

Maternal Environmental Factors Associated with Congenital Hydrocephalus

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ABSTRACT

Background: Congenital hydrocephalus is characterized by dysregulated cerebrospinal fluid circulation and is associated with serious morbidity. The objective of this study was to identify the various maternal factors related to the occurrence of congenital hydrocephalus.

Patients and methods: This was a retrospective study conducted at the University of Health Sciences, Lahore (UHS) and Children's Hospital and Institute of Child Health. A total of 96 patients of congenital hydrocephalus along with their mothers were enrolled in this study. Data was collected by using proforma for history taking from mothers regarding antenatal period and family history details. Collected data was entered, processed, and analyzed in SPSS version 21.0.

Results: The mean maternal age of the participants was 27.88 ± 5.36 years. The results of maternal parity showed a mean of 2.85 ± 1.86 children. A history of self-medications including analgesics, over-the-counter antibiotics and herbal medicines used in the first trimester was found in 53 (55.2%) mothers. Eighty (83.3%) mothers did not take folic acid supplementation during pregnancy compared to only 16 (16.7%) mothers who regularly took folic acid. No mother was reported to be a smoker or alcoholic. A family history of congenital HCP was reported by 10 (10.4%) mothers. Consanguinity history showed that 40 (40.7%) patients had consanguineous marriages while 56 (58.3%) had non-consanguineous marriage histories.

Conclusion: The common maternal factor associated with the occurrence of congenital hydrocephalus was the lack of regular folic acid supplementation during antenatal care.

Keywords:

Congenital, Hydrocephalus, Maternal factors

INTRODUCTION

Hydrocephalus (HC) is a collection of heterogeneous, complex and multi-factorial disorders characterized by abnormalities in the flow or resorption of cerebrospinal fluid (CSF) resulting in ventriculomegaly (VM).¹ The prevalence is variable across different regions of the globe. The prevalence of congenital hydrocephalus is not exactly known in the local population but it is thought to be 1-1.5% prevalent.² Congenital hydrocephalus accounts for approximately 50% of all forms of hydrocephalus and may occur due to the development of neural tube defects.³⁻⁵ A variety of different environmental factors are also involved in the pathophysiology of hydrocephalus.⁶ These include maternal diabetes, pregnancy-induced hypertension, consanguinity, elicit or over-the-counter drug use, multiparous gestation, alcohol and smoking history.^{7,8} Regular folic acid consumption during the antenatal

period reduces the risk of neural tube and other congenital defects including cleft lip, limb defects, anomalies of CVS and urinary tract and folic acid supplementation is recommended in the antenatal period to reduce the risk of these congenital anomalies.⁹ In addition, a family history of HC is also important due to genetic predisposition.^{6,9} The objective of this study was to systematically assess and identify the various maternal factors related to the occurrence of HC. Appropriate assessment of these factors during the antenatal period and pre-natal screening may help in early detection of HC and may help prevent the detrimental effects of HC on disease-related morbidity and mortality.

PATIENTS AND METHODS

This was a retrospective study from October 2017 to 2018 conducted at University of Health Sciences, Lahore (UHS) and Children's Hospital and Institute of Child Health (CH&ICH), after approval by the Ethical Review Committee. Total of 96 patients of congenital hydrocephalus, and their mothers, referred from all over the Punjab to Neurosurgery Department (ward) of

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Children's Hospital and Institute of Child Health (CH&ICH), Lahore, were enrolled. Patients diagnosed to have acquired hydrocephalus or with any brain tumor were excluded. The sample size was calculated by keeping 95% confidence interval, the margin of error 6% and a prevalence 10% was used from the previous literature.¹⁰ Complete demographic and clinical profile were obtained from each patient on a pre-designed proforma. This included all the basic biodata, family history of congenital hydrocephalus and other congenital anomalies, consanguinity history and detailed maternal history, regarding the antenatal period which included the history of parity, TORCH infections, self-medication, folic acid intake, gestational diabetes, pregnancy-induced hypertension, history of previous miscarriages or termination of pregnancy, history of immunization against tetanus, essential hypertension and history of anomaly scan. Collected data was analyzed by using the SPSS software, version 21. Mean \pm SD was calculated for numeric variables such as age of the patient's mothers, and maternal parity. Frequency and percentages were calculated for categorical variables.

RESULTS

A total of 96 patients with congenital hydrocephalus along with their mothers were included in the study, of which 58 (60.4%) were male. The clinical picture of 1 of the HC patients is shown in Figure 1. Mean maternal age was 27.88 ± 5.36 years (range of 18-45 years) and 83 (86.5 %) mothers were below 35 years of age. The mean age of children was 7.83 ± 6.79 months (range 1-30 months). 85 (88.54 %) patients were born at normal gestational age, 10 (10.42%) were preterm and 1 (1.04%) were post-term births (Table 1). 29 (30.2 %) of hydrocephalus children were first born, with birth order ranging from 1st to 8th child (Figure 2).

Family history of congenital HCP was present in 10 (10.4%) families and a history of other congenital anomalies in the family was present in 19 (19.8%) patients which included congenital heart disease, club foot, muscular dystrophies, and congenital deafness. Consanguinity history showed that 40 (41.7%) children were the product of consanguineous marriages while 56 (58.3%) were the product of non-consanguineous marriages

The results of maternal parity showed a mean of $2.85 (\pm 1.86)$ with a range from 1 to 8 children. Among the maternal parity history, 30 (31.3%) mothers were para-1 mothers, 22 (22.9%) were para-2 and the rest varied from para-3 to para-8.



Figure 1: Clinical Picture of a patient with congenital hydrocephalus

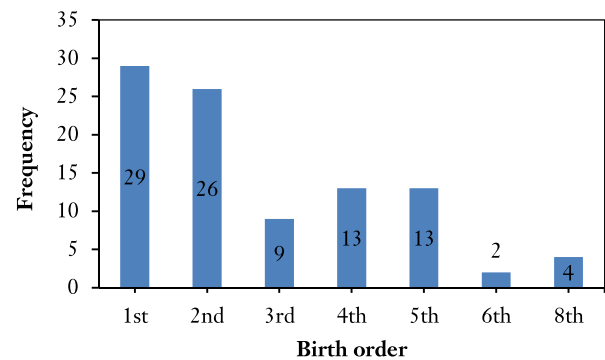


Figure 2: Bar Chart showing frequencies of birth orders

The history of previous miscarriage and termination of pregnancy was reported in 22 (22.9%) and 7 (7.3%) mothers. TORCH infection was not detected in any mother of the affected children. History of self-medications including analgesics (Paracetamol and other NSAIDs), over the counter antibiotics and herbal medicines used in the first trimester was found in 55.2% of mothers. A total of 83.3% of mothers did not take folic acid supplementation during pregnancy compared to only 16.7 % of mothers who regularly took folic acid. Gestational diabetes and pregnancy-induced hypertension were reported in 3.1% and 18.8% of mothers respectively. A total of 90.6% of mothers were immunized against tetanus while no mother was reported to be a smoker or alcoholic. None of the mothers had a history of anomaly scans during the antenatal period (Table 2).

Table 1: Patients and mothers demographic characteristics

Characteristics	Frequency (%)
Maternal age [mean ± SD (years)]	27.88 ± 5.36 (range = 18-45 years)
Age of hydrocephalic children [mean ± SD (months)]	7.83 ± 6.79 (range = 1-30 months)
Gender of hydrocephalic children	
Male	58 (60.4)
Female	38 (39.6)
Gestational age at birth	
Preterm (<37 weeks)	10 (10.42)
Term (37-40 weeks)	85 (88.5)
Post-term (>40 weeks)	1 (1)

DISCUSSION

The mean maternal age was 27.88 years and the majority of mothers (86.5%) were below 35 years of age. Among the maternal parity history, 30 (31.3%) mothers were para-1 22 (22.9%) were para-2 and the rest 44 (45.8 %) varied from para-3 to para-8 (multiparous). These findings are contradictory to the findings of another study done in Pakistan by Gul et al., according to them incidence of congenital malformations was highest (67%) in multiparous mothers.¹¹ The maternal profile identified various extrinsic factors, among which self-medication with NSAIDs for regional musculoskeletal pain was among the mothers of the affected children but not significant, alongside with most frequent factor was lack of regular folic acid intake was reported by 83.3% of mothers. Various studies have reported a lack of folic acid intake as a vital link to the predisposition of developmental defects.¹² It has been reported that folic acid supplementation can prevent several congenital malformations including CNS abnormalities.¹³ Similarly, one recent study from Egypt and another from China reported that less or poor peri-conceptual folic acid intake by pregnant mothers had significantly increased the occurrence of HC in their children.^{14,15} Furthermore, 53 (55.2 %) patient's mothers reported self-intake of various over the counter medications, including anti-depressants and antibiotics as well. Undocumented and unprescribed use of some antibiotics and anti-depressants may pre-dispose the fetus for untoward effects that may render the fetus to develop an anomaly.¹⁵ History of previous miscarriage and termination of pregnancy was reported in 22.9% and 7.3% of mothers, respectively. Other risk factors including gestational diabetes, pregnancy-induced HTN, previous history of termination of pregnancy and maternal HTN were also identified in some patients. This is in concordance with the previous studies done by other researchers.^{15,16} Moreover, none of the patients in the study, had undergone anomaly

Table 2: Profile of mothers having hydrocephalic children

Maternal History Variables	Frequency (%)
Maternal TORCH profile*	0 (0)
Maternal self-medication	53 (55.2)
Folic acid intake	16 (16.7)
Gestational diabetes	3 (3.1)
Pregnancy induced HTN	18 (18.8)
Previous history of abortion/ miscarriage	21 (22.9)
Previous history of termination of pregnancy	7 (7.3)
Maternal immunization against tetanus	87 (90.6)
Maternal hypertension	1 (1)
History of the anomaly scan	0 (0)

Abbreviations: TORCH = Toxoplasmosis, Other pathogen (Syphilis), Rubella, Cytomegalovirus and Herpes simplex virus; HTN = hypertension

ultrasound scan at regular intervals during the antenatal period. Screening with ultrasonography at a timely interval is the easiest and cheapest tool available to identify susceptible cases beforehand.¹⁷ Ultrasound can not only accurately detect fetal structural irregularities but is also helpful for intraventricular decompression, performed during the fetal period if no genetic abnormality is detected.¹⁸ Comparatively fewer patients in this study were the product of consanguineous marriages. This result is contradictory to the work of Gul and colleagues, which showed congenital HCP was one of the congenital anomalies that was significantly associated with consanguinity. This is also contradictory to the fact that high numbers of genetic disorders are reported from Pakistan due to the high rate of consanguinity in our population.¹¹ Studies reported mutation as an important factor in familial HC. This is a very important point to address as the treating obstetrician needs to be vigilant on the prenatal diagnosis of HC and other anomalies, especially where a family history of HC and anomaly is evident.^{11,19}

This study represents a systemic collation of facts, which form part of the causal relationship with hydrocephalus. Timely evaluation of the risk factors for HC and other associated anomalies is a crucial step during antenatal follow-ups, as early delivery and neonatal ventricular shunting are available options to prevent detrimental outcomes.

CONCLUSION

The common maternal factor associated with the occurrence of HC was a lack of regular folic acid supplementation during antenatal care. Also, the regular implementation of timely antenatal anomaly ultrasound scans at all basic healthcare facilities can play an important role in the early detection of the disease in almost all patients.

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