

犬貧血的診療小秘訣 以及病例分享

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- 現任高雄中興動物醫院內科主任
- 經營獸醫好想告訴你粉專

貧血麻煩的點

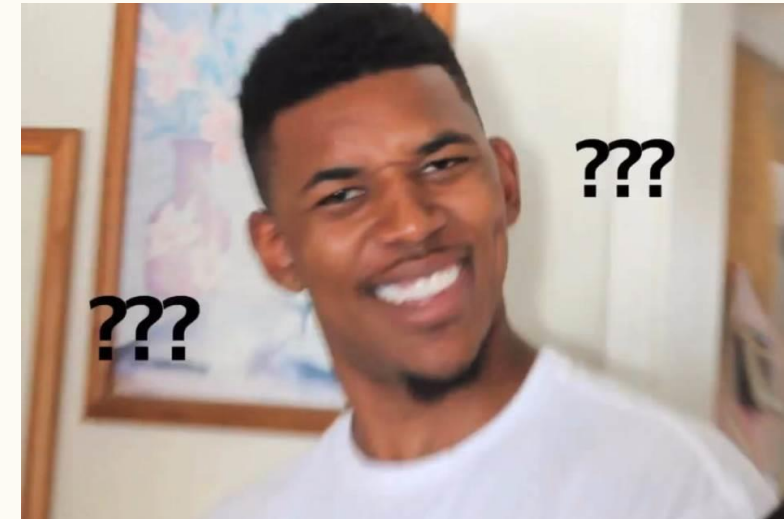
- **Differential diagnosis**

- Regenerative v.s non-regenerative (or preregenerative)
- Hematology
- Underlying: Bleeding? Hemolysis? Infectious disease? Immune mediated?

- **Stability of vital signs**

- Cross match
- Fluid therapy? Blood transfusion? Other blood products?

- **Treatment**



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Experimental Hematology

Experimental Hematology 35 (2007) 1182–1189

Erythrocyte adenylate kinase deficiency: characterization of recombinant mutant forms and relationship with nonspherocytic hemolytic anemia

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STANDARD ARTICLE



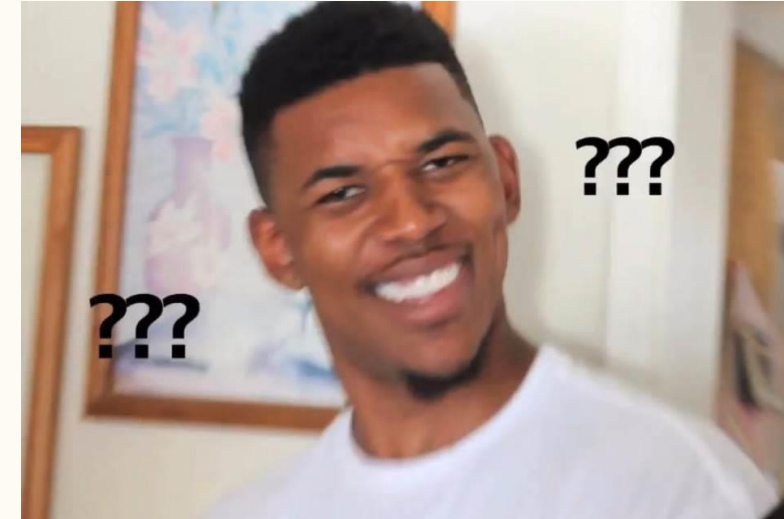
Reactive oxygen species, glutathione, and vitamin E concentrations in dogs with hemolytic or nonhemolytic anemia

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Erythrocytic Pyruvate Kinase Mutations Causing Hemolytic Anemia, Osteosclerosis, and Secondary Hemochromatosis in Dogs

G. Inal Gultekin, K. Raj, P. Foureman, S. Lehman, K. Manhart, O. Abdulmalik, and U. Giger

Background: Erythrocytic pyruvate kinase (PK) deficiency, first documented in Basenjis, is the most common inherited erythroenzymopathy in dogs.

Objectives: To report 3 new breed-specific PK-LR gene mutations and a retrospective survey of PK mutations in a small and selected group of Beagles and West Highland White Terriers (WHWT).

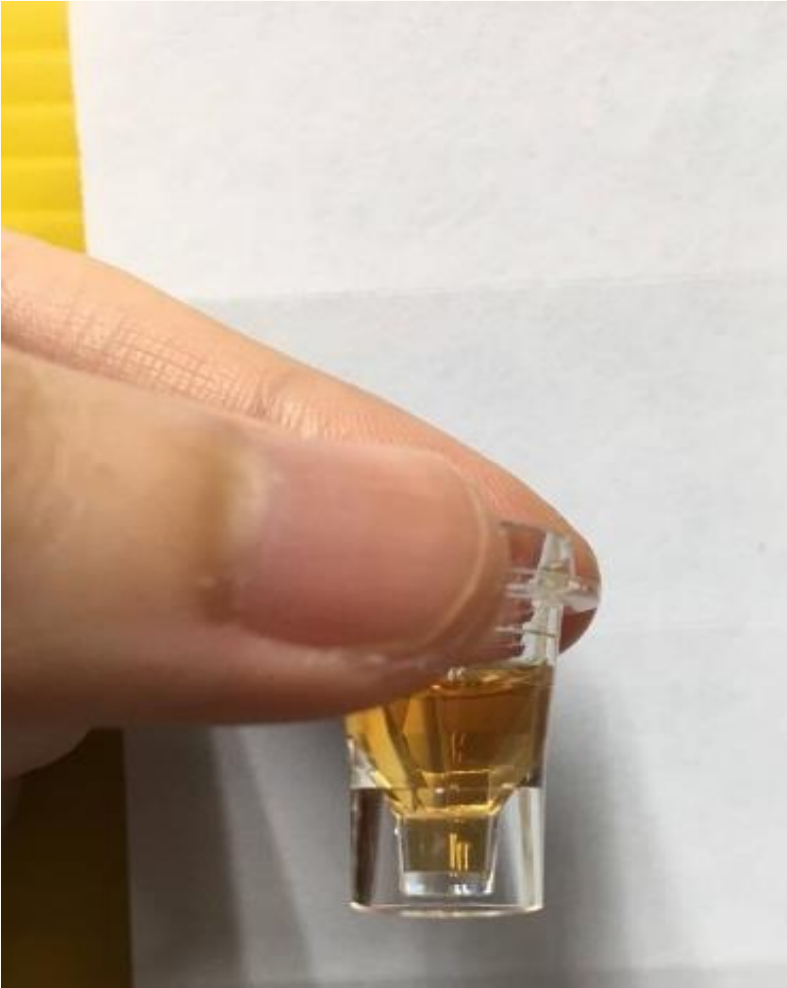
Animals: Labrador Retrievers (2 siblings, 5 unrelated), Pugs (2 siblings, 1 unrelated), Beagles (39 anemic, 29 other), WHWTs (22 anemic, 226 nonanemic), Cairn Terrier (n = 1).

Methods: Exons of the PK-LR gene were sequenced from genomic DNA of young dogs (<2 years) with persistent highly regenerative hemolytic anemia.

Results: A nonsense mutation (c.799C>T) resulting in a premature stop codon was identified in anemic Labrador Retriever siblings that had osteosclerosis, high serum ferritin concentrations, and severe hepatic secondary hemochromatosis. Anemic Pug and Beagle revealed 2 different missense mutations (c.848T>C, c.994G>A, respectively) resulting in intolerable amino acid changes to protein structure and enzyme function. Breed-specific mutation tests were developed. Among the biased group of 248 WHWTs, 9% and 35% were homozygous (affected) and heterozygous, respectively, for the previously described mutation (mutant allele frequency 0.26). A PK-deficient Cairn Terrier had the same insertion mutation as the affected WHWTs. Of the selected group of 68 Beagles, 35% were PK-deficient and 3% were carriers (0.37).

Conclusions and Clinical Importance: Erythrocytic PK deficiency is caused by different mutations in different dog breeds and causes chronic severe hemolytic anemia, hemosiderosis, and secondary hemochromatosis because of chronic hemolysis and, as yet unexplained osteosclerosis. The newly developed breed-specific mutation assays simplify the diagnosis of PK deficiency.

QC → assessment (serum, macroclot) → (dot plot) → CBC → smear



- PCV or Hct?
- EDTA volume
- $Hb * 3 = Hct$



金寶

- 2-3y/o intact male mix
- Emergency visit
- No obvious abnormality yesterday
- Vomiting was noted since this morning
- Bloody diarrhea since afternoon and took to LVH for fluid therapy
- Didn't improve after treatment
- **Severe weakness noted by owner at night**
- School dog
- Regular HW and ectoparasites prevention
- Regular vaccination

金寶 emergency and critical care

- Acute blood loss



	HR (bpm)	BP (mmHg)	CRT (secs)	Other	Treatment
2000	60	Unmeasurable, weak pulse	>2	No palpebral reflex	RS 150mL bolus
2010	180	60	>2	Bloody diarrhea	RS 150mL bolus, Hetarstarch 50mL
2020	178	60	=2	Glu 60	5% saline 100mL/h
2100	168	70	=2	Conscious recovered	RS 150mL bolus

- Treatment plan:
- Aggressive fluid therapy (based on electrolytes)
- Metronidazole 11mg/kg i.v q12h, enrofloxacin 5mg/kg s.c sid
- Sucralfate 100mg/kg pom q6h
- Cyanocobalamine, folic acid, omeprazole

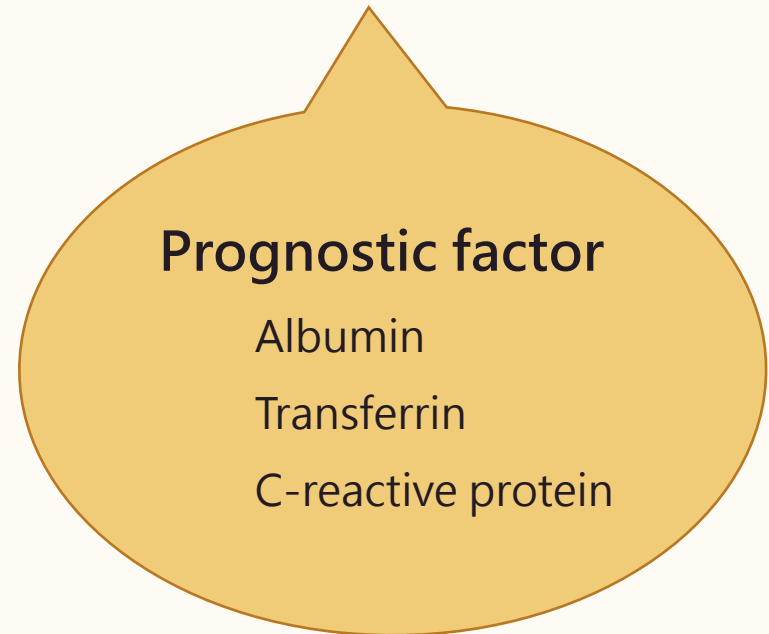
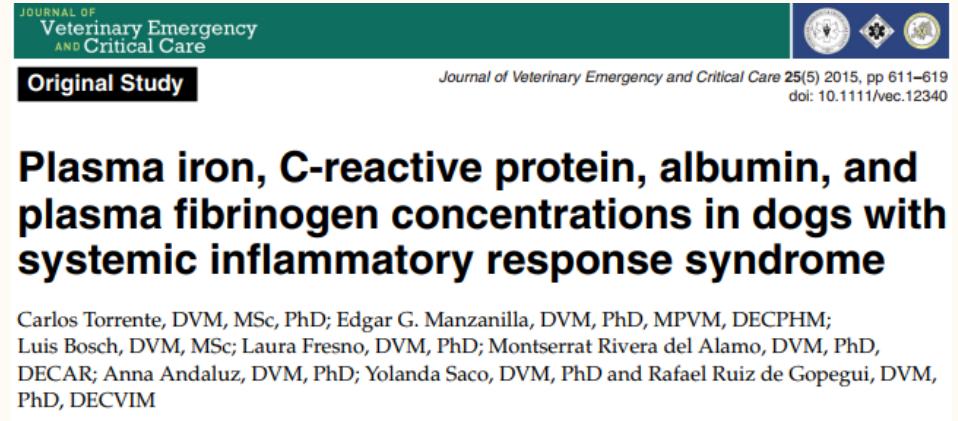
Hematology of HGE progression

	12/18	12/20	12/21	12/24	12/25	12/27
RBC	10.31	7.73	5.78	3.63	4.21	4.8
Hct	66.9	48.6	36.2	21.8	25.4	28.2
Hb	23.1	17.5	13.1	8.1	9.5	10.9
MCV	64.9	62.9	62.6	60.1	60.3	58.8
MCHC	34.5	36	36.2	37.2	37.4	38.7
Retic	172.2	34	10.4	7.3	12.6	33.1
Retic-Hb	23.4	16.9	15.8	23.2	24.3	20.9
WBC	15.06	11.71	9.99	14.92	23.95	17.39
Neu	6.7	0.24	4.47	9.35	15.27	11.54
Band	+	+	+	+	+	-
Lym	4.5	3.16	3.5	3.69	6.5	4.54
Mon	3.85	8.22	1.64	1.64	1.98	1.2
Eos	0.01	0.09	0.38	0.24	0.19	0.1
Bas	0.00	0.00	0.00	0.00	0.01	0.01
PLT	111	73	45	150	155	190
Alb	2.4	1.9	1.8	1.9	2.2	2.4

- Acute blood loss:
dehydration > anemia
- PLT and Alb might be able to monitor inflammation
- Low MCV might indicate iron deficiency or inflammation
- Dehydration or recover?
 - According to PE

Hematology of HGE progression

Positive APPs	Negative APPs
C-reactive protein (CRP)	Albumin
Serum Amyloid A (SAA)	Transferrin
Haptoglobin (Hp)	Transthyretin
Ceruloplasmin	Retinol-binding protein
α 2-Macroglobulin	
α 1-Acid glycoprotein (AGP)	
Fibrinogen	
Complement (C3, C4)	





金寶

- HGE induced acute blood loss: fluid therapy, correct dehydration, **restore circulation**
 - Crystalloid D: 90mL/kg/h, C: 60mL/kg/h
 - Hypertonic saline D:5mL/kg, C:3mL/kg
 - Colloid D:15-20mL/kg/h, C:10-15mL/kg/h, make sure hemostasis
- Blood loss = loss of **Alb**
- **dot plot** → hematology
- Monitor: clinical signs, dot plot, PLT, Alb

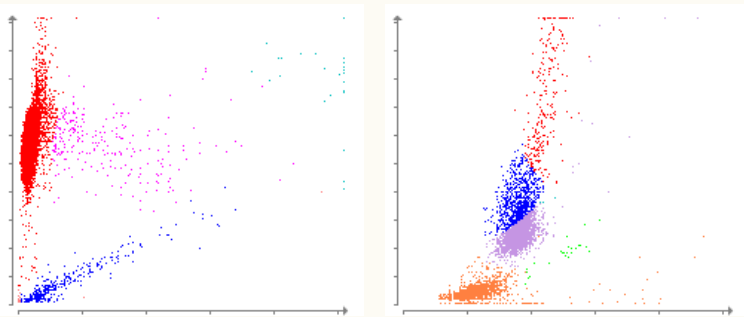


Bobo 2017.05.19

- 7 y/o castrated male chihuahua
- Referred by LVH
 - Blood transfusion twice
 - IMHA suspected
- Decreased appetite and vomiting since 1w ago
- Regular HW and ectoparasites prevention
- Regular vaccine history
- One dog family living indoor

Bobo 2017.05.19

- BW 5.5, fever, melana noted while measuring BT
- Normal activity, normal hydration, normal LN palpation, pink to pale MM
- Hematology and echo:
 - Saline agglutination test (-)
 - Echo: GB wall thickening (0.3cm), hyperechoic of pancreas noted, normal spleen morphology

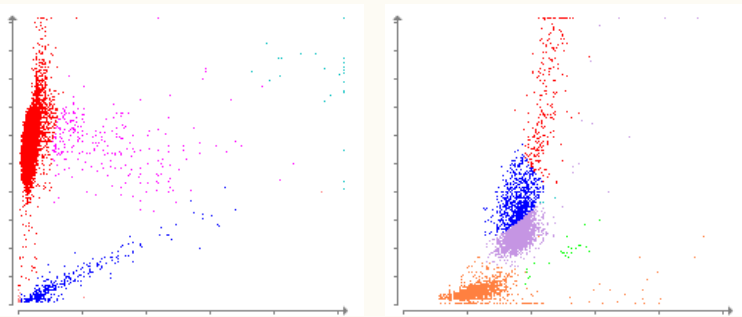


LVH hema	5/15	5/17
Hb	5.8	6.5
PCV	16.3	19.3
MCHC	35.6	33.7
PLT	157	144
WBC	3.3	7.5
Pgram	48.5	60
Gram	1.6	4.5
Lm	1.7	3
Alb		2.3
Tp		3.3

**	5/19
RBC	4.78
Hct	30.2
Hb	10.7
MCV	63.2
MCHC	35.4
Retic	47.3
WBC	4.14
Neu	2.73
Lym	1.1
Mon	0.28
PLT	50
Dot plot	

Bobo 2017.05.19 problem list

- BW 5.5, **fever, melana** noted while measuring BT
- Normal activity, normal hydration, normal LN palpation, pink to pale MM
- Hematology and echo:
 - Saline agglutination test (-)
 - Echo: **GB wall thickening** (0.3cm), hyperechoic of pancreas noted, normal spleen morphology



LVH hema	5/15	5/17
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Dot plot

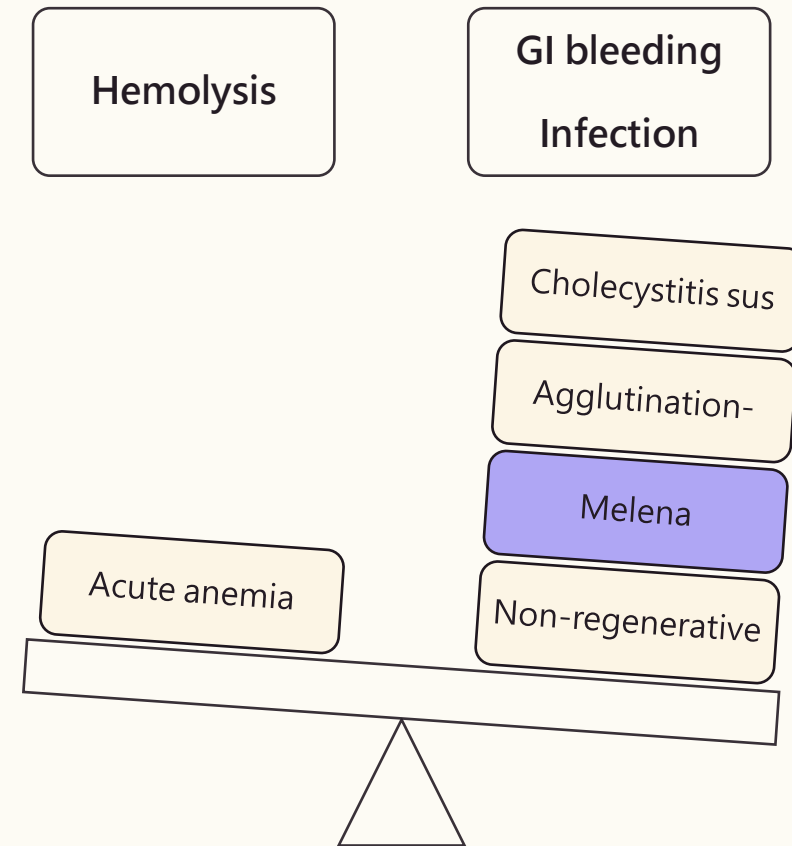
DDx and Treatment plan

- **DDx**

- Cholecystitis
- Pancreatitis
- Iatrogenic GI bleeding
- Biliary tract cancer
- Bone marrow disease
- IMHA

- **Treatment plan**

- Stop prednisolone administration
- Enrofloxacin+Augmentin, (owner refuse to culture)
- Supportive care

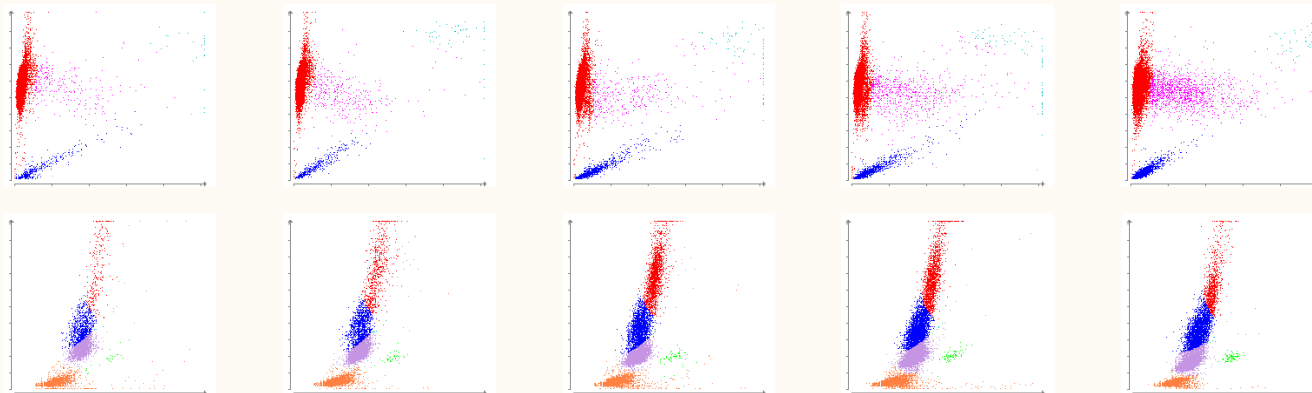


Pre-regenerative, Retic MCV

**	5/19	5/20	5/21	5/22	5/27
RBC	4.78	4.53	4.85	4.63	4.88
Hct	30.2	29.1	31.3	29.4	33.5
Hb	10.7	10.3	10.7	10.2	10.8
MCV	63.2	64.2	64.5	63.5	68.6
MCHC	35.4	35.4	34.2	34.7	32.2
Retic	47.3	56.6	68.4	127.8	298.2
WBC	4.14	7.56	11.03	16.35	13.47
Neu	2.73	5.37	6.35	10.18	8.53
Lym	1.1	1.4	2.56	4.04	3.77
Mon	0.28	0.73	2.04	2.03	1.07
PLT	50	31	126	164	502

- GI bleeding
 - ◆ Underlying diseases
- Iron deficiency
 - Microcytic hypochromic anemia, leptocyte
 - Retic MCV
- Ferrous iron
 - ◆ better absorption
 - ◆ GI irritation, Fecal color

Dot plot



Indices of Iron Deficiency	Day 0	Day of First Significant Difference* (day)	Day 35
Conventional			
MCV _{conv} (fL)	69.9 ± 1.8	67.9 ± 1.6 (day 7)	65.5 ± 2.3*
MCHC _{conv} (g/dL)	32.3 ± 0.3	33.2 ± 0.3 (day 7)	32.8 ± 0.5
Reticulocyte			
MCV _{retic} (fL)	86.4 ± 2.2	92.6 ± 1.7 (day 7)	71.3 ± 5.3*
% Macro _{retic}	31.2 ± 6.6	51.8 ± 6.9 (day 7)	5.2 ± 4.1*
% Hypo _{retic}	20.9 ± 10.5	48.6 ± 12.5 (day 7)	65.0 ± 19.1*
CH _{retic} (pg)	25.8 ± 0.3	21.4 ± 2.6 (day 28)	19.5 ± 2.2*
% High CH _{retic}	64.0 ± 3.8	21.5 ± 19.9 (day 28)	9.0 ± 8.3*
% Low CH _{retic}	2.3 ± 1.5	35.7 ± 22.9 (day 28)	59.1 ± 26.2*
Biochemical			
Serum iron (µg/dL)	130 ± 41	—†	91 ± 78
TIBC (µg/dL)	321 ± 28	411 ± 30 (day 7)	432 ± 16*
Tf Sat (%)	40 ± 11	18 ± 7 (day 28)	21 ± 19
Ferritin (ng/mL)	388 ± 87	236 ± 34 (day 21)	222 ± 53*

*Values were significantly different from day 0 values, $P < .01$.

†Results were not statistically different at any time point.



球球

- 10y/o spayed female Japanese Spitz
- Melena and decreased appetite since 1w ago
- No regular HW or ectoparasites prevention
- No regular vaccine history
- 2-dog family, living indoor

球球

- Polychromatophilic cells

- NMB stain

- Heinz bodies, Howell-Jolly bodies, staining artifact, RBC parasites, basophilic stippling might be mistaken

- Retic%*RBC

- 80000/uL
 - 150000/uL mild
 - 300000/uL moderate
 - 500000/uL marked

- PLT count=10HPF/10*15000

	2/8	2/11	2/13	2/14	2/16	2/19	2/28
RBC	6.31	3.82	2.94	2.89	3.45	4.37	5.23
Hb	14.5	8.9	7	7	8.3	10.6	12.8
PCV	39.8	24.8	21	21.2	26.2	33.1	37.3
MCV	63.1	64.9	71.4	73.4	75.9	75.7	71.3
MCHC	36.4	35.9	33.3	33	31.7	32	34.3
WBC	9.34	30.88	44.05	44.68	36.21	35.98	40.62
PLT	0	0	4	9	111	401	444
4DX	All-						
PCR		-					
Pred mg/kg/d		2				1.5	
Doxy 10mg/kg/d							
Echymosis	+++	++	++	+	+/-	-	-
Melena	+	+	+/-	+/-	-	-	-

Vincristine 0.02mg/kg single dose

**老夫當年推了vincristine
血小板應聲拔地而起**

**原本還在噴血喇的止住
身上的瘀青出血斑一個個消失**

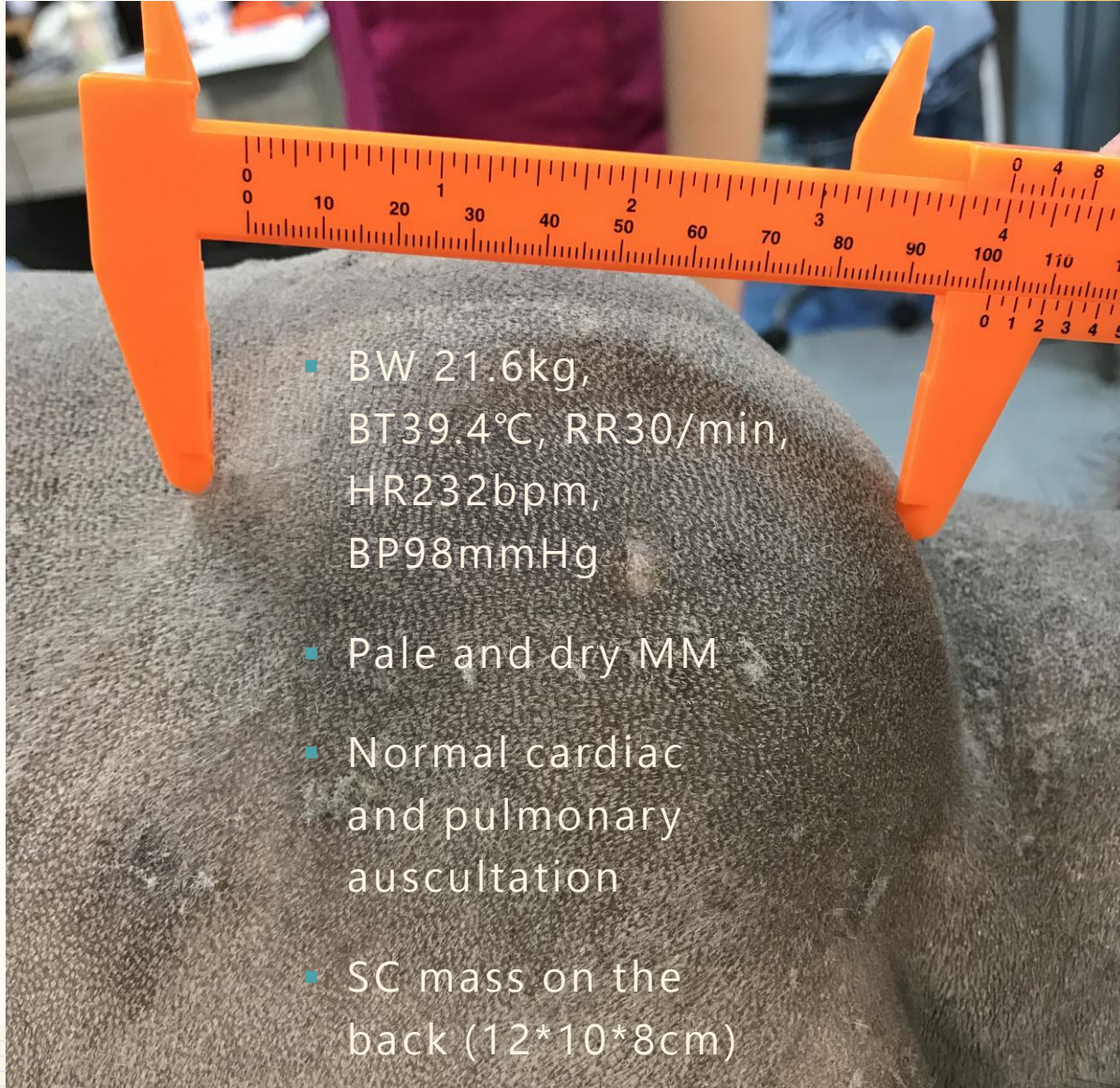




阿呆

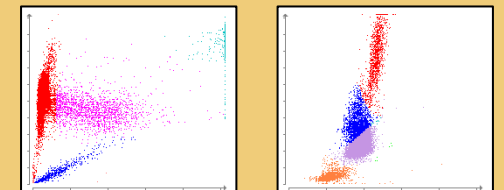
- 12 y/o spayed female husky
- Suddenly decreased activity and appetite since yesterday
- Tachypnea was noted by owner since yesterday
- Polydipsia, normal stool and urination
- No vomiting
- Regular HW prevention
- No routine ectoparasites prevention
- Regular vaccine history

阿呆 at presenting



	8/18
RBC	3.25
Hct	19.2
Hb	7
MCV	59.1
MCHC	36.5
Retic	256.4
WBC	48.32
Neu	41.77
Band	+
Lym	4.45
Mon	2.07
Eos	0.01
PLT	53
Alb	2.9

Dot plot



CAUSES OF CANINE ANEMIA IN TAIWAN: A FIVE-YEAR RETROSPECTIVE SURVEY

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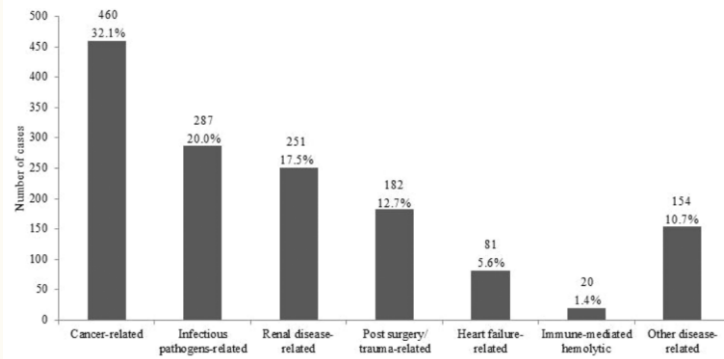
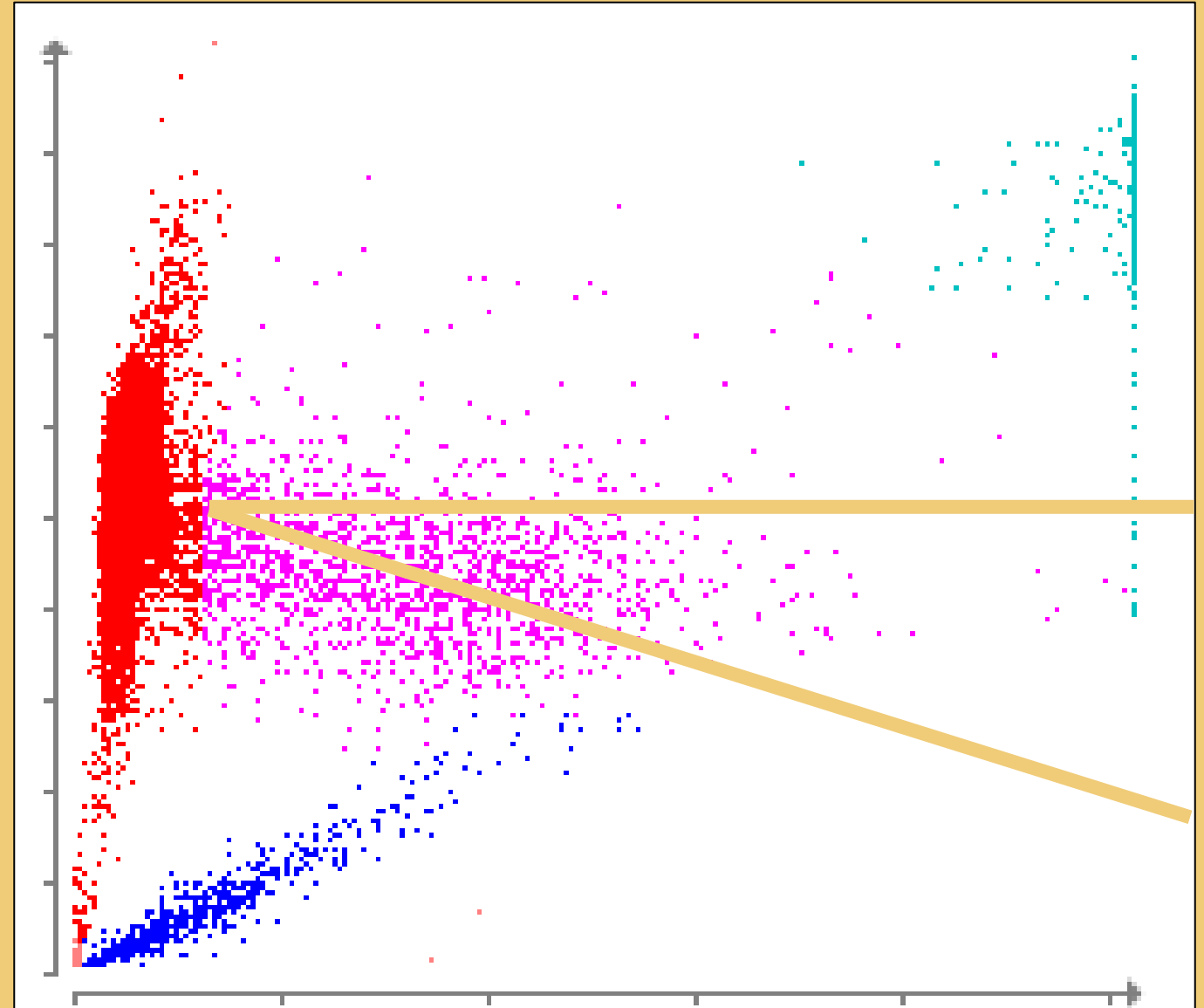


Fig. 1 Distribution of causes of anemia in 1435 single-cause anemic dogs (number of cases).

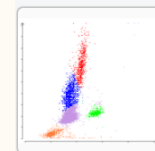
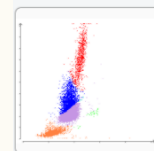
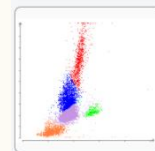
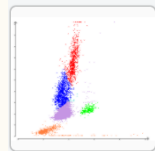
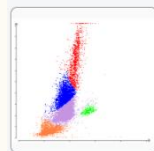
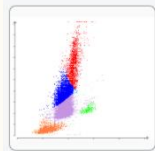
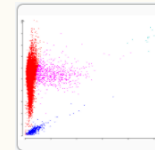
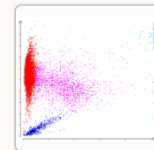
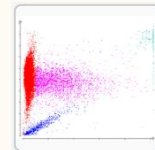
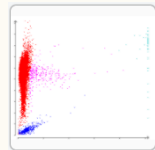
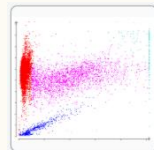
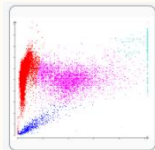


阿呆 9/29-10/29

	9/29	9/30	10/13	10/19	10/20	10/30
RBC	1.62	3.5	4.87	3.83	5.66	5.51
Hct	11.6	24.1	31.7	24.3	37.8	36.6
Hb	3.6	8.6	11.1	8.5	13.3	12.8
MCV	71.6	68.9	65.1	63.4	66.8	66.4
MCHC	31	35.7	35	35	35.2	35
Retic	398.4	410.2	80.4	402.5	437	204.4
Retic-Hb	20.1	19.9	21.6	18.9	18.2	22.3
WBC	41.69	27	19.01	36.31	41.14	14.37
Neu	31.9	19.72	15.97	30.17	34.18	11.57
Band	+	+	-	-	+	-
Lym	7.02	5.37	1.63	4.24	5.37	1.42
Mon	2.42	1.5	0.99	1.38	1.52	0.83
Eos	0.32	0.41	0.4	0.5	0.06	0.54
PLT	45	51	156	68	101	332



Dot plot



- Histopath:
hemangiosarcoma
- Decreased
bleeding tendency?
- Metronomic
therapy
 - Low dose
cyclophosphamide
 - Piroxicam
- 雲南白藥

Veterinary and Comparative Oncology
Original Article DOI: 10.1111/vco.12100

In vitro effects of Yunnan Baiyao on canine hemangiosarcoma cell lines

K. A. Wirth, K. Kow, M. E. Salute, N. J. Bacon and R. J. Milner
Department of Clinical Sciences, University of Florida, Gainesville, FL, USA

Case Report
Hemangiosarcoma in a Dog: Unusual Presentation and Increased Survival Using a Complementary/Holistic Approach Combined with Metronomic Chemotherapy

Phillip Chaikin^{1,2} and Anja Welihozki³



Bleeding

- Treat underlying diseases (might be systemic)
- Hemostasis confirmed
- Long-term bleeding → iron supplementation
- Non-regenerative v.s pre-regenerative anemia
- Circulation first



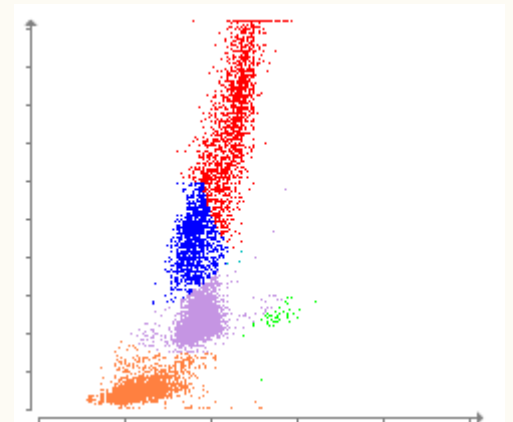
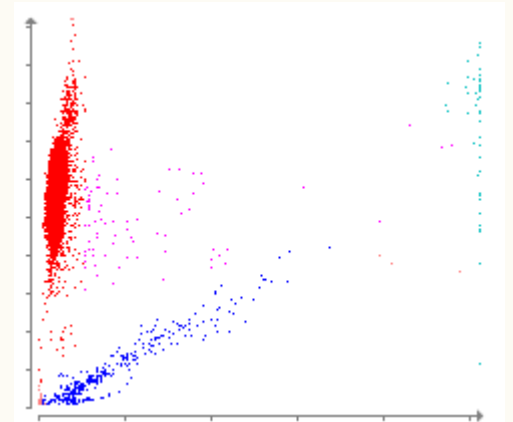
Sakura 8/15

- 11y/o spayed female maltese
- Decreased appetite and activity since 2days ago
- Severe weakness noted this morning
- Reverse sneezing?
- Diarrhea noted yesterday
- PE:
 - BW3.4kg, BT39.2°C, BP114mmHg, panting
 - Systolic heart murmur 4/6, normal lung auscultation
 - Unknown MM and HR

8/16 sakura

- Still lethargy and anorexia
- Syncope sus after urination
- Echocardiography: MR, LA/Ao1.0, TR3.6m/s, TRPG51mmHg, mild increased Rt. Ventricle size, no obvious Lt. Ventricle compression or PR noted
- PE:
- BT39.4, BP96mmHg
- Anemia, thrombocytopenia

	8/16
RBC	3.95
Hct	25.3
Hb	9.5
MCV	64.1
MCHC	37.5
Retic	13.4
Retic-Hb	19.3
WBC	8.27
Neu	4.51
Lym	16.
Mon	2.11
Eos	0.05
PLT	31
CRP	>10 (27)
Serum biochemistry	NSF



8/16 sakura

	8/16	8/19	8/21	8/28	9/4	9/11	10/2
RBC	3.95	3.03	3.51	3.98	5.3	5.97	5.98
Hct	25.3	18.9	22.9	28	39	43.5	42.7
Hb	9.5	7.1	8.3	9.3	12.9	14.8	15.6
MCV	64.1	62.4	65.2	70.4	73.6	72.9	71.4
MCHC	37.5	37.6	36.2	33.2	33.1	34	36.5
Retic	13.4	9.1	150.9	456.5	129.3	90.7	66.4
Retic-Hb	19.3	24.9	23.5	25.9	24.8	23.9	24.2
WBC	8.27	16.63	21.07	26.52	18.09	17.53	14.94
Neu	4.51	7.44	10.46	13.29	10.26	9.91	8.78
Lym	16.	3.97	6.34	8.65	4.94	4.43	3.84
Mon	2.11	5	4	3.91	1.78	1.45	1.5
Eos	0.05	0.22	0.26	0.66	1.1	1.73	0.78
PLT	31	69	142	234	500	562	477
CRP	>10 (27)						

Doxycycline 10mg/kg/d

Clindamycin 30mg/kg bid

imidazole

Veterinary Clinical Pathology

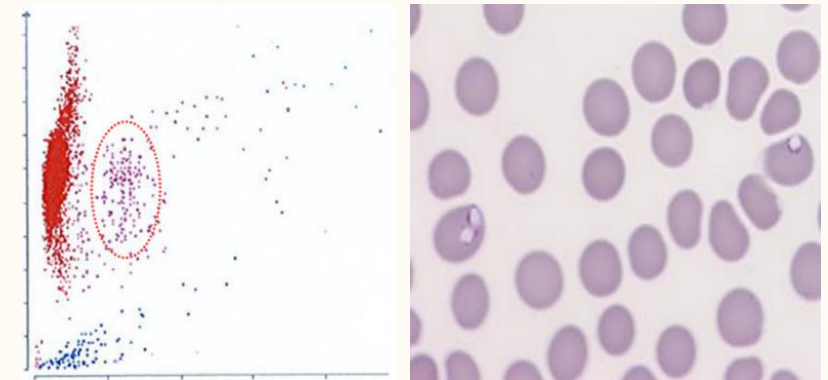
An International Journal of Laboratory Medicine

Case Report

Spurious reticulocyte profiles in a dog with babesiosis

Laetitia Plane, Marie-Laure Théron, Marcel Aumann, Catherine Trumel

First published: 18 October 2016 | <https://doi.org/10.1111/vcp.12395> | Citations: 1



Veterinary Parasitology 186 (2012) 159–164



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Veterinary Parasitology

journal homepage: www.elsevier.com/locate/vetpar



The therapeutic efficacy of two antibabesial strategies against *Babesia gibsoni*

Emerald Cheng-Yi Lin^{a,c}, Ling-Ling Chueh^b, Chao-Nan Lin^{b,d}, Li-En Hsieh^b, Bi-Ling Su^{a,c,*}

8/16 sakura

	8/16	8/19	8/21	8/28	9/4	9/11	10/2
RBC	3.95	3.03	3.51	3.98	5.3	5.97	5.98
Hct	25.3	18.9	22.9	28	39	43.5	42.7
Hb	9.5	7.1	8.3	9.3	12.9	14.8	15.6
MCV	64.1	62.4	65.2	70.4	73.6	72.9	71.4
MCHC	37.5	37.6	36.2	33.2	33.1	34	36.5
Retic	13.4	9.1	150.9	456.5	129.3	90.7	66.4
Retic-Hb	19.3	24.9	23.5	25.9	24.8	23.9	24.2
WBC	8.27	16.63	21.07	26.52	18.09	17.53	14.94
Neu	4.51	7.44	10.46	13.29	10.26	9.91	8.78
Lym	16.	3.97	6.34	8.65	4.94	4.43	3.84
Mon	2.11	5	4	3.91	1.78	1.45	1.5
Eos	0.05	0.22	0.26	0.66	1.1	1.73	0.78
PLT	31	69	142	234	500	562	477
CRP	>10 (27)						
	Doxycycline 10mg/kg/d						
		Clindamycin 30mg/kg bid					
		imidazole					



Aagroup:

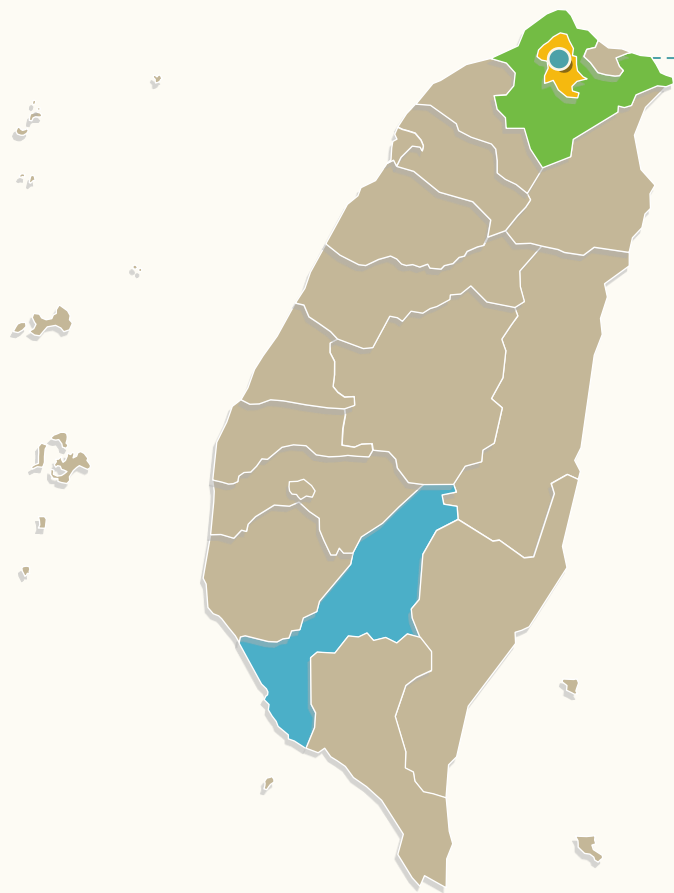
atovaquone 13.3 mg/kg PO q8 h
azithromycin 10 mg/kg PO q24 h

CDI:

1st diminazene aceturate 3.5 mg/kg IM
2nd imidocarb dipropionate 6 mg/kg SC
clindamycin 30 mg/kg PO q12 h

IMMUNE

常見的貧血原因之中：常見的嚴重貧血原因



CAUSES OF CANINE ANEMIA IN TAIWAN: A FIVE-YEAR RETROSPECTIVE SURVEY

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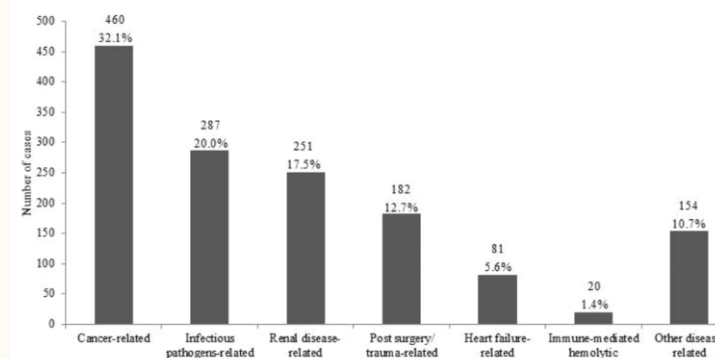


Fig. 1 Distribution of causes of anemia in 1435 single-cause anemic dogs (number of cases).



一朗 at presenting

- 9y/o spayed male
WHWT
- CC: mild weakness
- Normal appetite
- Normal defecation
and urination
- No regular HW
and ectoparasites
prevention
- PE:
- Pale MM, panting,
fair activity

	6/9
RBC	0.62
Hct	5.8
Hb	1.7
MCV	93.5
MCHC	29.3
Retic	24.6
Retic-Hb	22.9
WBC	1.83
Neu	0.93
Lym	0.71
Mon	0.19
Eos	0.00
PLT	5
Alb	2.6
A/G	0.6
EC Ab	+



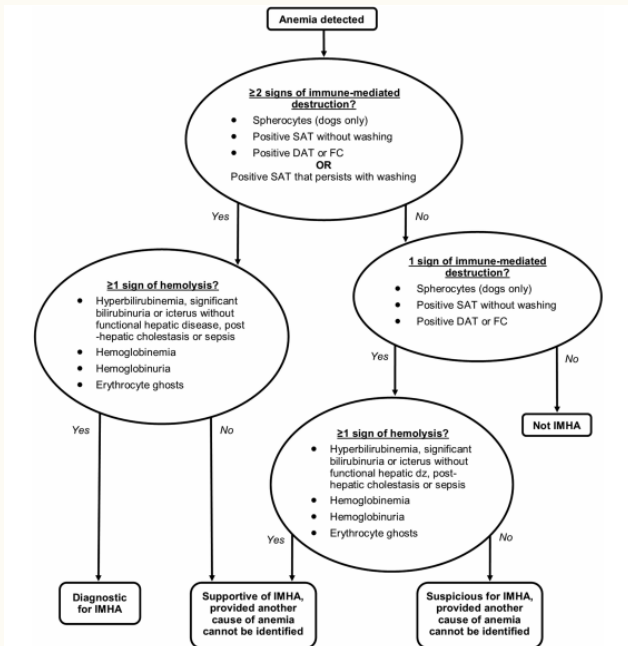
Sushi

- Referral for EC treatment
- 10y/o spayed female mix
- Anemia and EC+ (4DX) noted
- Condition didn't improve after doxycycline administration
- Orange to red urine noted
- No regular HW or ectoparasites prevention
- No regular vaccination
- PE
 - Pale MM, mild weakness, BP126mmHg, BT38.2

Sushi

	11/26/ 17	11/27/ 17	11/28/ 17	11/29/ 17	11/30/ 17	12/02/ 17	12/07/ 17	12/26/ 17	01/18/ 18
RBC	2.08	2.01	1.72	2.47	2.74	2.86	3.97	5.24	6.07
Hct	15.2	15.5	14.0	21.0	25.4	21.5	38.1	41.8	47.7
Hb	4.5	4.2	3.8	6.2	6.9	7.4	10.9	13.7	15.7
MCV	73.1	77.1	81.4	85.0	92.7	75.2	96.0	79.8	78.6
MCHC	19.6	27.1	27.1	29.5	27.2	34.4	28.6	32.8	32.9
Retic	314.9	357.6	--	409.3	529.1	559.1	288.6	117.4	114.7
WBC	65.35	75.59	102.05	76.88	59.12	49.14	12.34	12.53	9.65
Neu	54.2	55.80	76.05	58.36	44.18	40.20	9.03	10.09	7.72
Lym	7.72	16.15	21.80	14.59	11.96	6.18	2.00	1.27	0.95
Mon	3.06	3.29	3.79	3.61	2.76	2.66	1.20	0.51	0.37
Eos	0.23	0.29	0.35	0.25	0.17	0.05	0.10	0.64	0.56
PLT	260	254	310	180	203	199	384	470	372
Alb	3.1							3.2	2.9
Glob	4.8								3.5
ALT							223	250	555
ALP	220						371	338	765
Tbil	1.6		No icterus				0.1	0.3	
Prednisolone 2mg/kg sid							1.5mg/kg sid		
			Azathioprine 2mg/kg sid						

- Saline agglutination test (+)
 - Difference of agglutination and rouleaux
- pRBC transfusion
- Taper prednisolone, pulse therapy





Bobi

- Referral for severe anemia
- 10y/o neutered male poodle
- Dark urine noted 3days ago, decreased activity and appetite
- Anemia, leukocytosis, 4DX plus-, tick born diseases PCR-, Lac 10.2
- One-dog family living indoor
- No regular ectoparasites prevention
- PE
 - **Icterus and pale MM**, RR 120/min, HR 168bpm, Systolic heart murmur, BW 5.8kg, BT 38.8°C, Decreased activity, Normal lymph node palpation, Normal hydration

Intravascular hemolysis: Bobi

CBC & biochemistry

RBC	2.03	5.65-8.87 (M/uL)
PCV	15.5	37.3-16.7 (%)
Hgb	4.8	13.1-20.5 (g/dL)
MCV	76.4	61.6-73.5 (fL)
MCH	23.6	21.2-25.9 (pg)
MCHC	31	32-37.9 (g/dL)
RDW	23.8	13.6-21.7(%)
Retic	205	10.0-110.0 (K/uL)
PLT	93	148-484 (K/uL)
MPV	11.2	8.7-13.2 (fL)
PDW	23	9.1-19.4 (fL)
PCT	0.1	0.14-0.46 (%)
WBC	30.35	5.05-16.76 (K/uL)
Neu	18.04	2.95-11.64 (K/uL)
Lym	9.94	1.05-5.10 (K/uL)
Mono	2.27	0.16-1.12 (K/uL)
Eos	0.1	0.06-1.23 (K/uL)
Alb	3.0	2.3-4.0 (g/dL)
ALT	830	10-125 (U/L)
ALKP	572	23-212 (U/L)
Tbil	19.9	0-0.9 (mg/dL)

- Coomb's test+
- SAT-
- Intravascular hemolysis
- Prognosis poor
- Treatment plan
 - Whole blood transfusion
 - Prednisolone 4mg/kg/day
 - Cyclosporine 10mg/kg/day
 - Doxycycline 5mg/kg/day
 - Metronidazole 30mg/kg/day
 - Fluid therapy
 - GI protection
 - sAME





Kitty

- 12 y/o spayed female schnauzer
- Cardiac disease controlled by LVH since 3-y ago (benazepril)
- Weakness and syncope were suspected on the day before yesterday and took to another LVH
- Pimobendan and Lasix were provided with unknown dosage, but condition didn't improve
- Hematuria and hemorrhagic diarrhea were noted yesterday and LVH found 4DX plus were all negative then unknown dose of prednisolone was provided, but the condition didn't improve either.
- The dog started tachypnea and took to another LVH this afternoon, PCV 13% was found and transfer to my clinic
- No regular HW and parasites prevention, 1-dog family living indoor and go out for a walk everyday
- The owner said the dog won't approach to any toxic material include onion, acetaminophen
- Appetite decreased and PD was noted by owner today
- PE: BW 7.28kg, HR176bpm, BP108mmHg, RR44/min, BT 38.9, Weakness, pale MM, lethargy, normal hydration, no heart murmur or crackle was noted (no cardiac disease sus)

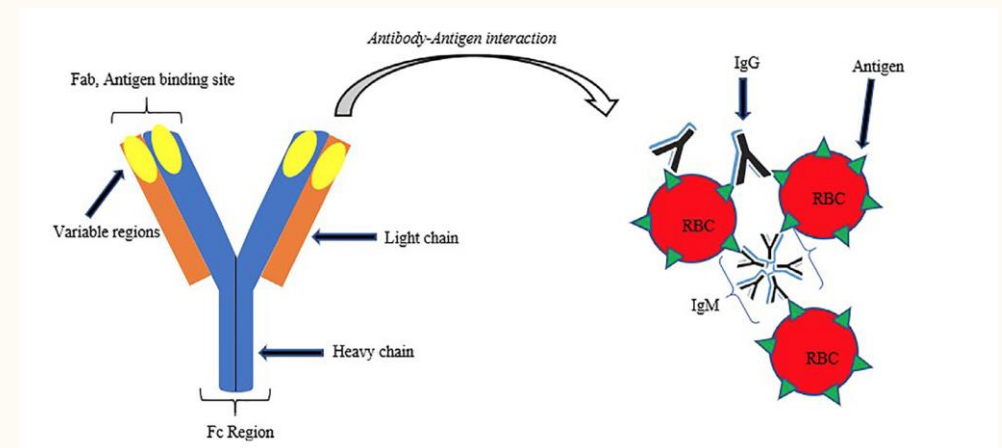
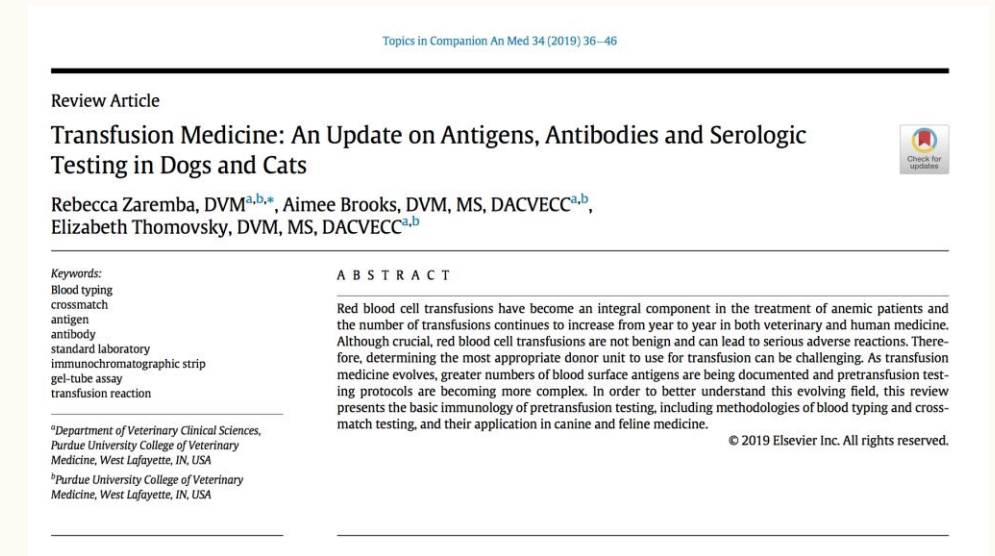
Kitty

Date	10/10	10/11	10/12		10/13		10/14		10/15-19	
Time		0900	2200	0700	1900	0300	1700	0700		
Blood mL	150	-	-	150	-		125	-		140 (80)
Pred 2 mg/kg sid	Pred 2mg/kg q12h									
Baytril 5mg/kg sid				Baytril+metronidazole 10mg/kg i.v						
	Cyclosporine 5mg/kg q12h									
Clopidogrel 1mg/kg po sid										
	Sucralfate 100mg/kg po bid→tid									
Other				Iron dextran Single dose		Nandrolone 1.5mg/kg im		hIVIG 3G CRI 24h		
RBC	2.03	3.7	2.57	1.87	2.91	2.47	2.22	3.07	2.57	1.5
Hct	12.1	21.3	16	11.3	16.9	14.3	12.6	17.5	14.4	10.4
Hb	4.9	8.1	6.2	4.3	6.6	5.4	4.8	6.5	5.3	3.7
MCV	59.6	62.6	62.3	60.4	58.1	57.9	56.8	57	56	69.3
MCHC	40.5	38	38.8	38.1	39.1	37.8	38.1	37.1	36.8	35.6
Retic	9.7	17.7	18	24.1	24.4	23.5	24	38.7	102.3	477.2
Retic-Hb	22.2	21.6	23.9	23	19.8	21.6	21.8	19.7	19.8	22.1
WBC	27.66	23.46	36.89	48.99	37.47	45.08	51.63	39.58	44.86	56.76
Neu	21.04	16.59	25.37	34.25	28.75	33.54	37.18	27.94	24.68	21.98
Band	+	+	+	+	+	+	+	+	+	+
Lym	4.18	4.02	7.8	9.08	6.24	8.24	10.8	8.76	14.9	27.41
Mon	2.39	2.69	3.66	5.62	2.38	3.2	3.55	2.83	5.21	7.14
Eos	0.03	0.12	0.03	0.04	0.08	0.04	0.06	0.03	0.05	0.2
Bas	0.02	0.04	0.03	0.00	0.02	0.06	0.04	0.02	0.02	0.03
PLT	231	151	152	165	127	133	180	137	174	326
MPV	13.9	15.3	15.6	16.2	15.4	15.9	15.9	15.5	15.7	14.4
Tbil		3.2		2.8				2.7	1.1	1
Phos		2.7								6.1
Other	DAT+									
	SAT-									
Icterus A/G	+++	++++		++		++			+/-	-
Hburia	+++	++++	Bilirubinuria			++			--	-
Other			Diarrhea, add metro			improved				pale

- Problem list: hemoglobinuria (intravascular hemolysis sus), severe anemia, mild fever(?)
- DDX: IMHA, babesia spp. infection, PIMA, acetaminophen intoxication?
- Treatment plan: blood transfusion (no pRBC available), prednisolone 2mg/kg sid, enrofloxacin 5mg/kg sid, acetylcysteine 70mg/kg bid, omeprazole 0.5mg/kg po bid, silimerin 15mg/kg po bid, cyproheptadine 0.2m/kg bid, ursodesoxycholic acid 15mg/kg bid, Clopidogrel 1mg/kg po sid
- Sent the blood sample to the lab for Babesia, hemotropic mycoplasma and Ehrlichia PCR, 10/13: all negative

Complication of blood transfusion

- The most significant complication: Acute Hemolytic Transfusion Reaction (AHTR)
 - Dogs: 0.2-1% (underestimation)
- 46% transfused dogs were incompatible by crossmatch to their original DEA1 matched donors
- 17% transfusion naïve dogs were incompatible by **crossmatch**





Heinz bodies

Microscopic view of red blood cells. Two red arrows point to dark, irregular inclusions within the cells, identified as Heinz bodies.

8.5.12



Evidence of hemolysis

- Hyperbilirubinemia without functional hepatic disease
- Hemoglobinemia
- Hemoglobinuria
- Erythrocyte ghosts



8.5.15

Microscopic view of red blood cells, showing a higher density of cells compared to the previous image.



Clinical features of precursor-targeted immune-mediated anemia in dogs: 66 cases (2004–2013)

ORIGINAL RESEARCH

Histologic and cytologic bone marrow findings in dogs with suspected precursor-targeted immune-mediated anemia and associated phagocytosis of erythroid precursors

Cynthia de A. Lucidi¹, Christian L. E. de Rezende², L. Ari Jutkowitz², Michael A. Scott¹

Departments of ¹Pathobiology and Diagnostic Investigation and ²Small Animal Clinical Sciences, College of Veterinary Medicine, Michigan State University, East Lansing, MI, USA

Idiopathic pure red cell aplasia and nonregenerative immune-mediated anemia in dogs: 43 cases (1988–1999)

Tracy Stokol, BVSC, PhD, DACVP; Julia T. Blue, DVM, PhD, DACVP; Tracy W. French, DVM, DACVP

J. Comp. Path. 2008, Vol. 138, 46–53

Available online at www.sciencedirect.com

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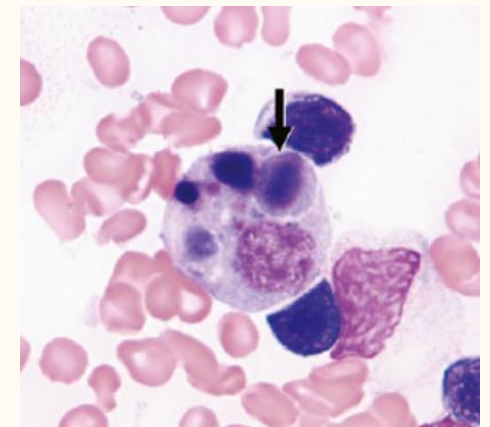
Bone Marrow Pathology in Dogs and Cats with Non-Regenerative Immune-Mediated Haemolytic Anaemia and Pure Red Cell Aplasia

D. J. Weiss

PIMA/nonregenerative IMHA

<u>Destruction of mature cells in circulation</u>	<u>Destruction of marrow precursors ± mature cells in circulation</u>	
Classic IMHA	NRIMA/PIMA	PRCA
Regenerative	Non-regenerative	Non-regenerative
Spherocytes	± spherocytes	± spherocytes
Coombs positive	Coombs weak/-	Coombs weak/-
Icterus	No icterus	No icterus
Thrombosis	Thrombosis?	Thrombosis?
Erythroid hyperplasia	Erythroid hyperplasia, ± myelofibrosis, left-shifted maturation, "maturation arrest"	No/few erythroid precursors ± myelofibrosis

- Non-regenerative anemia without any infection or hemolytic signs
- Rubriphagocytosis noted under bone marrow aspiration
- Prolong immunosuppressant administration





Hero

- 10-year old spayed Abyssinian Sand Terrier
- Referral due to long term non-regenerative anemia
- Regular HW and parasites prevention
- Living indoor
- PE: BW 4.8kg, systolic heart murmur, normal activity, BP158, panting, HR156bpm, BT37.4

Hero

- Problem list
- BW increased
- Non-regenerative anemia
- Lipemia
- Systolic heart murmur
- No obvious anemia signs

	3/10	4/6	4/30	?		
PE	BW4kg	BW4.5kg BP128	Heart murmur			
Treatment	Pet tinic 2mL/d	N/A	MMVD B1-2			
RBC	5.23	4.39	5.18	?	M/ μ L	5.65-8.87
HCT	35.4	30.9	33.2	?	%	37.3-61.7
HGB	12.6	11.4	12.5	?	g/dL	13.1-20.5
MCV	67.7	70.4	64.1	?	fL	61.6-73.5
MCH	24.1	26.0	24.1	?	pg	21.2-25.9
MCHC	35.6	37.0	37.7	?	g/dL	32.0-37.9
RDW	16.2	20.4	17.0	?	%	13.6-21.7
RETIC	14.1	N/A	25.9	?	K/ μ L	10.0-110.0
RETIC-HGB	25.3	N/A	24.2	?	pg	22.3-29.6
NEU	3.55		4.18	?	K/ μ L	2.95-11.64
LYM	2.85	2.1	2.35	?	K/ μ L	1.05-5.10
MONO	0.28		0.60	?	K/ μ L	0.16-1.12
EOS	0.36		0.48	?	K/ μ L	0.06-1.23
BASO	0.07		0.03	?	K/ μ L	0.00-0.10
PLT	547	477	489	?	K/ μ L	148-484

Table 2. Nonregenerative Anemia Associated With Pathology of Specific Organ Systems.

Disease	Proposed Mechanism(s) of Anemia
Chronic renal failure	Impaired EPO production ¹⁵² Dysregulation of the renin-angiotensin-aldosterone system ⁴⁹ Neocytolysis ¹⁵⁴ Inflammation ¹⁶⁴ Decreased renal excretion of hepcidin ¹⁵⁵ Presence of factors in uremic serum that inhibit erythropoiesis, ¹⁰¹ erythropoietin, ⁴⁷ and/or heme synthesis ⁴⁷ Lack of stimulating factors in uremic serum ²³ Myelosuppressive factors in uremic serum ⁷⁷ Iron deficiency secondary to chronic blood loss associated with uremic toxin-induced platelet dysfunction, ¹⁸ gastric ulceration ¹⁶¹ Depletion of iron stores by erythropoiesis-stimulating agents ⁵¹ PTH-induced inhibition of EPO synthesis ¹⁷⁸ PTH-induced myelofibrosis ¹³⁹ Anti-EPO antibodies secondary to recombinant EPO therapy ⁵² Antierthropoietic effects of angiotensin-converting enzyme inhibitors and angiotensin receptor antagonists ¹³³ Complications of dialysis (vitamin/mineral deficiency, ⁷⁵ aluminum toxicity ⁷⁶)
Heart failure	Inflammation ⁹ GI dysfunction ¹¹⁸ Neurohormonal activation ⁸⁹ Cardiorenal syndrome ¹⁰²
Hypothyroidism	Decreased cellular metabolic rate and tissue oxygen requirements ⁴³ Lack of erythropoiesis-stimulating thyroid hormones ¹⁵⁴
Hypoadrenocorticism	Deficiencies in cortisol and androgens ⁷ GI hemorrhage ⁶⁷
Diabetes mellitus	Inflammation ⁹⁷ GI dysfunction ¹¹⁸ Renal injury (diabetic nephropathy) ¹⁷⁶ Relative EPO deficiency secondary to neuropathology ²¹ Destabilization and degradation of hypoxia-inducible factor-1 α secondary to hyperglycemia ¹² Decreased iron availability secondary to glycation of transferrin ⁷⁹ GI hemorrhage secondary to portal hypertension
Hepatic disease	Inflammation ⁹ Certain viral diseases ¹⁶⁰ In patients with portosystemic anomalies, the mechanism of anemia is unknown, but iron sequestration causing a functional iron deficiency is suspected ¹⁶
Nutritional and GI disease	Iron deficiency secondary to chronic GI blood loss (eg, strongid infection, ⁷⁵ GI ulceration) Inadequate dietary iron, ¹¹ copper ²⁵ Inflammation ⁹ Increased gastric hepcidin ¹⁵⁴ associated with <i>Helicobacter pylori</i> infection

EPO, erythropoietin; GI, gastrointestinal; PTH, parathyroid hormone.

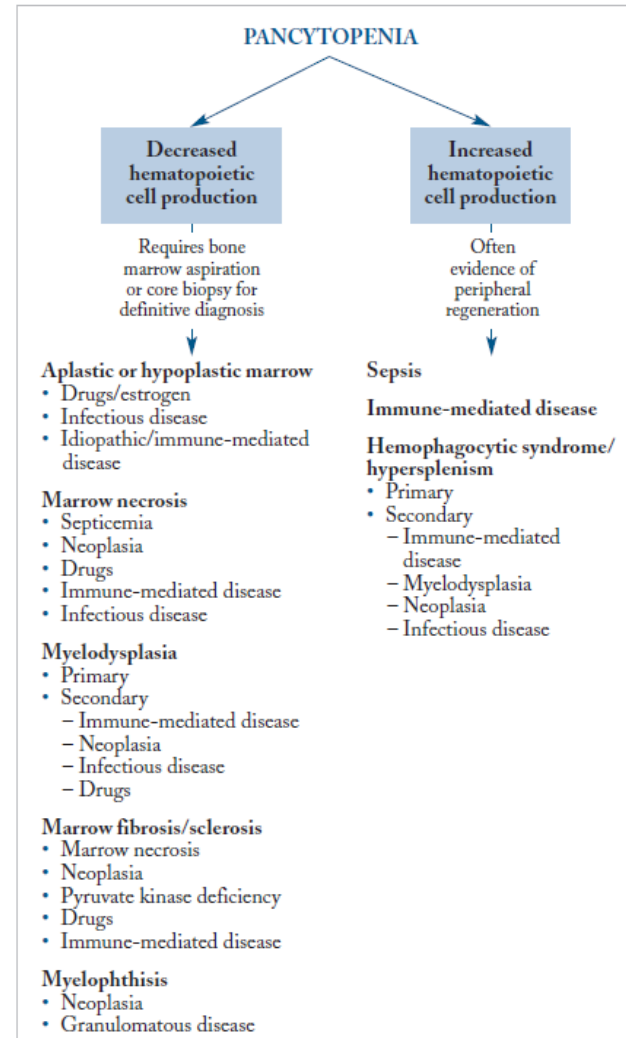


黃大勝

- 10y/o castrated male shiba inu
- Decreased activity since 2m ago, EC inf. Sus since 1m ago and start doxycycline therapy but the condition didn't improve
- Decreased appetite these days
- Vomiting once today
- Moderate pancytopenia noted today

黃大勝

	5/20	5/21	5/22	5/23	5/24	5/25	5/26	5/27	5/28	5/29	5/30
PCV	25.3	21.7	22.1	26.9	24.6	19.1	16.7	17.4	12.7	13.8	10.3
Reti	75.6	48	33.7	26.2	10.7	4.3	6	6.3	2.7	1.7	1.3
WBC	1.28	1.31	0.96	0.79	0.38	0.42	0.26	0.31	0.15	0.15	0.2
neu	0.32	0.32	0.23	0.21	0.12	0.11	0.09	0.16	0.05	0.04	0.02
lym	0.53	0.52	0.32	0.26	0.12	0.11	0.04	0.05	0.02	0.03	0.06
mono	0.42	0.41	0.37	0.31	0.13	0.19	0.12	0.1	0.08	0.08	0.12
eosin o	0	0.02	0.01	0	0	0	0.01	0	0	0	0
baso	0.01	0.04	0.03	0.01	0.01	0.01	0	0	0	0	0
PLT	95	78	53	83	51	32	13	18	1	0	2
CRP	7.8		8.9				8.7	9.2			



- Non-regenerative anemia with thrombocytopenia and neutropenia
- Infection? Sepsis? Pancreatitis?
- Saline agglutination test-
- Shiba MCV 45.7, low Retic-Hb
- Bone marrow core biopsy

肉丸

- 9 y/o intact male chowchow
- GDV history 5y ago
- Vomiting noted 5days ago
- Fever was found by LVH and unknown antipyretic drug administration
- Anorexia since 5days ago and didn't improved after medication
- Anemia was found and referred to 梅西AH
- Eat table food+dry food (no onion or other spice consumption)
- 1-dog family
- Regular ectoparasites prevention



肉丸

- BT : 39.2
- BW : 19.3kg
- RR : 120/min
- PR : 144bpm
- normal LN palpation
- pink to pale MM
- normal activity (aggressive)
- abdominal palpation: huge mass(?) or splenomegaly sus
- 3-6% dehydration



Hematology Results
Software Version: 4.3
Date: 18-200-21 15:07

Species: Dog
Patient:

Tests	Results	Units	Normal Range	Indicator
				LOW NORMAL HIGH
HCT	22.8	%	37.0 - 55.0	
HGB	8.0	g/dl	12.0 - 18.0	
MCBC	35.1	g/dl	30.0 - 36.9	
WBC	49.4	$\times 10^3/L$	6.0 - 16.9	
GRANS	41.6	$\times 10^3/L$	3.3 - 12.0	
SGRANS	84	%	1.1 - 6.3	
L/M	7.8	$\times 10^3/L$		
%M	16	%		
PLT	427	$\times 10^3/L$	175 - 500	
Retic	1.4	%		

Buffy Coat Profile

— DNA
— RNA/LP

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MULTI-PANEL-V2 QROJ58

1 BUN	18	mg/dl
2 Glu	98	mg/dl
3 ALP	129	IU/L
4 T-Pro	8.1	g/dl
5 GPT	25	IU/L
6 Cre2	1.0	mg/dl
SINGLE EJK75 FLOJ83 GGOK66		
7 Alb	2.7	g/dl
8 T-Bil	0.5	mg/dl
9 IP	4.9	mg/dl

— DNA
— RNA/LP



Conclusion

- Stable vital sign before DDx
- Regenerative or non-regenerative, it is a clue
- Cross-match before transfusion!!!!!!!!!!
- Parasites, SAT, Coombs, blood smear, primary lesion (US, CT)
- Medical record

感謝聆聽

