

**Szent István University
Postgraduate School of Veterinary Science**

**Diagnostic and therapeutic possibilities
in the veterinary care of bats (Chiroptera)**

Brief version of the PhD thesis

By

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2008

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1. SUMMARY

There is an increasing demand on the veterinary care of sick and injured specimens of the endangered wildlife. In the course of the veterinary care of bats the small body size, the anatomical and physiological characteristics should be considered.

During our studies we examined 87 specimens of two species belonging to the Megachiroptera suborder and 124 specimens of 12 Microchiropteran species. The limited possibilities of the physical clinical examination emphasize the significance of the complementary imaging techniques. Among these diagnostic methods radiology (11 species, 96 specimens, 254 radiographs) proved to be extremely important in bats. Among complementary laboratory diagnostic methods gross pathology (7 species, 97 specimens) and histopathology (5 species, 29 specimens, 132 tissue samples) is quite often essential to obtain a definitive diagnosis. From the frequency of usage point of view is the cytological examination of fine-needle aspirations and smears (4 species, 7 specimens) plays a subordinate role among diagnostic tools however it is of outmost informative value.

Bats are the natural reservoirs of a lot of viruses. We studied rabies (3 species, 12 specimens), Adenovirus (4 species, 39 specimens) and Herpesvirus (4 species, 8 specimens) infections. We could demonstrate bat

rabies in a Serotine bat (*Eptesicus serotinus*), herpesvirosis in a Serotine bat and an Egyptian flying fox (*Rousettus aegyptiacus*).

Defining anaesthesia protocols in homeothermic and heterothermic bat species 74 specimens of 11 species were anaesthetised. For injectable anaesthesia the combination of ketamine plus medetomidine, for inhalation anaesthesia isoflurane proved to be as the best medication.

Preparing the thesis, 56 specimens of 11 species have been subject of complete orthopaedic examination. Injuries of the small metacarpal bones and finger phalanges were treated by simple external fixation (bandage, casting – 5 species, 9 specimens) that normally proved to be satisfactory. Intraosseal pinning had been applied on 15 specimens of 3 species. We suspect that the complete failure of the recovery in these cases due to the iatrogenic injury during the procedure of the “main” nutritive blood vessel in the intraosseal cavity (arteria centralis medullae osteum). Percutan fixateur externe (2 species, 4 specimens) proved to be the most successful and promising in the treatment of the fractures of long tubular bones, however the method should be improved to answer the challenges posed.

Examinations were carried out mainly at the Faculty of Veterinary Science, Szent István University and Budapest Zoo and Botanical Garden.

2. MATERIALS AND METHODS

Preparing the thesis between February 1995 and June 2003 examinations were carried out at the Szent Istvan University, Faculty of Veterinary Medicine, Department and Clinic of Internal Medicine, Outpatient Clinic, and between June 2003 and October 2007 at the Budapest Zoo and Botanical Garden. A lot of partner institutions were involved into the research with specific requests. The number of specimens examined and/or treated is shown in the **Table**.

Table Number of specimens examined and/or treated

species type of examination	Lyle flying fox (<i>P. lylei</i>)	Egyptian flying fox (<i>R. aegyptiacus</i>)	Lesser horseshoe bat (<i>Rh. hipposideros</i>)	Greater mouse-eared bat (<i>M. myotis</i>)	Bechstein's bat (<i>M. bechsteini</i>)	Daubenton's bat (<i>M. daubentonii</i>)	Common pipistrelle (<i>P. pipistrellus</i>)	Nathusius' bat (<i>P. nathusii</i>)	Kuhl's bat (<i>P. kuhlii</i>)	Common noctule (<i>N. noctula</i>)	Leisler's bat (<i>N. leisleri</i>)	Serotine (<i>E. serotinus</i>)	Parti-coloured bat (<i>V. murinus</i>)	Gray long-eared bat (<i>P. austriacus</i>)	Σ
physical examination	9	78	1	8	1	1	3	3	1	62	1	35	5	4	211
radiography	5	16	-	6	1	1	2	2	-	40	-	19	3	1	96
ultrasonography	2	7	-	-	-	-	-	-	-	5	-	-	-	-	14
computed tomography	-	1	-	-	-	-	-	-	-	3	-	-	-	-	4
magnetic resonance imaging	-	1	-	-	-	-	-	-	-	3	-	-	-	-	4
blood examination	1	1	-	-	-	-	-	-	-	8	-	1	1	-	12
cytology	-	1	-	-	1	1	-	-	-	4	-	-	-	-	7
microbiology	2	57	-	-	-	-	-	-	-	6	-	-	1	-	66
virology															
rabies examination	-	-	-	-	-	-	1	-	-	3	-	8	-	-	12
Adenovirus PCR	1	36	-	-	-	-	-	-	-	1	-	1	-	-	39
Herpesvirus PCR	1	5	-	-	-	-	-	-	-	1	-	1	-	-	8
gross pathology	4	60	1	-	-	-	1	-	-	11	-	8	-	3	88
histopathology	1	18	1	-	-	-	-	-	-	5	-	4	-	-	29
electronmicroscopy	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
anaesthesiology	2	4	-	6	1	-	1	3	1	35	-	15	5	1	74
soft tissue surgery	-	1	-	2	-	-	-	-	-	2	-	1	-	-	6
orthopaedic examination and therapy	-	5	-	2	1	1	-	2	1	22	1	14	5	2	56

3. NEW SCIENTIFIC RESULTS

- We pointed out that radiography is the most important diagnostic method in the veterinary care of bats. It can not be omitted in the diagnosis of any alteration of the shoulder region covered heavily with muscles.
- We performed for the very first time contrast radiology to determine the food transit time in Common noctules (*Nyctalus noctula*) and pointed out that the emptying of the stomach starts immediately after feeding the contrast material and the appearing of it in the rectum can be expected at the 45. minute. We suppose that the process might be temperature dependent in heterotherm bat species.
- We proved for the very first time the occurrence of a typical tropical haemoparasite, a *Trypanosoma* sp. from the blood smear of a Common noctule (*Nyctalus noctula*) in Hungary. However, the presence of the protozoon did not seem to play any pathological role.
- We reported worldwide for the very first time on a secondarily calcificated retention cyst at the caudal end of the testicle (spermatocoele). The diagnosis was made by radiology, cytology and histopathology. The alteration was treated by closed castration which caused the compensatory hypertrophy in the contralateral testicle for a month.
- We reported for the very first time bat rabies in Hungary. The infected Serotine bat (*Eptesicus serotinus*) showed typical CNS signs and died 14 days after founding. The laboratory examinations confirmed the presence of a rabies-related virus distinct from the European sylvatic rabies virus (most probably European Bat Lyssavirus-1).

- We detected simultaneously with two research institutions from Berlin, Germany (Institut für Zoo- und Wildtierforschung, and Robert Koch Institut) a novel gammaherpesvirus in a Serotine bat (*Eptesicus serotinus*). The causative role of the detected virus in the fatal condition of the Serotine bat showing icterus could not be proven, but it is most likely that reactivation from a latent infection allowed the detection of the virus by nested PCR.

- We discovered a novel betaherpesvirus in an Egyptian flying fox (*Rousettus aegyptiacus*) with the same PCR assay.

- We empirically worked up anaesthesia and monitoring protocols for bats. For injectable anaesthesia ketamine alone (80-120 mg/bwkg), or in combination can be used. Ketamine (50 mg/bwkg) plus medetomidine (0.5 mg/bwkg) or ketamine (40-50 mg/bwkg) plus xylazine (2 mg/bwkg) or ketamine (100 mg/bwkg) plus diazepam (0.5 mg/bwkg) proved to cause a reliable anaesthetic level. For inhalative anaesthetic agent isoflurane proved to be satisfactory (induction 4,5-5 vol%, maintenance 1,8-2,5 vol%).

- The main nutritive vessel of the long tubular bones of Microchiropteran species runs not in the periosteum or endosteum but in the middle of the bone marrow cavity, which inevitably gets injured in the case of opened fracture. This arteria was never mentioned before in the literature, therefore we suggested the name *arteria centralis medullae osteum* which was reported to the Nomina Anatomica Veterinaria.

- The intraosseal pinning technique as one of the most commonly used osteosynthetic method hurts inevitably the *arteria centralis medullae osteum*, so this method should be reconsidered in microbats. Percutaneous fixateur externe as minimally invasive method proved to be the most successful for the treatment of the fractures of long tubular bones. It almost does not hurt the nutritive vessel and the postoperative rotation can be excluded. However, it is a time consuming and labour intensive technique.

4. THE AUTHOR'S PAPERS PUBLISHED CONCERNING THE THESIS

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5. ACKNOWLEDGEMENT

I would like to thank **Ferenc Felkai, Péter Sóttonyi, Károly Vörös, Gábor Csorba, Dóra Rigó, Botond Molnár, My Mum, Zoltán Molnár, Attila Beregi, Endre Sós, Mátyás Liptovszky, László Lehner, Tamás Verőczey, Máté Jánoska, György Barátossy, Mária Benkő, Balázs Czuppon, Zoltán Diószegi, Károly Erdélyi, Gábor FánCSI, Béla Fenyves, János Gál, Rita Garamvölgyi, Róbert Glávits, Balázs Harrach, Ákos Hornyák, Csaba Jakab, Bálint Kerekes, Zoltán Lajos, Ákos Lukáts, László Mezősi, Vilmos Pálfi, Nimród Pálmai, Edina Perge, Zsolt Petrási, Miklós Rusvai, András Szántó, Zoltán J. Széll, Péter Vajdovich, Beáta Bakos, Eyal Opher, Noémi Váradi, Éva Orbán, József Büki, Tímea Makrai, Edit Oláh, Éva Pádár, Józsefné Kampó, Eszter Lázár, Lászlóné Merl, Ágnes Ráczné Mészáros, Julianna Turák, János Perényi, András Székely, Luis Estuardo Rios (Guatemala), Susan Barnard (United States), Anette Liesegang (Switzerland), Krisztina Alexa, Anna Becsei, Nóra Biró, Noémi Papp, Vera Tari, Krisztina Szenes, Éva Fonád, Péter Estók, Tamás Görföl, Péter Paulovics and at last but not least Péter Rudas for their assistance with the clinical management of the cases, and the help in manuscript and thesis preparation.**