

# An Incidence of Pseudopregnancy Associated with the Social Enrichment of Rabbits (*Oryctolagus cuniculi*)

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Here we describe a case of pseudopregnancy in a New Zealand White rabbit as a result of pair housing with an aggressive conspecific. Clinical signs included fur pulling and nest building that developed shortly after separation from the aggressor. An ovariectomy was performed, and histopathologic findings support the diagnosis of pseudopregnancy. When introducing adult female rabbits to pair housing, stable pairs may be difficult to achieve because of the dominance-associated behavior that can occur as hierarchical relationships are formed. Does that are pair-housed after puberty should be monitored for aggressive behavior.

Although pseudopregnancy does not occur frequently in the laboratory animal setting, its frequency was reported to be as high as 23% in a commercial rabbit breeding facility where does were group-housed.<sup>10</sup> Pseudopregnancy in rabbits can result from a sterile mating, an injection of luteinizing hormone, or from the stimulation caused when one doe mounts another,<sup>4</sup> given that rabbits are induced ovulators. In a normal estrus cycle, the corpus luteum regresses if the doe is unsuccessful in conceiving. However, with pseudopregnancy, the corpus luteum persists and continues to release progesterone, the hormone responsible for the maintenance of pregnancy. Pseudopregnancy in rabbits generally lasts 16 to 18 d, and the continual secretion of progesterone causes physical and behavioral changes consistent with a normal pregnancy.<sup>4</sup> Under this hormonal influence, the uterus and mammary glands start to enlarge in preparation for gestation and lactation. The pseudopregnant doe frequently engages in maternal behaviors and often pulls hair from her body to build a nest.<sup>4,6</sup>

Rabbits are naturally social animals. However, incompatible pairs may experience increased aggressive behavior and stress. Aggression is prevalent in group-housed male rabbits due to their territorial behavior.<sup>7</sup> Similar behavior is not uncommon in newly group-housed female rabbits that are unfamiliar with each other.<sup>1–3</sup> In the current report, we describe a mature New Zealand White rabbit that developed pseudopregnancy after being pair-housed with an incompatible conspecific that began to exhibit signs of aggression after being pair-housed for 2.5 mo.

## Case Report

The rabbits were housed and cared for in compliance with the *Guide for the Care and Use of Laboratory Animals*<sup>8</sup> in an AAALAC-accredited program. All procedures involving animal care and use were approved by the IACUC at the University of Tennessee.

Four intact female New Zealand White rabbits (age, 2 y; average weight, 3 kg) were purchased from a commercial source (Harlan Laboratories, Oxford, MI) and singly housed in standard caging (Ken Kage, Wheeling, IL). Vendor surveillance reports were negative for rabbit hemorrhagic disease virus, myxomatosis, rotavirus, *Bordetella bronchiseptica*, cilia-associated respiratory bacillus, *Clostridium piliforme*, *Corynebacterium kutscheri*, dermatophytes, *Helicobacter bilis*, *Helicobacter hepaticus*, other *Helicobacter* spp., *Klebsiella oxytoca*, *Pasteurella multocida*, *Pseudomonas aeruginosa*, *Salmonella* spp., *Streptococcus pneumoniae*, *Streptococcus* spp., *Toxoplasma* spp., *Treponema cuniculi*, ectoparasites, endoparasites, enteric protozoa, and *Encephalitozoon cuniculi*. Rabbits were maintained on a 12:12-h light:dark cycle and received commercial diet (Harlan Teklad Diets, Madison, WI), papaya tables (Oxbow Animal Health, Murdock, NE), timothy hay (Oxbow Animal Health, Murdock, NE), and free-choice tap water. Each rabbit was uniquely identified by an ear tattoo.

For the first 2 y at our institution, these rabbits were singly housed and had little physical contact with their conspecifics. Rabbits were provided with manipulanda, including metal rattles, pineapple rings, and jingle balls (Bio-Serv, Flemington, NJ). Toys and treats were rotated weekly. New caging (Lenderking Caging Products, Millersville, MD) was introduced into the facility to address cage-height recommendations in the *Guide* and to facilitate pair housing. The new caging consisted of double-wide cages that accommodated pair housing after the removal of a clear center partition. In addition, a solid-bottom, molded-plastic kiddie pool (diameter, 2.4 m; wall height, 30 cm) was used in the secondary housing area to serve as a novel space for rabbits to play in and explore. Cell-Sorb Plus (Fangman Specialties, Cincinnati, OH) was used as bedding material, and a 61 × 46 cm PVC tunnel was used as a shelter. Introduction to pair housing was gradual, to acclimate rabbits to increased activity and to establish relationships between rabbits. Rabbits were limited to 30 min of contact daily for the first 2 wk and were monitored for aggression. Aggression was defined as chasing, biting, attacking, circling, threatening, or nudging. When excessive aggression was noted, the aggressor was removed and replaced with a different rabbit, and the incompatibility was

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noted in the medical record. The partition dividing each pair of rabbits was clear, with perforations to allow sensory contact with the pairmate during periods of single housing. Once the introductory period was completed successfully, a pair was identified as compatible and allowed to be pair-housed both in the cage and in the kiddie pool.

Approximately 2.5 mo after the implementation of pair housing, the animal care staff noticed mild abrasions and fur missing over the dorsum of the neck of one of the rabbits. Due to the location of the missing fur, these lesions were suspected to be the result of dominance-associated mounting behavior exhibited by the conspecific. The rabbits were separated, and the injured rabbit was treated with a topical antiseptic (VetOne, Boise, ID) for 7 d. Two weeks later, the rabbit began to show signs of stress, including tachypnea, diarrhea, and inappetance. In addition, the rabbit was seen digging at the cage floor, pulling hair, and nest building (Figure 1), resulting in patchy areas of hair loss on the back of neck, ventral neck, and ventrocaudal abdomen. Hemorrhagic discharge from the urogenital area was noted as well. Differential diagnosis included pseudopregnancy, neoplasia, endometriosis, mucometria, endometritis, cystitis, and bladder stones. The decision was made to perform an ovariectomy, and the rabbit was transported to the University of Tennessee Veterinary Medical Center for surgery. Abdominal radiographs performed prior to surgery showed a mildly enlarged uterus and uterine horns. The uterus and ovaries were processed for histopathologic examination. The results indicated mild chronic cystic endometrial hyperplasia (Figure 2), edema, and bilateral corpora lutea consistent with pseudopregnancy.

## Discussion

Laboratory rabbits have been housed individually to aid in their identification and to minimize disease spread and transmission. Rabbits that are singly housed lack the psychological stimulation, socialization, and exercise that pair or group housing can afford. The *Guide* states that “appropriate social interactions among members of the same species (conspecifics) are essential to normal development and wellbeing.”<sup>8</sup> Pair housing of rabbits in double-sized cages can potentially improve welfare by providing both increased space and social interactions that are unpredictable and novel.<sup>5</sup> One potential result of this unpredictability is injurious aggression and pseudopregnancy, as described in the current report. Establishing dominance hierarchies is a normal behavior in adult female rabbits.<sup>1,2</sup> In one study, aggression was mitigated by reducing sudden changes in social structure.<sup>3</sup> In addition, establishing social groups at weaning might reduce aggression in paired female rabbits.<sup>5</sup>

Pseudopregnancy may resolve spontaneously but often recurs. Chronic pseudopregnancy can cause complications including endometritis, pyometra, hydrometra, and mastitis.<sup>9</sup> The affected rabbit was 4 y old at the time of the event, and because the procedure would not interfere with study plans, an ovariectomy was considered to be the best means to eliminate these risk factors.

When planning a change from individual to pair housing of rabbits, it is essential to consider sex, age, breed, housing, husbandry, and experimental design. Stable pairs of adult rabbits may be difficult to achieve if they have not been pair-housed previously. In addition, when introducing adult does to pair housing, they should be monitored for aggressive behavior.



Figure 1. Rabbit exhibiting nesting behavior due to pseudopregnancy.

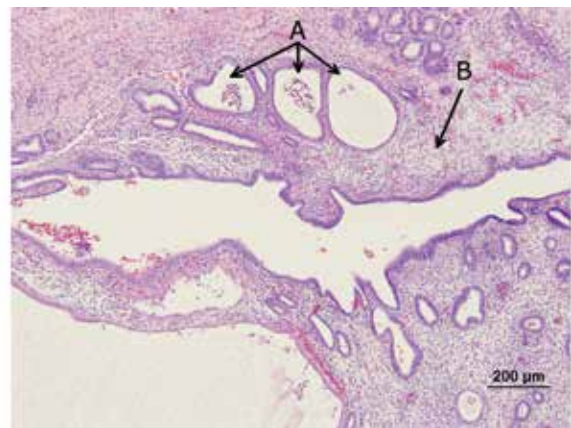


Figure 2. Uterine histology showing cysts (A) and endometrial hyperplasia (B). Bar, 200  $\mu$ m.

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