

Practitioner's guide to pocket pet and rabbit theriogenology

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Abstract

This paper provides a review of reproductive characteristics of hamsters, guinea pigs, gerbils, hamsters, rats, and mice, as well as rabbits and chinchillas. It is not intended to be a source of the facts of reproduction (which can be readily found in many references) but rather to highlight some of the unique characteristics of the various species and common problems that clients may present to theriogenologists. This paper includes information regarding sexing, mating, gestation, parturition, lactation, and comments regarding spays and neuters.

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1. Introduction

Many small and large animal practitioners are periodically confronted with the occasional pocket pet with some kind of problem. Pocket pets included in this paper will be the hamster, guinea pig, gerbil, hamster, rat and mouse, as well as the rabbit and chinchilla. As theriogenologists, dealing with breeding populations can be challenging. This paper is not meant to be a reference for duration of gestation and other reproductive data (that are readily available in several sources and the internet). Instead, the author has chosen to highlight similarities and differences among species, with the intent of providing practical guidance to the practitioner and highlighting the uniqueness of each species.

2. Sex and the single practitioner

One of the questions that often come with a pocket pet is, “what sex is it?” Unfortunately, this can be very

difficult to determine in young animals. Unless the practitioner is very skilled in the particular species of interest, young animals are best sexed on a comparison basis. Most pocket pets (mice, rats, hamsters, gerbils, chinchillas) can be sexed by anogenital distance. The anogenital distance is about twice as long in the male as in the female. By comparing littermates (where there is a mix of sexes), one can often determine gender. However, the anogenital distance rule is not valid for guinea pigs and rabbits. Both sexes of guinea pigs have a Y-shaped genital area; boars have a penile opening inside the “cup” of the Y and the penis can be manually extended. In contrast, the female has a U-shaped vulva with a vaginal membrane. Young rabbits can be very difficult to sex, as the female has a vaginal papillae that can be confused with the penis. The female has more of a slit in the vaginal area, whereas the male has two holes. The rabbit's anus is above (i.e. cranial to) the genitalia. In contrast, in other species, the anus is more caudal than the genitalia. It is recommended that a rabbit's sex be verified prior to admission for spaying or neutering [1]. Chinchillas are best sexed by anogenital distance; the female has a cone-shaped clitoris, ventral to the vaginal opening that can be confused with a penis [2].

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With most species, as the males get older, their testes descend and become more prominent, making it easier to determine the sex of individuals. It is noteworthy that rabbits can withdraw their testes towards the abdominal cavity and “hide” them (to prevent trauma from another male when fighting). The scrotal sacs are still evident however and the testes can often be manipulated back into the scrotal area. Male chinchillas do not have a true scrotum; their testes lie just underneath the skin over the inguinal canals and they become more prominent and easier to detect when a female is proximate. In hamsters and chinchillas, males are usually smaller than females.

3. Estrus

Most pocket pets are continuously polyestrous, spontaneous ovulators and exhibit postpartum estrus. Rabbits, however, are induced ovulators with no post partum estrus, going through periods of receptivity lasting about 7–10 d, followed by a “quiet” period for 1–2 d [3]. Most pocket pets have some seasonality in cycling regularity and mating. However, seasonality is very pronounced in hamsters and rabbits; they are usually more sexually active during long photoperiods (spring and summer). Chinchillas also demonstrate reproductive seasonality.

It is possible to do vaginal smears to determine the stage of the cycle in mice and rats and hamsters. However, changes in the vaginal smears of gerbils are not as obvious as in rats and mice [4]. One technique is to place one drop of sterile saline into the vagina with an eyedropper, aspirate it back, transfer it to a slide, stain with dilute New Methylene Blue, apply a coverslip, and examine microscopically [5]. Vaginal cytology is useful about 70% of the time in Chinchillas [6].

Cycles can be manipulated in the mouse by taking advantage of the Whitten and Bruce effects. The Whitten effect is observed when group-housed female mice tend to go into anestrus. However, the scent or sight of a male terminates the anestrus and most of the mice will come into estrus in approximately 72 h [7]. The Bruce effect occurs when pregnant animals (from 1 to 4 d of pregnancy) exposed to a “strange” new male animal lose the first pregnancy (apparently implantation is prevented) [8]; they will then return to estrus and become pregnant by the second male. Although rats usually do not show these effects as strongly as mice, the Bruce effect has been documented in gerbils [9].

Hamsters complete their cycle every 4 d. Prior to ovulation, hamsters have a clear vaginal discharge that becomes opaque white and can be seen on the vulva. This is normal. It is not purulent or bloody and has no

strong smell. Occasionally, hamster owners will see it and worry that something is wrong with their animal. If the discharge is not observed 4–5 d after mating, the animal can be assumed to be pregnant [10].

Many pocket pets (mice, rats, hamsters, gerbils, guinea pigs) tend to become sexually mature very early (as early as 1 mo of age). Therefore, it is important to wean litters quickly and separate the sexes before the animals become sexually active. Most weaning is done by 21–28 d of age (guinea pigs should be separated by 21 d of age as females will begin cycling, whereas rabbits are weaned at approximately 4–6 wk).

4. Mating

There are marked differences among species in mating behavior. Most species are more active at night, except gerbils, which are active in late afternoon. Vaginal plugging is present in mice, rats, gerbils (can be difficult to see), hamsters and chinchillas and can be used to designate the first day of gestation. However, female chinchillas will eject wax-like “plugs” about 2.5–5 cm in length from the vagina at the start of estrus; these should not be confused with the plug that occurs after mating and stays in the canal several hours before falling out. Sometimes the waxy plugs of estrus will be retained and need to be lubricated and manipulated for removal [11].

There are many mating systems used, depending on the goals of production and the animals themselves. Mice and rats can be housed in pairs or harems; usually the male mouse is removed when the female shows signs of pregnancy. The male rat is “family-orientated” and will usually be good with the pups. Gerbils do well in monogamous relationships, weaned into pairs and kept together. Hamster, rabbit and chinchilla females can be very aggressive towards males, although chinchillas are often monogamous in the wild. Rabbits and hamster females are often taken to the male and watched; they are immediately separated if no mating or aggression occurs. However, if the female rabbit is receptive, they will mate twice within about 30 min and then should be separated [12]. If hamsters are receptive, they can remain together for the night, but should be separated in the morning. Chinchilla breeders often have a system of tunnels or raceways where the male can visit multiple females but leave if the females become aggressive; typically the female is fitted with a collar that prevents her from entering the tunnel (allowing the male to escape). Chinchilla females with pups are usually very aggressive to males, even if the male is the father and known to the female.

Female guinea pigs must be mated for the first time at <10 mo of age (ideally at 5–6 mo). The pubic symphysis must open to allow normal delivery of baby pigs; if pigs are bred for the first time at >10 mo of age, the pubic symphysis might be fused and unable to open as needed (leading to dystocia). Impending parturition in the guinea pig can be determined by measuring the distance between the two pubic bones; the pubic symphysis opens to approximately 1.5 cm at 48 h prepartum and subsequently increases to 2–3 cm at parturition [13].

5. Gestation

Hamsters have the briefest gestation (6–19 d) whereas guinea pigs (approximately 59–72 d) and chinchillas (105–115 d) have the longest. Most rodents are easily palpable to determine if they are pregnant. Enlarged abdomens become obvious as well. Implantation can be delayed in many of these species if they are lactating. The greatest extent of delay is seen in the gerbil; their gestation is delayed 1.9 d/pup when three or more pups are nursing [14].

Guinea pigs commonly have difficulties during gestation, especially if they are obese. They are also prone to several metabolic problems. In breeding colonies, maternal mortality and loss of pigs can be an important problem. During pregnancy, exercise is extremely important, as well as a carefully balanced diet, including sufficient vitamin C (up to 30 mg/kg/d during pregnancy [15]) and not too many calories. It is recommended that pregnant guinea pigs receive supplemental calcium (4 mg/kg/d) during late pregnancy to prevent eclampsia [16]. Many of the problems occur right around parturition so pregnant sows at day 65 or later need to be closely monitored for reduced appetite or premature labor (green ink-like discharge due to placental separation). Since guinea pigs do not make nests, that behavior cannot be used to predict impending parturition. However, as discussed previously, the pubic symphysis distance can be very helpful (as long as it is not fused).

Clinical signs of eclampsia (hypocalcemia) are similarly to those in cattle with parturient paresis (milk fever). As in cattle, it is caused by a sudden demand for calcium, with inadequate ability of the bones to liberate calcium. Sows with eclampsia will have muscle spasms, possibly convulsions and be depressed. Calcium gluconate (1 mg/kg)iv is recommended. Prognosis is very guarded.

Pregnancy toxemia (ketosis) is usually seen 1–2 wk before and after parturition. If a sow becomes anorexic, she becomes “at risk”, especially if she is a primiparous,

obese sow. These sows become lethargic, adipic, salivate, and are uncoordinated. They may show signs of hyperexcitability, dyspnea and die acutely. There is also a toxic form, attributed to fetal pressure on the aorta that leads to uterine ischemia and fetal death. Disseminated intravascular coagulation is also seen with this form (uterine hemorrhage). Diagnosis can be made by detecting ketones and acidic urine (guinea pigs generally produce alkaline urine). Hypoglycemia, hyperlipidemia, hyponatremia, and hypochloremia can also be seen. The sow may also be anemic and thrombocytopenic. Prognosis for both of these forms of ketosis is poor to guarded, although treatment with fluids containing dextrose (IV or IO) and calcium gluconate (1 mg/kg) can be attempted. Steroids (2 mg/kg of prednisone) can also be given if the sow is in shock. At necropsy, there is often hepatic lipidosis and placental necrosis [17].

During pregnancy, a sow doubles her weight and her food consumption triples [18]. Sometimes late-gestation sows will find it very difficult to ambulate due to the size of the fetal mass in the uterus. These sows should always have easy access to food and water and be monitored closely for problems.

Overweight rabbits may be at risk of pregnancy toxemia as well, although it is less common than in guinea pigs. Prevention of toxemia for both of these species is to prevent obesity, feed them balanced diets with adequate fiber, give them exercise during pregnancy, avoid causing anorexia (stress, high ambient temperatures, excessive noise or transport) and treat them quickly if signs occur. Layman chinchilla breeders will also recommend providing calcium and Vitamin C supplementation to pregnant chinchillas; several recommendations were found in internet-based layman information, but no authoritative reference was cited. Pregnant chinchillas may also experience constipation as the gravid uterus places pressure on the colon.

6. Parturition

Mice, rats, gerbils, hamsters and rabbits bear altricial young, with eyes and ears closed, and no hair. Guinea pigs and chinchillas bear young that are precocial (born with teeth, hair, eyes and ears open (newborn hamsters also have teeth).

Many of these species give birth at night with very few problems. If a mouse is found to be straining and having obvious labor during daylight hours, it is probably experiencing dystocia. In our facilities, C-sections are not routinely performed in mice. However, we will have success about half of the time with subcutaneous fluids (approximately 2–3 mL), oral dextrose (can add to the

water bottle or give via syringe or gavage needle) and 0.1 U of oxytocin subcutaneously. We also tend to give penicillin G (1000 U/mouse) as a prophylaxis. If a pup is visible, we will attempt to assist delivery. If we do not see pups within 30 min of administering oxytocin, a second dose might be tried if the mouse is doing well systemically. However, mice that fail to respond are usually euthanized. If the babies are valuable, we can attempt to deliver them and foster them to another dam (if available).

Guinea pigs and chinchilla babies need to be quickly delivered once parturition has begun. Since neonates are relatively well developed, they have a high demand for oxygen and a low tolerance for CO₂. They rapidly deteriorate if they are still within the uterus and placenta separation occurs. Furthermore, dystocia in guinea pigs is difficult to detect, given the variability of gestation length (59–72 d), the lack of nest building and very abrupt onset of labor. Once labor begins, the baby pigs are normally all delivered within 10–30 min (5–10 min between successive pups). Therefore, if a dystocia is suspected, time is of the essence. A sow that has been continuously straining unsuccessfully for >20 min or intermittently for >2 h is probably experiencing dystocia. Most dystocias, at least in guinea pigs, are associated with some kind of physical problem (intrapelvic fat or a fused symphysis) that impede vaginal delivery. Oxytocin will induce parturition if the pig is over 66 d of pregnancy. If the pelvic symphysis is examined and confirmed to be non-fused, oxytocin may be given (dose ranges from 0.2 to 0.3 U/kg IM [19] to 1 to 2 U/guinea pig IM [20] (which generally weigh about 1 kg). If no pups are produced within 15 min, a C-section should be considered.

Chinchillas rarely experience dystocias (characterized as labor for >4 h). Oxytocin and calcium gluconate (0.5 mL of a 20% solution) IM may be helpful. As with the guinea pig, if treatment fails to yield results within 15–20 min, a C-section should be considered. Chinchillas are more prone to retained feti that have died late in gestation and are not delivered at parturition. This can lead to neglect of the babies in conjunction with depression of the dam. It is always good to check chinchillas post delivery to be sure all the babies are delivered (radiographs can be helpful). C-sections (combined with spays) should be performed to remove retained babies if the mother is valuable or highly prized [21]. Surgery will be discussed later in this paper.

Mice and hamsters are famous for cannibalizing litters if they feel stressed, unprotected or overcrowded. Gerbils have been reported to cannibalize as well. Hamsters will take their pups into their cheek pouches

to protect them. Sometimes the litter will apparently disappear and subsequently reappear (however, there is a risk of suffocation). With any of these smaller species, it is a good practice to supply the mother with extra bedding, food and water and leave her and the litter alone as long as possible (at least 1 wk) before disturbing them; this will facilitate development of maternal bonding.

7. Lactation

Rabbits do not nurse their kits more than twice a day. They also do not retrieve their young should they wander from the nest. Inexperienced clients may think the mother is neglecting her young. As long as the pups are gaining weight, they are doing fine. Wandering kits returned to the nest are usually accepted by the mother (despite being handled by humans), but she may reject them if they are cold.

Mother mice sprawl out over the top of their litters to nurse. Guinea pigs nurse sitting up. Guinea pig babies get all of their maternal antibodies from the placenta, not the milk. Most rodents will foster pups from different litters fairly readily (although it may be useful to make the foster pups smell like the litter that the mother already has). Guinea pigs and chinchillas may not nurse immediately and orphaned guinea pigs will often refuse food for the first 12 h post partum. Chinchillas may initially display agalactia, but will usually increase milk production by 12–72 h post partum. If the chinchilla's nipples are difficult to find postpartum, she is probably not making enough milk. Oxytocin may be tried; however, if it is unsuccessful, the pups should be fostered or hand-raised [22].

Chinchillas will sometimes show postpartum septicemia. This is often acute and signs include hypothermia, recumbency, anorexia, fever, brownish uterine discharge, and a decrease in milk production. Although a specific infectious agent has not been identified, the syndrome apparently involves a uterine infection. These chinchillas need parenteral treatment with penicillin (or an alternative antibiotic), fluids, and other supportive care. Flushing the uterus with normal saline followed by infusion of an appropriate antibiotic is also useful [23].

8. Surgery

Pet rabbits should be spayed, as uterine neoplasia is common in intact female rabbits. Another problem we have commonly encountered is a ruptured uterine venous varicosity that causes serious blood loss. Ideally rabbits should be spayed early in life (4–6 mo of age is

ideal). Neutering rabbits decreases aggression and territoriality. A concurrent spay is recommended for animals that are undergoing C-sections.

The following are helpful comments regarding surgery in rodents and rabbits [24]. Minimize blood loss. Avoid excess sutures and tight sutures; although rabbits are noted for chewing out their sutures, if the sutures are placed evenly and gently, most rabbits will leave the incision alone. Even staples will be chewed out if there is excessive tension. Tissue glue is very useful in the thin-skinned animals. Keep the animals warm with warmed fluids, IV or IO or IP. Attempt to intubate once, maybe twice, especially rabbits, but give up quickly if you are not successful. Use accurate syringes for the small doses you will be giving or reduce concentrations to facilitate delivery of the correct amount. Get the animals eating as soon as possible (postoperative analgesia is paramount, especially for rabbits and guinea pigs).

In my opinion, buprenorphine is one of the best pain relievers for rodents and rabbits, with relatively prolonged duration of action (8–12 h). Flunixin works well in rabbits, whereas carprofen and meloxicam are good for home medication. Using local anesthetics injected subcutaneously along incision lines can be useful as well.

All rodents and rabbits have open inguinal rings. In the literature, there is ample warnings giving rearing postoperative inguinal herniation. Neuters can be performed using an open technique; the epididymal fat pad may reduce the incidence of inguinal herniation. Most practitioners seem to prefer a closed technique or a modified open technique where the tunica is included in the suture that is used to tie off the spermatic cord and vessels. Direct closure of the inguinal canal can be done as well, but be wary of excessive sutures leading to tissue reactions and sterile abscesses.

Vasectomies and ovariectomies are performed routinely in the laboratory animal world. I will not describe them here, but both procedures are commonly done in mice.

Rabbit spays are not much more difficult than kitten spays unless the rabbit is fat. Fat rabbits are susceptible to hepatic lipidosis when they are fasted. Fat accumulates in the uterine broad ligament, making it very difficult to locate vessels and the tissue very friable. If you are presented with a fat rabbit for spay, see if you can reduce its weight prior to performing surgery.

As the bladder is thin walled, it should be expressed carefully to avoid rupture. The uterine tubes are longer than in the dog or cat and the ovarian artery sits in the broad ligament a little more caudally than where you are

used to finding it (it does not extend from the ovary but from the infundibulum). The vaginal body is flaccid and will fill with urine when the rabbit micturates; if not tied off tightly at the cervix, urine leakage into the abdomen could result. Also, the caudal vesicular artery comes off the uterine artery to supply the bladder. This vessel must be avoided when tying off the base of the uterus. Suture placed just cranial to the cervix will lie securely and avoid the vesicular artery (and ureters). This may leave some residual uterine tissue that could lead to development of cancer later in life (fortunately, the source of ovarian steroids has also been removed). Tissue caudal to the cervix is more difficult to tie securely [25].

9. Cystic ovaries

Many older animals (hamsters, gerbils, guinea pigs) that are intact will develop cystic or neoplastic ovaries. In these cases, the abdomen will be distended and enlarged ovaries are palpable. Guinea pigs develop a symmetrical alopecia and progressive hairloss which will respond to HCG (1000 U once every 7 d for 1–3 wk) when they have cystic ovaries or ovarian neoplasia. However, the ovarian cancer itself does not respond to HCG and carries more severe symptoms than the cystic ovary. On ultrasonography, cystic ovaries will be manifest as round hypoechoic areas, whereas ovarian neoplasia is characterized by a relatively more solid, mixed echodensity. Guinea pig abdomens generally have fairly poor radiological contrast due to a lack of intra-abdominal fat [26].

10. Conclusion

As practitioners, we might tend to group all small rodents and rabbits together into a single category. However, as veterinarians, we know and value the diversity of the animals that we work on. The objective of this paper was to describe similarities and differences among rodents and rabbits (with some comparisons to cats and dogs). Fortunately, there are many good resources available to the practitioner who wishes to further enhance their knowledge of these species.

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