
EXERCISE 37 *RATTUS RATTUS* III: THE URINOGENITAL SYSTEM

Structure

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37.1 INTRODUCTION

The urinogenital system (Refer Unit 9, Block 3, Course LSE-10) consists of two independent systems, quite unrelated in function. They are:

1. The urinary or excretory system that functions to filter metabolic wastes from the blood and eliminates them; it also functions to regulate the salt-water balance of body fluids.
2. The genital or reproductive system which functions to produce haploid sex cells or gametes and sex hormones for maintenance of reproductive functions; in the female it further serves to support and nourish the developing offspring,

These two systems, although functionally unconnected, are physically in intimate contact due to developmental similarities. Some parts of their duct systems have a common embryological origin, later diverging and modifying to suit individual functions.

In the male, the terminal part of the duct or urethra is still a common passage shared by the two systems for the discharge of urine and semen.

In the female, however, there is absolutely no connection at all because of a separate urethra (exclusively for the passage of urine) and a vagina (exclusively for the discharge of gonoduct secretions and the birth of the offspring). Thus, in the female at least, the term 'urinogenital' becomes a misnomer.

The two systems do share some common features with respect to their organisation. Both have a main functional organ, followed by a system of ducts as a passage for the functional products, and a discharge aperture outside the body in the pubic region,

In the excretory system, the main functional organ is the kidney, the duct system consists of the ureters and the urethra, and the discharge aperture is the urinary or urethral orifice.

In the male reproductive system the main functional organ is the testis and the duct system consists of the epididymis and vas deferens ending in the common urethra. The genital orifice therefore, is the urethral orifice as well (a common urinogenital aperture).

In the female reproductive system the main functional organ is the ovary, the duct system consists of the fallopian tube, the uterus, the cervix and the vagina and the discharge aperture is a separate genital orifice.

In the present exercise, you will see that the excretory systems are exactly similar in both the sexes while the reproductive systems are grossly different. Shown below are

two simplified diagrams of the male and female reproductive systems of the rat (Fig. 37.1). Make a comparative study before you proceed with either of the two dissections.

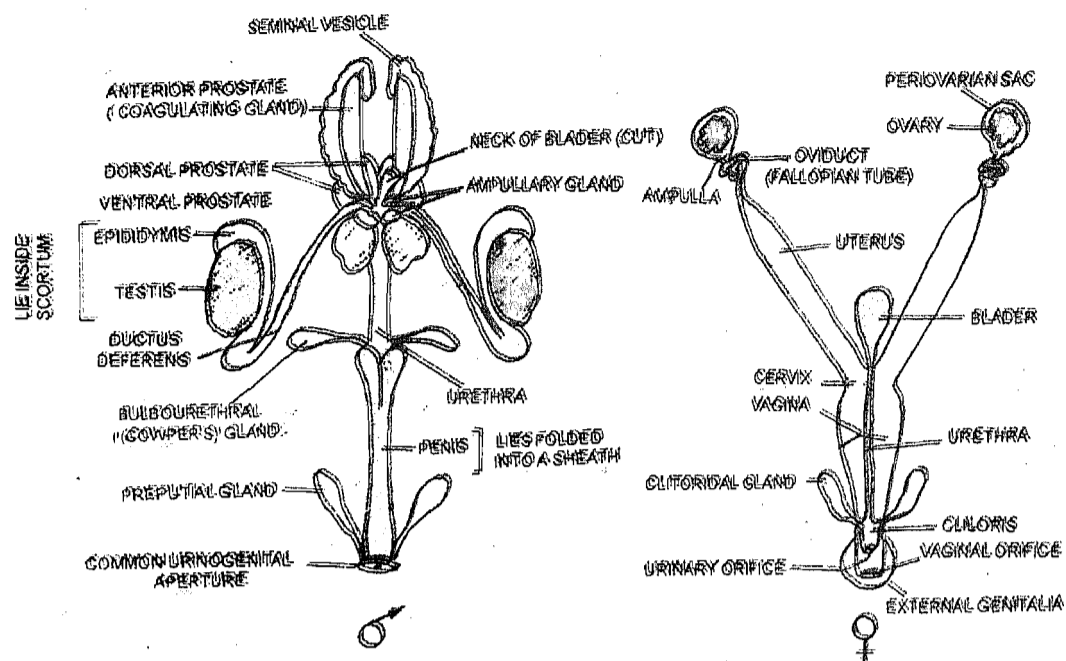


Fig. 37.1: Simplified diagrams of the male (♂) and female (♀) urinogenital systems.

Objectives

After completing this exercise, you should be able to:

- dissect and flag label the urinogenital systems of both the male and female rat, demonstrate **and** compare the organisation of both the systems.
- briefly describe the functions of the various structures.
- draw neat labelled diagrams of the male and female reproductive systems and highlight their differences.

Points to remember

You have learnt to differentiate between a male and female rat under section 35.4 of exercise 35 and shown in Fig. 35.2.

1. In a male, the scrotal sac is not always prominent as sometimes, the testes ascend into the abdominal cavity. If you see a wrinkled perineal skin without any aperture, then massage the abdomen downwards and the testes will descend down.
2. If you find a female in an advanced state of pregnancy, do proceed to dissect it. In such a female there is less fat masking the structures that are all hypertrophied and prominent. You must of course dissect a non-pregnant rat as well.

37.2 MATERIAL REQUIRED

1. Mature rats
2. Chloroform
3. Killing jar with lid
4. Dissection tray
5. Pins
6. Large beakers with water
7. Petri dishes to collect discarded tissues

8. Cotton wool
9. Blotting sheets
10. Napkins
11. Dissection instruments
12. **Any** antiseptic solution
13. Hand lens
14. White and black paper
15. Flag labels
16. Laboratory manual
17. Pencil and eraser

37.3 THE MALE URINOGENITAL SYSTEM OF *Rattus rattus*

37.3.1 Structural Organization of the System

The following description is a brief explanation of the structural organisation of the various parts of the male urinogenital system.

The reproductive system begins with a pair of gonads or testes lodged **extra-abdominally** in the **scrotal** pouch. Their internal duct system connects externally to **the gonoduct** system. The **gonoduct** system begins with a **minute** set of efferent ductules (not visible to the naked eye), that lead into the epididymis. The epididymis is a prominent C-shaped organ embracing the testis. It is divisible **into** a cobra-hood like head (**caput**), a long, slender body (**corpus**) and a bulbous end portion (**cauda**). The **vas deferens** arises as a narrow, long tubular duct from **the** end of the epididymis. It makes a sharp bend reflecting upwards **from** the **scrotal** pouch into **the** pelvic cavity via the **inguinal** passage. Here, it enters the urethra close to the **neck** of the urinary bladder. Its entry point is largely masked by well-developed accessory **sex** glands, mainly the prostate gland. To continue with the explanation of the duct system, the urethra as **mentioned** earlier receives the contents of the urinary bladder as well as sperms from the vas deferens. It thus becomes a common passage for the two systems. The urethra continues its passage outside as an extension, the phallus or penis.

The accessory sex **glands** are of different types and very well developed in the male. They are each a pair of seminal **vesicles**, coagulating glands (anterior prostate), ventral prostates, dorsal prostates, bulbourethral glands (or **Cowper's** glands), **ampullary** glands and the preputial glands. Excepting the **Cowper's** and the preputial glands, all others are concentrated around the anterior part of the urethra. The **Cowper's** glands are situated **at** the junction of the urethra and the penis. The preputial glands are situated at the **terminal** end of the penis as part of the prepuce or foreskin.

The excretory system begins with **a** pair of asymmetrically placed kidneys. These bean-shaped structures have their concave facets **inwards** from where a **fine** translucent white duct, the ureter, emerges. The two ureters run posteriorly and dorsal to the seminal vesicles and the end of the vas deferens. From here, they curve upwards to cross the vas **deferens** and enter the neck of the urinary bladder. The urinary bladder, as mentioned, drains into the urethra.

37.3.2 Procedure for Dissection and Display

1. Pin the animal high up in the tray so as to bring the pelvic region in the middle. This will give you more freedom to work in the posterior region. You can cut the tail if you find it **interfering** although it is not necessary to do so. Keep the figure 37.2 at your side for the guidance.
2. **DO NOT ADD WATER TO THE TRAY UNTIL YOU REMOVE THE ALIMENTARY CANAL. YOU HAVE TO BE SPEEDY WITH YOUR WORK OR THE TISSUES WILL DRY UP.**

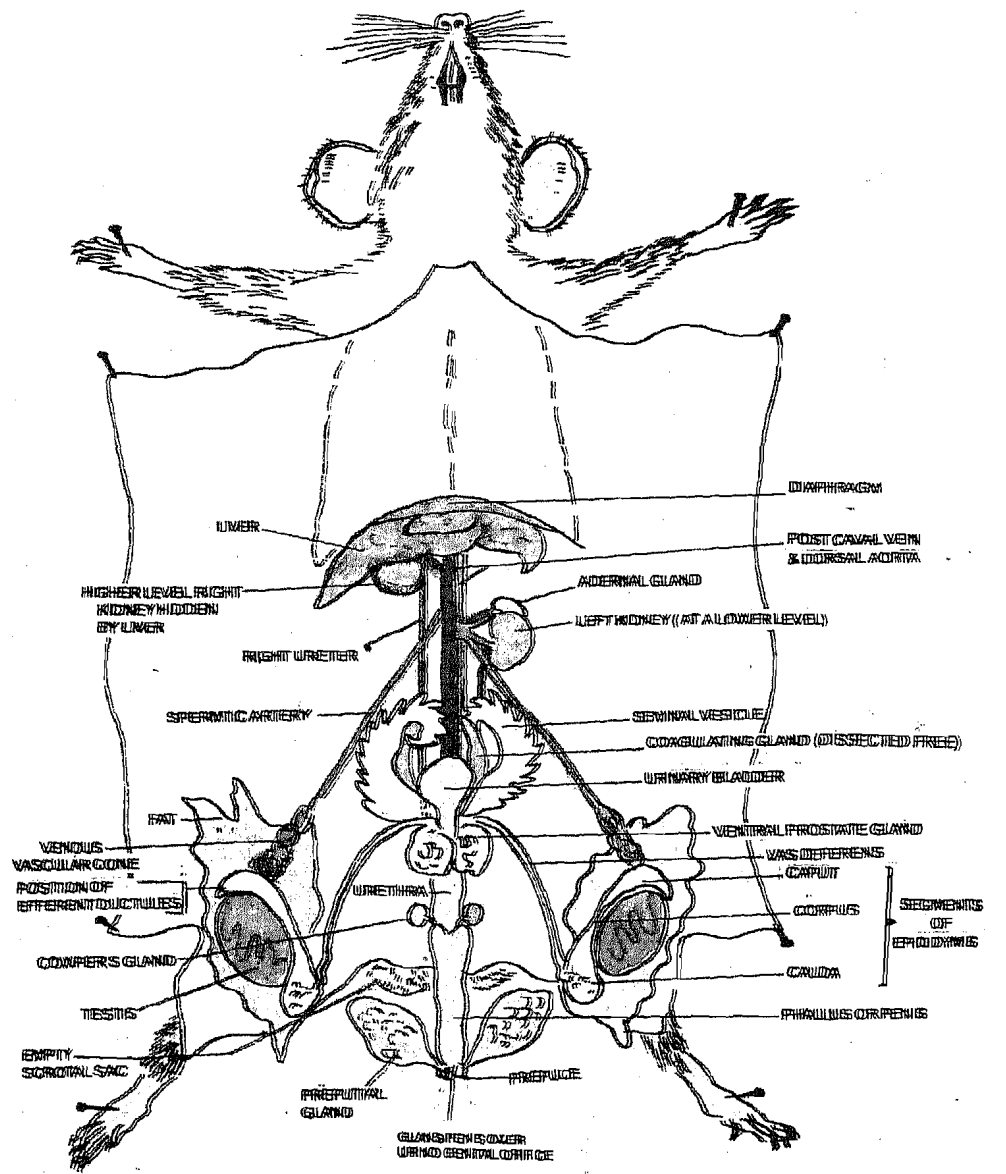


Fig.37.2: Male urinogenital system of *Rattus rattus*.

3. Make a median incision in the scrotal skin (where you see a depression between the two bulging testes) up to the pink tubercle of the penis – the glans penis.
4. **Start** with the skin above the glands and slit medially up to the thorax. Cut sideways bordering the thorax; we don't need to go further forwards as our work area concerns the posterior region only. Cut the skin in the legs and free the flaps from the underlying fascia and pin.
5. Note that there is no fascia or muscle below the scrotal skin. Do you see a translucent and glossy membrane inside? Cut this membrane and tease on both the sides. You **can** now see the two testes as two large ovoid cream-coloured glossy structures. Hold each testis by a blunt forceps and pull outwards gently. Look below. You can see the epididymis in close contact beneath it. Even with a slight pressure applied to them, the testes along with the epididymis disappear into the pelvic cavity. It does not matter if they do. Proceed further with the dissection.

6. Look into the muscles on either side of the glans penis; lodged in the muscle is a pair of large, flat, spoon-shaped structures. These are the preputial glands. Release them by teasing the surrounding muscles. They are flat, rubbery and light pink in colour with short ducts opening into the prepuce.
7. Your next step concerns with straightening the penis out from its sheath. In repose i.e., when withdrawn, it lies like an S within the sheath. Trim the prepuce all around the glans taking care not to cut the preputial glands away. Gently pull the tip of the penis while releasing the surrounding tissues; its full length now becomes visible. Straightening the penis out from its sheath must be done before proceeding to cut open the viscera as otherwise, it may get cut away while slitting the muscle.
8. Cut open the viscera and pull out the loops of the alimentary tract. Locate the colon and cut as far down as possible. **BE CAREFUL NOT TO DAMAGE ANY MAJOR BLOOD VESSELS, THE URETERS OR THE URINARY BLADDER.** Make another cut between the oesophagus and the stomach. The alimentary canal is not yet free as it is held by the mesenteries and blood vessels; cut these as well. Bleeding will occur; mop up, clean and wash. Discard the cut alimentary tract. **ADD WATER TO THE TRAY AT THIS STAGE.**
9. Look for the urinary bladder; it can be seen as a small straw-coloured balloon just above the pubic bone.
10. Two prominent cream-coloured structures curving like horns lie just above the bladder. They have saw-like margins and are the seminal vesicles.
11. Lodged in the inner curvature of the seminal vesicles can be seen an elongate, pale-pink coloured coagulating gland. Try and separate the two glands by releasing the membrane between them.
12. Just below the urinary bladder are a pair of bulging and spongy glands which are the ventral prostates.
13. On either side of these glands can be seen the entry point of the vas deferens. Tease the tissues surrounding the terminal end to be able to see the ampullary glands. They may not always be distinct.
14. If the testes are still in the scrotal pouch, push them up so that all the structures i.e., the testes, epididymis and the vas deferens can be seen together.
15. Locate the ureters from the kidneys to the neck of the urinary bladder. Tilt the bladder down to see their entry dorsally. Can you see the ends of the ureters crossing the ends of the vas deferens?
16. Further clearing requires the cutting of the pubic symphysis and removing wedges of pubic bone. Insert the blunt end of your large scissors lifting the blade up as you cut the symphysis. Make two more cuts on either sides of the median cut and remove the bone. Bleeding will occur and is unavoidable. Change the water and proceed. Look into the space from where the pubic bone was removed. The urethra can now be seen as a short and broad tube just below the urinary bladder and ventral prostates.
17. Clear the tissues around and below the urethra and note its continuation with the penis.
18. Turn the seminal vesicles and bladder down to see the dorsal side of the urethra. Two compact, pink and spongy lobes similar in texture to the ventral prostates can be seen. These are the dorsal prostates.
19. The Cowper's glands lie at the junction of the urethra and the penis; but they are somewhat deep-seated to be seen immediately. To expose them, put a finger below the base of the tail and push upwards while teasing the muscles at the junction. A small pea-shaped white gland will pop up. Hold the gland and clear further to see its duct entering the junction. Repeat on the other side.
20. Your dissection is now complete. To display, lay black paper below the testes, penis and preputial glands and pin to hold them in place. Also slip appropriately sized strips of black paper below the urethra, ureters and the glands. Flag label all the parts you want to display.

37.4 THE FEMALE URINOGENITAL SYSTEM OF *Rattus rattus*

37.4.1 Structural Organization

The description below concerns the structural organization of the female reproductive system. The female reproductive system begins with a pair of gonads or ovaries situated in the pelvic cavity just below the kidneys. They are enclosed in a thin membranous sac, the periovarian sac. As they have no internal duct system, they release the gametes or ova by rupturing. The released ova are picked up by the first part of the gonoduct system viz. the fallopian tubes. The fallopian tube is a very small, white and tightly coiled narrow duct with its open end applied to the periovarian sac. The other end leads into the wider-bodied uterus. The rat uterus is bicornuate i.e., it has a short straight body or corpus leading anteriorly to two diverging horns or cornua (singular: cornu). The whole structure appears as a Y. The fallopian tube connects with the cornu of its side. The corpus leads into the cervix which is not visibly distinguishable from the former. The cervix can be felt to be a firm and hard structure compared to the soft and pliant corpus. The last segment of the gonoduct system is the vagina. It is a broad and long tube highly stretchable in nature. It opens outside by the genital orifice or vulva.

The accessory sex glands in the female are poorly developed structures not visible externally. The only visible structure is the preputial gland or the clitoral gland. It has the same appearance as in the male, its duct opens into the preputial skin covering the vulva and the genital tubercle or the glans clitoridis above it. The excretory system in the female is exactly similar to that in the male. The only difference being that the urethra is a separate and exclusive passage for the urine. The vagina below it is exclusively a genital duct.

37.4.2 Procedure for Dissection and Display

1. Open the skin and muscles from the clitoris forwards up to the thorax. Proceed to open the viscera and pin the skin and muscles as explained earlier. Keep figure 37.3 along side for your reference.
2. Expose and clear the preputial glands.
3. Remove the alimentary canal and add water to the dissection tray.
4. Cut the pubic symphysis and remove the wedges of the pubic bone.
5. The two uterine cornua can be seen diverging upwards above the urinary bladder.
6. Look above each cornu for the minute tightly coiled fallopian tube. Use a hand lens for this purpose.
7. Just above the fallopian tube can be seen a reddish-pink and granulate structure. This is the ovary. In a non-pregnant or immature female, it is masked by a lot of fat. Remove the fat to reveal the ovaries.
8. Lift the uterine cornu up. You can see that the ovary along with the fallopian tube and the cornu has a sheet of peritoneal membrane stretching below. This is the mesovarium and mesometrium. Several fine branches of arteries and veins invade this membrane.
9. Pull the two uterine cornua slightly upwards and tilt the urinary bladder down. You can now see the short uterine corpus and feel for the hard cervix right below.
10. The urinary bladder lies just over the uterine corpus. Can you see the ureters curving below the end of the uterine cornua to enter the neck of the bladder?
11. A narrow duct leads down from the bladder to open out through the urinary orifice. This is the urethra in the female. It is attached by membranes to the vagina below. To release it, follow the next step.
12. Push the blades of a blunt forceps through the genital orifice. Once left in, the open ends of the blades stretch the vagina, its extensive stretchability can thus be seen. This step also makes the narrow urethra above it quite distinct.
13. Hold the clitoris along with the preputial glands and trim the prepuce. Pull the structure upwards releasing the urethra from the underlying vagina.

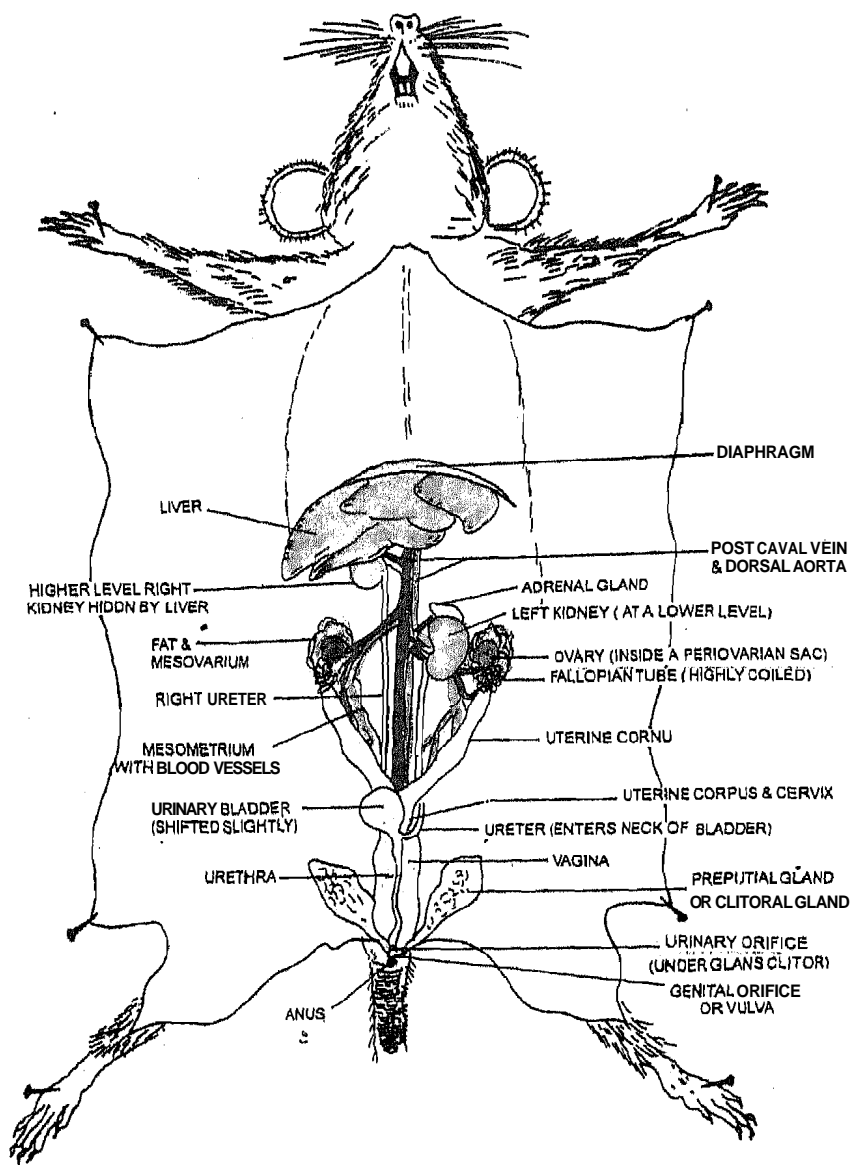


Fig. 37.3: Female urinogenital system of *Rattus rattus*.

14. The kidneys and ureters are as described earlier.
15. Your dissection is now complete. Slip appropriately sized strips of black paper below all the structures to highlight them. Flag label the relevant structures.

37.5 TERMINAL QUESTIONS

1. Write down the precautions you should take while dissecting the urinogenital systems of male and female rats.

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Animal Diversity Lab.

2. Make a neat labelled drawing of your dissections. You can take the guidance from Fig. 37.2 and 37.3.

a) Male **urinogenital** system

b) Female **urinogenital** system