1 (1) Direct visualization. Place the anaesthetized rabbit in sternal recumbency, extend the neck, grasp the tongue gently and retract it through the diastema and hold to one side. Visualize the larynx using a Wisconsin size 1 laryngoscope blade (**1a**) and insert a 2.5–3 mm endotracheal tube (**1b**). Alternatively, position the rabbit as above, visualize the larynx using an otoscope or Wisconsin size 1 laryngoscope blade or similar, place an introducer (e.g. 3–5 Fr urinary catheter) into the larynx through an otoscope or over a laryngoscope, remove the otoscope/laryngoscope and introduce an endotracheal tube gently over the introducer and then remove the introducer. The larynx can be visualized using a small rigid endoscope.

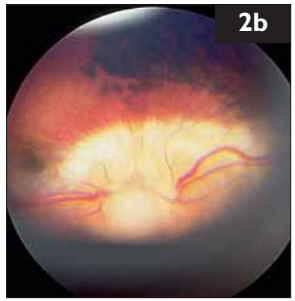
All the above methods can also be performed with the rabbit in dorsal recumbency with the neck extended.

(2) Blind technique. Hold the anaesthetized rabbit in sternal recumbency with the head and neck extended. Pass an endotracheal tube over the tongue and advance it until exhalation is heard loudly either by placing the end of the tube to the ear (**1c**) or by the presence of condensation at each breath if using a clear tube, then advance the tube gently as the rabbit inhales and it will pass into the trachea.

For all these techniques, positioning is important. Some practitioners prefer to hyperflex the neck, whereas the author prefers to extend the neck vertically with the forelimbs just dangling above the table surface. As with many techniques, there are several options and personal preferences. Always allow the rabbit to breathe 100% oxygen for 3–4 minutes before intubation is attempted. With all these techniques, never force the tube into the larynx as this will cause haemorrhage and oedema and increase the risk of laryngospasm. A good rule is to make three attempts only and, if unsuccessful, revert to a mask. Topical lidocaine spray applied to the larynx may be used. This can be done under direct visualization with a spray. Some practitioners prefer to insert the tube blind to the level of the larynx and trickle or gently blow a few drops of lidocaine down the inside of the tube onto the larynx.

2 a The fundus picture shows marked cupping of the optic disc. This may be compared with the merangiotic fundus of the normal rabbit eye (**2b**). This is a result of loss of optic nerve fibres due to progressive glaucoma. The blindness will not have been a sudden occurrence but will have been present prior to the change of housing, the rabbit coping well with its limited environment.

b The prognosis for restoration of vision is nil but provided the rabbit can be encouraged to learn its way around the run and can find and compete for food successfully, it can lead a satisfactory life.



3 This four-year-old female house rabbit (**3**) has been hospitalized for assessment and treatment of a chronic GI hypomotility problem and a more recent perineal accumulation of uneaten caecotrophs. Clinical examination and diagnostic tests have led to the conclusion that obesity is the most significant contributory factor in the development of both of these problems. A review of the history reveals that the diet consists of a concentrated mixed ration provided *ad libitum*, a handful of yoghurt/carob drops each morning, occasional fresh greens and access to hay twice a week.

a What is the definition of obesity?

b How would you achieve weight loss in this rabbit?

4 a What procedure is depicted (**4**)?

b Describe how this is performed.

c What is the significance of a mixed bacterial culture being obtained?

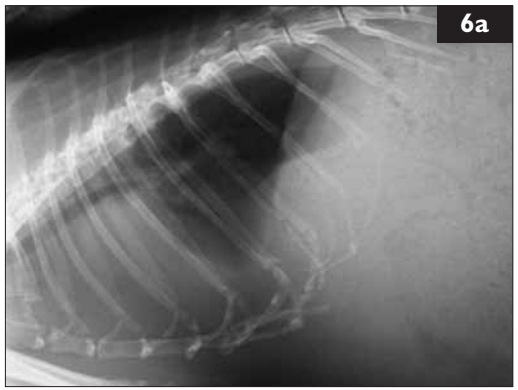
3 a An excessive accumulation of fat in the body, mostly in the subcutaneous tissues. This occurs when the energy intake exceeds the energy expenditure and obesity can be diagnosed in any rabbit whose body weight is more than 20% above that considered desirable with regard to age, breed and build.
b Weight loss must be gradual (no more than 1–2% of body weight weekly) and care should be taken from the outset to prevent periods of anorexia (caused by offering an unfamiliar diet), as this may lead to the development of hepatic lipidosis.

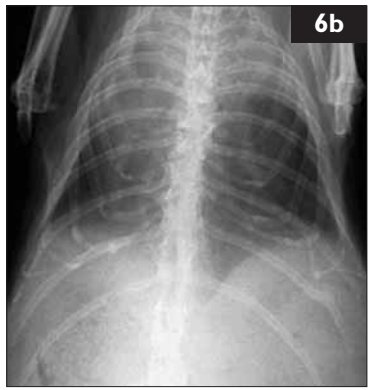
The daily energy requirement can be calculated using the following equation: metabolizable energy (kcal/day) = $100 \times W^{0.75}$, where W is the short-term target weight of the rabbit in kilograms. Using the energy density of the mixed ration that the rabbit is familiar with, calculate the maximum amount that can be fed each day. Provide good quality hay *ad libitum* and gradually reduce the quantity of yoghurt/carob drops and other treats that are offered. An increasing proportion of the concentrate ration should be slowly replaced by mixed fresh greens, unless GI upset occurs. If selective feeding of the concentrate is occurring, consider replacing the mixed ration with a homogenous pellet, preferably one with a reduced energy content. In the UK there is a commercial concentrate diet marketed for weight loss in rabbits. However, there is a strong argument for eliminating concentrates completely in obese rabbits. All changes to the diet must be gradual.

The eventual aim would be to convert this rabbit to a diet based on *ad libitum* provision of hay, access to grass and fresh weeds, a daily serving of mixed fresh greens and a very limited amount of mixed ration or pellets. If insufficient weight loss is achieved, no concentrates should be fed. Most obese rabbits are largely inactive. To complement dietary changes, increasing activity levels by encouraging play time, providing environmental enrichment and/or allowing access to large outdoor runs or escape-proof gardens will help enormously in any weight loss programme.

4 a A deep nasal swab being obtained for bacterial and fungal culture.
b This procedure requires the rabbit to be anaesthetized. A fine swab is premeasured to the level of the medial canthus of the eye from the external nares. This is introduced into the ventral nasal cavity and advanced slowly in a ventromedial direction. Iatrogenic damage to the nasal turbinates is common. Nasal endoscopy may be used to aid this procedure. Unless care is taken, contaminants are common from the external nares. Both sides should be sampled for comparison.
c A pure single culture is likely to be clinically significant, whilst a mixed culture probably represents normal bacterial flora. Bacteria found in normal nasal flora in healthy rabbits include *Moraxella catarrhalis*, *Bordetella bronchiseptica*, *Pasteurella multocida*, *Staphylococcus* spp., *Streptococcus* spp. and *Bacillus* spp.

5 Why is mask induction with a volatile anaesthetic agent risky in an unsedated rabbit (**5**)?





6 A seven-year-old intact male English rabbit, housed indoors, presents with acute onset tachypnoea and laboured breathing. There is a three-month history of weight loss, hindlimb weakness and rapid fatigue. The rabbit is alert, thin and weak. The mucous membranes are pale, with prolonged capillary refill time. A good response is noted to oxygen administration. The rabbit is sedated with intravenous midazolam and lateral and ventrodorsal radiographs of the thorax are taken (**6a, b**).
a What are the differential diagnoses in this case?
b Based on the radiographic findings, what immediate treatment would you consider?
c What further diagnostic tests might be helpful?

5 Due to their prey status, rabbits are very easily stressed. They are also very prone to prolonged breath holding and bradycardia when in contact with volatile anaesthetic agents. Firm restraint is generally required in an unsedated rabbit, as it will resent the face mask and agent and will struggle, risking spinal injury. Breath holding may go unnoticed and the induction concentration may be increased to high levels before a breath is taken, resulting in sudden inspiration of a high concentration. Stress will increase circulating catecholamines and there will be an increased risk of cardiac arrest, especially if halothane is used.

If mask induction is used, the rabbit must be monitored closely and the face mask removed if breath holding occurs and replaced when breathing recommences.

It is preferable to use a tranquillizer or sedative prior to induction. This will not prevent breath holding but will prevent excessive struggling.

6 a Congestive heart failure (myocardial, valvular and congenital disease) is seen in middle-aged to older rabbits. The weakness, weight loss and rapid fatigue observed, although non-specific signs, should arouse suspicion of cardiac or lower respiratory disease. Other differentials include: pyothorax – pleuropneumonia typically due to pasteurellosis but other bacterial agents are often involved; modified transudates seen secondary to neoplasia, lung lobe torsion or diaphragmatic hernia; haemothorax – seen in viral haemorrhagic disease, coagulopathies or trauma.
b The radiographs show a pleural effusion. Immediate thoracocentesis will help stabilize the rabbit as well as determine the type of effusion. Drain the thorax bilaterally using a 23 gauge butterfly catheter placed ventrally in the chest wall. Remove as much fluid as possible by aspirating multiple sites. Oxygen should be provided via a face mask during this procedure and stress should be kept to a minimum. Sedation is often not required in debilitated animals, although diazepam (0.5–1 mg/kg i/v or i/m) or midazolam (1–2 mg/kg i/v or i/m) may be used if necessary. In this case 20 ml of a serosanguinous fluid was obtained from both left and right sides of the chest. It was found to be a modified transudate with a protein of 22.4 g/l (2.4 g/dl) (ref: 25–30 g/l [2.5–3 g/dl]) and a nucleated cell count of 2×10^9/l (2000/µl) (ref: 1–7×10^9/l [1000–7000/µl]). No organisms were cultured.
c Once the rabbit is stable the thoracic radiography is repeated to evaluate fully the thoracic contents. Echocardiography should be carried out to characterize any cardiac disease further. Electrocardiography, blood pressure measurement and routine blood tests are useful in reaching a definitive diagnosis and treatment plan.

7 A four-month-old male Dwarf Lop rabbit living outside in a hutch is destructive each time he comes into the home. The owners also report that he uses a litter tray in the home but leaves faecal pellets on the carpet from time to time. Ideally the owners want to bring him into the home but are concerned by his behaviour. He is fed on a diet of concentrated food plus small amounts of hay and lots of fresh fruit and vegetables. What advice would you give the owners regarding his destructive behaviour?

8 A six-year-old castrated male crossbred rabbit is presented with chronic weight loss, decreased appetite and lethargy. An oral examination and skull radiographs show no evidence of dental disease. Blood is taken. In-house serum biochemistry analysis and haematology performed at an external laboratory yields the following results:

	SI units	Range	Old units
RBCs	3.70* × 10^{12}/l	(4.8–7.2)	3.7 × 10^6/µl
Hb	45* × g/l	(103–155)	4.5 g/dl
PCV	0.17* l/l	(0.35–0.48)	17%
MCV	46.7* fl	(61–76)	46.7 fl
MCHC	260* × g/l	(282–342)	26 g/dl
WBCs	1.2* × 10^9/l	(3.3–12.0)	1.2 × 10^3/µl
Neutrophils	0.89* × 10^9/l	(2.6–6.0)	0.89 × 10^3/µl
Lymphocytes	0.29* × 10^9/l	(1.8–6.3)	0.29 × 10^3/µl
Monocytes	0.02 × 10^9/l	(0–1.8)	0.02 × 10^3/µl
Albumin	19* g/l	(35.9–41.4)	1.9 g/dl
ALT	51 iu/l	(22.1–80.2)	51 iu/l
TP	46* g/l	(53–79)	4.5 g/dl
Urea	17.3* mmol/l	(3.0–9.5)	48.44 mg/dl

a What are the main abnormalities?
b What is the likely cause?
c How may this be confirmed?

7 Ideally this rabbit should be living in the home full time but there are several factors to address. The first is puberty. It is probable that this rabbit's intermittent toileting is a consequence of his need to mark areas with his scent, particularly as he is not in the home that often. If the rabbit is also exhibiting inappropriate sexual behaviour, it is probably worth discussing neutering with the owner.

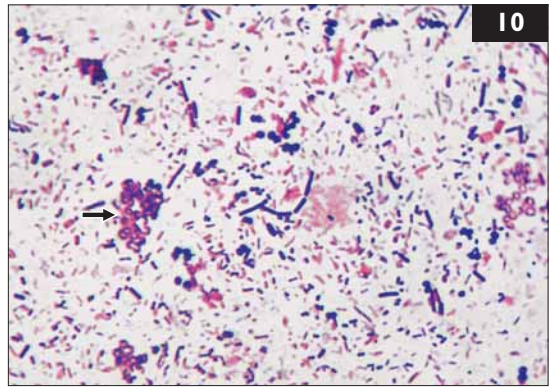
Rabbits that live in the home should have an area that they can retreat to, so an indoor cage would be an appropriate purchase. The owners should place the litter tray in this location, as well as his food. If necessary, the rabbit can be confined in this area for a period of 3–4 days to help establish appropriate toilet training. A dog exercise pen that consists of removable wire panels is a useful method of providing a safe exercise area indoors.

The destructive behaviour is quite normal in an animal that grazes to obtain his food. The owners should be advised to rethink the rabbit's diet to ensure that he is spending more time obtaining food than at present. The emphasis should be on good quality hay making up the bulk of the diet and being used in foraging exercises. The owners can be encouraged to fill toys with hay or to introduce a hayrack. In addition, a small amount of green vegetables and extruded pellet can be fed to the rabbit.

To avoid inappropriate learning and a fearful response, the owners should be encouraged not to reprimand the rabbit for the destructive behaviour. When the rabbit first comes into the home he should initially be given access to small areas so that he can be supervised and also offered toys, old cardboard boxes, inner tubes of kitchen rolls and egg boxes to chew as an alternative. Filling them with hay or food can encourage interest in these items.

8 a Pancytopenia, hypoproteinaemia and uraemia.
b Renal failure. Decreased erythropoietin production leads to a non-regenerative anaemia. Bone marrow suppression associated with chronic disease occurs commonly in rabbits. With results like these, where all the haematology parameters are low, a dilution artefact, such as flushing a syringe with heparin-saline before taking a small volume blood sample, should be considered. This is unlikely in this case, as while some biochemistry results are low, urea is elevated. If in doubt, haematology and biochemistry should be repeated. Low proteins may be due to a renal protein loss. While serum creatinine levels have not been evaluated, urea is elevated and azotaemia is likely.
c Serum creatinine levels should be evaluated to confirm an azotaemia. Urine SG determined with a refractometer and proteinurea evaluated on urine dipsticks will help determine if the azotaemia is of renal origin. Isosthenuric urine may indicate a loss of tubular function. While trace proteins may be present in normal rabbit urine, this should be evaluated in conjunction with the SG. Proteinuria is relatively more important when detected in dilute urine. It is possible to evaluate the degree of proteinuria further by calculating the urine protein to creatinine ratio, which should normally be <1.0. Examination of urine for casts can also be useful.

9 A trace from lead II of the electrocardiogram of the rabbit in **6** is shown (**9**). The echocardiogram revealed biatrial enlargement and evidence suggesting reduced systolic function. The rabbit was normotensive and the haematology and serum biochemistry results were unremarkable.
a Describe the findings shown by lead II of the electrocardiogram.
b What treatment is indicated?
c What is the prognosis?



10 A gram-stained faecal smear from a six-week-old male New Zealand White rabbit that presented with peracute onset diarrhoea, anorexia and depression is shown (**10**).
a Identify the indicated organism. Why is this staining not what one would expect?
b Is this organism a normal part of the rabbit enteric flora?
c What specific requirements are needed for isolating this organism?
d What causes the clinical signs seen?
e What factors predispose to the development of clostridial enterotoxaemia?