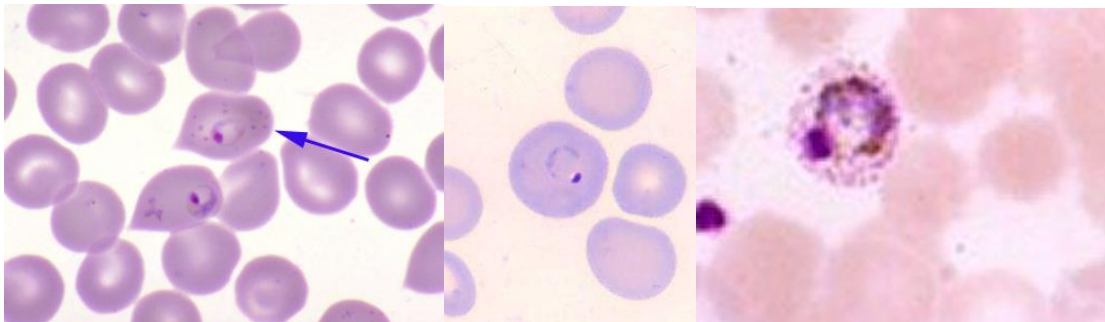


## PRESENTATION OF DIAGNOSTIC QUIZ #79

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A 37-year-old male from California presented to the Tropical Disease Clinic with a suspect malaria infection. He had returned from approximately 10 months in various areas in Africa, including Uganda and Kenya. During his trip he used an untreated bed net and was taking appropriate prophylaxis. However, he did indicate he skipped several doses while in Uganda and Kenya. On his original return, he had been screened for malaria using routine microscopy and PCR for *Plasmodium vivax* and *P. falciparum*, all of which were negative. Prior to being seen in the Tropical Disease Clinic, he had been seen elsewhere and a *P. vivax* infection had been diagnosed on the basis of microscopy. He had been treated appropriately for *P. vivax*. He improved, but three weeks later he presented with fever and fatigue; at this point he was seen at the Tropical Disease Clinic. The following images were seen; this same picture was diagnosed as *P. vivax* prior to visiting the Tropical Medicine Clinic. Because there were some questions raised regarding the species identification, more extensive molecular testing was performed.



### QUESTIONS:

1. What organisms are suggested from the images shown above?
2. How does his history impact possible parasitic infections?
3. Does the morphology provide an accurate identification? Why or why not? What might this parasite mimic?

4. What are the pros and cons of routine microscopy, rapid testing, and molecular testing for the diagnosis of *Plasmodium* to the species level?

**(Scroll Down for Answers and Discussion)**

### **ANSWER AND DISCUSSION OF DIAGNOSTIC QUIZ #79**

The images presented in Diagnostic Quiz #79 are the following:

#### **ANSWERS TO QUESTIONS:**

1. The images certainly indicate an infection with *Plasmodium* species; however, it is easy to see how these organisms might be confused with *P. vivax* rather than *P. ovale*.
2. The patient history is consistent with several species of *Plasmodium*; since *P. vivax* and *P. falciparum* are the most common, it was practical to screen for these two species.
3. The overall morphology of *P. vivax* and *P. ovale* can be very similar; not all stages can be clearly assigned to one or the other species. More characteristic organisms belonging to the two species can be seen below.

4. As seen from this case, the use of routine microscopy can be problematic in identifying the organisms as either *P. vivax* or *P. ovale*. The use of malaria rapid cartridge tests does not identify *P. ovale* as accurately as *P. vivax* or *P. falciparum*. Consequently, the use of molecular methods provides a much more accurate identification to species for the five species of human malaria (rapid test methods are under development for *Plasmodium knowlesi*).

#### **COMMENTS ON THE PATIENT and INFECTION:**

This case highlights the need to consider *P. ovale* as a cause of imported malaria and to include its detection, as well as *P. malariae*, in imported malaria screening programs. This patient presented particular diagnostic challenges that resulted in a failure of early detection and diagnosis of *P. ovale* infection based on the microscopic examination of the blood films. Distinguishing *P. ovale* from *P. vivax* by microscopy, already difficult due to the species' morphologic similarity, can lead to inaccurate species identifications.

#### **COMMENTS ON THE METHOD RECOMMENDATIONS:**

The routine microscopic examination of stained blood films can be difficult, particularly in the accurate identification to the species level; *P. vivax* and *P. ovale* tend to resemble one another and can easily be confused. Differentiation to the species level can be a particular problem for all five species of human malaria when ring forms only are seen in the blood films.

#### **COMMENTS ON THE IMAGES:**

The images seen in the original smears are difficult to differentiate between *P. vivax* and *P. ovale*. More characteristic images of all five species of human malaria can be seen below. Row 1 is *P. vivax*; row 2 is *P. ovale*; row 3 is *P. malariae*; row 4 is *P. falciparum*; row 5 is *P. knowlesi*.

#### **REFERENCE**

Garcia, L.S. 2016. *Diagnostic Medical Parasitology*, 6th Ed., ASM Press, Washington, D.C.

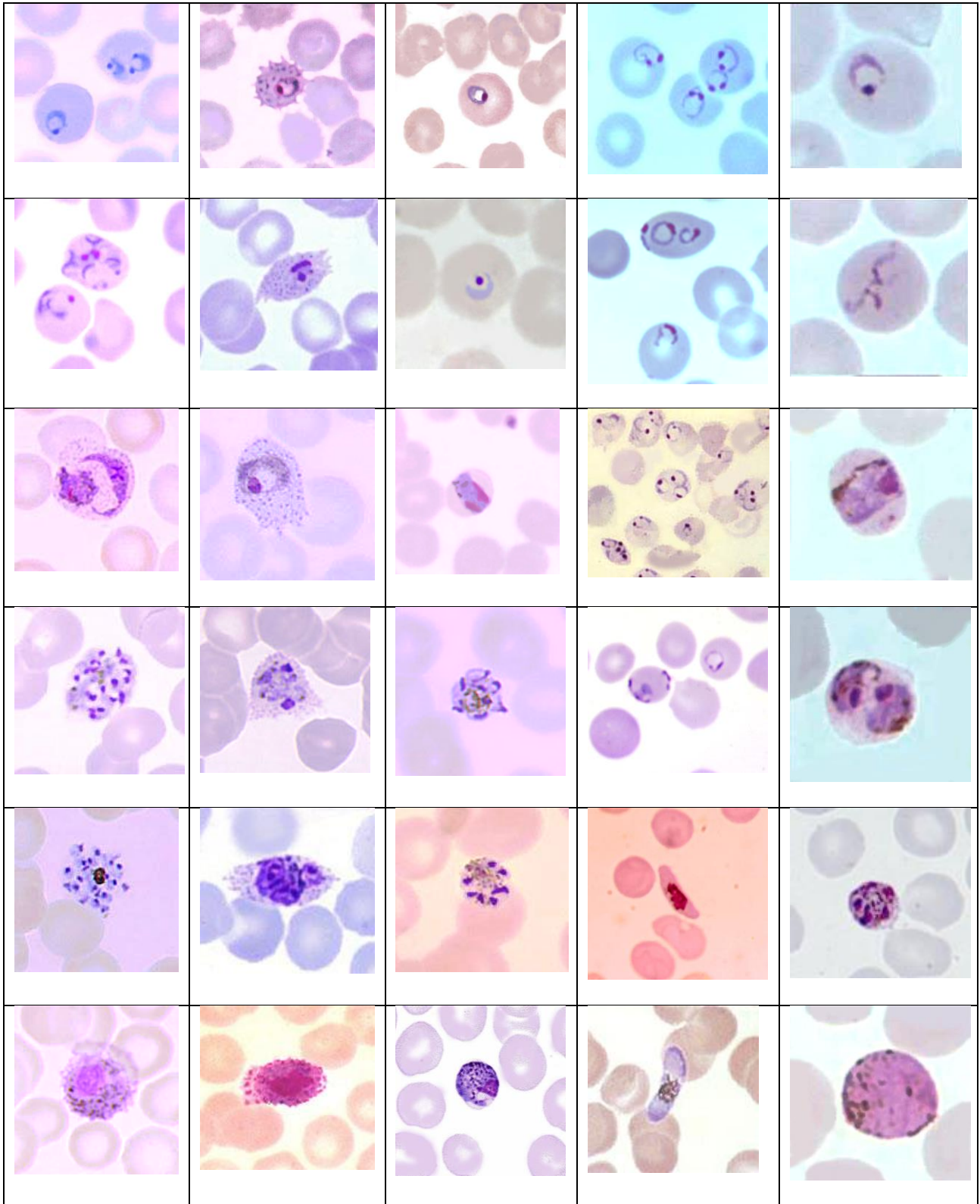
1

2

3

4

5



**Malaria characteristics with fresh blood or blood collected using EDTA with no extended lag time (preparation of thick and thin blood films within < 60 min of collection)**

***Plasmodium vivax*** (benign tertian malaria)

1. 48-hour cycle
2. Tends to infect young cells
3. Enlarged RBCs
4. Schüffner's dots (true stippling) after 8-10 hours
5. Delicate ring
6. Very ameboid trophozoite
7. Mature schizont contains 12-24 merozoites

***Plasmodium malariae*** (quartan malaria)

1. 72-hour cycle (long incubation period)
2. Tends to infect old cells
3. Normal size RBCs
4. No stippling
5. Thick ring, large nucleus
6. Trophozoite tends to form "bands" across the cell
7. Mature schizont contains 6-12 merozoites

***Plasmodium ovale***

1. 48-hour cycle
2. Tends to infect young cells
3. Enlarged RBCs with fimbriated edges (oval); usually one end of RBC only – different from crenated RBCs
4. Schüffner's dots appear in the beginning (in RBCs with very young ring forms in contrast to *P. vivax*)
5. Smaller ring than *P. vivax*
6. Trophozoite less ameboid than that of *P. vivax*
7. Mature schizont contains average 8 merozoites

***Plasmodium falciparum*** (malignant tertian malaria)

1. 36-48-hour cycle
2. Tends to infect any cell regardless of age, thus very heavy infection may result
3. All sizes of RBCs
4. No Schüffner's dots (Maurer's dots: may be larger, single dots, bluish)
5. Multiple rings/cell (only young rings, gametocytes, and occasional mature schizonts are seen in peripheral blood)
6. Delicate rings, may have two dots of chromatin/ring, appliqué or accolé forms
7. Crescent-shaped gametocytes

***Plasmodium knowlesi*** (simian malaria)\*

1. 24-hour cycle
2. Tends to infect any cell regardless of age, thus very heavy infection may result
3. All sizes of RBCs, but most tend to be normal size
4. No Schüffner's dots (faint, clumpy dots later in cycle)

5. Multiple rings/cell (may have 2-3)
6. Delicate rings, may have two or three dots of chromatin/ring, appliqué forms
7. Band form trophozoites commonly seen
8. Mature schizont contains 16 merozoites, no rosettes
9. Gametocytes round, tend to fill the cell

\*Early stages mimic *P. falciparum*; later stages mimic *P. malariae*