CENTRAL NERVOUS SYSTEM BIRTH DEFECTS IN SURGICALLY TREATED INFANTS IN SARAJEVO REGION OF BOSNIA AND HERZEGOVINA

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Abstract

Congenital anomalies of the central nervous system (CNS) are common. The prevalence of these anomalies shows considerable geographical variation and female predominance. The aim of this work was to obtain the frequency of different CNS congenital anomalies types and their sex distribution among cases hospitalized in a Department of Neurosurgery, University of Sarajevo Clinics Center, Bosnia and Herzegovina, during the period January 2001 to December 2004. Retrospective study was carried out on the basis of the clinical records. Standard methods of descriptive statistics were performed for the data analysis. A total of 103 cases were surgically treated in the period from 2001 through 2004. Out of that number 56 (54,4%) were female patients, while 47 (46,6%) were male patients. Seven different CNS birth defect types were found in this investigation. These were: spina bifida (42 cases or 40,78%), congenital hydrocephalus (35 cases or 33,98%), arachnoid cyst (15 cases or 14,56%), Dandy-Walker syndrome (5 cases or 4,85%), dermoid cyst (4 cases or 3,88%), one of Arnold-Chiari syndrome (0,98%) and one of encefalocele (0,98%). According to this investigation, CNS congenital birth defects were slightly higher in females (54,4%). The most frequent types were spina bifida (40,78%) both in females (22,33%) and in males (18,45%), hydrocephalus (33,98%) and arachnoid cyst (14,56%). The anomalies of the other organ systems, associated with CNS anomalies obtained in this investigation, were pes equinovarus, cheiloshisis, cardiomegalia and palatoshisis. They were found in six cases (5,82%), equal in both sexes.

KEY WORDS: congenital anomalies, CNS, frequency, sex distribution

Introduction

A congenital disorder is any medical condition that is present at birth, as contrasted with an acquired disorder. Birth defects, congenital malformations, and congenital anomalies are all-encompassing terms currently used to describe congenital disorders. A congenital disorder can be recognized before birth (prenatal), at birth, or many years later. Congenital disorders can be a result of genetic abnormalities, the intrauterine environment, or unknown factors. A congenital disorder can have trivial or grave effects. The most severe, such as anencephaly, are incompatible with life. Birth defects are a leading cause of death in early infancy, accounting for the deaths of nearly 2 out every 1000 infants, according to data from the U.S. Centers for Disease Control (1). About 2% to 3% of babies are born with significant congenital birth defects. Birth defects involving the brain are the largest group at 10 per 1000 live births, compared to heart at 8 per 1000, kidneys at 4 per 1000, and limbs at 1 per 1000. All other defects have a combined incidence of 6 per 1000 live births. Birth defects of the heart are the most common birth defect leading to death in infancy, accounting for 28% of infant deaths due to birth defects, while chromosomal abnormalities and respiratory abnormalities each account for 15% and brain defects about 12% (2). Due to the complexity of its embryological development, congenital anomalies of the central nervous system (CNS) are common. It is interesting that the prevalence of these anomalies shows considerable geographical variation (3) and female predominance (4,5,6). Defects in the closure of the neural tube account for most anomalies. Normally, in human embryos, the closure of the neural tube occurs around the 30th day after fertilization. However, if something interferes and the tube fails to close properly, a neural tube defect will occur. The incidence of neural tube defects is 2,6 in 1000 worldwide. Among the most common tube defects are anencephaly, encephalocele, and spina bifida. The anomalies may be limited to the nervous system or they may include the overlying tissues. Severe abnormalities of the CNS may result from congenital anomalies of the ventricular system of the brain and may be associated with neural tube closure defects. Congenital abnormalities of the brain may be caused by alterations in the morphogenesis or the histogenesis of the nervous tissue or they can result from developmental failures occurring in associated structures notochord, somites, mesenchyme and skull (7). Spina bifida (Latin: "split spine") is a developmental birth defect involving the neural tube: incomplete closure of the embryonic neural tube results in malformed vertebrae that do not fully enclose the spinal cord. Other neural tube defects include anencephaly and encephalocele. Spina bifida is one of the most common birth defects, with an average worldwide incidence of 1-2 cases per 1000 births, but certain populations have a significantly greater risk. In the United States, the average incidence of 0,7 per 1000 live births. The incidence is higher on the East Coast than on the West Coast, and higher in whites (1 case per 1000 live births) than in African Americans (0,1-0,4 case per 1000 live births). Immigrants from Ireland have a higher incidence of spina bifida than do nonimmigrants. The highest incidence rates worldwide are found in parts of the British Isles, mainly Ireland and Wales, where 3-4 cases of myelomeningocele per 1000 population have been reported, along with more than 6 cases of anencephaly (both live births and stillbirths) per 1000 population. The reported overall incidence of myelomeningocele in the British Isles is 2-3,5 cases per 1000 births. Siblings of patients with spina bifida have an increased incidence of neural tube defects (8,9,10). Spina bifida ranges from clinically significant types to minor anomalies that are clinically unimportant. Spina bifida malformations fall into three categories: spina bifida occulta, spina bifida cystica (myelomeningocele), and meningocele. The most common location of the malformations is the lumbar and sacral areas of the spinal cord. Spina bifida occulta (occulta is Latin for "hidden") occurs in L5 or S1 vertebrae in about ten per cent of otherwise normal people (11). This is one of the "mildest" forms of spina bifida although the degree of disability can vary depending upon the location of the lesion and actually be very severe in some patients. In spina bifida occulta there is no opening of the back, but the outer part of some of the vertebrae are not completely closed. The split in the vertebrae is so small that the spinal cord does not protrude. The skin at the site of the lesion may be normal, or it may have some hair growing from it; there may be a dimple in the skin, or a birthmark (12). A posterior skin dimple in the median plane of the sacral region may be associated with a spinal dermal sinus. These dimples indicate the region of closure of the caudal neuropore at the end of the fourth week and therefore represent the last place of separation between the surface ectoderm and the neural tube. In same cases the dimple is connected with the dura mater by a fibrous cord. Severe types of spina bifida, involving protrusion of the meninges and/or spinal cord through the defect in the vertebral arch, are often referred to collectively as spina bifida cystica because of the cystlike sac that is associated with these anomalies. Spina bifida cystica occurs about once in every 1000

births. When the sac contains meninges and cerebrospinal fluid, the condition is called spina bifida with meningocele. In the most serious form, the sac or cyst not only contains meningeal membranes tissue and cerebrospinal fluid but also nerves and part of the spinal cord. The spinal cord is damaged or not properly developed. The malformation is called spina bifida with meningomyelocele. Meningoceles and meningomyeloceles may occur anywhere along the vertebral column, but they are most common in the lumbar region (13). About 80-90% of fetuses or newborn infants with spina bifida - often associated with meningocele or myelomeningocele - develop hydrocephalus. Hydrocephalus affects one in every 500 live births, making it one of the most common birth defects, even more common than Down's syndrome or deafness (14). According to the National Institutes of Health website, there are an estimated 700 000 children and adults living with hydrocephalus, and it is the leading cause of brain surgery for children in the United States. There are over 180 different causes of the condition, one of the most common being brain hemorrhage associated with premature birth (15). Arnold-Chiari malformation occurs about once in every 1000 births and is frequently associated with both spina bifida and hydrocephalus (1,16). Arnold-Chiari malformation (deformation, syndrome), sometimes referred to as 'Chiari malformation', is the most common congenital anomaly involving the lower brain stem and cerebellum. A tongue-like projection formed by elongation of the medulla and inferior displacement of the vermis of the cerebellum herniates through the foramen magnum into the vertebral canal (17). Dandy-Walker syndrome is a congenital brain malformation involving the cerebellum and the fluid filled spaces around it. The definition of the syndrome used by Hart et al. was 3-fold: (1) hydrocephalus, (2) partial or complete absence of the cerebellar vermis, and (3) posterior fossa cyst contiguous with the fourth ventricle (18). Dandy-Walker syndrome causes 12% cases of all congenital hydrocephalus (19). Arachnoid cysts are a congenital disorder (20), and most cases begin during infancy; however, onset may be delayed until adolescence (21). Arachnoid cysts are extraparenchymal, nonneoplastic accumulations of fluid with density similar to that of cerebrospinal fluid. They account for approximately 1% of intracranial space-occupying lesions, although studies since the advent of CT scanning suggest a higher percentage. A striking male preponderance has been observed. Arachnoid cysts are seen in 4% of the population. Only 20% of these have symptoms, usually from secondary hydrocephalus (22). A study that looked at 2536 healthy young males found a prevalence of 1,7% (95%, confidence interval 1,2 to 2,3%). Only a small percentage of the detected abnormalities require urgent medical attention (23). A rare developmental disturbance of the spinal cord, but an interesting one from the standpoint of theoretical embryology, is an intramedullary or intradural dermoid mass or cyst. During the very early stages in the establishing of the CNS the superficial ectoderm is continuous on either side with the margins of the neural plate. Ordinarily when the neural groove closes over to form the neural tube, there is a clean-cut separation of the ectoderm destined to form epidermis and that destined to form nervous tissue. In the genesis of a dermoid cyst, a few cells of epithelial potentialities must be carried in with the closure of the neural tube (25). Dermoid cyst is usually present at birth, representing a disorder of embryologic development, generally occurring along lines of embryonic fusion, with middorsal, midventral, and branchial cleft locations, most often involving the head, especially around the eyes and the neck (26). The aim of this work was to obtain the frequency of different CNS congenital anomalies types and their sex distribution among cases hospitalized in a Department of Neurosurgery, University of Sarajevo Clinics Centre, Bosnia and Herzegovina, during the period January 2001 to December 2004.

Patients and Methods

Retrospective study was carried out on the basis of the clinical records in a Department of Neurosurgery, University of Sarajevo Clinics Centre, Bosnia and Herzegovina. From 1 January 2001 to 31 December 2004 a total of 103 cases of CNS anomalies were hospitalized. The cases were divided in groups by different types of CNS anomalies. Standard methods of descriptive statistics were performed for the data analysis.

Results

Structure of CNS congenital anomalies treated cases in a Department of Neurosurgery; University of Sarajevo Clinics Centre according to the sex is shown in Table 1. A total of 103 cases were treated in the period from 2001 through 2004. Out of that number 56 (54,4%) were female patients, while 47 (46,6%) were male patients.

GENDER	N°	%
Female	56	54,4%
Male	47	46,6%
TOTAL	**103**	**100%**

TABLE 1. Frequency of hospital treated CNS congenital anomalies cases in a Department of Neurosurgery, University of Sarajevo Clinics Centre, during the period January 2001 to December 2004.

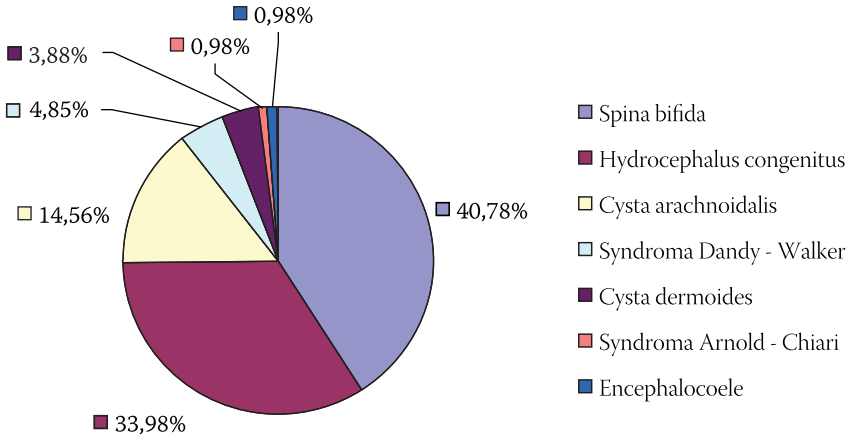

FIGURE 1. Frequency of particular types of CNS birth defects from 2001 to 2004.

Seven different CNS birth defect types were found in this investigation. These were: spina bifida (42 cases or 40,78%), congenital hydrocephalus (35 cases or 33,98%), arachnoid cyst (15 cases or 14,56%), Dandy-Walker syndrome (5 cases or 4,85%), dermoid cyst (4 cases or 3,88%), one of Arnold-Chiari syndrome (0,98%) and one of encefalocele (0,98%). The Figure 1. shows the frequency of different CNS birth defects types treated in a Department of Neurosurgery, University of Sarajevo Clinics Centre, from 2001 to 2004.

The most common malformation found at girls was spina bifida (23 cases or 22,33%), following congenital hydrocephalus (19 cases or 18,44%), arachnoid cyst (7 cases or 6,79%), Dandy-Walker syndrome (3 case or 2,91%), dermoid cyst (2 cases or 1,94%), and Arnold-Chiari syndrome and encephalocele (one of each or 0,98%). Spina bifida was also the most frequent malformation found at boys (19 cases or 18,45%). Hydrocephalus follows with 16 cases (15,53%) and arachnoid cyst (8 cases or 7,76%). Finally, we found Dandy-Walker syndrome and dermoid cysts, 2 cases per each (1,94%). Sex distribution of different CNS birth defects types treated in a Department of Neurosurgery, University of Sarajevo Clinics Centre from 2001 to 2004 is shown in Figure 2.

Different types of spina bifida were myelomeningocoela lumbosacralis (30,96%), myelomeningocoela thoracolumbalis (19,05%), myelomeningocoela sacralis (16,66%), myelomeningocoela lumbalis (9,53%), ly-

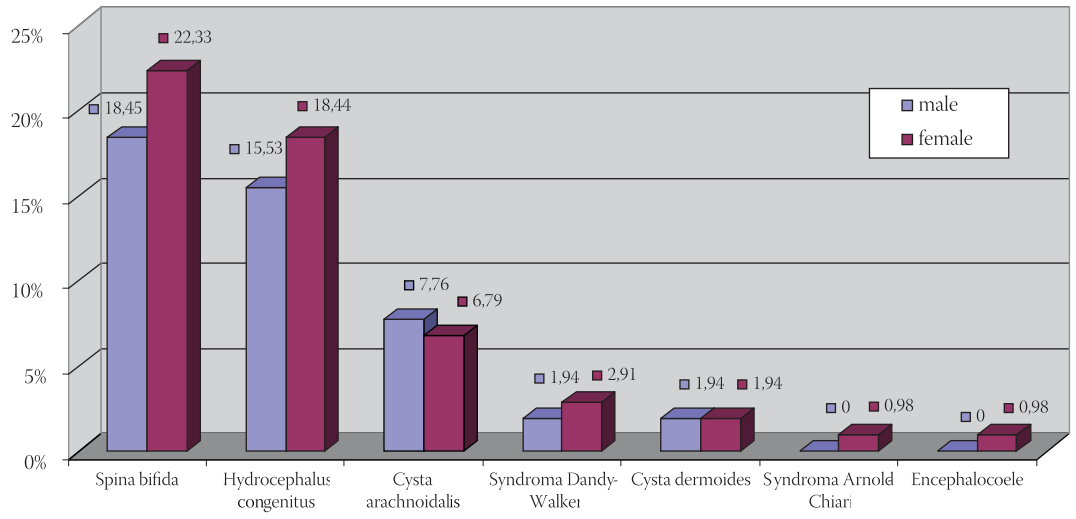

FIGURE 2. Sex distribution among particular CNS birth defects cases

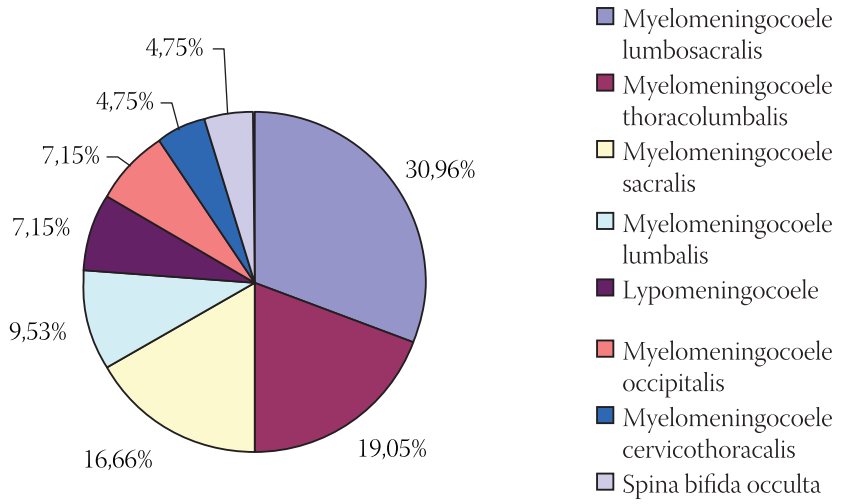

FIGURE 3. Frequency of particular types of spina bifida

pomeningocoela (7,15%), myelomeningocoela occipitalis (7,15%), myelomeningocoela cervicothoracalis (4,75%) and spina bifida occulta (4,75%). Structure of different spina bifida types treated in a Department of Neurosurgery, University of Sarajevo Clinics Centre from 2001 to 2004 is shown in Figure 3. Seven different localizations of arachnoid cyst were found. These were: cystis arachnoidalis thoracalis (26,66%), cystis arachnoidalis temporoparietalis (20%), cystis arachnoidalis sacralis, fissurae Silvii and laminae quadrigeminae (13,34% each), cystis arachnoidalis frontoparietalis and cystis arachnoidalis retrocerebellaris (6,66% each) (Figure 4.). Multiple anomalies were found in six cases (5,82%), equally in both sexes. The anomalies associated with CNS anomalies obtained in this investigation were: pes equinovarus, cheiloshisis (two of each case), cardiomegalia and palatoshisis (one of each).

Discussion

In the period from 1 January 2001 to 31 December 2004 a total of 103 cases of CNS anomalies were registered and that 56 (54,4%) females and 47 (46,6%) males; sex ratio – 1,2:1. Among total number of seven different types of investigated CNS anomalies, the most frequent ones was spina bifida (40,78%). The following were congenital hydrocephalus (33,98%) and arachnoid cyst (14,56%). Dandy-Walker syndrome (4,85%), cystis der-

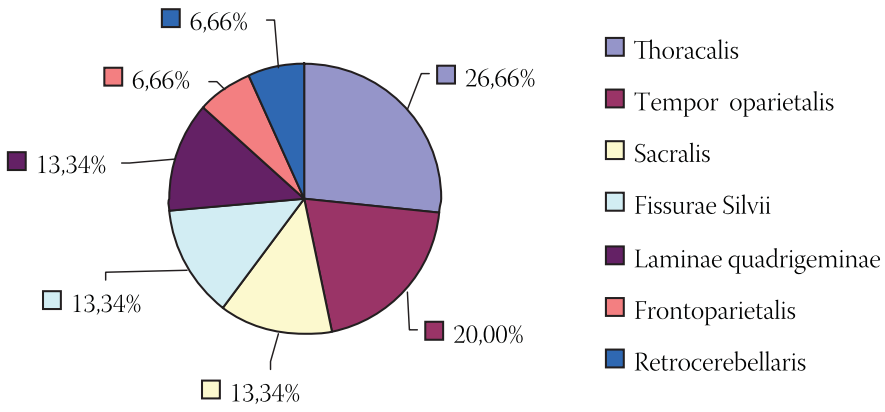

FIGURE 4. Frequency of particular localizations of arachnoid cysts

moides (3,88%) and Arnold-Chiari syndrome and encephalocele (0,98% both) were much rare. Almost half of all hospitalized cases (40,78%) had spina bifida. This malformation were dominant in females (22,33%) and males (18,45%) both. The most frequent type of spina bifida were myelomeningocoela lumbosacralis (30,96%). These findings correspond with literature ones (13). Prevention of birth defects is one of the greatest national interests. Prevention of spina bifida through dietary folate supplements and prenatal counseling is now widespread. In our country must be given more attention to the prevention programs and activities. There is a need to consider an intensive approach to periconceptional folic acid supplementation, genetic counseling and to the establishment of country congenital anomaly registries. The establishment of congenital anomaly registries has taken place for the purpose of the surveillance of the birth defects in a view of their growing contribution in infant morbidity and mortality structure (14). EUROCAT is a network of population-based registries for the epidemiologic surveillance of congenital anomalies that is active in Europe over last 25 years, covering 1,2 million births per year. The objectives of the EUROCAT registry are: providing essential epidemiologic information on congenital anomalies, early detection of teratogenic exposure and clustering in time and space, evaluating the effectiveness of policies and practice of primary prevention and prenatal screening in European countries. EUROCAT operates as an effective collaborative network and infrastructure for research related to the causes and prevention of birth defects (14,27). The establishment the Bosnia and Herzegovina registry and the Referral Centre of the Ministry of Health for Surveillance of Birth Defects would improve the quality control and enhance the planning of the health care programmes for pregnancy and early childhood.

Conclusion

According to this investigation, CNS congenital birth defects were slightly higher in females (54,4%). The most frequent types were spina bifida (40,78%) both in females (22,33%) and in males (18,45%), hydrocephalus (33,98%) and arachnoid cyst (14,56%). The anomalies of the other organ systems, associated with CNS anomalies obtained in this investigation, were pes equinovarus, cheiloshisis, cardiomegalia and palatoshisis. They were found in six cases (5,82%), equal in both sexes.

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