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## **PATHOLOGY OF THE FEMALE REPRODUCTIVE TRACT IN THE KOALA, *Phascolarctos cinereus* (GOLDFUSS), FROM VICTORIA, AUSTRALIA**

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**Abstract:** Lesions occurred in the female genital tract of 10 of 16 (63%) koalas, *Phascolarctos cinereus*, examined in Victoria. Inflammation of the uterine horns was seen in all 10 affected koalas; six of these had vaginitis and eight also had salpingitis. Cystic dilation of the ovarian bursa, occasionally with hydrosalpinx, was seen in six koalas with concurrent inflammatory lesions of the lower tract. Cystic lesions were considered to have developed as chronic sequelae to previous inflammation in the ovarian bursa. Lesions were not found in the ovaries. Lesions in the urinary tract lesions were noted in four koalas with genital tract pathology. The significance of these findings in relation to the reproductive success of the koala population on Phillip Island is discussed.

### **INTRODUCTION**

Abnormalities of the female reproductive tract of the koala have long been recognized. An apparent predisposition to an unspecified cystic ovarian condition was referred to by MacKenzie.<sup>1</sup> Pratt<sup>1</sup> considered the high prevalence of such cystic conditions in the female's upper genital tract a potential threat to the survival of koalas in Queensland. Both Backhouse and Bolliger<sup>1</sup> and Finckh and Bolliger<sup>2</sup> found a 74% prevalence of genital tract lesions amongst females in the Sydney region. The most common lesion they described were cystic structures associated with the fallopian tubes and ovaries.

The pathological findings in the female genital tract of koalas in Victoria, Australia are presented in this paper. The cystic genital tract lesion is given particular attention in an attempt to determine its pathogenesis. Correlations between the pathological findings and

the fertility of the population on Phillip Island are also discussed.

### **MATERIALS AND METHODS**

Between November, 1975 and April, 1980, a total of 16 female koalas was examined at necropsy. The koalas were received for examination with permission from the Victorian Division of Fisheries and Wildlife, Ministry for Conservation. All the animals were assessed as independent mature adults. Nine came from Phillip Island, four from the You Yangs — Brisbane ranges area, with individual specimens from Walkerville, Mt. Macedon and Pental Island. The majority of animals were submitted alive with a history of recent road trauma or external signs of illness (blindness, lameness, emaciation, or 'wet-tail'). These animals were euthanised only after a clinical examination indicated a poor prognosis for recovery.

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Genital tracts were examined during routine necropsy. Affected tracts were removed and examined with the aid of a dissection microscope. All reproductive tracts were fixed in 10% formol-saline, embedded in paraffin, sectioned at 5  $\mu$ m and stained with haematoxylin and eosin. Vaginae were fixed unopened and hence results are given for microscopic examination only. Selected genital tracts were sampled for bacteriological isolation using routine aerobic culture methods.

## RESULTS

### GROSS FINDINGS

At necropsy, gross abnormalities of the genital tract were noted in 10 female koalas; eight were from Phillip Island, one from Pental Island and one from Mt. Macedon. The pathological findings encountered in these 10 animals are summarized in table 1.

**Uterine Horns.** Enlargement of one or both of the uterine horns was noted in eight koalas. Frequently this caused considerable asymmetry in the appearance of the tract. In cases with unilateral enlargement of the uterus, the ovarian bursa on the same side was cystic. The wall of affected uterine horns appeared thicker than normal with accumulations of purulent material in the lumen. In genital tracts with evidence of mucopurulent cervical discharge, the uterine horns contained smaller quantities of purulent material. Inspissated casts of necrotic debris were seen in the uterine lumen of two animals. Bilateral enlargement of both uterine horns and fallopian tubes were seen in a further two females with closed cervixes.

**Fallopian tubes and ovarian bursae.** Fluid-filled cystic structures in association with the upper genital tract were located in the paralumbar region of six koalas. A single unilateral cyst was recorded in five animals while bilateral cysts were seen in only one individual.

The cysts were spherical to ovoid in shape but varied considerably in size. The largest cyst measured 6 cm by 8 cm and the smallest, 1.5 cm in diameter. Each cyst was a fluid-filled distension of the normal peritoneal bursa that envelopes the ovary and the fimbriated end of the fallopian tube. In normal ovarian bursae, a peritoneal opening was found in the dorso-medial aspect of the bursa. No similar opening was located in cystic bursae. In three cases the bursal dilatation was continuous with a fluid-filled distension of the upper third of the fallopian tube. Extensive fibrous adhesions between the cystic bursa, the adjacent uterine horn and the overlying urinary bladder were noted in three cases with cystic ovarian bursae.

The wall and inner lining of cystic bursae were grossly similar to those of normal ovarian bursae. Numerous fibrous tags, occasionally forming thick trabecular strands, were commonly seen traversing the interior of cystic bursae. Polypous out-growths of tissue were seen at the points of attachment between the ovary and the bursal wall, both in normal and cystic bursae. In cystic bursae, however, these out-growths were larger and often pedunculated.

The cyst fluid varied in both colour and consistency. In four cases it was a straw-coloured liquid or viscous gel, however, in the unilateral cystic bursae of two koalas it was red-brown and turbid. In two koalas with a unilateral cystic ovarian bursa, the other ovarian bursa appeared normal externally. However, small quantities of floccular turbid fluid with numerous fibrous adhesions between the opposing sides of the bursal wall were found in these undistended bursae.

**Ovaries.** The ovaries in both cystic and normal ovarian bursae appeared normal, although those within the cystic bursae were generally smaller and flattened into the wall of the bursae. All ovaries showed some evidence of cyclic activity in the form of one or more of the following structures: fluid-filled follicles,

TABLE 1. List of genital tract pathology depicting the presence or absence of lesions in various parts of the genital tract. The presence or absence of urinary tract pathology is also shown.

Case	Origin	Vaginal inflammation		Inflammation of uterine horns		Inflammation of fallopian tubes		Cystic ovarian bursae		Urinary tract inflammation	
		Left	Right	Left	Right	Left	Right	Left	Right	Left	Right
1.	Philip Island	+	-	+	-	+	+	+	-	-	-
2.	"	-	+	+	+	-	-	+	+	-	+
3.	"	-	+	+	+	+	-	-	-	-	+
4.	"	+	+	+	+	+	-	+	-	-	-
5.	"	+	+	+	+	+	-	+	-	-	+
6.	"	+	+	+	+	+	-	+	-	-	+
7.	"	-	+	+	+	+	+	-	-	-	-
8.	"	-	+	+	+	+	+	-	-	-	-
9.	Pental Island	+	+	+	+	+	N.E.	-	+	+	-
10.	Mt. Macedon	+	+	+	+	-	+	-	-	-	-
Prevalence		$\frac{6}{10}$		$\frac{10}{10}$		$\frac{8}{10}$		$\frac{6}{10}$		$\frac{4}{10}$	

N.E. — Not examined.

corpora lutea, c. haemorrhagica and c. albicans.

#### MICROSCOPIC FINDINGS

Microscopic lesions were recorded in the reproductive tracts in each of 10 koalas with gross abnormalities.

**Lateral vaginae and uterine horns.** Mild vaginitis associated with the presence of neutrophils in the lateral vaginae was seen in six koalas. Superficial mucosal erosions and focal accumulations of neutrophils within the vaginal epithelium were seen in five of these cases.

Endometritis or pyometritis was diagnosed in the uterine horns of 10 koalas. In all but one animal, both uterine horns were affected. The endometrial inflammatory reaction consisted of focal mucosal erosions, submucosal lymphocytic and plasma cell accumulations, as well as infiltrations of neutrophils and macrophages within uterine glands. Focal cystic dilatation of the uterine glands was also noted in 3 of the 6 koalas with endometritis.

Active pyometritis was diagnosed in two koalas. There was generalized inflammation of the uterine wall with extensive inflammatory cell infiltrates and mucosal ulceration. Haemorrhage into the uterine lumen, necrosis of the uterine wall and large accumulations of intra-uterine pus were recorded in these cases. In two other koalas, the uterus contained mineralized purulent material, however, the mucosa was intact with little evidence of inflammation of the uterine wall.

**Fallopian tubes and ovarian bursae.** Salpingitis was recorded in 8 of 10 koalas with uterine inflammation and 3 of 6 with cystic ovarian bursae. Hydrosalpinx accompanied bursal dilatation in three koalas. The inflammatory reaction in the fallopian tubes consisted of accumulations of plasma cells, lymphocytes and macrophages in

the submucosa with polymorphs and macrophages present in the lumen. In one koala with a unilateral cystic ovarian bursa and ipsilateral endometritis the middle third of the fallopian tube was obliterated. Extensive fibro-granulomatous reactions in the submucosa and loss of ductal epithelium accompanied this lesion.

Cystic distension of the ovarian bursa was recorded in six koalas. Histologically, the lining of both normal and cystic bursae was similar. The bursae were lined by flattened serosal cells. At the point of attachment of the ovary to the bursal wall, the lining changed abruptly to a tall columnar epithelium which then continued over the ovarian pedicle and ovary. In several cystic and normal bursae, this ovarian lining epithelium formed extensive hyperplastic proliferations in the region of the ovarian pedicle. This tissue was arranged in papillated and tubulo-acinar arrays, often forming large polypous aggregations. The epithelial cells within these arrays were uniform and supported on an adequate connective tissue stroma. No evidence of dysplasia or anaplasia was observed in these cells.

In two undistended bursae, polymorphonuclear cells and extensive fibrous adhesions were found in the space between the ovary and the bursal wall.

**Ovary.** The ovaries in both cystic and normal bursae contained graafian follicles, developing follicles, recently ruptured follicles containing blood clots, corpora lutea and fibrous remnants of degenerate corpora lutea. No abnormalities were recorded in the ovaries from either cystic or normal bursae.

**Other related pathological findings.** Intercurrent urinary tract inflammation was found in one female with pyometritis and salpingitis and in three females with pyometritis, salpingitis and cystic ovarian bursae. The gross and histopathological findings in the urinary

tract were consistent with an ascending infection characterized by cystitis, ureteritis and pyelonephritis.

### BACTERIOLOGY

Bacterial cultures from the uterine horns of cases of active pyometritis yielded pure isolates of non-haemolytic *Escherichia coli* in one case, and alpha-haemolytic *Streptococcus* sp. in the other. Bacteria were not isolated from cystic ovarian bursal lesions, although non-haemolytic *E. coli* were recovered from the fallopian tubes and ovarian bursae of the two cases in which the bursae contained pus and fibrous tags.

### DISCUSSION

The results of this study indicate that lesions in the female genital tract are common, particularly amongst the koalas of Phillip Island. However, the significance of these findings cannot be considered without some understanding of the normal anatomy of the genital tract in female koalas.

MacKenzie<sup>3</sup> has demonstrated that the tract is didelphic, consisting of two uterine horns with associated cervixes that open separately into the vaginal *cul-de-sac* region. Each uterine horn has a short convoluted fallopian tube. Each ovary, along with the fimbriated extremity of the fallopian tube, is contained within a bursa formed by a thin fold of peritoneum. The peritoneal ostium is located in the wall of the bursa, yet the exteriorization of the ovary and fimbriae through this orifice is often difficult.<sup>3</sup> Finckh and Bolliger<sup>2</sup> have proposed that the predisposition to cystic conditions involving the ovarian bursae and fallopian tubes in koalas may be related to this particular arrangement of the ovary contained within the bursa.

In this study, although the peritoneal opening was evident in several undistended bursae, no such orifice was found in cystic bursae. In addition, the presence of fibrous tags within several

distended ovarian bursae, associated with focal adhesive peritonitis of areas adjacent to the bursae suggested past episodes of inflammation. These adhesions in and about the bursa were thought to cause obliteration of the peritoneal ostium and thereby predispose to fluid retention within the bursa. Inflammation of the uterine horn and fallopian tube on the same side as the cystic ovarian bursa was seen in 3 of 6 koalas; in another two koalas the presence of suppuration and fibrous adhesions within the ovarian bursae was accompanied by generalized genital tract inflammation. In the light of these findings, it is proposed that the cystic dilatation of the ovarian bursae represents a chronic sequel of an ascending inflammation of the genital tract.

No cases of serous cystadenomata are reported in this study, however, hyperplasia of the ovarian lining epithelium is described from both cystic and normal bursae. The close resemblance between the condition reported here and the histopathological description of ovarian serous cystadenomata given by Finckh and Bolliger<sup>2</sup> suggests that a reassessment of this lesion in koalas is required.

The high prevalence of genital tract pathology in female koalas from Phillip Island is consistent with their recognized poor reproductive success (Martin, Pers. Comm.). Although the ovaries showed evidence of normal follicular and luteal activity, the tubular genitalia were sufficiently altered by inflammatory processes to prevent these tissues from functioning normally. The occurrence of both urinary and genital tract pathology in four Phillip Island koalas is probably significant. The close anatomical association of the external opening of both these tracts within the urogenital sinus may predispose to ascending urogenital tract inflammation.

The pathology and bacteriology data suggests that bacteria may be important in the development of the observed

genital tract lesions. Until a large number of normal and inflamed genitalia are cultured, the significance of these bacteriology findings remains obscure. The factors predisposing to the establishment of these inflammatory lesions in the tubular genitalia are also unknown.

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