category II\(^1\) resemble the individuals who have triplication for no. 14 (Fig. 2 and 3); thus, cases of 'Snodgrass syndrome, category II' might represent cases of trisomy 14.

In conclusion, our observation of 46,XX/47,XX,+14 mosaicism indicates that trisomy for no. 14 is compatible with life, at least when associated with a normal diploid cell line. Furthermore, phenotypic similarities among patients with triplication of at least a portion of chromosome 14 suggest an associated clinical pattern.

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References


\(^1\)Snodgrass et al. (1966) classified cases of D trisomy on the basis of their craniofacial defects. Those in 'category I' were said to have severe prosencephalic defects, e.g. cleft lip, cleft palate, and ocular anomalies. Those in 'category II' were said to be characterized by a large nose with a broad bridge and a bulbous tip, a long upper lip that overhangs the lower lip, an everted lower lip, a large mouth that turns downward at the corners, 'mild' micrognathia, and loose skin folds in the mandibular and periorbital regions.


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45,X/47,XYY mosaicism

SUMMARY This paper describes and discusses the clinical and cytogenetic findings in an infant with an unusual sex chromosome abnormality, 45X/47XYY.
There is a wide range of phenotypic and cytogenetic abnormalities in women with primary amenorrhoea; in such patients correlation of genotype with phenotype is extremely difficult. Sex chromosome mosaics are a particularly interesting group in that the cytogenetic diagnosis may be difficult and the management poses complicated problems. Many cases of 45X/46XY mosaicism have been reported (Jackson et al., 1966). A much rarer finding is that of 45X/47XY mosaicism. Jacobs et al. (1961) reported 1 such case in a phenotypic female ascertained during a survey of women with primary amenorrhoea. Another case in a 16-year-old girl with primary amenorrhoea was described by Cooper et al. (1962). A third case, the only phenotypic male, was briefly reported by Trowell and Hamilton in 1965. Here we describe a fourth case of 45X/47XY mosaicism.

Case report

This female infant was born on the 22 November 1973, the second child of healthy unrelated parents. Maternal age at birth was 25 years, paternal age 29 years. Pregnancy of 40 weeks' duration was uneventful and terminated in the normal delivery of an infant weighing 3435 g with an Apgar score of 9. The infant had an enlarged clitoris but no other physical abnormalities were noted. Cytogenetic studies indicated that the infant was an unusual sex chromosome mosaic 45X/47XY. She was reared as a female but the parents were informed of the chromosome findings. At the age of 3 months the clitoris was noted to have enlarged further, and bilateral inguinal herniae developed. At 9 months of age an episode of obstruction occurred in the left inguinal hernia. This was managed conservatively, but in view of the possibility of recurrence, early investigation of the genitourinary tract was undertaken. Under general anaesthesia the vulvar area was explored and two openings found. The more anterior opening was catheterized and urine obtained. The introduction of radio-opaque dye resulted in a satisfactory outline of a normal bladder. A catheter was then passed into the posterior orifice and a further injection of dye revealed a normal vagina and uterus with tubes on either side. A few days later both inguinal canals were explored under general anaesthesia and the hernial sacs opened. Each sac contained a gonad with part of the broad ligament, the left being smaller than the right. Histological examination of frozen sections taken from each pole of both gonads indicated that testicular tissue was present in all areas. Both gonads were, therefore, removed and the later reports confirmed that they were composed entirely of testicular tissue. The clitoral hypertrophy is to be corrected at a later date.

Cytogenetics

Chromosome examination undertaken at birth because of the ambiguous appearance of the external genitalia revealed the presence of two distinct cell lines in peripheral blood culture. Of the 100 cells examined, 60 had a modal number of 45 chromosomes. No Y chromosome was noted in any of these 60 cells and all lacked one C group chromosome. Forty cells had a modal number of 47 chromosomes and all contained two Y chromosomes. The Y chromosomes were morphologically distinct from the G group chromosomes. Q-banding confirmed the presence of 1 X chromosome and the lack of a Y chromosome in those cells with a modal number of 45 chromosomes and the presence of two Y chromosomes in those cells containing 47 chromosomes. Skin fibroblast culture undertaken at the age of 3 months confirmed the presence of the 2 cell lines. The results of serial leucocyte and skin fibroblast cultures are shown in the Table. In the second leucocyte culture undertaken 14 months after the original investigation, 2 cells with karyotype 46,XY were observed. We do not consider that this finding was the result of random loss of 1 Y chromosome from a 47,XY cell as the preparations were of high quality with little scatter of chromosomes.

Discussion

Sex chromosome mosaicism is said to be present in 30% of all females with ovarian dysgenesis (Hamerton, 1971a). Mosaicism is generally considered to be the result of an accident in cell division occurring at an early stage in zygotic cleavage. If the error occurs late in cleavage after the establishment of a normal cell line, a multiple cell line mosaic will result (Hamerton, 1971b). There have been several reports of such triple cell line mosaics (Fraccaro et al., 1966). In the present case, only 2 cells in the 400 cells examined had a normal male karyotype. This finding may indicate the presence of a normal male cell line in tissue not examined by us, but the absence of such a cell line in any significant proportion suggests that in the case described the error in cell division occurred soon after cleavage of an XY zygote.

The table sets out the clinical and cytogenetic findings in the present case and the 3 previously reported cases of 45,X/47,XY mosaicism. It can be seen that correlation of these widely varying findings is extremely difficult.

In our patient, the proportion of the cell lines present in serial leucocyte cultures was reversed over a period of 14 months. Taylor (1968), studying mosaic mongols, also observed that the proportion of
Table Clinical and cytogenetic findings in 4 cases of 45X|47, XYY mosaicism

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Reference</th>
<th>Age at ascertainment (y)</th>
<th>Clinical findings</th>
<th>Primary sex organs</th>
<th>Cytogenetic findings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>External phenotype</strong></td>
<td><strong>Primary sex organs</strong></td>
<td><strong>Tissue cultured</strong> <strong>Date</strong> <strong>Total cells counted</strong> <strong>Chromosome counts</strong></td>
</tr>
<tr>
<td>1</td>
<td>Jacobs et al. (1961)</td>
<td>33</td>
<td>Short stature; neck webbing; female external genitalia with sexual hypoplasia</td>
<td>Laparotomy not done</td>
<td>Blood Jan. 1961 1000 2 69</td>
</tr>
<tr>
<td>2</td>
<td>Cooper et al. (1962)</td>
<td>16</td>
<td>Short stature; female external genitalia; sexual hypoplasia</td>
<td>Absent uterus; blind Fallopian tubes opening directly into vagina; streak gonads in position of ovaries</td>
<td>Blood 1962 50 1 1</td>
</tr>
<tr>
<td>3</td>
<td>Trowell and Hamilton (1965)</td>
<td>29</td>
<td>Short stature; obesity; gynaecomastia; male external genitalia; small testes; Wilms tumour removed at age of 16 mth</td>
<td>Testicular biopsy (1960) showed tubules lined only with Sertoli cells; well-preserved Leydig cells of normal numbers; absent spermatogenesis</td>
<td>Blood 1965 59</td>
</tr>
<tr>
<td>4</td>
<td>Present case</td>
<td>Newborn</td>
<td>Enlarged clitoris; ambiguous external genitalia</td>
<td>Normal uterus and Fallopian tubes; normal vagina; gonads attached to broad ligament were composed of testicular tissue</td>
<td>Blood Nov. 1973 100</td>
</tr>
</tbody>
</table>

We wish to thank Dr. A. Grauvaug who referred the case and Dr. Don Gutteridge who reviewed the manuscript. We thank Dr. J. C. McNulty, Commissioner of Public Health and Medical Services, for permission to publish this report.

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References


Reproduction in a woman with low percentage t(21q21q) mosaicism

**SUMMARY** The birth of a child is described with Down syndrome followed by the conception of a fetus bearing the t(21q21q) chromosome in 100% of their cells in a woman mosaic for the translocation in less than 10% of 2 of her examined tissues and in none of the cells in her peripheral blood. Various hypotheses for explaining the above findings are discussed. The importance of examining as many parental tissues as possible for the detection of low percentage mosaicism is stressed.

Dallaire and Fraser (1964) reported a similar family. Lymphocyte cultures on the parents were likewise normal, but long-term cultures of maternal skin fibroblasts revealed 0.87% mosaicism for trisomy-21.

Maternal mosaicism (46,XX/47,XX,+21) as a cause of Down syndrome was first reported by Smith *et al.* in 1962 and other cases have since been described (see for example Aarskog, 1969; Kaffe *et al.*, 1974).

Maternal mosaicism for trisomy-21 has also been described (Hsu *et al.*, 1971; Méhes, 1973).

G/G translocation in Down syndrome (Wilroy *et al.*, 1969) has occurred in two sibs. Both parents had normal karyotypes in their peripheral lymphocytes, but no other tissue was examined. Waxman and Arakaki (1966) also reported familial occurrence of G/G translocation. The mother had a normal karyotype in all of her peripheral lymphocytes examined and a 46,XX/46,XX,+F,−G karyotype in 8 out of 27 cells from her skin. She had one normal child and 3 children with clinical Down syndrome. Studies on 2 of the children with Down syndrome showed a G/G translocation. No banding study was performed.

We wish to report a family in which the mother is a low percentage mosaic for a (21q21q). Blood, skin, ovary, and amniotic fluid were studied. Banding technique was successful in clearly identifying the marker as either an isochromosome for 21q or a t(21q21q) chromosome.

**Case report**

A 24-year-old gravida II para I phenotypically normal woman was referred for amniocentesis in her 19th week of pregnancy because of a previous delivery of a male infant with Down syndrome. In her second pregnancy chromosomal analysis of cells derived from an amniotic fluid culture revealed a 46,XY,−G,+t(GqGq) karyotype subsequently shown to be 46,XY,−G,+t(21q21q) by trypsin-Giemsa staining technique. The patient, therefore, elected to undergo

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**Table**

<table>
<thead>
<tr>
<th>Patient</th>
<th>Tissue</th>
<th>Total no. of metaphases</th>
<th>No. of metaphases with marker</th>
<th>Cytogenetic diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proband</td>
<td>Peripheral blood</td>
<td>30</td>
<td>0</td>
<td>46,XX</td>
</tr>
<tr>
<td></td>
<td>Skin</td>
<td>50</td>
<td>4</td>
<td>46,XX/46,XX, −G,+t(GqGq)</td>
</tr>
<tr>
<td></td>
<td>Right ovary</td>
<td>30</td>
<td>1</td>
<td>46,XX/46,XX, −G,+t(GqGq)</td>
</tr>
<tr>
<td>Proband’s husband</td>
<td>Peripheral blood</td>
<td>100</td>
<td>0</td>
<td>46,XY</td>
</tr>
<tr>
<td>Proband’s first offspring</td>
<td>Peripheral blood</td>
<td>30</td>
<td>30</td>
<td>46,XY,−21, +t(21q21q)</td>
</tr>
<tr>
<td></td>
<td>Amniotic fluid</td>
<td>50</td>
<td>50</td>
<td>46,XY,−G, +t(GqGq)</td>
</tr>
<tr>
<td></td>
<td>Cord blood</td>
<td>30</td>
<td>30</td>
<td>46,XY,−G, +t(GqGq)</td>
</tr>
<tr>
<td></td>
<td>Heart blood</td>
<td>30</td>
<td>30</td>
<td>46,XY,−G, +t(GqGq)</td>
</tr>
<tr>
<td></td>
<td>Skin</td>
<td>30</td>
<td>30</td>
<td>46,XY,−G, +t(GqGq)</td>
</tr>
<tr>
<td>Proband’s fetus</td>
<td>Frozen skin</td>
<td>(Banded identification)</td>
<td></td>
<td>46,XY,−21, +t(21q21q)</td>
</tr>
</tbody>
</table>