Hermaphroditism in a Rat

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Hermaphroditism is characterized by the coexistence in an individual of ovarian and testicular tissues. It is rare in human beings but is more common in some lower forms. The literature of mammalian intersexuality has been reviewed by KOCH. In domestic animals hermaphroditism is more frequent in pigs than other species. In small laboratory animals spontaneous hermaphroditism is a rare condition. It has been described in the mouse, the rat, the Syrian hamster, the guinea pig, the rabbit, the dog, and the monkey.

Despite the common use of rats for experimental purposes the literature of hermaphroditism in this species is very limited, containing only occasional reports. A summary of reported cases, including the case described herein, is given in Table I.

Report of Case

History

A Sprague-Dawley rat supplied by the breeder (AB Anticimex, Norrviken, Sweden) at 2 months of age was included in a toxicological investigation as a female animal. The treatment did not influence the hormonal state of the animal. During the experiment the rat did not show any clinical sign. It was killed at 3 months of age at the termination of the experiment and discovered to be a hermaphrodite as an incidental observation in connection with the routine autopsy.

Macrosopic Examination

Externally the rat resembled a female. The nipples were characteristic of females. No penile structure or external orifice of the vagina was found.
**Table I. Hermaphroditism in the rat: Summary of 10 cases from the literature and one new case**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Right side</th>
<th>Left side</th>
<th>Male accessory glands</th>
<th>Vagina</th>
<th>Vaginal orifice</th>
<th>Vaginal-urethral communication</th>
<th>Urogenital sinus</th>
<th>External sexual appearance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gonad</td>
<td>Oviduct</td>
<td>Uterine horn</td>
<td>Epididymis</td>
<td>Vas deferens</td>
<td>Gonad</td>
<td>Oviduct</td>
<td>Uterine horn</td>
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<tr>
<td>Burrill, et al. (1941)²⁸</td>
<td>Ovte</td>
<td>—</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Ov</td>
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<tr>
<td>Green (1942)¹¹</td>
<td>Ov</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Te*</td>
<td>—</td>
<td>—</td>
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<tr>
<td>Arey and Greene (1957)¹¹</td>
<td>Ovte</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Ovte</td>
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<tr>
<td>Iglesias (1958)¹⁰</td>
<td>Te**</td>
<td></td>
<td></td>
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<td>Ovte</td>
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<tr>
<td>Bradbury and Bunge (1958)⁵</td>
<td>Ovte</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Ovte</td>
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<tr>
<td>Maibenco, et al. (1963)²⁰</td>
<td>Te*</td>
<td>—</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Ovte</td>
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<tr>
<td>Petora (1968)³³</td>
<td>Ovte</td>
<td>—</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Ovte</td>
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<tr>
<td>Magnusson (1971)</td>
<td>Ovte</td>
<td>—</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>Ovte</td>
<td>—</td>
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</tr>
</tbody>
</table>

Ovte = Ovotestis, Ov = Ovary, Te = Testis

+= present, -= absent

M = predominantly male, F = predominantly female

* = chryptorchid, ** = scrotal

M/F = not characteristic of any sex
Fig. 1. Dorsal view of the reproductive system of a hermaphroditic rat. The left gonad is an ovary and the right one an ovotestis. The planes through which the histological sections of the ovotestis were obtained are indicated (A, B).

Fig. 2. The right uterine horn with the vas deferens located in the mesometrium. The epithelium of the uterine horn becomes squamous towards the mesometrium. H & E, ×40.

Internally on the left side there was an ovary, normal as to appearance and position but somewhat small. On the right side there was an irregular gonad with a diameter of about 1.5 cm (Fig. 1). Most of the right gonad was smooth. Both sides had Müllerian derivates. On the left there were an oviduct and a uterine horn. On the right there was no oviduct, the uterine horn ending blindly. The right uterine horn was somewhat shorter and thicker than the left. The 2 uterine horns fused to a common cervix and vagina. The vagina was short, dilated, and lacked an external orifice. An epididymis was attached to the right gonad. This epididymis continued as a vas deferens located in the mesometrium (Fig. 2). The vas deferens terminated via a communication with the urethra. No vestige of male accessory glands was discovered.
Fig. 3. A cross section of the right gonad through plane A in Fig. 1. The seminiferous tubules are without any sign of spermatogenesis. Intertubular oedema and numerous interstitial cells. H & E, ×75.

Fig. 4. A cross section of the right gonad through plane B in Fig. 1. There are both ovarian (upper area) and testicular (lower area) tissues. H & E, ×40.

**Microscopic Examination**

Samples of tissue from the gonads, the uterine horns, and vagina were preserved in 10% aqueous formalin, embedded in paraffin, sectioned, and stained with hematoxylin and eosin.

The left gonad was a normal ovary with numerous follicles of different stages of maturity. No corpus luteum was recognized. The right gonad was an ovotestis. A section through plane A (Fig. 1) revealed testicular tissue (Fig. 3). A section through plane B (Fig. 1) contained testicular tissue primarily and a minor area of ovarian tissue on the surface (Fig. 4). In the ovarian component there were
follicles of different stages of maturity but no corpus luteum. In the testicular component the seminiferous tubules were small, empty, and separated by moderate interstitial oedema. The seminiferous epithelium was poorly developed, the tubules being lined by 1 or 2 rows of cells. Mature spermatozoas were lacking. Leydig's interstitial cells were numerous. The epididymis had small tubules embedded in a well-developed fibrous stroma and lined by columnar epithelium. The tubules were empty.

The left uterine horn was lined by columnar epithelium. In a very limited area adjacent to the mesometrium the epithelium appeared squamous. The mesometrium contained no seminiferous duct. The right uterine horn was lined by a mixture of columnar and squamous epithelium, the latter occurring adjacent to the mesometrium. There was a vas deferens in the mesometrium (Fig. 2).

The vagina was greatly dilated, lined by squamous epithelium, and contained a large amount of cornified material.

Discussion

Ten cases of hermaphroditism in the rat were found in the literature (Table I). The low incidence of spontaneous hermaphroditism in the rat coincides with the experience from our laboratory. The case reported here is the only one from about 6000 complete autopsies on rats.

On an anatomical basis hermaphroditism can appear as bilateral (testicular and ovarian tissue on both sides), unilateral (testicular and ovarian tissue on one side; testicular or ovarian tissue on the other side), or lateral (testicular tissue on one side, ovarian tissue on the other side). Among the collected cases the hermaphroditism was bilateral in 4 rats, unilateral in 4, and lateral in 3.

Some additional features of hermaphroditism in the rat are evident from the collected series. In connection with an ovotestis, there has always been a uterine horn, an epididymis, and a vas deferens, but an oviduct has been lacking in some animals. The presence or absence of the oviduct may be due to different strength of hormonal activity of the corresponding gonad at the time of sexual differentiation. In the present case there was neither an epididymis nor a vas deferens on the ovarian side, contrary to findings in other rats. This might possibly be explained by a difference in influence by sexual hormones. The collected cases also reveal that male accessory glands have mostly been demonstrated, that the vagina has always lacked an external orifice but has communicated with the urethra via a small patent duct, and that in one rat the vagina fused with the urethra, forming a urogenital sinus.

It is known that the distribution in an ovotestis of testicular and ovarian tissues vary. In general the former is more abundant than the latter. The testicular tissue can appear as a medulla and the ovarian one as a cortex. In the present rat the testicular tissue dominated in the ovotestis, and the ovarian component occupied only a small area on the surface of the gonad. A corresponding appearance of an ovotestis has been observed in both rats and mice.

In the described case no corpus luteum indicative of recent ovulation was demonstrated in either the ovary or the ovarian part of the ovotestis. The same
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A case of spontaneous unilateral hermaphroditism in a Sprague-Dawley rat is reported and 10 cases from the literature summarized.

References


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