Epidemiology of Spina bifida cystica in Sohag, A hospital-based study

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Abstract

Introduction:

Spina bifida refers to a wide range of neural tube defects (NTDs) affecting the spine and spinal cord. These defects result from the maldevelopment of the neuropore and the adjacent mesodermal and ectodermal structures during embryogenesis. Spina bifida can be classified as either open or closed type according to the presence or absence of exposed neural tissue. These are called spina bifida aperta and spina bifida occulta, respectively. Spina bifida aperta is caused by the failure of primary neurulation resulting in exposed neural tissue or meninges with or without cerebrospinal fluid leakage. It includes two main types: myelomeningocele and meningocele.

Our aim in this study is to report epidemiological data and possible risk factors of spina bifida cystica patients in our locality.

Patients & method:

A descriptive prospective and retrospective study reporting 122 babies with spina bifida cystica came to the neurosurgery clinic in Sohag university hospital between January 2009 and June 2016. We collect their epidemiological data and ask their parents about the possible factors.

Results:

In 122 patients with spina bifida cystica, the age varied from 1 day to 8 months (the mean age was 2 months ± 33 days). The study involved 66 males (54.1%) and 56 females (45.9%). Seventy one cases had associated hydrocephalus (58.2%), 33 had congenital talipus deformity (27%) and 26 cases had the associated cardiovascular disease (21.3%). Eighty nine cases (73%) were from rural area.

Conclusion:

MMC is a common disease in Sohag governorate. Both sexes were affected equally. Incidence was higher in rural areas, mothers who took medications in the first trimester and those who were not on regular folate intake. There is a higher incidence of MMC in families who had a previous baby with MMC.

Keywords:

Spina bifida (SB) – myelomeningeocele (MMC) – congenital anomalies – neural tube defects (NTDs) – cardiovascular (CV) – neurological deficit (ND).

Introduction:

There is evidence that spina bifida (SB) existed in ancient Arabian and Greek civilizations (1). Peter Van Forest first recorded a child with spina bifida in 1587, and in 1610, he performed the first reported surgical resection of the myelomeningocele sac. The term spina bifida was first used by Professor Nicolai Tulp of Amsterdam in 1652. He drew the first anatomic illustration in 1641. In 1761, Morgagni was the first to describe associated diseases as congenital hydrocephalus observed in patients with the myelomeningocele (2).

Neural tube defects (NTDs) include a wide variety of pathologies due to intrauterine failure of neural tube closure (3). It includes anencephaly which is incompatible with life, encephalocele and myelomeningocele and meningocele (4). Myelomeningocele (MMC) is the commonest and worst form in which the spinal cord and the meninges protrude from a defect in the spine (5). Meningocele is a less severe form in which only the meninges protrude into a sac (5). MMC represents a major health problem with a higher incidence in developing countries (6). It is one of the death associated diseases in infants and early childhood. It compromises the patient's life quality and causes lifelong disabilities (7).

Spina bifida occurs in early gestational age (within 6 weeks of gestation) resulting in neurological dysfunction as paraplegia or paraparesis, sensory loss and urinary and fecal incontinence (8). SB has many hazardous complications as repeated urinary tract infection which is the major cause of death in these cases (8). Other congenital anomalies might be associated with SB like congenital hydrocephalus, congenital talipus, and congenital heart diseases (9).

From an embryological point of view, there are two well-established theories; the old theory (watery tumors of the vertebrae) assumed by Morgagni which postulated that the

continuous pressure of the CSF in hydrocephalic babies leads to rupture of the neural tube and bone. The second recent theory assumed that there is failure of the embryonic neural plate to close in its caudal part with the failure of the vertebral arches to fuse (10).

There are many associated factors that might contribute to the occurrence of MMC, like drug intake in the first trimester especially antiepileptic and chemotherapeutic agents, diabetic mothers and maternal infection during pregnancy (TORCH) infections (11). Genetic risk factor plays a fundamental role; Loss of the Sox2 gene was observed in most cases of NTDs (12). Positive family history of NTDs was in about 10%, and they increase markedly if there were two previously affected family members (12).

The prevalence of NTDs at birth varied markedly in each country and race. It ranges from as high as 1% in China, to approximately 1 case in 5000 or less in Norway and Sweden (13). Its incidence varies from 3% from total live births to 0.003 % in the Unites States (US) (14), while no accurate data recorded its incidence in Egypt. The common sites for MMC are lumbosacral and cervical regions (87%) as they are the last areas of closure of neural tube, very rare in the dorsal region. More than half of MMC cases are associated with hydrocephalus (Chiari malformation II) (13).

Patients & method:

This descriptive study was done on 122 patients in the neurosurgery department at Sohag University Hospital between January 2009 & June 2016. Demographic data of the babies regarding gender, type of spina bifid cystica, mother's age, presence or absence of consanguinity between parents, history of mother's drug intake, parity of the mother, gestational age, and mode of delivery were recorded. The data were analyzed by SPSS, version 19. Chi square, Fisher exact

and Student's t-test were applied whenever necessary. The p-value of 0.05 or less was considered statistically significant.

Inclusion criteria: Spina bifida cystica came to Neurosurgery clinic in the period between January 2009 and June 2016.

Exclusion criteria:

1. Spina bifida occulta
2. Other NTDs as encephalocele or anencephaly

Results

We collected 122 cases of spina bifida cystica. The demographic and clinical data of these cases were summarized in table 1.

Table 1. Demographic and clinical data of the study group with comparison between meningocele and myelomeningocele cases.

		Meningocele	Myelomeningocele	Total	P value
1) Sex distribution:	Male	23(59.0%)	43(51.8%)	66	0.459
	Female	16(41.0%)	40(48.2%)	56	
2) Age of the mother	15-19 ys	4(10.3%)	8(9.6%)	12	0.597*
	20-24 ys	16(41.0%)	26(31.3%)	42	
	25-29 ys	14(35.9%)	22(26.5%)	36	
	30-34 ys	3(7.7%)	19(22.9%)	22	
	35-39 ys	2(5.1%)	6(7.2%)	8	
	40 yrs and more	0	2(2.4%)	2	
3) Parity	Primi-para	19(48.7%)	25(30.1%)	44	**0.046**
	multi-Para				
	p2	12(30.8%)	16(19.3%)	28	
	p3	5(12.8%)	13(15.7%)	18	
	p4	2(5.1%)	18(21.7%)	20	
	p5	1(2.6%)	11(13.3%)	12	
4) Gestational age	Full term	26(66.7%)	52(62.7%)	78	0.666
	Pre-term	13(33.3%)	31(37.3%)	44	

		Meningocele	Myelomeningocele	Total	P value
5) Complaint at pregnancy	Hyper emesis gravidarum	6(15.4%)	14(16.9%)	20	0.836
	Fits	1(2.6%)	4(4.8%)	5	0.924
	Fever	0	2(2.4%)	2	0.832
	Anemia	16(41.0%)	26(31.3%)	42	0.293
	No comp.	16(41.0%)	37(44.6%)	53	0.712
6) Complications during delivery:	Bleeding	0	8(9.6%)	8	0.107*
	Obstructed Labor	2(5.1%)	4(4.8%)	6	0.707*
	PROM	11(28.2%)	4(4.8%)	15	**0.0007***
	Normal delivery	26(66.7%)	67(80.7%)	93	0.089
7) Twins:		2(5.1%)	6(7.2%)	8	0.964
8) Mode of delivery:	Normal vaginal	18(46.2%)	40(48.2%)	58	0.834
	CS	21(53.8%)	43(51.8%)	64	
9) Drugs intake during the first trimester (Valproate – Antibiotics-methotrexate)	Valproate	4(10.3%)	14(16.9%)	18	0.337
	Antibiotics	19(48.7%)	37(44.6%)	56	0.669
	Methotrexate	4(10.3%)	8(9.6%)	12	0.827*
	Other drugs	5(12.8%)	22(26.5%)	27	0.089
10) Folic acid intake during pregnancy:	No	10(25.6%)	18(21.7%)	28	0.698
	Irregular intake	12(30.8%)	22(26.5%)	34	
	Late in pregnancy	17(43.6%)	43(51.8%)	60	
11) Other Risk factors during pregnancy:	Radiation	8(20.5%)	12(25.3%)	20	0.399
	Alcohol	0	0	0	-
	Fever	12(30.8%)	31(37.3%)	43	0.478
	Trauma	15(38.5%)	34(41.0%)	49	0.793
	Smoking	4(10.3%)	6(7.2%)	10	0.830
12) Family history	Positive	4(10.3%)	7(8.4%)	11	1.000*
	Negative	35(89.7%)	76(91.6%)	111	
13) Consanguinity	Positive	13(33.3%)	18(21.7%)	31	0.168
	Negative	26(66.7%)	65(78.3%)	91	
14) Neonatal history:	Jaundice	12(30.8%)	54(65.1%)	66	**0.0004**
	Cyanosis	0	4(4.8%)	4	0.163
	Convulsions	0	5(6.0%)	5	0.118
15) Mode of Nutrition of the baby:	Breast only	15(38.5%)	48(57.8%)	63	0.128
	Bottle only	10(25.6%)	13(15.7%)	23	
	Mixed	14(35.9%)	22(26.5%)	36	
16) Social state	Rural	22(56.4%)	67(80.7%)	89	**0.0048**
	Urban	17(43.6%)	16(19.3%)	33	
17) Education	Illiterate	21(53.8%)	26(31.3%)	47	0.082*
	Low	12(30.8%)	29(34.9%)	41	
	Moderate	5(12.8%)	28(33.7%)	33	
	High	1(2.6%)	0	1	

		Meningocele	Myelomeningocele	Total	P value
18) Occupation	Housewife	29(74.4%)	50(60.2%)	79	0.128
	Employee	10(25.6%)	33(39.8%)	43	
19) Neurological examination of the fetus after birth:					
A) Leg movements	Good leg mov.	39(100%)	42(50.6%)	81	**<0.0001**
	Paraplegic	0	31(37.3%)	31	
B) Bladder	Continent	39(100%)	33(39.8%)	72	**<0.0001**
	Incontinent	0	49(59.0%)	49	
C) Anterior fontanel	Bulge	33(84.6%)	33(39.8%)	66	**<0.0001**
	Not	6(15.4%)	50(60.2%)	56	
D) Associated developmental anomalies	Hydrocephalus	34(87.2%)	58(69.9%)	92	**0.038**
	Cardiac	13(33.3%)	21(25.3%)	34	0.356
	Orthopedics	5(12.8%)	35(42.2%)	40	**0.0013**
	Multiple	0	21(25.3%)	21	**0.0006**
	No other anomalies	21(53.8%)	6(7.2%)	27	**<0.0001**

There were 83 cases of myelomeningocele (68%) and 39 cases of meningocele (32%) (Figure 1), males were 54% (n = 66) and females were 46% (n = 56), with male/female ratio 1.18 with no statistical difference (Figure 2). The mean age of mothers was 24±7 years. Moreover, 100% of mothers were not on regular intake of folic acid since the 1st trimester. Consanguinity was found only in 25.4%. It was more predominant in illiterate and low education mothers (72%) while it was very low in highly educated mothers (0.008%), the level of education affects in awareness of the importance of folic acid intake and avoidance of any drugs or radiation, especially in the first trimester. Spina bifida cystica were more common in rural areas (73% n = 89 cases) than in urban areas (27% n = 33cases). No significant difference was found between normal vaginal delivery and caesarean section. The majority of mothers took medications in their first trimester 92.5% (Antibiotics- valproate-methotrexate and others). Only in 8 babies, they had twins with the other twin neurologically free. More than one-third of cases (36%) born to primiparous women, while multiparous women shared in 64% of cases. No significant relation between the gestational age and occurrence of NTDs; full term babies with spina bifida cystica

were 64% while preterm babies were 36%. Incidental or occupational exposure to radiation increases the risk of NTDs. About 16% of mothers were subjected to radiation during her first trimester; one of them was a nurse in the orthopedic department in our hospital subjected frequently to C-Arm radiation. Positive family history with the previous baby with spina bifida cystica occurred in 9%. Positive neonatal history occurred in 61% of babies; 66 babies with jaundice, 5 babies with convulsions and 4 babies with cyanosis. Half of the babies 51% (n=63) were breastfed, 19% were bottle only fed while 30% were mixed fed. Housewives constituted 65% of mothers while 35% of women were employed. Complications during pregnancy were frequent (56.5%), 42 mothers were diagnosed with anemia, 20 complained of hyperemesis gravidarum, 5 mothers with fits and 2 mothers had a history of fever. More than 80% of babies had associated hydrocephalus (n=102), while 40 babies had associated orthopedic anomalies, 34 babies had cardiac anomalies, 21 babies had multiple congenital anomalies and 27 babies had no other congenital anomalies. More than two-thirds of babies had good leg movement while one-third of babies were paraplegics.

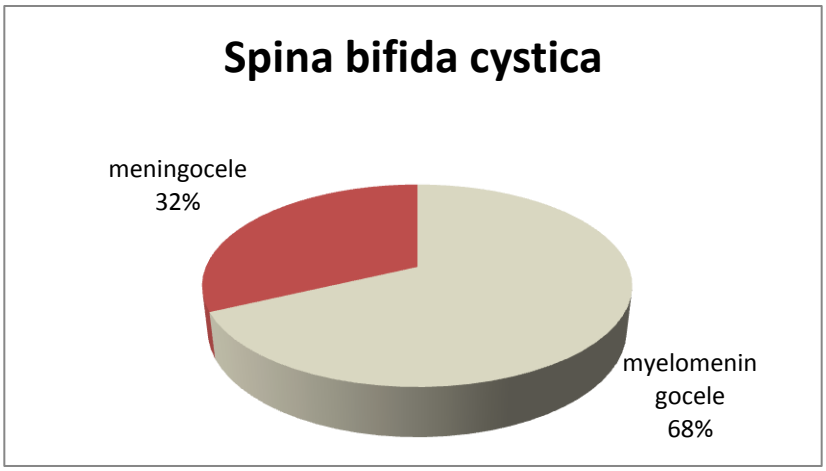

Figure (1): Percentage of spina bifida cystica subtypes

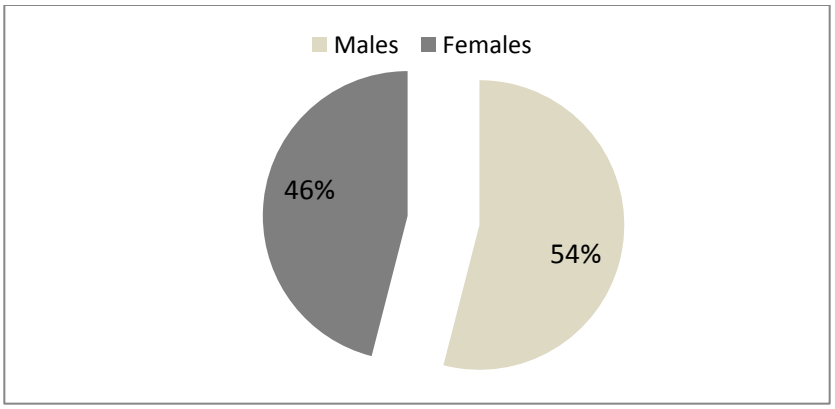

Figure (2): Gender distribution

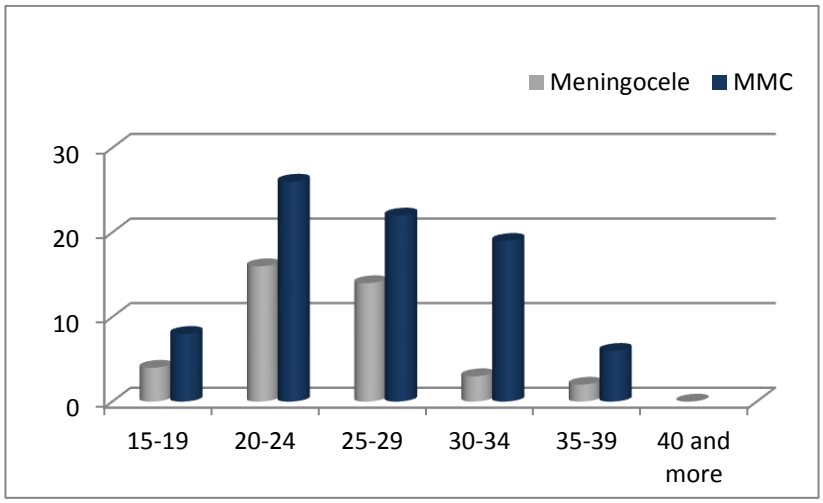

Figure (3): Maternal age

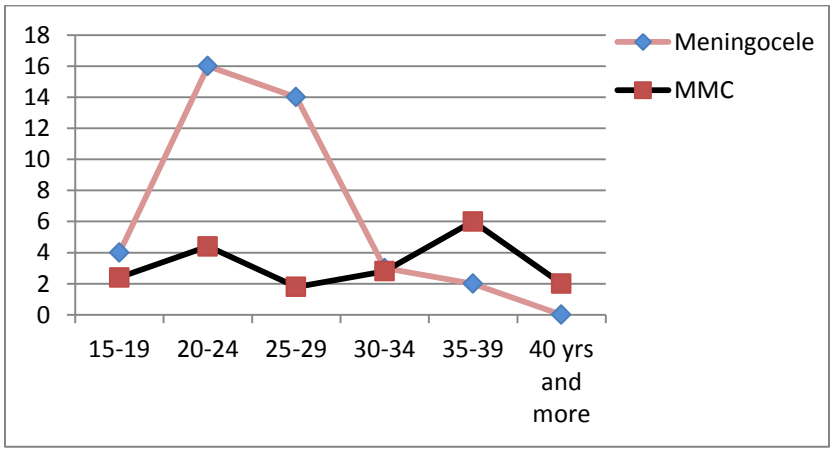

Figure (4): Distribution of maternal age

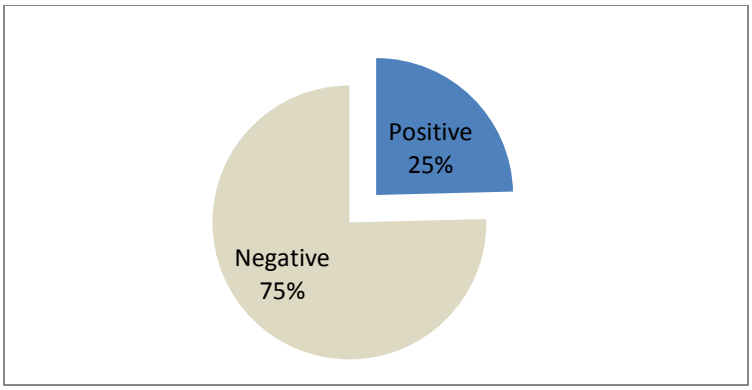

Figure (5): Consanguinity among parents

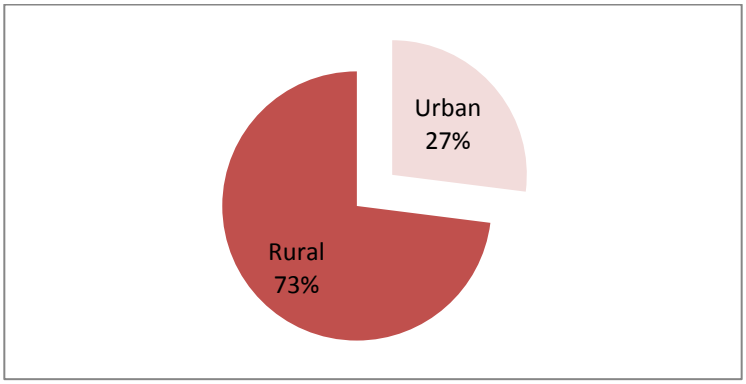

Figure (6): Residency distribution

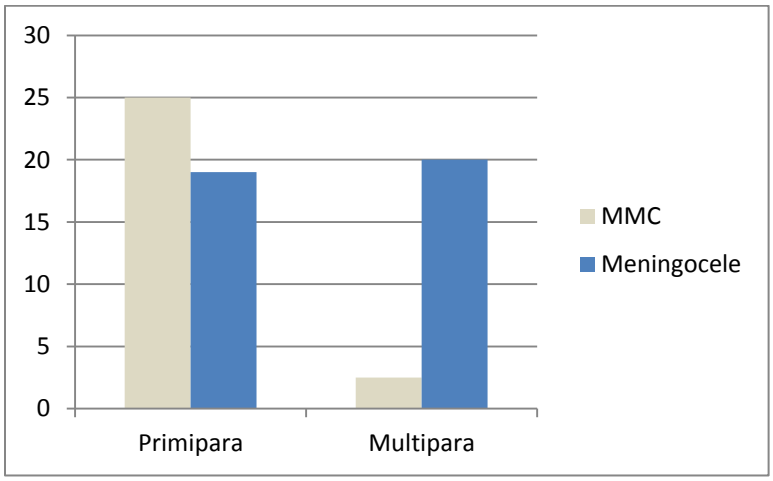

Figure (7): Parity among mothers

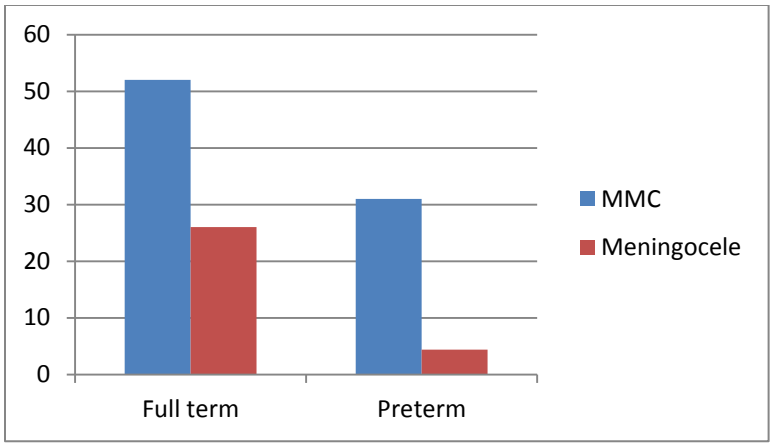

Figure (8): Gestational age

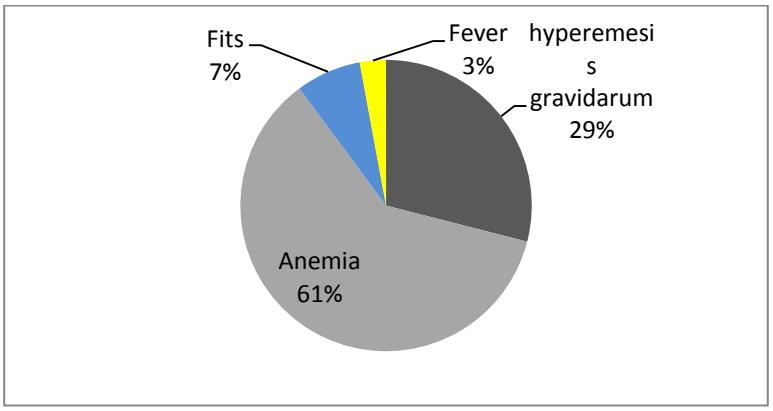

Figure (9): Complications during pregnancy

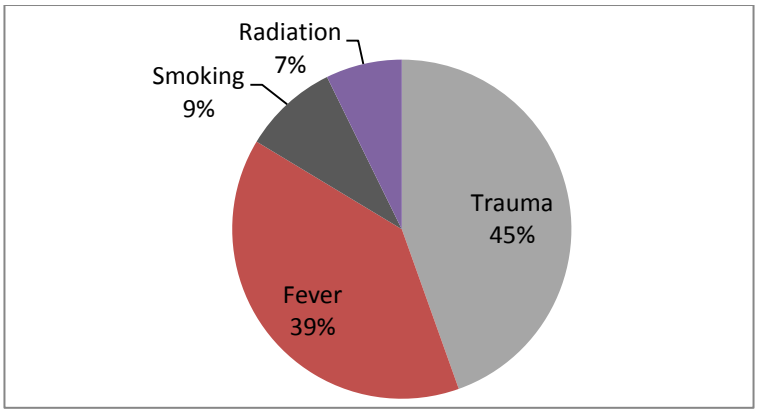

Figure (10): Risk factors during pregnancy

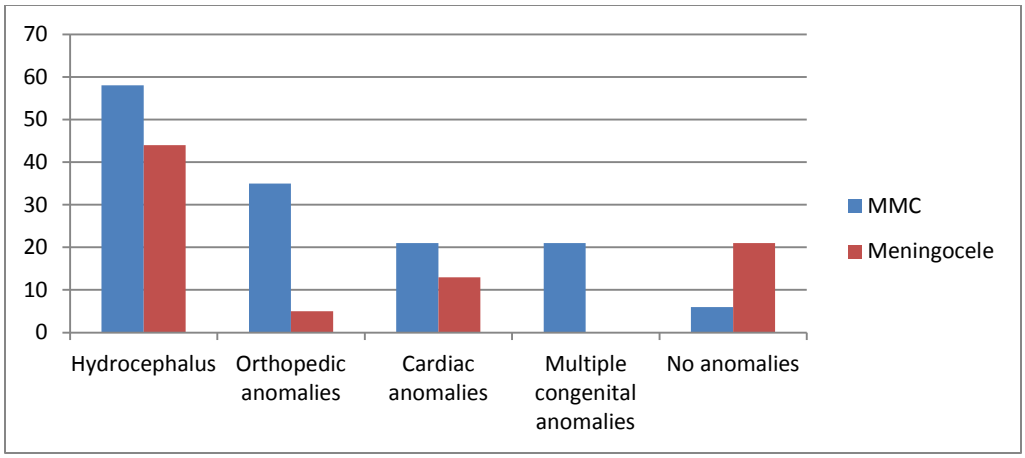

Figure (11): Associated congenital anomalies

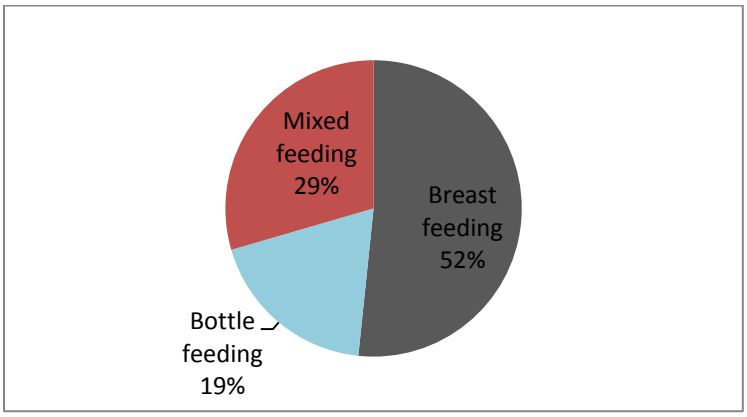

Figure (12): Type of feeding

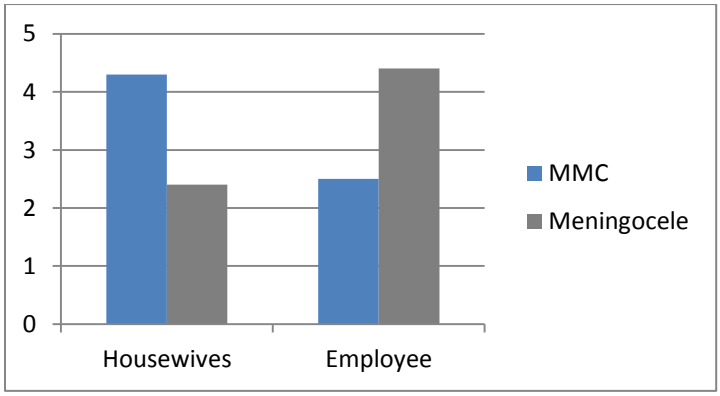

Figure (13): Maternal occupation

Discussion:

In our study, MMC cases were 68% and meningocele cases were 32%, Rankin et al. collected 984 cases of NTDs including 50.2% had spina bifida, more than half of them were MMC cases (56%) and 44% had meningocele (15). In 2002 Zlotogora et al. recorded 401 cases

of NTDs with equal cases of both anencephaly and spina bifida (167 cases for each), and 48 encephalocele cases. There was a slight male predominance in our results that match with other studies (16).

In our study, females represented 46 % in comparison to Houcher et al. 52.4%, David Whiteman et al. 57.7% and Richard Olney& Joseph Mulinare 52.4% (17-19). In our study the peak of maternal age was from 20-24 years (35%) and 25-29 years (30%) that match with other studies as Houcher et al. who reported the incidence in maternal age 20-24 years was 26%, in 25-29 years was 25% and also David Whiteman et al. who reported the incidence in 20-24 years was 50.7%, and in 25-29 years was 27.2% (17,18). In our study, mothers who were 15-19 years old represented 10%, while in Houcher et al. represented 4.3% and David Whiteman et al. 16.2%. In our study, maternal age 30-34 years represented 18%, and above 35 years was 6%, while in Houcher et al. maternal age 30-34 years represented 21.7%, and above 35 years comprised 6%, and David Whiteman et al. maternal age 30-34 years (4.8%), above 35 years constituted 1%(17,18).

In our study, there was an increased risk in primiparous mothers 36% that is similar to other studies; as David Whiteman et al. 36.8%, while Berry et al. reported 57%, and Moore et al.reported 42% (18,20,21). In this study, only 25.4% of spina bifida cystica cases occured to the babies of parents with consanguinity, On the other hand, the other studies Afshar et al. showed 50% consanguinity and Houcher et al. 57.1% (17,22).

Low socioeconomic status including the education level of the mother and place of residence were associated with a higher number of spina bifida cases; in this study, 38.5% of cases were born to illiterate mothers, compared to Berry et al.18 %, and Moore et al. 37%, while

one case only was born to a highly educated mother (20,21). Rural residency had a higher number of cases (89 cases) with 73%. Housewives were more than working mothers, 79 (64.7%) and 43 (35.3%) cases consequently, that match with some other studies where mothers were exposed to heavy manual work; Berry et al. 87%, and Moore et al. 64% (20,21).

In our case series, nearly all mothers were not on regular folic acid intake in early pregnancy due to lack of concept of giving folic acid in early pregnancy while in Salih et al. study, showed that folic acid fortification leads to decrease in NTDs by 79% (23). In the United States (US), food fortification with folic acid had lead to marked decline of NTDs cases by 26% (24). The Food and Drug Administration (FDA) recommended folic acid fortification to cereals, flour, and rice (25). In Canada at which folic acid fortification is obligatory since 1998, a significant drop was achieved in the number of NTDs cases (26).

On the other hand, in Chile after application of food fortified with folic acid, marked decrease by 31% was achieved (27). Since 1998, 50 countries started folic acid fortification programs (28,29). In our series, 58% of mothers had associated diseases with pregnancy that is comparable to other studies; Afshar et al. 50% (22). In our study, 47.5% had a normal vaginal delivery that is in line with other studies (22). In our study, twins represented 6% that match with David Whiteman et al 2.1% (18). In our study, 66.4% of cases had good leg movement, while other 33.6% were paraplegics, 59% were continents as regard urine and stool (72 cases p-value highly significant 0.00001), while 37% were incontinents, 77.8% has associated other anomalies, while in David Whiteman et al, 79.1% had associated other anomalies (18).

CONCLUSIONS:

Folic acid fortification should be implemented to reduce the incidence of NTDs. Providing folic acid tablets for both parents is mandatory when pregnancy is planned and when there is no contraceptive method is given. Spina bifida cystica is common in our locality, Sohag governorate; higher incidence is associated with previously affected babies, low educated mothers and rural areas. Both genetic and environmental factors are direct leading causes.

Acknowledgment:

The authors would like to thank the whole members of neurosurgery department for allowing us to analyze the NTDs data for this study.

Funding: None

Disclosure: No conflict of interests among authors

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الملخص العربي

مرض القيلة المائية في محافظ سوهاج، دراسة في المستشفى الجامعي

مقدمة البحث:

أمراض فتق العمود الفقري متعددة وترجع لعدم تكوين القناة العصبية بشكل سليم. بعض هذه الامراض ينتج عنها الوفاة بشكل مباشر وبعضها الاخر قد ينتج عنه شلل أو ضعف بالأطراف السفلية وفقد على الاحساس بالنصف السفلي من الجسم وعدم القدرة على التحكم بالبول والبراز. يعد مرض القيلة المائية أشهر نوع من أنواع فتق العمود الفقري. مرض القيلة المائية يمثل مشكلة صحية كبيرة وسبب من الأسباب الرئيسية للوفاة في الاطفال. ان هذا المرض يوثر على حياة المريض كما انه يؤثر بشكل مباشر وغير مباشر على عائلته والاقارب المحيطين به.

الهدف من الدراسة:

تتبع الصفات الشخصية للمرضى ومحاولة معرفة الاسباب المؤدية والمصاحبة لهذا المرض في محافظة سوهاج

طريقة البحث:

دراسة وصفية لمائة واثنان عشرون طفلا مصابون بمرض القيلة المائية في مستشفى سوهاج الجامعي في الفترة ما بين يناير ٢٠٠٩ ويونيو ٢٠١٦. تم تسجيل كل البيانات والمعلومات الخاصة بالاطفال وسؤال الابوين عن الاسباب المحتملة لحدوث هذا المرض.

نتائج البحث:

عمر المرضى كان يتراوح ما بين عمر يوم الى عمر ٨ شهور (المتوسط العمري شهرين). شملت الدراسة ٦٦ ذكرا و٥٦ أنثى. واحد وسبعون طفلا كانوا مرضى باستسقاء المخ، ٢٦ كانوا يعانون من أمراض خلقية بالقلب. تسعة وثمانون مريضا كانوا من مناطق ريفية.

ملخص البحث:

فتق العمود الفقري مرض شائع بمحافظة سوهاج. كلا الجنسين من الممكن أن يصابوا بهذا المرض بصفة متساوية تقريبا. ينتشر هذا المرض بصفة أكبر في المناطق الريفية والمولودين لامهات قد أخذن علاج دوائي في الثلاث شهور الاولى من الحمل وللامهات المولود لهم أطفال بنفس المرض سابقا والامهات الذين لم يأخذوا أقراص حمض الفوليك بشكل منتظم.