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TESTICULAR GERMINAL DYSGENESIS (MALE TURNER'S SYNDROME)

Report of a case with chromosomal studies and review of the literature

By

M. Fraccaro, D. Ikkos, J. Lindsten, R. Luft and K. G. Tillinger

ABSTRACT

A case of so-called male Turner's syndrome is reported in a 25 year old patient. Chromosomal studies revealed a normal male karyotype. The sex chromatin pattern was negative. Histological examination of the bilaterally cryptorchid testes showed a picture typical for intraabdominal testes. Analysis of the published cases of so-called male Turner's syndrome revealed uniform histological changes of the testis in the form of slight to moderate alterations of the tubular walls and absence or immaturity of the cells of the germinial epithelium. The clinical, histological and hormonal findings in this syndrome have been tentatively defined. The term testicular germinal dysgenesis is suggested as more appropriate for this syndrome than the commonly used name of male Turner's syndrome.

The first female patient to be reported with a combination of webbed neck and infantilism was probably the one published by Funke in 1902. Interest in this syndrome was aroused mainly by the report of Turner (1938), and the number of cases reported has since increased considerably. It then became apparent that the clinical picture could vary considerably: webbing of the neck and short stature may be absent, and a few of the patients may have spontaneous men-

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struations – although mostly only for a short period of time. The only constant feature of »female« Turner’s syndrome is gonadal dysgenesis (Greenblatt 1958). Application of the sex chromatin technique demonstrated that in 80% of these patients the sex chromatin pattern was negative (see Grumbach & Barr 1958). Studies of the chromosome complement have shown, however, that females with Turner’s syndrome and a negative sex chromatin pattern have a somatic complement of 45 chromosomes instead of the usual 46 (Ford et al. 1959; Fraccaro et al. 1959; Tjio et al. 1959), and that their chromosome constitution is of the XO type, i.e. with only one X chromosome.

Cases of phenotypic males with Turner’s syndrome – short stature, webbed neck, other congenital malformations of the pterygium type and different degrees of hypogonadism – have appeared sporadically in the literature. Cassilsh (1952) collected 15 such cases, and since this review another 16 have appeared in the literature (McCullagh 1948; Reforzo-Membribes et al. 1949; Cunningham & Harley 1951; James 1952; Sougin-Mibashan & Jackson 1953; Mackenzie 1953; Öster 1954; Reiner & Grnja 1955; Avin 1956; Halonen et al. 1956; Jackson & Hoffenberg 1957; de la Balze et al. 1958; Becker 1958; Court-Brown et al. 1960).

In view of the chromosomal findings in phenotypic females with Turner’s syndrome it was of obvious interest to determine the chromosomal constitution in patients with the male Turner’s syndrome. In this report a description is given of such a patient, in whom we had the opportunity of determining the somatic chromosome complement in bone marrow cells cultivated in vitro.

**CASE REPORT**

The patient was seen by us for the first time in 1952 at the age of 25. He complained of short stature, tiredness, bilateral absence of testes and hypogonadism. He is the fourth of six children – three males and three females – of apparently healthy parents. The oldest brother died at the age of 24 of heart disease – post mortem examination was not performed. Three of the living sibs are married and have healthy children. The fourth is unmarried and apparently healthy. Information about the remaining relatives could not be obtained, since the relatives of both parents are living abroad.

The patient was born at term after an uneventful pregnancy. His mother could not recall having been ill or receiving any medicine during this pregnancy. Marked bilateral palpebral ptosis and undescended testes were noticed at birth. Because of deformation of the chest, »rickets« was diagnosed at the age of two.

The development of the patient was somewhat slow. For instance, he started to walk at 22 months, and he has always been shorter than other boys of his age. Puberty began at the age of 16–17, progressed very slowly, and was not completed at the age of 25 when the patient was first seen by us. He never had erections, and interest in the opposite sex was absent. Axillary and pubic hair growth was scanty, and beard growth was insignificant.

The patient had always complained of muscular weakness and »weak joints«. More-
Fig. 1.
The patient; December 1, 1959.
over, his vision has been impaired bilaterally since birth. His mental development and social adjustment has, however, been quite normal. He finished elementary school at the appropriate age with good marks, and has been working as a laboratory assistant since the age of 15.

The patient's bilateral palpebral ptosis was surgically corrected in 1949. In 1950 pterygium of the right eye was diagnosed which was operated repeatedly between 1950 and 1956. He has otherwise always been healthy except for measles and mumps before the age of 10.

Physical examination in February 1952 revealed a short man with normal proportions and with a number of malformations (Fig. 1). Body height was 154 cm (normal 3 sigma-limits for Swedish men at the age of 20, 163.2 to 193.2 cm, mean 178.2), span 154 cm, symphysis pubis to floor 77 cm. The body weight – 52 kg – was at the upper limit of the normal variation (30.7 to 53.7 kg at a body length of 154 cm, mean 42.2 kg). The patient had a peculiar face with pronounced bilateral ptosis despite the previous operation, pterygium of the right eye, slight convergent strabismus, marked horizontal nystagmus and a slightly hypoplastic chin. The implantation of the hair was low on the forehead and on the neck. Malformations of the external ears were present. The neck was rather short and showed a clear, although slight webbing. The palate was highly arched. Chest deformity of the so called shield-like type was present. The distance between the nipples was abnormally large. The normal thoracic kyphosis was missing, and scapulae alatae were present on both sides. Clear-cut cubiti valgi and slight geni valgi were seen. Furthermore the patient had long, hyperflexible fingers and toes, and the nails were unusually soft but not brittle.

The skin was thin and soft as in hypogonadism. Facial and pubic hair were scanty; axillary and body hair were absent. The penis was clearly postpubertal, but not of adult size. The scrotum was rather well developed but testes were not palpable in the scrotum or the adjacent regions. The prostate was not palpable.

The clinical examination was otherwise negative. The blood pressure in the arm was normal, both femoral arteries were normally palpable, and no signs of cardiac disease could be found. Neurological examination was negative.

Roentgenologic studies showed a somewhat retarded skeletal age (of approximately 20 years). The cervical spine was of infantile type. No other skeletal changes were present. A slight coarctation of the aorta could be seen on plain X-ray films; heart catheterization and/or angiocardiography were not performed. X-ray of the skull was normal.

Routine haemograms and urine analysis were normal, and the serological examinations for syphilis were negative. Blood cholesterol, BMR, glucose tolerance test, insulin tolerance test, water loading test and concentration of inorganic phosphate in plasma (3.9 mg %) were within normal limits. The daily excretion of 17-ketosteroids was low, varying between 0.7 and 3.3 mg/24 h. The urinary gonadotrophin excretion was high, the levels being between 13 and 53 MU/24 h and above 96 MU/24 h.

Between 1952 and 1958 the patient was treated symptomatically with androgenic hormones – at the beginning with implantations of Perandren© and later with intramuscular injections of Triolandren©. This was followed by enlargement of the penis, development of the prostate which reached normal size, increase in body hair growth, deepening of the voice and also appearance of erections. Gonadotrophin excretion remained high during this period.

The patient was hospitalized for further studies in October 1958. The physical findings at that time were unchanged except for a moderate beard growth, normal pubic and axillary hair growth, adult-sized penis, palpable prostate of adult size and
consistency, and a deeper voice. The patient had had erections and pollutions but no sexual experience.

At laparotomy performed in October 1958 testis-like structures were found bilaterally at the entrance of the pelvis minor. Because of the increased danger of malignancy in intraabdominal testes, the established need for androgen substitution and the absence of sperm in the seminal fluid, the testes were removed. Connected with the testes were epididymis-like structures, which continued into vas deferens of normal appearance. During the operation contrast medium was injected bilaterally into the coloboma of the vas deferens and demonstrated on X-ray normal seminal vesicles and prostate. No abnormal intraabdominal structures were observed.

Microscopical examination of the testes (Fig. 2)

The histological picture of the two testicles was essentially the same. The tubules were smaller than in normal adult testes with a diameter varying from 140 µ to total obliteration. Five to 10 per cent of the tubules were obliterated due to sclerosis of the wall and present in varying degrees in all tubules. The tubular epithelium was composed only of Sertoli cells at different stages of differentiation. Spermiogones were not identified, a situation which may be termed »germinal cell aplasia«. Differentiated Sertoli cells of normal size

Fig. 2.
Microscopical appearance of the testes. Two tubules with slight wall sclerosis. The upper one shows differentiated Sertoli cells and some intercellular »vacuoles«. The lower tubule shows a stratified, undifferentiated epithelium. No spermiogones. Mature Leydig cells can be seen.
were observed as well as atrophic and »wind-swept« ones. Most of them showed rather marked vacuolization. A number of tubules showed stratified, poorly differentiated epithelium with oval nuclei and no vacuoles in the cytoplasm (immature »Sertoli« cells). The septuli were broader than in normal adult testes. There was a moderate degree of intralobular and a slight peritubular fibrosis.

Most of the interstitial cells were Leydig cells with well-defined borders and nuclei of normal appearance. They were not disposed in large clusters, but there was a diffuse, relative hyperplasia of these cells. There were signs of an ecto-endoplasm arrangement usually observed in many normal Leydig cells (Tillinger 1957), but a large number of small vacuoles were observed in the ectoplasm. Reinke’s crystalloids were scarce and pigmentation rare.

The microscopic appearance of the testes exhibited the two characteristic features of a cryptorchid organ, viz. delay in maturation and degeneration. The pronounced vacuolization of the Leydig and Sertoli cells, which is not seen in untreated cryptorchidism, might have been due to the previous testosterone treatment. It was not possible to decide whether the germinal cell aplasia was congenital or acquired.

**Chromosome studies**

Bone marrow cells obtained by sternal puncture were plated into Petri dishes containing a cover-slip, and cultivated at 37°C in an atmosphere of 5 per cent CO₂ in air in the presence of a fluid medium. The cells attached to the cover-slip were, at suitable stage of cultivation, treated with a hypotonic solution of 0.7 per cent sodium citrate and fixed and stained with a solution of 2 per cent orcein in 50 per cent acetic acid. When necessary, squashing was performed by manual pressure. Chromosome delineation of the karyotype was obtained by cutting photographic enlargements of photomicrographs, and by arranging the chromosome pairs according to size and centromere position. A detailed description of the cell culture and cytological methods is given by Fraccaro et al. (in press). Cells were also stained with basic fuchsin (Feulgen’s reaction) and light green for detailed observation of the morphology of the resting nucleus (Fraccaro & Lindsten 1959). They were constantly sex chromatin negative.

Chromosomes counts were performed only in mitotic cells of high technical standard. Some twenty such cells were studied and constantly displayed 46 chromosomes. One chromosome in the medium size range was left unpaired, its position being either pairs 5 and 6 or pairs 6 and 7. This was interpreted as being an X chromosome, but its location was difficult to assess even by the criteria of length and arms ratio and it was therefore left unnumbered. The acrocentric chromosome in the small size range assumed to be the Y chromosome was constantly longer and more acrocentric than those of pairs 21 and 22.
Fig. 3.
Mitotic metaphase in a bone marrow cell cultured *in vitro*. 46 chromosomes.

Fig. 4.
The chromosomes of Fig. 3 disposed according to size and centromere position. The sex chromosome are marked XY.
A representative mitotic metaphase and the karyotype obtained from the
same photograph are shown in Figs. 3 and 4. The chromosomes are disposed
according to a delineation of the normal human karyotype to be published
elsewhere (Fraccaro & Lindsten, in press).

On the basis of the above findings it was concluded that the patient has an
apparently normal male somatic chromosome complement.

DISCUSSION

The total number of cases so far reported as male Turner’s syndrome is limited.
Caflish (1952) reviewed all cases with the Bonnevie-Ullrich status or pterygium
syndrome reported in the literature up to 1950, adding seven cases of his own.
The total number amounted to 197, 68 of which were classified as infantilismus
pterygo-nucalis or Turner’s syndrome. Fifteen of these 68 cases - or 22 per cent -
were phenotypic males.* We have been able to find another 16 cases reported
as male Turner’s syndrome in literature (see introduction). The total number of
such patients, including our own, thus amounts to 31.

The criteria on which the diagnosis of male Turner’s syndrome has been
based have not been very strict. In analogy to the female Turner’s syndrome,
the presence of short stature, malformations of the pterygium type and hypogo-
nadism have been considered as prerequisites for the diagnosis of male
Turner’s syndrome. However, the majority of the reported cases concerned
patients at or before puberty. It is therefore impossible to decide, whether hypogo-
nadism was present or not in this group of patients, since »hypogonadism« is
a normal phenomenon in that age group. Consequently, these patients may have
had only a combination of malformations of the pterygium syndrome and short-
ness of stature. Only nine cases of male Turner’s syndrome in adults (aged 18
or more) are known (Flavell 1943; Martin 1947; McCullagh 1948; Greenblatt
& Nieburghs 1948; (Case 2); Sohval 1951; Sougin-Mibashan & Jackson 1953;
Mackenzie 1953; Halonen et al. 1956; present case).

In Table 1 are presented data concerning the gonads, the genital organs and
the excretion of hormones in cases reported as male Turner’s syndrome in
patients aged 10 years or over. A few of the reported cases of that age group
are not included, either because the original descriptions of the cases were not
available to us (Weissenberg 1928), or because data concerning the sexual
development of the patients were not included in the presentations (Matolesy
1936; Court-Brown et al. 1960).

* Cases reported by Basch 1891; Steche 1905; Weissenberg 1928; Fanconi & Grob 1934;
Matolesy 1936; Kopits 1937; Marquardt 1937; Bizarro 1938; Flavell 1943; Martin 1947;
Dorff et al. 1947; Greenblatt & Nieburghs 1948; Caflish 1952).
<table>
<thead>
<tr>
<th>Case no.</th>
<th>Authors</th>
<th>Age years</th>
<th>Genital organs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Penis</td>
</tr>
<tr>
<td>1</td>
<td>Öster (1954)</td>
<td>10</td>
<td>small palpable on a level with the external abdominal ring</td>
</tr>
<tr>
<td>2</td>
<td>Reforzo-Membrubes et al. (1949)</td>
<td>$10^{9/12}$</td>
<td>small, well-shaped right: $1.6 \times 0.8$ cm left: $1.5 \times 0.7$ cm hypoplastic</td>
</tr>
<tr>
<td>3</td>
<td>Avin (1956)</td>
<td>11</td>
<td>prepubertal left: $1.5$ cm³ right: undescended</td>
</tr>
<tr>
<td>4</td>
<td>Reiner &amp; Grnja (1955)</td>
<td>12</td>
<td>slightly developed pea-sized</td>
</tr>
<tr>
<td>5</td>
<td>Jackson &amp; Hoffenberg (1957) (Case 2)</td>
<td>14</td>
<td>infantile infantile</td>
</tr>
<tr>
<td>6</td>
<td>Bizarro (1938)</td>
<td>14</td>
<td>(normal) left: not palpable right: small at the external inguinal ring</td>
</tr>
<tr>
<td>7</td>
<td>Becker (1958)</td>
<td>15</td>
<td>very large (8.5 cm) operation for bilateral cryptorchism at 13 years of age small</td>
</tr>
<tr>
<td>8</td>
<td>de la Balze et al. (1958)</td>
<td>15</td>
<td>small (4 $\times$ 2.5 cm) hypospadic right: in the inguinal canal, 1 cm long left: $3 \times 2 \times 2$ cm</td>
</tr>
<tr>
<td>9</td>
<td>Martin (1947)</td>
<td>18</td>
<td>normal normal</td>
</tr>
<tr>
<td>10</td>
<td>Mackenzie (1953)</td>
<td>19</td>
<td>large small</td>
</tr>
<tr>
<td>11</td>
<td>Flavell (1943)</td>
<td>21</td>
<td>normal hypoplastic ($\frac{1}{2}$ of the normal)</td>
</tr>
</tbody>
</table>
Table 1 (cont.).

<table>
<thead>
<tr>
<th>17-KS mg/24 h</th>
<th>Gonadotrophin MU/24 h</th>
<th>Testicular histology</th>
<th>Sex chromatin pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>50</td>
<td>not available</td>
<td>-</td>
</tr>
<tr>
<td>0.6-1.2</td>
<td>negative</td>
<td>thickened albuginea; basal spermiogones present; only a few cells of the first degree spermiogenesis; Leydig cells absent - testis of a normal 10 year old boy</td>
<td>-</td>
</tr>
<tr>
<td>1.2</td>
<td>41</td>
<td>not available</td>
<td>-</td>
</tr>
<tr>
<td>1.5</td>
<td>normal</td>
<td>thickened capsula; fibrous interstitial tissue; no Leydig cells; tubules rare with large, pale, degenerated spermiogones, no sperms</td>
<td>-</td>
</tr>
<tr>
<td>-</td>
<td>&lt;12</td>
<td>infantile testicular development (as seen in the first six years of life)</td>
<td>negative</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>not available</td>
<td>-</td>
</tr>
<tr>
<td>0.4</td>
<td>0</td>
<td>atrophic tubules with thickened but not hyalinized tunica; few spermiogones and praespermides, no mature forms; isolated Sertoli cells; Leydig cells present in clusters; pronounced increase of interstitial tissue</td>
<td>negative</td>
</tr>
<tr>
<td>9.2</td>
<td>+</td>
<td>left: seminiferous tubules with hyalinized, thickened basal membrane; thickened tunica; no cells of the germinal series; Sertoli cells present; Leydig cells normal right: no cells of the germinal series; Sertoli cells present; a few tubules with spermiogones and spermiocytes; Leydig cells normal; thickened hyalinized basal membrane; thickened tunica</td>
<td>negative</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>not available</td>
<td>-</td>
</tr>
<tr>
<td>low</td>
<td>high</td>
<td>not available</td>
<td>-</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>not available</td>
<td>-</td>
</tr>
</tbody>
</table>
Table 1 (cont.).

<table>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Penis</td>
</tr>
<tr>
<td>12</td>
<td>McCullagh (1948)</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Halonen et al. (1956)</td>
<td>21</td>
<td>(normal)</td>
</tr>
<tr>
<td>14</td>
<td>Present case</td>
<td>25</td>
<td>subnormal</td>
</tr>
<tr>
<td>15</td>
<td>Greenblatt &amp; Nieburghs (1948) (Case 2)</td>
<td>30</td>
<td>very large</td>
</tr>
<tr>
<td>16</td>
<td>Sougin-Mibashan &amp; Jackson (1953)</td>
<td>30</td>
<td>normal</td>
</tr>
<tr>
<td>17</td>
<td>Sohval (1951)</td>
<td>36</td>
<td>subnormal</td>
</tr>
</tbody>
</table>

Malformations of the pterygium type were present in all cases, and the appearance of the patients, in all cases but one, was analogous to that of phenotypic females with classical Turner’s syndrome. Body length was below normal in all patients except those of Avin (1956) and Sohval (1951). The patient described by Sohval (1951) was of normal body length and had an eunuchoid body build. Malformations of the pterygium type were, however, present even in the latter case in the form of infantile cervical spine on X-ray. Secondary hair growth was present in all cases, but its abundance varied considerably.

The size of the penis was mentioned in eight of the nine adult patients (Table 1). It was considered as normal in four, subnormal in two, «very large» in one, and larger than average in another patient. Enlargement of the penis was also reported by Becker (1958) in a patient aged 15 years, and an enlarged penis is easily discerned on the photographs of the patients reported by Jackson & Hoffenberg (1957) (Case 3) and Greenblatt & Nieburghs (1948).
Table 1 (cont.).

<table>
<thead>
<tr>
<th>17-KS mg/24 h</th>
<th>Gonadotrophin MU/24 h</th>
<th>Testicular histology</th>
<th>Sex chromatin pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1-6.2</td>
<td>6-105</td>
<td>hypoplasia; thickening of the basement membrane; moderate fibrosis; Leydig cells absent; distinctly immature gametogenic cells</td>
<td>–</td>
</tr>
<tr>
<td>6- 53</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0-4.2</td>
<td>&lt; 65</td>
<td>normal tunica propria; no sclerosis or hyalinization of the tubules; hypoplasia of the germinal tissue with immature sperm cell formation and small spermiocyte heads here and there; Sertoli cells normal, Leydig cells sparse</td>
<td>–</td>
</tr>
<tr>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.7-3.3</td>
<td>13-53</td>
<td>tubules smaller than normal with sclerosis of the wall; Sertoli cells normal; spermioones absent; Leydig cells present</td>
<td>negative</td>
</tr>
<tr>
<td>96</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-11.9</td>
<td>(negative assay in serum)</td>
<td>right: hypoplasia of the seminiferous tubules; azoo-spermia; relative increase in interstitial cells</td>
<td>–</td>
</tr>
<tr>
<td>96</td>
<td></td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>11.1</td>
<td>180</td>
<td>small tubules with thickening of lamina propria; Sertoli cells present; cells of gametogenic series absent; conspicuous number of Leydig cells</td>
<td>–</td>
</tr>
</tbody>
</table>

The testes were reported as small in all cases except one. Moreover, different degrees of unilateral or bilateral cryptorchidism were sometimes observed. The size of the prostate was mentioned in four of the adults, and was smaller than normal in all of them.

The urinary excretion of 17-ketosteroids was normal in two and definitely low in three of the adult patients. Values for urinary gonadotrophin were reported in five adult patients. Values for urinary gonadotrophin were reported in five adult patients, and in all of them high values were found. It is of interest in this connection that high gonadotrophin excretion has also been found in two boys with Turner’s syndrome aged 10 and 11 (Öster 1954; Avin 1956).

Microscopical examinations of the testis were reported in five adult cases. Seminiferous tubules were easily discerned, but they were »hypoplastic« or »small«. The basement membrane was found thickened with moderate or different degrees of tubular sclerosis. Sertoli cells were present in all cases.
The cells of the germinal series were either completely missing or, when present, always immature; sperms were never seen. Leydig cells of normal appearance were found in three patients, while such cells could not be identified in the patient of Sohval (1951). It seems therefore that the two constant findings in the histological picture of the testes were the absence of mature forms of the cells of the germinal series and changes of the walls of the tubules, the latter abnormality never attaining the degree observed in Klinefelter's syndrome.

Testicular biopsies are also available in five non-adult patients described as male Turner's syndrome. In the case reported by de la Balze et al. (1958) a few tubules with spermiogones and spermiocytes were observed in the right cryptorchid testis, while cells of the germinal series were absent in the remaining part of the right testis and in the intrascrotal left testis. This absence of development of the cells of the germinal series in the majority of the tubules examined is indicative of gonadal dysgenesis. Gonadal dysgenesis was probably present even in the case of Reiner & Grnja (1955) since germinal cells were totally absent at the age of 12, a finding similar to that in the case of Sohval (1951). The significance of the findings in the remaining three cases cannot be decided because of the low age of the patients. Since spermiogones were present in all cases, the diagnosis of germinal aplasia can, however, be excluded.

The sex chromatin pattern was negative in the present case. Sex chromatin studies are not available in the remaining adult cases. In three non-adult cases (Jackson & Hoffenberg 1957; de la Balze et al. 1958; Becker 1958) a negative sex chromatin pattern was found. Chromosomal studies in the present case showed an apparently normal male karyotype. The same chromosome pattern was recently reported by Court-Brown et al. (1960) in a male patient with pterygium syndrome, who was originally thought to be perhaps a male example of Turner's syndrome.«

On the basis of the above review the following findings may tentatively be considered as characteristic of male Turner's syndrome:

- **stature** short in the majority of cases
- **external appearance** usually as in female Turner's syndrome
- **penis** variable in size (small, normal or enlarged)
- **testes** generally small, sometimes unilateral or bilateral cryptorcidism
- **scrotum** normal
- **prostate** small to moderate
- **17-ketosteroid excretion** low to normal
- **urinary gonadotrophins** elevated
- **testicular histology**
  - tubules small with slight or moderate sclerosis
  - Sertoli cells immature or normal
  - germinal cells absent or immature
  - Leydig cells normal (eventually absent).
<table>
<thead>
<tr>
<th></th>
<th>chromosome pattern</th>
<th>sex chromatin</th>
<th>phenotype</th>
<th>external genital organs</th>
<th>internal genital organs</th>
<th>tubules</th>
<th>Sertoli cells</th>
<th>germinative cells</th>
<th>Leydig cells</th>
<th>gonadotrophin excretion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germinal aplasia or agenesis (del Castillo)</td>
<td>?</td>
<td>-</td>
<td>male</td>
<td>male</td>
<td>male</td>
<td>size slightly reduced, no sclerosis</td>
<td>normal</td>
<td>absent</td>
<td>normal</td>
<td>normal or elevated</td>
</tr>
<tr>
<td>Testicular germinal dysgenesis (male Turner's syndrome)</td>
<td>XY</td>
<td>-</td>
<td>male</td>
<td>male</td>
<td>male</td>
<td>size reduced, some sclerosis</td>
<td>normal or immature</td>
<td>absent or immature</td>
<td>present (eventually absent)</td>
<td>elevated</td>
</tr>
<tr>
<td>Testicular tubular dysgenesis Klinefelter</td>
<td>XXY</td>
<td>+</td>
<td>male</td>
<td>male</td>
<td>male</td>
<td>size reduced, pronounced sclerosis</td>
<td>normal or immature</td>
<td>mostly immature, eventually some tubules with mature spermiogenesis</td>
<td>hyperplasia</td>
<td>elevated</td>
</tr>
</tbody>
</table>

*Table 2.*
Comparison of the three common types of testicular dysgenesis.
Since the only constant finding in all patients is the histological changes in the testes, and since these changes concern principally the cells of the germinal series, we suggest for this syndrome the name testicular germinal dysgenesis, which we consider more appropriate than male Turner’s syndrome. A renaming of the syndrome also seems to be indicated from the point of the chromosome findings. The sex chromosome type (XY) in the male Turner’s syndrome is different from the one in female Turner’s syndrome (XO). Moreover, the term testicular germinal dysgenesis has the advantage of connecting the syndrome with other known types of testicular dysgenesis and with gonadal dysgenesis in general.

The relation between testicular germinal dysgenesis and the two common types of seminiferous-tubule dysgenesis is summarized in Table 2. The male character of the phenotype and the external and internal genital organs as well as the elevated gonadotrophin excretion are common characteristics of these three types of testicular dysgenesis. With regards to the histology of the testis, testicular germinal dysgenesis lies between the two other forms. Changes in the tubular walls are present but not to the same extent as in tubular dysgenesis or Klinefelter’s syndrome. Cells of the germinal series, on the other hand, are usually present in testicular germinal dysgenesis but mature forms have not been seen, while such forms were found in non-destroyed tubules in a few cases of tubular dysgenesis. From a histological point of view testicular germinal dysgenesis in easily distinguished from tubular dysgenesis or Klinefelter’s syndrome. On the other hand, there seems to be a less sharp difference, perhaps only quantitative, between germinal aplasia and testicular germinal dysgenesis. For instance, in the case of germinal dysgenesis of Sohval (1951) germinal cells were totally absent, while in the one of de la Balze et al. (1958) such cells were only found in some of the tubules. Furthermore, isolated tubules with spermiogenesis might be encountered in testes with the typical histological picture of germinal aplasia. From a genetic point of view, testicular germinal dysgenesis can be distinguished from Klinefelter’s syndrome but not from germinal aplasia. In the latter syndrome chromosomal studies are lacking, but the sex chromatin pattern has been shown to be negative – as in testicular germinal dysgenesis. Because of the identical sex chromatin pattern and the similarity in testicular histology it may be debated, whether testicular germinal dysgenesis and germinal aplasia represent different degrees of a common entity.

The somatic malformations in testicular germinal dysgenesis link this syndrome to other known types of gonadal dysgenesis. Malformations of the pterygium type are common in Turner’s syndrome, and have been reported in other types of gonadal dysgenesis such as gonadal dysgenesis with phallic enlargement and in gonadal dysgenesis with male pseudohermaphroditism (see Grumbach & Barr 1958; Greenblatt 1958) as well as in patients with the syndrome of rudimentary ovaries (del Castillo & Argonz 1957). The report of
"male" and "female" variants of Turner's syndrome in the same family (Reiner & Grnja 1955) cannot be interpreted at present, due to lack of chromosome studies.

The enlarged penis in cases of gonadal dysgenesis with phallic enlargement is usually attributed to the presence of gonads during the intra-uterine life (Wilkins 1957; Grumbach & Barr 1958; Greenblatt 1958). On the other hand, enlargement of the penis was present in one of the five adult cases of testicular germinal dysgenesis, was mentioned in two non-adult cases of this syndrome (see Table 1), and was eventually present in another two cases. The excretion of 17-ketosteroids was normal in those three cases, in which this measurement was performed. Consequently, there is no support for the hypothesis that the enlargement of the penis was due to hormonal influence. One might therefore consider the enlargement of the phallus in some cases of testicular germinal dysgenesis as well as in cases of gonadal dysgenesis with phallic enlargement as one of the malformations encountered in these syndromes.

In females with Turner's syndrome the diagnosis can be established before puberty on the basis of the characteristic chromosomal complement and the negative sex chromatin pattern, or the demonstration of vestigial gonads. In contrast, the diagnosis of testicular germinal dysgenesis can be established only after puberty, since the finding characteristic for this syndrome, i.e. immaturity of the cells of the germinal series, is normally encountered before puberty.

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