

## Lung hemorrhage in a green iguana (*Iguana iguana*) with chronic metabolic failure: a case report

V. JEKL<sup>1</sup>, R. HALOUZKA<sup>2</sup>, Z. KNOTKOVA<sup>1</sup>, G.M. DORRESTEIN<sup>3</sup>, Z. KNOTEK<sup>1</sup>

<sup>1</sup>Avian and Exotic Animal Clinic, <sup>2</sup>Institute of Pathological Morphology, Faculty of Veterinary Medicine, University of Veterinary and Pharmaceutical Sciences, Brno, Czech Republic

<sup>3</sup>Diagnostic Laboratory of the NOIVBD, Veldhoven, The Netherlands

**ABSTRACT:** A six year old male iguana (*Iguana iguana*) was brought to our clinic after a fall from a height of 1.5 meters. The patient showed apathy, dehydration, and paresis of all the limbs. Postural reflexes, palpebral reflex, and response to painful stimuli were minimal. The patient had extremely high levels of uric acid (1 734.0  $\mu\text{mol/l}$ ) and phosphorus (9.80 mmol/l), ratio of calcium to phosphorus (0.18), leucocytosis ( $23.3 \times 10^9/\text{l}$ ) with heterophilia ( $17.10 \times 10^9/\text{l}$ ), and high activity of ALT, AST and CK (2.09, 6.59, and 260.0  $\mu\text{kat/l}$ ). Tracheoscopy and pneumoscopy revealed presence of blood clots in the trachea and lungs with haemorrhage within the parenchyma. Based on the results of the clinical examination, endoscopy and laboratory diagnostics, the clinical diagnosis was chronic kidney failure, liver lipidosis and lung haemorrhage. Because of a very poor prognosis, the patient was euthanised. At necropsy, the signs of visceral gout and hepatomegaly with diffuse yellowish white discoloration and with dotted brown pigmentation were also observed. The kidneys were enlarged, and stained brown grayish. The gross and histopathological examination confirmed the clinical diagnosis of visceral gout, chronic kidney failure, liver steatosis and granulomatous pneumonia, with lung haemorrhage associated with urate deposits in lung tissue and posttraumatic status.

**Keywords:** renal disease; endoscopy; gout; trauma; liver lipidosis

Traumatic injuries of different extensity and intensity are common in green iguanas kept by private owners. The lesions are usually caused by inappropriate manipulation and poor terrarium construction and facilities, as well as by fights between animals (Knotek et al., 1999). Due to the anatomy and behaviour, superficial skin injuries and fractures of limbs and tail are frequently seen (Hernandez-Divers, 2001). However, traumatic injuries of internal organs are rather rare, and severe lung injuries are exceptional. Traumatic lung injuries and possible haemorrhage in reptiles are generally caused by inappropriate fixation or by other animals (Schumacher, 2003; Wellehan and Gunkel, 2004). The diagnosis of trauma can be evident from physical examination, radiography or endoscopy

(Rubel et al., 1991; Schumacher and Toal, 2001). Another cause of lung haemorrhage could be the calcification of soft tissues, urate depositions in lung tissue or lung vessels due to kidney failure.

This paper describes lung haemorrhage in a green iguana (*I. iguana*) associated with fall from a height, and urate deposition in lung tissue and vessels.

### MATERIAL AND METHODS

#### History

A six year old male green iguana (*I. iguana*) weighing 2.10 kg was brought to the clinic. This iguana was kept as a single animal in a terrarium

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(2.5 × 2 × 2 m, w × h × l) equipped with a source of UV light, and heated to the maximum temperature of 45°C underneath a bulb-heater. The photoperiod was 12 hours of light a day. Branches were placed in the terrarium and coconut fibre was used as substrate. A waterpool was positioned at the bottom of the terrarium and the water was changed once every two days.

The animal was fed once or twice a day, and the diet consisted of peas, green beans, alfalfa, dandelion leaves, and vitamin and mineral supplements (Vitamix-REP, Biofaktory, Czech Republic). The iguana had never been treated before. The only problem observed in the last 14 days was a low feed consumption. The reason for the visit to the clinic was the apathy and an unwillingness to move after a fall from a branch at a height of 1.5 meter.

### Haematology and plasma biochemistry

A heparinized blood sample (2 ml) was collected from the ventral coccygeal vein. A differentiation of the cells was done in a blood smear stained with May-Grunwald/Giemsa-Romanowski. The total numbers of red and white blood cells were counted manually using Natt-Herrick solution in Burker chamber, and a dilution of 1:100. Haematocrit was assessed using the microhaematocrit method by centrifugation of the sample for 6 minutes at 3 000 rpm. The haemoglobin concentration was evaluated by the classical cyanide-haemoglobin (haemoglobin-cyanide) method using a spectrophotometer (Unicam Helios Epsilon, Thermospectronic, USA). Biochemical analysis included the assessment of plasmatic concentration of total protein (TP), uric acid, glucose, activity of aspartataminotransferase (AST), alaninaminotransferase (ALT), alkaline phosphatase (AP), creatin kinase (CK), and the level of calcium and phosphorus using CobasMira (Roche) and Atomspec (Hilger 1550) automatic analysers.

### Radiography

For radiological examination of the patient, a dorsoventral projection by vertical beam and laterolateral view in sternal position by horizontal beam using Durolux (typ 397 6142011-C 211, Chirana, Czech Republic) was made.

### Endoscopy

The patient underwent an endoscopic examination of the trachea and lungs. Prior to the surgical intervention, the patient was administered antibiotics (enrofloxacin, Baytril 2.5% inj., Bayer AG, Germany, 15 mg/kg i.m.), rehydration solution (saline with 3% glucose, 20 ml/kg s.c.), vitamin K (Kanavit inj., Hoechst-Biotika, SR, 0.5 mg/kg s.c.) and B-vitamins with amino acids (Duphalyte inj. ad us.vet., Fort Dodge Veterinaria, Spain, 5 ml/kg s.c.). This examination was carried out in sternal position without sedation as the patient showed significant apathy. The tracheoscopy was followed by a laparoscopy with left-side access.

The patient was intubated and supplied with a gas mixture of oxygen with isoflurane (Isoflurane Rhodia, Torrexpharma GmbH, Vienna, Austria) and at a concentration of 1.5% and a flow rate of 100 ml/kg per minute. A half-open system with assisted patient ventilation was chosen. After ten minutes the patient was moved to a heat blanket set to 39°C. The isoflurane concentration was reduced to 1%. Rigid endoscopes were used for the patient examination (Hopkins Documentation Forward-Oblique Telescope 64018 BS, ø 2.7 mm, 18 cm, Karl Storz Tuttlingen; Oblique Telescope ø 4.0 mm, 30 cm, Wolf Tuttlingen) with protective canal (Examination Sheath 67065 CC) and xenon source of light (Xenon Nova 20131520, Karl Storz Tuttlingen). Electronic Endoflator (26 430520 Karl Storz Tuttlingen) was employed for coelom insufflation.

After the endoscopic examination, the patient was washed with oxygen for 15 minutes. Heart beat and blood oxygen saturation (SpO<sub>2</sub>) were monitored with pulse oximeter (V3301 Pulse Oximeter, SurgiVet, USA).

### Post-mortem examination

Because of the very poor prognosis, and after consultation of the owner, the animal was euthanised (T61, Intervet, The Netherlands) and a necropsy was performed. Cytological slides stained with May-Grunwald/Giemsa-Romanowski were prepared from liver, spleen and lungs and examined. Tissue samples from lungs, liver, spleen, kidneys, heart and testicle were fixed in 10% buffered formalin and routinely embedded in paraffin. Tissue sections 4–6 µ thick were stained with haematoxylin and eosin

(HE). Evaluation was performed in the Institute of Pathological Morphology, University of Veterinary and Pharmaceutical Sciences, Brno, Czech Republic and in the Department of Pathobiology, Utrecht University, The Netherlands.

## RESULTS

### Clinical examination

The patient showed significant apathy and tetraparesis of the limbs. Postural reflexes, palpebral reflex, and response to painful stimuli were minimal. Mild scoliosis and kyphosis were notified in the lumbar part of the backbone. The iguana was in a good nutritional state, and no external abnormalities were visible. The mucosa of the oral cavity and tongue were pale without erosions. A large blood clot was observed in the trachea, but airflow through the lumen was maintained, and there was no dyspnoea. Palpation of the abdominal region revealed that caudal part of the intestine contained

solid excrements and the urinary bladder was not distended. Two symmetrical oval masses protruding 2 cm over the pelvis were palpated in the caudal part of the pleuroperitoneal cavity. Suspected nephromegaly was confirmed by cloacal examination.

Results of the haematology and biochemistry are summarized in Table 1. The patient had severe leucocytosis with heterophilia, high activity of ALT, AST, CK, extremely high levels of uric acid and phosphorus, and low ratio of calcium to phosphorus (0.18).

The radiography revealed presence of a hemivertebra between third and fourth lumbar vertebrae. Lung field exhibited no radioopaque shading. The liver was slightly enlarged, and the colon was filled with large amount of radioopaque material with small amount of gas. The enlargement of the kidneys was not recognized on the radiographes.

Tracheoscopy, pneumoscopy and laparoscopy showed blood clots in the trachea and lungs (Figures 1 and 2). The laparoscopy demonstrated a lung trauma with small areas of haemorrhages

Table 1. Blood profile values for the green iguana

	Units	This case	Divers et al., 1996	Knotek et al., 1999; Pejrilova et al., 2004	Harr et al., 2001
Haemoglobin	g/l	72	67–122	92–94	67–122
PCV	l/l	0.44	0.25–0.35	0.32–0.36	0.29–0.47
RBC	$10^{12}/l$	1.3	1.0–1.9	0.88–1.02	1.0–1.8
WBC	$10^9/l$	23.3	3.0–10.0	11.8–15.5	8.0–25.2
Heterophils	$10^9/l$	17.21	0.35–5.2	2.3–5.12	0.6–6.4
Eosinophils	$10^9/l$	0	0.0–0.3	0.03–0.25	0.0–0.4
Basophils	$10^9/l$	0.5	0.0–0.5	0.33–0.76	0.1–1.2
Lymphocytes	$10^9/l$	3.7	0.5–5.5	8.4–9.0	5.0–17.2
Monocytes	$10^9/l$	1.9	0.0–1.8	0.2–0.6	0.2–2.7
Azuropils	$10^9/l$	0	–	0.39–0.93	–
TP	g/l	75.1	50–78	22.0–78.2	42–76
Glucose	mmol/l	5.7	–	8.3–16.5	–
AP	$\mu\text{kat}/l$	0.5	–	0.7–4.9	–
ALT	$\mu\text{kat}/l$	2.09	–	0–1.2	–
AST	$\mu\text{kat}/l$	6.59	0.08–0.87	0–1.6	0.12–1.70
CK	$\mu\text{kat}/l$	260	–	–	–
Uric acid	$\mu\text{mol}/l$	1 734	70–140	70.4–145.3	40–390
Ca	mmol/l	1.8	2.2–3.5	2.2–3.5	2.1–5.8
P	mmol/l	9.8	1.5–3	1.4–3.1	0.9–3

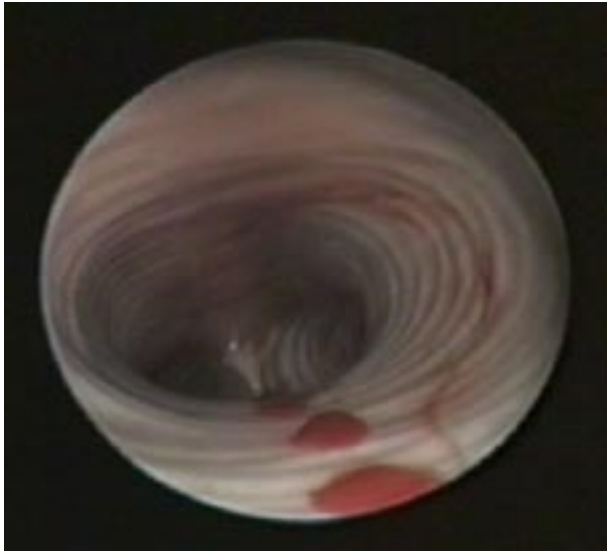


Figure 1. Tracheoscopy. A view of the bifurcation and blood drops

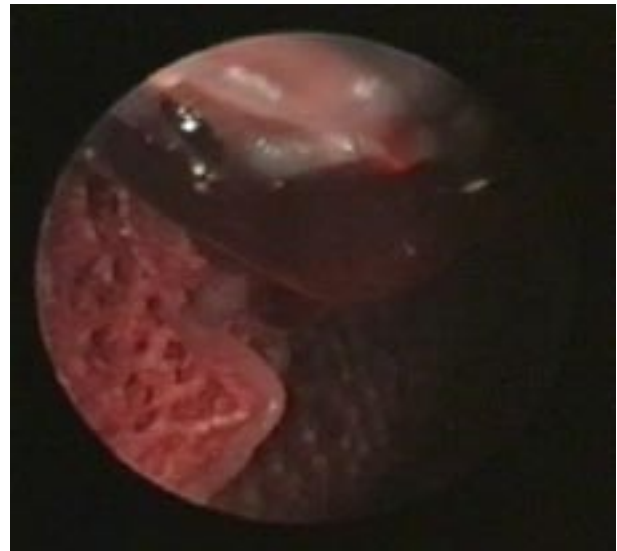


Figure 2. Pneumocopy. Blood drop in the lungs

within the parenchyma. The pleuroperitoneal cavity was free of exudates. A large amount of adipose tissue was found on the pleuroperitoneum and pericardium; fat bodies were very large. The enlarged liver was yellowish-white in colour, with brown dotted pigmentation. Under the capsule of the brown-red spleen were dark spots of 1 mm in diameter. The kidneys were enlarged, greyish-brown in colour, and without subcapsular urates.

Based on the above-described examinations, the diagnosis was made as a combination of metabolic failure and posttraumatic shock with lung haemorrhage. With regard to the patient's condition, an adverse prognosis was anticipated. Having consult-

ed the owner, we opted for intravenous euthanasia (T61, Intervet, The Netherlands) and carried out a pathomorphological examination.

At necropsy, the presence of blood clots in the trachea and lumen of the cranial lobes of both lungs was confirmed (Figures 3 and 4). Almost 30% of the ventral lung parenchyma was affected by hemorrhagic effusion. The pericardium was covered with a chalky coating. The oesophagus contained a small amount of blood clots. The cranial part of the stomach was filled with clotted blood, which was sharply separated from yellow-brown contents. There was no content in the small intestine and the colon was stuffed with a large amount of material.

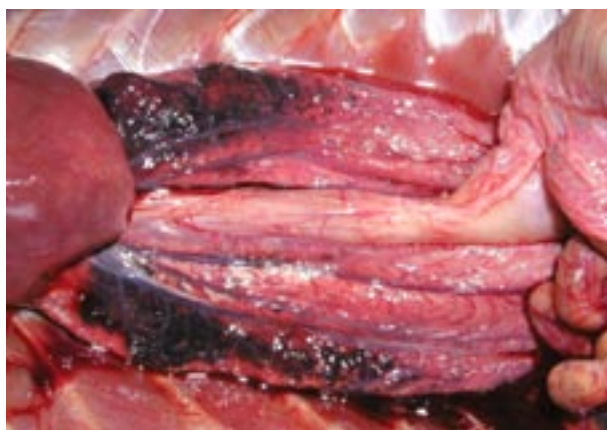


Figure 3. View of the caudal part of the heart and lungs *in situ*. See blood clots in cranial parts of lungs (necropsy)

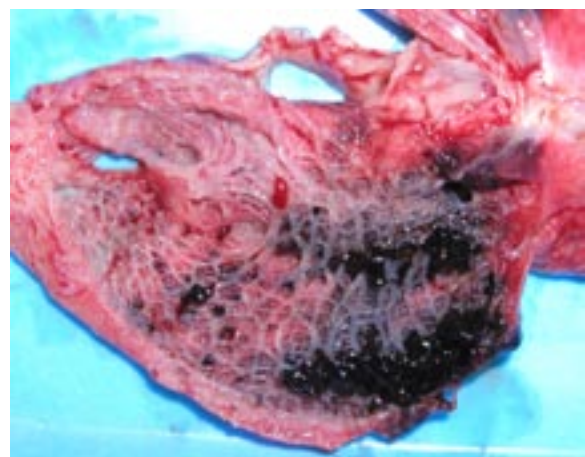


Figure 4. Intraluminal view the right lung (necropsy). See blood clots in cranial parts of lungs



Figure 5. View of the symmetric nephromegaly greyish-brown in colour (necropsy)

There were no erosions or other changes in the gastrointestinal mucosa.

The enlarged liver was yellow-white of colour, had rounded edges, and was of fragile consistency. The cytological examination of the liver confirmed presence of large vacuoles in the hepatocyte cytoplasm, and the nuclei were displaced to the cell membrane. The gall bladder was distended with green-yellow liquid. Petechial haemorrhages were found underneath the spleen capsule (spleen size  $4.5 \times 1.2$  cm). The kidneys were bilaterally symmetrically enlarged, of amber colour, and of a solid consistency (Figure 5). Homogenous parenchymal structure with no urate content in the parenchyma was visible in the tissue section.

On histopathological examination, urate deposits and extensive haemorrhages were found in some

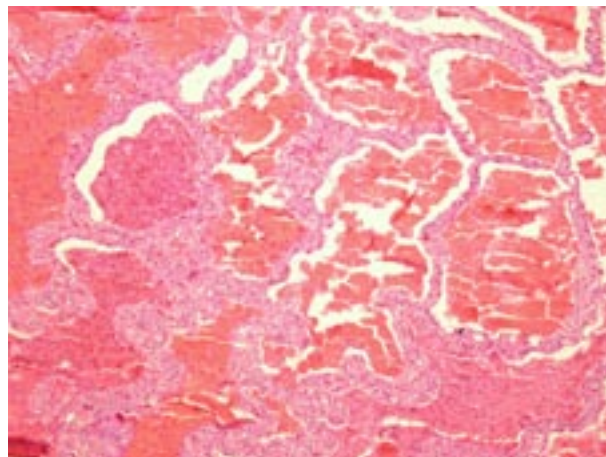


Figure 6. Lungs – hyperaemia, haemorrhage and lung oedema. (histology, 100×)

parts of the lung parenchyma, especially in areas of squamous metaplasia of the epithelium (Figure 6). There was also a granulomatous pneumonia with a number of rod-shaped bacteria inside the lesions. In the heart there were some small subepicardial round-nuclear infiltrates. Liver steatosis with “fatty necrosis” and dispersed melanocyte granulomas were seen (Figure 7). The main cell types in the spleen were a diffuse mixture of histiocytes, granulocytes, and erythrocytes with almost no lymphoid cells. Tubuli with a high epithelium and dilated collecting tubules containing amorphous eosinophilic material and fluid in the lumen were observed in the kidneys (Figure 8).

The final diagnosis was a metabolic failure – chronic kidney failure with visceral gout, extensive liver steatosis and lung haemorrhage.

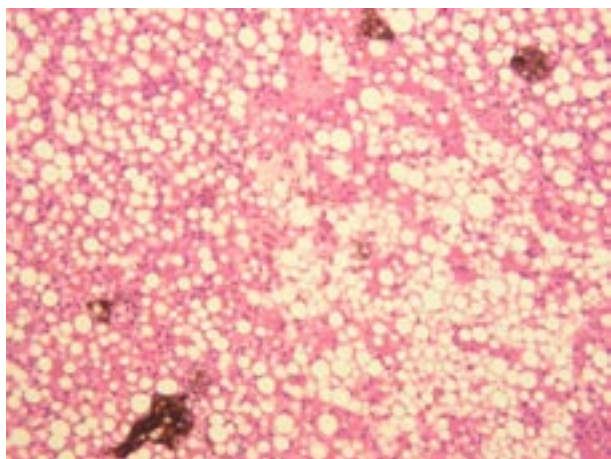


Figure 7. Liver steatosis, fatty necrosis and melanomacrophage proliferation (histology, 200×)

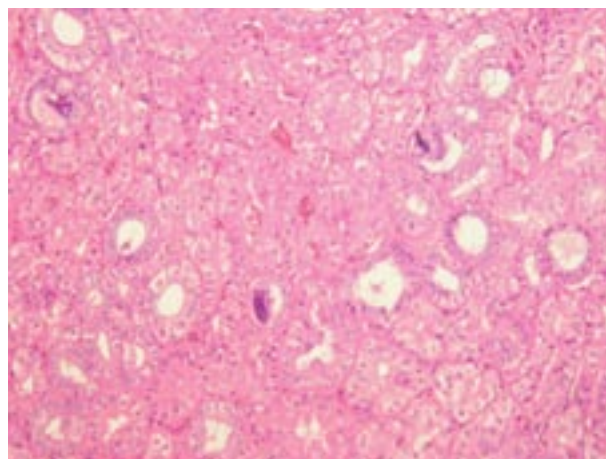


Figure 8. Mineralization of kidney tubules (histology, 200×)



## DISCUSSION

Apathy, lack of appetite, and an overall muscular weakness are common non-specific clinical symptoms of many diseases in lizards (Barten, 1996; Blahak, 2000). These symptoms are mostly a result of metabolic diseases (Zwart, 2001). Haematological and biochemical blood parameters give indirect diagnostics information in reptiles (Stein, 1996; Knotek et al. 2002; Wilkinson, 2004). In the green iguana, leucocytosis with heterophilia was found. A high number of heterophils in the blood indicates an acute inflammatory reaction, traumatic injuries of tissues, stress, bacterial or parasitic infections, neoplastic processes or acute kidney failure (Campbell, 1996; Redrobe and MacDonald, 1999; Hernandez-Divers, 2003). In this case, the heterophilia is a response to granulomatous pneumonia and kidney failure. The high plasma activity of AST and CK could be caused, in this case, by muscular tissue damage, which would be consistent with the anamnesis mentioning the fall from a height. AST alteration in reptiles was also observed in connection with kidney failure, due to presence of this enzyme in renal tubules (Hernandez-Divers, 2003).

Alterations of transaminase activity in reptilian blood can provide indirect information about acute processes in liver, bones, kidneys, or intestines. Interpretation of laboratory results, when dealing with chronic organ diseases, is complicated because a significant rise of enzyme activities were absent because depletion of the cells. Furthermore, elevation of phosphorus and uric acid, and altered ratio of calcium to phosphorus were reported in chronic nephropathies in reptiles (Campbell, 1996; Knotek et al., 2002). In our case the hyperuricaemia, a hyperphosphatemia as well as the low ratio of calcium to phosphorus (0.18) indicate failure of kidney function. Zwart (1992) argued that urates precipitate and visceral and articular gout develops when the uric acid level exceeds 1 457  $\mu\text{mol/l}$ .

For anaesthesia, isoflurane was used as it is considered to be the best choice for the patients with chronic metabolic disease (Bennet, 1991; Read, 2004). Because of the intrapulmonary haemorrhage, we used positive pressure ventilation, as described in dogs and cats (Paddleford, 1996).

A valuable diagnostic contribution is a direct endoscopic visualization of organs supplemented with biopsy of sample tissue for laboratory analyses (Divers, 1999; Hernandez-Divers, 2003; Wilkinson et al., 2004). Recent literature describes evaluation

of kidney function by scintigraphy and glomerular filtration rate (Greer et al., 2004; Hernandez-Divers et al., 2005).

In this case report, the endoscopic examination revealed extensive haemorrhages in the lungs. No dyspnoeic signs were recorded by this examination. It was an acute state, since the haematocrit and red blood cell count was still in normal levels. The treatment of an acute lung haemorrhage includes localization and compression of bleeding vessels, together with enabling patency of the airways (Briscoe and Syring, 2004). As a supportive treatment, an infusion of solutions with glucose and the administration of B vitamins and vitamin K are indicated (Wellehan and Gunkel, 2004).

At the time of the examination of the patient, the blood in the respiratory tract was already clotted. The expired blood was partially swallowed and found in the stomach. No haemorrhages into the peritoneal cavity were observed. The endoscopic examination of the pleuroperitoneal cavity demonstrated a bilateral nephromegaly and a severe liver steatosis. Liver and kidney diseases are frequently diagnosed in iguanas (Zwart, 1992; Mader, 1996). These diseases are often associated with both primary and secondary damage resulting in metabolic and systemic disorders (Knotek et al., 2002, 2003). Long-term inappropriate feeding and insufficient hygienic conditions are among most frequent causes mentioned by many authors.

The final diagnosis and assessment of the extent of the pathological changes were based on the post-mortem examination. The fall of the iguana in association with granulomatous pneumonia and urate deposits in lung tissue resulted in severe haemorrhages in the lungs. The visceral gout was diagnosed along with the liver steatosis and nephrosis. In this case overfeeding with protein and purine rich food, with a high content of phosphorus was the most likely primary cause of the chronic kidney failure and liver damage. Hemivertebra between third and fourth lumbar vertebrae was most probably a congenital problem.

Traumatic injury, based on owner information, was not the real cause of the disease. The clinical examination and overall health establishment of the patient based on blood analyses and particularly by direct visualization of affected organs with the endoscope enabled a prompt conclusion and an objective prognosis. The chronic kidney failure and the extensive liver damage resulted in the euthanasia of the patient.

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Corresponding Author:

MVDr. Vladimír Jekl, Ph.D., University of Veterinary and Pharmaceutical Sciences Brno, Faculty of Veterinary Medicine, Avian and Exotic Animal Clinic, Palackého 1–3, 612 42 Brno, Czech Republic  
Tel. +420 541 562 368, +420 732 615 647, e-mail: jeklv@vfu.cz

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