MACROMORPHOMETRIC STUDY ON PARANAL SINUSES IN A BROWN BEAR (*URSUS ARCTOS*)

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**Summary**


The aim of the study was to establish the macromorphometric parameters of paranal sinuses and their projections onto the skin in a brown bear. It is shown that the brown bear’s paranal sinuses were similar to those of domestic dogs, and also located between the external and internal sphincters. Data about the colour, texture and amount of the organ’s secretion are provided. According to the present study, the brown bear possessed well developed paranal sinuses.

**Key words**: anatomy, brown bear, morphometry, paranal sinus

The Veterinary Anatomical Nomenclature defines anal sacs (*Sinus paranalis; SP*) as a lateral cutaneous pouch between *Canalis analis* and *M. sphincter ani externus* and as a cutaneous sac, opening with excretory duct into the anus, containing a fatty gray secretion with an unpleasant odour (Frewein & Vollmerhaus, 1994). Many authors have conducted detailed morphological and histochemical studies of the paranal sinuses in dogs (Coquot *et al.*, 1933; Nielsen, 1953; Baker, 1962; Getty, 1975) and cats (Greer & Colhoun, 1966).

The malodorous paranal sinus fluid is composed of the secretory products of the apocrine paranal sinus glands and the sebaceous glands of the excretory duct (Frewein & Vollmerhaus, 1994).

Few studies have investigated the paranal sinus secretion in brown bears. Pocock (1921) found greatly reduced anal sacs in the American black bear – *Ursus americanus* (Hall, 1981), but did not find them in the brown bear – *Ursus arctos* (Linnaeus, 1758). Rossell *et al.* (2011) affirm that the brown bear has anal sacs, whereas Dyce *et al.* (1987) stated that they do not exist in bears. Rossell *et al.* (2011) also suggested that brown bears might use anal gland secretion for long-lasting olfactory communication, as do the giant panda (Yuan *et al.*, 2004).

The literature data on the topography and morphology of the paranal sinuses in the brown bear are very scarce. Therefore, the aim of the study was to establish the projections of paranal sinuses onto the anal region skin, and their weight and macromorphometric parameters in a brown bear.
The paranal sinuses of a sexually mature female brown bear aged 28 years and weighing 180 kg were studied. The animal died after an intoxication, and was referred for necropsy in the Department of General and Clinical Pathology at the Faculty of Veterinary Medicine Stara Zagora from the zoo in Pleven.

The paranal sinuses were removed, and the residues of muscle and adipose tissues were thoroughly cleaned. Their weight was determined on analytical electronic scale (AE ADAM, AQT-200 with 0.01 g precision).

The macrometric parameters of the bear’s paranal sinus were determined with a graphing paper and caliper gauge, measuring the length, width and circumference of each sinus. The paranal sinus diameter and the diameter of its lumen were measured by means of castings made of dental impression material (STOMAFLEX PASTA, Spofa Dental, Czech Republic) according to the modified method of Vodenicharov et al. (1990). For this purpose, the paste was mixed with equal amount of xylene (1:1) to obtain a solution with a suitable viscosity. One drop of hardener (catalyst) was added to every millilitre of the paste. After the addition of hardener paranal sinuses were rapidly filled with a syringe whose needle was inserted into their excretory duct.

The projections of the two paranal sinuses covered by the external anal sphincter were identified on the anal region skin (Fig. 1 and 2) by imaginary lines.

For this purpose, the body's median line (Linea mediana – LMn) ventral to the anus was used as a landmark (Fig. 2). At various distances parallel to LMn, another two lines were drawn: a medial line

Fig. 1. Paranal sinuses (SP) located between the anal canal and musculus sphincter ani externus (MSAE). Distance (arrow) between the epidermis of Zona cutanea and the caudal part of the sinus. A – anus. Bar = 1 cm.
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(Linea medialis – LM) and a lateral line (Linea lateralis – LL). The ventral edges of LM and LL were defined from the ventral edge of LMn, which coincided with the ventral boundary of the organ and positioned at different distances from the anus. The dorsal edge of LL reached the level of the opening of the paranal sinus excretory duct, while the dorsal edge of LM was situated relatively to Linea anocutanea (LA) at a distance equal to the distance between the opening of the organ’s excretory duct and LA. The medial line determined the medial boundary of the sinuses and the lateral line – the lateral boundary of the sinus, covered by the external anal sphincter. The ventral line (Linea ventralis – LV), which connected the ventral ends of medial and lateral lines determined the ventral boundary of sinus. The dorsal line (Linea dorsalis – LD) was imaged by a refracted line connecting the dorsal ends of medial and lateral lines and passing through the opening of sinus excretory ducts. It denoted the dorsal boundary of the organ.

The projection of the paranal sinus longitudinal axis was presented by the line joining the opening of the organ’s excretory duct with a point bisecting the line that determined the ventral margin of the sinuses.

Also, the distance between the epidermis of the Zona cutanea (ZC) of the anal canal and the caudal part of the sinus, and the distance between the ZC epidermis and the cranial part of the organ were measured (Table 1).

The weight and some morphometric parameters of the paranal sinuses are presented in Table 2.

The inner surface of the sinus wall was gray and had many folds (Fig. 3). The outer surface of the organ was smooth and gray. The paranal sinus secretion was thick, paste-like, finely granular and with an unpleasant odour. The colour of the secretion was yellow-gray. The amount of the left paranal sinus secretion was 6 mL and that of the right one – 6.46 mL.
Our results confirmed convincingly the presence of paranal sinuses in brown bears and supported the findings of Rossell et al. (2011) who affirmed the presence of anal sacs in this species based on data from the colour and composition of the anal gland secretion. We however believe that the term “anal gland secretion” is not appropriate and suggest using paranal sinus secretion instead.

Therefore, the claims of Dyce et al. (1987) that the bear does not possess paranal sinus are not exact. This study provided convincing evidence that the brown bear paranal sinuses are similar to those of domestic dogs. They are located between the external and internal sphincter muscles and help the excretion of intestinal contents. It was found out that the ventral, dorsal and lateral parts of the sinus wall as well as the cranial quarter of the medial wall were covered by the external anal sphincter.

Our results about the consistence and colour of the paranal sinus secretion support the investigation of Rossell et al. (2011). In this report, we provide information about the amount of this secretion in the bear for the first time. It was also demonstrated that although the size of the sinus in the brown bear was almost identical to that of the dog, the amount of secretion (about 6 mL) in the bear was significantly greater than the respective

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**Table 1.** Some morphometric parameters related to the topography of the paranal sinus and its excretory duct in a 28-year-old female brown bear (body weight 180 kg)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Paranal sinuses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>left</td>
</tr>
<tr>
<td>Distance between LM and LMn (mm)</td>
<td>10.9</td>
</tr>
<tr>
<td>Distance between LL and LMn (mm)</td>
<td>24.7</td>
</tr>
<tr>
<td>Distance between the anus and the bottom of sinus (mm)</td>
<td>20.2</td>
</tr>
<tr>
<td>Distance between the excretory duct opening and LA (mm)</td>
<td>1.9</td>
</tr>
<tr>
<td>Distance between both excretory duct openings (mm)</td>
<td>26.3</td>
</tr>
<tr>
<td>Distance between the ZC epidermis and the caudal part of the sinus (mm)</td>
<td>7.6</td>
</tr>
<tr>
<td>Distance between the ZC epidermis of and the cranial part of the sinus (mm)</td>
<td>30.2</td>
</tr>
</tbody>
</table>

LM – Linea mediana; LA – Linea anocutanea; ZC – Zona cutanea of the anal canal.

**Table 2.** Weight and some morphometric parameters of the paranal sinus and its excretory duct in a 28-year-old female brown bear (body weight 180 kg)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Paranal sinuses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>left</td>
</tr>
<tr>
<td>Weight (g)</td>
<td>1.89</td>
</tr>
<tr>
<td>Diameter of the lumen (mm)</td>
<td>27.7</td>
</tr>
<tr>
<td>Length (mm)</td>
<td>35.3</td>
</tr>
<tr>
<td>Circumference (mm)</td>
<td>78.9</td>
</tr>
<tr>
<td>Diameter (mm)</td>
<td>29.6</td>
</tr>
<tr>
<td>Excretory duct length (mm)</td>
<td>6.1</td>
</tr>
</tbody>
</table>

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In conclusion, the present morphologic study revealed that the brown bear possessed a well developed paired paranal sinus similar to that in the dog.

REFERENCES


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Paper received 12.09.2011; accepted for publication 11.11.2011

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