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Glandular Complex in the Perineal Sac of the Guinea Pig

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ABSTRACT

Pungent sebum, which accumulates in the perineal sac of the adult male guinea pig, was thought to be a product of compound saccular sebaceous glands imbedded in flattened, oval structures called perineal glands. However, similar clusters of sebaceous glands were found in two lateral bands in the walls of the perineal sac and in a dorsal band located in the roof of the sac. Ducts of all these glands open directly on the walls of the perineal sac, or in the case of perineal glands, into the pockets of this sac. In the adult female guinea pig, the perineal sac walls contain considerable amounts of adipose tissue and the perineal glands are smaller in size when compared with the male. Sebaceous glands situated in other locations of the perineal sac are reduced in size or completely missing. Very little sebum was found in the perineal sac of the female. Long-term castration of adult male guinea pigs resulted in partial replacement of compound sebaceous glands in the perineal sac with adipose tissue, while simple branched sebaceous glands in the dorsal band were only reduced in size. In newborn guinea pigs, all sebaceous glands of the perineal sacs were associated with hair follicles. Secretions from all these glands probably contribute to chemical communication among guinea pigs.

INTRODUCTION

In guinea pigs, the perineal sac of the male opens as a longitudinal slit between scrotal pouches, while the smaller and shallower perineal sac of the female opens transversely between the vagina and anus (Cooper and Schiller, 1975) . Perineal glands of the guinea pig, regarded as odoriferous glands (Berüter et al., 1974), are situated caudo-laterally on each side in the walls of the perineal sac, close to the anus (Fig.1). These glands form discrete bodies and are larger and more active in males than in females (Grosz, 1904; Martan and Shepherd, 1987) and their ducts, lined with stratified squamous keratinizing epithelium, lead into the pockets which open by slits into the perineal sac (Schaffer, 1940; Martan and Shepherd, 1987).

Perineal glands of the guinea pig were discovered by Grosz in 1904 and were called perineal or anal glands by a succession of investigators. The earlier literature was reviewed by Schaffer (1940). In more recent behavioral studies, only Rood (1972) called them anal glands. We call these glands perineal because they are located between the genital and anal openings and they secrete into the perineal sac. In our previous studies

(1987), the number of ducts belonging to perineal glands were probably overestimated because we failed to observe that ducts of other groups of compound sebaceous glands open in the wall of the perineal sac. In the present study, five to six main ducts were observed which lead to pockets in the walls of the perineal sacs.

Histologically, perineal glands are aggregates of compound sebaceous glands with a holocrine type of secretion. Their product in male guinea pigs is strongly pungent sebum which accumulates inside the perineal sac. In females, tiny amounts of secretion appear in the perineal sac, and it is odorless to humans (Martan and Shepherd, 1987).

In an unpublished study, perineal glands and those parts of the perineal sac walls containing pockets were removed from five 15-day-old males. We hypothesized that at maturity, the lack of secretion and its odor would render operated animals unrecognizable males by intact guinea pigs. To our surprise, the perineal sacs of all 5 males in their adulthood contained pungent secretion, and intact guinea pigs treated them as males. Observations on the dissected perineal sacs from these 5 males are included in the present report.

MATERIALS AND METHODS

Guinea pigs, strain SR/Siuz (McGlinn et al., 1976), used in this experiment were from an inbred colony maintained in the Department of Zoology at Southern Illinois University at Carbondale. Animals are fed laboratory chow supplemented with cabbage and carrots. In addition, grass was provided during the summer months and hay during the winter. The guinea pigs were maintained on a 14 hr/10 hr, light/dark schedule.

After killing the animals by overdose with intraperitoneal injections of sodium pentobarbital, perineal sacs and adjacent perineal glands were dissected from 5 intact adult males, 5 adult females, 6 newborn males, and 6 newborn females for histological examination. Perineal sacs were also removed from 5 adult males which had been castrated for periods ranging from 2 to 8 months, and from 5 males whose perineal glands were removed at 15 days of age.

Perineal sacs were fixed in Baker's formol and cut in cross or sagittal sections 15 μm thick. Every third section was mounted and stained with Mallory's aniline blue-orange G.

RESULTS

In the walls of the perineal sac in adult male guinea pigs, besides a pair of perineal glands with ducts opening into the pockets of the sac, other aggregations of free sebaceous glands were found. The latter formed two lateral bands which stretch anteriorly to meet at the anterior end of the sac (Fig. 1). Histologically, compound sebaceous glands in the lateral bands are similar to those described in perineal glands (Martan and Shepherd, 1987), even showing few hair follicles among the branching ducts. Ducts of all glands had a stratified squamous epithelium continuous with the epidermis of the perineal sac on which surface they opened. Even the smallest branches of the main ducts showed some cornification. Sebaceous secretory units of perineal glands may be continuous with those located caudally in the lateral bands, or may be separated by narrow strips of connective tissue.

Another band of smaller simple branched sebaceous glands is located dorsally on the anterior half of the perineal sac (Fig. 1). Ducts of these glands, lined with keratinizing stratified squamous epithelium open into the roof of the perineal sac. In these glands, hair follicles were not observed. In addition, masses of well-developed simple sebaceous glands associated with hair follicles were found around the rim of the perineal sac.

Five males whose perineal glands were removed at 15 days of age showed no regeneration of these glands. However, other sebaceous glands of the perineal sac were as well developed as in normal males. All 5 males had an abundance of pungent secretion in their perineal sacs.

In guinea pig females, the discrete structures called perineal glands were mostly adipose tissue in which one or two small compound sebaceous glands were embedded as reported by Martan and Shepherd, 1987. Ducts of these glands opened into the pockets in the walls of the perineal sac. Aggregations of sebaceous glands in the lateral and dorsal bands as described for males were absent.

Beauchamp (1974) has reported that the perineal glands of males decrease in size following castration. In the present study, the reduction in size of the glands was accompanied by replacement of sebaceous saccules with adipose tissue (Fig. 2). Although saccules were replaced by fat, some ducts remained. A similar replacement by adipose tissue appeared in the compound sebaceous glands in the lateral bands. In castrated males, glands located in the dorsal band (Fig. 1) and those associated with hair follicles on the rim of the perineal sac were not replaced by fat but were much smaller than their counterparts in normal males. The amount of fatty tissue in the walls of the perineal sacs and the amount of secretion in the perineal sac varied among castrates. The eight-month castrate had the largest amount of adipose tissue, and the perineal sac was completely devoid of secretion. In the two-month castrates, smaller amounts of adipose tissue were observed in the perineal sac glands, and a modest amount of secretion remained in the sac.

In newborn guinea pigs of both sexes, sebaceous saccules of the perineal glands were associated with hair follicles. These glands, larger in males (Fig. 3) than in females, displayed branching ducts and well-developed saccules. However, only the glands of males showed secretory activity. In contrast to adult females, perineal glands of newborn females were not surrounded by adipose tissue. All other glands of the glandular complex in both sexes were not developed.

DISCUSSION

The marked differences in size and development found in all glandular components of the perineal sac between the two sexes suggest an influence by testicular hormones on these glands. This contention is supported by the larger size and greater secretory activity of glands in males and their diminished size and secretory activity in the castrated males. Our results are in agreement with those of Beauchamp (1974), who reported regression of the perineal gland following castration in males. Similar sexual dimorphism in the supracaudal gland of the guinea pig was observed by Martan (1962). However, there seems to be a variation in hormonal response among different glandular components of the perineal sac, best seen in newborn animals. Sebaceous units forming young perineal glands and located closest to the pockets in the perineal sac walls were either more sensitive to testicular hormones and had developed into compound glands before the birth of the animal, or they did not require hormones for their development. In newborn males, but not in females, these glands already have shown some secretory activity. The less responsive sebaceous glands in the remainder of the perineal sac may require a higher level of testicular hormone to be affected the same way. In the female, the perineal glands do not grow much beyond the size at birth, while other glandular components of the female perineal sac remain undeveloped. These observations may be related to androgen level.

The glandular components of the perineal sacs of males varied in response following gonadectomy. While the size and secretory activity of all sebaceous glands were affected by castration, only aggregations of histologically-similar compound glands located in the perineal glands and caudal portions of the lateral bands showed replacement by adipose tissue. These glands are the largest and the most numerous in the perineal sac glandular complex, probably producing the great majority of sebum accumulated inside the sac. Variation in responsiveness to hormonal withdrawal of some sebaceous glands in the guinea pig was previously reported by Martan and Price (1967).

We suggest that secretions of the whole glandular complex of the perineal sac in the guinea pig function in chemical communication. Perineal glands are only a part, though a significant part, of that complex. Our proposal is supported by the following facts. A considerable amount of secreted sebum was found inside perineal sacs of 5 adult males from which perineal glands were removed at 15 days of age. Intact guinea pig males and females recognized operated males as if they were intact males. Berüter et al. (1974), in their chemical analysis of sebum from perineal glands, were probably testing secretions from all glandular components of the perineal sac. These secretions may function in territorial marking as adults draw their perineum across the ground. This behavior, called perineal drag, was observed and described by Kunkel and Kunkel (1964); Beauchamp et al. (1971); Rood (1972); Beauchamp (1974); and Berüter et al. (1974), and according to these authors is more common in males than in females. They also reported that dominant males marked their territory more frequently than submissive ones.

We realize that our proposal involves speculation, and that chemical analyses of secretions from sebaceous glands discussed in this paper and further behavioral testing may confirm or refute what has been proposed.

SUMMARY

Aggregations of sebaceous glands in various locations in the perineal sacs of the guinea pig probably function as odoriferous glands. Their development and secretory activity differ according to sex and age of the animal.

For complete development of the glandular complex within the perineal sac of the adult male guinea pig testicular hormones appear to be necessary. Size and secretory activity of all sebaceous glands in the perineal sac are affected by castration, but only the largest sebaceous units present in perineal glands and lateral bands are replaced by adipose tissue.

Sebaceous units located closest to the two pockets in the perineal sac walls do not seem to require testicular hormones for their maintenance. These units are well developed in newborn guinea pigs of both sexes and are the only compound sebaceous units found in the adult female perineal glands. Sebaceous glands in the lateral and dorsal bands are

missing in newborn males and their development seems to require testicular hormone. This variation in development and secretory activity among the glandular components of the perineal sac in the guinea pig may be responsible for the qualitative differences between the sexes in the secretory products.

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Fig. 1. Dissected perineal sacs from adult guinea pig males, ventral view (a) and dorsal view (b) turned around. Longitudinal slit, ls; perineal gland, pg; lateral glands, lg; and dorsal glands, dg.

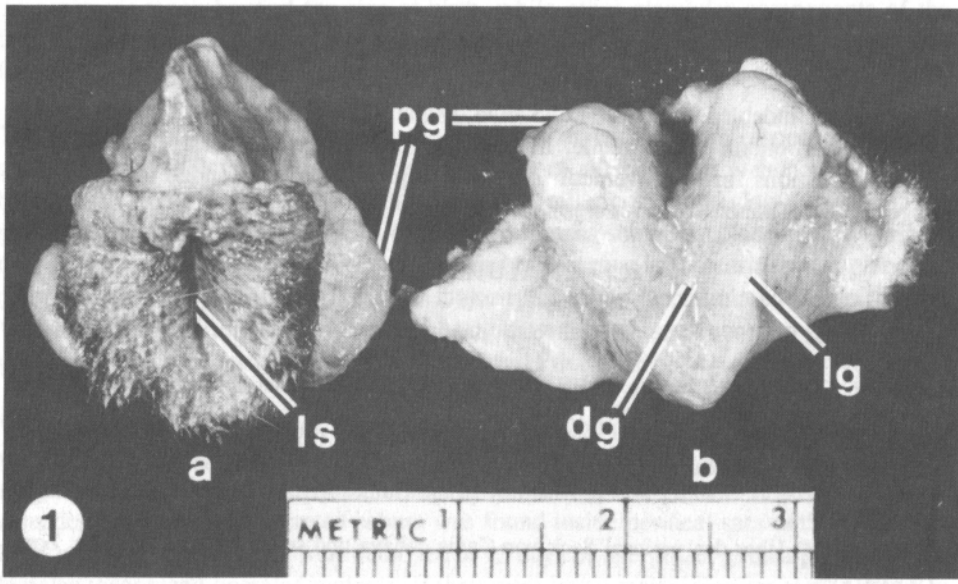

Fig. 2. Replacement of sebaceous saccules by adipose tissue (at) in the perineal gland of an adult male guinea pig, castrated for 8 months: Ducts, d; hair follicle, hf; X51.

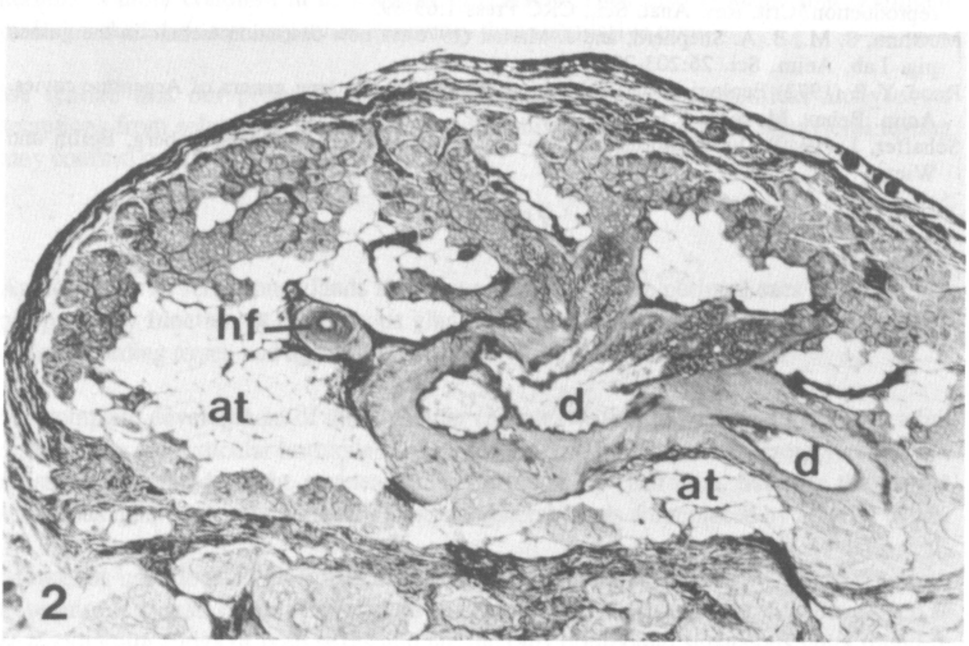

Fig. 3. Cross-section of the perineal gland in a newborn male guinea pig: Hair follicle, hf; perineal sac pocket, sp; and duct, d. X51.