Anatomy and Forensic Medicine Departments  
Faculty of Veterinary Medicine, Cairo University, Giza/Egypt

Sinus Paranasalis of the Egyptian Buffalo,  
Bos (Bubalus) bubalis L.  

By  
M. S. El Din Moustafa and Sh. H. Kamel

With 4 figures

(Received for publication September 28, 1970)

Introduction  
The buffalo occupies an important role in meat and milk production and,  
therefore, increasing research is being carried out on the anatomy and histo-  
logy of its different systems. In 1966, Kamel and Moustafa gave a detailed  
description of the skull of the buffalo compared with that of the cow. In the  
present paper the authors have added new information about the paranasal  
sinuses of this animal.

Material and Methods  
This work is based on the examination of twenty fresh heads of adult  
buffaloes obtained from Cairo slaughterhouse. The sinuses were dissected  
after removal of muscles, blood vessels, nerves etc., as well as the periosteal  
coverings of the bones. Para-median sections of some specimens were made for  
convenience of examination.

Results and Discussion  
To facilitate their description, the paranasal sinuses of the buffalo can be  
grouped according to their position into two groups, dorsal and ventral. The  
former includes the frontal, the dorsal turbinate, ethmoidal and lacrimal  
sinuses. The ventral group contains the maxillary, palatine and sphenoidal  
sinuses.

The dorsal group  
1. Sinus frontalis (frontal sinus)  
This is the largest of the paranasal sinuses. It occupies the whole extent of  
the frontal and parietal bones and extends in the supraoccipitalis up to the  
level of the nuchal line. A complete bony septum separates both sinuses on  
either side.
The sinus is roughly triangular, extending to a level of a transverse line taken between the anterior limits of the orbital rim. In a macerated skull this line is represented by the naso-frontal suture of both sides. Aborally, it extends to the nuchal line. The frontal suture together with the septum marks the medial limits of the sinus. Laterally, the sinus extends to about an inch medial to the orbital rim in the middle of its anterior third and into the cornual process of the frontal bone, in the caudal third its lateral limit is 1—2 cm. lateral to the parietal crest. The supra-orbital canal (Fig. 1 No. 1) is short in the buffalo and does not pass into the frontal sinus, in contrast to that of the ox (Sisson and Grossman, 1958). The sinus as in the ox is divided into two unequal compartments. The smaller (Fig. 1 No. 2) lies in the median plane, occupying a level between the middle of the orbital rims and the anterior extremities of the cornual process and limited medially by the frontal suture. It is triangular in shape with its base facing caudally. It is not divided into diverticulae, but opens by a small rounded orifice of about 0.5 cm. diameter into the summit of the maxillary sinus. This orifice is found in the most anterior part of the floor of this compartment.

The other compartment is very large and encircles the minor compartment on all sides. It is divided by bony septa extending from the roof to the floor of the sinus, dividing the compartment into communicating diverticulae through large orifices. These diverticulae fall into three groups according to their position in the skull. The post-orbital diverticulum (Fig. 1 No. 3) is situated medial and caudal to the orbit, extending from just in front of the extreme anterior end of the orbital margin and occupying the space between the orbital cavity and the small compartment. It extends caudally to the anterior extremity of the root of the cornual process and communicates orally with the turbinate sinus by a small rounded orifice (about 0.5—1 cm. diam.) situated on a level with the anterior end of the orbital margin. Aborally, the diverticulum communicates with the sinus by a large crescentic orifice measuring
about 2.5 cm. in width which is on a level with the anterior border of the root of the cornual process. The cornual diverticulum (Fig. 1 No. 4) occupies the cornual process of the frontal bone and extends inside the horn core to an extent which varies greatly from one animal to another. The extension of the cornual diverticulum inside the horn core has no relation to sex, age or size. The nuchal diverticulum (Fig. 1 No. 5) is the largest of all diverticulae of the frontal sinus and occupies nearly all the caudal half of the sinus. It extends into the parietal bone, the interparietal and the supra-occipital part of the occipital bone. It extends ventrally to a level beyond the nuchal crest by about 1—1.5 cm. It communicates orally with the frontal sinus by a large orifice which is irregularly rounded and measures about 3 cm. in its greatest width.

The floor of these diverticulae is very irregular owing to the projection of various ridges and septa. The major compartment communicates with the nasal cavity by a small oval orifice about 0.5 cm. in length situated at the floor of the extreme anterior end of the post-orbital diverticulum. This orifice opens into the nasal cavity just lateral to the great ethmo-turbinate bone.

2. Sinus concha nasalis dorsalis (dorsal turbinate sinus)

The dorsal turbinate sinus (Fig. 2 No. 1) occupies the cavity of the caudal half of the dorsal turbinate bone and has a lanceolate form. Its maximum height is at a level with the anterior extremity of the great ethmoidal cell at the bifurcation of the middle meatus nasi (Fig. 4 No. 3). It communicates with the frontal sinus (anterior part) by a large oval orifice on the lateral wall of this sinus. This orifice measures about 2—2.5 cm. and is also partially closed in the fresh state by a thin layer of mucous membrane. The orifice is situated in the caudal part of this sinus and on a level with the fronto-nasal articulation and so it communicates indirectly with the nasal cavity through the frontal sinus.

![Fig. 2. Para-median section of buffalo skull. 1 — Sinus concha nasalis dorsalis, partially opened; 2 — Sinus palatinus (transverse ridge); 3 — Palatine canal](image)

3. Sinus ethmoidalis (ethmoidal sinus)

This sinus occupies the cavity of the second ethmo-turbinate and has an irregular pyramidal form. The base is caudally situated while the apex is at the bifurcation of the middle meatus nasi. Its cavity is simple and is not
divided by bony septa. The sinus communicates with the nasal cavity through an oval orifice (0.5 cm. in diam.) at its extreme posterior end. This orifice is closed in the fresh state by a delicate mucous membrane and opens into an ethmoidal meatus between the great and second ethmoidal cells.

4. Sinus opercularis (ethmoid sinus)

This sinus is within the ethmoid bone and can be considered as the dorsal extension of the maxillary sinus since it is in free communication with the latter. Its lateral wall is formed by the facial part of the lacrimal bone, while its medial wall is bounded by the lamina lateralis of the lateral mass of the ethmoid bone and the caudal fourth of the dorsal turbinate bone. Its caudal wall is formed by the orbital part of the lacrimal bone. It is irregularly triangular in shape, with its base at the orbital cavity. It communicates freely ventrally with the maxillary sinus and so indirectly with the nasal cavity. The sinus is not divided by ridges and the osseous naso-lacrimal duct traverses its extreme lateral side, being connected to its lateral wall.

The ventral group

1. Sinus maxillaris (maxillary sinus)

The maxillary sinus (Fig. 3 No. 1) occupies the greater part of the maxillary bone. Its lateral wall is formed by the facial plate of the maxillary and malar bones. Its medial wall is formed partly by the nasal plate of the maxillary bone and partly by the basal lamina of the ventral turbinate. This wall is incomplete since the sinus communicates freely by a long slit-like,
articulation with the supra-orbital process, while in the temporal branch it extends to its terminal end in the middle of the zygomatic arch. This backward extension of the sinus into the malar bone is not observed in the ox (Chauveau, 1891; Nickel et al., 1954 and Sisson and Grossman, 1958). The anterior limit of the sinus is found on a level with the second upper molar, about 2.5 cm. behind the infra-orbital foramen. Its dorsal limit can be taken as a line extending from the infra-orbital foramen to the medial canthus in the living animal and the lacrimo-zygomatic articulation in the dried skull. The ventral limit of the sinus is 1—2 cm. above the alveolar border, on a level with the third or fourth upper molar. On a level with the sixth upper molar the ventral limit of the sinus above the alveolar border becomes about 4 cm. The floor of the sinus shows low ridges between the roots of the upper molar teeth from the second to the last.

The sinus is triangular in shape, with its base directed caudally and apex cranially behind the infra-orbital foramen.

The sinus communicates with the nasal cavity indirectly through the palatine sinus with which it is in free communication over the infra-orbital canal. The length of this communication is about 8 cm.

2. *Sinus palatinus* (*palatine sinus*)

This sinus occupies the palatine process of the maxillary bone and the horizontal part of the palatine (Fig. 2 No. 3), both of which constitute its floor. It is larger than the maxillary sinus.

It is separated from the other side by a complete thin bony septum where it reaches the median plane. Its lateral wall is formed by the alveolar border of the maxillary bone.

The dorsal wall is incomplete and is formed by the nasal plate of the palatine process of the maxillary bone. In the dried skull this wall presents a large bony defect which is closed in the fresh state by a thick layer of mucous membrane.

The sinus extends anteriorly beyond the level of the first premolar tooth by about 2.5 cm. and behind the last upper molar by about 4.5—5 cm. It is irregularly rectangular in outline, being slightly narrow in front and behind. The cavity of the sinus shows on its lateral wall several ridges corresponding
to the roots of the upper molars. The sinus seems to be divided into two equal compartments by an incomplete transverse ridge (Fig. 2 and 4 No. 2) which lies exactly on the transverse palatine suture. The anterior compartment has no special feature while the posterior one is traversed by the palatine canal (Fig. 2 No. 3) which divides it into a small medial compartment extending upward in the anterior part of the perpendicular plate of the palatine bone and a large lateral compartment. The sinus communicates with the nasal cavity by a slit-like orifice about 1—1.5 cm. long, located at the caudal fourth of the middle nasal meatus (Fig. 4 No. 1).

3. Sinus sphenoidalis (sphenoidal sinus)

This sinus seemed to be absent in all the cases examined, with one exception, where it was found in the left half of the body of the pre-sphenoid bone, occupying the orbital wing of the sphenoid bone up to its articulation with the frontal bone, with the sinus of which it communicates by a small oval orifice (about 0.5 cm.), and closed in the fresh state by a layer of delicate mucous membrane.

Summary

Twenty heads of Egyptian buffaloes, Bos (Bubalus) bubalis L. were examined. A full anatomical description of the paranasal sinuses is given.

Zusammenfassung

Der Sinus paranasalis des Ägyptischen Büffels, Bos (Bubalus) bubalis L. 

Die Anatomie des Sinus paranasalis des Ägyptischen Büffels wird beschrieben.

Résumé

Sinus paranasal du buffle égyptien, Bos (Bubalus) bubalis L.

Nous avons examiné vingt têtes de buffles égyptiens, Bos (Bubalus) bubalis L. Nous donnons une description anatomique complète et détaillée des sinus paranasaux.

Resumen

Los senos paranasales del búfalo egipcio, Bos (Bubalus) bubalis L.

Se examinaron 20 cabezas de búfalos egipcios, Bos (Bubalus) bubalis L. Ofrece una descripción anatómica detallada de los senos paranasales.

References


Anschrift der Verfasser: Prof. Dr. Shokry H. Kamel, Head of Forensic Medicine Section, Faculty of Veterinary Medicine, Giza-Egypt.