

Clinical Pathology of Parrots

-autotutorial programs

Marie Gunnarsson

Handledare: Harold Tvedten
Institutionen för biomedicin och veterinär folkhälsovetenskap avd för
bilddiagnostik och klinisk kemi

Sveriges lantbruksuniversitet
Fakulteten för veterinärmedicin och
husdjursvetenskap
Veterinärprogrammet

Swedish University of Agricultural Sciences
Faculty of Veterinary Medicine and
Animal Sciences
Veterinary Medicine Programme

Examensarbete 2006:8
ISSN 1652-8697
Uppsala 2006

Degree project 2006:8
ISSN 1652-8697
Uppsala 2006

INNEHÅLLSFÖRTECKNING

SUMMARY	1
SAMMANFATTNING.....	1
INLEDNING	1
Collecting Samples for Testing	2
Avian Hematology	2
Avian Biochemistry	2
Common Avian Diseases	2
Avian Cases	3
LITTERATURFÖRTECKNING	4
Internetkällor	4

SUMMARY

At the Veterinary Medicine Programme there is very little time allotted paid to exotic pets, which include psittacine birds, compared to other kinds of animals. However parrots are quite often seen as patients in the animal clinics in Sweden currently. Many veterinarians have unfortunately not enough knowledge to take care of such patients in a proper manner.

The aim of this degree project was to put together a CD with information about hematology and clinical chemistry in parrots. The information is supposed to be easily available and designed for interested veterinary students and veterinarians. The CD also includes information about how to collect blood samples and common avian diseases. It consists of five Power Point presentations: Collecting Samples for Testing, Avian Hematology, Avian Biochemistry, Common Avian Diseases and Avian Cases. The language is English to make this project also available for foreign students and veterinarians.

SAMMANFATTNING

På veterinärutbildningen vid Sveriges lantbruksuniversitet ägnas knappt någon tid alls åt de udda sällskapsdjuren, dit papegojor räknas, i jämförelse med andra djurslag. Det är dock inte så ovanligt att papegojor kommer in som patienter till djurklinikerna. Många veterinärer har inte de kunskaper som krävs för att kunna ta hand om de här patienterna på ett professionellt sätt.

Syftet med det här examensarbetet var att skapa en CD-rom där information om framför allt hematologi och klinisk kemi hos papegojor ska finnas lättillgänglig för veterinärstudenter och yrkesverksamma veterinärer. Även information om provtagning och vanliga sjukdomar ingår. På CD-skivan ingår fem Power Point-presentationer: Collecting Samples for Testing, Avian Hematology, Avian Biochemistry, Common Avian Diseases och Avian Cases. Språket som används är engelska för att även utländska studenter och veterinärer ska kunna ta del av utbildningsmaterialet.

INLEDNING

Papegojor tillhör den grupp djur som brukar kallas exotiska eller udda sällskapsdjur i veterinärmedicinska sammanhang. På veterinärutbildningen vid Sveriges lantbruksuniversitet är de utan tvekan exotiska, men denna beskrivning stämmer allt sämre när man ser till vilka typer av patienter som dyker upp på djurklinikerna i Sverige. Allt fler djurägare har sina papegojor försäkrade och uppsöker veterinär när fåglarna blir sjuka. Det växande behovet av kunskap hos veterinärer inom detta område möts enligt min mening inte upp av veterinärutbildningen.

Eftersom undervisningen på veterinärprogrammet inte tar upp udda sällskapsdjur i någon större utsträckning och detta är ett område som speciellt intresserar mig har jag valt att under min sista termin på veterinärprogrammet fördjupa mig inom ämnet. Jag har inriktat mig framför allt på hematologi hos papegojor.

För att andra veterinärstudenter och även färdigutbildade veterinärer ska kunna ta del av mina nyförvärvade kunskaper på ett lättillgängligt och inspirerande sätt har jag skapat en CD-rom som innehåller fem olika Power Point-presentationer. Dessa presentationer är utformade så att den intresserade ska kunna följa dem på egen hand i valfri turordning. För bästa utbyte bör presentationerna ses i fullbildsformat. De flesta bilder som ingår är tagna för det här projektet av min handledare Harold Tvedten eller utvalda ur hans arkiv och några är tagna av veterinärstudent Torvald Netterby. Resten av bilderna är bilder från internet som inte är upphovsrättsskyddade. Mer information om dessa bilders ursprung finns på CD-skivan. Språket som används är engelska för att även utländska studenter och veterinärer ska kunna ta del av utbildningsmaterialet. Nedan följer en kort beskrivning av de olika Power Point-presentationerna.

Collecting Samples for Testing

En förutsättning för att kunna undersöka papegojornas blod är naturligtvis att ett blodprov ska kunna tas. Detta kan säkert skrämman många som inte är vana att hantera fåglar. Det är dock viktigt att komma ihåg att det inte är svårare att ta ett blodprov från en papegoja än vad det är att ta ett blodprov från en hund eller en katt. Naturligtvis underlättar det om en van person håller i fågeln och lämplig utrustning används. Den här presentationen går igenom förberedelser inför provtagning, provtagningsförfarande och rutiner efter provtagning till exempel hur ett blodutstryk utförs.

Avian Hematology

Den största skillnaden mellan fågelblod och blod från däggdjur är att alla blodceller i perifert fågelblod är kärnförande. Detta innebär alltså att hos fåglar har både erythrocyter och trombocyter kärnor. En annan skillnad är att fåglar saknar neutrofila granulocyter som finns hos däggdjur. Istället har de en celltyp som kallas heterofila granulocyter. Dessa två olika celltyper motsvarar varandra. Den här presentationen går framför allt igenom den normala morfologin hos de olika celltyperna, men även lite mer speciella fynd såsom toxiska heterofiler och reaktiva lymfocyter tas upp. Anemi och artefakter är två andra ämnen som också ingår i presentationen. Presentationen avslutas med frågor och svar som får läsaren att tänka till och kontrollera sin kunskaper.

Avian Biochemistry

Vilka biokemiska analyser som är meningsfulla att genomföra skiljer sig mellan djurslag. Presentationen som handlar om biokemi tar upp de analyser som oftast genomförs på papegojor enligt Gunnel Andersson, som arbetar som veterinär på Djurkliniken Roslagstull i Stockholm, där de är specialiserade på papegojor och andra udda sällskapsdjur. Även hur provsvaren sedan ska tolkas ingår i stora drag i presentationen.

Common Avian Diseases

Papegojor drabbas till viss del av samma sjukdomar som däggdjur, men det finns en del sjukdomar som är specifika för fåglar. De sjukdomar som tas upp i den här presentationen är bland de vanligaste som förekommer hos fågelpatienter på djurkliniken. Psittacine beak and feather disease är inte vanligt förekommande i Sverige, men ingår ändå eftersom det är en så pass viktig sjukdom. Vissa

sjukdomar som drabbar papegojor är zoonoser, t.ex. chlamydios eller papegojsjuka som den även kallas. Dessa sjukdomar är kanske extra viktiga att känna till när man arbetar med fågelpatienter.

Avian Cases

Denna presentation tar upp två autentiska fall som är hämtade ur patientunderlaget på Regiondjursjukhuset Strömsholm. Bilderna på blodutstryken är tagna av Harold Tvedten från de blodutstryk som tillhör de riktiga patienterna. Syftet med presentationen är att visa typiska fall så att läsaren kan bilda sig en uppfattning om hur det kan vara att ha en papegoja som patient. Det sista fallet visar även att det inte alltid blir riktigt som man tänkt sig.

LITTERATURFÖRTECKNING

- Andersson, Gunnel. Legitimerad veterinär, Djurkliniken Roslagstull, Stockholm. Udda sällskapsdjur. Föredrag 2005-10-15.
- Austic RE & Scott ML. (1991) Nutritional diseases. In: Calnek BW, Barnes HJ, Beard CW, Reid WM & Yoder HW Jr. (Eds.) *Diseases of poultry*. 9 ed. 45-71. Ames: Iowa state university press.
- Campbell TW. (1988) Avian hematology and cytology. Ames: Iowa state university press.
- Campbell TW. (1994) Hematology. In: Ritchie BW, Harrison GJ & Harrison LR. (Eds.) *Avian medicine: Principles and applications*. 176-198. Lake worth: Wingers Publishing, Inc.
- Coles BH. (1991) Cage and aviary birds. In: Beynon PH. & Cooper JE. (Eds.) *Manual of exotic pets*. 150-179. Cheltenham: British Small Animal Veterinary Association
- Fudge AM. (2000) Laboratory medicine avian and exotic pets. Philadelphia: W.B. Saunders Company.
- Girling SJ. (2003) Veterinary nursing of exotic pets. Oxford: Blackwell Publishing.
- Harcourt-Brown NH. (2000) Psittacine birds. In: Tully TN, Lawton MPC & Dorrestein GM (Eds.) *Avian medicine*. 112-143. Oxford: Butterworth-Heinemann.
- Harris DJ. (2000) Clinical tests. In: Tully TN, Lawton MPC & Dorrestein GM (Eds.) *Avian medicine*. 43-51. Oxford: Butterworth-Heinemann.
- Hawkey CM, Hart MG, Knight JA, Samour JH & Jones DM. (1982) Haematological findings in healthy and sick African grey parrots (*Psittacus erithacus*). Vet Rec 18/25, 580-582.
- Kazacos EA & Van Vleet JF. (1989) Sequential ultrastructural changes in the pancreas in zinc toxicosis in ducklings. Am J Pathol 134, 581-595.
- Lu J. & Combs GF Jr. (1988) Effects of excess dietary zinc on pancreatic exocrine function in the chick. J Nutr 118, 681-689.
- Lucas AM. & Jamroz C. (1961) Atlas of avian hematology. Washington: United States department of Agriculture.
- Lumeij JT & Remple JD. (1991) Plasma urea, creatinine and uric acid concentration in relation to feeding peregrine falcons (*Falco peregrinus*). Avian Pathol 20, 79-83.
- Samour JH. (2000) Avian Medicine. London: Mosby.
- Zdziarski JM, Mattix M, Bush RM & Montali RJ. (1994) Zinc toxicosis in diving ducks. J Zoo Wildl Med 25, 438-445.
- Zinkl JG. (1986) Avian hematology. In: Nemi JC. (Ed.) *Schalm's veterinary hematology*. 256-273. Philadelphia: Lea & Febiger.

Internetkällor

- <http://www.californiaavianlaboratory.com/artifact.html>. (2005-03-11)
- <http://www.californiaavianlaboratory.com/bileac.html>. (2005-03-11)
- <http://www.californiaavianlaboratory.com/chempro.html>. (2005-03-11)
- <http://www.californiaavianlaboratory.com/chempro.html>. (2005-03-11)
- <http://www.californiaavianlaboratory.com/leukocount.html>. (2005-03-11)

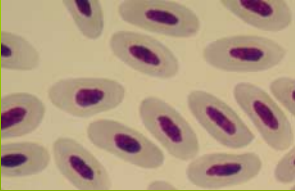
<http://www.merckvetmanual.com/mvm/htm/bc/170304.htm> (2005-12-04)
<http://www.merckvetmanual.com/mvm/htm/bc/170310.htm> (2005-12-04)
<http://www.merckvetmanual.com/mvm/htm/bc/170318.htm> (2005-12-04)
<http://www.merckvetmanual.com/mvm/htm/bc/170319.htm> (2005-12-04)
<http://www.merckvetmanual.com/mvm/htm/bc/170322.htm> (2005-12-04)
<http://www.merckvetmanual.com/mvm/htm/bc/206100.htm> (2005-12-04)



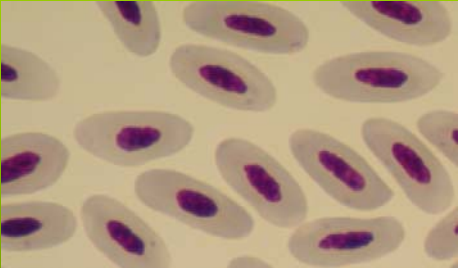
Birds have nucleated erythrocytes. The cell is oval with an oval centrally positioned nucleus.

Avian erythrocytes are much larger than most mammalian erythrocytes. The size varies among species.

Erythrocytes

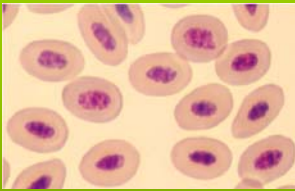


This 1.5 year old African grey parrot had a problem with feather plucking but had normal appearing erythrocytes.



The chromatin in the nucleus is uniformly clumped and becomes more condensed with age. The cytoplasm has a uniform texture and stains orange-pink.

Erythrocytes

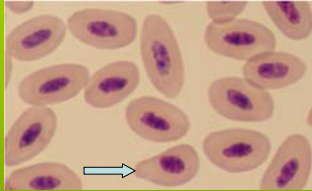


These are normal erythrocytes from a healthy 11 year old African grey parrot.

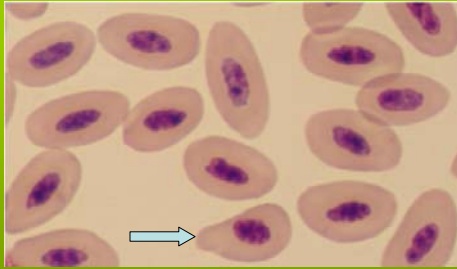


In avian blood smears variations from the typical erythrocyte are occasionally seen. The shape can vary (poikilocytosis) from irregular to round or elongated. Changes limited to certain areas are often artifactual.

Erythrocytes



The occasional abnormally formed erythrocyte was from the same normal African grey parrot seen previously.



Erythrocytes

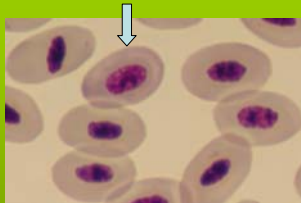
It is important to separate artifact from true morphologic changes.

Erythrocytes missing nuclei are called erythroplastids. They are often due to preparation artifact.

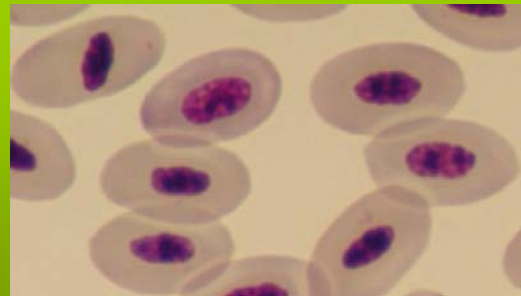


Occasional immature polychromatophilic erythrocytes are normally seen. Their cytoplasm is more basophilic and chromatin more dispersed than in mature erythrocytes.

Erythrocytes



This blood is from a healthy 11 year old African grey parrot.

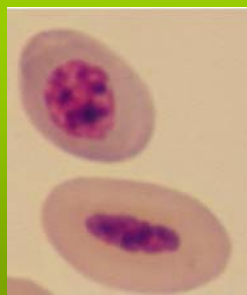


Erythrocytes

Immature erythrocytes are also more round than mature erythrocytes.

Question:

Which one of these erythrocytes is the most immature?

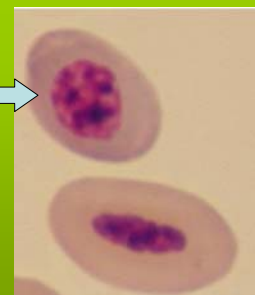


Erythrocytes

Answer:

This is the most immature erythrocyte.

The blood is from a healthy African grey parrot.



Anemia

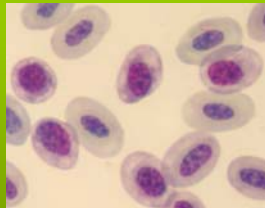
An indication of erythrocyte regeneration (bone marrow response to an anemia) is the degree of polychromasia. 1-5 % erythrocyte polychromasia is normal in a healthy bird. In a blood smear from a bird with regenerative anemia the degree of polychromasia will increase.

Anemia

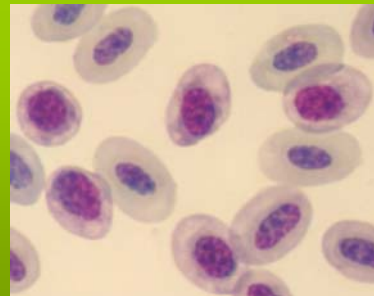
Anisocytosis (variability in cell size) occurs normally in blood smears from healthy birds. With an active bone marrow response to anemia, anisocytosis increases and it is characterized by younger larger and rounder erythrocytes.

Anemia

This is an example of regenerative anemia. Notice that about half of the erythrocytes are immature polychromatophilic cells.



This is blood from a 3 month old male red fronted kakariki with hemolytic anemia.



Anemia

Nonregenerative anemia has no or little increase immature erythrocytes and a low degree of polychromasi which indicates a lack of effective bone marrow response. One should identify the underlaying cause to allow a better prognosis.

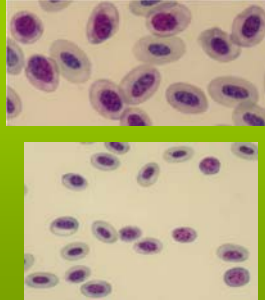
Anemia

Increased erythrocyte destruction, decreased erythrocyte production or blood loss can result in anemia.

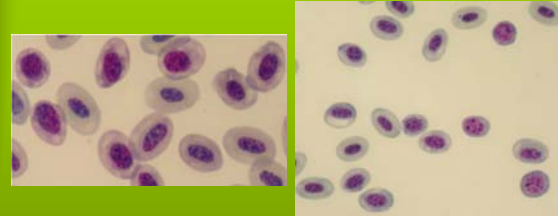
Blood loss anemia may result from trauma, bloodsucking ectoparasites, gastrointestinal parasitism, coagulopathies, ulcerated neoplasms or rupture of internal organs.

Anemia

Increased erythrocyte destruction may be associated with bacterial septicemias, acute aflatoxicosis, toxemias or blood parasites.



This is blood from the red fronted kakariki with hemolytic anemia.



Anemia

Decreased erythrocyte production may be associated with chronic infectious diseases such as tuberculosis, chlamydiosis, aspergillosis and chronic hepatic disease.

Other causes are nutritional deficiencies (iron, folic acid), chemicals and toxins (lead, aflatoxin). It may also be associated with neoplasias, such as lymphoid neoplasia.

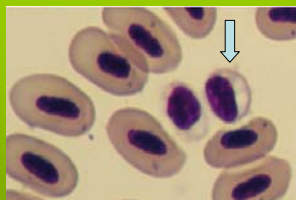
Anemia

This picture present anemia and hypochromic erythrocytes caused by lead poisoning.



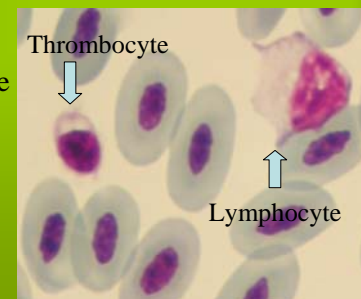
Thrombocytes

Thrombocytes are nucleated and function like mammalian platelets in hemostasis. Thrombocytes are smaller and more rounded than mature erythrocytes.



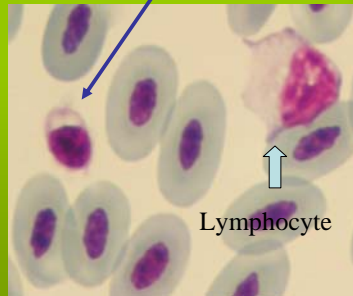
Compared to the erythrocyte nuclei, thrombocyte nuclei are more rounded and have a higher nuclear/cytoplasmic ratio.

Thrombocytes



Avian thrombocytes are often mistaken for lymphocytes by beginning hematologists and even automated hematology analyzers.

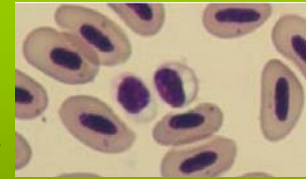
Thrombocytes



Lymphocyte

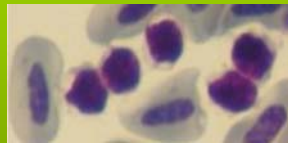
Thrombocytes

The cytoplasm is clear but not homogenous. Thrombocytes contain specific granules in variable number, size and position in the cell. They take a pink to reddish color.

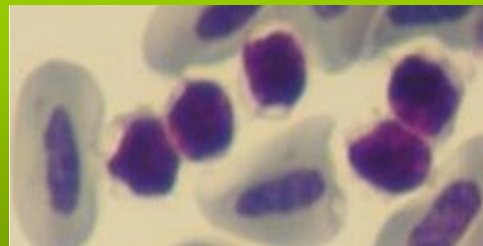


Thrombocytes

Thrombocytes tend to clump, so it is difficult to do a thrombocyte count. A subjective estimation can be made. Seeing 1-2 thrombocytes in an average monolayer oil immersion field is normal.



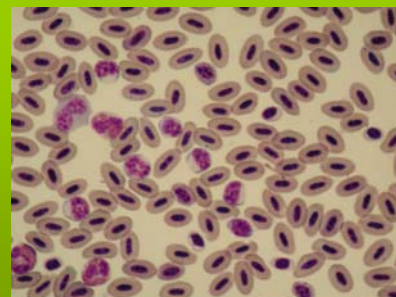
This is blood from a 3 month old female kakariki with signs of liver disease. The thrombocytes look normal.



Thrombocytes

Enlargement of the thrombocyte's cytoplasm indicates a reactive change. Thrombocytes have a phagocytic defense function and the reactive changes are thought to be associated with this function.

Leukocytes



Leukocytes

Differential white cell count:

Interspecies variations are great and these reference values are only a very rough guide.

Heterophils	30-75%
Lymphocytes	20-65%
Monocytes	0-5%
Basophils	0-5%
Eosinophils	0-4%

Leukocytes

Disease or physiologic changes such as "stress" may cause **leukocytosis** (increased number of leukocytes in blood). Infection is the most common cause to disease related leukocytosis.

Leukocytes

Stress leukocytosis occur in species like macaws, cockatoos, African greys and ratites. Stress causes endogenous release of cortisone which has many effects on blood and other tissues. Treatment with corticosteroids can also result in stress hemograms. Elevated leukocyte counts are common although the bird may not be diseased.

Leukocytes

Mild leukocytosis: bacterial, fungal and chlamydial infections.

Moderate leukocytosis: yolk peritonitis, granulomatous disease, some phases of septicemia.

Severe leukocytosis: active chlamydiosis, aspergillosis, tuberculosis, leukemia.

Leukocytes

Leukopenia is reduced leukocyte numbers which are often an artifact related to sample handling such as:

- Blood clots before placement in anticoagulant
- Lysis due to excessive shipping and storage time
- Poor quality blood films

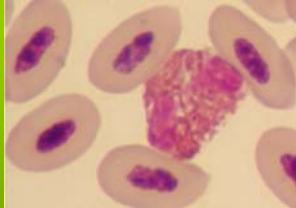
Leukocytes

True leukopenia is usually a result of overwhelming bacterial infection, severe viral disease or toxic substances.

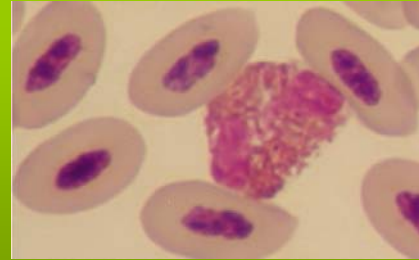
Consider the variation of leukocyte count between species. Smaller birds tend to have lower leukocyte count than larger birds.

Heterophils

Heterophils, the cells analogous with mammalian neutrophils, are the most common leukocyte in avian blood. They are round with colorless cytoplasm and eosinophilic rod-shaped granules.

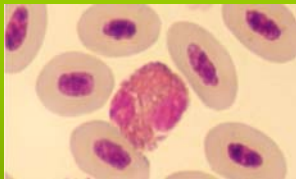


This is a heterophil from an 11 year old African grey parrot.

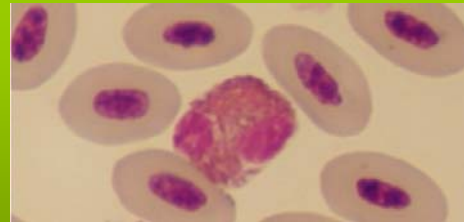


Heterophils

The nucleus is lobed in mature heterophils with clumped chromatin that stains purple. The cytoplasmic granules often hide the nucleus. Heterophils show a little variability in size.

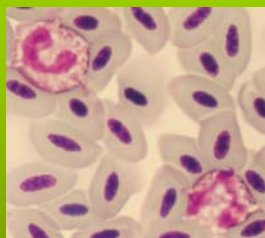


This is another heterophil from the same 11 year old African grey parrot as seen previously.

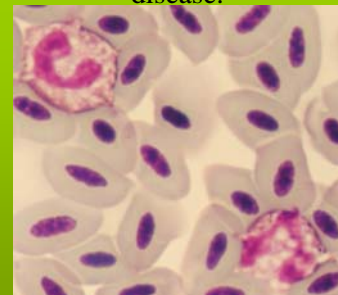


Toxic heterophils

Heterophils may exhibit toxic changes, including cytoplasmic basophilia, nuclear hypersegmentation, vacuolization and basophilic cytoplasmic granules.

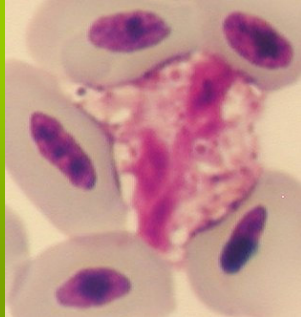


These are two toxic heterophils from a 17 year old Amazon parrot with respiratory disease.



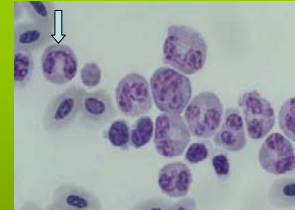
Toxic heterophils are seen with septicemias, viremias and chlamydial infections. More severe toxic change indicates more severe and often infectious disease.

Toxic heterophils



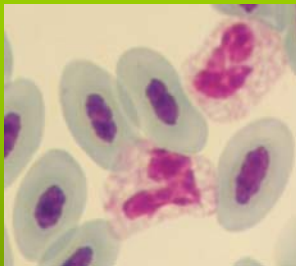
Left shift

Immature heterophils when seen indicates severe inflammation. Both toxic heterophils and immature heterophils have cytoplasmic basophilia and it is easy to confuse these two.

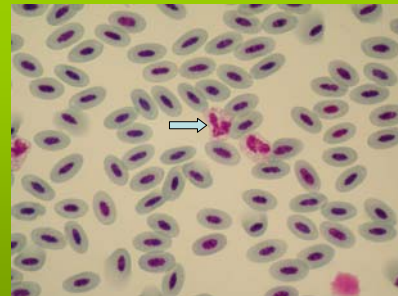


It is important to recognize a normal cell even if there is a technique artifact involved. Stain that is too old may cause this artifact where heterophil granules fail to stain. This is an artifact and not toxic change in these heterophils.

Artifacts

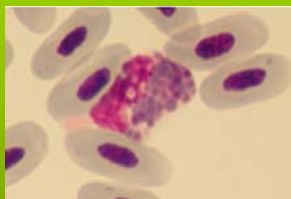


These heterophils were from a cockatoo with no clinical signs of disease.

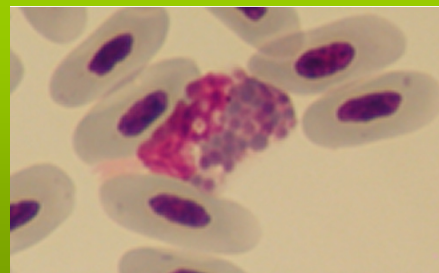


Eosinophils

Eosinophils tend to be more irregular than heterophils. They are typically round and have round granules. Eosinophil cytoplasm is pale blue. Granules may be red, blue or clear. Cell size varies quite a lot.

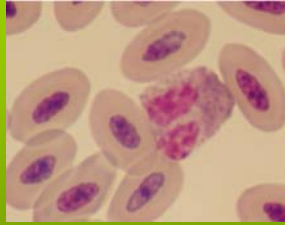


This is a eosinophil from an 1.5 year old male African grey parrot.

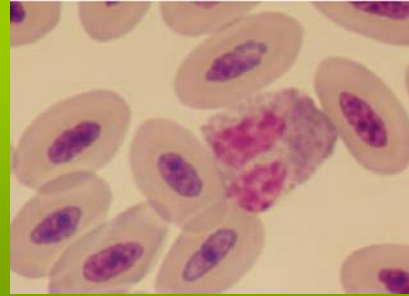


Eosinophils

The nucleus of the eosinophil often stains more blue and is more noticeable than the heterophil nucleus. Eosinophil nuclei are lobed with clumped chromatin that stains purple.



This is an eosinophil from a healthy African grey parrot.



Basophils

Avian basophils are round with a round nucleus. The nucleus is centrally located and light blue. The cytoplasmic granules stain deeply basophilic and often hide the nucleus.



Lymphocytes

In some avian species lymphocytes are the most common leukocyte. They are round but can sometimes look irregular due to molding around other adjacent cells. The nucleus is round.



Lymphocytes

The amount of cytoplasm may vary from a narrow band to abundant cytoplasm in large lymphs. The nuclear to cytoplasmic ratio is high. The cytoplasm is light blue and hyaline.

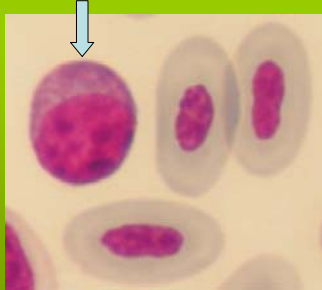


Antigenic stimulation transforms lymphocytes into reactive lymphocytes. Viral and chlamydial infections may be responsible but the nonspecifically indicate an immune response.

Reactive lymphocytes

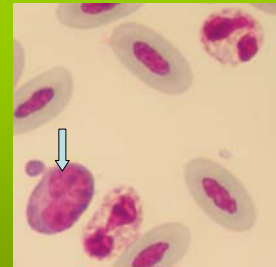


This is a reactive lymphocyte from a 15 year old parrot.

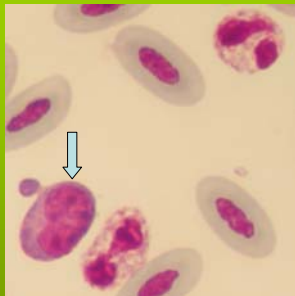


Reactive lymphocytes

The cytoplasm of reactive lymphocytes is darker blue reflecting protein synthesis. The nucleus often has an immature appearance.

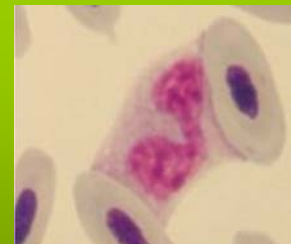


This is another reactive lymphocyte from a 15 year old parrot.

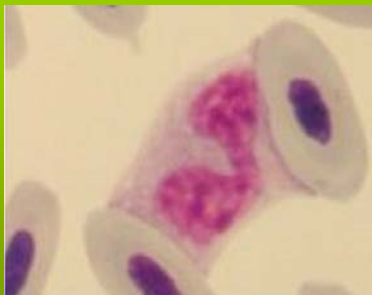


Avian monocytes are large and round or irregular. The nucleus is eccentrically placed in many monocytes and may be round or bilobed. The chromatin is delicate and lacelike, but chromatin clumps can be present.

Monocytes



This is a monocyte from an 1.5 year old male African grey parrot.

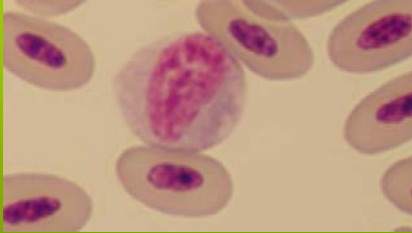


Monocytes

The cytoplasm has a finely granular appearance and stains blue-gray. Sometimes it contains vacuoles.



This is a monocyte from an 11 year old male African grey parrot.



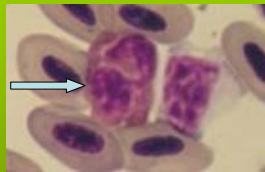
Question

One of these leukocytes is a heterophil. Which one is the heterophil and what type of leukocytes is the other one?



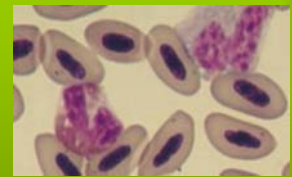
Answer

This is the heterophil (arrow) and the other leukocyte is a lymphocyte.



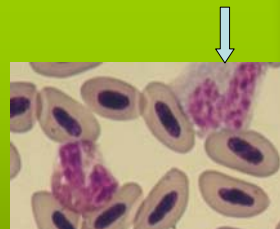
Question

One of these leukocytes is a monocyte. Which one is the monocyte and what type of leukocytes is the other one?



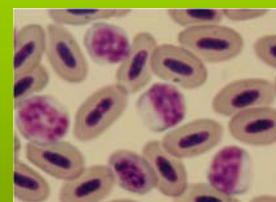
Answer

This is the monocyte (arrow) and the other leukocyte is a heterophil.



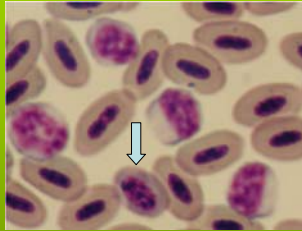
Question

How many lymphocytes do you see in this picture?



Answer

There are four lymphocytes in this picture. It's easy to get confused by the immature erythrocyte (arrow).



Question

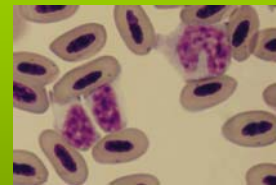
What characterize an immature erythrocyte?

Answer

Immature erythrocytes are polychromatophilic with basophilic cytoplasm. They are also rounder than mature erythrocytes.

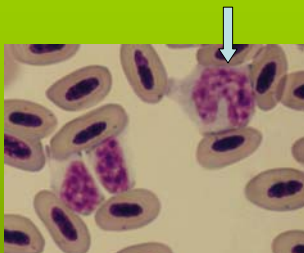
Question

What kind of leukocytes can you see in this picture?



Answer

This is a monocyte (arrow). The other two leukocytes are lymphocytes.



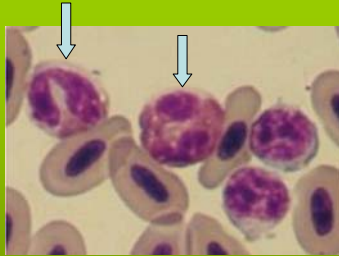
Question

Identify these leukocytes.



Answer

The two leukocytes to the left are heterophils (arrows) and the two leukocytes to the right are lymphocytes.



Question

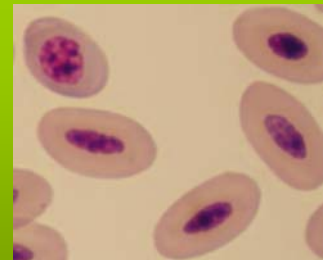
Name a disease that causes severe leukocytosis.

Answer

Active chlamydiosis, aspergillosis, tuberculosis and leukemia are some examples of diseases that causes severe leukocytosis.

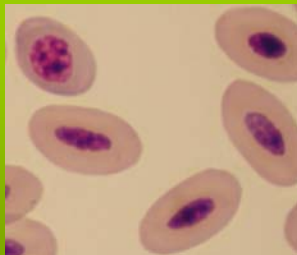
Question

Identify these blood cells.



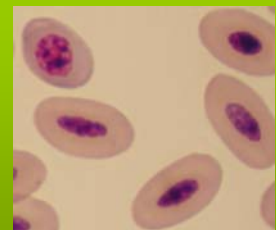
Answer

All the cells are erythrocytes. The one in the upper left corner is the most immature.



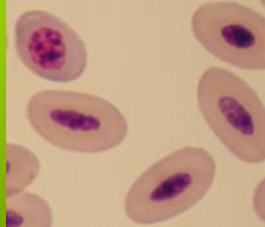
Question

This blood is from a bird with anemia. How can you differentiate between non-regenerative anemia and regenerative anemia in a blood smear?



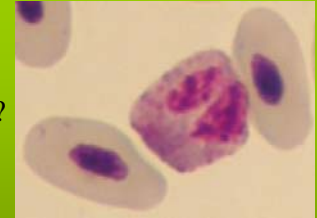
Answer

In regenerative anemia the degree of polychromasi and anisocytosis increases.



Question

What kind of leukocyte is this?



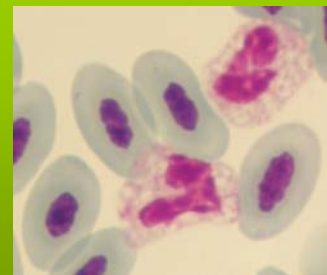
Answer

This is an eosinophil (arrow).



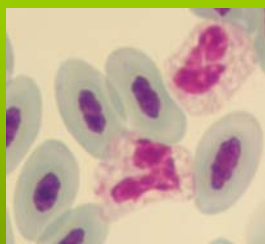
Question

Identify these leukocytes.



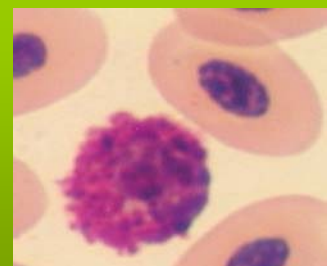
Answer

The two leukocytes are normal heterophils. Their abnormal appearance is due to an artifact.



Question

What kind of leukocyte is this?



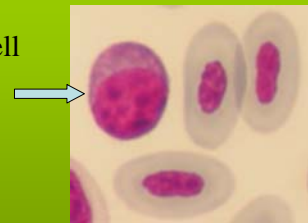
Answer

This is a basophil (arrow).



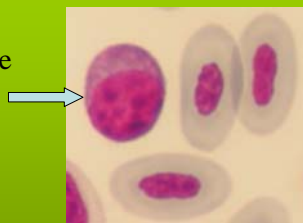
Question

What kind of cell is this?



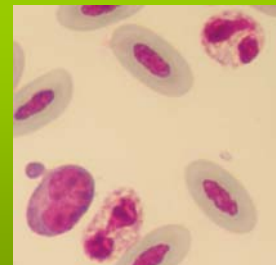
Answer

This is a reactive lymphocyte.



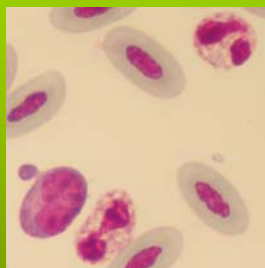
Question

What is the cause of reactive lymphocytes?



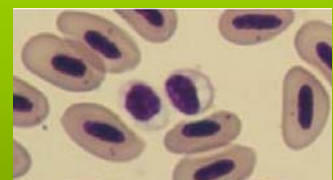
Answer

Antigenic stimulation causes the transformation of resting lymphocytes to reactive lymphocytes.



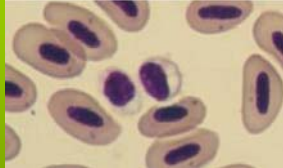
Question

Identify these blood cells.



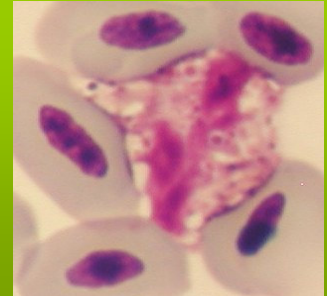
Answer

The two smaller cells in the middle are thrombocytes and the cells surrounding them are erythrocytes.



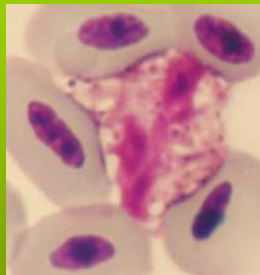
Question

Identify this leukocyte.



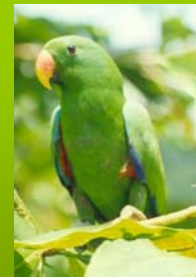
Answer

This is a toxic heterophil. Notice the dark and round and irregularly shaped granules.



Good luck!

This was a good start but continue reading the literature for more information about avian hematology.



Avian Biochemistry

Marie Gunnarsson
Institute for Clinical Chemistry
Swedish Agricultural University

Avian biochemistry

The most common analyses are:

- AST – aspartate aminotransferase
- CK - creatine kinase
- Bile acids
- Glucose
- Protein
- Uric acid
- Calcium
- Amylase
- Cholesterol
- Triglycerides
- Lead and zinc

Aspartate aminotransferase

AST will get elevated within days following liver or muscle damage. If both AST and CK are elevated the bird can suffer from liver and/or muscle damage. If only AST is elevated liver damage is indicated.

Severe hemolysis in the serum sample is another reason for high AST.

Aspartate aminotransferase

AST has high sensitivity but lower specificity for it leaks from both liver and muscle when those tissues are damaged.



Creatine kinase

Elevated CK can be a sign of active muscle damage. It has both high specificity and high sensitivity for muscle disease.

An elevation of CK can also be due to severe sample hemolysis.



Bile acids

From cholesterol bile acids are synthesized in the liver. Bile acids are released from the gallbladder after a meal. Even in birds without gallbladder there is an increased release after eating.

Elevation in bile acids is a sign of reduced hepatic function. Liver-related enzymes are not as sensitive as bile acids when it comes to detecting reduced hepatic function.

Chronic hepatic damage with persistent loss of liver function may be detected by measuring bile acids. AST will often return to normal after acute insult if there is not continuing damage to hepatocytes with leakage of AST.

Bile acids



Bile acids

Persistent elevation in bile acids is an indication for a hepatic biopsy. A biopsy can give a more specific morphologic or etiologic diagnosis.



Glucose

Birds have a much higher normal glucose value than mammals.

The main regulatory hormone is glucagon, rather than insulin.

Glucose

Glucocorticoid hormones may cause hyperglycemia by increased glucose production. Adrenergic hormones are glycogenolytic and result in increased glucose release.

Glucose

Diabetes mellitus is a possible diagnosis when glucose is elevated to very high concentrations ($>1000\text{mg/dL}$).



Glucose

Granivorous birds can not maintain constant plasma glucose levels as long as carnivorous species.

Very low values are often due to bacterial contamination or samples stored too long before analysed.

Protein

Inflammatory disorders and hemoconcentration due to dehydration can result in absolute and relative elevations of protein.



Protein

Acute blood loss or protein losing enteropathies should cause hypoproteinemia. Starvation may cause hypoproteinemia but homeostasis often maintains plasma protein normal.



Uric acid

Uric acid is synthesized in the kidney, but to a greater extent in the liver. It is filtered by the glomerules and secreted by the proximal tubules. Elevated blood uric acid indicates either extensive proximal tubular damage (renal azotemia) or severe dehydration (prerenal azotemia) in the noncarnivorous bird. Significant elevations of blood uric acid occur after a high-protein meal in carnivorous birds.

Uric acid

Uric acid concentration is not a sensitive renal function test, but it is the best way to assess the renal function in birds. Urea and creatinine are not useful.



Calcium

During ovulations large elevations of calcium can be seen. Neurological signs may be caused with hypocalcemia.



Calcium

Malnutrition may be cause hypocalcemia but normal serum values do not rule out disorders in calcium metabolism. Homeostasis can often hold calcium and phosphorus concentrations within normal limits.



Calcium

Hypocalcemia is often related to specific nutritional deficiencies. Nutritional imbalance is most commonly due to seed diets. The classic seed mix contains little or no vitamin D3, excess fat, small amounts of calcium, and excess phosphorous giving a low Ca/P ratio in the diet.

Calcium

Good-quality sample is needed for calcium analysis. Hemolysis, lipemia, bacterial contamination and unseparated samples adversely affect calcium assays.



Amylase

Plasma amylase elevations can be associated with pancreatitis. As in mammals some cases of enteritis may result in amylase elevations. To obtain a specific diagnosis pancreatic biopsy is indicated.



Cholesterol and triglycerids

By measuring cholesterol and triglycerids the fat metabolism can be assessed.

Obesity is a common problem for birds that eat too much seeds with excess fat.



Cholesterol and triglycerids

Elevated cholesterol levels are associated with hypothyroidism, hepatic lipidosis, high fat diets and starvation, especially in obese birds. But unfortunately there are no clear indicators to determine whether or not an abnormal cholesterol level is associated with a particular condition.

Lead

Lead is a toxic heavy metal of no nutritional value. It is absorbed through the intestine into the blood and affects a variety of systems.

Common clinical signs of lead poisoning are neurological signs, vomiting and fatigue.

Lead

Whole blood should be collected for hematology and lead analysis. Different laboratories require different sample sizes and some laboratories prefer a particular anticoagulant.



Zinc

Zinc is an essential element. It is required for many enzymatic systems but can cause toxicity if the intake is too high. Excess zinc exposure interferes with the normal exocrine function of the pancreas, reduce egg production and initiates moult among other things.

Zinc

When zinc toxicosis is suspected radiography, hematology and analysis of whole blood, plasma or serum should be used for diagnosis.



Hopefully these comments on avian biochemical analyses helped. Much work still needs to be done to aid in avian diagnosis so keep reading and even think of projects to improve our knowledge.

Good luck!



Collecting Samples for Testing



Marie Gunnarsson
Institute for Clinical Chemistry
Swedish Agricultural University

Clinical procedures

Handling birds stresses and occasionally kills them. Minimize how often you catch a bird or restrain it.

Have all the equipment you'll need to take blood ready before clinical examination commences.



Clinical procedures

If the best quality equipment is used the risk for erroneous results decreases. Anticoagulant bottles for example, should have been stored properly.

Since human health may be at risk when taking samples appropriate guidelines should be followed. Be aware of zoonotic infections!

Clinical procedures

Following sample collection the bird should be carefully monitored. This provides further information on the condition of the bird and also makes sure of the well-being of the bird.



The following techniques can be carried out on avian blood:

- Hematology
- Biochemistry
- Parasitology
- Toxicology
- Microbiology
- DNA and chromosomal studies
- Blood gas analysis

Collection of blood samples

The total blood volume of a bird is approximately 10% of its body weight and in a healthy bird it is safe to remove 10% of the blood volume. In a severely ill bird this volume should be reduced.

Collection of blood samples

A 30 g bird will have approximately 3 ml of blood and therefore 0,3 ml can be safely removed.



Collection of blood samples

The blood collected is usually of venous origin and can be taken from the right jugular vein which is larger than the left. On the right side of the neck there is an area without feathers where you usually easy find the vein.



Collection of blood sample

Blood can also be drawn from the basilica vein (wing or brachial vein) where it crosses the elbow on the inside of the wing, but this often results in large hematomas. Another alternative is the caudal tibial vein on the medial side of the tibiotarsus above the tarsal joint.

Collection of blood samples

It is not necessary to collect blood during anesthesia but it can reduce the stress for the bird. If the bird has to go through further examination, x-ray for example, it can be a good idea to do all diagnostic investigations at once during anesthesia.



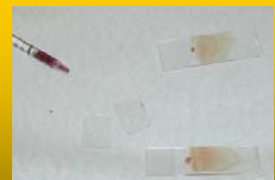
Collection of blood samples

The blood is taken using a thin needle and a 1-2 cc syringe or an "insulin syringe". The blood is drawn into the syringe and then transferred into the different tubes needed depending on choice of analysis.



Collection of blood samples

For biochemistry a tube with heparin is usually used. A drop of fresh blood should immediately be placed on a slide and spread for differential white cell count. Since all bloodcells have nuclei the count has to performed manually.

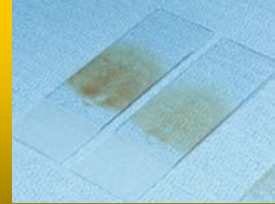


Preparation of blood smear

A plain capillary tube is used to place a small drop of blood at one end of a slide. At an angle of 45 degrees a spreader slide is positioned in front of the drop. The spreader is then moved backwards and touches the drop of blood which will run across the edge of the slide.

Preparation of blood smear

Before the blood reaches the sides of the slide the spreader is pushed forward in a steady movement and creates a uniform blood smear.



Preparation of blood smear

If excessive pressure is applied to the spreader it results in an increased amount of cellular rupture. To minimize the cell damage a bevel-edged microscope slide should be used. Avian blood cells are more sensitive for pressure than mammalian blood cells.

Preparation of blood smear

Another method is the use of a microscope slide and a coverglass. A drop of blood is then placed on the slide and a coverglass is immediately dropped onto it. The slide and the coverglass are pulled apart horizontally to produce the smear as the blood spreads between the two. The spread of the smear should be initiated before the blood reaches the edge of the slide. This method will minimize cell damage even more.

Processing of hematology samples

On the same day of collection the samples should be processed in the laboratory. If this is impossible blood smears should be made and air dried at the time of collection. Air dried smears are stable for days, but it is important that they do not come into contact with moisture or formalin fumes.

Good luck!

It is not more difficult to collect blood from a bird than from a cat or a dog if you use the correct equipment and the bird is held in a proper manner.





Common diseases

Common diseases in caged parrots:

- Trauma
- Toxicosis
- Neoplastic disease
- Compulsive egg laying
- Egg-binding
- Respiratory disease
- Aspergillosis
- Chlamydiosis

Common diseases

Common diseases in caged parrots:

- Obesity
- Inguvitis
- Hepatitis
- Proventricular dilatation syndrome
- Mites (scaly beak and tassel foot)
- Psittacine beak and feather disease
- Feather plucking

Trauma

Injuries is mostly seen among birds that are allowed to fly freely inside the house. The most important advice is to prevent the injuries before they happen.



Trauma

Common causes to trauma:

- The bird sits on top of a door that is being closed and fractures a leg or toe.
- The bird flies into a window and gets a concussion or fractures a wing.
- The bird lands onto the stove or into a boiling pot and gets burn injuries.

Trauma

Common causes to trauma:

- The bird is being chased/captured by the family's cat or dog and gets bitten. Remember that a cat bite is always life threatening to the bird. The bird can die from an infection within 12 h.
- The bird sits on top of another bird's cage and gets bitten in the toes.

Toxicosis

The most common causes to toxicosis:

- Heavy metals (lead and zinc)
- Smoke (from fire or an owner smoking)
- Teflon (birds can die within a couple of hours from a gas that develops when food is burnt in a frying pan with teflon surface.)
- Avocado

Lead poisoning

Lead is for example found in foil surrounding wine bottles, weights in toys for birds, frames to old mirrors or windows, weights to curtains and in old paint.



Lead poisoning

Clinical signs

Clinical signs of lead poisoning include: weakness, lethargy, vomiting, passage of blood in the faeces, seizures, kidney and liver damage, chronic non-regenerative anemia due to bone marrow suppression and death.

Lead poisoning

Diagnosis

A blood sample to measure the level of lead in the blood is required to diagnose lead poisoning. Radiography can be helpful if a radio dense particle can be seen in the gizzard or ventriculus. However, a negative radiographic examination does not rule out the diagnosis lead poisoning.

Lead poisoning

Treatment

The goal with the treatment is to remove the lead from the blood and the gastrointestinal tract to prevent further uptake. Ca-EDTA binds metal in the blood and is given intramuscular. To prevent uptake from the intestine activated charcoal and laxative like peanut butter is given.

Zinc poisoning

Zinc can be found in galvanized metal which include a lot of things in the bird's surroundings for example zippers, paper clips, wires in bird cages and bowls for water and food.



Zinc poisoning

Clinical signs

Clinical signs of zinc poisoning include: hemolytic anemia, kidney and liver damage, weakness, lethargy, vomiting, seizures, convulsions, feather plucking and death.

Diagnostic tests and treatment are the same as with lead poisoning.

Treatment should be initiated as soon as lead or zinc poisoning are suspected since it will pass several days before diagnosis is confirmed.

Zinc poisoning



Neoplasitic disease

Tumors occur mostly in elderly birds. An exception to this rule is budgerigars who often have tumors already from one year of age.

Neoplasitic disease

Renal adenocarcinoma in budgerigars is a leading cause of death in males. In females ovarian tumors are more common. Males can also have testicular cancer. Clinical signs are in all cases lameness, weight loss and a palpable abdominal mass. Radiographs are helpful in diagnosis.

Neoplasitic disease

Lipomas are most commonly seen among budgerigars. The lipoma eventually gets troublesome for the bird as it apply pressure on surrounding organs and changes the bird's centre of gravity.



Neoplasitic disease

Caged birds often have fibrosarcomas that have affinity for wings, legs and face. Some of these can be treated with amputation.

Lymphosarcomas and avian leukosis-like syndromes are also commonly reported in pet birds.

Compulsive egg laying

Compulsive egg laying is a rather common problem in cockatiels and lovebirds. Instead of laying an ordinary large litter of 3-5 eggs she continues to lay egg after egg. To accomplish this a great amount of calcium and nourishment is required. Eventually the egg laying leads to malnutrition with egg-binding as a possible result.

Compulsive egg laying

It is not easy to break the bird's unnatural behaviour but it can be done without medical treatment or surgery.



Compulsive egg laying

To break the behavior, the daylight length should be reduced to 6-8 hours the first three weeks. The following weeks the light can be turned on 10-12 hours a day. Nesting boxes have to be removed. The eggs are supposed to be left in with the hen to inhibit further laying. For some birds it is enough to move around the things in the cage or to move the cage to different rooms now and then.

Compulsive egg laying

Unfortunately these manipulations are seldom enough to inhibit the compulsive egg laying. In those cases medical treatment with hormones or surgical spaying are indicated.



Egg-binding

Egg-binding is most commonly seen among cockatiels, budgerigars and lovebirds. It can be caused by many different factors like age, obesity, cold, dry air, poor diet, calcium deficiency, compulsive egg laying and salpingitis. The hen bird often sits on the floor of its cage and becomes lethargic. Sometimes they breath heavily and get staggering.

Diagnostics include history, clinical signs, palpation of the egg and radiography.

Treatment by giving the bird calcium and provide suitable nesting material and a warm damp environment may be adequate.

Egg-binding



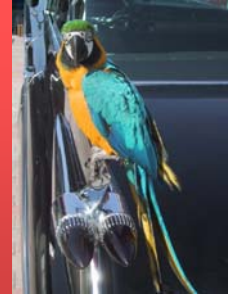
Egg-binding

In more difficult cases the egg has to be collapsed with needle and syringe either per cloaca or via midline through the abdominal wall. This procedure is obviously performed during anesthesia.



Respiratory disease

Respiratory diseases are very common among caged birds. Several factors contribute to developing disease. Examples of such factors are vitamin A deficiency, dry indoor air, polluted air from smoking and food containing mold.



Respiratory disease

Common respiratory diseases:

- Chronic rhinitis
- Sinusitis
- Airsacculitis
- (Aspergillosis)
- (Chlamydiosis)

Aspergillosis

(Mycotic pneumonia, Pneumomycosis)

Aspergillosis is caused by *Aspergillus* spp frequently *Aspergillus fumigatus*. Inhalation of spores from contaminated litter or feed causes infection. The fungal spores settle out in the region of the syrinx, the abdominal air sacs and the lung.

Aspergillosis

Clinical signs

Clinical signs of Aspergillosis include: dyspnea, hyperpnea, inappetence, emaciation, increased thirst, somnolence and other neurological signs. If aflatoxin is produced the bird can contract liver damage, failure and death.

Aspergillosis

Diagnosis

- Markedly elevated WBC count
- Radiographs to show thickening of air sacs
- Endoscopy to examine syrinx and internal air sacs
- Tracheal and lung washes

Aspergillosis

By culture or by microscopical examination of fresh preparations the fungus can be demonstrated.

Treatment is difficult. It may have to go on for the rest of the bird's life.



Chlamydiosis

(Psittacosis, Ornithosis, Papegojsjuka)

Chlamydiosis is a zoonosis easily spread to people. It is caused by the bacterium *Chlamydophila psittaci*. Birds may carry it and develop disease under stress. Shortly after purchase birds should be tested.

Chlamydiosis

Clinical signs

Clinical signs of chlamydiosis include weight loss, depression, lime-green urates, loose feces, emaciated when examined and respiratory signs usually related to an airsacculitis.

Chlamydiosis

Diagnosis

- Radiography – enlarged liver and/or spleen
- Hematology – elevated WBC count, monocytosis
- Biochemistry – elevated AST

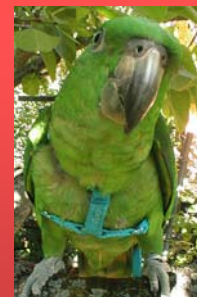
Chlamydiosis

Diagnosis

- Serology – can only show if the bird has been in contact with the disease.
- Antigen in feces – risk for false negative
- Culture – difficult, often false negative

Chlamydiosis

All birds with a positive test result have to be treated even if they show no sign of disease. Treatments with doxycycline are very effective but require 45 days of therapy.



Obesity

Obesity is a very common disease among budgerigars and amazons. The problem is related to the fact that the seed diets commonly fed to the birds have excess fat.



Obesity

Obesity increase the risk for:

- Hepatic lipidosis
- Atherosclerosis
- Lipoma
- Xanthomatosis

Ingluvitis

Ingluvitis means inflammation of the crop. It can be caused by a variety of pathogens; yeast such as *Candida albicans*, bacteria such as *E.coli* and parasites such as *Trichomonas* spp. Regurgitation of seed in budgerigars and cockatiels is often caused by *Trichomonas* spp.

Diagnosis of the causal agent can be made by cytology or culture of a crop wash.

Clinical signs of ingluvitis may include vomiting, weight loss, depression and a palpable crop filled with fluid.

Ingluvitis



Hepatitis

Hepatitis is a very common disease among pet birds. It is often caused by a combination of an increased number of bacteria in the environment and poor feed.

Clinical signs include vomiting, inappetence, loose faeces and yellow-green urates.

Hepatitis

Hepatitis caused by bacteria can be treated with antibiotics for a long period of time in combination with improved feed.



Proventricular dilatation syndrome

The disease was initially seen in macaws and therefore also referred to as macaw wasting syndrome (arasjuka). Later on it has been seen in other species as well. A viral etiology is suggested, although this remains unproven.

Proventricular dilatation syndrome

Clinical signs

The disease is characterized by lethargy, regurgitation, chronic weight loss, enlarged proventriculus, nervous signs, abnormal droppings and crop impactions.

Proventricular dilatation syndrome

Diagnosis

Diagnosis is based on clinical signs, radiographs showing an enlarged proventriculus and exclusion of differential diagnoses. For a certain diagnosis a biopsy of the gizzard or crop is required.

Proventricular dilatation syndrome

There is no treatment for this disease. It has always a deadly outcome.



Cnemidocoptes pilae is common on budgerigars and rare on all other psittacines. The disease is thought to depend on a immunodeficiency and is therefore not thought to be contagious.

Mites



Mites

The mites cause conditions known as scaly beak and tassel foot. The signs in the face are crusting of eyelids, corners of the mouth and cere at the base of the beak often causing beak deformities. Thickening and crusting of the skin are signs of disease on the legs.

The mites can be recovered from skin scraping and demonstrated by microscopy.

Mites



Ivermectin is an effective treatment.

Psittacine beak and feather disease

This disease is caused by psittacine circovirus. It may infect any psittacine bird. Primarily birds <3 years old appears to be affected.

The disease is not common in Sweden. When it occurs it is mostly in african grey parrots and lovebirds.

Psittacine beak and feather disease

Clinical signs

Typical signs are feather loss, abnormal pin feathers, abnormal mature feathers, lack of powder down, beak abnormality, pigment loss in colored feathers and immunosuppression.

Psittacine beak and feather disease

Diagnosis

- Clinical signs
- Detect virus in blood
- Biopsies of affected feather follicles

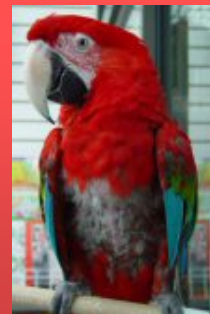
Psittacine beak and feather disease

There is no treatment for this disease. Most birds die within four years in other infections due to immunosuppression. African grey parrots usually die within a few days due to severe hematological changes.



Feather plucking

It is thought that 25% of the birds that have a problem with feather plucking suffer from an actual clinical disease. 75% are due to psychological reasons.



Initially disease has to be excluded by performing a complete dermatological examination. If no disease is found the bird's environment has to be investigated and hopefully the triggering cause can be found.

Feather plucking



Feather plucking

Possible triggering factors:

- Small cage
- Boredom
- Sexual or social stress or frustration
- Attention seeking
- Fear, nervousness
- Changed diet
- Compulsive egg laying
- Lack of privacy

Treatment of feather plucking birds with psychological problems implies gradually changing the birds environment. Most often the birds unfortunately become constant feather pluckers.

Feather plucking



Good luck!

Please turn to the reference literature for more information about the mentioned diseases or if you are interested in other avian diseases.





Avian cases

The following two cases are authentic cases from Regiondjursjukhuset Strömsholm.

The laboratory reference ranges used are taken from Fudge AM. (2000) *Laboratory Medicine Avian and Exotic Pets*.

Case 1

Signalment

20 year old male amazon.

This is a picture of another amazon



History Case 1

Three female amazons had died within three days. They sat in different cages a couple of meters from each other. The owner never noticed they were ill. The patient eats "Nutribird", apples, oranges, pasta, rice, broccoli and carrots. It drinks community water. The day he came to the clinic he seemed ill and sat with his eyes shut.

Case 1

Blood was collected from the bird without anesthesia.

Results from blood analyses:

Hematocrit	42	%	41-53
Leukocytes	29.8	$\times 10^9/l$	5-17
AST	3.3	ukat/l	2.6-5.9
Uric acid	119	umol/l	132-618

Case 1

Lymphocytes	25	%	20-67
Heterophils	62	%	31-71
Basophils	0	%	0-2
Eosinophils	0	%	0-0
Monocytes	13	%	0-2

Polychromasia 12-13%

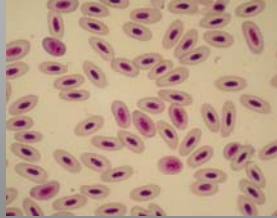
Moderate poikilocytosis

The polychromasia indicates regenerative anemia

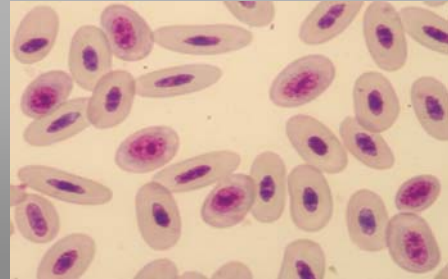
Case 1

This is a picture of a blood smear from the amazon with the unknown illness.

The polychromasia of the erythrocytes indicates regenerative anemia.



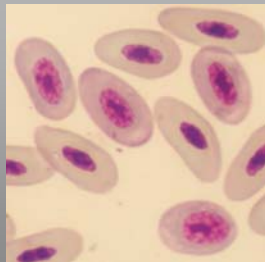
Prominent polychromasia: Regenerative anemia



Case 1

Blood was also sent in for lead and zinc analyses, but the results from those analyses take several days to receive.

Note polychromasia of the erythrocytes.



Case 1

Chlamydial diagnostics

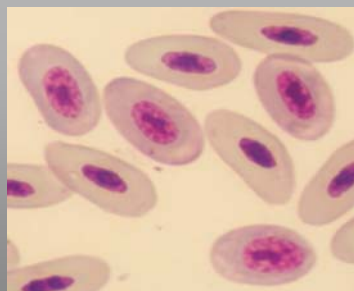
- Culture – negative
- Serology – low titer

This is a picture of blood collection from another bird.



Case 1

If this bird had Chlamydia infection, then what kind of anemia should that infection cause?



Case 1

Treatment

The amazon was treated with enrofloxacin, Na-EDTA, vitamin K and fed via a crop tube.

This is a picture of yet another amazon.



Case 1

The amazon was hospitalized for three days. When he went home he was feeling a lot better. The owner continued to treat the bird with Na-EDTA and enrofloxacin at home.

Diagnosis?

Case 1

The results from the lead and zinc analyses:

Zinc	53	mmol/l	0-30
Lead	0.10	mmol/l	0-1

The amazon was suffering from **zinc poisoning!**

Case 1

Zinc poisoning causes a hemolytic anemia. Hemolytic anemia is a regenerative anemia. Infections cause a nonregenerative anemia, so the hematology results should have steered us away from just an infection like chlamydiosis. A metal foreign body containing zinc was not reported.

Case 2

Signalment

Female moluccan cockatoo, age unknown.



This is a picture of another cockatoo.

Case 2

History

This bird lived in a zoological park and came to the clinic for a health check up. Blood was collected for a number of analyses.

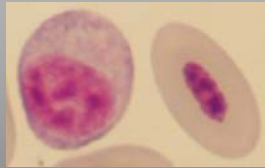
Case 2

Results from blood analyses:

Leukocytes	14.1	x10.9/l	8-12
Lymphocytes	19	%	19-50
Heterophils	78	%	44-71
Basophils	1	%	0-1
Eosinophils	1	%	0-2
Monocytes	1	%	0-1
AST	1.3	ukat/l	2.3-6.2
Uric acid	446	umol/l	190.3-632.9

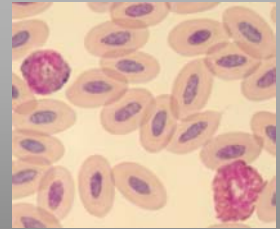
Case 2

A few reactive lymphocytes were found in the blood smear from the cockatoo. This is a picture of a reactive lymphocyte and an erythrocyte.



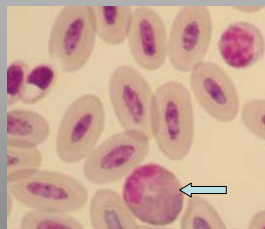
Case 2

This is another picture of the blood smear. The two leukocytes are an eosinophil (left) and a heterophil (right).



Case 2

In this picture you can see one eosinophil (arrow), two thrombocytes (upper left corner) and one lymphocyte (upper right corner). The rest of the cells are erythrocytes.



Case 2

Chlamydial diagnostics

- Culture – negative
- Serology – high titer

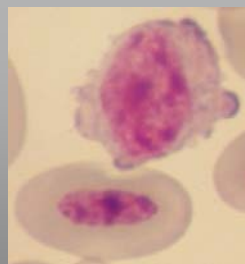
This is a picture of yet another cockatoo.



Case 2

The cockatoo was also tested for psittacine beak and feather disease. This test was negative.

This is a picture of another reactive lymphocyte from the patient.



Case 2

Since the serology test for chlamydiosis showed high titer for the disease the bird was treated with doxycycline.

After a few weeks the bird died. Why? Had something been missed at the health check up?

Case 2

Autopsy

The autopsy showed a stenosis in trachea.
This turned out to be caused by
aspergillosis.

Good luck!

The two previous cases illustrate some of the diseases of parrots.
Unfortunately the second bird had 2 infections/diseases.
We often have trouble diagnosing the second unexpected disease.

