MAJOR CONGENITAL MALFORMATIONS AMONG SAUDI INFANTS ADMITTED TO ASIR CENTRAL HOSPITAL

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While infections and malnutrition are the dominant causes of infant morbidity and mortality in the poorer countries of the world,[1] in the developed countries these causes are cancer, accidents and congenital malformations.[2,3] In Saudi Arabia, a rich and fast-developing nation with a very effective expanded program on immunization, childhood malnutrition has virtually been eradicated and infection is fast disappearing; and therefore, congenital malformations, accidents and cancer will rank as the major childhood health problems.

Surveys on congenital malformations have been carried out in Riyadh[4] and Al-Qassim,[5] which are cities in the central area of Saudi Arabia. In these studies, the prevalence of congenital malformations was found to be high, with a male preponderance, and etiologically related to heredity. To our knowledge, a similar study has not been conducted among infants in the Southwestern area; there may be regional variations in the pattern of congenital anomalies. It therefore becomes desirable to study the pattern of congenital malformations (CM) in the Asir Region, which is in the Southwestern area of Saudi Arabia. In this paper, we have attempted to analyze the pattern of CM seen in the neonatal intensive care unit of Asir Central Hospital, Abha, Saudi Arabia, during a four-year period. For genetic and racial homogeneity, the study was confined to infants of Saudi nationality.

Patients and Methods

This is a retrospective study which involves all neonates admitted and treated in Asir Central Hospital (ACH) with a confirmed diagnosis of

congenital malfor-mation during a four-year period (January 1992 to December 1995). The pediatric service of the hospital has the subspecialties in cardiology, neonatology, neurology, nephrology and pediatric surgery. There are laboratory facilities for plain and contrast radiography, computerized tomography, ultrasound, echocardiography, chromosomal analysis and electron microscopy. Each case was investigated as indicated; for instance, chromosomal analysis was limited to infants with dysmorphic features and multisystemic defects. However, every newborn with CM had a complete blood count, urea, electrolytes, blood sugar and plain radiograph done as a routine. Magnetic resonance imaging scan can be easily carried out in a hospital within the vicinity. Asir Central Hospital serves as a tertiary and referral institution for all other hospitals and clinics in the Asir Region of Saudi Arabia. The region has a population of about two million and covers an area of about 80,000 square kilometers. ACH is one of 19 hospitals and 238 primary health centers (PHC) in the region. As a policy, it is mandatory that any patients in this catchment area requiring transfer for the purpose of specialized investigations and treatment must be referred to ACH. These other primary and secondary health institutions do not have facilities for sophisticated investigations and pediatric surgery.

The NICU admission and newborn surgery registers were scanned to sort out all the infants admitted or operated upon for congenital malformations. The NICU register contains both the admission and discharge or definitive diagnosis on each patient. The charts of these patients were subsequently pulled out for detailed study. Data abstracted included the date of admission, age, sex, place of birth and nationality. Other information included clinical, laboratory and operative findings, treatment measures and outcome (discharged, transferred or dead). No autopsy examinations were performed on those infants who succumbed. Patent ductus arteriosus secondary to prematurity and acquired hydrocephalus associated with

TABLE 1. *Number of Saudi newborns admitted per year and those with CM in the years 1992 to 1995.*

Year	Number admitted	Number with CM (% total)
1992	193	65 (33.7)
1993	221	77 (34.8)
1994	214	77 (36)
1995	223	66 (29.6)
Total	851	285 (33.5)

TABLE 2. *Number of cases of congenital malformations prevalent in 285 Saudi newborns.*

Location of CM	Number of cases	Percentage of cases
Alimentary tract	162	43.1
Central nervous system	70	18.6
Cardiovascular	67	17.8
Genitourinary	26	6.9
Chromosomal	16	4.6
Respiratory	14	3.7
Craniofacial	8	2.1
Musculoskeletal	7	1.8
Ophthalmic	4	1
Miscellaneous	2	0.5
Total	376	100

TABLE 3. *Frequency distribution and percentages of different CM among 285 Saudi infants admitted (Jan. 1992 to Dec. 1995).*

Congenital malformations	Frequency	Percentage of total (n=285)
Alimentary tract	162	56.8
Central nervous system	70	24.6
Cardiovascular	67	23.5
Genitourinary	26	9.1
Chromosomal	16	5.6
Respiratory	14	4.9
Craniofacial	8	2.8
Musculoskeletal	7	2.5

Ophthalmic	4	1.4
Miscellaneous	2	0.7

ventriculitis and intraventricular hemorrhage were excluded.

For the detailed data analysis, only the Saudi patients were ultimately considered. The data were therefore analyzed to highlight the pattern and the relative importance of the different types of congenital defects prevalent among the Saudis in the Asir region. Though commonly used terms such as anomalies, deformities and defects have different connotations, we have decided to use them interchangeably with malformation occurring and presenting at birth or recognized later. To classify the anomalies, we used a system similar to that of Christianson et al.[6] A major congenital malformation is defined as any condition of prenatal origin which is potentially life-threatening or if not corrected, would seriously impair development or well-being.

Results

During the four-year period, a total of 969 infants were admitted into the NICU of ACH. These were made up of 851 (87.8%) Saudi and 118 (12.2%) non-Saudi infants. Of these groups, 285 Saudis and 37 infants of other nationalities were discovered to have congenital malformations (CM). It can be seen from Table 1 that, overall, and for every consecutive year during the period, about one-third of the Saudi infants were admitted into the unit on account of CM. This implies that the yearly prevalence of CM in the population is the same every year. The sex incidence among these 285 infants was 153 males to 132 females (ratio 1.2:1). These included seven infants with ambiguous genitalia, who were proven by chromosomal analysis to be five males and two females.

Tables 2 and 3 provide the different types of CM and the numbers seen. Some infants had a multiplicity of anomalies, so that the total number of congenital lesions exceeds the number of affected newborns. Altogether, 376 anomalies were documented in the 285 infants.

The alimentary canal was the most affected, involving 162 or 56.8% of the 285 patients. Among this group, the most frequent lesions were imperforate anus, tracheo-esophageal fistula, diaphragmatic hernia and

ileal atresia, representing 12.6, 8.8, 7.7 and 6.3% of the 285 patients, respectively. Of the 22 cases of diaphragmatic hernia, 20 (91%) were in the left side and 2 (9%) involved the right side. There were five cases of esophageal atresia without fistula.

The central nervous system (CNS) came second in frequency, involving 70 or 24.6% of the newborns. Hydrocephalus (34 patients or 11.9%), followed by meningomyelocele (21 patients or 7.3%) were the most prominent CNS lesions. All of the 21 cases of meningomyelocele were associated with hydrocephalus.

In the cardiovascular system (CVS), which involved 67 or 23.5% of patients, ventricular septal defect was the most common lesion detected. This lesion was isolated in five cases and associated with other structural cardiac abnormalities in eight cases. Pulmonary stenosis, transposition of the great arteries and atrial septal defect were also fairly important. In nine patients, the cardiac lesion could not be clearly defined and had to be referred to the cardiac center in Riyadh, where they were unfortunately lost to follow-up.

In the genitourinary system, the most common anomaly was ambiguous genitalia. Five of the seven infants were of the salt-losing type. Imperforate anus was associated in two of the seven cases. The 16 of the trisomy syndromes were dominated by Down syndrome (11 cases). Thirteen of these also had anomalies involving the alimentary canal (eight cases) and the CVS (five cases).

Multisystem Involvement

The anomalies were limited to one functional system in 260 patients, two systems in 21, three in three and four in one patient. Thus, there was an associated multiple condition in 8.8% of the infants. It was common to find that within an affected anatomical system, multiple areas were involved, especially in the heart and craniospinal axis.

Management and Outcome

Three children with isolated patent ductus arteriosus, coarctation of the aorta and tetralogy of Fallot (Blalock-Taussig shunt only), respectively, were surgically corrected in Asir Central Hospital, but all other cardiac

cases requiring surgery had to be referred to the central cardiac referral center either in Riyadh or Jeddah. All the noncardiac cases were routinely and surgically managed in our institution.

Fifty-two (18%) of the 285 patients with CM died. Congenital malformation therefore constitutes 6% mortality of the 851 Saudi newborns admitted during the period. The fatality rate related to each functional system is demonstrated in Table 4. The death rate was comparatively the highest (21.9%) in patients with the CVS malformation. This was followed by those with trisomies (18.8%) and alimentary canal anomalies (17.9%). The three deaths among the trisomy cases were related to cardiac defects. Thirteen infants with cardiac defect died before they could be transferred. The one with Blalock-Taussig anastomosis also died following a leakage from the shunt site.

Discussion

The observations made in this communication should only be regarded as preliminary. Ours is a referral institution; thus, we are encountering only those infants with major congenital defects. It is expected that those with minor defects were retained by the referring hospitals. Also, we have had no access to stillbirths, a number of which would have been due to lethal congenital malformations. It is therefore difficult to quote with any degree of accuracy the incidence of congenital malformation in the Asir population. However, since ACH acts as the only clearing house for all patients within the Asir Region, requiring specialized investigative and treatment procedures, the authors believe that the NICU in ACH had pulled perhaps the entire bulk of the infants with major congenital anomalies in the area. This study therefore can provide some clue as to the prevalent types and the pattern of major CM in the population. We will therefore limit our comments to only the major CM and hope that some clue will be derived regarding the prevalent pattern of this condition in the Asir region.

The study has identified that over the period of four years, congenital malformation constituted about one-third of the neonatal admissions in every consecutive year. This implies that CM contributes significantly to perinatal and infant morbidity in the Asir region of Saudi Arabia.

TABLE 4. *Mortality frequency and fatality rate related to the affected system.*

System affected	# of cases	# of deaths	Fatality rates (%)
Alimentary tract	162	29	17.9
Central nervous system	70	4	5.7
Cardiovascular	67	14	21.9
Chromosomal	16	3	18.8
Respiratory	14	2	14.3

A male preponderance corroborates the results of other researchers.[5,7-9] It may be speculated that either the females were afflicted with more lethal CM and could not survive to be transferred, or that their malformations were so mild that they did not require referral.

In this study, the alimentary tract, nervous system and cardiovascular system are the most commonly affected parts in descending order of frequency. This is at par with the experience in the central area of Saudi Arabia.[4,5] Surveys in another Gulf country, the United Arab Emirates,[10] and Hungary[11] have revealed a similar picture. In contrast, surveys in the USA[12] and the United Kingdom[13] identified the CNS as leading among these top three.

In the alimentary tract, imperforate anus, diaphragmatic hernia and tracheoesophageal fistula were the most prevalent lesions. This is in consonance with the observation in Al Qassim in the central region of Saudi Arabia.[5] Regarding the central nervous system, the most prevalent anomaly encountered was hydrocephalus with and without meningomyelocele. With special reference to the neural tube defect, the incidence of this condition has markedly declined in most of the developed world countries following mass promotion and mandatory prescription of folic acid for pregnant mothers.[14-16] We are not able to determine compliance to folic acid prophylaxis in the Asir region. It would be desirable to evaluate from time to time if the antenatal clinics in the Asir region are prescribing this drug for their clients. In the cardiovascular system, the ventricular septal defect is the most common lesion, as is the experience the world over. Of all organs, the heart was the one with the greatest multiplicity of lesions, which is a reflection of the high-quality pediatric echocardiography service in our institution. Generally, the study revealed multisystem lesions among a significant number of infants, thus reflecting the polymorphous nature of congenital malformation. This finding might have been utilized in formulating a syndromal diagnosis, but the preliminary nature of this survey precluded a venture on this perspective.

The study has revealed that 6% of the Saudi infants admitted into our NICU die of causes related to CM. This figure most likely represents an overestimation of events in the population, since this institution admits only those infants with major malformations and therefore, with poor prognosis. The fatality rate was 18% which, on the other hand, appears an underestimation, as some of the infants might have died in other hospitals to which they were further transferred. The mortality toll was highest among those with cardiac defects. This underscores the importance of establishing a cardiac surgery unit in the Asir region in order to avoid a delay in instituting appropriate treatment measures on those infants with surgically correctable cardiac defects.

The Al Qassim study[5] discovered that a maternal age above 25 years, chronic maternal disease, and consanguineous marriage were associated with a high incidence of CM. In that survey, 54% of the patients with CM were of consanguineous marriages. Consanguineous marriage is an important correlate of congenital malformation.[17] We are unable to comment on the etiological correlates of our findings due to limitations of our retrospective study in a purely referral unit. For instance, the parents were rarely available to provide the sociodemographic aspect of the history. Nevertheless, we hope that the present study can be utilized as a database for further surveys. An in-depth analytic research is necessary to determine the possible genetic, sociodemographic and socioenvironmental factors underlying the various types of CM encountered in the Asir region and therefore to consider possible preventive measures.

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