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REVIEW

OUTCOME OF SPONTANEOUS PREGNANCY IN TURNER SYNDROME

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Abstract

Turner syndrome (TS) is the most common form of chromosomal hypogonadism in women. Clinical features are correlated with the haploinsufficiency of X genes which produces a precocious ovarian degenerescence, sexual hormones secretion deficiency and primary sterility. The review of medical literature reported 87 patients with different cytogenetic form of TS that have 185 pregnancies. In 45,X/46,XX women were described 61 pregnancies in 32 patients. In X homogeneous monosomy were described 43 pregnancies in 21 patients followed by X trisomy mosaicism which was identified in 9 women with 45,X/47,XXX formula (20 pregnancies) and at 11 patients was described 45,X/46,XX/47,XXX formula (35 pregnancies). An increased risk for abnormal pregnancies was proved by frequent miscarriages: 30 cases in 45,X/46,XX, followed by 16 in 45,X/46,XX/47,XXX and 13 in X homogeneous monosomy. Other possible gestational complications in patients with TS could be: dissection of aorta, endocrine diseases (diabetes mellitus, hypothyroidism), arterial hypertension and eclampsia, dystocia. The spontaneous menarche and pregnancy in TS patients are rare events, and usually the gestation is marked by obstetrical complications. The patients with 45,X/46,XX chromosomal formula have the highest risk for chromosomal abnormality in foetus and for miscarriage. The worst prognosis was cited for TS patients with partial X monosomy.

Key words: Turner syndrome , pregnancy with X monosomy, mosaicism, chromosomal hypogonadism, miscarriage.

INTRODUCTION

Turner Syndrome (TS) a common form of hypogonadism in women - 1/2.500 female newborn - is produced by X monosomy. Chromosomal analysis could reveal: homogeneous X monosomy (53.33% of cases), X monosomy mosaicism (22.52% of cases) partial X monosomy (20.36% of cases) or other forms (3.79% of cases) (1). Phenotype is correlated with haploinsufficiency of X genes that are not inactivated by heterochromatinization. The absence of the second gonosome produces ovarian degenerescence with oestrogen/ progesterone deficiency and absence of oocytes with definitive sterility. Studies on TS patients have shown that pubertal development and ovarian function can sometimes be normal, with development of mammary glands in 25% of patients and spontaneous menarche in 3% of cases with homogeneous X monosomy and 10% of cases with X monosomy mosaicism. These women present usually secondary amenorrhea, with progressive degradation of functional ovarian tissue. Under these circumstances, the spontaneous pregnancy in a woman with TS is a rarely event. Until the introduction of *in vitro* fertilization techniques (IVF), there were cited fewer than 200 pregnancies in women with TS (1-3). We made a meta-analysis of reports concerning pregnancies in Turner syndrome.

PUBERTY CHANGES IN TURNER SYNDROME

The pregnancy in TS is a rare event, 85% of patients have not pubertal development and 98% of them are sterile (1). Low reproductive potential in TS is correlated with ovarian dysgenesis induced by X monosomy.

A retrospective study on 522 TS patients confirmed spontaneous menarche in 84 cases (16.1%), but only three spontaneous pregnancies (2). Other study showed a spontaneous menarche in 10% of homogeneous X monosomy, in 15.62% of women with X isochromosome or X ring chromosome, in 43.18% of patients with X monosomy mosaicism, in 78.51% of TS with deletion on X chromosome, but menarche was absent in all cases with marker chromosome or mosaicism with Y chromosome (3).

Freriks *et al.* (2011) found a spontaneous

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menarche in 36 women from 150 adult patients with TS (4).

Borgstrom *et al.* (2009) investigated the function of ovaries in 57 adolescents with TS. They found follicles in: 6/7 cases with 45,X/46,XX, 6/22 cases with structural chromosomal abnormalities and 3/28 patients with 45,X. All girls started the puberty, and level of FSH and anti-Mullerian hormone was normal (5).

Homer *et al.* (2010) analysed 71 cases with 45,X/46,XX karyotype and spontaneous menarche that asked a FIV procedure. Only seven presented a spontaneous pregnancy (finished by spontaneous abortion). They found that sex chromosome mosaicism below 30% has no impact on the ovarian reserve of females, but mosaicism increases risk for miscarriage (6).

A recent study of Mohamed *et al.* (2015) analyzed a cohort of 42 patients with Turner syndrome with spontaneous puberty and showed that in mosaic form of X monosomy the spontaneous puberty is more frequent than in cases with homogeneous X monosomy (61.9% *vs.* 36.8%). Also, the menarche was more frequent in mosaic form of X monosomy (6 *vs.* 3 cases) one of these women having two spontaneous pregnancies (7).

SPONTANEOUS FERTILITY IN TURNER SYNDROME

Dewhurst reviewed pregnancy in TS and identified 7 pregnancies in 5 women with X homogeneous monosomy, 18 pregnancies in patients with 45,X/46,XX mosaicism, 6 pregnancies in 3 women with 45,X/47,XXX mosaicism and 23 pregnancies in 7 women with 45,X/46,XX/47,XXX mosaicism. Pregnancies were abnormal in 31 cases and normal in 23 women (8).

Tarani *et al.* (1998) presented six cases of women with TS that have 13 pregnancies, finished by six abortions and eight live-births. The review of literature made by Tarani *et al.* (1998) indicated that 29% of pregnancies in women with TS ended in spontaneous abortion, 7% led to the perinatal death of the foetus, 20% gave birth to malformed babies and in 38% of cases healthy children were born (9).

Elsheikh *et al.* (2002) reviewed 154 pregnancies in women with TS and identified 32 pregnancies in 16 women with 45,X (14 normal, 15 miscarriages, 3 with congenital or chromosomal anomalies), 104 pregnancies in 49 women with X monosomy mosaicism (39 normal, 39 miscarriages and 26 with congenital or chromosomal anomalies), 12 pregnancies in 7 patients with X ring chromosome (5 normal, 1 miscarriage and 6 with congenital or chromosomal anomalies) and 6 pregnancies in 3 patients with X deletions (1 normal, 2 miscarriages and 6 with congenital or chromosomal anomalies) (10).

Sybert (2002) analysed the reproductive potential of 222 patients with different forms of X monosomy. In 45,X/47,XXX mosaicism spontaneous puberty was present in 75% cases and spontaneous pregnancies were identified in 50% of cases. In women with 45,X/46,XX/ 47,XXX mosaicism the spontaneous puberty was found in 68.08% cases and the spontaneous pregnancies registered in 44.68% of cases. The 45,X/46,XX mosaicism was characterized by spontaneous menarche in 34% cases and spontaneous pregnancy in 19% of cases. The worst prognosis was in homogeneous X monosomy: spontaneous menarche in 11% of cases and only one pregnancy (0.8% of cases) (11).

A study based on Danish Cytogenetic Central Register (1973-1993) included 410 women with TS in the fertile age. The chromosomal formulas were: 45,X (49%) 45,X/46,XX (19%) other X monosomy mosaicism (23%) and partial X monosomy (9%). 62 spontaneous pregnancies were identified in 31 women (7.6%): 27 women with X monosomy mosaicism, and four women with partial X monosomy. In women with 45,X/46,XX formula, 48% had the X monosomy in less than 10% of the analyzed cells (12).

Bryman *et al.* (2011) identified 124 pregnancies in 57 patients from 482 women with TS. 25 patients with 45,X/46,XX mosaicism have 82 pregnancies: 36 finished by deliveries of 37 babies (1 twin pregnancy), 37 miscarriages (without chromosomal analysis), 8 women chose the termination of pregnancy and one extra uterine pregnancy. Four from 37 born children have congenital anomalies or neuropsychiatric disorders (13).

Hagman *et al.* (2011) analyzed 909 patients with TS, registered in Swedish Genetic Turner Register in period 1973-2007. They found 205 pregnancies in 112 women with TS. The 45,X formula was identified in 10 women, the mosaicism 45,X/46,XX was found in 50 patients, and 52 women have other types of X monosomy (complex mosaicism or partial X monosomies). In 9 of 205 children there were registered congenital anomalies, but only one has a chromosomal anomaly (21 trisomy) (14).

Hadnott *et al.* (2011) analysed data of 276

Table 1. The history of pregnancies in women with different form of X monosomy (2, 16-89)

X monosomy type	Total number of cases	Number of pregnancies	Normal children	Miscarriages	Congenital anomalies	Stillborn children	X monosomy pregnancies	21 trisomy
45,X/46,XX	32	61	19	30[1]	5	3	4	0
45,X	21	43	23	13[2]	0	2	4[3]	1
45,X/47,XXX	9	20	15	4	0	0	0	1
45,X/46,XX/47,XXX	11	35	9	16	1	3	5	1
X ring chromosome	6	11	4	2	0	0	5	0
X deletion	4	7	2	1[4]	0	0	4[5]	0
Other types	5	8	3	0	0	0	5	0
Total	87	185	75	66	6	8	27	3

[1]one patient chose the termination of gestation; [2]one case with X homogeneous monosomy; [3]one pregnancy finished by miscarriage; [4]case with X homogeneous monosomy; [5]one case with X deletion associated a homogeneous 21 trisomy

women with TS registered by National Institute of Child Health and Human Development. They found 5 women (1.4%) with spontaneous menarche that had 8 spontaneous pregnancies, all finished by birth of normal children. One patient has a 45,X/46,XX mosaicism, 3 cases have 45,X karyotype, and one has a 45,X/46,X,del(X) mosaicism (15).

Alves *et al.* (2013) made a retrospective analysis concerning the cases of Turner syndrome diagnosed in Endocrinology and Human Reproduction Departments of Universitary Hospital from Coimbra (Portugal). They found 79 cases with Turner syndrome: 20 with spontaneous puberty and menarche (3 cases with 45,X chromosomal formula, 13 cases with X monosomy mosaicism and 4 cases with X partial monosomy) and 59 with induced puberty (27 cases with 45,X chromosomal formula, 16 cases with X monosomy mosaicism and 16 cases with X partial monosomy). The pregnancy was noted only in two women, both with induced puberty and 45,X/46XX mosaicism. One pregnancy was obtained spontaneously, but finished at 30 weeks of amenorrhea by in utero death (without chromosomal analysis). The other was obtained by FIV with oocyte donation (16).

Search of PubMed using terms "TS and pregnancy" revealed 909 indications between 1956 and 2015. Only 78 of them provide direct information about pregnancy in TS and 57 articles were reviews regarding TS. Overall, we identified 51 articles describing pregnancies occurred in TS patients. Using all sources of documentation we found information about only 87 TS cases which developed spontaneous pregnancy and had a total of 185 pregnancies (Table 1) (2, 16-89).

Majority of pregnancies were present in 45,X/46,XX women (61 pregnancies in 32 women) followed by X homogeneous monosomy (43 pregnancies in 21 patients). X trisomy mosaicism was identified in 9 women with 45,X/47,XXX formula (20 pregnancies) and in 11 patients with 45,X/46,XX/47,XXX (35 pregnancies). The pregnancy in partial X monosomy was rare: 11 pregnancies in 6 cases with X ring chromosome, 7 pregnancies in 4 cases with X deletion, 1 pregnancy in a psuIdic(Xq) and 1 pregnancy in an unbalanced complex (X;Y) translocation. In one case with unspecified X structural chromosomal anomaly the woman has a daughter with the same anomaly. In one case with 45,X/46,XY/47,XYY mosaicism the patient has two normal girls. In one case with 45,X/46,X,add(X)(q26) mosaicism the patient has two girls with 47,XX,add(X)(q26)mat chromosomal formula. The history of pregnancies in X monosomy cases is summarized in Table 1 (2, 16-89) and Table 2 (2, 16-89).

The data of Table 1 indicates that 45,X/46,XX mosaicism increases risk for abnormal pregnancies (41 from 61 pregnancies) with a high level of miscarriages (30 cases). These women have four children with X monosomy: two with 45,X/46,XX mosaicism, one with 45,X/46,X,del(X) mosaicism and one with 45,X formula.

A similar situation we found for 45,X/46,XX/47,XXX mosaicism. These women have a lot of abnormal pregnancies (26/35) with preponderance of miscarriages, five cases presenting X monosomy (45,X, 45,X/46,XX/47,XXX, 45,X/46,XX, 45,X/46,X,r(X) and 45,X/46,XY) and one 21 trisomy. On the other hand, in 45,X/47,XXX cases the predominant situation was the normal pregnancy and the only chromosomal abnormality was a 21 trisomy.

Kuo and Guo (2004) analysed 18 patients with low-grade X-chromosome mosaicism that have recurrent miscarriages. In 44.4% of these patients they identified a diminished ovarian reserve and in 16.7% they found uterine anomalies. The patients with diminished ovarian reserve presented a higher abortion rate (68.6%) and a higher rate of abnormal karyotypes

Table 2. Chronologic reports of spontaneous pregnancies in Turner syndrome (2, 16-89)

Chronological Report	Karyotype	Puberty	Pregnancy
Bahner *et al.* (1960) (17)	45,X	-	1 normal boy
Lewis *et al.* (1963) (18)	45,X/47,XXX	-	3 normal boys
Briggs *et al.* (1963) (19)	45,X/46,XX/47,XXX	-	1 normal girl
de Toni *et al.* (1965) (20)	45,X/46,XX/47,XXX	-	1 girl 45,X/46,XX Twins: 45,X and 45,X/46,XX/47,XXX
Bomers-Marres (1966) (21)	45,X/46,XX	-	2 normal children (1 girl and 1 boy)
Armendares *et al.* (1967) (22)	45,X/46,XX/47,XXX	-	1 child with 21 trisomy 1 normal boy
Nielsen and Thomsen (1968) (23)	45,X/46,XX/47,XXX	-	1 stillborn male
Maclean *et al.* (1968) (24)	45,X/47,XXX	-	2 normal children
Kava and Klinger (1968) (25)	45,X/46,XX	-	1 normal boy 1 miscarriage
Predescu *et al.* (1969) (26)	45,X/47,XXX	-	1 child with Down syndrome 4 miscarriages
Bishun *et al.* (1969) (27)	45,X/46,XX	-	1 plurimalformate child 1 child with neural tube defect 1 stillborn child
Giraud (1970) (28)	45,X/46,XX/47,XXX	-	1 boy 45,X/46,XY with congenital heart disease 1 girl (46,XX) with congenital heart disease
Nakashima and Robinson (1971) (29)	45,X	-	1 normal girl (46,XX)
Mackay *et al.* (1971) (30)	45,X/46,XX	-	1 normal girl
Siegelman (1972) (31)	45,X/46,XX		1 normal boy (46,XY) 1 girl 45,X/46,XX 3 miscarriages;
Hsu *et al.* (1972) (32)	45,X/46,XX/47,XXX (first case)	Normal	2 miscarriages
Hsu *et al.* (1972) (32)	45,X/46,XX/47,XXX (second case)	Normal	3 miscarriages 1 normal boy 1 boy with 21 trisomy 1 boy died by leukemia
Grace *et al.* (1973) (33)	45,X	-	1 normal girl (46,XX)
Lieber and Berger (1973) (34)	45,X/46,XX	-	Termination
Kim *et al.* (1975) (35)	45,X/46,XX/47,XXX	-	1 stillborn child 2 miscarriages
Reyes *et al.* (1976) (36)	45,X/47,XXX	-	1 normal girl (46,XX)
Groll and Cooper (1976) (37)	45,X	-	1 stilborn girl 1 normal girl
Philip and Sele (1976) (38)	45,X	-	1 stilborn child 1 normal boy (46,XY)
Ioan *et al.* (1978) (39)	45,X/46,XX (3 cases)	-	miscarriages
Lajborek-Czyź (1976) (40)	45,X	-	1 boy with 21 trisomy
King *et al.* (1978) (41)	45,X	Normal	1 normal boy
Nielsen *et al.* (1979) (42)	45,X	Normal	1 normal girl (46,XX)
Kohn *et al.* (1980) (43)	45,X	-	2 miscarriages
Muasher *et al.* (1980) (44)	45,X/46,X,r(X)	Normal	1 girl 45,X
Wray *et al.* (1981) (45)	45,X	Normal	2 normal girls (46,XX)
Dinkelmann and Landolt (1981) (46)	45,X/47,XXX	-	2 normal girls
Taysi and Opitz (1983) (47)	46,X,del(X)(q26)	Normal	1 normal child 1 child with del(X)(q26) and 21 trisomy
Ayuso *et al.* (1984) (48)	45,X/46,XX/47,XXX	Normal	6 children: 5 normal and 1 girl with 45,X/46,X,r(X) 8 miscarriages
Pescia *et al.* (1984) (49)	45,X/46,XX (2 cases)	-	1 normal girl 1 malformated boy 2 miscarriages
Baudier *et al.* (1985) (50)	45,X	Induced puberty	2 normal children 2 miscarriages
McCorquodale and Bowdle (1985) (51)	45,X/46,XX	Normal	2 normal children
Swapp *et al.* (1989) (52)	45,X	Normal	2 normal children
Meyer *et al.* (1989) (53)	45,X/46,XX (4 cases)	-	2 normal children 1 stillborn child 6 miscarriages
Vignetti *et al.* (1990) (54)	45,X/46,XX (first case)	-	1 normal child 2 miscarriages
Vignetti *et al.* (1990) (54)	45,X/46,XX (second case)	-	1 girl 45,X 1 miscarriage

Chronological Report	Karyotype	Puberty	Pregnancy
Kaneko *et al.* (1990) (55)	45,X	Normal	1 normal boy
Cockwell *et al.* (1991) (56)	46,X,del(X)(q22.3-q26)	-	1 46,XY normal child 1 miscarriage with 45,X fetus
Varela *et al.* (1991) (57)	45,X	Normal	1 girl 46,X,del(X)(p21) 1 miscarriage
Massa *et al.* (1992) (58)	46,X,del(X)	Normal	2 girls 46,X,del(X)
Verschraegen-Spae *et al.* (1992) (59)	45,X/46,XX	Normal	1 girl 45,X/46,X,del(Xp)
Apostolopoulos *et al.* (1994) (60)	45,X	Normal	1 miscarriage
Palka *et al.* (1994) (61)	45,X/ 46,X,del(X) (pter p22.2::p11.3 qter)	-	1 girl 46,X,del(X) (pter p22.2::p11.3 qter)
Ditkoff et. al. (1996) (62)	45,X/46,XX	-	1 normal girl after ovarian stimulation
Taga *et al.* (1996) (63)	45,X/46,X,r(X)/46,XX	-	2 normal children
Pasquino *et al.* (1997) (2)	Turner syndrome patient with structural chromosomal abnormality (first case)	Normal	Girl with Turner syndrome patient with structural chromosomal abnormality
Pasquino *et al.* (1997) (2)	45,X/46,XX (second case)	Normal	1 normal girl
Pasquino *et al.* (1997) (2)	45,X/46,XX (third case)	Normal	1 twins girls (46,XX) with cleft palate
James *et al.* (1997) (64)	45,X/ 46,X,psu idic(Xq)	Normal	1 normal boy
Blumenthal and Allanson (1997) (65)	45,X/46,X,r(X)	Induced puberty	1 normal boy 1 miscarriage 1 girl 45,X/46,X,r(X)
Uehara *et al.* (1997) (66)	45,X / 46,X,r(X)(p22.3q27)	Normal	1 girl 45,X /46,X,r(X)(p22.3q27)
Leśniewicz *et al.* (1998) (67)	45,X/46,XX (first case)	Normal	1 miscarriage 1 stillborn child
Leśniewicz *et al.* (1998) (67)	46,XX/ 46,X,r(X)(p22q26) (second case)	Normal	1 normal child
Roglić *et al.* (1998) (68)	45,X/46,XX/47,XXX	Normal	1 normal child 1 miscarriage
Ortiz *et al.* (1998) (69)	45,X/46,XX	Normal	1 normal boy
Magee *et al.* (1998) (70)	45,X	Normal	1 normal boy 5 miscarriages 1 miscarriage with 45,X fetus
Lukács *et al.* (2000) (71)	45,X/46,X,r(X)	Normal	1 miscarriage 1 girl 45,X/46,X,+mar 1 girl 45,X/46,X,r(X)
Schwack and Schindler (2000) (72)	45,X	Normal	3 normal children
Eblen and Nakajima (2003) (73)	45,X/47,XXX	Normal	1 normal child
Zieliński and Sirko (2003) (74)	45,X/46,XX	Normal	1 normal child
Rizk and Deb (2003) (75)	45,X/46,XX	Normal	9 miscarriages 1 normal boy
Waelkens (2004) (76)	45,X	Normal	1 girl 45,X/46,X,r(X)
Cools *et al.* (2004) (77)	45,X	Normal	1 normal girl 1 miscarriage 1 girl 45,X
Landin-Wilhelmsen *et al.* (2004) (78)	45,X/46,XY/47,XYY	Normal	2 normal girls (46,XX)
Livadas *et al.* (2005) (79)	45,X/46,XX/47,XXX/46,X,+mar	Normal	1 normal girl
Su *et al.* (2006) (80)	45,X/46,XX	Normal	1 miscarriage 1 twins: 46,XX and 45,X/46,XX
Jez *et al.* (2006) (81)	45,X/46,XX (first case)	Normal	1 normal boy (46,XY)
Jez *et al.* (2006) (81)	45,X/46,XX (second case)	Normal	1 normal boy (46,XY)
Manno *et al.* (2009) (82)	45,X/47,XXX	Normal	1 dizygotic twins: 1 girl (46,XX) and 1 boy (46,XY) by ovarian stimulation followed by ICSI
Mortensen *et al.* (2010) (83)	45,X (first case)	Induced puberty	2 normal boys
Mortensen *et al.* (2010) (83)	45,X (second case)	Induced puberty	1 girl and 1 boy both normal
Bouchlariotou *et al.* (2011) (84)	45,X/47,XXX	-	2 normal children
Donnez *et al.* (2011) (85)	45,X/46,XX	Prematury ovarian failure (POF)	1 normal girl
Alves and Silva (2012) (86)	45,X/47,XXX	Normal	1 normal girl 1 normal boy
Portnoi *et al.* (2012) (87)	45,X/46,X,der(X)t(X;Y) (p11.4;p11.2)	Normal	1 girl 47,X, der(X)t(X;Y)(p11.4;p11.2), der(X)t(X;Y) (p11.4;p11.2) /46,X,der(X)t(X;Y)(p11.4; p11.2)
Ramachandram *et al.* (2013) (88)	45,X/46,X,add(X)(q26)	POF	2 girls 47,XX,add(X)(q26)mat
Alves *et al.* (2013) (16)	45,X/46,XX	Induced puberty	1 stillborn
Murakami *et al.* (2014) (89)	45,X/46,XX	Normal	1 girl 46,XX obtained after ovulation induction

in the abortus (73.7%). Authors concluded that the oocytes of women with X-chromosome mosaicism are in a suboptimal state of development and are prone to embryonic lethality (90). A similar conclusion was found Homer *et al.* (2010) that showed that sex chromosome mosaicism below 30% has no impact on the ovarian reserve of females, but mosaicism increases risk for miscarriage (6).

The presence of 45,X/46,XX mosaicism increases the probability of spontaneous menarche and pregnancy in TS. The study of Castronovo *et al.* (2014) that used multiple cytogenetic and molecular analyses in TS, showed that in 4 from 5 cases with 45,X/46,XX chromosomal formula the menarche appeared spontaneously, while this feature was rare in X homogeneous monosomy (2 patients from 31 cases) and absent in all 8 cases with X partial monosomy (91). Hewitt *et al.* (2013) indicated that ovaries of women with TS could produce the oocyte only if they contain germ cells with 46,XX chromosomal formula, and this situation is likelihood even if blood karyotype is 45,X. Actually, the majority of women with Turner syndrome present a somatic mosaicism with the absence of second gonosome in blood cell line (92). This could represent an explanation for cases with Turner syndrome, 45,X chromosomal formula in blood line cell, but with multiple pregnancies, like patients reported by Mortensen *et al.* (2010) (83).

The data of Table 1 show that in opposition with 45,X/46,XX mosaicism, and somewhat paradoxically the women with X homogeneous monosomy have a great probability to have a healthy child. Thus, from 42 pregnancies only 5 were with chromosomal abnormalities in offspring: 21 trisomy (1 case) and different types of X monosomy (2 cases - 45,X, 1 case - 46,X,del(X), 1 case - 45,X/46,X,r(X)).

Probably the partial X monosomy has the worst prognosis and increases risk for abnormal offspring. Thus, 7 from 11 pregnancies in women with X ring chromosome were abnormal (2 miscarriages and 5 with X ring chromosome). Similarly, in 5 from 7 pregnancies of women with X deletion partial monosomy was described.

In the last 20 years, the natural evolution of Turner syndrome was modified by application of IVF techniques with cryopreserved or donated oocytes. The study of such pregnancies allowed new information like high risk for different obstetrical complications: aortic dissection (150 times higher than in general population) arterial hypertension, preeclampsia/eclampsia, gestational diabetes and hypothyroidism. Other problem is dystocia link to short stature and uterine hypoplasia (or congenital anomalies of uterus) so that optimal conduit is the birth by caesarean section. Women with TS who conceive using their owning oocytes have supplementary risk for chromosomal abnormality in foetus (93-95). In addition, the cardiovascular complications, like aortic dilatation (above 25 mm/m) aortic coarctation, arterial hypertension and history of cardiovascular surgery, represent absolute contraindications for pregnancy in Turner syndrome (96).

In conclusion, the spontaneous menarche and pregnancy in TS patients is a rare event, and usually the gestation is marked by different obstetrical complications. The prognosis of pregnancies in patients with Turner syndrome is correlated with the type of chromosomal abnormality. The women with homogeneous X monosomy - 45,X – present a reduced probability to have a pregnancy, but in the majority of cases the foetus will be normal. In opposition, for the TS patients with 45,X/46,XX chromosomal formula the probability of pregnancy is higher, but they present also a higher risk for chromosomal abnormality in foetus and miscarriage. The worst prognosis was cited for TS patients with partial X monosomy generated by unbalanced structural abnormalities of X chromosomes. In these cases, the number of pregnancies was very low and usually the foetus had an unbalanced chromosomal abnormality. The evolution of pregnancy in TS patients is complicated frequently by spontaneous abortion, arterial hypertension and aortic dissection. Thus, any pregnancy in a woman with TS must be considered a high risk pregnancy and need special attention from the obstetricians.

Conflict of interest

We declare that there is no conflict of interest.

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