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The hedgehog – as it typically presents for clinical examination

Veterinary care of the hedgehog

IAN ROBINSON AND ANDREW ROUTH



lan Robinson qualified from Bristol in 1975. After 15 years in mixed practice, he joined the RSPCA to run the RSPCA Norfolk Wildlife Hospital, near King's Lynn, which admits around 5000 casualties a year. He holds certificates in sheep health and production and in zoological medicine.



Andrew Routh qualified from Liverpool in 1981. He developed an interest in wildlife while working in general practice and, in 1994, joined the RSPCA to set up a wildlife hospital and cattery at Stapeley Grange, Cheshire. He worked there until 1998 gaining the certificate in zoological medicine in 1997. Since then he has been working in wildlife rehabilitation around the world. He is currently involved in raptor rehabilitation in India.

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hazards.

netting.

THE European hedgehog (*Erinaceus europaeus*) is probably the most frequently treated wild mammal in Britain. Its small size, relative tolerance of human interference and non-aggressive nature make it an ideal species for rehabilitators. The wide range of clinical problems encountered also make it a fascinating subject for the veterinarian.

NATURAL HISTORY AND BEHAVIOUR

The hedgehog is Britain's only spiny mammal. About 5000 spines (modified hairs) cover the dorsal surface of an adult. These are shed and regrown constantly, each spine lasting about a year. The spines are hollow and strengthened by a corrugated inner wall. They have a pointed tip and a bulbous base preceded by a narrow neck at an angle to the main shaft, which acts as a shock absorber in the event of a blow or fall. Strong erector and panniculus muscles and a massive circular orbicularis muscle enable the hedgehog to adopt its characteristic defensive manoeuvre of rolling into a ball, presenting an impenetrable surface of projecting spines.

Hedgehogs have few predators – perhaps surprisingly for their small size – although badgers and occasionally foxes are able to breach their defences. Man is a major threat. Hedgehogs are still widely persecuted by gamekeepers because they

occasionally take the

eggs of ground-nesting

injury on the roads is

common and, while they

are well suited to the

habitat of the suburban

garden, hedgehogs also

face many dangers there:

damage by strimmers.

entanglement in garden

garden chemicals, and

disruption of nesting

sites are all frequent

ingestion

Death

or

of

gamebirds.

Hedgehogs are insectivores but enjoy a varied diet. Caterpillars and moth larvae, the larvae and adults of beetles, slugs and snails, earthworms, toads, slowworms, small mammals, birds and their young and eggs, and carrion all feature in hedgehog diets. Increasingly, artificial food supplied by humans is a regular dietary addition.

Adult hedgehogs are solitary in nature, but share overlapping home ranges, each of which may extend over several acres. A hedgehog builds several nests in its home range and will visit the nearest nest at the end of a night's foraging, spending the daylight hours concealed. It is abnormal to find a hedgehog out of its nest and active during the hours of daylight. The home range is not defended or marked, although aggressive behaviour between males can occur during the mating season.

Hedgehogs hibernate at temperatures below 8°C, although they will emerge during spells of warm winter weather.

BIOLOGICAL DATA

Age	Normal weight	Appearance
Newborn	12-20 g	White spines covered by a swollen cutis. Ears and eyes closed. Umbilical remnant visible
2-3 days		Brown spines start to grow
7 days	50 g	Hair starts to grow
12-14 days		Eyes start to open
21-23 days	100 g	Deciduous teeth start to erupt
7-9 weeks	250-300 g	Permanent teeth start to erupt
Adult	Up to 1⋅5 kg	Higher weights are recorded, especially when artificial food sources are available



Two-week-old orphan hoglet - a case for hand-rearing

RESCUE AND REARING

A female hedgehog may produce two litters per year, the average litter size being four or five hoglets. Juveniles must weigh at least 450 g by the autumn to survive their first hibernation. In the autumn, as food supplies become scarce, hedgehogs may be found out during the day. This is often, but not invariably, associated with ill health. Healthy hedgehogs benefit from supplementary feeding at this time, but weak and emaciated individuals require rescue. These hedgehogs can be successfully treated and reared through the winter and will remain active and feeding if maintained in an artificially heated environment.

Radiotracking studies indicate that both adult and juvenile hedgehogs (including hand-reared orphans and overwintered, naïve juveniles) released after a period in captivity rapidly adopt natural behaviour patterns, although some dispersal from the site of release may take place.

HAND-REARING ORPHANS

Orphan hedgehogs may be fed artificial bitch's milk (eg, Esbilac; Pet Ag) or goat's colostrum using a syringe or bottle and teat of a size suitable for feeding orphan kittens. Feeding should be carried out two- to fourhourly, and the hoglet's bodyweight monitored at least daily. Night feeds can be withdrawn once steady bodyweight gains are achieved. After feeding it is necessary to massage the anogenital area to stimulate urination and defecation (a moist cotton bud is useful for this purpose). If the skin becomes excoriated, petroleum jelly or a bland ointment may be used.

Hoglets will often lap milk from a bowl from an early age and, by three weeks of age, should be eating solid food. Complete puppy foods (eg, Pedigree Chum puppy food) are ideal first solid foods. It is important to continue monitoring bodyweight daily to ensure an adequate intake and weight gain until the hoglets are fully weaned.

CLINICAL EXAMINATION

When disturbed, hedgehogs sometimes utter a harsh cough as an alarm call and a jerky, jumping movement, with the spines erect, may be made in an attempt to deter the handler. Most hedgehogs, however, will simply roll up tightly when first handled. If left undisturbed on the examination table the patient may unroll and start to explore, allowing a visual inspection, although any attempt at handling usually results in the hedgehog instantly rolling up again. Gentle stroking of the dorsal spines craniocaudally, using a towel or glove if necessary, will often result in the hedgehog gradually



(left and below) Reflex roll in an alopecic hedgehog



unrolling. The handler can then gently grasp the hindlegs and lift the hindquarters, taking care to ensure the front feet remain in contact with the examination table. This leaves the body fairly accessible for visual examination.

Care should be taken when handling hedgehogs, as they will occasionally bite.

Hedgehogs and zoonoses

The wearing of latex gloves when handling hedgehogs is recommended.

The most common zoonotic infection transmitted by hedgehogs is ringworm. This often presents initially as small fluid-filled bullae below a thickened epidermis and may not always be recognised by medical practitioners. Bites from hedgehogs are rare, but severe pyogenic infection has resulted from cases of bite wounds which have broken the skin.

Salmonella enteriditis is of low pathogenicity to humans and has been recorded in children (and also in dogs); other, less common, Salmonella species represent a greater zoonotic risk.

Hedgehogs often roll in faecal matter to anoint themselves. Skin punctures from spines may therefore turn septic.



Conscious hedgehog being unrolled and grasped by the hindlegs to facilitate clinical examination

Pain will cause a hedgehog to roll up despite all efforts to prevent it. Some hedgehogs simply refuse all attempts at unrolling. In these circumstances, general anaesthesia (see box below) is the only option.

ROUTINE INVESTIGATIONS

Despite the fact that the cranial vena cava or saphenous vein may be accessible in the anaesthetised hedgehog, it is difficult reliably to obtain a blood sample, although a microsample may be collected from the nail bed. Because of these difficulties, haematology and clinical chemistry rarely feature in routine investigations in hedgehogs. Reference ranges are available but tend to be based on small data sets.

COMMON DISEASES

SKIN DISEASE

The principal causes of skin disease in the hedgehog, together with recommended treatments, are listed in the table overleaf.

RESPIRATORY DISEASE

Lungworm (verminous pneumonia)

Two species of nematode occur in the lung: *Capillaria aerophila* and *Crenosoma striatum*.

The intermediate/transport host for *C aerophila* is the earthworm. Bipolar eggs can be found in the faeces; however, differentiation microscopically from those of gut *Capillaria* is difficult on standard wet preparations. The intermediate hosts for *C striatum* are slugs and snails, while the occurrence of this nematode in unweaned hedgehogs suggests that direct (possibly transplacental) transmission also takes place. Live larvae are found in the faeces.

The morbidity rate associated with lungworm infection can be very high. Virtually 100 per cent of juvenile

Heavy lungworm burden in a hedgehog lung sectioned postmortem



General anaesthesia

Induction in an anaesthetic chamber with a gaseous anaesthetic is the method of choice for general anaesthesia in hedgehogs. Isoflurane is the preferred volatile agent, although halothane is adequate. If an induction chamber is not available, a 90° connector can be used as a mask, and introduced over the nose of even a tightly rolled hedgehog. Once induced, a small mask can be used for maintenance, although it is difficult to obtain a tight seal against the spines to minimise environmental contamination. An endotracheal tube can be inserted in larger individuals; a stylet in the tube facilitates insertion.

Intramuscular ketamine can be used for examinations, minor procedures and as an induction agent; the injection technique is described in the box on page 137. (below left) Induction of general anaesthesia using a volatile agent. The induction chamber is connected to anaesthetic gas scavenging equipment. (below right) Endotracheal intubation of an albino hedgehog following gaseous induction





SKIN DISEASES IN THE HEDGEHOG			
Cause	Clinical signs/comments	Treatment	
Fleas Archaeopsylla erinacei	Ubiquitous and easily seen. Heavy infestation may be indicative of poor condition	Pyrethrum, piperonyl butoxide or synthetic pyrethroids Treat only heavy infestations	
Mites Caparinia tripilis	Scurfy or scaly skin and spine loss. White mites just visible to the naked eye (similar to <i>Cheyletiella</i> mites in dogs). Infestation often occurs synergistically with dermatomycoses	Topical ivermectin	
Demodex erinacei	Raised papules and crusty skin lesions. Mites in sebaceous glands; found on deep scrapings only	Ivermectin by injection	
Notoedres cati	Encrustations, particularly on ears and around the head	Topical ivermectin	
Otodectes cynotis and Sarcoptes species	Also recorded		
Ticks Ixodes hexagonus and Ixodes ricinus	Small numbers of ticks are asymptomatic, but large numbers may sometimes cause anaemia (100+ ticks on one small hedgehog have been recorded). The role of the tick as a vector of disease has been largely unexplored in the hedgehog	Topical ivermectin Physical removal	
Myiasis Lucilia and Calliphora species	Both primary fly strike and secondary wound infestation occur from mid-summer until well into the autumn. Ears, eyes, anus and genital openings are frequently attacked	Physical removal Various insecticidal washes Topical coumaphos	
Dermatomycosis (rin Trichophyton mentagrophytes (var erinacei); occasionally Microsporum species	ngworm) Characteristic crusts around base of spines. Mites (see above) and bacterial infection often also present	Topical natamycin or enilconazole Oral griseofulvin	
Bacterial infections Notably Staphylococcus species	Secondary or in conjunction with other disease. Also causes a primary exudative dermatitis of the ventral thorax and abdomen	Preferably based on culture/ sensitivity: amoxycillin/ clavulanate (30-50 mg/kg bid); clindamycin (5-10 mg/kg bid); or enrofloxacin (10 mg/kg bid)	

bid Twice daily

hedgehogs presented in the autumn are infected with one or both of these parasites, most exhibiting typical clinical signs of dyspnoea, coughing, nasal discharge, weakness and emaciation. Mortality can also be high. Lungworm treatment comprises levamisole (27 mg/kg), fenbendazole (100 mg/kg) or mebendazole (100 mg/kg).

Bacteria

Bordetella bronchiseptica has been isolated from hedgehogs, infection often occurring secondarily to verminous pneumonia. Associated clinical signs are dyspnoea and epistaxis. *Pasteurella multocida* has also been recorded.

Treatment is carried out with enrofloxacin (10 mg/kg twice daily), clavulanate/amoxycillin (30 to 50 mg/kg twice daily) or clindamycin (5 to 10 mg/kg twice daily). Respiratory diseases may also be treated symptomatically with mucolytics, bronchodilators and non-steroidal anti-inflammatory drugs. In hedgehogs with severely congested respiratory tracts, nebulisation can be a useful technique. Mucolytics, such as acetylcystine, can be combined with antibiotics; gentamicin is ideal as it is not absorbed systemically, but there are health and safety implications in using this technique and personnel should not come into contact with the suspended droplets.



Ectoparasitic skin infestations. (above) Flea burden from a juvenile hedgehog after treatment with synthetic pyrethroid powder. (below) *Sarcoptes* infection in a juvenile hedgehog, diagnosed from a skin scraping. This individual responded well to treatment with ivermectin by injection



GASTROINTESTINAL DISEASE Endoparasites

A wide variety of endoparasites have been recorded in hedgehogs. The ones most commonly associated with clinical disease are discussed below.

■ THREADWORMS. *Capillaria erinacei* and other *Capillaria* species are found in the intestine and, where very heavy infestations occur, cause green mucoid diarrhoea. Bipolar eggs, often present in large numbers, are seen in direct faecal smears but are not easily differentiated from those of *C aerophila*. Like *C aerophila*, the intermediate host of these endoparasitic threadworms is the earthworm. Treatment is as described above for lungworm.

■ TAPEWORMS. Infection with the tapeworm *Hymenolepis erinacei* is usually asymptomatic, although proglottids are sometimes seen in faeces. Beetles are the intermediate host, and the recommended treatment is praziquantel.

■ INTESTINAL FLUKE. The fluke *Brachylaemus erinacei* appears to have a patchy geographical distribution, being an important parasite in some areas of southern England, Wales and the Channel Islands, yet rare or absent from northern England and East Anglia. Clinical signs of fluke infestation are melaena and persistent restlessness

and unipolar eggs are seen in direct faecal smears. Praziquantel is the treatment of choice.

■ COCCIDIA. Both *Eimeria* and *Isospora* species occur in hedgehogs. Infection is usually subclinical, but these protozoa can cause clinical disease, especially among hand-reared orphans if hygiene is poor. Clinical signs are bloody diarrhoea and weight loss. Oocysts are seen in direct faecal smears. Treatment is effected with sulphadimidine, potentiated sulphonamides or amprolium.

Bacteria

Salmonella enteriditis phage type 11 appears to be endemic in hedgehogs. Deaths in wild hedgehogs have been attributed to primary salmonellosis, while acute salmonellosis can cause problems in hand-reared hedgehogs, especially around weaning. Clinical signs include persistent weight loss, green diarrhoea, rectal or bowel prolapse and dyspnoea. In unweaned hoglets sudden death may occur. Postmortem examination may reveal mucohaemorrhagic enteritis, hepatomegaly and focal pneumonia. In the authors' experience, swabs and fresh tissue submitted by post to laboratories have failed to result in reliable isolation of salmonellae and submission of whole carcases is recommended.

Various other *Salmonella* species have been isolated, including *S typhimurium*. Treatment (preferably based on culture and sensitivity) is carried out using enrofloxacin, amoxycillin/clavulanate or spectinomycin.

OTHER CONDITIONS

Dental tartar and gingivitis

Dental tartar and gingivitis are seen in both wild hedgehogs and those in captivity. A link to the feeding of soft dog food diets has been postulated, but not substantiated. Wild hedgehogs do, nevertheless, often receive supplementary feeding by householders.

Traumatic injuries

■ SKIN WOUNDS. Many wounds are old and contaminated (sometimes fly infested – see table on page 132) when presented, and are best cleaned, debrided and left to heal by second intention. Access to skin wounds for cleaning or suturing can be improved by cutting the surrounding spines short with scissors. Intrasite gel (Smith & Nephew) and Orabase (ConvaTec) are local applications which have been particularly successful at promoting rapid healing in large wounds.

■ FRACTURES. Spinal fractures can often be detected by failure of the spines to erect caudal to the site of injury, and by protrusion of the hindlegs when rolled. Long bone fractures can be stabilised with intramedullary pins (external fixators cannot be used as they would be dislodged by the orbicularis muscle when rolling up). Damage to the snout can result in severe respiratory distress as hedgehogs are reluctant to mouth-breathe. Fractures involving the maxillary bone are not uncommon; often the fracture is just caudal to the incisor teeth. Damage to turbinates may affect the animal's sense of smell and have long term effects on its foraging



wound are cut short with scissors to provide better access for cleaning and debridement (B). (C) The wound after closure using a standard suturing technique, with a piece of fenestrated drip tubing in place. Recovery was uneventful



Traumatic palatine injuries carry a guarded prognosis



Examination under general anaesthesia revealed grossly infected comminuted fractures of the radius and ulna in the left forelimb of this hedgehog. Euthanasia was carried out

ability, which must be considered before release back into the wild.

■ BONFIRE DAMAGE. Hedgehogs caught in garden bonfires will often be presented with patches of charred or melted spines. The underlying skin may appear normal but often will slough some days later, so a period of time in captivity for observation is justified. Signs of respiratory distress associated with smoke inhalation are also common.

Poisoning

Metaldehyde, paraquat, organophosphorus, alphachloralose and anticoagulant rodenticide poisonings are all seen in hedgehogs.

MEDICAL TREATMENT

The drugs and doses given in the table on the right are believed to be both safe and effective in hedgehogs. Where a drug is mentioned but no dose is listed, the authors feel that, although the drug appears to be safe, they have insufficient experience or data to suggest a specific dose rate as effective, and it is left to the discretion of the clinician to determine a dose following the general guidelines discussed below.

DRUG DOSAGES

Many dose rates suggested for hedgehogs are based on cat or dog dosages or are empirically derived. An allometric approach would calculate both the dose rate and frequency for a 350 g hedgehog to be approximately three times that of a 10 kg dog (see box below). The implication, therefore, is that use of standard dose rates for dogs and cats for the treatment of hedgehogs results in significant underdosing. However, the disturbance and stress of handling for such frequent drug administration may be impractical or undesirable. Dose rates and frequencies are therefore often a compromise between theory and practice. Therapeutic levels may only be achieved intermittently. Administration of drugs in food or water, where appropriate, may result in a more frequent uptake.

Allometrically derived dose rates

The dose of clavulanate-potentiated amoxycillin for a 10 kg dog and a 350 g hedgehog, based on the specific minimum energy cost (SMEC), is:

10 kg dog	12·5 mg/kg	2 x daily
350 g hedgehog	28-9 mg/kg	5 x daily

 $SMEC = K(W_{kq}^{-0.25})$

W = bodyweight K = constant based on metabolic rate (Hainsworth's energy group constant)

Adapted from Sedgewick (1993)

Drug/treatment	Trade name	Dose	Frequency	Route
Ketamine hydrochloride	Various	80 mg/kg		im
Enrofloxacin	Baytril (Bayer)	10 mg/kg	bid	po, im, sc, ip
Clavulanate/ amoxycillin	Synulox (Pfizer)	30-50 mg/kg	bid	po, im, sc
Clindamycin	Antirobe (Pharmacia & Upjohn)	5-10 mg/kg	bid	ро
Levamisole*	Levacide (Norbrook) Levadin 75 (Vétoquinol)	27 mg/kg	Repeated three times at 24-hour intervals. Showing best results for initial treatment of nematode infections	sc
Ivermectin	lvomec (Merial)	3 mg/kg	May be suitable for mange. Not recommended as single dose for lungworm	sc
	lvomec (Merial)	Diluted 1:9 with propylene glycol		A few drops topically
Fenbendazole*	Panacur (Hoechst)	100 mg/kg	sid for 5-7 days	ро
Mebendazole*	Telmin (Janssen)	100 mg/kg	sid for 5-7 days	ро
Praziquantel	Droncit (Bayer)			po, sc
Coumaphos [†]	Negasunt Powder (Bayer)			Topically (sparingly)
Permethrin [†]	Head-to-Tail Flea Powder (Schering-Plough)			Topically (sparingly)
Fipronil [†]	Frontline (Merial)			Topically
Hartmann's solution	Aqupharm No. 11 and No. 18 (Animalcare)		Up to 10% bodyweight over 24 hours	sc, ip, io
Saline (0·18%) with glucose (4%)			As for Hartmann's solution	sc, ip, io
Amino acids, glucose, etc	Duphalyte (Fort Dodge)			po, iv, sc, ip, io
Carprophen	Zenecarp (C-Vet)	4 mg/kg	sid for 3 days	sc

sid Once daily, bid Twice daily, im Intramuscular, po Oral, sc Subcutaneous, ip Intraperitoneal, io Intraosseous

*Anthelmintic regimens suggested in the current literature, often based on canine dose rates, can be ineffective. In a trial conducted recently by the authors on overwintered hedgehogs in Norfolk, use of levamisole at 27 mg/kg and ivermectin at 3 mg/kg resulted in only a 50 per cent reduction in the incidence of positive faecal smears, with no significant difference between the two treatments. Mortality due to lungworm within five days of admission was high and persisted for some time despite frequent dosing. However, repeated dosing with levamisole at 24-hour intervals appears to produce a significant reduction in both morbidity and mortality, although trials are still in progress. Oral benzimidazoles, fenbendazole and mebendazole appear to be effective if administered at 100 mg/kg daily over five to seven days and can be given in food. However, oral administration to inappetent hedgehogs can be difficult due to reflex rolling

[†]Hedgehogs are reported to be very sensitive to organophosphorous compounds, both as powders and sprays. In the authors' experience, these compounds are effective and safe if used sparingly. However, it is very easy to overdose small hedgehogs with aerosol preparations, especially if the animal is replaced in a poorly ventilated area, such as a closed cardboard box, after spraying

Injection technique

■ SUBCUTANEOUS injections can be given between the spines, either superficially or deep to the panniculus muscle

■ INTRAMUSCULAR injections are best given into the orbicularis or purse string muscle, as this is exposed even when the hedgehog is rolled up. The injection site is on the ventrolateral aspect, at the junction of the hair and spines

INTRAVENOUS access is difficult

Acknowledgement The photographs accompanying this article were taken by Andrew Routh.

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SEDGEWICK, C. J. (1993) Allometric scaling and emergency care: the importance of body size. In Zoo and Wild Animal Medicine. Current Therapy 3. Ed M. E. Fowler. Philadelphia, W. B. Saunders. pp 34-37 inotropic support is required to stabilise a patient, dobutamine can be administered by constant rate infusion. This is only practical where equipment and staffing levels allow the accurate administration of the drug and where close monitoring of the patient throughout the period of administration is possible.

In the future, use of other drugs with novel modes of action may be possible but data from human trials suggest that long-term administration of inotropic agents to heart failure patients may be harmful except in the case of digoxin.

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CORRECTION

Veterinary care of the hedgehog

The picture showing endotracheal intubation in a hedgehog on page 131 of the above article (*In Practice*, March 1999, pp 128-137) was incorrectly orientated. It should have been rotated 90° , to show the animal in sternal recumbency with dorsoflexion of the head to allow passage of the tube. The error is regretted.

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Ian Robinson and Andrew Routh

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