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Neural Tube Defect: Epidemiologic and Demographic Implication

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Abstract: *Congenital abnormalities can develop at any time after the first month of pregnancy. From conception to birth, the embryo, and the fetus have to adapt, at a molecular and transcriptional level, to various changes in their cellular mileau . At conception, this environment depends on the micronutritional status of maternal and paternal germ cells and after conception on maternal nutritional status, metabolism, and lifestyle. Neural tube defect (NTD) is one of the commonest malformations with worldwide prevalence of 1-3/1000 live births. They are caused by failure of neural tube to close during neurulation in 21-28 embryonic days. The most common types of NTD are anencephaly and spina bifida, which are caused by failure of closure of cranial pore and spinal part of neural tube, respectively. Unfortunately the number of studies on this aspect is too scanty in our state. Therefore the present research work has been undertaken in the Department of Anatomy, M.K.C.G. Medical College, Berhampur during the period 2011-2013 with the help of Department of Obstetrics and Gynaecology and Radiodiagnosis to study the Neural tube defect aiming to know the prevalence and demographic status , to reduce maternal and fetal morbidity and mortality by selected obstetrical management.*
Keyword: *Anencephaly , Congenital , Neural tube defect , Neurulation , Spina bifida .*

I. Introduction

Neural tube defects (NTDs) are major congenital defects with multifactorial etiology . Neural tube defects (NTDs) top the list of birth defects in India contributing to both morbidity and mortality. The annual worldwide incidence of the two commonest forms of NTDs i.e. spina bifida and anencephaly put together is about 400,000 newborns. [1] Folate deficiency has a well-established teratogenic effect, leading to an increasing risk of neural tube defects.

Observational and interventional studies have all been consistent with a 50–70% protective effect of adequate women consumption of folates on neural tube defects. [2] Since strategies to modify women's dietary habits and vitamin use have achieved little progress.

Unfortunately the number of studies on this aspect is too scanty in our state. Therefore the present research work has been undertaken to correlate and study the craniospinal anomalies aiming to know the prevalence and also counselling the couples to reduce maternal and fetal morbidity and mortality by selected obstetrical management.

II. Material & Method

The study was carried out at M.K.C.G. Medical College and Hospital, Berhampur in the department of Anatomy in collaboration with the department of Radiodiagnosis and Obstetrics and Gynecology for a period of 5 years from July, 2008 to August, 2013. The study was retrospective from July, 2008 to August, 2011 (3 years) and prospective from September,2011 to August, 2013 (2 years).For retrospective cases data was retrieved from the record section (Birth record, Stillborn record and Fetal death reports) of Obstetrics and Gynaecology department.

For prospective cases, after obtaining permission from the ethical committee of M.K.C.G. Medical College and Hospital, Berhampur and with an informed consent, women attending the antenatal clinic in this institute who were referred for routine ultrasonography and those women referred as high risk patients to emergency and PP centre were selected for the study. The cases were also taken from stillbirth, spontaneous and therapeutic abortions.

III. Observation & Analysis

Table-I

Number of NTD's during the year of occurrence from August, 2008 to July, 2013

Period	Anencephaly	Spina bifida	Encephalocele	Holoprosencephaly	Iniencephaly	Total
Aug.08 - July 09	8	19	4	3	2	36
Aug.09 - July, 10	16	22	5	4	3	50
Aug.10 - July,11	15	13	3	2	2	35
Aug.11 - July, 12	11	12	5	1	2	31
Aug.12 - July, 13	3	10	2	0	0	15
TOTAL	53	76	19	10	9	167

Table-II

Number and Percentage of Sub-Types of Anencephaly and Spina bifida

Sub-Types		Number	Percentage
Anencephaly (n=53)	Meroanencephaly	7	13.21
	Holoanencepahy	40	75.47
	Craniorachischisis	6	11.32
Spina bifida (n=76)	Occulta	11	14.47
	Meningocele	13	17.11
	Meningomylocele	52	68.42

Table-III

Spina bifida as per location

Region	Occulta (n=11)	Cystica	
		Meningocele(n=13)	Meningomylocele(n=52)
Cervical	2 (18.18)	2 (15.38)	5 (9.62)
Thoracic	5 (45.45)	2 (15.38)	6 (11.54)
Lumbar	4 (36.36)	8 (61.54)	35 (67.31)
Sacral	0 (0.00)	1 (7.69)	6 (11.54)

DEMOGRAPHIC PARAMETERS OF NEURAL TUBE DEFECTS –

Table-IV

NTD following Consanguineous Marriage

History of Consanguineous marriage	Anencephaly (n=53)	Spina bifida (n=76)	Total
Yes	5 (9.43)	10 (13.16)	15 (11.63)
No	48 (90.57)	66 (86.84)	114 (88.37)

Table-V

Incidence of different craniospinal anomalies in different social classes

Socio-Economic Status	Anencephaly (n = 53)	Spina bifida (n = 76)	Encephalocele (n = 19)	Holoprosencephaly (n = 10)	Hydrocephalus (n = 87)
Low (n=196)	42 (79.25)	63 (82.89)	13 (68.42)	9 (90)	72 (82.26)
Medium (n=46)	11 (20.75)	13 (17.11)	6 (31.58)	1 (10)	15 (17.24)
High (n=0)	0 (20.75)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)

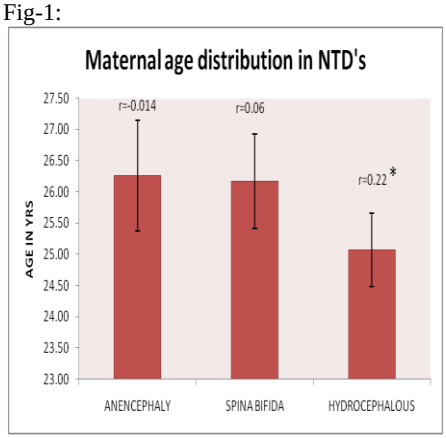
n = donates the number of total cases in specified category

Table – VI

Demographic Status of the neural tube defect cases

Groups (No.)	Maternal age in Years				
	<20	20-24	25-29	30-34	≥ 35
Anencephaly (n=53)	10 (18.87)	13 (24.53)	8 (15.09)	19 (35.85)	3 (5.66)
Spina bifida (n=76)	14 (18.42)	25 (32.89)	7 (9.21)	19 (25.00)	11 (14.47)
Encephalocele (n=19)	5 (26.32)	4 (21.05)	1 (5.26)	6 (31.58)	3 (15.79)
Holoprosencephaly (n=10)	1 (10.00)	4 (40.00)	1 (10.00)	3 (30.00)	1 (10.00)
Iniencephaly (n=10)	0 (0.00)	4 (40.00)	0 (0.00)	3 (30.00)	3 (30.00)
Hydrocephalus (n=87)	12 (13.79)	33 (37.93)	18 (20.69)	19 (21.84)	5 (5.75)
Total	38 (15.70)	78 (32.23)	40 (16.53)	58 (23.97)	28 (11.57)

Fig-1:



r =denotes correlation coefficient values.
* denotes p <0.05 is significant

Fig-2:

Anencephalic case with angiomatous stroma

Fig-3:

Closed Neural tube defect

Fig-4:

Open Neural tube defect

Fig-5:

Iniencephaly

IV. Discussion

On analysis of data, for year wise incidence of neural tube defects, a decreasing trend was observed from 2009-2013. According to our study, the overall prevalence of NTD's is 9.12 per 1000 deliveries. The incidence of NTD's reported in India i.e. 6.57 – 8.21/1000 live births is higher than that in our study, that is 4.47/1000 live births. **(Table-I)**

Decreasing order of NTD's rates was for spina bifida (45.5%), anencephaly (31.7%), encephalocele (16.2%), holoproscecephaly (5.9%) and iniencephaly**(Fig-5)** (5.4%). which is compatible with study in Urmia (**I.Abdi,** 2008), as well as in California (**Feuchtbaum LB**,1999) **[1],[2]**

As regards the subtypes of Anencephaly, Holoanencephaly were maximum followed by Meroanencephaly and Craniorachischisis and among spina bifida cases, meningomyelocele outnumbered those of meningocele and spina bifida occult as recorded from **Table-II. (Fig-2,3,4)**

The lumbar region is more prone for spina bifida**(Table-III)** and this finding corroborates with a study done by **Isada Nelson B**. (1993), but contradicts the study done by **Jean – Pierre Bernard** (2012). **[3],[4]**

As regards the consanguineous marriage, 11.63% of the affected group had a positive history. **(Table IV)** Similar finding were quoted in the study of **N.N. Dissanayake** (2009).**[5]**, **B.Mahadevan** (2005) - 10.3/1000 couples and **Agarwal SS** (1999), 16.3-20.6/1000 couples.**[6],[7]**

While correlating the socio-economic status **(Table V)** with Neural tube defect our observation shows population with low socio-economic status mainly having babies with neural tube defects. Similar observations by **N.N. Dissanayak** (2009)[5],**Shaw G M.et.al** (2002),**S. Halwachs** (2010),**D.A.Hansen**(2008),**R.Schultz.et.al** (2003) corroborate with our study**.** **[5],[8],[9],[10],[11]**

While correlating the maternal age with the occurrence of neural tube defects our observations show maximum number of cases in the age group of 20-24 years while anencephlic cases are mostly in women more than 30 years of age and spina bifida in mothers between age group of 20-24 years followed by the age group of more than 30 years which is in consonance with the study of **I. Abdi** (2008) and **Sharada B. Menasinkai** (2010) and **Golalipour et al** (2010) . **[1],[12],[13]**

The analysis by **Vieira AR, Castillo Taucher S,** 2005 revealed that there is an increased risk of having an offspring with NTD's for mothers of 40 years of age or older. There is also evidence that mothers of 19 years old or younger have a higher risk of having a child with spina bifida**.** [14]

In our study the mean maternal age for neural tube defects is 26 years and is significantly higher for ($P<0.05$) hydrocephalus **(Table VI, Graph 1). Orv Hetil.Joó JG** states maternal median age was 27 ± 5.8 years, ranging from 15 to 47 years. [15]

V. Conclusion

Neural tube defects are an enigmatic problem that occurs as a result of the interplay between a number of genetic and environmental factors. Our study reveals the high incidence and their possible etiological factors such as consanguineous marriage, low socioeconomic status and maternal age.

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