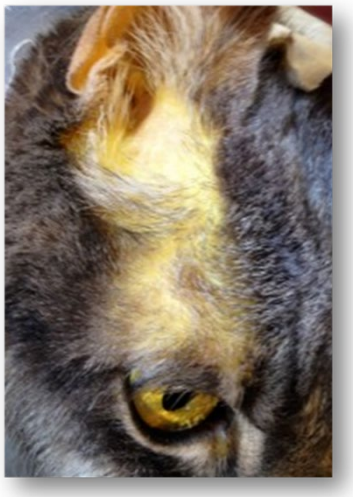
Laboratory Investigation of the Liver and Biliary System Workshop

Case 1: Lola



Lola is a 10-year-old female spayed domestic shorthair cat. On physical exam, she looked overweighted, jaundiced, and had tacky mucous membranes and mild hyperthermia. She presented with decreased appetite, weight loss, lethargy, and intermittent vomiting over the last few weeks.

CBC	Units	Result	Reference interval
Haemoglobin	g/L	117	77-156
RBC	x 10^{12}/L	7.2	4.9-10.0
Haematocrit	L/L	0.36	0.25-0.48
MCV	fL	52	43-55
MCH	pg	16	13-17
MCHC	g/L	321	282-333
WCC	x 10^{9}/L	**25.1**	5.5-19.0
Neutrophils	x 10^{9}/L	**20.7**	2.0-13.0
Lymphocytes	x 10^{9}/L	3.9	0.9-7.0
Monocytes	x 10^{9}/L	0.5	0-0.7
Eosinophils	x 10^{9}/L	0	0-1.1
Basophils	x 10^{9}/L	0	<0.1
Platelets	x 10^{9}/L	326	300-800

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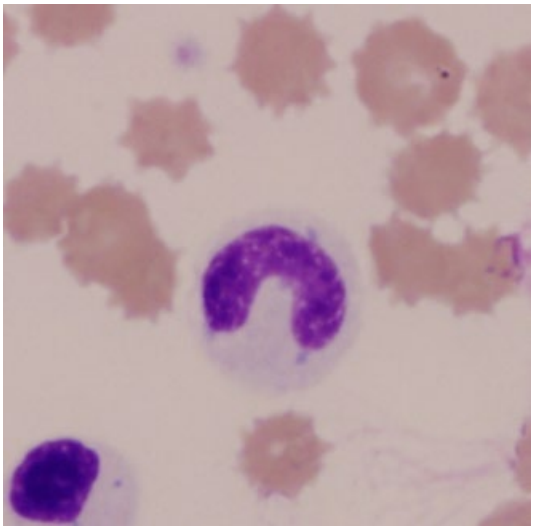

Blood film 100x

Biochemistry	Units	Result	Ref interval
Urea	mmol/L	**16.3**	5.0-15.0
Creatinine	mmol/L	0.14	0.08-0.20
Glucose	mmol/L	4.8	3.2-7.5
Cholesterol	mmol/L	4.0	2.2-5.5
Total Bilirubin	µmol/L	**74**	0-7
Conjugated Bilirubin	µmol/L	**33**	<3
ALT	U/L	**437**	19-100
AST	U/L	**181**	2-62
ALP	U/L	**239**	5-50
GGT	U/L	**83**	<12
CK	U/L	**570**	73-510
Total protein	g/L	79	60-84
Albumin	g/L	36	23-38
Globulin	g/L	43	31-52

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Questions

1. What abnormality can you detect in this image of her head?

Yellow discolouration of skin = icterus/jaundice

2. What are the three primary mechanisms for the development of this abnormality?

Prehepatic – haemolysis

Hepatic – hepatopathy causing cholestasis

Post-hepatic – biliary obstruction

3. What other physical examination findings would you expect with this abnormality?

Icteric sclera and mucous membranes

May see dark yellow urine (bilirubinuria)

If haemolysis, mucous membranes are pale

4. Evaluate Lola's haematology results. Which mechanism for the abnormality can we now exclude?

RBC/Hct/Hb are within normal limits, so not a prehepatic icterus

5. Is the elevation in Lola's AST more likely to reflect muscle or liver damage? Justify your answer.

CK is only mildly increased, whereas AST is moderately increased – this suggests hepatocellular damage is the source of the AST elevation rather than CK. However, as CK falls faster than AST, it could reflect muscle injury a few days prior. As the ALT is also increased and the degree of elevation is much higher than the AST elevation, this strongly supports hepatocellular damage as the cause.

6. What is the most likely mechanism for hyperbilirubinaemia? Justify your answer.

The elevated total bilirubin is a mix of conjugated (direct) and unconjugated (indirect). This, with the liver enzyme elevations supporting hepatocellular damage and cholestasis, supports a hepatic cause for icterus/hyperbilirubinaemia.

7. Are you concerned about liver failure? Would it be worthwhile to run bile acids to assess Lola's hepatic function? Justify your answer.

Albumin, cholesterol, urea, and glucose are not low; thus, there is no evidence of hepatic insufficiency. Bile acids would NOT help assess hepatic function as there is icterus and hence a failure to excrete bile which would cause an increase in serum bile acids without this reflecting hepatic failure. If we wanted to assess for hepatic failure, ammonia levels would be indicated.

8. Do you think Lola's hepatopathy is more likely to be acute or chronic? Justify your answer.

More likely acute as the history suggests her illness is recent rather than long-term. In addition, her haematology results suggest acute inflammation.

Final Dx: Cholangiohepatitis and pancreatitis

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Case 2: Betty

Betty is a 7-month-old female Maltese Terrier. She was thin, looked small for her age and breed, and had slightly pale mucous membranes. The owner mentioned that she is a picky eater who vomits occasionally and gets lethargic after a meal.

CBC	Units	Result	Reference interval
Haemoglobin	g/L	**98**	100-206
RBC	x 10^{12}/L	**4.8**	4.9-8.2
Haematocrit	L/L	**0.33**	0.35-0.58
MCV	fL	**62**	64-76
MCH	pg	25	21-26
MCHC	g/L	312	310-360
Reticulocytes	x 10^9/L	25	0-81
WCC	x 10^9/L	12.0	4.5-17.0
Neutrophils	x 10^9/L	7.5	3.5-12.0
Lymphocytes	x 10^9/L	4.0	0.9-3.5
Monocytes	x 10^9/L	0.5	0-1.2
Eosinophils	x 10^9/L	0	0-1.5
Basophils	x 10^9/L	0	<0.1
Platelets	x 10^9/L	210	200-500

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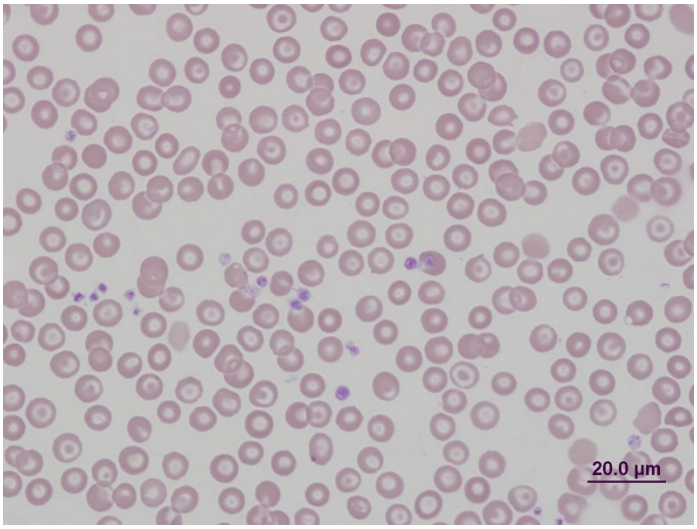
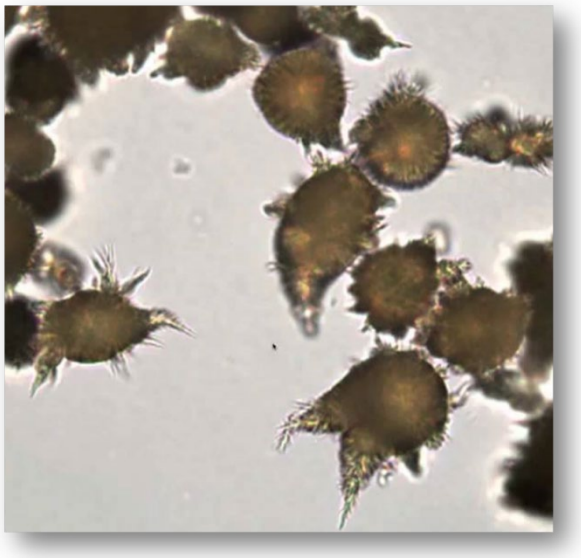


Blood film 100x



Urine sediment 40x

Biochemistry	Units	Result	Reference interval
Urea	mmol/L	**2.8**	3.0-7.5
Creatinine	µmol/L	100	40-140
Glucose	mmol/L	**2.8**	3.0-7.0
Cholesterol	mmol/L	**2.9**	3.6-9.0
Total Bilirubin	µmol/L	1	0-10
ALT	U/L	22	5-95
ALP	U/L	**354**	40-100
GGT	U/L	9	1-10
CK	U/L	243	50-400
Amylase	U/L	900	<2000
Lipase	U/L	80	<200
Total protein	g/L	60	60-84
Albumin	g/L	28	23-38
Globulin	g/L	32	24-44

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Questions

1. What are some potential causes for poor growth in a puppy?

Portosystemic shunt
Malnutrition
Parasitism
Congenital cardiac disease

2. The owner has read about portosystemic shunts (PSS) on the internet and is concerned this could be the problem. Based on the above blood results, what do you think?

Liver enzymes can be normal with a PSS and in the low end of the RI as they have reduced hepatic mass. There is evidence of reduced hepatic function – hypocholesterolaemia, hypoglycaemia, and low urea. In addition, she has mild microcytic anaemia, also seen with PSS.

3. What are the potential causes for the high ALP? Which is most likely in this case? Justify your answer.

Bone isoform – bone growth in a puppy of this age will increase ALP, most likely the cause in this puppy
Cholestasis – bilirubin is normal, so less likely the cause
Corticosteroid induction – no history of corticosteroid Rx so less likely, but could reflect stress hypercortisolaemia. We could measure the steroid isoform of ALP to check.

4. If she does have a PSS, what urinalysis findings might you expect?

Often have poorly concentrated urine and can have ammonium biurate crystalluria.

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5. What tests could be performed to confirm a PSS? Bile acid stim test and hepatic imaging

Bile acid stim test and hepatic imaging

Final Dx: PSS

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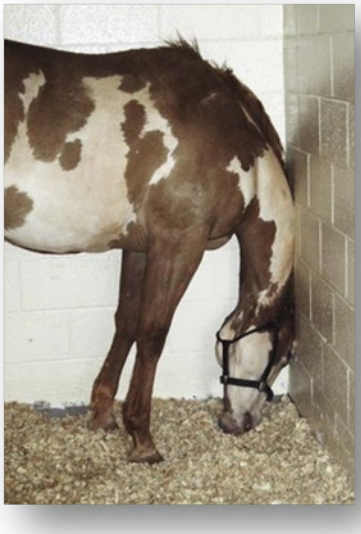
Case 3: Abacus



Abacus is an 11-year-old Thoroughbred horse presented with a history of weight loss over the past month and mild diarrhoea. He was quieter than usual for the past week and noticed pressing his head against the gate today. Abacus lives in a paddock with two cows, and both seem fine.

Biochemistry	Units	Results	Reference Interval
Urea	umol/L	**3.2**	5.0 – 9.7
Creatinine	umol/L	99	97 – 176
Total Protein	g/L	**84**	55 – 80
Albumin	g/L	30	30 – 45
Globulins	g/L	**54**	25 – 50
GGT	IU/L	**251**	7 – 17
ALP	IU/L	**601**	40 – 400
GLDH	IU/L	**54**	0 – 12
AST	IU/L	**580**	185 – 300
CK	IU/L	340	130 – 470
Glucose	mmol/L	**3.1**	3.6 - 7.7
Total Bilirubin	umol/L	**132**	10 – 36

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Questions

1. What are the potential causes for the yellow colouration of the serum? Which is most likely in this case?

- *Dietary carotenes*
- *Hyperbilirubinuria due to prehepatic, hepatic, or post-hepatic causes or anorexia*

In this case, hepatic disease-causing cholestasis is most likely

2. What does the increase in GLDH indicate?

The liver enzyme changes support hepatopathy as the cause of the hyperbilirubinuria

3. What is the most likely mechanism for hyperbilirubinaemia?

The liver enzyme changes support hepatopathy as the cause of the hyperbilirubinuria

4. Do you think the hepatopathy is more likely to be acute or chronic? Justify your answer.

The month-long history of weight loss suggests a chronic hepatopathy is more likely

5. Which results suggest there is decreased hepatic function in this horse?

Low urea and low glucose, and hyperbilirubinaemia

6. Are there any tests you would recommend before hepatic biopsy?

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I would recommend a coagulation profile as a hepatic disease can lead to insufficient production of coagulation factors which could then cause excessive bleeding when the liver is biopsied

7. What are the common causes of liver disease in horses?

pyrrolizidine alkaloid toxicity (more susceptible than cattle), cholangiohepatitis, hepatic lipidosis, hepatic abscess, fluke and parasitic migration, neoplasia