International Journal of Current Research and Review
DOI: http://dx.doi.org/10.31782/IJCRR.2022.14911

Original Article

IJCRR
Section: Healthcare
ISI Impact Factor (2021-22): 2.176
IC Value (2020): 91.47
SJIF (2020) = 7.893

The Study of Trends and Treatments of Neural Tube Defects: A Cross-Sectional Study

Abdul Razaque Mari[1], Fahmida Arab Mallah[2], Muzamil[3], Rayif Rashid Kanth[4], Asim Shahzad[5], Syed Aamir Shah[6]

[1]Associate Professor Neurosurgery, People's University of Medical and Health Sciences for Women Nawabshah Pakistan; [2]Assistant Professor Neurosurgery, People's University of Medical and Health Sciences for Women Nawabshah Pakistan; [3]Assistant Professor Neurosurgery, People's University of Medical and Health Sciences for Women Nawabshah Pakistan; [4]Assistant Professor Neurosurgery, Maroof International Hospital Islamabad, Pakistan; [5]Consultant Neurosurgeon, Pakistan surgical Center Islamabad Pakistan; [6]Assistant Professor Neurosurgery, Pakistan Institute of Medical Sciences Islamabad, Pakistan

ABSTRACT

Introduction: Neural tube defects (NTDs) are serious birth abnormalities of the central nervous system caused by a defect in the embryonic neurulation process. The most common congenital defects are congenital heart defects (CHDs) and neural tube defects (NTDs).

Aim: The study's aim was to figure out the patterns of neural tube defects (NTD) and how to treat them.

Methodology: The ages of the mother, the method of delivery, the kind, and quality of neural tube defects (NTDs,) and also the treatment, were all acquired from case reports (medical and surgical). Warmth was provided to the newborn with an open NTD, and the abnormality was coated with a sterile moist saline bandage. To avoid putting strain on the deformity, the patient was placed in a supine posture. Children with breathing difficulties were given supplemental oxygen. In patients with urine dysfunction, clean intermittent catheterization (CIC) was employed. All infants with an open NTD had to have the problem checked right away. Conventional neurosurgical procedures were used to close the wound. Once the NTD was closed, a ventriculoperitoneal shunt was implanted in infants with associated hydrocephalus.

Results: A total of 59 patients were involved in this study. Males made up 50.6% of the population, while females made up 49.4%, resulting in a gender ratio of 1.5 in males. The majority of the participants' parents (57.6%) were socioeconomically poor. The most prevalent kind was myelomeningocele (62.7%), followed by 5.08 percent cases of meningocele and 11.8 percent cases of lipomeningocele. The lumbosacral area was the most frequent site of these abnormalities (55.9 percent). Lumbar (32.2 percent), sacral (6.77percent), and thoracolumbar (5.08 percent) locations were among the others.

Conclusion: The most frequent kind of NTD in our area was Lumbosacral Myelomeningocele. The main concern factor was lower economic level.

Key Words: Neural tube defects, Newborn, Myelomeningocele, Birth abnormalities, Congenital Disorders, Clean intermittent catheterization

INTRODUCTION

Neural tube defects (NTDs) are serious birth abnormalities of the central nervous system caused by a defect in the embryonic neurulation process. [1] The most common congenital defects are congenital heart defects (CHDs) and neural tube defects (NTDs). [2] The Modell Database of Congenital Disorders (MGDb) was newly established to quantify worldwide congenital condition occurrence at infancy. [3] NTDs may contribute to 29% of infant fatalities owing to visible birth abnormalities in countries with low economies. [4] Inherent hazards attributable to genetic (such as MTHFR mutations among women of a given ethnicity and race), ecological, and nutrition variables can impact the estimated frequency of NTDs in countries. [5] Neural tube abnormalities are more common in certain regions, races, and ethnic groups. Initial reports revealed that Africa had a lower incidence than Europe and North America. [6, 7] A interdisciplinary team effort, involving surgeons, doctors, and psychologists, is required for the treatment and monitoring of a child and the family

Corresponding Author:
Abdul Razaque Mari, Associate professor Neurosurgery, People's University of Medical and Health Sciences for Women Nawabshah Pakistan.
Email: razakmari@yahoo.com

ISSN: 2231-2196 (Print) **ISSN:** 0975-5241 (Online)

Received: 15.03.2022 **Revised:** 05.04.2022 **Accepted:** 20.04.2022 **Published:** 03.05.2022

with an NTD, including one member (typically a pediatrician) serving as the advocate and supervisor of the treatment program. Families are devastated and angry when they know that their newborn kid has a life-threatening illness like myelomeningocele. Prenatal folate deficiency, caused by insufficient amounts of vitamin B9 (folic acid), is the most well-known health hazard for fetal NTD. [8] A strong family record, smoking, and household air pollution from charcoal and biomass burning, which are primarily used in underdeveloped nations, are also significant risk elements for the formation of NTDs. [9] Moreover, NTD is also associated with a deficiency of nutrients in the mother as well as obesity. [10] We decided to conduct this research with a focus on the diagnosis and therapy elements in order to better manage the neural tube abnormalities in our nation.

Study design: A cross-sectional study

Place and Duration: This study was conducted at People's University of Medical and Health Sciences for Women Nawabshah Pakistan from June 2020 to June 2021.

METHODOLOGY

It was a cross-sectional and retrospective study conducted in our hospital. Permission was taken from the ethical review committee of the institute. All neonates and infants with a neural tube defect who had been examined at the hospital, all through the study period and whose patient records were full were included in the study

The researcher obtained the patients' folders (case records) from the hospital records office after recognizing them from the registers (hospitalization registers and outpatient consultation registers) (s). Data were collected using standardized papers (questionnaires) created specifically for the research. Clinical and Para clinical examination (as documented by physicians in the patient's case records) led to the identification of NTD. The binders contained information on the participant's antenatal background, the background of teratogenic medication exposure (valproic acid, misoprostol, mycophenolate, thalidomide, warfarin, carbamazepine, topiramate, ibuprofen, and captopril), and family background of consanguinity. The ages of the mother, the method of delivery, the kind and quality of NTDs, and also the treatment, were all acquired from these case reports (medical and surgical).

Warmth was provided to a newborn with an open NTD, and the defect was coated with a sterile moist saline bandage. To avoid putting strain on the deformity, the patient was placed in a supine posture. Children with breathing difficulties were given supplemental oxygen. In patients with urine dysfunction, clean intermittent catheterization (CIC) was employed. Among all patients having an open NTD, broad-spectrum antibiotics were administered to avoid and manage infections (meningitis, septicemia, site infection).

The primary goal of the operational restoration was to retain brain functioning and avoid infection by achieving a healthy skin closure over the lesion. All infants with an open NTD had to have the problem checked right away. Conventional neurosurgical procedures were used to close the wound. Once the NTD was closed, a ventriculoperitoneal shunt was implanted in infants with associated hydrocephalus.

The infants were placed on the foot of a reversed table in a supine position so that the doctor and assistant could sit comfortably. With wrapped cloths, the body was properly cushioned at any pressure areas (ankles, pelvis, shoulder, and skull). Only saline or Ringer lactate solution was used to cleanse the wounds, as chemicals that could harm uncovered brain tissue were avoided. The MMC's Five-layer sealing approach was utilized in an effort to prevent post-operative difficulties:

The neuronal placode is isolated and tabulated. The dural residual is reflected and closed. The lumbodorsal fascia is reflected and closed. Sealing of the deep subcutaneous layer (wide-undermining). Sealing of the skin (avoiding edges blanching). An operational microscope was used to visualize the defect(s) throughout the repair process.

Techniques for repairing encephalocele

The child's position throughout surgery is determined by the location of the encephalocele. The remaining tissue is gently removed after making an elliptical skin incision around the bottom of the encephalocele and separating the dural margins from the parenchyma. A tight dural suture is required, which can be made with pericranium or another material if required. After that, the bone abnormality must be repaired. This is best accomplished by utilizing the interior table of the skull from a nearby place. For a desirable outcome, skin sealing using a Subgaleal and cutaneous layer may necessitate removing superfluous skin margins.

RESULTS

There were 11,776 hospital deliveries over the study period, with 59 of them having NTD, for a rate of 5.5 per 1000 births. There were 30 (50.6%) males and 29 (49.4%) females among the 59 cases of NTD recruited, resulting in a male-to-female ratio of 1.5:1. In our study, the yearly incidence of neural tube abnormalities was 4.8 instances per year. Forty-two patients (64.3%) presented in the first week of life, whereas seven (15.3%) and seven (15.3%) appeared in the second and fourth weeks of life, correspondingly. The remaining three (5.1%) were appeared in the third week of life.

Table 1 shows the hazard variables for NTD in our sample, including maternal age, economic status, and folic acid administration, as well as clinical features of the defects.

Over the crucial phase, seven (15.3 percent) mothers reported using various conventional remedies, alcohol, and other medications such as "kaolin." Anti-epileptic drugs were not consumed by any of them during their pregnancies. Furthermore, we observed that the third birth rank has been the most commonly affected (15; 30.4 percent). The second birth rank (14; 28.6 percent) and the fourth birth rank (10; 20.6 percent) were both close behind.

Twelve mothers (26%) said they had a fever within the first trimester, whilst the remainder (36; 74%) said they had no idea if they had a fever throughout this crucial time. Although the majority of the patients were medicated for malaria, the precise reasons for this illness were not mentioned in their files.

In our dataset, one patient (1.69%) had a family background of spina bifida (in her aunty). Merely 6 (10.16 percent) of the NTDs found in our group were diagnosed prenatally, all of them within the third trimester with the help of obstetric ultrasound. In 39 (66.1 percent) of the cases, hydrocephalus was discovered. The most frequent concomitant orthopedic congenital anomalies identified were talipes equinovarus and talipes calcaneovalgus; fetal heart illness and bilateral undescended testes were also observed in a few cases, as indicated in Table 2.

A total of 14 cases (37.8%) of myelomeningocele, 7 cases (87.5%) of meningocele, 3 cases (100%) of encephalocele, 7 cases (100%) of lipomeningocele and 4 cases (100%) of Meningoencephalocele were treated with only simple operation closure, while the 23 cases (62.1%) of meningomyelocele and 1 case (12.5%) of meningocele was treated with Operating closure linked to VPS.(As shown in Table 3)

In each of the thirty-nine (39) cases of hydrocephalus, brain CT tests were performed. Triventricular hydrocephalus was found in 83.37 percent of patients, tetra ventricular hydrocephalus in 13.42 percent of cases, and biventricular hydrocephalus in 3.22 percent of cases. After surgical correction of their abnormalities, 47 (69.49%) of the 59 participants in our research population were discharged. Three of them (5.1%) were discharged despite medical advice, and two more (5.0%) expired before operation. All of the 47 (69.49%) participants who were discharged following surgery were provided medical care (antibiotics, analgesics)

Forty-five patients (76.2%) had their malformations addressed at birth, and 26 (44%) of them did so within the initial 48 to 72 hours of arrival. Following the fourth day of admission, 17 (28.8%) of the others were incarcerated. In 24 (40.6 percent) of the 31 (52.54 percent) patients with hydrocephalus, ventriculoperitoneal shunting was done.

Thirty-one (52.5%) of our patients experienced problems after surgery, whereas the remaining twenty-eight (47.4%) had no initial post-surgery issues. Wound infections were the most prevalent postoperative consequence (28; 474 percent). Scar dehiscence (21; 35.5 percent), CSF leaking (9; 15.2 percent), and meningitis/sepsis were the most acute post-operative problems (17; 28.8 percent). Three patients died soon the following surgery as a result of cardio-pulmonary complications. Altogether, 13.2 percent of the population died.

Participants with ruptured tumors at presentation had a higher rate of post-surgery difficulties than those with undescended lesions. Surgical infection, wound dehiscence, and meningitis was among the consequences. The p-value of 0.0001 indicated that this was statistically significant (As shown in Table 4). Participants treated in the initial week of life had a higher rate of post-surgery complications (16; 27.1%) than those treated in the second, third, and fourth weeks after birth. This was not a statistically meaningful result. Infants with an average body weight had more complications after the operation. This did not have any statistical significance. Following the operation, participants with myelomeningocele had higher problems than those with other types of lesions. This did not have any statistical significance.

A total of17 (28.8 percent) of the 41 patients who were discharged from the institution following the operation were totally gone to follow-up a couple of months to years later. Ten (25.4%) of the other 30 patients were said to have perished shortly after the operation (some a few years). The majority of them were reported to be suffering from developing hydrocephalus (enlarging cranium, sun-setting appearance of the eyes, vomiting, dilated scalp veins). The remainder 15 (37.6 percent) are said to be living, with the most (13; 81.0 percent) suffering from gross muscular & sensory deficiencies as well as bi-sphincteric abnormalities. The remaining three (21.0 percent) have fully healed. Myelomeningocele was found in thirty-seven (62.7%) of those living with substantial muscular and sensory impairments, as well as bi-sphincteric abnormalities.

Table 1: Threat elements and

Clinical features		
Variables	**Frequency**	**Percentage (%)**
Mothers age (years)		
>40	7	11.86
30 - 40	33	55.93
20 - 30	15	25.42
<20	4	6.77
Maternal folic acid supplementation After pregnancy	05	8.4
Throughout pregnancy	54	91.5

Table 1: *(Continued)*

Clinical features		
Variables	**Frequency**	**Percentage (%)**
Mothers' socio-economic status Lower class	34	57.6
Middle class	21	35.5
Upper class	4	6.7
Type of skull deformity encephalocele	3	5.08
Meningoencephalocele	4	6.7
Kind of spina bifida Meningocele	8	13.5
Myelomeningocele	37	62.7
lipomeningocele	7	11.8
Nature of spina bifida Ruptured	26	44.0
Un ruptured	33	55.9
Thoracolumbar	3	5.08
Lumbar	19	32.2
Lumbosacral	33	55.9
sacral	4	6.77
Size of cut Larger than 15 cm	2	3.3
10 - 15 cm	12	20.3
5 - 10 cm	40	66.7
Less than 5 cm	5	8.47
Related neurological shortage Urinary and fecal shortage	26	44.0
Lower limb motor and sensory shortage	33	55.9

Table 2: Related birth abnormalities.

Variables	Frequency	Percentage
Hydrocephalus	39	66.1
Bilateral talipes calcaneovalgus	8	13.5
Bilateral talipes equinovarus	9	15.2
Unilateral talipes calcaneovalgus	1	1.6
Unilateral talipes equinovarus	3	5.0
Overriding toes	3	5.0
Genu recurvatum	1	1.6
Congenital hip dislocation	2	3.2
Congenital heart disease (ventricular septal defects)	1	1.6
Bilateral undescended testes	1	1.6
No abnormality	14	23.7

Table 3: Diverse surgical methods as per the clinical type of cut

Kind of lesion	Simple operating closure only	Operating closure linked to VPS
myelomeningocele	14 (37.8%)	23 (62.1%)
meningocele	7 (87.5%)	1 (12.5%)
encephalocele	3 (100%)	0 (0%)
Lipomeningocele	7 (100%)	0 (0%)
Meningoencephalocele	4 (100%)	0 (0%)

Table 4: Relating the nature of the cuts and difficulties after the operation

Nature of the cuts	No difficulty	Difficulty	Total	Chi-square p-value
Ruptured	5	19	24	0.000
Un-ruptured	14	8	22	1

DISCUSSION

The research's major goal was to evaluate the prevalence and treatment of neural tube abnormalities. A total of 59 participants were recruited, resulting in a yearly frequency of 4.8 instances per year. The worldwide prevalence of NTDs (range: 0.3–199.4 per 10,000 births) is highly variable, according to this comprehensive study (range: 0.3–199.4 per 10,000 births). [11] It is worth noting that the least and greatest point estimations in this worldwide range originated from investigations done in Beijing [12] and Luliang [13], respectively. NTD incidence statistics are strong all around the globe, with roughly 80% of recorded prevalence rates exceeding 6.0 per 10,000 births. [14] Following brain/spinal cord disorders and hydrocephalus, spina bifida is the 3rd most frequent cause for admission in pediatric neurosurgery departments. [15]

Because our Hospital is a reference hospital where certain illnesses are successfully addressed, not every instance of neural tube abnormalities is treated there. Furthermore, due to the prevalent popular religious faith about the incidence of spina bifida, a few of the individuals recommended from other health centers to this reference hospital for adequate therapy of their babies' deformities may not have come to our Hospital. Some people believe that having such a kid is a punishment from God. Some folks believe witchcraft is to blame for their child's plight.

A total of 59 patients were involved in this study. Males made up 50.6% of the population, while females made up 49.4%, resulting in a sex ratio of 1.5 in favor of males. According to the literature, there is little female dominance. These variances, in our judgment, may be attributable to the context, as NTDs are believed to vary from one place to the next. Despite the fact that neither of the participants

was seen inside the initial 24 hours of their lives, the bulk of them (31; 64.3 percent) were seen throughout their initial week of life. Several (8; 15.3%) have only been diagnosed in the fourth week of life. Such findings are comparable to findings of a previous study. Neither of their patients was seen until the sixth (6th) hour of life, according to them. In fact, 52.3 percent of their participants were only examined following the initial week of their lives. "The proportions of infants with NTDs are seen within their initial month of birth," The youngsters are exposed to many risks prior to and post-surgery as a result of this delayed first neurosurgical appointment. NTDs are often thought to be a divine punishment, which we believe is related to early referral, financial challenges, and sometimes traditional cultural and theological views. Merely four (6.7 percent) of the participants' families had a higher social status, whereas forty-four (59.4%) possessed a low income. Communities with poorer socioeconomic positions have been found to have a greater prevalence of NTDs. [16]

Supplementing with folic acid in the diet during the time of birth has historically been recognized to lower the incidence of NTD in infants. [17] Although this type of medication is beneficial, it is limited to women who are considering a pregnancy or who have already given birth. Prenatal folate deficiency, caused by insufficient amounts of vitamin B9 (folic acid), is the most well-known health hazard for fetal NTD. [8] To ensure that females who are expecting have sufficient folate stores, the US National Institutes of Health (NIH) and Institute of Medicine (IOM) suggest that expecting females take 600 mg of folic acid every day, which should be maintained entire pregnancy and decreased to 500 mg during breastfeeding. [18] No mother in our study was given folic acid supplements prior to conception, and those who did not take it throughout the crucial phase. This could be attributed to a number of factors, including a late start to prenatal care consultations. They lacked expertise, and the majority of the time, they were unaware that they were expecting throughout this crucial phase.

According to a study, the third birth order was the greatest commonly impacted (15; 30.6 percent). The 2nd birth order (14; 28.6%), as well as the 4th birth order (10; 20.4%), came in second and fourth, correspondingly. [19] This could be owing to the mother's folate storage being depleted as a result of multiple conceptions. In females with greater parity, a larger dosage of multivitamin medications may be required in order to improve nutrient retention in the body.

The females' modal age cohort was 30 - 40 years old (33; 55.9%), while their average age was 30 6 years old. NTD births were more common amongst females around 20 to 30 years old and were strongly linked to poorer degrees of mother's literacy. [20] The probability of a birth defect-affected pregnancy rises as the mother's age rises. In fact, neural tube abnormalities are thought to be especially common in mothers under the age of 19 and over the age of 40.

Throughout this time, no cases of anencephaly were discovered. Because a significant percentage of anencephalic infants are aborted instantaneously or die shortly after birth, the rare event of anencephaly, as documented by Njamnshi KA as well as his associates in cross-sectional retroactive research does not truly indicate its present evidence. Furthermore, anencephalic newborns born in other healthcare facilities may not have been referred to our hospital for treatment because this kind of neural tube defect is recognized to be life-threatening.

Myelomeningocele was the medical form of spina bifida cystica in the overwhelming of individuals (37; 62.7 percent). According to research, the most prevalent clinical form is myelomeningocele (85.8 percent). [21] MMC was the more common kind of lesion in 64.22 percent, 63.20 percent, and 78.56 percent of cases, according to several additional investigators. According to the research, myelomeningocele accounts for roughly 80% of spina bifida aperta cases. As a result, these MMC percentages correspond to reports in the research. Meningocele affected nearly a tenth (9; 18.4%) of our participants. Several publications documented a significant incidence of meningocele (71.1%), whereas others obtained data that were comparable with ours: 13.3% and 14.5 percent, correspondingly. Throughout this time, just one instance of lipomeningocele (2.1%) was observed. 3.79 percent of cases of lipomeningocele were documented by those who obtained similar outcomes.

Throughout this time, three instances of encephalocele were discovered, two of which were Meningoencephalocele (65.7%) and one of that was a meningocele (32.3%). Sanoussi with his colleagues recorded 58 instances of encephalocele over the course of a decade in a retroactive analysis. Neural tube problems arise in different ways depending on where you live, who you are, and when you were born.

Lumbosacral lesions were the more frequent type of lesion (21; 46.8 percent). The lumbar (18; 40.3 percent), sacral (3; 6.4 percent), and thoracolumbar regions are also affected (2; 4.2). The lesions were not found in the cervical region. According to several other research, lumbosacral MMC is the most typical medical kind of spina bifida aperta. These numbers match those found in the research.

Further observation was that approximately half of the patients (23; 52.3%) had ruptured lesions upon the appearance, whilst the remaining 21 (46; 8%) had complete lesions, which had a substantial impact on post-operative problems. All of the newborns who had ruptured lesions were born per-vagina (vaginally delivery/breech), whereas all of the babies who were born via elective Cesarean delivery had unruptured lesions. The bursting of the lesion might have been caused by

stress to the lesions during per-vaginal childbirth. Furthermore, the majority of patients were transferred and arrived late to the specialized care facilities that treat congenital problems. As a result, the tiny, brittle membrane that covers the neural placode breakages prior to the patients' entrance.

A broad array of the prenatal spine and spinal cord problems are caused by neural tube anomalies. These anomalies are caused by a misalignment of the neuropore throughout embryogenesis, which leads to the stemming of the neighboring bone and mesenchymal components. The more frequently occurring anomalies encountered by brain surgeons are neural tube defects. [22] Participants with myelomeningocele had varying levels of neurological deficiencies, dependent on the severity of the injury. At the time of diagnosis, 31 (60.2%) of the participants in our study had urine and fecal incontinence, whereas 33 (66.3%) exhibited lower limb muscular and sensory impairments. We can also list teratogenic medicines that must not be utilized throughout childbirth, in addition to socio-cultural aspects such as early motherhood, cohabitating marriages, and poor socio-economic position.

CONCLUSION

With an average incidence of 4.8 cases/year at our Hospital, neural tube defects (NTDs) are a severe impairing but avoidable prenatal abnormality. The vast majority of our patients were born to parents with poor socioeconomic status. Generational poverty and popular cultural and theological views hampered prenatal care and birth outcomes in our study. Other linked birth problems, such as orthopedic deformities and urine incontinence, are poorly treated in our environment. In our study, the total death rate was relatively high (12.4 percent). This level was largely due to delayed referral, budget restrictions, and the occurrence of problems prior to operation.

RECOMMENDATIONS

Inform the public about the dangers of NTDs. Help fund and promote the use of folic acid supplements by females of reproductive age throughout the periconception phase. Consider implementing compulsory folic acid enrichment of wheat and other consumables, as suggested by the World Health Organization. Encourage women who are expecting a child to start taking 400 mg of folic acid daily 2 months earlier than their expected due date and maintain until they are 12 weeks pregnant.

ACKNOWLEDGMENT

Authors acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript. The authors are also grateful to authors / editors / publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed

Source of funding

None

Conflict of interest:

None

Permission

It was taken from the ethical review committee of the institute.

Author Contribution

All authors contributed equally towards the data collection, data analysis & compilations

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