Scientific Report

Iron deficiency anemia and seizure in a kitten

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Summary

The aim of this article was to describe the clinical management of a case with seizure, possibly due to iron deficiency anaemia (IDA) in a kitten. A 38-day-old female European shorthair cat was presented with acute onset of impaired consciousness, seizures and lateralised upper motor neuron tetraparesis. Haematology results showed severe microcytic hypochromic anaemia with marked anisocytosis and thrombocytosis, while a low plasma iron concentration (<0.9 µmol/L) was the most remarkable biochemical alteration encountered. Iron deficiency anaemia was suspected and oral iron therapy was started together with supportive treatment. The cat responded to therapy and clinical signs started to improve on the second day and returned to normal eight days after referral to the clinic.

Key words: Cat, Iron deficiency anaemia, Seizure

Introduction

In cats, iron deficiency anaemia (IDA) has been well documented only in weanling kittens, in whom iron supplementation results in rapid resolution of the clinical and hematologic abnormalities. IDA is extremely rare in adult cats (Couto, 2009). IDA can occur in breastfeeding children as well (Collard, 2009) and it is characterized by microcytosis, hypochromasia and poorly regenerative anaemia. A few case reports note that seizure may also be induced by IDA in children (Daoud *et al*., 2002; Hartfield *et al*., 2009). Many different kinds of seizure etiology in cats have been published (Schriefl *et al*., 2008; Pakozdy *et al*., 2010) but, to the best of our knowledge, there have been no reports considering possible association between seizure and IDA in this species.

Case history

A 38-day-old female European shorthair cat with a body weight of 510 g was presented at the clinic because of weakness and two acute generalized seizures for 2 min. The seizure was witnessed by the referring veterinarian and did not respond to intravenous glucose bolus (1 ml 50% glucose). This cat had been exclusively fed on maternal milk. The other littermate was already being fed by commercial cat food in addition to maternal milk and was healthy. Neurological examination revealed non-ambulatory tetraparesis, sleepiness, blindness and confusion. Moreover, the cat showed head turn, proprioception was severely decreased in all four limbs while spinal reflexes were normal. The kitten was hospitalized and treated with constant rate infusion of a balanced electrolyte solution (Ringer's solution, Fresenius Kabi, Graz, Austria) (2 ml/h IV). During treatments, the cat showed generalized seizure without hypoglycaemia (11 mmol/L). The seizure was successfully treated with midazolam (Gespag, Linz, Austria) (0.1 mg IV) but severe tetraparesis, confusion and blindness

persisted.

While the results of initial biochemical profile were unremarkable (Table 1) the haematological results (Avia 2120i, Siemens, Austria-setting for cats) showed severe anaemia with microcytosis, anisocytosis, poikilocytosis (keratocytes, schistocytes), hypochromasia, moderate polychromasia and thrombocytosis (Fig. 1). Based on the history (feeding purely maternal milk), iron deficiency was suspected as the cause of anaemia and plasma was submitted for iron measurement. Serum iron concentration was determined using a colorimetric assay (Iron [kit # 197 07 04], Roche, Mannheim, Germany) with a chemistry analyser (Hitachi 911 Chemistry Analyser, Roche, Mannheim, Germany) and was lower than 0.9 µmol/l (which was the lower detection limit of the assay; reference range 12.5-37.5 µmol/L). Additionally, test for feline leukaemia virus (FeLV) antigen (FeLV Snap test, Idex Laboratory, Maine, USA), faecal examination for parasites and urinalysis were negative or unremarkable. Further treatments of the cat included administration of iron fumarate (Ferretab, Lannacher Heilmittel GmbH, Lannach, Austria) (50 mg PO) and vitamins B1, B2,

B6 and B12 (Multivit-B inj., Lannacher Heilmittel Ges.m.b.H, Lannach, Austria) (SC). The cat could eat with assistance and was fed by commercial food (Recovery, Royal Canine, Aimargues, France) (2-4 g 6-7 times per day).

On the next day, the kitten showed some neurological signs such as generalized ataxia and non-ambulatory tetraparesis, confusion and occasional decerebrate rigidity and blindness. The neurological status gradually improved and the kitten could stand for longer periods, tetraparesis ameliorated and some reaction to visual stimuli could be detected. Because leukocytosis was detected (Table 1), treatment with a combination of amoxicillin and clavulanic acid (Clavamox inj., Sandoz GmbH, Austria) was started (20 mg/kg, IV) and continued (Clavaseptin tab., Vetoquinol, Vienna, Austria) for five days (20 mg/kg/day, PO). On day 8, the cat was clinically normal, neurological deficits were absent, packed cell volume (PCV), serum iron concentration were normal (Table 1) and the cat was discharged from the hospital. The last hospital visit of the cat was on day 21, when the cat was still clinically normal and PCV was within reference limits. No problems were reported by the

Table 1: Neurological, haematological and biochemical results of a kitten showing acute neurological signs

Major neurological complains	Day 1	Day 3	Day 8	Reference interval
	Seizures, severe tetraparesis, severe confusion, blindness	Moderate tetraparesis, circling	None	
Packed cell volume (%)	10.6	12.7	37	25.5-28.7[**]
RBC (10^6/µl)	4.5	4.8		5.4-6.4[**]
Haemoglobin (g/dl)	3.8	4.0	12.6	8-9.2[**]
MCV (fl)	22.0	26.4		43-48.2[**]
MCH (pg)	8.4	8.3		13.7-16[**]
MCHC (g/dl)	37.8	31.5	34	30.7-33.1[**]
Thrombocyte (10^3/µl)	792	106		150-430[*]
Leukocyte (count/µl)	11620	28200		14700-20190[**]
Neutrophil (count/µl)	9412	25662		6270-12870[**]
Lymphocyte (count/µl)	1394	1692		4870-7950[**]
Monocyte (count/µl)	581	564		0-900[*]
Eosinophil (count/µl)	232	282		970-1970[**]
Creatinine (mg/dl)	0.2			0.9-2.2[*]
Total protein (mg/dl)	6			6-7.5[*]
Albumin (mg/dl)	3.3			2.8-3.9[*]
Glucose (mg/dl)	210	152		60-120[*]
Bile acid (µmol/L)	4			0-5[*]
Potassium (mmol/L)	3.7			3.5-5[*]
Iron (µmol/L)	<0.9	77	38	12.5-37.5[*]
FeLV		Negative		
Urinalysis		Unremarkable		

[*] Reference: Mahaffey, (2003). [**] Reference for 4–6-week-old kittens: Meyers-Wallen et al. (1984)

owner 12 months following initial presentation. The other littermate stayed clinically healthy and the blood examination did not reveal microcytic anaemia at the age of 40 days.
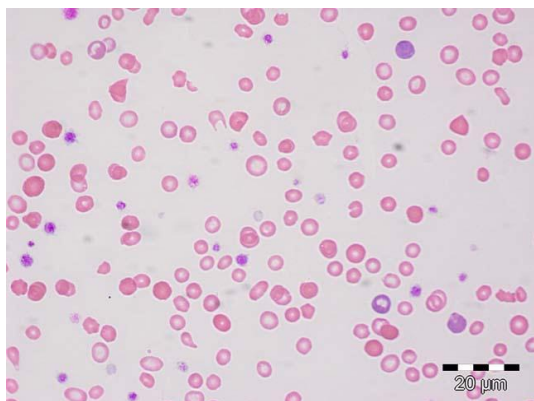

Fig. 1: Peripheral blood smear in a kitten showing acute neurological signs. Note the increased polychromasia, hypochromasia, anisocytosis and poikilocytosis, (modified wright's stain, ×100 objective)

Discussion

The etiology of IDA in this kitten could not be determined exactly: rapid growth, milk-only diet and possible malabsorption were considered. Iron deficiency anaemia is well characterized in nursing animals where transient iron deficiency occurs in association with rapid growth rate and a milk-only diet (Harvey, 2008; Couto, 2009). Feeding the mother by supplemental iron while nursing cannot compensate the lack of stores, since this treatment does not increase the iron content of the milk. Once consumption of solid food starts in growing animals, IDA usually disappears (Harvey, 2008). It seems that the additional feeding of commercial cat food prevented IDA in the other littermate as that kitten was reported to be healthy and having normal packed cell volume.

Multiple mechanisms could explain why iron deficiency impairs neurological function. Many enzymes in neural tissue require iron for normal function (Harvey, 2008). For example, cytochromes, which are predominantly involved in energy production, are also hem proteins. Iron is also essential for a number of enzymes involved in neurotransmitter synthesis including tryptophan hydroxylase (serotonin) and tyrosine hydroxylase (norepinephrine (NE) and dopamine (DA). In rats, weanlings maintained on iron-deficient diets developed severe behavioural anomalies, motor incoordination and seizures (Wienk *et al*., 1996).

Three further theories could explain the association between IDA and acute neurological signs based on human literature (Yager and Hartfield, 2002). The first is that the microcytic, hypochromic anaemia impairs tissue oxygen delivery and anaemic hypoxia may cause cerebral dysfunction (Ready and Lowry, 1989). The second theory is that plasma membranes of iron deficient red cells are abnormally rigid (Tillmann and Schroter, 1980), rigid red blood cells increase blood viscosity and increase the risk of thromboembolism in the brain (Karpatkin *et al*., 1974; Stehle *et al*., 1991). The third mechanism is explained with a hypercoagulable state caused by thrombocytosis, which frequently occurs in patients with IDA (iron inhibits thrombocytopoiesis) (Karpatkin *et al*., 1974) and this may also induce cerebral thromboembolism.

We could not confirm the connection between IDA and the neurological signs. Based on the very low initial serum iron concentration enzymopathy seems to be likely, however, in the presented case moderate thrombocytosis was observed, which may support thromboembolic etiology. The lateralised neurological symptoms make focal lesion and thromboembolic disease more likely.

The most likely differential diagnoses in young cats with seizures are: inflammatory/infectious diseases (toxoplasmosis, cryptococcosis, feline infectious peritonitis, blastomycosis, feline leukaemia virus infection, feline immunodeficiency virus infection), toxic disease (lead, organophosphate, ethylene glycol), anomalous brain disease (hydrocephalus), metabolic diseases (portosystemic shunt, hypoglycaemia, thiamine deficiency), traumatic and degenerative diseases (storage diseases) (Smith and Dewey, 2009).

Traumatic event was ruled out based on the history; portosystemic shunt and hypoglycaemia were excluded after the

measurement of bile acid and glucose. None of the other differentials were treated or could be suspected after a non-progressive clinical course.

This is the first feline case report where association between IDA and severe neurological signs was suspected. The exact etiology of the severe neurological signs remains unknown in this case but in the author's opinion, a vascular cerebral caused by IDA is the most likely explanation. Therefore, in kittens with acute neurological signs that were fed exclusively on maternal milk, IDA may be considered as a differential diagnosis. Iron supplementation with supportive care may result in full recovery.

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