X　　　　　Pericentric Inversion

[1],
[2]
[1]. 　　[1,2]. 　　[1]. 　　[1]. 　　[1]. 　　[2]. 　　[2]. 　　[2]. 　　[1]

Pericentric Inversion of the X Chromosome in a Male with Azoospermia and in the Family of a Pregnant Female Carrier

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We report on two cases of pericentric inversion of X chromosome. The cases were found in a 40-year-old man with azoospermia and in a family of a 38-year-old pregnant woman. The first case with 46,Y,inv(X)(p22.1q27) had concentrations of LH, prolactin, estradiol, and testosterone that were within normal ranges; however, FSH levels were elevated. Testis biopsy revealed maturation arrest at the primary and secondary spermatocytes without spermatozoa. There were no microdeletions in the 6 loci of chromosome Y. For the second case, the cytogenetic study of thepregnant woman referring for advanced maternal age and a family history of inversion X chromosome was 46,X,inv(X)(p22.11q27.2). The karyotype of her fetus was 46,X,inv(X)(p22.1q27). Among other family members, the karyotypes of an older sister in pregnancy and her fetus were 46,X,inv(X)(p22.11q27.2), and 46,Y,?inv(X), respectively. The proband's father was 46,Y,inv(X)(p22.11q27.2). All carriers in the family discussed above were fertile and phenotypically normal. In addition, the ratio of inactivation of inv(X) by RBG-banding was discordant between the two sisters, with the older sister having only 4.1% of cells carrying inactivated inv(X) while the proband had a 69.5% incidence of late replicating inv(X). Therefore, we suggest that the cause of azoospermia in the first case might be related to inversion X chromosome with positional effect. Also, the family of the second case showing normal phenotype of the balanced inv(X) might be not affected any positional effect of genes.

Key Words: Pericentric inversion of X chromosome, Azoospermia, Prenatal diagnosis

X　　　　　　　　　　(pericentric inversion)　　　1969　[1]　　　1999
25　　　　16
[2],　　　　　　　　.

X

1/28,000-38,000

X   p22

[2]   X

DNA   (low-copy repetitive DNA segment)

(nonhomologous pairing)

[3]

.

Xp   X   (critical
region) Xq13-22   q22-26

(gonadal
dysfunction)   [3, 4].   X

q27
SOX3(sex-determining region Y box3)

[5].   SHOX(short stature homeo-
domain)   X   Y   pseudo-
autosomal region(PAR)   (chondrocyte)
homeodomain

[6].   SHOX   (point
mutation)
Leri-Weill dyschondrosteosis(LWD), Langer mesomelic
dysplasis(LMD)   SHOX
(disruption)   [6]. X

(random inactivation)
(skewed X inactivation)   X

[3].   X

X

(azoospermia)

3

X

.

1

40

168 cm

.   sY84, sY129, sY134, sY254,
sY255, SRY   Y

1
(spermatocyte),   2

.

LH 5.1 (1.5-9.2 mIU/mL), FSH 20.0 (
1-14 mIU/mL), prolactin 4.8 (0-15 ng/
mL), estradiol 19.0 (15-80 pg/mL), testosterone
3.7 (1.31-8.13 ng/ml)   FSH

.   ,

GTG-
20   /
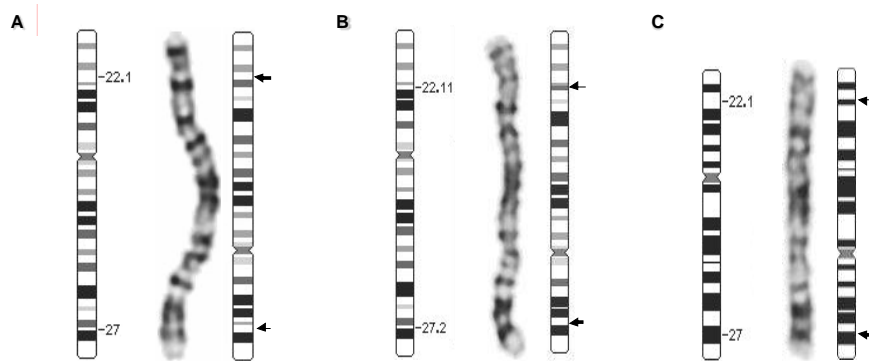
Fig. 1. Ideograms (normal X on the left, inv(X) on the right) and GTL-banded pericentric inversion X chromosome (middle) for each of the two cases. Arrows show breakpoints. (A) Case 1: A 38-year-old male carrier with azoospermia; 46,Y,inv(X)(p22.1q27). (B) Case 2: A 38-year-old pregnant woman with a family history; 46,X,inv(X)(p22.11q27.2). The patient had an uneventful pregnancy at term. (C) The female fetus of case 2, 46,X,inv(X)(p22.1q27).

. International System for Human Cytogenetic Nomencla-
ture (ISCN)   550-

                    X
46,Y,inv(X)(p22.1q27)   ,   (Fig. 1A).

            2

1   1   38
            17   X
                (Fig. 2 II-6)   (Fig. 2 III-5)

            .

                              GTG-
20   .
ISCN   700-
118   46,X,inv(X)(p22.11q27.2) (Fig. 1B)
,   *in-situ*
   550-   37   46,X,inv(X)
(p22.1q27) (Fig. 1C)   .

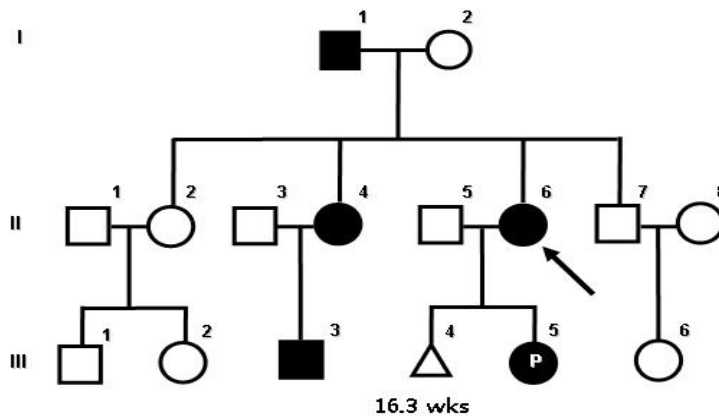   ,   2005
            39   (Fig. 2 III-3)
            46,Y,?inv(X)
            (Fig.2. II-4)

46,X,inv(X)(p22.11q27.2),   (Fig. 2 I-1)
46,Y,inv(X)(p22.11q27.2)
                        . X

                                              3   BrdU
(0.001M)   6
                                          Hoechst
33258(0.5ug/mL)   30   , 2XSSC   2
   , 55   2XSSC   2   Giemsa
RBG-   118
            X   : inv(X)
36 : 82 (30.5% : 69.5%)   X
            (Fig. 3).   X
            X : inv(X)   118 : 5 (95.9% : 4.1%)
            .   X

            .

                                    [3]. Wenger   [2]
1/28,000-38,000   , Schorderet   [3]   X
, 25   12   Xp   p22

16.3 wks

Fig. 2. Pedigree of the patient in case 2. All carriers had a normal phenotype
and exhibited normal fertility. The family exhibited balanced pericentric
inversion of the X chromosome. The karyotype of each family member was
as follows: I-1: 46,Y,inv(X)(p22.11q27.2); II-4: 46,X,inv(X)(p22.11q27.2);
II-6(patient): 46,X, inv(X)(p22.11q27.2); III-3: 46,Y,?inv(X); III-5:
46,X,inv(X) (p22.1q27). The arrow shows the pregnant woman in case 2.

A. GTL-band　　　**B. RBG-band**

inv(X)　　　　Active　　　Inactive
　　　　　　　inv(X)　　　inv(X)
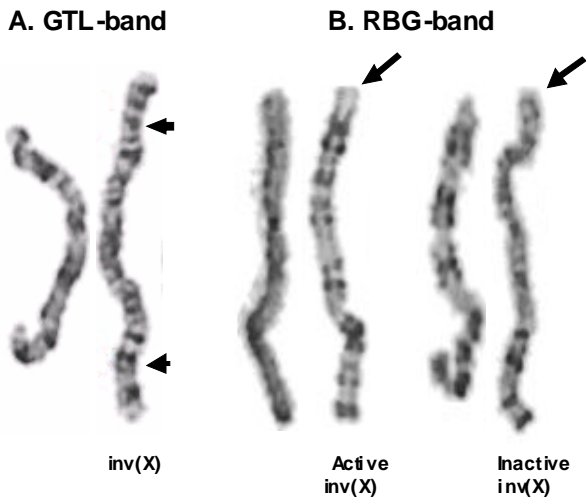
Fig. 3. Partial karyotype of case 2, 46,X,inv(X)(p22.1q27.2). (A) The normal X chromosome and pericentric inversion of X chromosome of a 850-band level ideogram. (B) Arrows show breakpoints on a GTL-banded inv(X). (C) Inactivation pattern of normal X and the inv(X). The proband had a 69.5% incidence of inv(X) late replication. Arrows indicate each active/inactive inv(X).

. , X
Xp22.3　　　　　　　　　　　(low-copy number repeat sequences)　contiguous gene syndrome
[7]. Xp
　　　　　　　　　　　, (chondro-dysplasia punctata), , steroid sulphate deficiency, Kallmann
[8]. X
Xq26.3-qter　　　　　(disomy)
,
(profound developmental delay), (hypotonia),
(microcephaly), (corpus callosum agene-sis), (dysmorphic facial features), ,
(left multicystic, dysplastic kidney)
[8].
X
.

(positional effect)

[9]. 25
X

46,Y,inv(X)(p11.4q11.2)[8]　　　　　　　[9]

. inv(X)
X

(spermatogenesis)　　　　　　　Xp-Yp
PAR1 (pseudoautosomal region 1)
X-Y

. Xq27.1　　　　SOX3

. 1
1, 2

FSH　　　　　　　　　　　　　　SOX3
FSH
. SOX3
,

, ,
X
(hypopituitarism)　　　　　　　[5].

. SOX3

. Bleyl [6]　　　Xq27.1
X
(corneal opacity), (adherent iris strands),
(keratolenticular cataract)
(Peter anomaly)
Xq27 SOX3
.

Xq13　　　　　　　(X-inactivation cen-ter, XIC)　　　　XIST(X-inactivation specific transcript)　　　X
X
, X　　　　　　　　　　　　　inv(X)
. X
X

Wenger [2]   inv(X)   X

, 66%

inv(X)   X   .

87%

X

.   40   3

2   3   (Fig. 2 I-1),   38   X

(Fig. 2 II-4)   (Fig. 2 III-3),   (Fig. 2 II-6)   ,

(Fig. 2 III-5)   5   .   LH, prolactin,

estradiol, testosterone   FSH   20 mIU/

.   mL   .

2005   inv(X)   1,   2   Y

4.1%   sY84, sY129, sY134, sY254, sY255, SRY

.   , X   .

.   .   GTL-

X   , 46,Y,inv(X)(p22.1q27)   .

X   ,   X   46,X,inv(X)(p22.11q27.2),

X   . ,   46,X,inv(X)(p22.1q27)   .

,   ,   ,

X   .   46,X,inv(X)(p22.11q27.2), 46,Y,?inv(X),

X   2   X   46,Y,inv(X)(p22.11q27.2)   inv(X)

X   inv(X)

.   RBG-   X

X   .   inv(X)   4.1%,   69.5%

,   ,   X

.   .   inv(X)

, X

X   .

,

,   1

.

inv(X)   ,

Xq27   SOX3

.

3   inv(X)

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