.

Mothers known to have been hyperthyroid or who were prescribed thyroid hormones or estrogen in pregnancy have been found to be at increased risk of giving birth to a child in whom cerebral palsy later develops.

Non-vertex and face presentations of the foetus are associated with an increased risk of cerebral palsy. [17] One interpretation of this fact is that an abnormal presentation does not cause cerebral palsy, but rather may be a marker of preexisting difficulties. According to this hypothesis, foetuses with hypotonia and other abnormalities that will later be manifested as cerebral palsy are less able than others to move into a vertex position.

The rate of cerebral palsy is 25 to 31 times higher among infants who weigh less than 1500 g at birth than among full- sized newborns. [18] Babies whose birth weight is less than 2500 g account for about one third of all babies who later have signs of cerebral palsy.[19]

As a generalization, the lower the birth weight and the gestational age, the higher the risk of cerebral palsy [20] and peri ventricular leukomalacia. Thus it should not be surprising that a number of low birth weight and early gestational age children are associated with peri ventricular leukomalacia, even among babies born prematurely. [21]

Nelson and Ellen berg wrote in 1986 "Of the . . . mother-infant pairs in the 5 percent with the highest risk (for cerebral palsy) only 208 percent produced a child with cerebral palsy, the false positive rate was thus 97 percent." Epidemiological studies published since then have not provided any reasons to change the impression that our ability to identify modifiable presumed causes of cerebral palsy is limited.

The burden imposed by cerebral palsy on society has not abated despite recent advances in medical care. Indeed, the increased survival of preterm newborns at risk for the disease has resulted in an increased number of children with cerebral palsy, mainly of the spastic diplegic variety. [22]

Table 3 : Incidence of cerebral palsy compared with the findings of published literatuve

Sr. No.	Author	Year	Country	Incidence
1	Fiona J. Stanley	1967 to 1985	Western Australia	2.5 to 5/1000 live births
2	Rosen MG	1992	USA	1 to 6 /1000 live births
3	Sofia franco		Kentucky USA	2.1 /1000 live births
4	Peggy S. Eicher	1993	Pennsylvania	2 /1000 live births
5	Mercer Rang	1993	Canada	5 /1000 live births
6	Kulkarni R.S.	1998 - 2000	Maharastra, India	8.1 /1000 live births

Thus, efforts to prevent cerebral palsy will require a focus on factors and events during pregnancy including those that predispose the mother and foetus to preterm delivery and low birth weight.

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