PATTERN OF CONGENITAL CENTRAL NERVOUS SYSTEM ANOMALIES AMONG NEWBORNS AT A REGIONAL SPECIAL CARE BABY UNIT (SCBU) IN MAKURDI, NORTH CENTRAL NIGERIA

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Abstract

Background: Congenital anomalies of the central nervous system (CNS) are important causes of childhood mortality, chronic illness and disability. They have significant implications for childhood growth and development particularly in resource limited settings. A review of their occurrence is valuable to instituting preventive and curative health care services.

Objective: To document the pattern of congenital CNS anomalies in our practice

Subjects and Method: A retrospective study of all neonatal admissions with congenital anomalies of the CNS (Patients) admitted into the Special Care Baby Unit (SCBU) of Benue State University Teaching Hospital (BSUTH) in Makurdi-Nigeria, between June 2013 and January 2016. The anomalies were classified according to the ICD 10 Classification. Other parameters assessed were: age at admission, gestational age at delivery, family history of congenital anomalies, maternal age, social class, history of ante natal care, and admission outcome.

Results: A total of 73 (9.3%) out of the admitted 785 neonates had congenital anomalies and majority (28, 38.4%) were of the CNS. The affected patients had a male preponderance (20, 71.4%). Myelomeningocele was the commonest CNS anomaly (20, 71.4 %). Poor antenatal care, lack of periconceptional folic acid (pFA) intake, late folic acid supplementation, low socio economic class, and late presentation were all associated with the incidence of congenital CNS anomalies. The patients had a neonatal mortality rate of 7.1% over the study period of 30 months (2.8% per year).

Conclusion: Congenital CNS anomalies were the predominant congenital anomalies, and myelomeningocele was the commonest. The study underscores the need to institute a comprehensive healthcare programme for the prevention and management of congenital anomalies of the CNS in our practice.

Key Words: Congenital anomalies, Central Nervous System, Newborn, Nigeria, Myelomeningocele

Introduction

Congenital anomalies are important causes of childhood death, chronic illness and disability.[1] These are structural and functional anomalies that occur during intra uterine life and can be identified pre natally, at birth, or later in life.[1] It has been estimated that over a quarter of a million deaths occur annually from congenital anomalies and 94% of severe congenital anomalies occur in low and middle income countries (LMICs)[1]. Congenital Central Nervous System (CNS) anomalies constitute a significant proportion of these anomalies and affect 1 to 10:1,000 live newborns[2-7]. In Nigeria, an incidence rate of 7/1000 live newborns have been reported[8].

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These anomalies include those of neural tube formation (Neural Tube Defects), regionalisation (holoprosencephaly), cortical development (microcephaly), posterior fossa structures (aplasia or hypoplasia of the cerebellar hemispheres, Dandy-Walker malformation), and combined (agenesis of the corpus callosum)[9]. Several studies indicate that Neural Tube Defects (NTDs) constitute a majority of these anomalies[2-9]. Recognised risk factors for the development of these congenital anomalies include: maternal diabetes, obesity, maternal hyperthermia, exposure to teratogens, and low socioeconomic status[1,2]. Several of these factors are prevalent in LMICs[1,2].

Children with congenital CNS anomalies are children with special health care needs. These children are prone to higher mortality, chronic disability, impaired health-related quality of life, and lifelong dependence on economic and psychosocially burdened caregiver(s)[10]. The challenges brought about by these outcomes are even more pronounced and profound in resource limited settings such as the LMICs[10].

In the developed countries, the incidence of some of these anomalies such as the NTDs has fallen over recent decades[1,2]. Institution of preventive strategies such as

the intake of periconceptional folic acid (pFA) has decreased the prevalence of NTDs by 50-70%[2,11]. The prevention and management of CNS congenital anomalies in several LMICs is quite underdeveloped[12].

There is limited information on the epidemiological and clinical characteristics of these anomalies in our environment. This could adversely affect the incidence, quality of care, and outcomes associated with these anomalies. The aim of this study was to further document the characteristics of congenital CNS anomalies in our environment with a view to instituting effective preventive strategies against the incidence and consequences of these anomalies.

Subjects and Methods

This is a retrospective study of the records of all neonatal admissions with a diagnosis of congenital anomalies of the CNS, in the Special Care Baby Unit (SCBU) of the Benue State University Teaching Hospital (BSUTH) in Nigeria, between January 2013 and January 2016. The hospital is a tertiary health facility that provides newborn health services to Benue state and the other five states that make up North Central Nigeria. The state has a population of 4.2 million persons and majority of the inhabitants are farmers.[13]

The SCBU of BSUTH has facilities for newborn resuscitation, incubator care, exchange blood transfusion, phototherapy and other essential newborn care services. It has a16 bed capacity for both in-borns and out-borns. The staff of the SCBU include: 2 supervisory consultant paediatricians, 3 paediatric residents in training, 2 house officers, and 12 nurses. International Classification of Diseases and Related Health Problems 10th Revision (ICD 10) Classification was used in classification of the disorders.[14] Social class classification (Classes I to V) was done according to that by Ogunlesi et al.[15] The social classes were further stratified into the upper (Classes I to III) and lower (Classes IV and V) classes based on similarity in social characteristics. A structured questionnaire was used in extracting information from the case notes. Parameters assessed included: Age at admission, gestational age at delivery, type of congenital anomaly, family history of congenital anomalies, maternal age, social class, history of ante natal care (ANC), and outcome of admission.

Ethical approval was obtained from the Human Research Ethics Committee of BSUTH.

Data was analyzed using Epi Info 3.5.3 and reported as proportions using frequencies and percentages. Chi-square test was used in determining the degree of significance in relationship between the obtained proportions and Yates correction where applicable. A p-value of less than 0.05 was regarded as significant.

Results

A total of 785 neonates were admitted into the SCBU over the study period and 73 (9.3%) of them had congenital anomalies. Out of those with congenital anomalies, 28(38.4%) of them had congenital CNS anomalies and their case notes were all reviewed. Congenital CNS anomalies, representing 3.6% of the total hospital neonatal admissions, were the commonest congenital anomalies among the neonates (Table I).

There were multiple congenital anomalies in nine (12.3%) out of the 73 neonates with congenital anomalies: Four patients had multi-system congenital anomalies involving the CNS and the Musculo-skeletal system; Two patients had congenital anomalies involving both the Digestive and Urogenital systems while the remaining three had multiple congenital CNS anomalies.

Myelomeningocele was the commonest (20, 71.4%) congenital CNS anomaly (Table II). Out of the patients with myelomeningocele, three (15%) and four (20%) had congenital hydrocephalus and talipes equinovarus respectively.

There was a male preponderance (20, 71.4%; Male: Female ratio 2.5:1) among the 28 patients. The age range at presentation, in days, was 1 to 21 days (Mean: 4.7±5.0 days; Median: 2.5 days). Majority (19, 67.9%) of the patients presented after 24 hrs of delivery and two (7.1%) of them were inborn. Three (10.7%) of the patients had a positive family history of congenital anomalies (two cases of umbilical hernia and one case of polydactyl). Only two (7.1%), who had their antennal care in BSUTH, had a prenatal diagnosis.

The age range of the mothers was 19 to 36 years (Mean 26.9 ±5.3 years), and most (22, 78.6%) were of the lower socio economic classes (Table III). The commonest place for ANC visits by the subjects' mothers was a Primary Health Care centre (8, 28.6%), and 13 (46.4%) of them did not receive ANC services (Table III). None of the mothers received pre conception folic acid supplementation, while 15 (53.6%) of the mothers who eventually had folic acid started after 3 months of gestation.

Half (14, 50%) the number of patients was discharged home to continue therapy from there while seven (25%) were discharged home against medical advice (Table IV). The mortality rate among the patients was 7.1% over the study period (2.8% per year). The mortality rate among the patients was significantly (p=0.009) lower than in the neonates with congenital anomalies of the other body systems (Table V). The rates per body system for discharges, discharge against medical advice and referrals out were higher, though not significantly, in the patients than in the other body systems' congenital anomalies (Table V).

Table I. Distribution of congenital anomalies by body system in the admitted 785 neonates

Body system	Number of neonates with congenital anomalies (n=73)	Percent of total
Central Nervous System	28	38.4
Digestive System	25	34.3
Musculo Skeletal System	18	24.7
Urogenital System	9	12.3
Cardiovascular System	4	5.5

Table II. Types of congenital CNS anomalies

Congenital anomalies	Number of Neonates (N=28)	Percent of total (95% Confidence Interval)
Myelomeningocele	20	71.4 (0.539-0.890)
Congenital hydrocephalus	6	21.4 (0.055-0.374)
Spina Bifida **Occulta**	2	7.1 (0.000-0.171)
Meningocele	2	7.1 (0.000-0.171)
Encephalocele	2	7.1 (0.000-0.171)
Microcephaly	1	3.6 (0.000-0.108)

Table III. Socio demographic characteristics of the 28 patients' mothers and their place of Ante Natal Care

Variable	Patients' mothers (n=28)	Percent of total
Age group (years)		
≤19	3	10.7
20-29	17	60.7
30-39	8	28.6
Social class		
Upper (I-III)	2	7.1
Lower (IV-V)	26	92.9
Place of ANC		
Primary Health Care Centre	8	28.6
Maternity Home/Clinic	3	10.7
General/Teaching Hospital	4	14.3
None	13	46.4

Table IV: Distribution of management outcome among the 28 patients

Management outcome	Number of neonates	Percent of total
Discharged home	14	50
DAMA	7	25
Referred out	5	17.9
Died	2	7.1
Total	28	100

DAMA= Discharged Against Medical Advice

Table V: Admission outcome variables in the 28 patients and others with congenital anomalies

Admission outcome	Patients	Others	P Value
	N=28(**100%**)	N=45(**100%**)	
Discharged home			
Yes	14(50)	16(35.6)	0.223
No	14(50)	29(64.4)	
DAMA			
Yes	7(25)	6(13.3)	0.205
No	21(75)	39(86.7)	
Referred out			
Yes	5(17.9)	6(13.3)	0.850*
No	23(82.1)	39(86.7)	
Died			
Yes	2(7.1)	17(37.8)	0.009*
No	26(92.9)	28(62.2)	

DAMA= Discharged Against Medical Advice, * With Yates correction

Discussion

Congenital anomalies of the CNS were the commonest congenital anomalies (38.4%) among neonates in this study with myelomeningocele ranking highest. A majority of the affected patients presented late. Furthermore, most mothers of the affected patients had no pre conception folic acid, had poor ante natal care, and were from the lower socio economic classes. The CNS anomalies had the lowest mortality rate when compared to other congenital anomalies.

The prominence of congenital CNS anomalies among other neonatal congenital anomalies has been reported from other studies conducted in Nigeria. Studies by Singh et al[16] from north-west Nigeria (44%), Obu et al (64.7%)[17] and Eke et al (68.1%)[18] from the eastern region of Nigeria all reported a predominance of congenital CNS anomalies among congenital anomalies in newborns. Reports from other parts of Africa[19], and the world [2, 20] also report a significant prevalence of CNS anomalies among neonates with congenital anomalies. The prevalence of CNS anomalies in these studies could be have been influenced by the fact that the relevant tertiary health services are rendered in the centres were the studies were conducted. Furthermore, the mothers in these studies also share similar socio demographic characteristics such as poor ante natal history and poor pFA supplementation. However, reports by Ambe et al [21] indicated a higher prevalence of anomalies of the digestive system over that of the CNS. The difference could be explained by the differences in the presence and expression of potential environmental, nutritional and genetic factors in the different populations studied. It is pertinent to note that in the study by Ambe et al, the prevalence of the CNS anomalies was second in ranking.

Myelomeningocele was the commonest congenital CNS anomaly identified in this study. This outcome is similar to that from studies within Nigeria,[16-18,22] and Africa[19] in general. The quite visible nature of myelomeningocele could facilitate its presentation for treatment. Furthermore, other conditions such as anencephaly and encephaloceles are associated with a higher fetal mortality rate.[23]. The specific role of identifiable risk factors in the mothers (lack of pre conception folic acid intake[11] and low socio economic status[24]) in the high prevalence of myelomeningocele over other congenital CNS anomalies was not ascertained in this study**.** Myelomeningocele has also been reportedly associated, at variable incidence rates, with hydrocephalus and talipes equinovarus.[25]In this study, 14.3% and 9.5% of the patients had the co morbidities of hydrocephalus and talipes equinovarus respectively. This is comparable to findings reported by Warf.[25] The causal relationship between these congenital anomalies is still a subject of continuous scientific research and beyond the scope of this study. However, these findings underscore the need to actively examine for other anomalies when one CNS anomaly is identified.

There was a poor history of ANC attendance among the mothers in this study. Poor attendance at ANC centres were associated with occurrence of congenital CNS anomalies in reports from Ambe et al[21] and Costa et al[26]. Inability to access ANC has been linked to being in the low socio economic class, limited knowledge of its benefits, lack of financial capacity to access the service, and utilisation of traditional medication during pregnancy.[27]The fact that majority of the mothers in this study were of the low socio economic class could have contributed to the low ANC visits. The receipt of ANC

by mothers promotes good health outcomes, for both the mother and unborn child.[28] The ANC practices such as the routine obstetric nutritional supplementation, health education, the early detection and prompt treatment of diseases, can reduce exposure to risk factors and consequently reduce the incidence of these congenital anomalies in pregnancy.[28]

The average period of ANC commencement, in those who had ANC, in this study was three months. At this stage any obstetric micro nutrient supplementation would be ineffective against the development of the main congenital CNS anomalies[11]. Late commencement of ANC has also been associated with the incidence of congenital CNS anomalies.[17] Additionally, none of the mothers in this study had pre conception folic acid supplementation. Preconception and periconceptional folic acid intake is reportedly poor in several LMICs[29]. Lawal and Adeleye reported poor intake of folic acid at preconception and early pregnancy among Nigerian mothers in south west Nigeria.[29] The poor intake was significant among working class mothers, those with limited education, and late attendees at ANC centres.[29] Poor folic acid supplementation could have contributed significantly to the prevalence of NTDs in this study. Globally, studies have shown that lack of pFA supplementation was significantly associated with occurrence of NTDs.[2, 11]

Majority of the mothers in the study were of the lower socio economic classes. Being in the low socio economic class has been associated with development of congenital anomalies.[24] Low-income may be an indirect determinant of congenital anomalies with 94% of severe congenital anomalies occurring in low- and middle-income countries.[1] Characteristics of these classes such as: poor income; poor nutrition; limited access to ante natal care services; low educational level and hazardous living conditions, could be significant contributory factors.[1] While some of these factors could play out in the upper socio economic classes, where they do not occur in the upper social classes, genetic susceptibility could play a more prominent role.

Advanced maternal age has been has been associated with chromosomal abnormalities, and other serious complications of pregnancy.[30] However the role of maternal age as a risk factor in the development of congenital anomalies has been in conflict.[30] Goetzinger et al recently reported that advanced maternal age is associated with an overall decreased risk for major congenital anomalies in the absence of aneuploidy.[30] However, in an earlier study, Hollier et al reported otherwise.[31] The average age of the mothers in this study was less than 35 years old. The high incidence of congenital CNS anomalies among young mothers has a severe implication in our setting and the entire sub Saharan region. This is because childbearing, in the region, is commoner in the younger populations of women.[32] Consequently, the focus of preventive strategies against development of these anomalies needs to be emphasised among young girls and women of reproductive age in the region.

There was a male preponderance among the patients. The male sex preponderance has also been reported from other similar studies from Nigeria and other regions of the world. [2, 16,17,18] The finding in this study could reflect the genetic etiology of the recorded disorders. However, hydrocephalus which could be X-linked, was only observed in three (15%) of the males. Male predilection could also suggest a sex –biased health seeking behavior of the parents. Using data from 17 sub Saharan African countries that reviewed parental health seeking behavior for sick children, it was observed that girls are disadvantaged for curative behaviors.[33] A gender bias against the girl child while seeking for health remedies for sick children has also been reported worldwide[34]. Furthermore, congenital anomalies in the females could have been more lethal and thus associated with early fetal mortality.

There is a higher recurrence risk in siblings of affected children and a higher incidence of NTDs in consanguineous marriages compared to controls.[2] In this study, 10.7% of the patients had a positive family history of congenital anomalies even though those anomalies involved other systems. The incidence of congenital anomalies in specific populations, irrespective of how benign they might seem, should provoke scientific enquiry in such populations. This could lead to identification of susceptible genes and development of modalities for reducing their expression.

The possibility of the contribution of other unidentified risk factors, to the prevalence of the congenital CNS anomalies, in this study cannot be overemphasized. Maize is one of the staple foods of the studied population. The ingestion of fumonisin in contaminated maize has been identified in the etiology of NTDs.[2] Also, exposure to pesticides, which are commonly used in farming populations such as the studied population, could also have been contributory.

In this study, the diagnosis and management of the patients were fraught with challenges. Only two (7.1%) had prenatal diagnosis. Limited specialist diagnostic services in our health system and the cost of accessing them could have been contributory. The poor ante natal care could also have been responsible for the poor prenatal diagnosis observed in this study. Absence of a prenatal diagnosis obviates therapeutic intervention before birth. Interventions such as intra uterine surgery have been reported to improve outcomes, reduce economic and psycho social burdens for congenital anomalies.[2] Late presentation for therapy constitutes another challenge in the management of these conditions, and has been associated with increased mortality.[35] The average age at presentation, for the patients, was 4.5 days after birth. Other studies from Nigeria and the sub Saharan Africa region have also

reported late presentation for treatment in patients with congenital CNS anomalies.[35] Contending with grief, lack of information as to what to do next, financial constraints are some of the reasons that have been adduced for late presentation.[35]

Abrupt cessation of management manifesting as request for DAMA is another management challenge. A sizable proportion of parents in this study asked for DAMA. This has also been reported in other similar studies from Nigeria.[36] Reasons that have been adduced for DAMA include: lack of conviction about the quality of care received, doubts about positive health outcomes, economic burden associated with sponsoring care, the desire to seek traditional health options, conviction about the etiology of the disease.[36] This type of discharge could promote poorer outcomes with the congenital CNS anomalies.

The management of these anomalies requires specialist services that are scarce in settings such as ours.[35] Receipt of specialist management services is associated with better health outcomes. In our study, the mortality rate in the subjects was significantly lower when compared with that associated with other congenital anomalies. The presence of specialists such as a paediatric surgeon and neurosurgeon in the management team, and the absence of such relevant specialists for the other anomalies, could have been contributory. Funding the management and provision of services for these anomalies is challenging. It has been estimated that the lifetime direct and indirect costs for severe Spina bifida are more than $250,000.[2] This is quite burdensome in the LMICs. High costs such as this could significantly affect the availability, accessibility, and utilisation of the relevant health care services.

In order to obviate the highlighted challenges it is important to adopt a comprehensive approach that is initiated and driven by the government. This because of the enormous cost associated with the provision of care for these anomalies. The first step in the approach is to assess the magnitude of the problem. This can be achieved through the conduct of a national survey on the prevalence of these anomalies. This will facilitate the right policy formulation towards addressing the anomalies, and the appropriate deployment of resources. Secondly, the government should increase spending in the health sector particularly in the areas of providing specialist centres and services. It should also invest in care capacity development through training of specialists in the relevant specialties. Thirdly, there should be institution of social service programmes that are supportive of the patients and their care givers. Corporate organisations should also be encouraged to participate actively, as part of their corporate social responsibility to the community, in the provision of relevant care services and facilities. Fourthly, massive enlightenment programs should also be instituted by the government. These programs should focus on the avoidance of the established risk factors within the country, and the promotion of healthy living habits.

Conclusion

Congenital CNS anomalies were an important cause of neonatal morbidity and mortality in this study. Poor ANC, lack of pre conception folic acid intake, late folic acid supplementation, and low socio economic class were all associated with the incidence of congenital CNS anomalies. A significantly low mortality rate, compared to that observed with congenital anomalies of other systems, was observed in the subjects. These findings underscore the need to promote and sustain preventive strategies against development of congenital CNS anomalies particularly in the country. As elucidated by the World Health Organisation, these strategies should include: promoting adequate nutrition among women of reproductive age, routine folic acid supplementation in girls and mandatory pFA institution at the earliest indication of pregnancy, avoidance of harmful substances such as tobacco and alcohol in pregnancy, limiting environmental exposure to hazardous substances, and promotion of ANC services.[1] Early detection of the congenital anomalies should also be promoted. This can be done through conducting maternal serum alpha-fetoprotein (MSAFP) test in pregnancy and neonatal screening.[1]

Globally, countries should be encouraged to implement the resolutions of the World Health Assembly on congenital anomalies.[1] These resolutions include: Developing and strengthening registration and surveillance systems; Developing expertise and building capacity; Strengthening research and studies on etiology, diagnosis and prevention; Promoting international collaborative efforts.[1] The establishment of national and regional referral centres, while strengthening the existing referral systems, for provision of specialised care to those affected will facilitate achievement of some of these resolutions. Also, instituting and fostering accessible social, economic, and educational support programmes will engender identification and compliance with effective management of these anomalies.

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