

# Parasites in Haematology

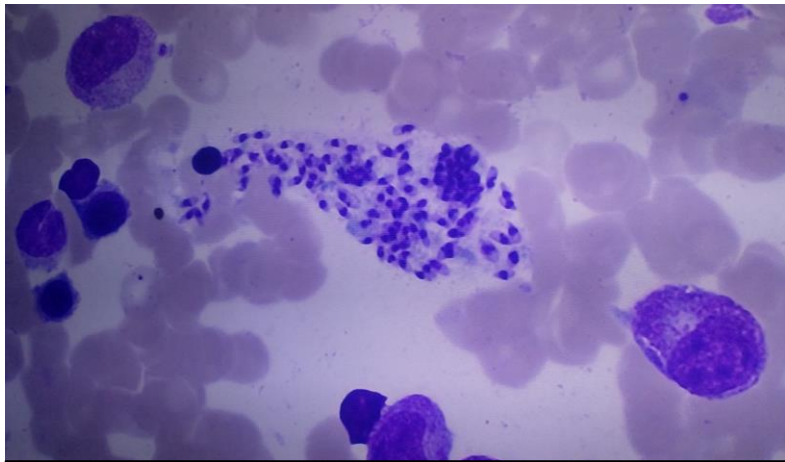
Jennifer Mills

# Introduction

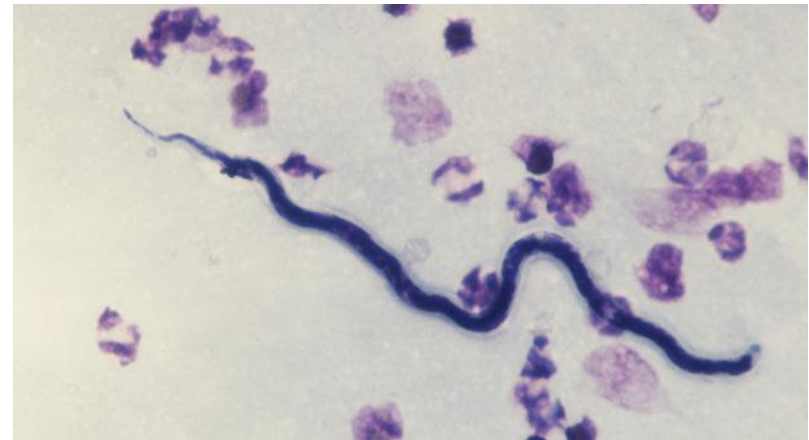
- Jennifer Mills
  - Trainee Clinical Scientist in Haematology and Transfusion
  - Previously worked as a shift Biomedical Scientist.
- Presentation.
  - Discuss the type of parasites found in blood.
  - Illustrate the methods available for identifying parasites in blood.
  - How positive cases are managed by the laboratory.
  - Real-life cases.

# Types of Blood Parasites

Plasmodium	Trypanosomes	Microfilaria
<i>P. falciparum</i>	Leishmaniasis	Loa Loa
<i>P. ovale</i>	Trypanosoma brucei	Wuchereria bancrofti
<i>P. vivax</i>		Mansonella
<i>P. knowlwelsi</i>		
<i>P. malarie</i>		

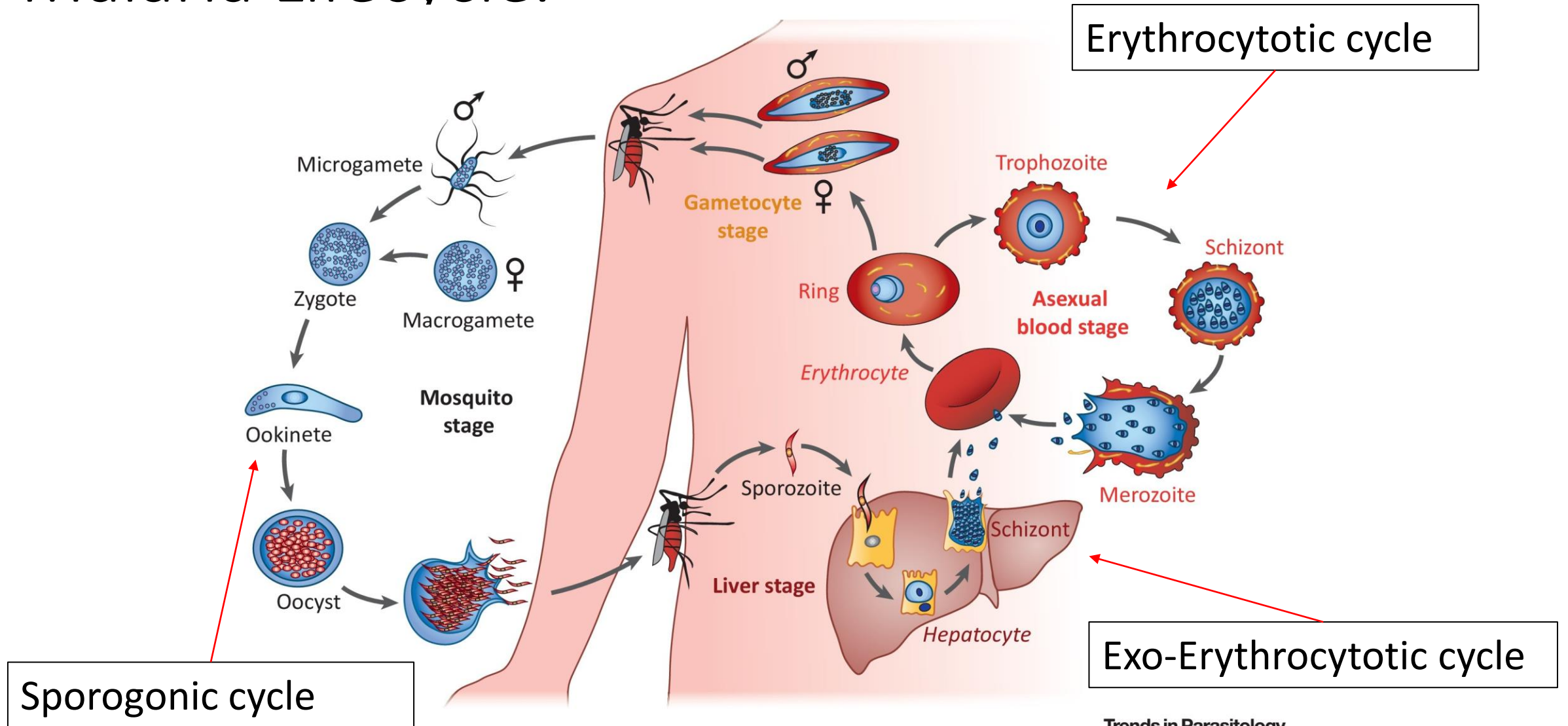


**Leishmaniasis in Bone Marrow.**



**Loa Loa in Peripheral Blood.**

# Malaria Lifecycle.



# Laboratory Testing- Malaria Requests.

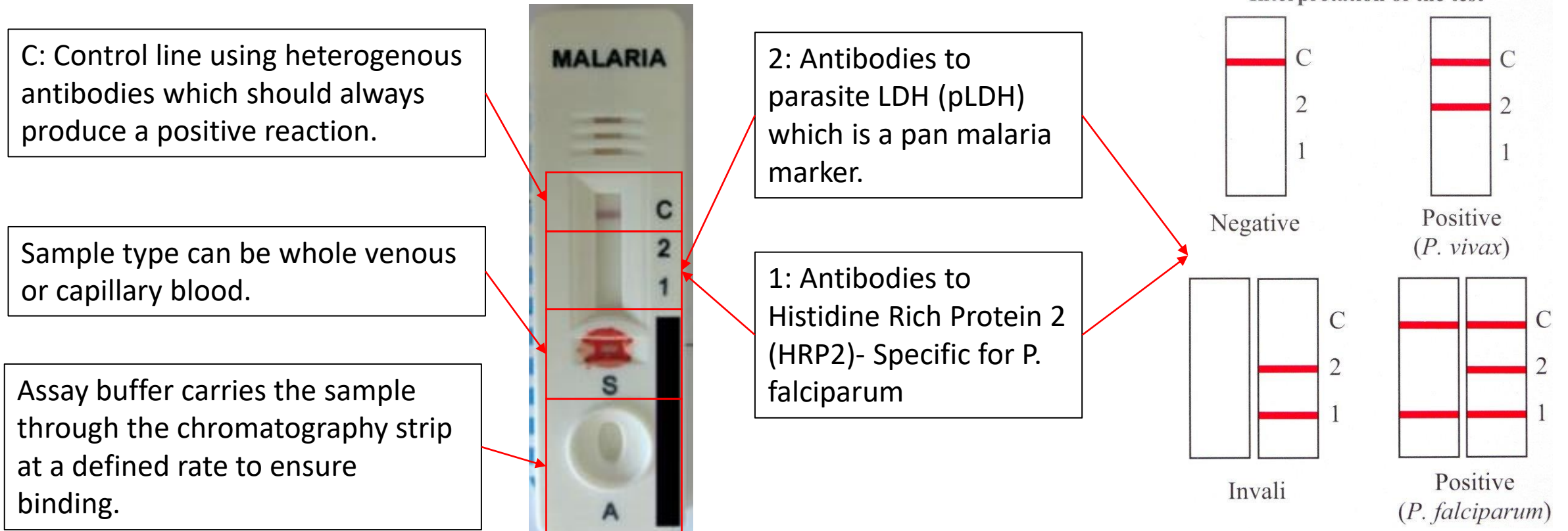
- Requests are accepted from any clinical location.
  - Typically requests will come from acute locations e.g. ACEM.
  - Requests have been received from wards, GP surgeries and outpatient depts.
- All requests require:
  - Previous travel history including:
    - Location travelled to
      - Location helps to ID parasite species as many are geographically restricted.
    - How long ago the travel was.
      - Typically symptoms present within a couple of weeks of travel/infection
      - *P. ovale* and *P. vivax* can relapse though!

# Laboratory Testing- Full Blood Count

- Red and white cells indices, and platelets.
- Full blood count results **can** be normal.
- Patients may have **normocytic anaemia**.
  - This is when the number of red cells is reduced, but the red cells are morphologically normal.
  - Malaria parasites destroy red cells as part of their lifecycle.
- **Low platelets** are typical in malaria infection.
  - The degree **correlates** with infection severity.
  - Exact role of platelets is not clear.
    - Some studies suggest platelet increase severity by clumping cells/assisting with adhesion.
    - Other suggest they help to kill parasite infected cells.

# Laboratory Testing- PFA Test

- Immunochromatography test- similar to a lateral flow!
- POCT test- but used in labs because they are rapid.

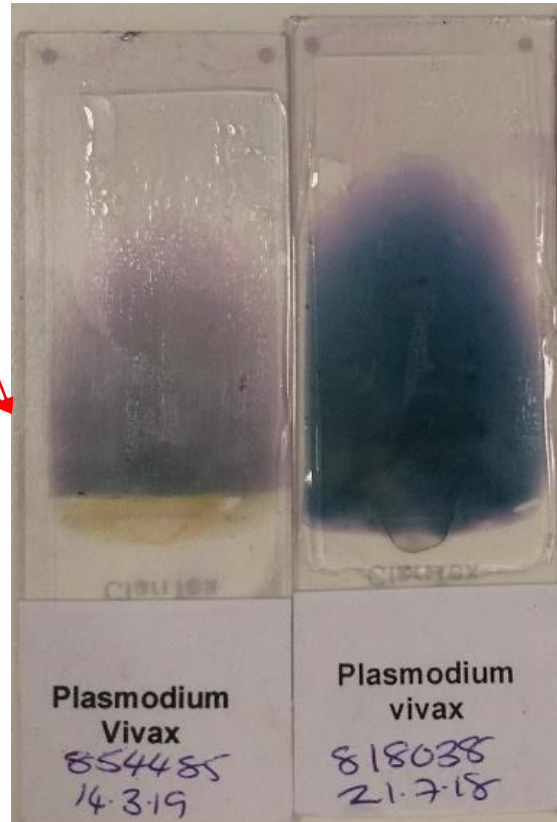


# Laboratory Testing- Morphology: Thin Films.

- Made by spreading whole blood on glass slides and staining.
- 2 types of slides made.

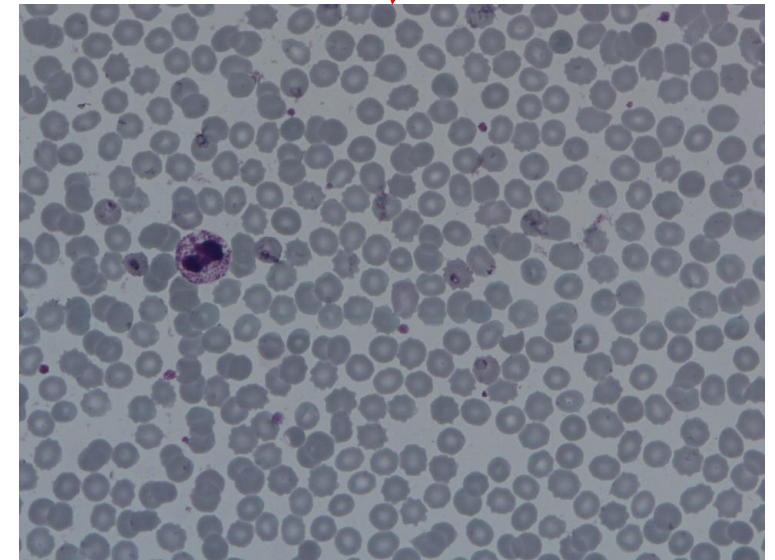
Romanowsky stain: standard blood film stain.

Used to review general morphology.



Malarial Geimsa: Uses Geimsa stain and a lower pH buffered water (6.8 rather than 7.2)

Gives better resolution of parasites and pigments.

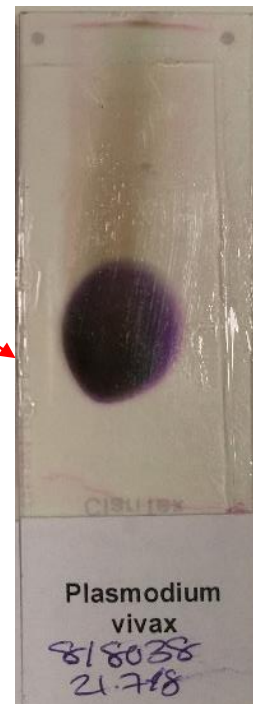




# Laboratory Testing- Morphology: Thick Films

- Produced by placing a drop of blood on a slide without spreading.
- Increases the likelihood of spotting a parasites in the sample!
- Slides have to be carefully dried, they need >1 hour, but <3 as the cells start to degrade.

Thick films use two stains “Field A” and “Field B” which lyses the red cells and stains parasites and white cells.



# Reporting Malarias

- Malaria slides are reported by 2 separate BMS'
- Each BMS should spend at least 7-10 minutes reviewing the slides.
- At least one slide of each type should be reviewed by each BMS.
- If parasites are found, BMS' make a "provisional" diagnosis.
- *P. falciparum* and *P. knowlesi* require **parasitaemia's**.
  - Several high powered fields are counted- the number of infected red cells is compared to the total number of red cells counted.
- The whole process takes at least 3 hours to complete!

# Managing Positive Cases

- **First Positive Sample.**

- *P. falciparum* and *P. knowlesi* require parasitaemia's.
- All positive cases must be reported to PHE.
- Samples are sent to the London School of Tropical Medicine.
  - Confirm by the species by PCR and confirm the parasitaemia.
- The requesting clinician and Microbiology consultants are informed.

- **Subsequent Samples.**

- Samples are tested daily until **3** negative results.
  - Patients do not have to remain in hospital if they are not symptomatic.
- Gametocytes can persist in blood, but do not count as a positive.
  - These cells cannot asexually reproduce, so cannot continue to infect the patient.

# Example Cases

# Case 1.

- 21-year-old Nigeran man new to the area.
- Patient recently arrived in the country from Nigeria.
- Presents to ACEM with fever and abdominal pain.



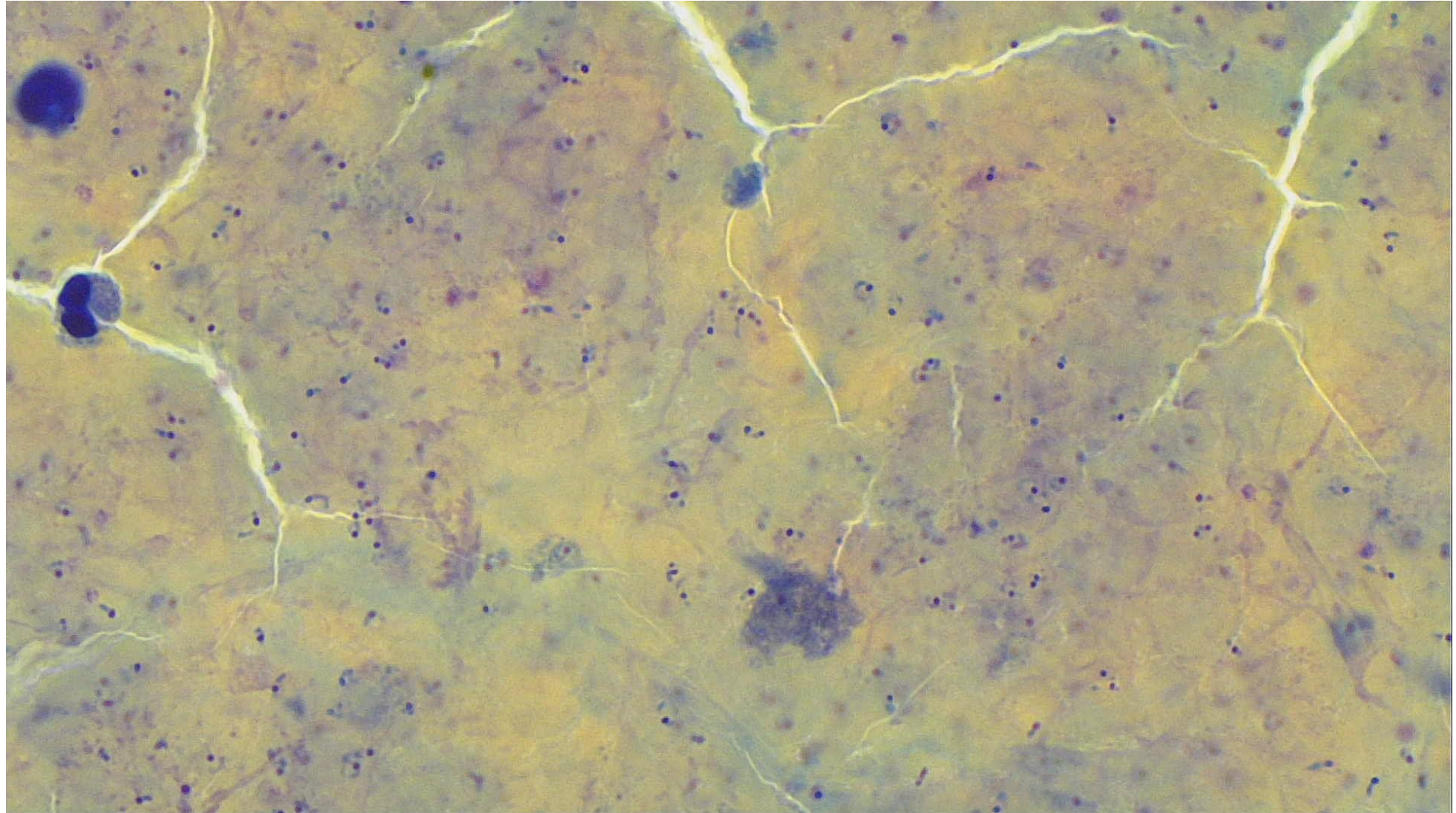
# Case 1: FBC Results.

14/10/2021 21:20 Blood

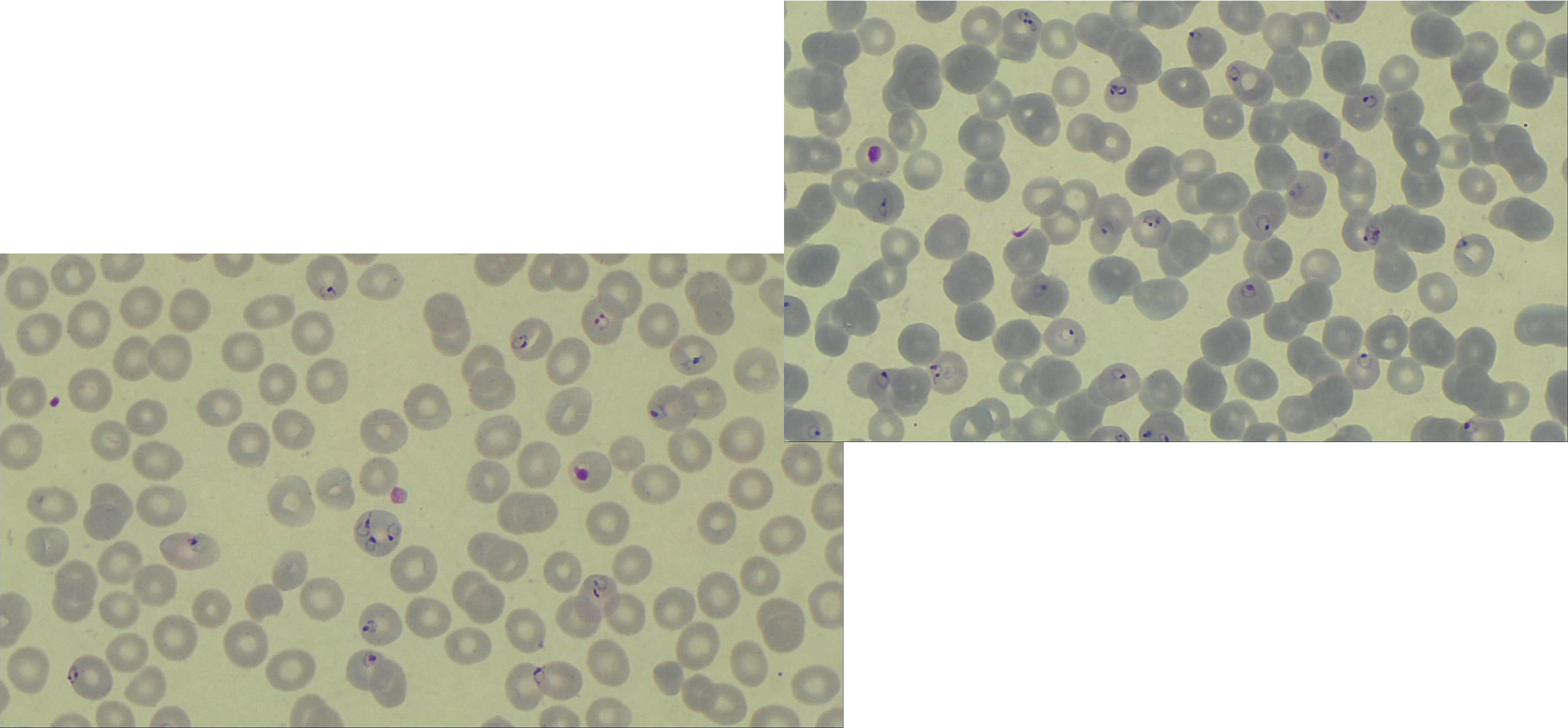
Request Reason : abd pain, fever. NO

HB	129	g/L	( 130 to 170 )	Auth
WBC	3.6	$10^9/L$	( 4.0 to 11.0 )	Auth
PLT	32	$10^9/L$	( 150 to 410 )	Auth
RBC	4.38	$10^{12}/L$	( 4.50 to 5.50 )	Auth
HCT	0.381	L/L	( 0.400 to 0.500 )	Auth
MCV	87.1	fL	( 83 to 101 )	Auth
MCH	29.5	pg	( 27.0 to 32.0 )	Auth
MCHC	338	g/L	( 315 to 345 )	Auth
RDW	14.1		( 11.6 to 14.0 )	Auth
MPV	7.6	fL	( 7.5 to 11.2 )	Auth
Neutrophils	3.3	$10^9/L$	( 2.0 to 7.0 )	Auth
Lymphocytes	0.3	$10^9/L$	( 1.0 to 3.0 )	Auth
Monocytes	0.1	$10^9/L$	( 0.2 to 1.0 )	Auth

# Case 1: Malaria Testing Results- Thick Film

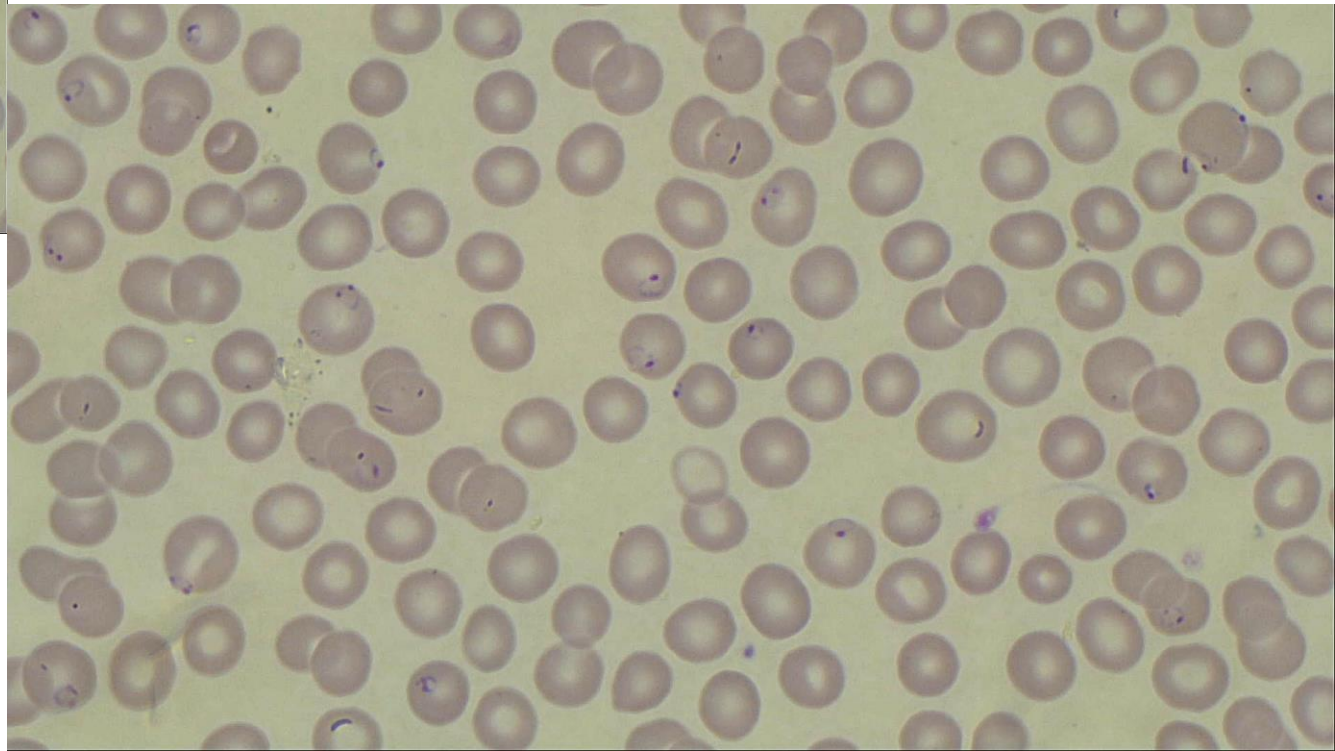
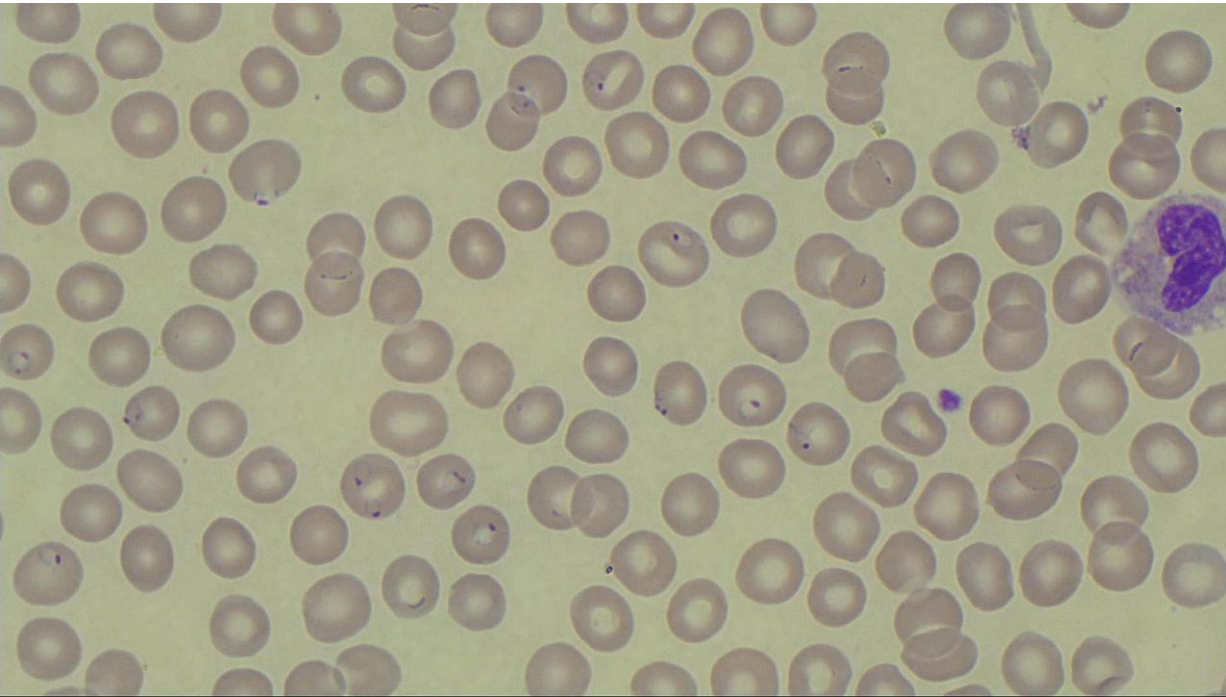


# Case 1: Malaria Testing Results- Malaria Giemsa



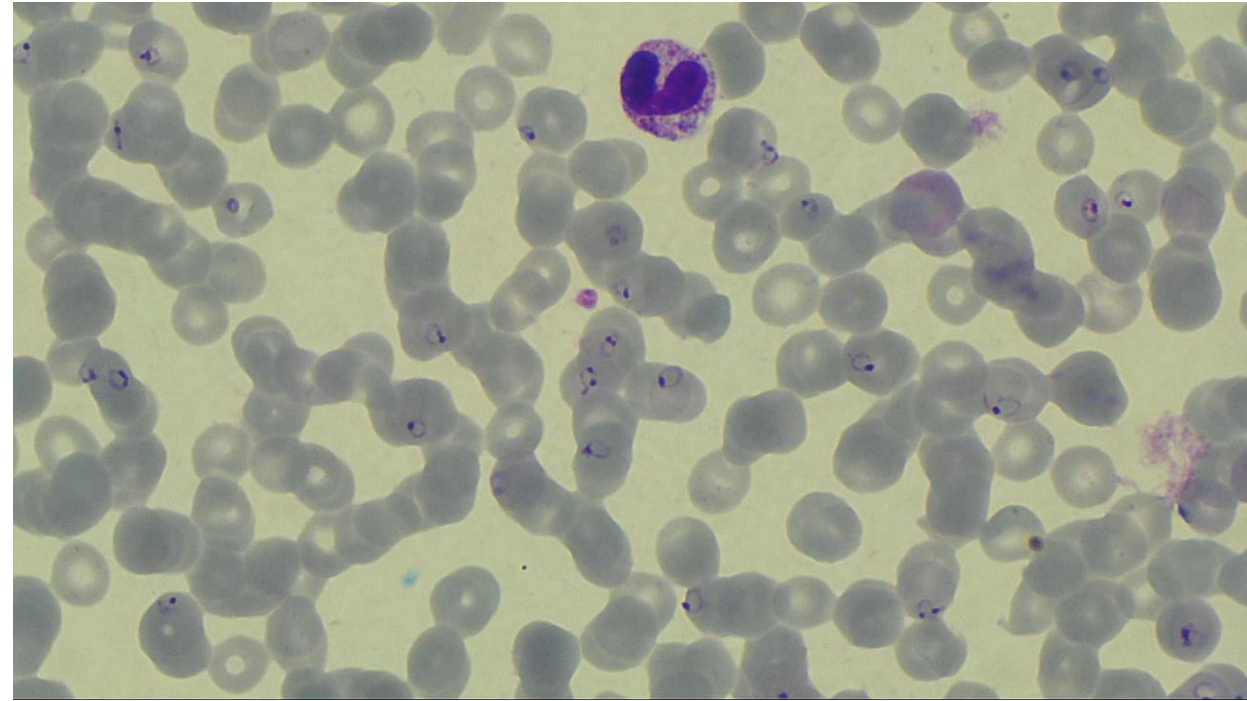


# Case 1: Malaria Testing Results- Romanowsky



# Case 1- Results.

- *p. Falciparum* Infection.
- Parasitaemia confirmed by London School as 12.7%.
- Most malaria species do not exceed 5%.
  - Falciparum can!
- High parasitaemia = >2%
  - In non-endemic counties (according to the WHO)
- High Falciparum parasitaemia = High risk of cerebral malaria.



# Case 1: What Happened?

- This patient had “uncomplicated malaria”
  - Meaning they did not have any cerebral symptoms.
- These patients are treated with Artemisinin combination therapy.
  - This is a more advanced version of the quinine treatments used historically.
    - Quinine is the original anti-malarial- it’s found in the bark of the cinchona tree.
      - Used to flavour tonic water- the original malaria prophylaxis!
- The patient was also found to have a bacterial infection and COVID-19.
- He self-discharged after 2 days in hospital.
- He was followed up in the community, and (miraculously) made a full recovery!

## Case 2.



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- A 38 year old woman presents to her General Practitioner with persisting fatigue, nausea and headaches.
- She has a negative COVID-19 PCR test and home pregnancy test but is currently self-isolating as she works on a paediatric ward.
- She does not admit to any recent travel history.
- The patient discusses her case over the phone with the GP, who recommends that she has a series of general blood tests.

# Case 2: Blood Test Results.

## Biochemistry

Urea	3.9	mmol/L	( 2.5 to 7.8 )	Auth
Sodium	137	mmol/L	( 133 to 146 )	Auth
Potassium	3.6	mmol/L	( 3.5 to 5.3 )	Auth
Serum Glucose	6.0	mmol/L	( 4.0 to 6.0 )	Auth
<b>Creatinine</b>	<b>74</b>	<b>umol/L</b>	<b>( 80 to 115 )</b>	<b>Auth</b>
<b>Phosphate</b>	<b>0.56</b>	<b>mmol/L</b>	<b>( 0.8 to 1.5 )</b>	<b>Auth</b>
Calcium	2.35	mmol/L	( 2.2 to 2.6 )	Auth
Tot. Bilirubin	16	umol/L	( 3 to 20 )	Auth
Total Protein	71	g/L	( 61 to 79 )	Auth
Albumin	37	g/L	( 35 to 50 )	Auth
Alk.Phos.	43	U/L	( 30 to 130 )	Auth
Adj. Calcium	2.38	mmol/L	( 2.20 to 2.60 )	Auth
<b>C-Reactive Protein</b>	<b>192</b>	<b>mg/L</b>	<b>( 0 to 7 )</b>	<b>Auth</b>

## Haematology

HB	142	g/L	( 130 to 170 )	Auth
<b>WBC</b>	<b>13.9</b>	<b>10*9/L</b>	<b>( 4.0 to 11.0 )</b>	<b>Auth</b>
<b>PLT</b>	<b>84</b>	<b>10*9/L</b>	<b>( 150 to 410 )</b>	<b>Auth</b>
RBC	4.52	10*12/L	( 4.50 to 5.50 )	Auth
HCT	0.416	L/L	( 0.400 to 0.500 )	Auth
MCV	92.1	fL	( 83 to 101 )	Auth
MCH	31.4	pg	( 27.0 to 32.0 )	Auth
MCHC	341	g/L	( 315 to 345 )	Auth
RDW	12.7		( 11.6 to 14.0 )	Auth
MPV	10.9	fL	( 7.5 to 11.2 )	Auth
<b>Neutrophils</b>	<b>11.8</b>	<b>10*9/L</b>	<b>( 2.0 to 7.0 )</b>	<b>Auth</b>
<b>Lymphocytes</b>	<b>0.9</b>	<b>10*9/L</b>	<b>( 1.0 to 3.0 )</b>	<b>Auth</b>
<b>Monocytes</b>	<b>1.2</b>	<b>10*9/L</b>	<b>( 0.2 to 1.0 )</b>	<b>Auth</b>
Eosinophils	0.0	10*9/L	( 0.00 to 0.5 )	Auth
BAS	0.1	10*9/L	( 0.0 to 0.1 )	Auth

A standard blood film was performed because of the mild thrombocytopenia.

## Case 2: Blood Film Report.

- A newly qualified Band 5 BMS reviewed the film and gives the following report.

FILM

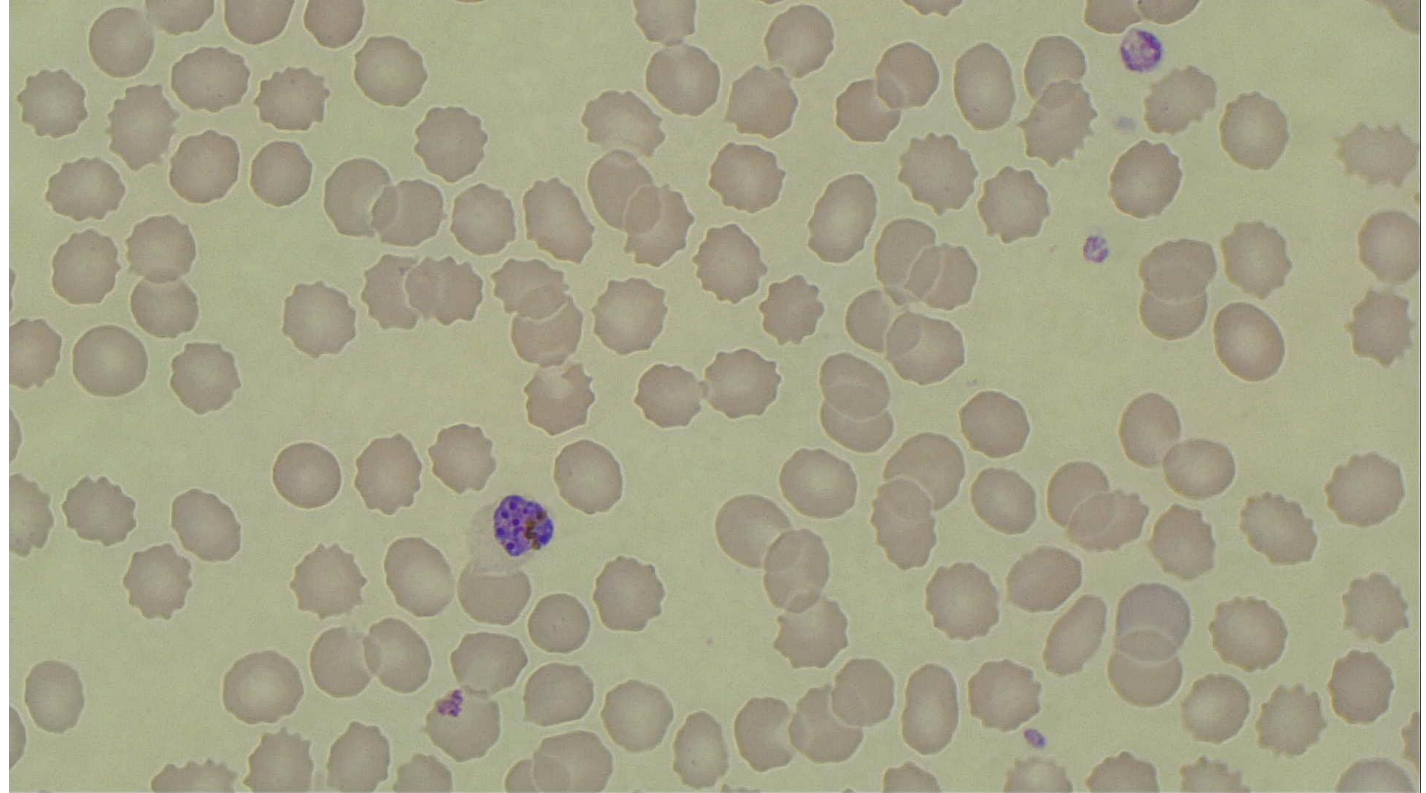
LTG Comments :

some stomatocytes,  
platelets on film agree with auto count,  
visual differential agrees with automated,

- The film is placed on the Clinical Authorising Queue because of the thrombocytopenia.

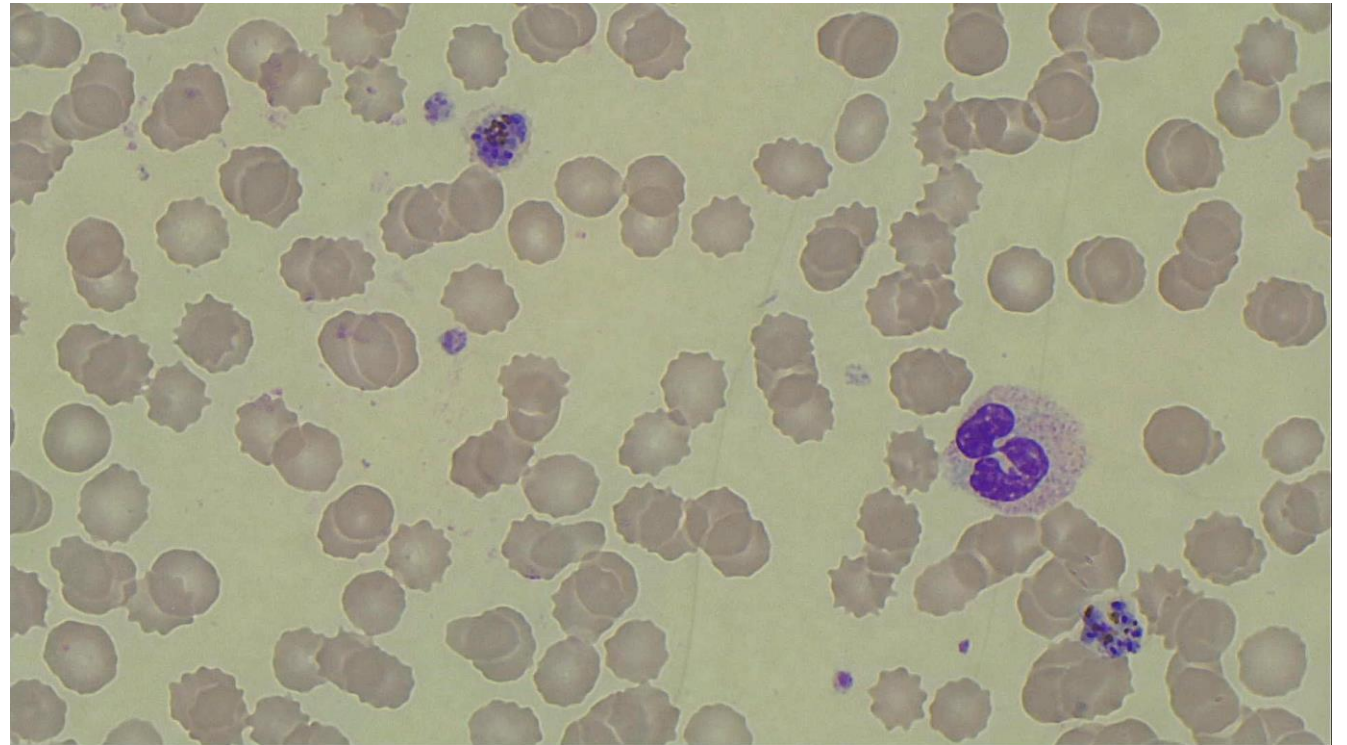
# Case 2: Worsening Clinical Status.

- However, in the meantime the patient has been admitted to ACEM with worsening symptoms.
- The lab is asked to re-review the film the look for a possible haemolytic/fragmentation syndrome.
- The film is reviewed by a senior BMS.



# Case 2: Results.

- The patient was identified with *p.Ovale*.
- The patient admits to travel 5 months ago to Nairobi to visit family.
- The patient did not have symptoms on her return.
- *p.Ovale* and *p.Vivax* can reside asymptotically in the liver.
  - Known as Hypnozoites.
- The patient was treated as an inpatient.





## Case 2: How was it missed?

- Lack of clinical suspicion meant PFA and Malaria films were not completed.
  - These would have made finding the parasites more likely.
- Patient had a very low parasitaemia (<1%)
  - The BMS may not have viewed enough fields.
- Inexperienced BMS viewed the first film.
  - May have mistaken the parasites for giant platelets.
  - Romanowsky stain does not highlight the pigments well.

# Case 3.

- A 50 year old man on D7 (orthopaedic ward.)
  - Patient is an inpatient for an infected ankle fracture repair.
- The ward requested an add-on Malaria test.
- The request did **not** indicate travel history.
- The patient had been on the ward for 2 weeks.
- The laboratory contacted the requesting department.



# Case 3: Conversation with the Ward.

Hello, this is D7.

Yes, I made that request, what's the issue?

The patient doesn't have any travel history.

Hello, D7, this is the haematology lab. We've received a Malaria request from your ward which we'd like to discuss.

Great! We just need to know the patient's travel history.

# Case 3: Conversation with the Ward.

No.

No.

Oh okay... Has the patient travelled at all in the past 6 months?

....Right. Do they work at an airport, or as a Taxi driver?

Uhm, okay. So, why are you suspicious of malaria?

# Case 3: Conversation with the Ward.

Well, he recently had sex with a woman from China.

Hello?


.....

.....

....Are you aware that Malaria is not sexually transmitted?

Hello?

# Case 3: Conversation with the Ward.



We're going to call  
you back.



\*Hangs Up\*

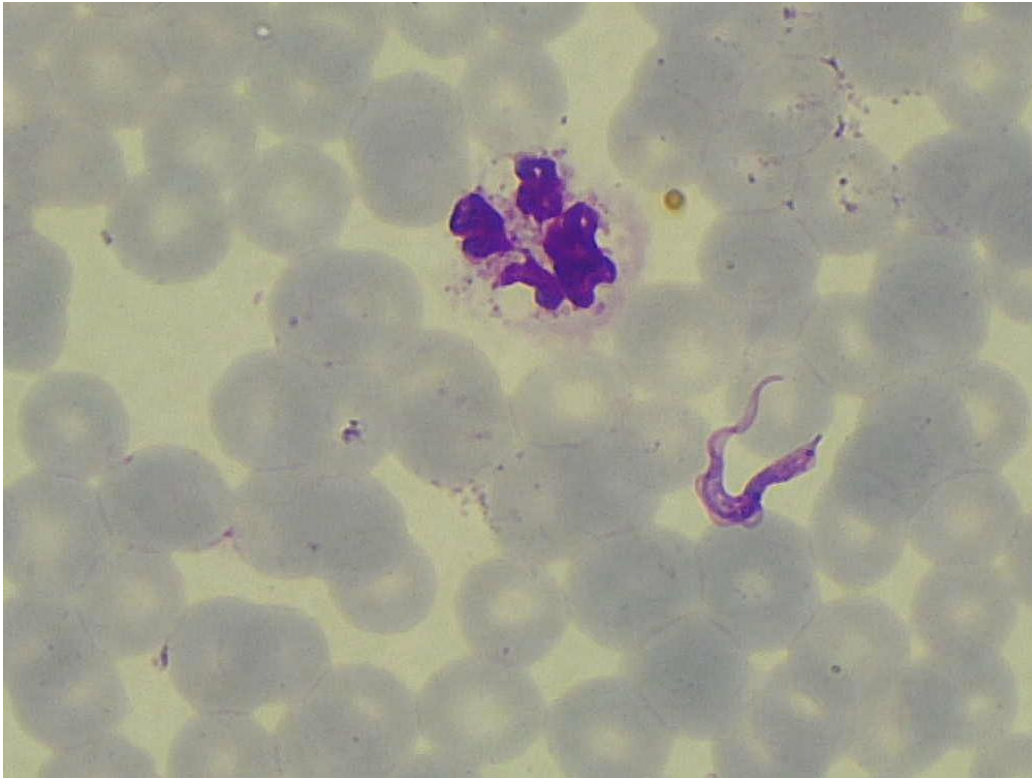


Are you su-

# Case 3: Education is Important!

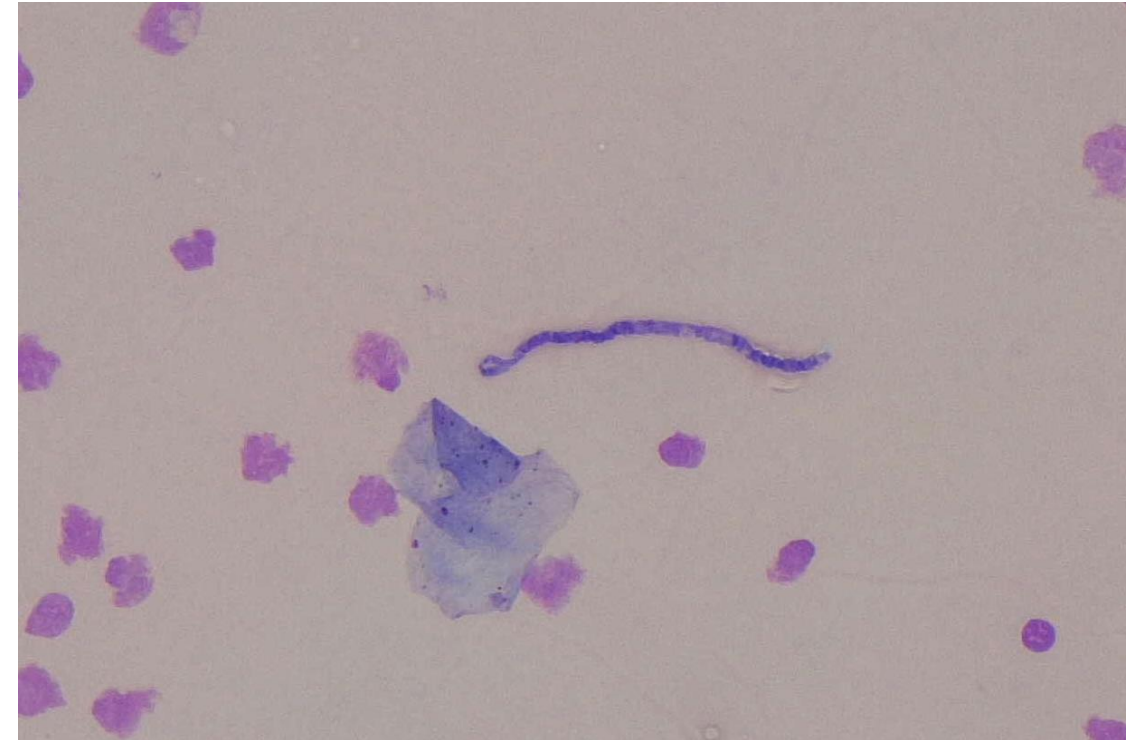
- Malaria is not endemic to the UK and so is often not an educational focus.
- However, patient's **do not** have to travel to catch malaria.
  - Airport workers have reported cases- mosquitos can live for up to 7 days in suboptimal conditions.
  - Taxi drivers who drive to airports may also be exposed to mosquitos in this way.
- However, Malaria is never expressed in non-blood fluids due to it's reliance on erythrocytes.
  - So it can **never** be sexually transmitted!!

# Bonus Parasites.



***Trypanosoma brucei*: Type of Trypanosome**

Transmitted by the tsetse fly in sub-Saharan Africa, causes, "Sleeping Sickness"



***Mansonella perstans*: Type of microfilaria**

Transmitted by certain species of midges in Africa and the Caribbean.



# Thanks for Listening

Any Questions?