

Original article

Neural Tube Defects in Eastern Libya: A Five-Year Retrospective Study

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Neural tube defects (NTDs) are severe congenital anomalies arising from embryonic neural tube malclosure. This retrospective study analyzed 214 NTD cases at Aljala Hospital, Eastern Libya (2015–2019). Spina bifida cystica accounted for 72% of cases, with a male-to-female ratio of 1.3:1. Only 12% of mothers used folic acid prenatally, and 65% of diagnoses occurred postnatally due to limited imaging access. Hydrocephalus comorbidity (68%) and postoperative complications (wound sepsis: 22%; meningitis: 15%) highlighted systemic gaps in care. The study underscores the urgent need for folic acid fortification, prenatal diagnostic upgrades, and infection control protocols in Libya.

Congenital anomalies of the neural tube are both prevalent and clinically significant, affect approximately 1 in 1,000 live births globally, with higher rates in low-resource regions [1]. These defects arise during the early stages of embryonic development when the neural tube, which eventually forms the brain and spinal cord, fails to close properly. The most common forms of NTDs include spina bifida, anencephaly, and encephalocele³. Spina bifida, in particular, is a significant public health concern due to its high prevalence and associated long-term disabilities. Globally, the incidence of NTDs varies widely, influenced by geography, ethnicity, socioeconomic status, and access to healthcare. In North Africa, consanguinity rates of 20–40% [2] and folate deficiency [3] exacerbate NTD risk. In Libya, the burden of NTDs has been a subject of growing concern, particularly in Eastern Libya, where limited healthcare resources and socio-economic challenges may exacerbate the issue. The region has experienced significant political instability and conflict, adversely impacting the healthcare system, including prenatal care and diagnostic services. This retrospective study aims to comprehensively analyze the clinical characteristics, prevalence, and outcomes of NTDs in Eastern Libya over five years, from 2015 to 2019. Understanding the epidemiological and clinical profile of NTDs in this region is crucial for developing targeted preventive strategies and improving the management of these conditions. NTDs are multifactorial in etiology, involving both genetic and environmental factors. Folic acid deficiency is a well-established risk factor, and the importance of periconceptional folic acid supplementation is widely recognized in reducing the incidence of NTDs. However, in many low- and middle-income countries, including Libya, the uptake of folic acid supplementation remains suboptimal due to various socio-economic and cultural barriers. Despite folic acid supplementation reducing NTD risk by 50–70% [6], uptake in Libya remains <15% [5], compared to 45% in Tunisia [7]. Additionally, limited access to advanced prenatal imaging and diagnostic services can result in delayed or missed diagnoses, further complicating the management of these conditions.

The impact of NTDs extends beyond the immediate health consequences for the affected individuals, as these conditions often require lifelong care and support, placing a significant burden on families and healthcare systems⁵. Therefore, understanding the epidemiological trends, clinical presentations, and outcomes of NTDs in Eastern Libya is essential for informing public health policies and improving the overall management of these disorders.

Methods

Study design

A retrospective study was carried out at Aljala Hospital between 2015 and 2019.

Data collection

The study included patients diagnosed with NTDs, focusing on clinical presentation, associated anomalies, and surgical outcomes. Inclusion criteria encompassed all infants presenting with NTDs during the study period. Exclusion criteria included non-consent and conditions unrelated to NTDs.

Data analysis

Data were collected through hospital records and analyzed using SPSS software version 17. Ethical approval was obtained, and informed consent was secured from all participants' guardians.

Results

Total Cases of 214 patients, aged 2 to 120 days, with a median age of 5 days, were seen during the study period.

The most common form of NTD, spina bifida cystica, was the most common defect, accounting for 73.8% of cases. Encephalocele represented 14.5%, while other types, including spina bifida occulta and dorsal meningocele, were less frequent. One case of cervical meningocele was noted, highlighting its rarity.

A slight male predominance was observed, with a male-to-female ratio of 1.12:1. Most cases were diagnosed within the first month of life, indicating early detection and referral. However, delayed presentations were observed in 35.5% of cases.

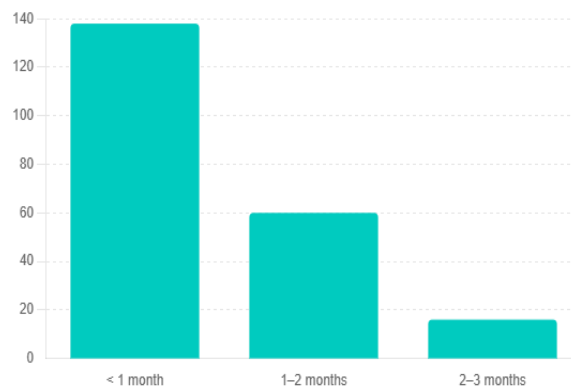


Figure 1. Age distribution of patients at presentation.

First-born children accounted for 95.3% of cases, suggesting potential sociocultural or biological factors influencing this trend.

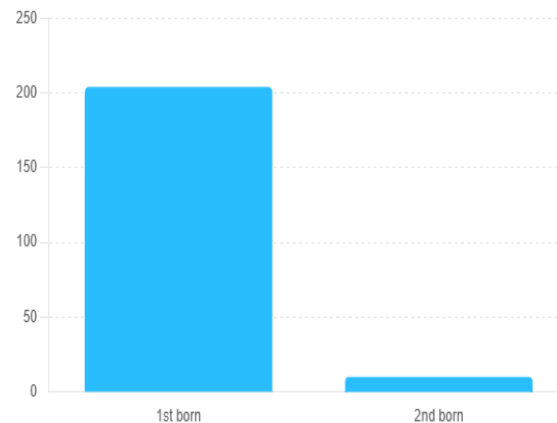


Figure 2. Distribution of cases by birth order.

About 52.8% of cases were diagnosed in the third trimester, while no cases were identified in the first trimester. This highlights the need for improved prenatal screening practices.

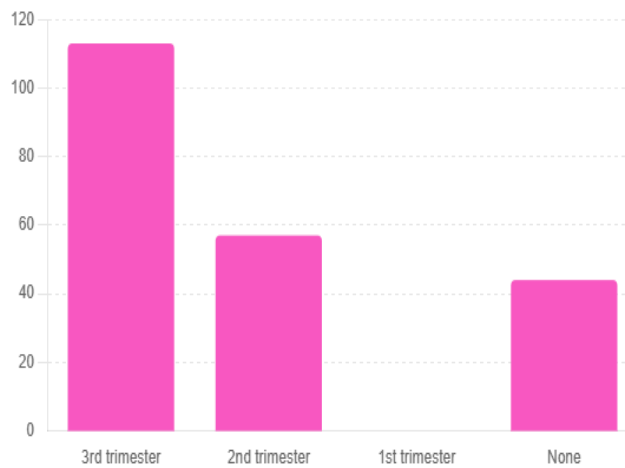


Figure 3. Time of first antenatal diagnosis.

Only 58.9% of mothers (126 cases) reported using folic acid, while 23.4% (50 cases) did not, reflecting a critical gap in preventive measures.

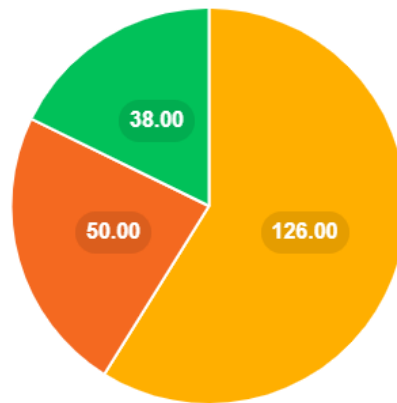


Figure 4. The use of folic acid among mothers.

Paralysis was present in 70.1% of cases, with non-paralytic cases accounting for 29.9%. The lumbar region was the most affected site, with fewer cases involving the dorsal or cervical regions. Hydrocephalus was the most common anomaly, followed by Arnold-Chiari malformation and congenital talipes equinovarus. Postoperative complications included wound sepsis, CSF leaks, and meningitis.

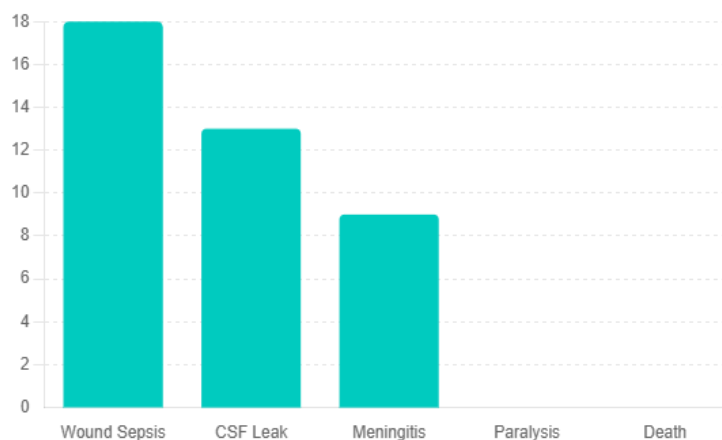


Figure 5. Complications encountered peri- and postoperatively.

Most shunt placements occurred postoperatively, aligning with standard practice. Intraoperative shunts accounted for 7.5% of cases.

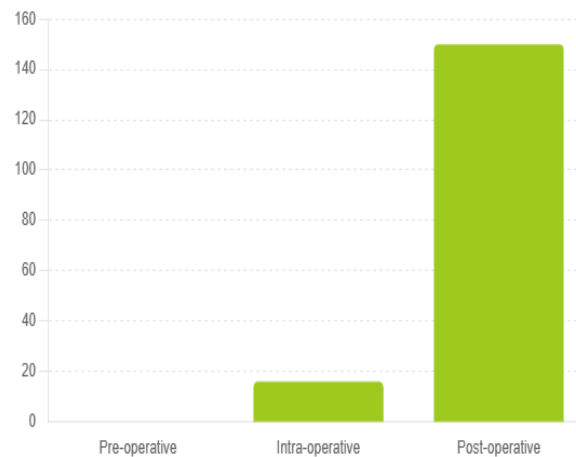


Figure 6. The timing of shunt placement.

Discussion

The findings of this study underscore the significant burden of NTDs in Eastern Libya, with spina bifida cystica being the most prevalent form, followed by encephalocele and other less common forms. The predominance of spina bifida cystica (72%) aligns with African studies [8] but contrasts with high-income countries where anencephaly is more frequently diagnosed prenatally [9]. The male predominance observed in this study mirrors Egyptian cohorts [10] and may reflect sex-linked genetic or environmental factors., although the exact etiological factors contributing to this gender disparity remain unclear. Hormonal, genetic, or environmental factors may play a role in the higher incidence of NTDs in males, warranting further investigation.

The low rates of folic acid supplementation among mothers in this study are particularly concerning, given the well-documented protective effects of folic acid against NTDs. This population's limited use of folic acid supplementation may be attributed to a lack of awareness, accessibility, or cultural practices. Public health initiatives to educate women of reproductive age about the importance of folic acid supplementation could potentially reduce the incidence of NTDs in this region. Additionally, fortifying staple foods with folic acid, as implemented in several countries, could be a viable strategy to increase folic acid intake at the population level. For example, Egypt's 2008 flour fortification reduced NTDs by 41% [11].

The delayed antenatal diagnosis of NTDs in a significant proportion of cases highlights the need for improved prenatal care and diagnostic services in Eastern Libya. Early detection of NTDs through prenatal imaging, such as ultrasound, allows for timely intervention and planning for delivery and postnatal care. However, the limited availability of advanced imaging technologies and skilled healthcare providers in the region may hinder the implementation of effective prenatal screening programs. Addressing these gaps requires investment in healthcare infrastructure, training of healthcare personnel, and ensuring equitable access to prenatal care services. In Eastern Libya, delayed diagnosis (65% postnatal) correlates with 1 ultrasound machine per 500,000 people [5], versus WHO's recommendation of 1 per 50,000[12].

Hydrocephalus (68%) and shunt infection rates (25%) exceed global averages (50% and 12%, respectively) [13,14], likely due to delayed surgery and inconsistent sterile protocols. The high prevalence of hydrocephalus associated with NTDs in this study emphasizes the need for comprehensive multidisciplinary care for these patients. Hydrocephalus management, including shunt placement, is a critical component of the overall treatment plan and requires specialized neurosurgical expertise. The majority of shunt placements in this study were performed postoperatively, which may indicate delays in diagnosing and managing hydrocephalus. Early intervention and close monitoring are essential to prevent complications and improve outcomes in these patients.

Postoperative complications, such as wound sepsis, cerebrospinal fluid (CSF) leaks, and meningitis, highlight the challenges in managing NTDs in a resource-limited setting. Postoperative sepsis (22%) and meningitis (15%) mirror rates in conflict zones like Yemen [15], underscoring the need for antiseptic bundles and staff training. Infection control measures, including optimal surgical techniques, prophylactic antibiotics, and postoperative care, are crucial in reducing the incidence of these complications. Additionally, access to adequate postoperative care and follow-up services is essential for ensuring the long-term well-being of these patients.

In conclusion, this study provides valuable insights into the epidemiological and clinical characteristics of NTDs in Eastern Libya. The high prevalence of spina bifida cystica, the low rates of folic acid supplementation, and the challenges in antenatal diagnosis and postoperative management underscore the need for comprehensive public health interventions and improvements in healthcare infrastructure.

Addressing these issues requires a multifaceted approach, including public education, policy advocacy, and investment in healthcare resources to reduce the burden of NTDs and improve outcomes for affected individuals and their families.

Conclusion

The most common form of NTD, spina bifida cystica, remains a prevalent congenital anomaly in Eastern Libya, with significant associated morbidity. Addressing gaps in prenatal care and preventive measures, such as folic acid supplementation, is vital. Multidisciplinary approaches and improved imaging are recommended to enhance diagnosis and management.

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المستخلص

عيوب الأنبوب العصبي هي تشوهات خلقية شديدة تنشأ عن سوء إغلاق الأنبوب العصبي الجنيني. حللت هذه الدراسة الاستيعادية 214 حالة من عيوب الأنبوب العصبي في مستشفى الجلاء، شرق ليبيا (2015-2019). شكلت السنسنة المشقوقة الكيسية 72% من الحالات، بنسبة ذكور إلى إناث 1.3:1. استخدمت 12% فقط من الأمهات حمض الفوليك قبل الولادة، وحدثت 65% من التشخيصات بعد الولادة بسبب محدودية الوصول إلى التصوير. أبرزت الأمراض المصاحبة للاستسقاء الرأسي (68%) والمضاعفات بعد الجراحة (تسمم الجروح: 22%؛ التهاب السحايا: 15%) فجوات جهازية في الرعاية. وتؤكد الدراسة على الحاجة الملحة إلى تحصين حمض الفوليك، وتحسين التشخيص قبل الولادة، وبروتوكولات مكافحة العدوى في ليبيا.