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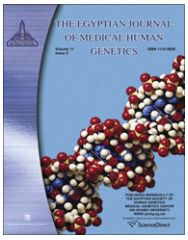

ORIGINAL ARTICLE

Chromosomal study in newborn infants with congenital anomalies in Assiut University hospital: Cross-sectional study

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Abstract In 40–60% of congenital malformations, the cause is unknown. Genetic factors account for approximately 15%; environmental factors produce approximately 10%; a combination of genetic and environmental influences produces 20–25%. The study aims to document prevalence and patterns of congenital malformations detected at birth in Assiut University hospital and clarify underlying chromosomal abnormalities of such malformations. Also possible predisposing factors will be studied.

Newborns with apparent congenital anomalies were selected from 5000 newborn infants delivered consecutively at the department of Obstetrics and Gynecology within 7 months. Full maternal history, family history, perinatal history, pedigree construction as well as clinical examinations and investigations including karyotype were done. Congenital anomalies were found in 103 cases with a prevalence of 2.06% with male to female ratio of 1.7:1. Skeletal system anomalies had the highest

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frequency (37.9%), followed in descending order by chromosomal abnormalities (27.2%), circulatory system anomalies (22.3%), central nervous system (CNS) anomalies (19.4%), genital organs anomalies (16.5%), gastrointestinal tract (GIT) anomalies (14.6%), eye and ear anomalies (8.7%), and lastly urinary system and others anomalies in 3.9% each. Breech presentation, perinatal asphyxia, incubator admission and the need for resuscitation were significantly associated with the presence of congenital anomalies. Higher prevalence of congenital anomalies was observed in neonates of grand multiparous women, diabetic mothers delivery by CS, cases with oligohydramnios and with positive consanguinity.

Chromosomal abnormalities were found in 28 cases (27.18% of malformed cases) (5.6/1000). Numerical abnormalities were found in 22 cases (21.35%) (4.4/1000), Down syndrome in 16 cases, Edward syndrome in two cases, Patau syndrome in one case and Turner syndrome (monosomy) in three cases. Structural abnormalities were present in six cases (5.83%) (1.2/1000), Down syndrome in two cases, Turner syndrome in two cases, balanced translocation [(12;13)(q15;q34)] with dysmorphic features and undescended testis in one case and deletion 9(q11;q31) with disorder of sex development in one case.

To conclude karyotype should not be done routinely for all malformed cases as many of them are due to genetic syndromes. So, it is more useful to consult expert dysmorphologists for proper syndrome identification and for the decision to use more recent molecular techniques for diagnosis.

1. Introduction

Congenital malformations, congenital anomalies, and birth defects are synonymous terms used to describe structural, behavioral, functional, and metabolic disorders present at birth [1]. Malformation is a term reserved for permanent change produced by an intrinsic abnormality of development in a body structure during prenatal life. The actual mechanisms providing malformations are largely unknown, but may involve various errors in embryonic cell proliferation, differentiation, migration and programmed death, as well as cell-to-cell "communication". Multiple tissue types may be involved, and if examined histologically, they usually have normal appearance. Malformative processes produce a wide variety of ultimate effects together with a considerable spectrum of severity. Some processes result in a structure that is too small, others produce overgrowth; some show disorganization of tissue, whereas still others simply change the shape of a part of the body [2]. In 40–60% of congenital malformations, the cause is unknown. Genetic factors, such as chromosomal abnormalities and mutant genes, account for approximately 15%; environmental factors produce approximately 10%; a combination of genetic and environmental influences (multifactorial inheritance) produces 20–25% [1].

2. Subjects and methods

The study was done in Assiut University hospital in upper Egypt within 7 months from 1/3/2007 to 1/10/2007 and neonates with apparent congenital anomalies were selected from 5000 newborn infants delivered consecutively at the department of Obstetrics and Gynecology. The work and karyotype were done at Genetics unit at Pediatric department. A full maternal history was taken regarding age, residence, parity, history of previous births, drug intake, acute and chronic illnesses during pregnancy, pregnancy complications as diabetes mellitus and pre-eclampsia, obstetric complications as multiple pregnancy, oligohydramnios, polyhydramnios, radiation exposure and bleeding. Family history was taken for similar cases, chromosomal abnormalities and still births. Relevant perinatal events as fetal presentation, mode of delivery, estimated gestational age, and perinatal asphyxia were recorded. A family pedigree was constructed for all cases. All newborns were examined thoroughly to determine gestational age, birth weight, jaundice, pallor, cyanosis, minor or gross external anomalies. Investigations were selected according to the demands of individual cases e.g. X-rays, echocardiography, abdominal ultrasonography, computerized tomography of the brain, and fundus examination. Karyotype was done for all malformed cases (103 cases). Congenital anomalies were classified using ICD-10 classification [3]. Statistical analysis was performed using *t*-test, chi-square test to investigate the significances of different variables.

3. Results

From 5000 liveborn infants (3052 males and 1936 females and 12 with DSD [Disorder of Sex Development]), the congenital anomalies were found in 103 cases with a prevalence of 2.06%: 65 males (2.13%), 38 females (1.95%) (after documenting that the 12 cases with DSD to be 2 males and 10 females) giving total male to female ratio of 1.7:1. From 103 cases; skeletal system anomalies had the highest frequency, followed in descending order by chromosomal abnormalities, circulatory system anomalies, central nervous system (CNS) anomalies, genital organs anomalies, gastrointestinal tract (GIT) anomalies, eye and ear anomalies, and lastly urinary system and other anomalies (Table 1, Figs. 1–4).

Neonatal circumstances in the present study as gestational age, sex, and birthweight did not have a significant effect on the occurrence of congenital malformations. On the other hand breech presentation, perinatal asphyxia, incubator admission and the need for resuscitation were significantly associated with the presence of the congenital anomalies (Table 2).

As regards maternal factors, there was no association between the occurrence of congenital anomalies and the age of the mother, drug intake, fever, pre-eclampsia, ante- and

Table 1 ICD Classification for congenital anomalies among 5000 livebirths.

Codes	Anomalies	$N = 103$	%	/1000
1. Central nervous system		20	19.4	4
Q00.0	Anencephaly	1	0.97	0.2
Q01.	Encephalocele	2	1.9	0.4
Q02.	Microcephaly	7	6.8	1.4
Q03.	Congenital hydrocephalus	9	8.7	1.8
Q05.	Spina bifida	5	4.9	1
Q07.8	Facial palsy + bulbar palsy	1	0.97	0.2
2. Eye and ear		9	8.7	1.8
(Q11.)	Anophthalmos, microphthalmos			
Q11.1	Bilateral anophthalmos	1	0.97	0.2
Q11.2	Microphthalmia	1	0.97	0.2
(Q12.)	Congenital lens malformation			
Q12.0	Congenital cataract	4	0.38	0.8
(Q17.)	Congenital malformation of the ear			
Q17.0	Accessory auricle	1	0.97	0.2
Q17.2	Microtia	1	0.97	0.2
Q17.8	Isolated cauliflower ear		1	0.97
3. Circulatory system		23	22.3	4.6
Q21.0	VSD	13	12.6	2.6
Q21.1	ASD	5	4.8	1
Q21.3	Tetralogy of Fallot's	1	0.97	0.2
Q21.4	PDA	5	4.8	1
4. Digestive system		15	14.6	3
Q35.	Cleft palate	4	3.88	0.8
Q36.	Cleft lip	1	0.97	0.2
Q37.	Cleft palate + cleft lip	5	4.85	1
Q39.2	Tracheo-oesophageal fistula	2	1.9	0.4
Q42.3	Imperforate anus	3	2.9	0.6
5. Genital organs		17	16.5	3.4
Q53.	Undescended testis	5	4.85	1
Q56.	Disorder of sex development	12	11.7	2.4
6. Urinary system		4	3.9	0.8
Q61.1	Polycystic kidney	2	1.9	0.4
Q64.1	Ectopia vesica	1	0.97	0.2
Q64.8	Rectovesical fistula	1	0.97	0.2
7. Skeletal system		39	37.9	7.8
Q65.0	Congenital hip dislocation	2	1.9	0.4
Q66.0	Congenital talipes equinovarus	11	10.7	2.2
Q69.0	Polydactyly	4	3.9	0.8
Q69.9	Pedunculated post-minimi	1	0.97	0.2
Q70.2	Syndactyly	2	1.9	0.4
Q70.4	Polysyndactyly	3	2.9	0.6
Q71.3	Absent thumb, absent 3 fingers	3	2.9	0.6
Q71.8	Reduction defects of upper limb (short right hand and short fingers)	1	0.97	0.2
Q72.8	Reduction defects of lower limb (absent foot and lower third of Rt. leg)	1	0.97	0.2
Q74.3	Arthrogryposis multiplex congenita	3	2.9	0.6
Q75.4	Treacher Collins syndrome	1	0.97	0.2
Q79.2	Exomphalos major and minor	6	5.8	1.2
Q79.4	Prune Belly syndrome	1	0.97	0.2
8. Others		4	3.9	0.8
Q82.8	Cutis laxa syndrome	2	1.9	0.4
Q87.2	Rubinstein-Taybi syndrome	1	0.97	0.2
Q87.5	Cornelia de lange syndrome	1	0.97	0.2

(*continued on next page*)

Table 1 (*continued*)

Codes	Anomalies	*N* = 103	%	/1000
9. Chromosomal abnormalities		28	27.2	5.6
Q90.	Down's syndrome	18	17.4	3.6
Q90.0	Trisomy 21, non-disjunction	14	13.5	2.8
Q90.2	Trisomy 21, translocation	2	1.9	0.4
Q90.9	Down syndrome unspecified (Trisomy 21 with marker chromosome)	2	1.9	0.4
Q91.	Trisomy 18 and Trisomy 13	3	2.9	0.6
Q91.0	Trisomy 18, non-disjunction	2	1.9	0.4
Q91.4	Trisomy 13, non-disjunction	1	0.97	0.2
Q93.	Monosomies, deletions from autosomes			
Q93.8	46,XY,del 9(q11;q31) disorder of sex development	1	0.97	0.2
Q95.0	46,XY,t(12;13)(q15;q34) dysmorphic features + undescended testis	1	0.97	0.2
Q96.	Turner syndrome	5	4.8	1
Q96.0	Turner syndrome, 45,X	3	2.9	0.6
Q96.1	Turner syndrome, 46,X,i(Xq)	2	1.9	0.4

N.B. There is overlap of anomalies so the number of anomalies in table is higher than the total number of anomalies as the single case may contain more than one anomaly.

post-partum hemorrhage, polyhydramnios, residence, or family history of congenital anomalies. On the otherhand higher prevalence of congenital anomalies was observed in neonates of grand multiparous, diabetic women, delivery by CS, in the presence of maternal oligohydramnios and in cases with positive consanguinity (Tables 3–5).

Normal karyotype was detected in 75 cases (72.8%) (46 males and 18 females and 11 cases presented as DSD who documented to be 10 females and 1 male by karyotype). Chromosomal abnormalities were found in 28 cases and classified into numerical and structural. Numerical abnormalities were present in 22 cases with a prevalence of 4.4/1000 in the form of Down syndrome in 16 cases, Edward syndrome in two cases, Patau syndrome in one case and Turner syndrome in three cases. Structural abnormalities were present in six cases with a prevalence of 1.2/1000 in the form of Down syndrome in two cases, Turner syndrome with iso(q) in two cases, balanced translocation [(12;13)(q15;q34)] presented as dysmorphic features and undescended testis in one case and deletion 9(q11;q31) presented as DSD in one case (Tables 6 and 7, Figs. 5–8).

Those patients with normal karyotype were due to either genetic syndromes, teratogenic or the cause cannot be detected.

4. Discussion

The prevalence of congenital anomalies in the present study in Assiut governorate in upper Egypt was 2.06% which is nearly similar to the prevalence in other localities in Egypt as in Mansoura (2.3%) [4] and Alexandria (2.4%) [5].

Similar results were found by Ruth Kohut and Rusen in Canada [6] and Plato [7] who reported prevalence of congenital anomalies in 2–3%. A lower prevalence was reported in other localities in Egypt as in Giza (1.16%) [8]. Also a lower prevalence was reported in Turkey (1.115) [9] and in Pakistan (1.14%) [10]. A higher prevalence was reported in other studies in Egypt as in Giza (2.75) [11] and in Cairo (2.75) [12]. The higher prevalence reported in Giza may be related to inclusion of live births and still births in the study. Also a higher prevalence was reported by Holmes (5%) [13].

From 103 cases with congenital anomalies detected in this study; skeletal system anomalies had the highest frequency (37.9%), followed in descending order by chromosomal abnormalities (27.2%), circulatory system (CVS) anomalies (22.3%), central nervous system (CNS) anomalies (19.4%), genital organs anomalies (16.5%), gastrointestinal tract (GIT) anomalies (14.6%), eye and ear anomalies (8.7%), and urinary system and others anomalies in 3.9% each. In another Egyptian study done by Shawky et al. [12] on 1000 liveborn infants in Cairo, the highest frequency of congenital anomalies involved the CNS (33%) followed in descending order by multiple congenital anomalies (19%), skeletal anomalies (15%), GIT anomalies (11%), renal anomalies (7%), and CVS anomalies (4%). In another Egyptian study done by Afifi et al. [8] in another locality in Egypt. They classified anomalies according to "Genetic/Diagnostic/Referral classification" the genetic counseling group represented the highest percentage (17%), followed by neurologic disorders (9.5%), chromosomal disorders (9.3%), genetic syndromes (8.3%), growth disorders (8.2%), mental retardation and behavioral disorders (8.1%), neuromuscular disorders (5.7%), metabolic disorders (5.3%), endocrinal disorders and skeletal disorders (4.9% for each), dermatological disorder (1.1%), renal disorders (0.5%), 6.4% of cases could not be classified because their investigations were incomplete, and 27.9% of cases had delayed milestones of motor and mental development for which the etiology was unknown. In the Egyptian studies the differences in frequency of congenital anomalies from one locality to another my be attributed to many reasons, first; the difference in the basis of classification of congenital anomalies as in this study we used ICD-10 classification which collect some categories of anomalies together while Shawky et al. [12] divided the anomalies into minor and major and put omphalocele with GIT anomalies and Afifi et al. [8] depend on another system for classification. Second; the higher frequency of consanguinity in upper Egypt than other areas in Egypt, third; the differences in environmental exposures from one locality to another in Egypt, fourth; nutritional status and habits (because of high cost in nutritional elements and low economic status of some individuals, some pregnant women cannot get necessary vitamins during their pregnancy). In a study done by Ahmadzadeh

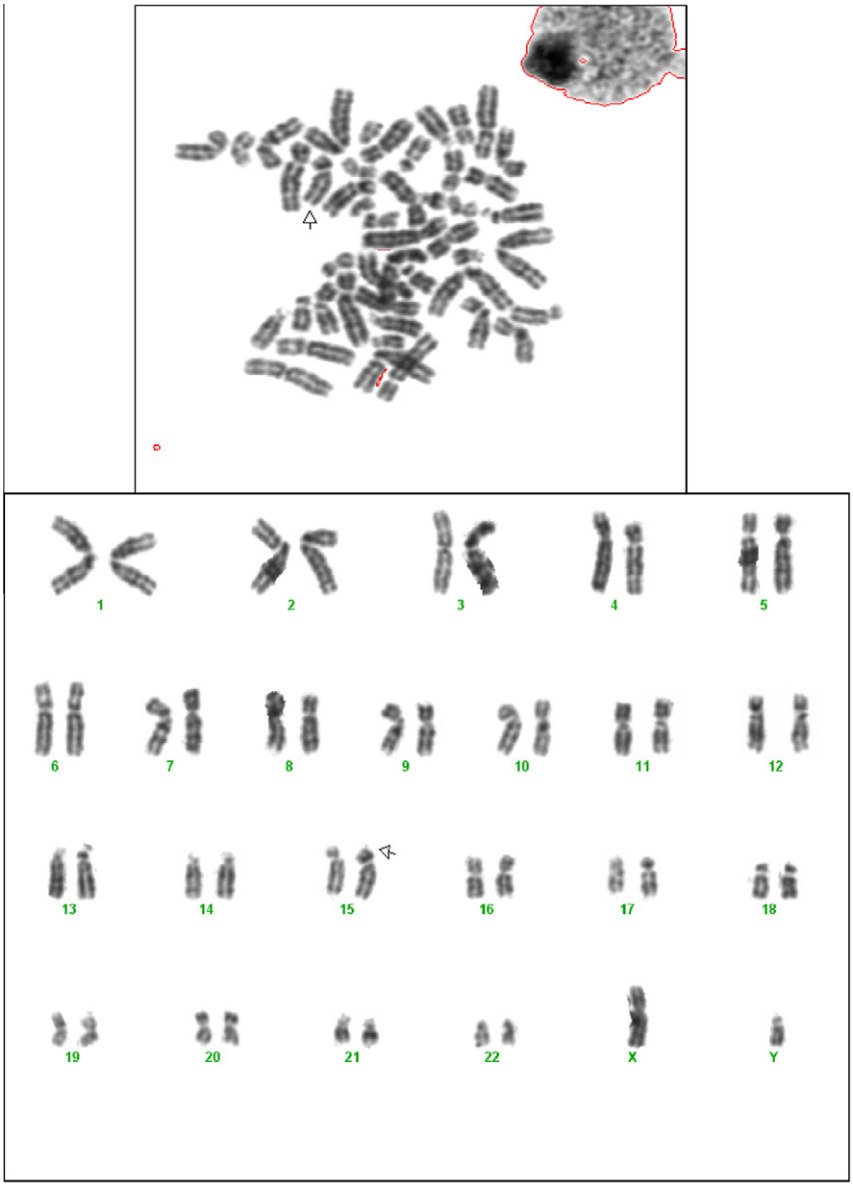

Figure 1 Case with karyotype 46,XY,der (15;21)(q10;q10) + 21. The finding are consistent with the diagnosis of Down syndrome.

et al. [14] in Iran, the most frequently involved system was musculoskeletal system anomalies (39.7%) followed in descending order by genitourinary system anomalies (35.1%), CNS anomalies (11.7%), digestive system (5.3%), chromosomal anomalies (4.3%), CVS anomalies (3.2%) and lastly respiratory tract anomalies (1.1%).

Male to female ratio of the studied cases with congenital anomalies was 1.7:1 which is similar to results of Ahmadzadeh et al. [14] in Iran who reported a ratio of 1.6:1 and lower than the results of another study in Iran (2.1:1) [15]. In the present study males were more affected than females meanwhile in another Egyptian study females were more frequently affected (0.6:1) [12]. It has been found that oxidative stress may induce the excess of congenital malformations and it has been found that male infants are more vulnerable to oxidative stress. Thus, increased vulnerability in male embryos to oxidative stress might be one of the causes for increased frequency of congenital anomalies in males than in females [16,17].

In this study a higher frequency of congenital anomalies was observed in neonates of grand multiparous women than control population (61.2% versus 23.7%, $p < 0.001$). The results were in agreement with the work of Sipila et al. [18] who found that congenital anomalies were higher in grand multipara than women with low parity because essential hypertension was more common among grand multiparae than among women of lower parity and this is probably a consequence of higher maternal age and Baskett [19] also showed lack of adequate antenatal care may be a cause [7]. Also Mwambingu et al. [20] found that in the grand multiparae, the incidences of gestational diabetes, hypertension, rheumatic heart disease, ante-partum, post-partum hemorrhage and macrosomic infants were increased.

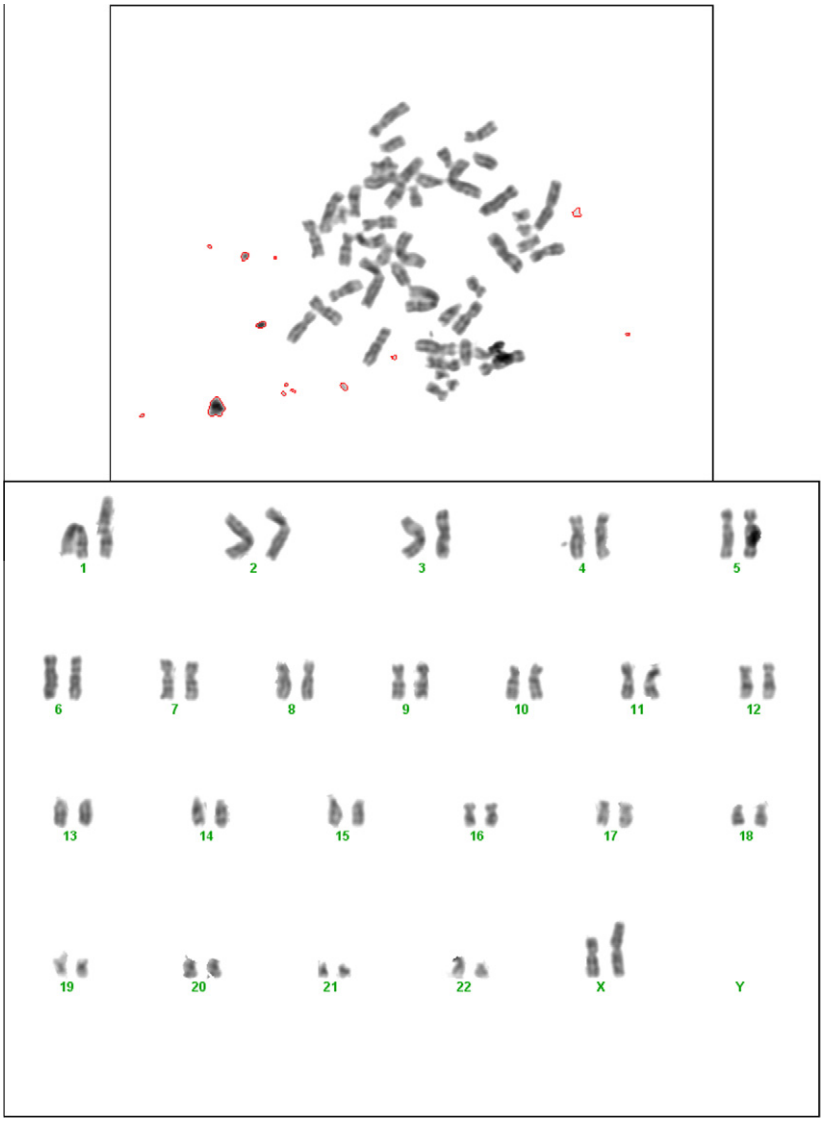

Figure 2 Turner syndrome with karyotype 46,X,iso(X)(q10;q10).

No significant association was found in this study between the age of the mother and the risk of increase in congenital anomalies and this agrees with the results of Shawky et al. [12]. Stein and Susser [21] stated that older women have a consistently increased risk only for Down's syndrome while others stated that the risk for chromosomal abnormalities and Down syndrome increases with increase in maternal age [22]. In our study the average age of mothers of Down syndrome cases was 36.4 years. The high figures of chromosomal abnormalities in our study may be due to increased number of Down syndrome cases (18/28) (64%).

Also in this study there is significant higher frequency of congenital anomalies in neonates delivered by CS than control population (54.4% versus 29.7%, $p < 0.001$). This agrees with the results of Treadwell et al. [23] who found the rate of CS was almost twice as high in infants with abnormal karyotypes as in the general population. However the results of Shawky et al. demonstrated no association between the frequency of congenital anomalies and the route of delivery [12], and attributed to other problems associated with congenital anomalies that my interfere with normal vaginal delivery as fetal distress, abnormal pituitary adrenal axis in patients with CNS anomalies, as intact pituitary adrenal axis is essential for initiation of normal labour. George and Ioannis [24] found that in humans, maternal plasma corticotropin releasing hormone (CRH), adrenocorticotropin hormone (ACTH), and cortisol levels increase during normal labour.

There is a significant higher frequency of congenital anomalies in neonates delivered to diabetic mothers than controls (25.2% versus 4.5%, $p < 0.001$). In this study the most commonly affected system in neonates of diabetic women was the musculoskeletal system (42%) (11/26) followed by the CNS (26.9%) (7/26), CVS (26.9%) (7/26), GIT (23%) (6/26), chromosomal abnormalities (19%) (5/26), and lastly eye and genital anomalies (3.8%) (1/26) for each. This result agrees with that of Casson et al. [25] who stated that infants of women with pre-existent insulin dependent diabetes mellitus have a 10-fold greater risk of a congenital malformation and a five-fold greater risk of being stillborn than infants in the general population. Potter and Kicklighter [26] stated birth defects in

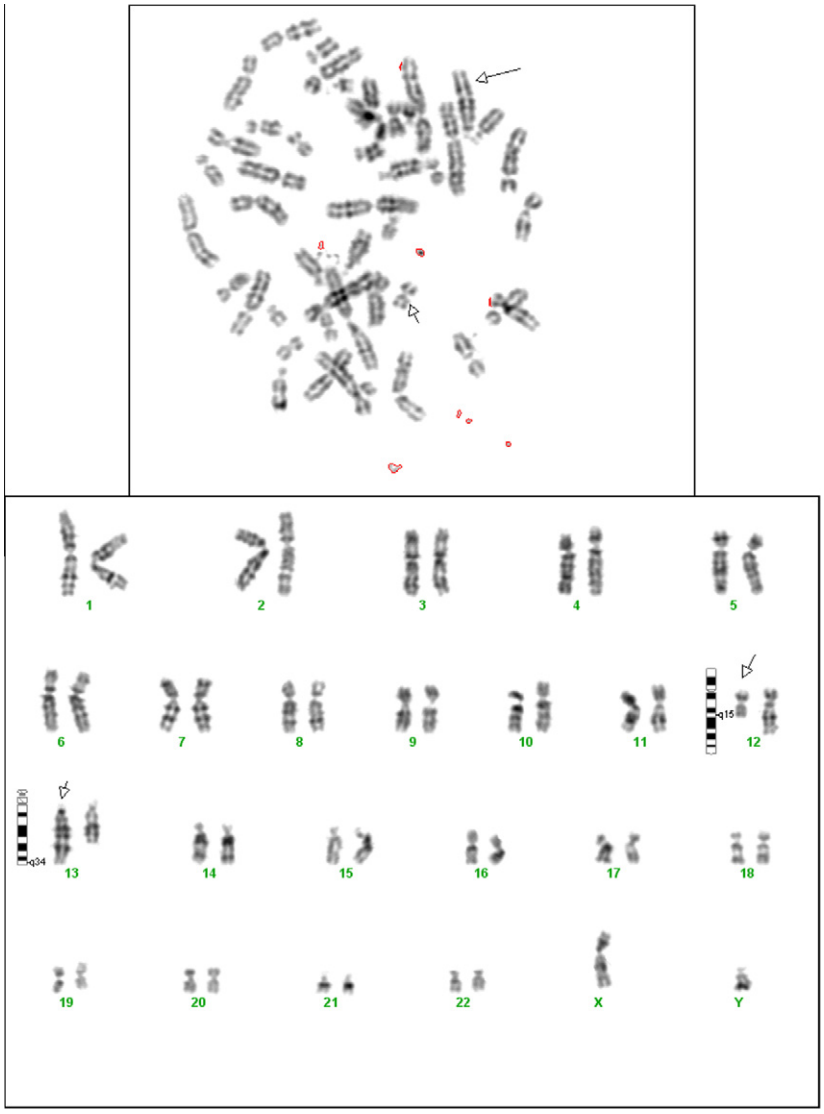

Figure 3 Case with karyotype 46,XY,t(12;13)(q15;q34).

infants of diabetic mothers may be related to reduced arachidonic acid and myoinositol levels and elevated sorbitol and trace metal levels in the fetus while others speculate about the role of excess oxygen radicals and hydroperoxides in the mitochondria of susceptible fetal tissues because these prostacyclin inhibitors may cause disruption in the vascularization of developing tissues.

In the present study there is no significant association between the presence of maternal fever and the risk of congenital anomalies in contrast to the study of Andrew et al. [27] who demonstrated an association between a higher risk for major congenital anomalies and high fever-related influenza, common cold with secondary complications, tonsillitis, and recurrent orofacial herpes. Edwards [28] stated that maternal hyperthermia during pregnancy can be teratogenic, in animal studies. Over the course of 40 years, Edwards demonstrated that cell death, membrane disruption, vascular disruption, and placental infarction and modest elevations in temperature prior to implantation and more sustained elevations during early embryogenesis may cause fetal death and abortion. Embryos surviving maternal hyperthermia during early development are at risk for a host of congenital anomalies, including neural tube and central nervous system (CNS), microcephaly, microphthalmia, cataracts, craniofacial, heart, renal, dental, and abdominal wall defects among others [28].

In the present study congenital anomalies were significantly associated with the presence of maternal oligohydramnios compared with controls (14.6% versus 8%, $p < 0.05$). This is in accordance with the results of Stoll et al. [29] who stated that careful fetal examination has to be performed when oligohydramnios is diagnosed as congenital malformations are often associated with it. However, no significant association between the frequency of congenital anomalies and presence of oligohydramnios was demonstrated by Shawky al. [12]. Blackburn [30] stated that the constraints on fetal movement imposed by oligohydramnios can result in a cascade of developmental events resulting in fetal anomalies. These anomalies include congenital contractures (due to relative or incomplete immobilization of the joints in a confined space); lung hypoplasia (lack of room for development of the thorax and

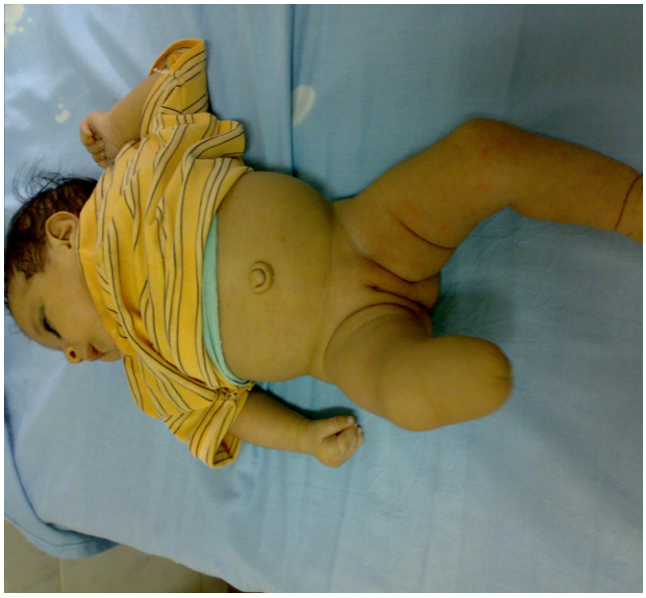

Figure 4 A case with absent foot and lower third of right leg.

distension of lung tissue); dysmorphic facies including micrognathia, low set ears, small alae nasi and hypertelorism (molding of the face by compressive forces); growth restriction (fetal motor activity is important for normal development of muscle mass and weight gain); perhaps microgastria (lack of stretching and distension because the volume of amniotic fluid available for swallowing is reduced) and also severe fetal renal anomalies (agenesis, dysplasia or obstructive disorder) may lead to oligohydramnios because of decreased or no urine output. In this study maternal oligohydramnios was present in 14.5% of malformed babies (15/103), the malformations most often associated with oligohydramnios involved a musculoskeletal system (40%), chromosomal aberrations (33%), CVS anomalies (26.7%), GIT anomalies (26.7%), CNS anomalies (20%), eye anomalies (20%) and lastly genital anomalies (6.7%).

In this study, consanguinity was significantly associated with the presence of congenital anomalies compared with control population. Congenital anomalies were more prevalent in cases from consanguineous marriage than from non-consanguineous marriage (3.67% versus 1.15%, $p < 0.001$). Our results are in accordance with the results of Talukder and Sharma [31] and Temtamy et al. [11]. The prevalence of consanguineous marriage in the Egyptian people in general is

Table 2 Effects of associated fetal factors on the percentage of congenital anomalies.

Variables	Subjects		Controls		Significance
	$N = 103$	%	$N = 4897$	%	
Preterm	26	24.2	1262	25.8	NS
Male	65	63.1	3054	62.3	NS
Female	38	36.9	1946	39.7	NS
Birth weight < 2.5 kg	38	36.9	1844	37.7	NS
Breech delivery	47	45.6	1022	20.9	< 0.001
Perinatal asphyxia	41	39.8	459	9.4	< 0.001
Incubator admission	45	43.7	345	7	< 0.001
Resuscitation	40	38.8	477	9.7	< 0.001

< 0.05 = significant; NS = not significant.

Table 3 Effects of maternal factors on the percentage of congenital anomalies.

Variables	Subjects		Controls		Significance
	$N = 103$	%	$N = 4897$	%	
Parity > 5	63	61.2	1161	23.7	< 0.001
Age of mother > 35	40	38.9	1912	39	NS
CS delivery	56	54.4	1448	29.7	< 0.001
Drug intake	58	56.3	2758	56.3	NS
DM	26	25.2	222	4.5	< 0.001
Fever	11	10.7	523	10.7	NS
Pre-eclampsia	16	15.5	761	15.5	NS
Ante- and post-partum hemorrhage	4	3.9	190	3.9	NS
Oligohydramnios	15	14.6	394	8	< 0.05
Polyhydramnios	11	10.7	495	10	NS
Residence					
Urban area	41	39.9	1949	39.8	NS
Rural area	62	60.1	2948	60.2	NS
Family history of congenital anomalies	9	8.7	427	8.7	NS

< 0.05 = significant; NS = not significant.

Table 4 Consanguinity rates among malformed cases and controls.

Variables	Subjects		Controls		Significance
	$N = 103$	%	$N = 4897$	%	
Consanguinity rate among cases and controls	66	64	1731	35.3	< 0.001
Consanguinity rate among first cousin marriage	47	45.6	1490	30.4	< 0.001
Consanguinity rate among more distant consanguineous marriage	19	18.4	241	4.9	< 0.001

N.B. < 0.05 = significant; NS = not significant.

Table 5 Consanguinity in relation to congenital anomalies.

Variables	Consanguinity		Non-consanguinity		Significance
	$N = 1797$	%	$N = 3203$	%	
Cases with multiple congenital malformations	66	3.67	37	1.15	< 0.001

N.B. < 0.05 = significant; NS = not significant.

Table 6 Karyotyping results of cases.

Karyotype	Phenotype	No.	%
1. 46,XY	Multiple congenital anomalies	46	44.7
2. 46,XX	Multiple congenital anomalies	18	14.4
3. 47,XY, + 21	Male Down	12	11.7
4. 47,XX, + 21	Female Down	2	1.9
5. 46,XX,der(21;21) + 21	Female Down	1	0.97
6. 46,XY,der(15;21)(q10;q10) + 21	Male Down	1	0.97
7. 48,XY, + 21, + mar	Male Down syndrome	1	0.97
8. 48,XX, + 21, + mar	Female Down syndrome	1	0.97
9. 45,X	Turner syndrome	3	2.9
10. 46,X,i(Xq)	Turner syndrome	2	1.9
11. 47,XY, + 18	Male Edward syndrome	1	0.97
12. 47,XX, + 18	Female Edward syndrome	1	0.97
13. 47,XY, + 13	Male Patau syndrome	1	0.97
14. 46,XY,t(12-13)(q15;q34)	Dysmorphic features + undescended testis	1	0.97
15. 46,XY,del(9)(q11;q31)	DSD	1	0.97
16. 46,XX	DSD	10	9.7
17. 46,XY	DSD	1	0.97
Total		103	

DSD = Disorder of sex development.

28.96% and it is 22%, 26%, and 39% in the urban, suburban, and rural areas, respectively. However, consanguinity rates are different in different countries and this difference is usually related to the race, the isolation of the society, and the religion [32]. Consanguinity rate among Arab population specifically first cousin marriages may reach 25–30% of all marriages. Socio-cultural factors, such as maintenance of family structure and property, ease of marital arrangements, better relations with in-laws, and financial advantages relating to dowry seem to play a crucial role in the preference of consanguinity in Arab populations [33].

In the present study chromosomal abnormalities, were found in 27.18% (5.6/1000). Numerical abnormalities were found in 21.35% (4.4/1000) and structural abnormalities were found in 5.83% (1.2/1000). The prevalence of chromosomal abnormalities in this study were similar to results of Vaz and Shyama [34] who reported that chromosomal abnormalities were present in 24.1% with prevalence of 4.7/1000 livebirths, numerical abnormalities were observed in 12.7% (2.46/1000) and structural abnormalities in 11.4% (2.22/1000). The prevalence in our study is lower than the results of Nielson and Wohlert [35] (8.45/1000) and higher than values of Higurashi et al. [36] and Madi et al. [37] (1.6/1000 and 2.18/1000, respectively) (Table 8).

The differences in prevalences of chromosomal abnormalities from one study to another may be related to the differences

Table 7 Types of chromosomal abnormalities.

	No.	%	/1000
Numerical abnormalities			
1. Down (non-disjunction)	16	15.5	3.2
2. Turner syndrome (monosomy)	3	2.9	0.6
3. Edward syndrome	2	1.9	0.4
4. Patau syndrome	1	0.97	0.2
Total	22	21.35	4.4
Structural abnormalities			
1. Down (translocation)	2	1.9	0.4
2. Turner syndrome iso(q)	2	1.9	0.4
3. Dysmorphic features + undescended testis, t(12q;13q)	1	0.97	0.2
4. DSD, del 9(q)ssdr3q	1	0.97	0.2
Total	6	5.83	1.2
Total number of chromosomal abnormalities	28	27.18	5.6

DSD = Disorder of sex development.

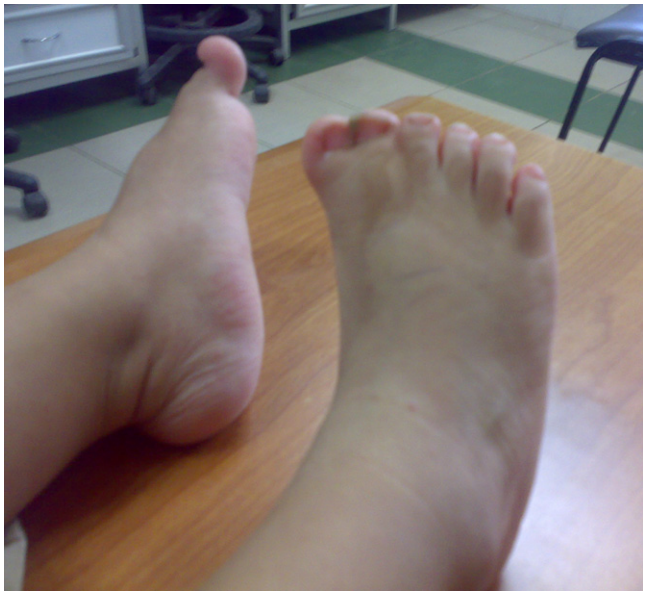

Figure 5 A case of isolated polysyndactyly in right foot.

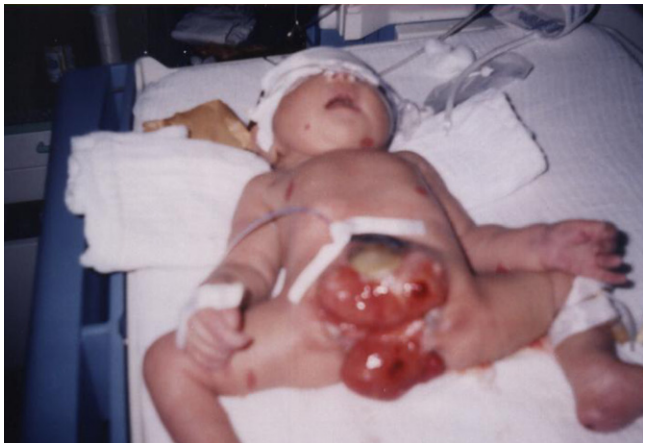

Figure 6 A case of ectopia vesica with absent pelvic bone and herniated caecum.

in risk factors of chromosomal abnormalities. The risk of having a baby with Down syndrome increases with a woman's age—steeply after age 35, having a family history (including the couple's children) of a chromosomal abnormality increases the risk), having had a live-born baby with a birth defect or a stillborn baby even when no one knows whether the baby had a chromosomal abnormality increases the risk of having a baby with a chromosomal abnormality. About 30% of babies born with a birth defect and 5% of visibly normal stillborn babies have a chromosomal abnormality. Having had several miscarriages may increase the risk of having a baby with a chromosomal abnormality. If the fetus in a first miscarriage has a chromosomal abnormality, a fetus in subsequent miscarriages is also likely to have one, although not necessarily the same one. Rarely, a prospective parent has a structural chromosomal abnormality that increases the risk of having a baby

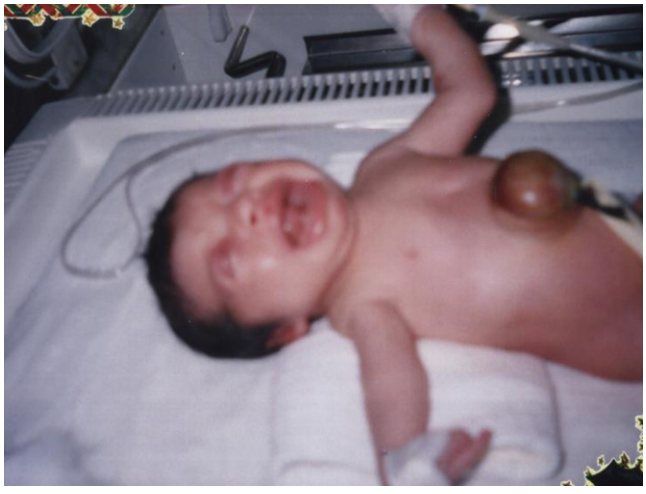

Figure 7 A case of exomphlus minor.

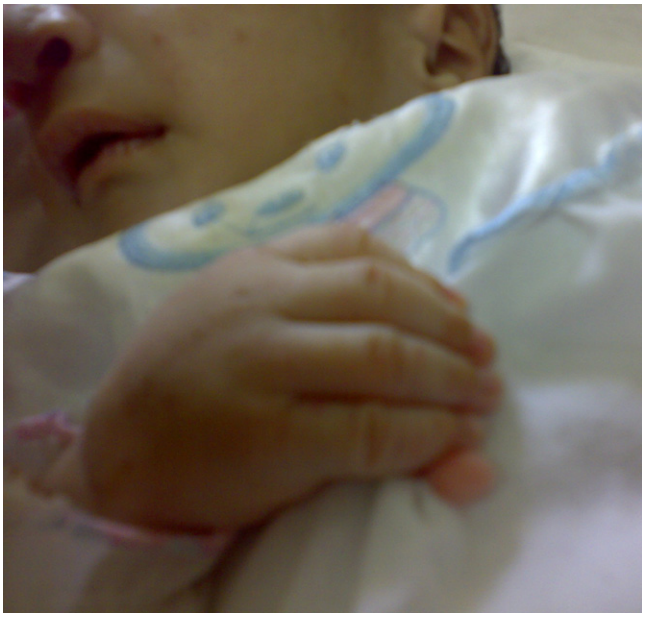

Figure 8 A case with attached post-minimi.

Table 8 Prevalence of chromosomal abnormalities in different population studies per 1000 livebirths.

	Y^1	N^2	H^3	M^4
Sex chromosome abnormalities				
Klienfelter' syndrome	–	1.73	–	–
XYY syndrome	–	1.18	–	–
Triple X syndrome	–	1.06	0.04	–
Turner syndrome	1	0.53	0.04	–
Autosomal chromosomal abnormalities				
Trisomy 21	3.6	1.69	1.08	1.67
Trisomy 18	0.4	0.29	0.18	0.38
Trisomy 13	0.2	0.09	0.13	0.13
Mar +	–	0.66	–	–
Ring	–	0.06	–	–
Deletions	0.2	0.11	0.09	–
Duplications	–	0.09	–	–
Der	–	0.09	–	–
Translocations	–	0.26	0.04	–
Robertsonian translocations	0.2	1.40	–	–
Inversions	–	0.34	–	–
Fra(X)	–	0.03	–	–
Total prevalence of sex chromosome and autosomal abnormalities	5.6	8.45	1.6	2.18

Y^1 = our study.
N^2 = Nielson et al. (1991) [35].
H^3 = Higurashi et al. (1985) [36].
M^4 = Madi et al. (2005) [37].

with an imbalance in the amount of structure of his/her chromosomes. A chromosomal abnormality in one or both parents increases the risk, even if the affected parent is healthy and has no physical signs of the abnormality [38].

5. Conclusion

Karyotype should be done routinely for all malformed cases as many of them are attributed to chromosomal abnormalities. Also, it is more useful to consult expert dysmorphologists for proper genetic syndromes identification and for the decision to use more recent molecular techniques for diagnosis. Consanguineous marriage is an important risk factor for congenital anomalies and the frequency of which may be reduced by creating awareness regarding its avoidance.

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