

LABORATORY ANIMAL MEDICINE AND SCIENCE - SERIES II

RABBITS: BIOLOGY

V-9003

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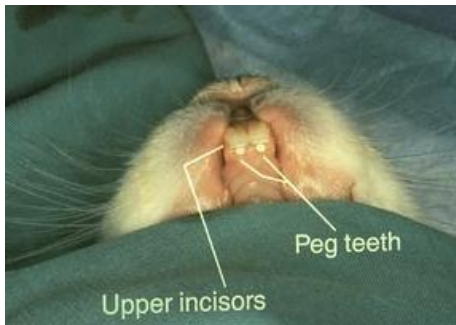
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PRIMARY AUDIENCE Veterinarians, Investigators using laboratory rabbits, Research technicians, and Laboratory animal technicians.

OBJECTIVES Upon completion of the program, you should be able to:

1. Give the taxonomic classification of the laboratory rabbit and identify the anatomic characteristic that distinguishes lagomorphs from rodents.
2. Compare the size and color of three common breeds of rabbit used for research, testing or teaching.
3. Differentiate between radiographs of a rabbit and of a cat of approximately the same size.
4. Recognize normal vital signs: temperature, heart rate, respiration.
5. Describe feces and urine from a healthy rabbit.
6. On a photograph, sketch, or animal, correctly identify and label the major artery and vein of the ear.
7. Recognize normal hematological values for the rabbit, and describe the rabbit neutrophil.
8. From a sketch or photograph, locate the major muscle groups that can be used for intramuscular injections.
9. Describe patterns of hair growth in the rabbit and state how these patterns can impact research.
10. Determine the sex of a mature rabbit.
11. Describe two aspects of the female reproductive tract that make the rabbit a valuable model for developmental studies.
12. Identify and label the distinguishable components of the thoracic and abdominal cavities.
13. State how the presence of atropinesterase in the rabbit may impact research studies.

1. Laboratory Animal Medicine and Science - Series II
2. Title Rabbits: Biology
3. Objectives At the conclusion of this program, you should be able to describe anatomical and physiological characteristics of the rabbit that are important to their use in research, testing, or teaching; and recognize deviations from normal parameters.
4. Taxonomy Our study of the biology of the laboratory rabbit will begin with its taxonomy. Rabbits are mammals belonging to the Order Lagomorpha, Family Leporidae, Subfamily Leporinae. Lagomorphs are distinguished from rodents by their incisor teeth.
5. Teeth



Lagomorphs have six incisor teeth, including the small teeth (frequently called peg teeth) directly behind the large upper incisors. By contrast, rodents have only four incisors.

6. European Of the six genus in the Subfamily Leporinae, only the European rabbit, *Oryctolagus cuniculus* is commonly used in research, testing, or teaching. Three of the most commonly used breeds are the New Zealand White, American Dutch, and Californian.
7. New Zealand White



The New Zealand White is an albino rabbit. It reaches a mature weight of about five kilograms, and it is the most readily available breed in the United States.

8. American Dutch



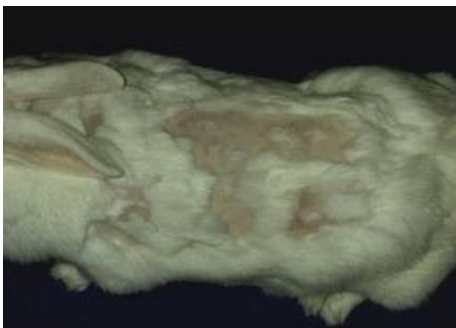
The American Dutch rabbit, shown here, is less than half the size of the New Zealand White, reaching a mature weight of only two kilograms. There are several color varieties of the American Dutch breed, but the most common is the black and white.

9. Californian



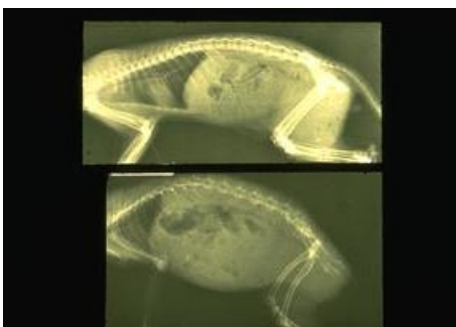
Another breed occasionally used is the Californian rabbit. It is only slightly smaller than the New Zealand White, reaching a mature weight of 4.5 kg.

10. Hair growth patterns



The hair growth patterns of the rabbit are somewhat unusual. After the rabbit's hair has been clipped, it may not grow back uniformly. Notice in this rabbit that some patches of hair are longer than others. This can make interpretation of some skin tests difficult.

11. Skeletal mass



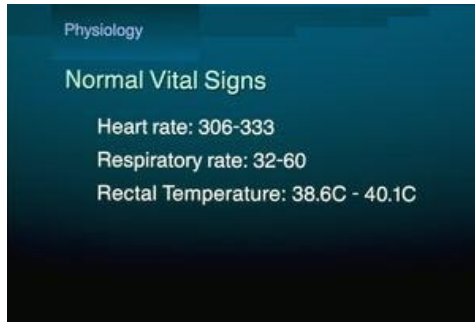
Only about 8% of the body weight of a rabbit is skeletal structure. Compare the bone density of a cat (on the top) with the rabbit of approximately the same weight (on the bottom). This is a lateral view radiograph. The muscle mass of a rabbit relative to bone structure makes it highly susceptible to lumbar fracture or dislocation.

12. Vital signs

Normal vital signs will vary with the age and breed of the rabbit, but for a healthy animal they should fall within these ranges:

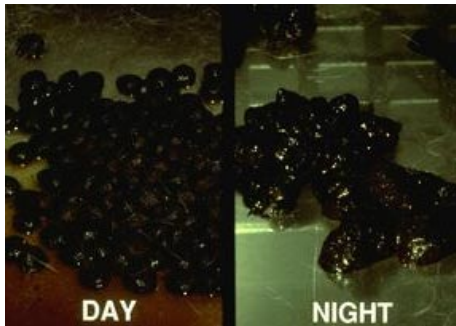
heart rate 306 - 333
respiratory rate 32 -60
rectal temp 38.6 C - 40.1 C

13. Urine



A healthy rabbit will produce about 130 milliliters of urine per kilogram of body weight each day. It will normally be dark yellow to brown and will appear turbid. This turbidity is due to mineral precipitates. Rabbit urine is normally alkaline with a pH of over 8.0.

14. Feces



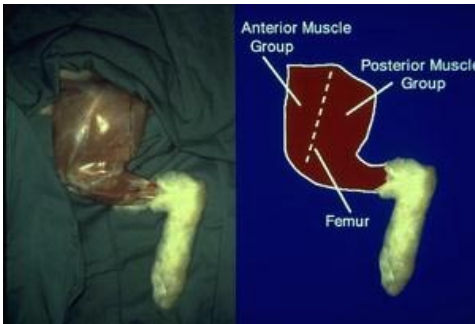
Healthy rabbits produce two types of feces. The droppings seen in the pan under the cage are hard fecal pellets that contain mostly waste fiber. The other type is a softer feces that is produced in the cecum, and is often called cecotrophs or night feces. This material is rich in vitamins and protein, and the rabbit may consume it directly from the anus.

15. Lumbar muscles



Intramuscular injections may be given into the lumbar muscles on either side of the backbone, ...

16. Rear leg muscles



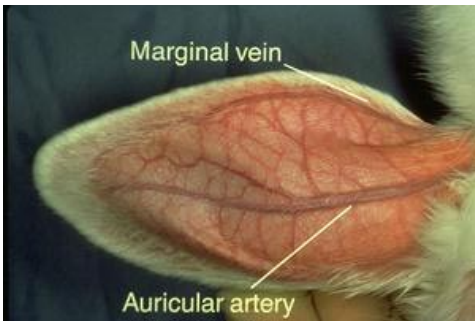
... or into the large muscle groups in the back leg, either anterior or posterior to the femur.

17. Ear



An important feature of rabbits is the prominent blood vessels in their ears.

18. Ear veins



This ear has been treated with xylene to demonstrate the central (or auricular) artery and marginal ear vein. The central artery is used for collecting large quantities of blood. The marginal ear vein is used for giving IV injections or collecting smaller quantities of blood.

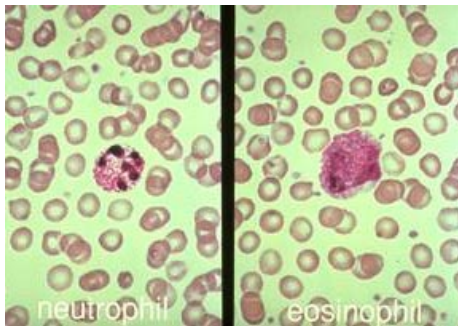
19. Hematology

The blood volume of a rabbit is approximately 56 ml/kg body weight. For a mature New Zealand White, weighing 5 kg, the total blood volume would be approximately 280 ml. Generally, 10 - 15% of the total volume can be taken as frequently as every two weeks without endangering the rabbit.

20. Hematology The normal range for the red blood cell count is $4.5 - 7.0 \times 10^3$. The total white blood cell count and differential fall within the range expected of most other species of laboratory animals, as shown here:

Total WBC $4.0 - 13 \times 10^3$
 Lymphocytes 30 - 50%
 Neutrophils 30 - 50%
 Monocytes 2 - 16%
 Eosinophils 0.5 - 5%
 Basophils 2 - 8% (Ref Kozma, et al.).

21. Neutrophil, eosinophil



The rabbit neutrophil, shown on the left, contains granules that stain red with eosin. Because of this staining characteristic, rabbit neutrophils are sometimes called pseudo-eosinophils, amphophils, or heterophils.

The eosinophil, shown on the right, is larger than the neutrophil. It has much larger granules that fill the cytoplasm. Normally, eosinophils do not exceed 5% of the total WBC count.

22. Atropinesterase

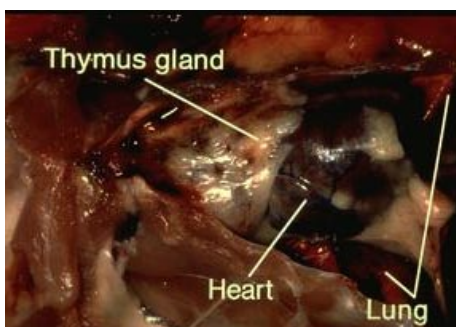
A notable feature of many rabbits is that their serum contains an enzyme, atropinesterase, that deactivates atropine and related drugs. The amount of this enzyme a rabbit has is a heritable characteristic, and there are in vivo and in vitro techniques to screen for it. The presence of atropinesterase will make a dramatic difference in how individual rabbits respond to premedication with atropine prior to surgery.

23. Cross-section, head



Now, let's look at a dissection of a rabbit to study the internal organs that are most commonly relevant to research uses. This is a sagittal section of the head showing the long oropharynx (red pin), large fleshy tongue, and the sagittal niches. It also shows the relationship of the esophagus (yellow pin), to the trachea (blue pin), epiglottis (below the red pin), and nasopharynx (white pin). All of these features combine to make passing an endotracheal tube difficult.

23. Thoracic cavity



Dissection into the thoracic cavity, shows the heart, which is relatively small for the size of the animal -- about 1/2 that of a cat of the same size. This becomes important when attempting to collect blood via cardiac puncture. Overlying the anterior-ventral aspect of the heart is the thymus. In contrast to many other animals, the thymus often retains its size into adulthood.

24. Lungs



The lungs differ from each other in size and construction. The right lung is normally larger, and it has three distinct lobes, whereas the left has only two. This image shows the bilobed left lung; it is difficult to determine the three right lobes in this view.

25. Abdominal cavity



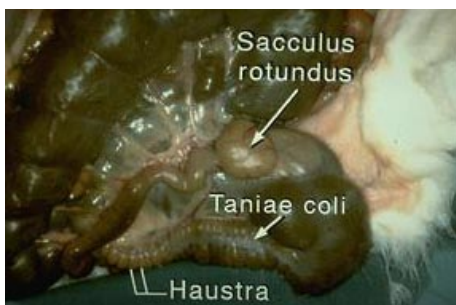
The abdominal cavity is proportionately large, reflecting the high roughage content of the diet. The liver lies above the stomach. The gall bladder is buried deep in the liver, and cannot be seen on this image. The caecum is very large, and has about ten times the capacity of the stomach...

26. Stomach



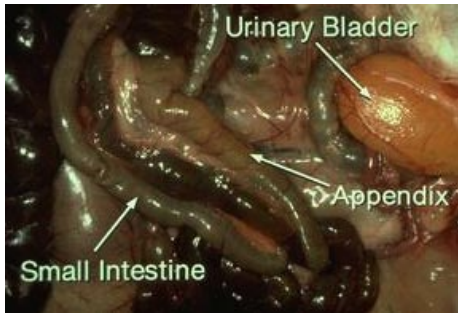
...which is large, thin-walled, not compartmentalized, and relatively aglandular. The pH in an adult rabbit stomach is very acid; i.e., approximately 1 - 2.

27. Intestines, colon



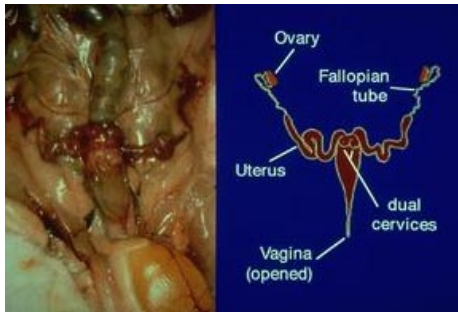
Moving to the intestines, the small intestine is very long. The distal end of the ileum is surrounded by the saccus rotundus, which is made up largely of lymphoid tissue. The large intestine, or colon, is characterized by sacculations called haustra, and by the teniae coli, an external longitudinal band of muscle.

28. Cecum



The cecum terminates in the lymphoid appendix, a narrow, thick-walled vermiform tube.

29. Female reproductive organs



This image shows the female reproductive organs -- the ovaries, uterine horns, and vagina which has been cut open longitudinally.

The uterine horns are separated their entire length. Each horn empties into a separate cervix and then into the vagina. With two completely separated uterine horns, an experimental manipulation can be accomplished on one horn of the uterus or on fetuses contained in one horn, and the contralateral horn can act as a control.

31. Placenta

The placental barrier in the rabbit is hemochorial, which means that the membrane enclosing the fetus is in direct contact with maternal blood. This means it is similar to the human barrier, making the rabbit a good model for studying transmission of agents through the placenta.

32. Sexing



Differentiating mature males from females is fairly easy. As females mature, they develop a soft fold of skin below their chin, from which they pluck hair when nesting. This is called a dewlap. Compare the profile of the female, left, with the male at the right.

33. Sexing



To determine sex by genitalia, gently press the skin back from the genital opening and stretch the perineum. In the male, this procedure will cause the penis to be everted. The vulva of the female has the appearance of a slit. This procedure is necessary when sexing young rabbits.

34. Summary In this program, we have provided an overview of the biology of the rabbit, with special emphasis on biological features important to use of the rabbit in research, testing, or teaching.

35. Credits

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REFERENCES

Kozma, Madelin, Conner, and Maver: *Anatomy, Physiology, and Biochemistry of the Rabbit IN The Biology of the Laboratory Rabbit*, Academic Press, 1974, pp 50-72.

NOTES