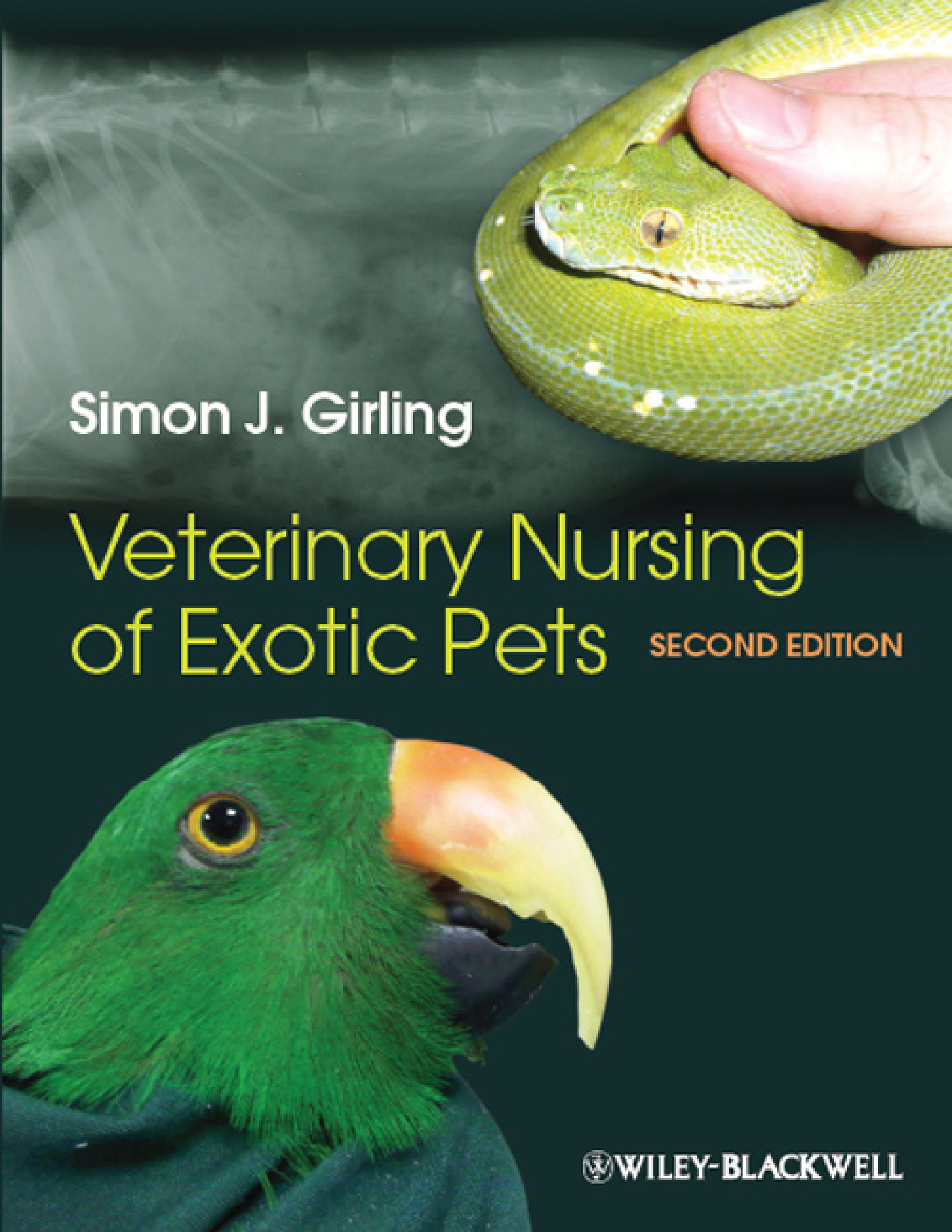

Simon J. Girling

Veterinary Nursing of Exotic Pets

SECOND EDITION

WILEY-BLACKWELL

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Veterinary Nursing of Exotic Pets

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Preface

Since the first edition of this textbook was published, exotic pet medicine has continued to develop at pace. More and more of the pet-owning public are turning to exotic pets whether it be due to their increased availability, physical attraction or the constraints of space making smaller pets more appealing. Veterinary nurses are now expected to understand the basics of diseases, husbandry, anatomy, and physiology of exotic pets as outlined by the RCVS examinations. Also as the veterinary nurse is often the practice–client interface, a sound knowledge base in these species is essential.

Many courses have developed over the last 12 years to support this increased need in training and this textbook acts as a companion to the City and Guilds NVQ level-4 equivalent qualification ‘Veterinary Nursing of Exotic Species'. This qualification is now in its 12th year and has seen over 500 veterinary nurses qualify and is now recognised as the industry standard for veterinary nurses wishing to train in this area in the UK. This year (2012), the course has been taken back in-house by Girling and Fraser Ltd. Training and Consultancy making it available to a wider audience (see www.girlingandfraser.co.uk).

This revised and enlarged second edition of ‘Veterinary Nursing of Exotic Pets' hopes to further educate and inform future generations of veterinary nurses, technicians and veterinary students in one of the most fascinating of subdisciplines of veterinary medicine.

Simon J. Girling

Part I

Small Mammals

Chapter 1

Small Mammal Handling and Chemical Restraint

Classification of small mammals

The commonly seen species of small mammals in veterinary practice are classified in Table 1.1.

Table 1.1 Classification of commonly seen small mammals.

Order	**Lagomorpha**	**Rodentia**						**Carnivora**	**Didelphimorphia**	**Diprotodontia**
Suborder		**Myomorpha**		**Hystricomorpha**			**Sciuromorpha**	**Caniformia**		
Family	**Leporidae**	**Muridae**	**Cricetidae**	**Caviidae**	**Chinchillidae**	**Octodontidae**	**Sciuridae**	**Mustelidae**	**Didelphidae**	**Petauridae**
Species	Domestic rabbit (*Oryctolagus cuniculus*)	Rat (*Rattus norvegicus*) Mouse (*Mus musculus*)	Gerbil (*Meriones unguiculatus*) Syrian hamster (*Mesocricetus auratus*) Russian hamster (*Phodopus sungorus*) Chinese hamster (*Cricetulus griseus*)	Guinea pig (*Cavia porcellus*)	Chinchilla (*Chinchilla laniger*)	Degu (*Octodon degus*)	Siberian chipmunk (*Eutamias sibiricus*) Eastern chipmunk (*Tamias striatus*)	Domestic ferret (*Mustela putorius furo*)	Virginia opossum (*Didelphis virginiana*)	Sugar glider (*Petaurus breviceps*)

RABBIT

Biological average values for the domestic rabbit

Table 1.2 gives the biological parameters for domestic rabbits.

Table 1.2 Biological parameters for the domestic rabbit.

Biological parameter	Domestic rabbit
Weight (kg)	1.5 (Netherland dwarf) to 10 (New Zealand whites and Belgian hares)
Rectal body temperature (°C)	38.5–40
Respiratory rate at rest (breaths per minute)	30–60
Heart rate at rest (beats per minute)	130 (New Zealand whites) to 325 (Netherland dwarf)
Gestation length (days)	29–35 (average 31)
Litter size	4–10
Age at sexual maturity (months)	
Male	5–8
Female	4–7
Lifespan (years)	6–10

Musculoskeletal system

The skeletal system of rabbits is light. As a percentage of body weight, the rabbit's skeleton is 7–8%, whereas the domestic cat's skeleton is 12–13%. This makes rabbits prone to fractures, especially of the spine and the hindlimbs.

Skull

The mandible is narrower than the maxilla, and the temporomandibular joint has a wide surface area, allowing lateral movement of the mandible in relation to the maxilla.

Axial skeleton

The cervical vertebrae are box-like and small and give mobility. The thoracic vertebrae possess attachments to the 12 paired ribs, which are flattened in comparison to cat's ribs. The pelvis is narrow and positioned vertically. The iliac wings meet the ischium and pubis at the acetabulum, where an accessory bone unique to rabbits, called the *os acetabuli*, lies. The pubis forms the floor of the pelvis and borders the obturator foramen which is oval in rabbits.

Appendicular skeleton

The scapula is slender and distally has a hooked suprahamate process projecting caudally from the hamate process. The scapula articulates with the humerus which in turn articulates with the radius and ulna. In rabbits, the ulna fuses to the radius in older animals and the two bones are deeply bowed. The radius and ulna articulate with the carpal bones which in turn articulate with the metacarpals and the five digits.

The femur is flatter than a cat ventrodorsally, and the tibia and fibula are fused in the rabbit. The tibia articulates distally with the tarsal bones where there is a prominent calcaneus bone. The tarsals articulate with the metatarsals which articulate with the four hindlimb digits.

The hindlimbs are well muscled and powerful.

Respiratory anatomy

Upper respiratory tract

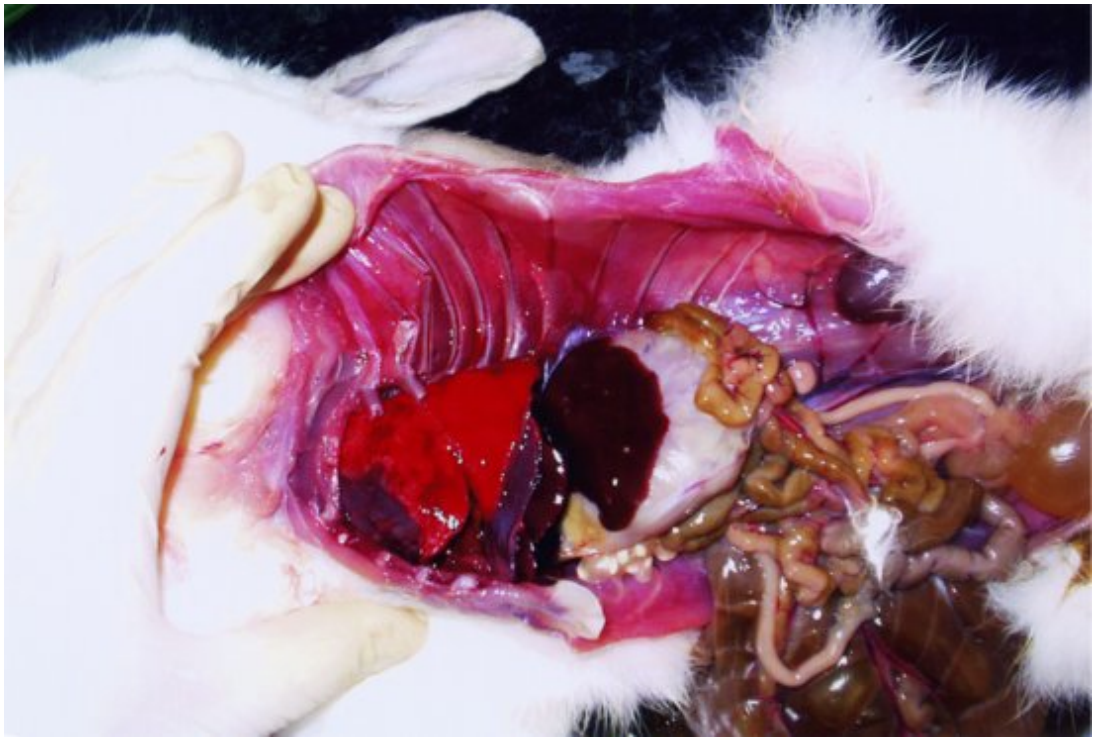
Rabbits, like horses, are nasal breathers, with the nasopharynx permanently locked around the epiglottis; hence, upper respiratory disease or evidence of mouth breathing is problematic. The nasolacrimal ducts open onto the rostral floor of the nasal passage. The epiglottis is not

visible easily from the oral cavity, making direct intubation difficult. It is narrow and elongated and leads into the larynx which has limited vocal fold development. The larynx leads into the trachea which has incomplete C-shaped cartilage rings for support.

Lower respiratory tract

The trachea bifurcates into two primary bronchi. There are two lungs, which are relatively small in proportion to the overall rabbit's body size. This means that even minor lung disease may cause serious problems. Each lung has three lobes, with the cranial ones being the smallest (see Figure 1.1).

Figure 1.1 Lateral post-mortem view of a rabbit with the chest and abdominal walls removed. The structures from left to right (cranial to caudal) are the dark red heart, bright red lungs (three lobes), darker brown diaphragm and liver, pale cream stomach, yellow brown small intestines (the dark brown large intestines and caecum are reflected ventrally) and yellow-coloured urinary bladder. The left kidney may be seen dorsally as a dark brown structure in the mid-abdomen tucked under a fold of skin. (Fraser and Girling, 2009)



Respiratory physiology

The impetus for inspiration derives from the muscular contraction and flattening of the diaphragm. The lung parenchyma possesses a cellular population that is well supplied with anaphylactic mediating chemicals. These are strong enough to cause fluid extravasation and blood pooling as well as spasms within the walls of the main pulmonary arterial supply, leading to rapid right-sided heart failure.

Digestive system

Oral cavity

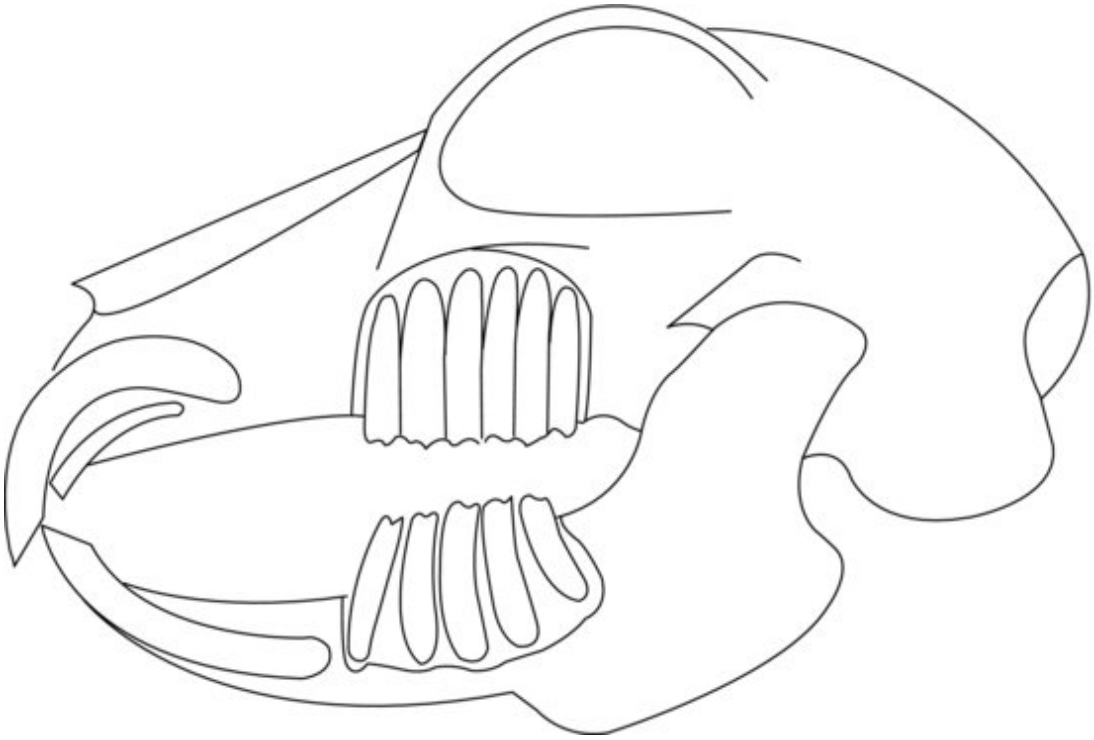
The dental formula is

I 2/1 C 0/0 Pm 3/2 M 3/3.

The teeth are elodont (‘open rooted'), allowing continual growth throughout the rabbit's life. The molar enamel is

folded providing an uneven occlusal surface with the ipsilateral jaw which allows interlocking. Wear is kept even by the lateral movement of the mandible, allowing independent left and right arcades to engage in mastication. The incisors differentiate Lagomorpha from Rodentia as rabbits and hares have two smaller incisors, or ‘peg teeth', behind the upper two, whereas rodents have only two upper incisors. The larger incisors only have enamel on the labial surface, whereas the smaller maxillary peg teeth have enamel on the labial and lingual sides. This creates a wedge-shaped bite-plane where the lower incisors close immediately behind the upper large incisors and fit into a groove made by the peg teeth. The permanent incisors are present at birth, although the peg teeth are replaced by permanent peg teeth at around the second week of life. The deciduous premolars present at birth are replaced and joined by permanent molars by the fourth week of life. There are no canines; instead, there is a gap, or diastema, between the incisors and premolars (Figure 1.2).

Figure 1.2 Lateral diagram of a normal rabbit skull showing the relation of tooth roots to the orbit and jawbones. Note peg-teeth incisors behind main incisors in maxilla.



Stomach

The stomach is a large, simple structure, with a strong cardiac sphincter (see Figure 1.1). This makes vomiting in the rabbit virtually impossible. There is a main body, or fundus, and a pyloric section with a well-formed pyloric sphincter. The lining of the stomach wall contains acid-secreting and separate pepsinogen-secreting cells. The pH of the rabbit's stomach contents is surprisingly lower than a cat's or dog's at 1.5–1.8. In addition, a healthy rabbit's stomach never truly empties.

Small intestine

The total length of the small intestine in the average rabbit may be some 2–3 feet! It is difficult to determine the divisions between duodenum, jejunum and ileum as they all have a similar diameter.

Caecum and large intestinal anatomy

At the junction of the ileum and caecum lies the *sacculus rotundus*. This is a swelling of the gut, infiltrated with lymphoid tissue and a common site for foreign body impactions. The caecum is large, sacculated and spiral-shaped, finishing in a blind-ended, thickened, finger-like projection known as the vermiform appendix, which also contains lymphoid tissue. The bulk of the caecum is thin walled and possesses a semi-fluid digestive content.

The start of the large intestine is the *ampulla coli* which sits near to the *sacculus rotundus* and caecum. It is a smooth-walled portion of the gut with some lymphoid infiltration of its walls, unlike the rest of the large intestine. It is also distinguished by having bands of fibrous tissue (known as *taeniae*) which create sacculations (also known as *haustra*). At the end of the proximal colon, the taeniae and haustra cease, and the gut is then known as the *fusus coli*, its walls becoming thickened and smooth because of the presence of large members of nerve ganglia which act as pacemakers for contraction waves in the large bowel. The distal descending colon continues through the pelvis to empty through the rectum and anus. There are a couple of anal glands just inside the anus, one on either side, emptying their secretions onto the faecal pellets.

Large intestinal physiology

Two types of faecal pellets are produced by the rabbit. One is a true faecal pellet, comprising waste material in a dry, light brown spherical form. The other is a much darker, mucus-covered pellet known as a caecotroph. The caecotroph is eaten directly from the anus, as soon as it is produced, which in the wild is during the middle of the day when the rabbit is underground. In captivity, they are often produced overnight, but may be produced at any time. The caecotroph contains plant material from which all of the nutrients have yet to be extracted.

The large bowel can produce two types of pellets due to the contraction waves in the large intestine and caecum. The proximal colon can separate out food as the haustra or sacculations of the colon hold on to the smaller particles. The larger particles become pushed towards the colon lumen. The haustra then push the small particles towards the caecum by contracting, and the segmental contractions of the colon itself propel the larger particles towards the rectum producing a waste pellet. When caecotrophs are produced, the haustra dramatically reduce their contractions, and instead the segmental activity drives material from the caecum through the distal colon where they are covered in mucus and then eaten directly from the anus. The caecum is thus the powerhouse filled with microbes which turn the ingesta into volatile fatty acids (VFAs) which can either nourish the caecal epithelium (butyrates) or be absorbed and converted to glucose by the liver (acetates). A high-fibre diet is important to maintain the balance of VFAs which should be made of predominantly acetates followed by butyrates and then propionates. Decreases in fibre levels increase butyrates and propionates at the expense of acetates, which results in reduction in the normal peristalsis of the gut and leads to hypomotility disorders and ileus or gut stasis.

Liver

The rabbit liver has four lobes. There is a gall bladder, which has an opening separate from the pancreatic duct into the proximal duodenum. The main bile pigment is biliverdin, rather than bilirubin seen in cats and dogs.

Pancreas

The pancreas is a diffuse organ, suspended in the loop of the duodenum. There is one single pancreatic duct, separate from the bile duct, emptying into the proximal duodenum.

Urinary anatomy

Kidney

The kidneys are bean shaped. The right kidney is more cranial than the left, and they are often separated from the ventral lumbar spine by large fat deposits. A single ureter arises from each kidney and traverses across the abdominal cavity to empty into the urinary bladder.

Bladder

The bladder lining is composed of transitional cell epithelium. The urethra in the male rabbit exits through the pelvis and out through the penis. In females, the urethra opens onto the floor of the vagina.

Renal physiology

Rabbit's urine is alkaline with a pH varying between 6.5 and 8, but it will become acidic if the rabbit has been anorectic for 24 hours or more. The urine contains varying amounts of calcium carbonate. This is because it has no ability to alter how much calcium is absorbed from the gut, and so any excess calcium must be excreted by the kidneys into the urine. This can be seen as a tan-coloured silt. Porphyrin pigments may also be seen in rabbit's urine. These are plant pigments and make the urine appear anywhere from a dark yellow to a deep wine-red in colour. This may mimic haematuria; therefore, to diagnose blood in the urine, it is necessary to examine it microscopically.

Cardiovascular system

Heart

The rabbit heart is small in relation to body size. The right atrioventricular valve has only two cusps instead of three. The pulmonary artery also has a large amount of smooth muscle in its wall which can contract vigorously during anaphylactic shock, causing immediate right-sided cardiac overload and failure.

Blood vessels for sampling

Vascular access in rabbits includes

Lateral ear vein

This runs along the lateral margin of either ear. It may be accessed using a 25 or 27 gauge needle or catheter and used for slow intravenous injections and blood sampling.

Cephalic vein

This runs in a similar position to that seen in cats and dogs. It may be split into two in some individuals, but may be used for intravenous fluids and sampling (Figure 1.3).

Figure 1.3 Cephalic vein access in a rabbit using a pre-heparinised butterfly catheter.

Saphenous vein

This runs across the lateral aspect of the hock, as in cats and dogs, and may also be used for venipuncture.

Jugular vein

The jugular veins are prominent in the rabbit but they form the major part of the drainage of blood from the orbit of the eye. If a haematoma or thrombus forms and blocks the lumen of a jugular vein, severe orbital oedema may occur, with possible damaging effects.

Lymphatic system

Spleen

The spleen is a flattened structure, oblong in nature and attached to the greater curvature of the stomach, and is thus found predominantly on the left side.

Thymus

The thymus is a large structure in the cranial thoracic compartment even in the adult rabbit. It provides the body with the T-cell lymphocytes.

Lymph nodes

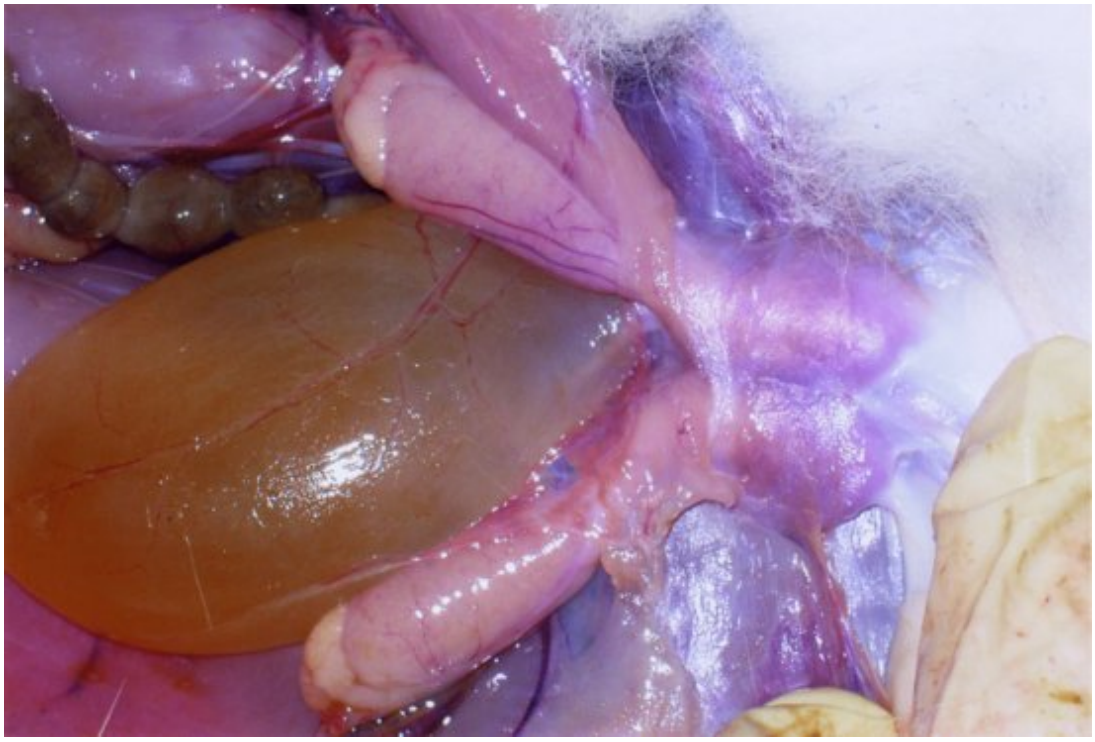
The root of the mesentery supporting the digestive tract is well supplied with lymph nodes, as is the hilar area of the lungs where the two main bronchi diverge to supply each lung. In addition, there are superficial lymph nodes in the popliteal, prescapular and submandibular areas.

Reproductive anatomy

Male

The paired testes can move from an inguinal position within the thin-skinned scrotal sacs, to an intra-abdominal position through the open inguinal canal (see Figure 1.4). The scrotal sacs are sparsely haired and lie on either side of the anogenital area.

Figure 1.4 Close-up of the caudal abdomen of a male rabbit showing the retracted testes and the inguinal canals and the full urinary bladder. (Fraser and Girling, 2009)



The accessory sex glands in the buck attached to the urethra in the caudal abdomen are: dorsal and smaller ventral prostate; bilobed vesicular gland; bilobed coagulating gland and a bilobed bulbourethral gland. The prepuce has numerous small preputial glands in the dermis, and there are a couple of inguinal glands situated on either side of the penis which secrete a brown-coloured sebum clearly seen adjacent to the anus.

Female

The ovaries are supported by the ovarian ligament and lie caudal to each respective kidney. The ovarian artery often splits into two parts after leaving the aorta, and it, along with the rest of the reproductive tract, is frequently encased in large amounts of fat.

The uterus is duplex – there is no common uterine body. Instead there are two separate uteri with separate cervices emptying into the vagina. The vagina is large and thin walled, with the urethra opening onto its floor cranial to the

pelvis. The vulva therefore is a common opening for the reproductive and urinary systems unlike many rodents. It lies just cranial to the anus and is flanked on either side by the inguinal glands, as with the buck.

The doe has on average four pairs of mammary glands extending from the inguinal region to the axillary areas.

Reproductive physiology

Male

The buck rabbit has the same sexual hormones as in cats and dogs, but they are on a seasonal time clock triggered by the lengthening daylight of spring. This is mediated through the pineal gland in the brain which has neural links from the eyes and controls the hormone melatonin. It in turn controls the pituitary release of follicle-stimulating and luteinising hormones which then act upon the testes.

Female

Does are induced ovulators. Waves of follicles swell and regress during the course of the season, starting to increase in activity in early spring. If not mated, these follicles will often dominate the cycle for 12–16 days at a time. There is no real anoestrus phase in does; instead, a slight waning in activity for 1–2 days occurs before a return to heat. During peak sexual activity, the vulva is often deeply congested and almost purple in colour and considerably enlarged.

Once mated, the male's semen may form a copulatory plug, which is a gelatinous accumulation of sperm which drops out of the doe's vagina 4–6 hours post-mating. Gestation lasts from 29 to 35 days, with the foetus forming a haemochorial placenta (where the outer chorion layer of the foetal placental membrane burrows into the lining of the

uterus so that it directly attaches to the blood in the intrauterine vessels) at about day 13. This is a common time for abortions to occur. A pregnant doe will remove fur from her ventrum to line the nest in the latter few days prior to parturition.

Dystocia is uncommon. The doe only nurses the kittens once a day for 20 minutes or so, often in the early morning. It is therefore not uncommon for owners to think that the doe is neglecting her young as she will often spend the rest of the time eating and away from the litter.

Pseudopregnancy often occurs after an unsuccessful mating or mounting activity by another buck or doe. A *corpus luteum* forms and this lasts for 15–17 days during which time the doe may produce milk and build a nest. At this time, the doe is susceptible to mastitis.

Neonatology

The young kits or kittens are altricial in nature, that is they are totally dependent on the mother for nutrition and survival for the first few weeks of life. They are born blind, deaf and furless. Fur growth appears around day 5–6, the eyes open at day 8–10 and the ears at 11–12. Weaning occurs around 6 weeks of age, with the young taking solid food from 2 to 3 weeks.

Sexing

The young may be sexed from 4 to 5 weeks of age. Gentle pressure is placed on either side of the reproductive or anal area to protrude the vulva or penis. The vulva of the young doe is rounded and has a central slit in midline and projects cranially. The penis of the young buck is more conical and pointed, with no central slit and tends to project caudally

when protruded. Once the buck is older, the testes descend into the scrotum.

Skin

Lop breeds, particularly does, have extra skin folds called ‘dewlaps' around the ventral neck region. In addition, such extra folds of skin may be found around the anogenital area, leading to increased risk of urine and faecal soiling.

Rabbits do not have keratinised footpads. Instead they have thick fur covering the areas of the toes and metatarsals which are pressed flat to the ground.

In addition to the para-anal scent glands mentioned above, there are a series of discrete submandibular chin glands. These are used to mark territory and also, in the case of does, to mark their young to distinguish them from others.

The rabbit has no skin sweat glands except a few along the margins of the lips. This means that they are very prone to heat stress at temperatures greater than 28°C.

The presence of many vibrissae or sensitive hairs around the lips and chin are important since rabbits cannot see anything immediately below their mouths, and so rely on touch to manipulate food towards the mouth.

Eyes

Rabbits have prominent eyes, which allow a near 360° field of vision. There is a prominent third eyelid, which moves from the medial canthus of the eye and possesses a large amount of reactive lymphoid tissue within its structure and a Harderian tear gland at its base. This is often enlarged in the buck during the breeding season and possesses two lobes in both the sexes.

Haematology

The most notable feature is the staining of the rabbit neutrophil, which resembles the cat or dog eosinophil, and so is often known as the pseudoeosinophil. Many rabbits have more lymphocytes than pseudoeosinophils, resembling other mammals such as cattle, rather than cats and dogs, in which the neutrophil is the commonest white blood cell.

RAT AND MOUSE

Biological average values for the rat and mouse

The normal biological values for the rat and mouse are given in Table 1.3.

Table 1.3 Biological parameters for the rat and mouse.

Biological parameter	Average range rat	Average range mouse
Weight (g)	400–1000	25–50
Rectal body temperature (°C)	37.6–38.6	37–38
Respiration rate at rest (breaths per minute)	60–140	100–280
Heart rate at rest (beats per minute)	250–450	500–600
Gestation length (days)	20–22	19–21
Litter size	6–16	8–12
Age sexual maturity (weeks)		
Male	8	6
Female	10	7
Oestrus interval (days)	4–5	4–5
Lifespan (years)	3–4	2–3

Musculoskeletal system