

# Anemia & Hematology Problems

A case-based approach



MGH/HMS Internal Medicine Review and Update

David B. Sykes, MD, PhD

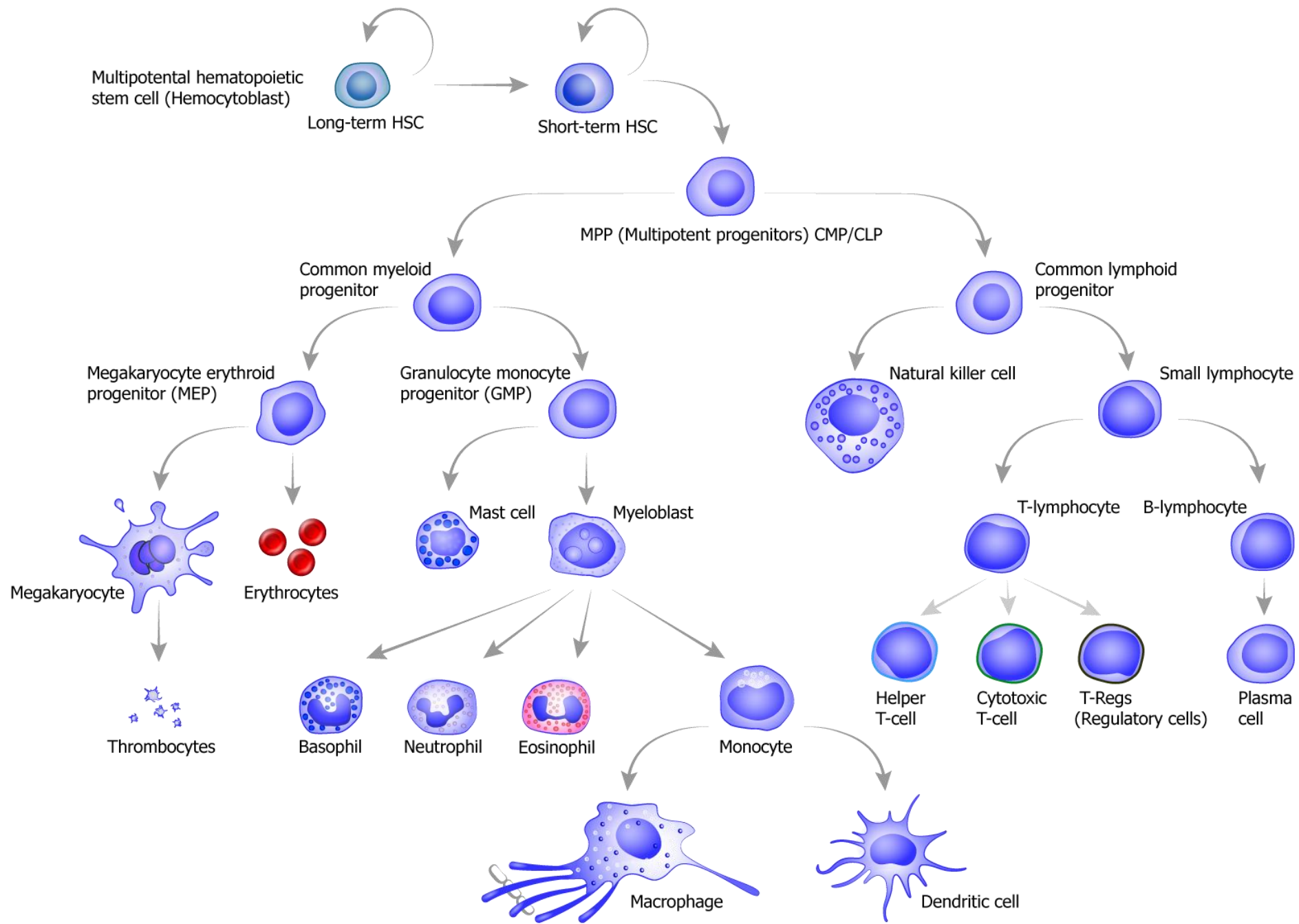
June 7, 2022

# CME Disclosures

- I have no relevant disclosures.
- Clear Creek Bio: co-founder, consultant, hold equity.
- SAFI Biosolutions: consultant & hold equity.

# Learning Objectives

1. Learn to identify the body's best organ – the **BLOOD** – of course.
2. Master all parts of the CBC.
3. Takeaway pearls from real hematology cases.



How many new **red blood cells** do you make every day?



- A. 2 million
- B. 20 million
- C. 200 million
- D. 2 billion
- E. 20 billion

COMPLETE BLOOD COUNT		
WBC	9.40	
RBC	2.79	▼
Hgb	8.3	▼
HCT	26.8	▼
MCV	96.1	
MCH	29.7	
MCHC	31.0	
PLT	463	▲
MPV	8.5	
RDW	19.7	▲

# Normal CBC numbers

	#	In each ul	In each ml	In each liter	5L person
WBC	8.0	8,000	$8 \times 10^6$	$8 \times 10^9$	$4 \times 10^{10}$
RBC	5.00	5 million	$5 \times 10^9$	$5 \times 10^{12}$	$2 \times 10^{13}$
PLT	400	400,000	$4 \times 10^8$	$4 \times 10^{11}$	$2 \times 10^{12}$

COMPLETE BLOOD COUNT	
WBC	9.40
RBC	2.79 ▼
Hgb	8.3 ▼
HCT	26.8 ▼
MCV	96.1
MCH	29.7
MCHC	31.0
PLT	463 ▲
MPV	8.5
RDW	19.7 ▲

# Blood production

	#	In each ul	In each ml	In each liter	5L person
WBC	8.0	8,000	$8 \times 10^6$	$8 \times 10^9$	$4 \times 10^{10}$
RBC	5.00	5 million	$5 \times 10^9$	$5 \times 10^{12}$	$2 \times 10^{13}$
PLT	400	400,000	$4 \times 10^8$	$4 \times 10^{11}$	$2 \times 10^{12}$

	#	5L person	Life-span	New daily	Every minute
WBC	8.0	$4 \times 10^{10}$	24 hours	$4 \times 10^{10}$	<b>30 million</b>
RBC	5.00	$2 \times 10^{13}$	120 days	$2 \times 10^{11}$	<b>150 million</b>
PLT	400	$2 \times 10^{12}$	5 days	$4 \times 10^{11}$	<b>300 million</b>





## 75F with anemia

	6/17/2016 1640
<b>COMPLETE BLOOD COUNT</b>	
WBC	8.36
RBC	2.16 ▼
Hgb	6.4 ▼
HCT	19.2 ▼
MCV	88.9
MCH	29.6
MCHC	33.3
PLT	150
MPV	8.8
RDW	13.4

- Isolated anemia.
- Normocytic anemia.
- The other CBC parameters are normal.



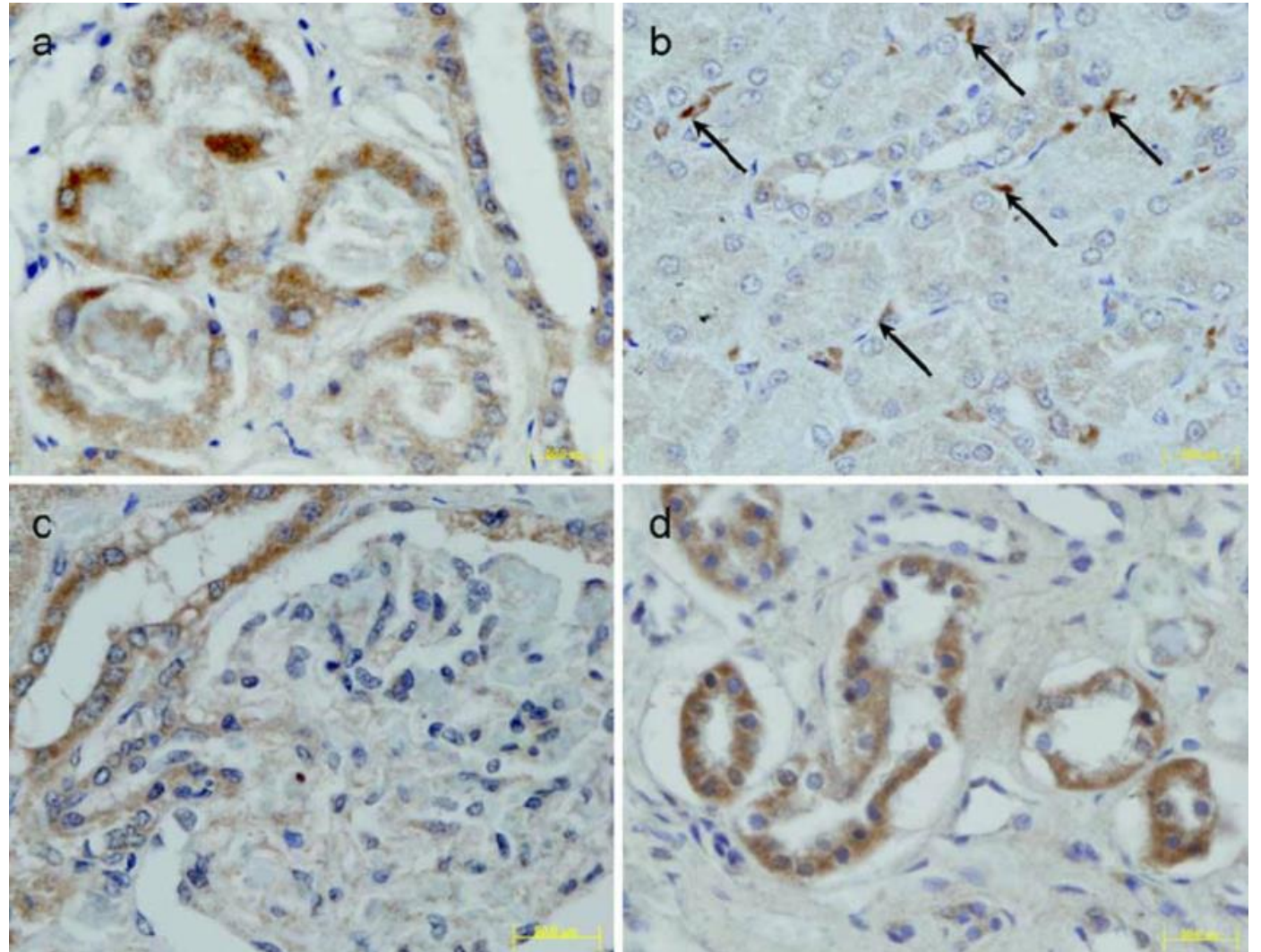
75F with isolated normocytic anemia.

- A. Anemia of chronic renal disease.
- B. Anemia of chronic inflammation.
- C. Autoimmune hemolytic anemia.
- D. Iron deficiency.
- E. Beta-thalassemia.

	6/17/2016 1640
<b>COMPLETE BLOOD COUNT</b>	
WBC	8.36
RBC	2.16 ▼
Hgb	6.4 ▼
HCT	19.2 ▼▼
MCV	88.9
MCH	29.6
MCHC	33.3
PLT	150
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## 75F with anemia of chronic renal disease

- **Erythropoietin** is produced in specialized kidney cells that are outside the glomerulus.



# 75F with anemia of chronic renal disease

		6/17/2016 1640
<b>COMPLETE BLOOD COUNT</b>		
WBC		8.36
RBC		2.16 ▼
Hgb		6.4 ▼
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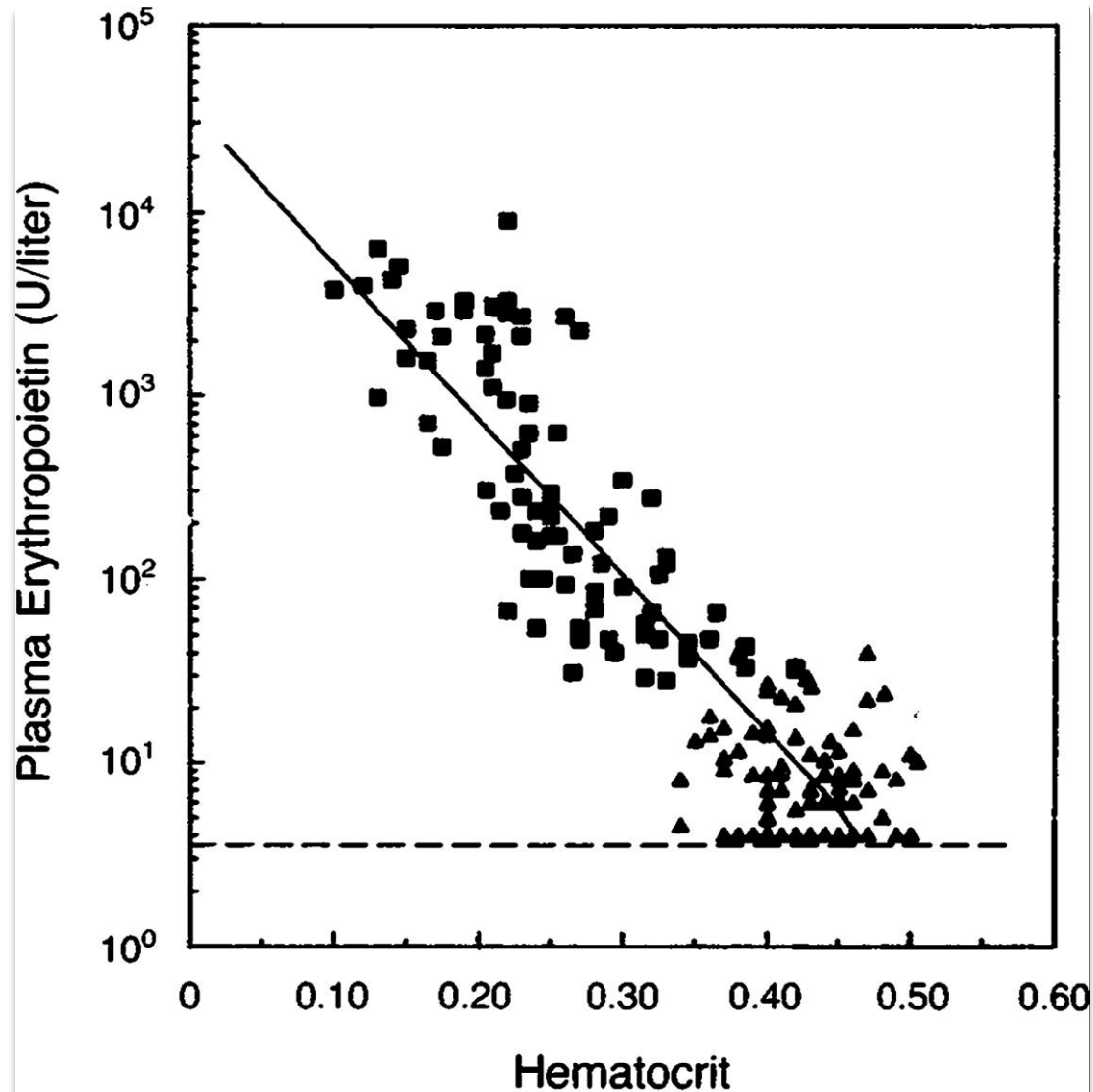
Confirming the  
diagnosis?



<b>CHEMISTRY MISCELLA...</b>	
Erythropoietin	32.1 ▲

Normal range  
~5-21

# Dynamics of serum erythropoietin



<b>HCT</b>	<b>Expected Serum EPO Response</b>
50%	1
40%	10
30%	100
20%	1000

# 75F with anemia of chronic renal disease

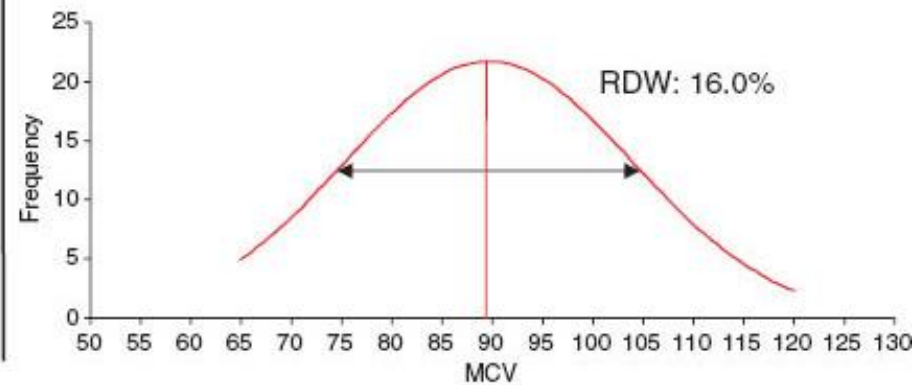
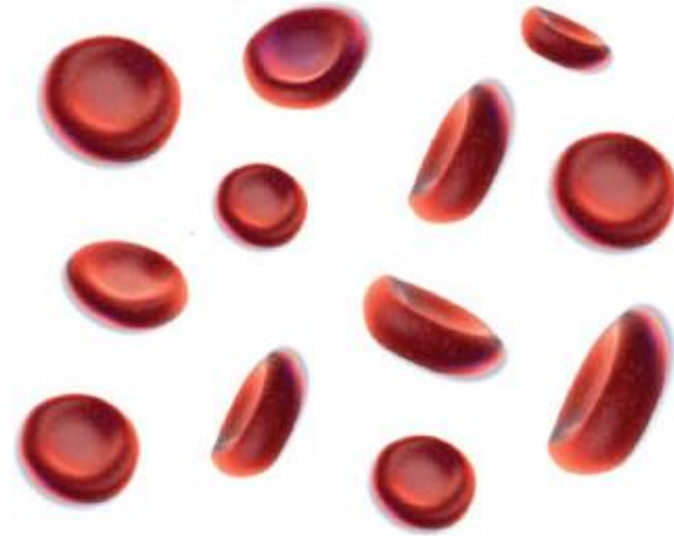
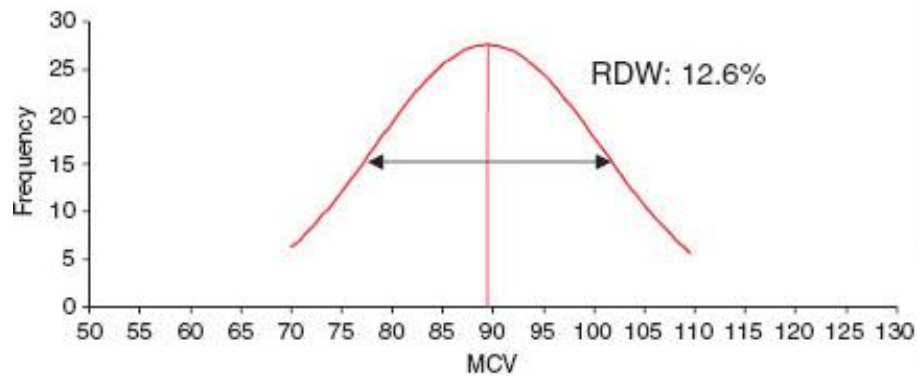
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**Erythropoietin**  
Started 10,000 U TIW  
Increased to 15,000 U TIW

	3/11/2021 1258
	7.71
	3.41 ▼
	10.5 ▼
	32.0 ▼
	93.8
	30.8
	32.8
	94 ▼
	8.8
	15.0 ▲

???? →

# The RDW



# RDW is a “quality control” metric of the bone marrow

- The bone marrow is supposed to make red blood cells according to specific tolerances of size and shape.
- The more regular the RBC, the smaller the RDW.
- Analogy:
  - Low RDW = Dunkin’ donuts.
  - High RDW = Expensive handcrafted hipster donuts.
- Certain underlying factors can predispose to a high baseline RDW, e.g., thalassemia, hereditary spherocytosis, etc.



# Anemia by the RDW

## Low RDW

- Marrow extrinsic effects.
- Anemia of chronic renal disease (e.g., low **erythropoietin**).
- Anemia due to hypogonadism (e.g., low **testosterone**).

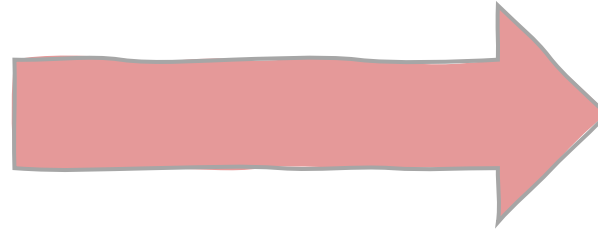
## High RDW

- Marrow intrinsic effects or limitations in RBC building blocks.
- Intrinsic (inherited): thalassemia.
- Intrinsic (acquired): infiltrative processes, hemolytic processes, production problems (**MDS**).
- RBC building blocks: Fe, B12, Folate.



# What happened between October and April?

	10/1/2020 0419
<b>COMPLETE BLOOD COUNT</b>	
WBC	4.60
RBC	1.66 ▼
Hgb	6.0 ▼
HCT	17.6 ▼
MCV	106.0 ▲
MCH	36.1 ▲
MCHC	34.1
PLT	29 ▼
MPV	11.2
RDW	25.6 ▲



<b>LIVER FUNCTION TESTS</b>	
ALT (SGPT) (U/L)	21
AST (SGOT)	30
Alk Phos	52
Bilirubin (Total)	20.2 ▲
Bilirubin (Direct)	3.9 ▲
Albumin	4.6

	4/22/2021 0907
<b>COMPLETE BLOOD COUNT</b>	
WBC	6.69
RBC	4.08 ▼
Hgb	13.2 ▼
HCT	38.8 ▼
MCV	95.1
MCH	32.4
MCHC	34.0
PLT	165
MPV	8.6 ▼
RDW	15.5 ▲

<b>LIVER FUNCTION TESTS</b>	
ALT (SGPT) (U/L)	30
AST (SGOT)	21
Alk Phos	85
Bilirubin (Total)	0.6
Bilirubin (Direct)	0.2
Albumin	4.0

# What happened?

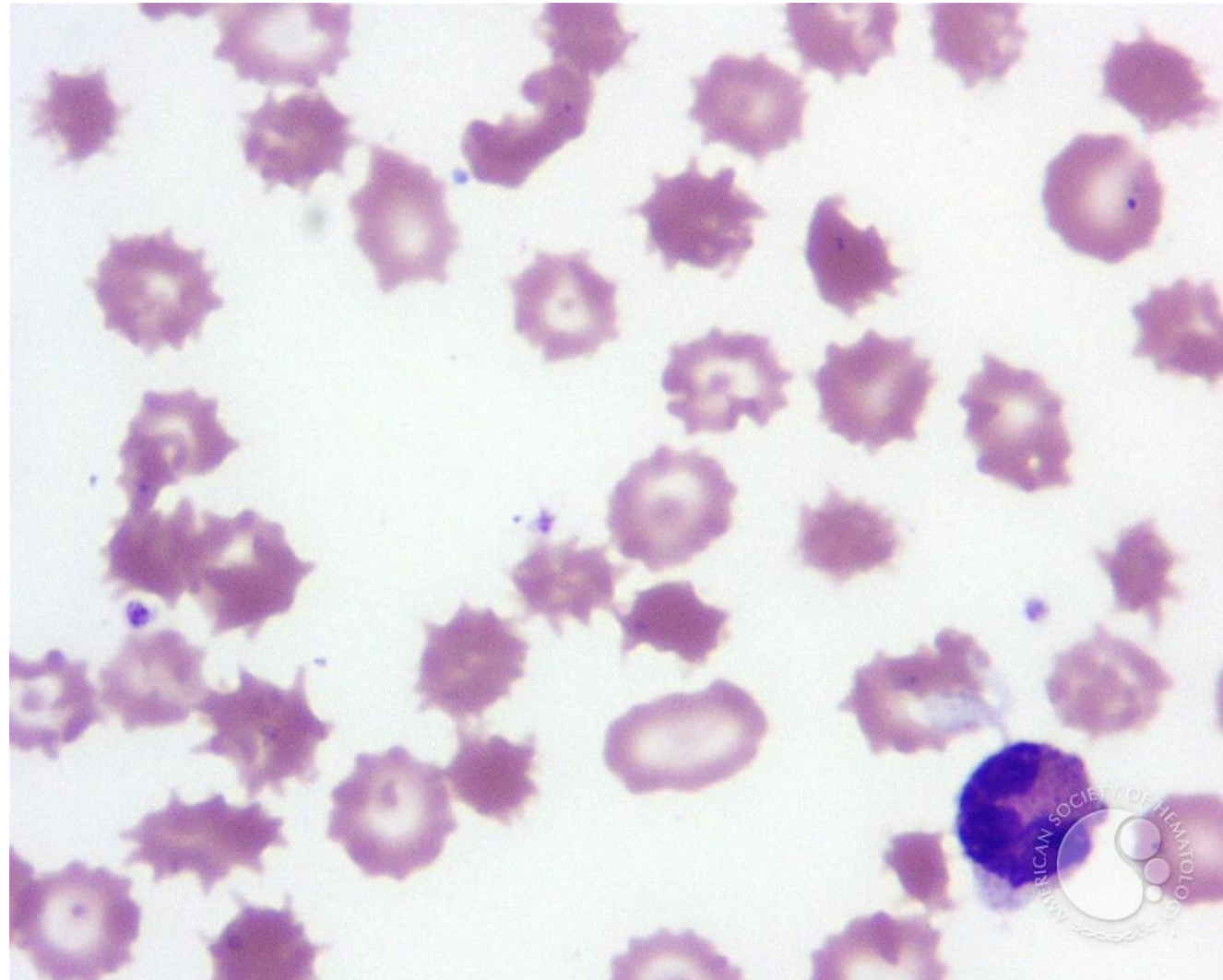
- A. Treatment of MDS.
- B. Consistent sobriety.
- C. Therapy for autoimmune hepatitis.
- D. Bone marrow transplant.
- E. Liver transplant.



10/1/2020 0419	
<b>COMPLETE BLOOD COUNT</b>	
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RBC	1.66 ▼
Hgb	6.0 ▼
HCT	17.6 ▼
MCV	106.0 ▲
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MCHC	34.1
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# Liver failure & spur cell anemia



# The liver is very important to bone marrow health

- Liver disease and spur cell anemia is very challenging.
- Tendency towards bleeding & clotting given the disrupted balance in the coagulation system.
- Tendency towards bleeding (esophageal varices, hemorrhoidal bleeding) and iron deficiency (+ patients are on proton pump inhibitors).

10/1/2020 0419	
COMPLETE BLOOD COUNT	
WBC	4.60
RBC	1.66 ▼
Hgb	6.0 ▼
HCT	17.6 ▼
MCV	106.0 ▲
MCH	36.1 ▲
MCHC	34.1
PLT	29 ▼
MPV	11.2
RDW	25.6 ▲





## 84M with mild anemia

	2/13/2018 1344	4/16/2018 0841	9/5/2018 0940	3/5/2019 1440	3/11/2019 1351
<b>COMPLETE BLOOD COUNT</b>					
WBC	5.51	4.16 ▼	4.01 ▼	5.01	5.35
RBC	4.35 ▼	4.88	4.39 ▼	4.40 ▼	4.63
Hgb	13.0 ▼	14.3	13.3 ▼	13.6	14.0
HCT	37.8 ▼	42.1	38.3 ▼	39.4 ▼	40.6 ▼
MCV	86.9	86.3	87.2	89.5	87.7
MCH	29.9	29.3	30.3	30.9	30.2
MCHC	34.4	34.0	34.7	34.5	34.5
PLT	225	231	228	313	319
MPV	11.9	11.9	10.9	10.8	10.3
RDW	14.3	13.7	13.3	12.8	12.9
<b>BLOOD DIFFERENTIAL %</b>					
Diff Method	Auto	Auto	Auto		Auto
Neutrophils	61.7	51.6	55.4		62.4
Lymphs	27.4	33.4	30.7		25.8
Monos	6.5	8.2	9.2		7.5
Eos	3.3	5.3	3.2		2.8
Basos	0.7	1.0	1.0		0.9



## 84M with anemia

IMMUNOGLOBULIN		
IgG	1,984	▲
IgA	13	▼
IgM	25	▼
SPEP	Abnormal patte... *	
IFX		
Kappa FLC (mg/L)	13.5	
Lambda Free Light ...	2.4 *	▼
Free Kappa/Lambda R...	5.63	▲

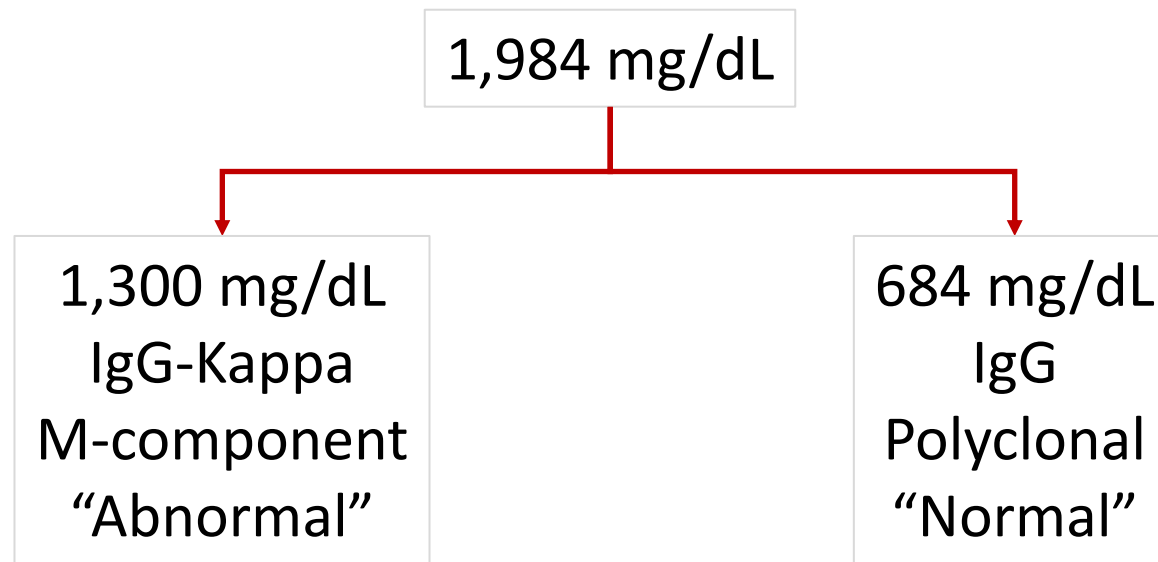
mg/dL

1.3 g/dL IgG-Kappa M-component  
(1300 mg/dL)

# 84M with anemia

IMMUNOGLOBULIN		
IgG	1,984	▲ mg/dL
IgA	13	▼
IgM	25	▼

1.3 g/dL IgG-Kappa M-component





Is the MGUS the cause of his anemia?

- A. Yes.
- B. Yes, and he should be referred for treatment.
- C. Yes, and he needs IVIG replacement therapy.
- D. No. It is an incidental finding that needs no follow-up.
- E. No. It is an incidental finding that should be followed annually.
- F. Probably not. It is an incidental finding that should be followed annually.

# David's MGUS-Library Analogy

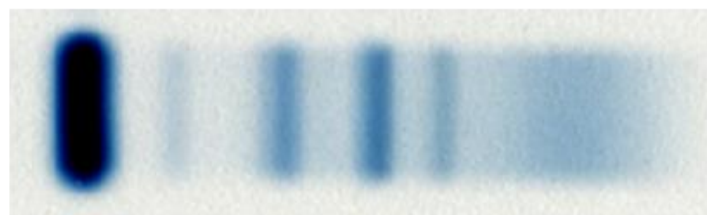
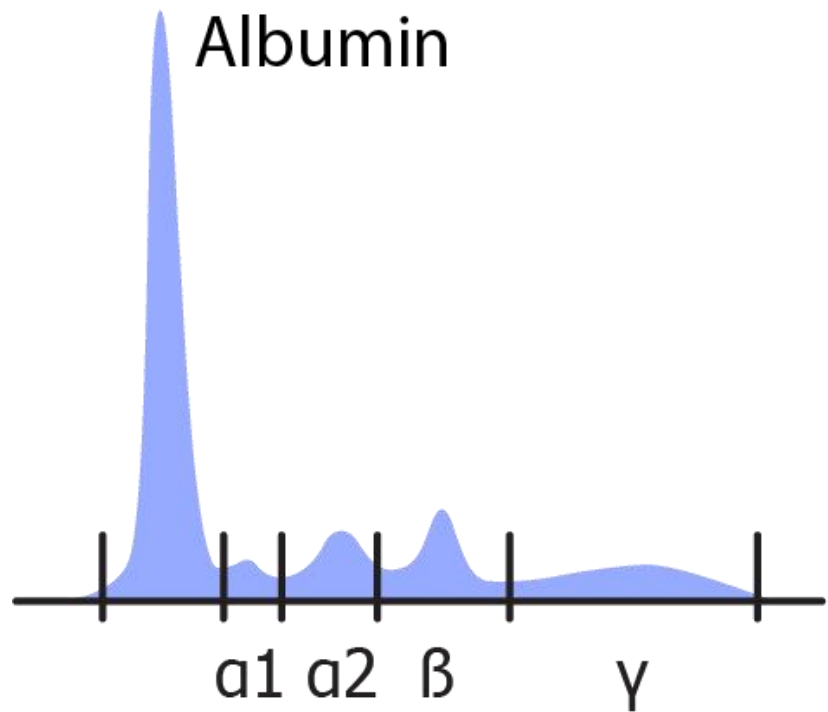
# Antibodies are like books in a library

## Normal Library

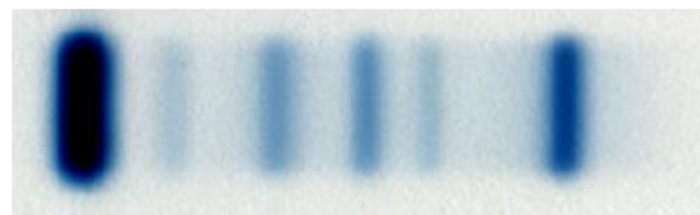
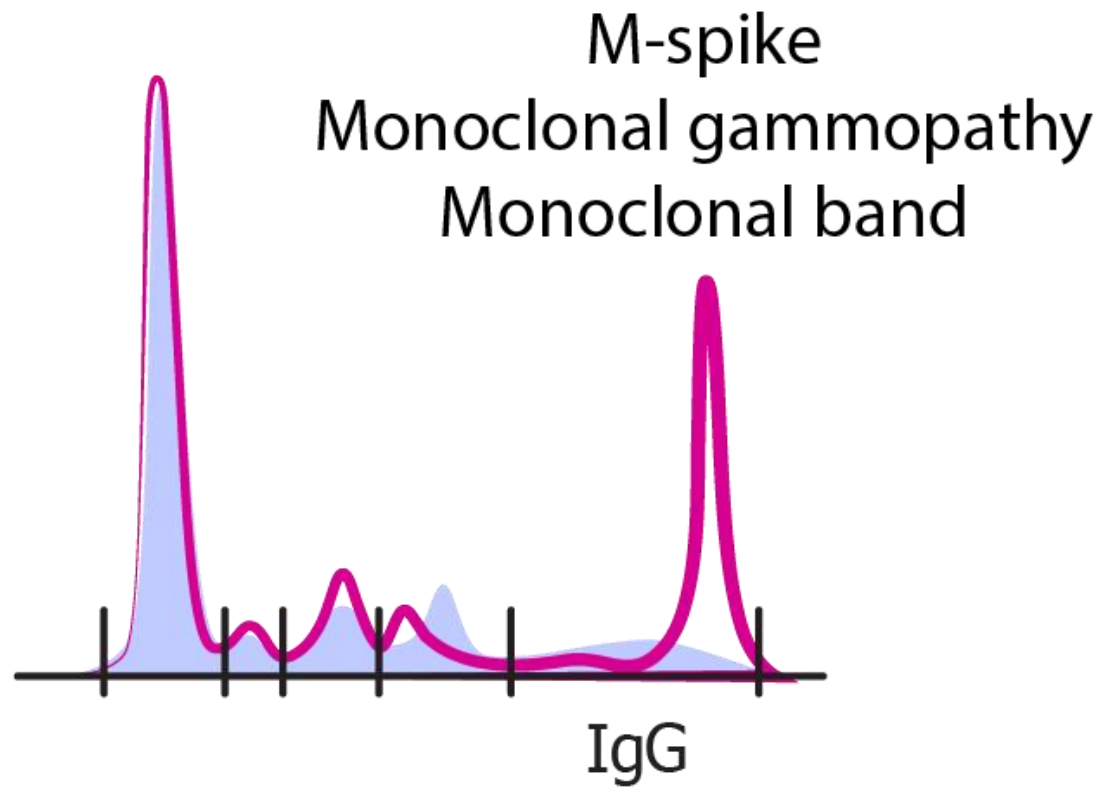
- 1,000,000 books
- 1 copy of each book
- Lots of appeal to every reader (and antibodies to recognize different infectious pathogens)

## MGUS Library

- 1,400,000 books
- 900,000 books with 1 copy of each
- 500,000 copies of Harry Potter
  - Monoclonal gammopathy
- Some loss of 'normal books' but generally speaking no increased risk of infection



**Normal Profile**



**MGUS**



# 72M with diabetes and proteinuria seen in renal clinic

COMPLETE BLOOD COUNT	
WBC	8.47
RBC	5.25
Hgb	15.3
HCT	45.6
MCV	86.9
MCH	29.1
MCHC	33.6
PLT	250
MPV	10.3
RDW	13.4

LYTES/RENAL/GLUCOSE	
Sodium	142
Potassium	4.4
Chloride	102
Carbon Dioxide	28
BUN	17
Creatinine	1.10

IMMUNOGLOBULIN	
IgG	1,073
IgA	66 ▼
IgM	36 ▼
SPEP	Abnormal pattern *
IFX	There is a 0.6... *
Kappa FLC (mg/L)	1,037.2 * ▲
Lambda Free Light ...	5.8
Bence-Jones Protei...	Small amount k... *
FREE KAPPA LAMBDA RAT	178.83 ▲

GENERAL CHEMISTRIES	
Albumin	4.7
Bilirubin (Direct)	
Bilirubin (Total)	0.6
Calcium	10.0
LDH	196



What is this?



- A. Nothing.
- B. MGUS – Monoclonal Gammopathy of Undetermined Significance.
- C. Multiple Myeloma.
- D. Light Chain Myeloma.
- E. Plasma cell leukemia.

## Is there any CRAB criteria?

- C – Calcium is normal.
- R – Renal function is normal.
- A – no Anemia.
- B – any bony disease?

## New IMWG criteria

- >60% plasma cells in the marrow
- Serum light chain ratio >100

IMMUNOGLOBULIN	
IgG	1,073
IgA	66 ▼
IgM	36 ▼
SPEP	Abnormal pattern *
IFX	There is a 0.6... *
Kappa FLC (mg/L)	1,037.2 * ▲
Lambda Free Light ...	5.8
Bence-Jones Protei...	Small amount k... *
FREE KAPPA LAMBDA RAT	178.83 ▲



## 33F with fatigue

- Long history of heavy menstrual periods.
- Pelvic ultrasound suggestive of adenomyosis.

<b>COMPLETE BLOOD COUNT</b>		
WBC	8.72	
RBC	3.37	▼
Hgb	5.5	▼
HCT	22.4	▼
MCV	66.5	▼
MCH	16.3	▼
MCHC	24.6	▼
PLT	102	▼
MPV	Not measured	
RDW	24.3	▲

## 33F with fatigue



- A. Looks like iron deficiency.
- B. Looks like iron deficiency on top of thalassemia.
- C. Looks like thrombocytopenia.
- D. Looks like early onset MDS.
- E. Looks like an acute bleeding event.

<b>COMPLETE BLOOD COUNT</b>	
WBC	8.72
RBC	3.37 ▼
Hgb	5.5 ▼
HCT	22.4 ▼
MCV	66.5 ▼
MCH	16.3 ▼
MCHC	24.6 ▼
PLT	102 ▼
MPV	Not measured
RDW	24.3 ▲

# 33F with fatigue

- Iron deficiency
  - Anemia + microcytosis + wide RDW
- Iron deficiency on top of thalassemia
  - Impossible to tell in this setting
- Thrombocytopenia
  - Lab artifact!
- Acute bleeding event
  - Acute bleed is a NORMOCYTIC anemia

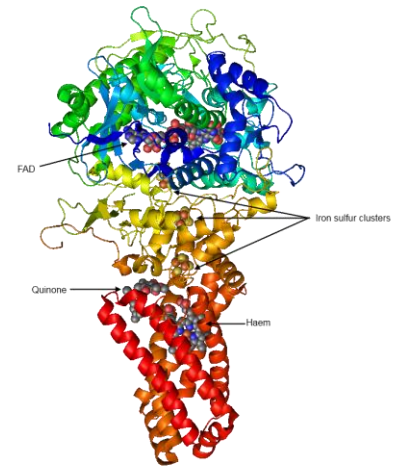
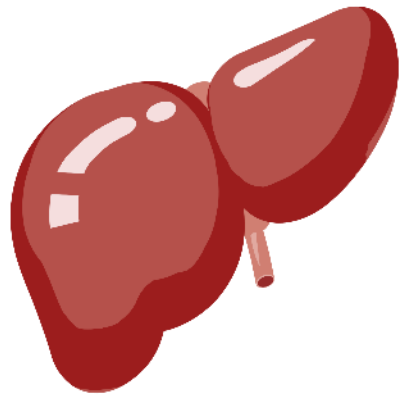
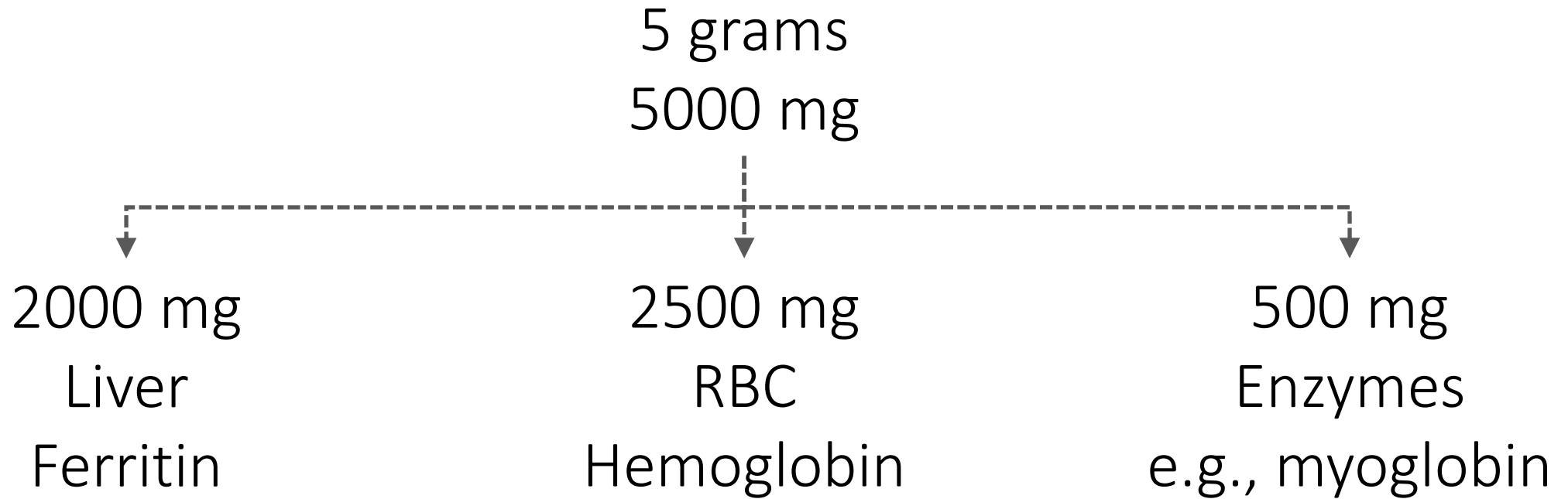
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HCT	22.4 ▼
MCV	66.5 ▼
MCH	16.3 ▼
MCHC	24.6 ▼
PLT	102 ▼
MPV	Not measured
RDW	24.3 ▲

## 33F with iron deficiency

<b>ANEMIA RELATED STU...</b>			
Ferritin	<b>14</b>		
Iron		<b>19</b>	▼
Iron Saturation		<b>4</b>	▼
TIBC		<b>518</b>	▲
Vitamin B12		<b>961</b>	

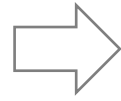


# Total body iron stores – about 5 grams of iron



5000 mg

Normal stores

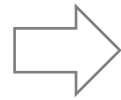


2000 mg  
**Liver**  
Ferritin ~50  
Iron sat ~20%

2500 mg  
**RBC**  
Hgb ~13  
Hct ~40%

500 mg  
**Enzymes**

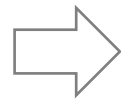
Our patient



Ferritin ~12  
Iron sat ~5%

Hct ~22%

Iron deficit



~1500 mg

1000 mg

2500 mg

# How to replete an iron deficit of 2500 mg?

- Oral iron
- **Low dose iron** is much better tolerated
- **Every-other-day iron** has better fractional absorption
- Assuming no further blood loss, and an excellent absorption of ~25 mg a day, a deficit of 2500 mg will therefore take ~100 days to overcome.

<b>Supplement Facts</b>		
<b>Serving Size 1 Tablet</b>		
<b>Servings per Container 90</b>		
	<b>Amount per Serving</b>	<b>% DV</b>
🌱Vitamin C (ascorbic acid with organic orange)	15 mg	17
🌱Folate (folic acid with broccoli) (400 mcg folic acid)	680 mcg DFE	170
🌱Vitamin B12 (cyanocobalamin with <i>S. cerevisiae</i> )	30 mcg	1250
🌱Iron (mineral bound <i>S. cerevisiae</i> )	26 mg	144
🌱Beetroot	125 mg	**

\*\* % Daily Value (DV) not established

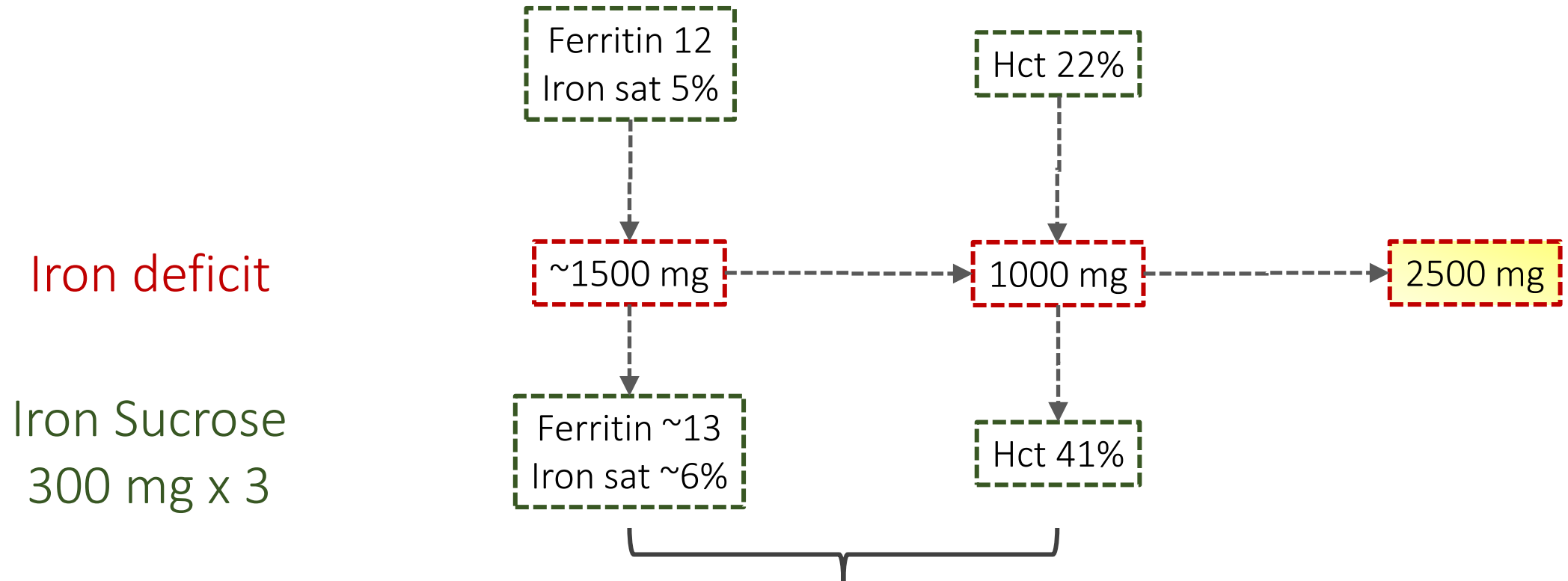
**Other Ingredients:** Stearic Acid, Cellulose.

**Suggested Use:** 1 tablet daily. May be taken anytime throughout the day, even on an empty stomach.

## How to replete an iron deficit of 2500 mg?

- Common preparations of intravenous iron
- **Iron sucrose:** 300 mg x 3 doses = 900 mg
- **Ferumoxytol:** 510 mg x 2 doses = 1020 mg

# Our patient gets 3 infusions of iron sucrose



The ferritin remains 13!  
Is she “iron-refractory?”

# Iron thoughts

- Iron is a math game, the iron IN must exceed the iron OUT
- Storage iron (e.g., ferritin) will not go up until the RBC have what they need
- Do not check for a response too early!
  - Red blood cell lifespan ~100-120 days (a little shorter in iron-deficient cells)
  - Wait for the cells to turnover once before rechecking labs



When can one declare iron “victory” (i.e., iron replete)

- A. The HCT/HGB are normal
- B. The HCT/HGB and MCV are normal
- C. The HCT/HGB and MCV and RDW are normal
- D. The MCHC is normal
- E. Magnets start to spontaneously adhere to the patient

# Anemia by the RDW

## Low RDW

- Marrow extrinsic effects.
- Anemia of chronic renal disease (e.g., low **erythropoietin**).
- Anemia due to hypogonadism (e.g., low **testosterone**).

## High RDW

- Marrow intrinsic effects or limitations in RBC building blocks.
- Intrinsic (inherited): thalassemia.
- Intrinsic (acquired): infiltrative processes, hemolytic processes, production problems (**MDS**).
- RBC building blocks: **Fe**, B12, Folate.





## 45M with anemia

Clear Grid	MGH	MGH
Print Grid	10/09/16 22:04	12/16/13 08:45
WBC	4.08(LT)	4.7
RBC	3.79(LT)	4.65
HGB	12.2(LT)	13.9
HCT	34.9(LT)	42.4
MCV	92.1(T)	91
MCH	32.2(T)	29.9
MCHC	35.0(T)	32.8
PLT	48(LLT)	213
MPV	10.4(T)	
RDW	14.7(HT)	12.8



## 45M with anemia

- A. Probably a transient viral process.
- B. Probably a medication side-effect.
- C. Probably ITP (immune thrombocytopenic purpura).
- D. Probably Aplastic Anemia.
- E. Probably MDS.
- F. Probably Acute Leukemia (AML or ALL).

WBC	4.08(LT)
RBC	3.79(LT)
HGB	12.2(LT)
HCT	34.9(LT)
MCV	92.1(T)
MCH	32.2(T)
MCHC	35.0(T)
PLT	48(LLT)
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RDW	14.7(HT)

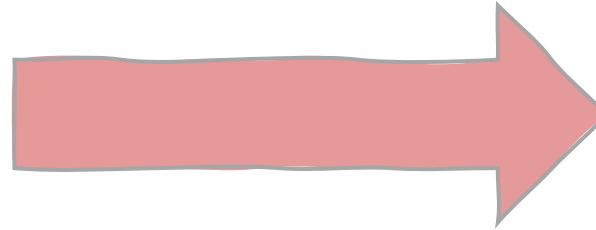
## 45M with anemia

- New (i.e., normal baseline albeit 3 years prior).
- Context: occurred in the setting of travel to India, suggesting an exposure of some sort.
- Concerns: this is not an isolated anemia, as all three lines appear to be down.

Clear Grid	MGH 10/09/16 22:04	MGH 12/16/13 08:45
Print Grid		
WBC	4.08(LT)	4.7
RBC	3.79(LT)	4.65
HGB	12.2(LT)	13.9
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MCV	92.1(T)	91
MCH	32.2(T)	29.9
MCHC	35.0(T)	32.8
PLT	48(LLT)	213
MPV	10.4(T)	
RDW	14.7(HT)	12.8
DIFFR		
METHOD	AUTO(T)	
TOTCELLS		
%NEUT	38.5(LT)	
%LYMPH	54.4(HT)	
%MONO	5.4(T)	
%EOS	1.5(T)	
%BASO	0.0(T)	

# Two-week outpatient follow-up

Clear Grid	<b>MGH</b>
Print Grid	<b>10/09/16 22:04</b>
WBC	<b>4.08(LT)</b>
RBC	<b>3.79(LT)</b>
HGB	<b>12.2(LT)</b>
HCT	<b>34.9(LT)</b>
MCV	92.1(T)
MCH	32.2(T)
MCHC	35.0(T)
PLT	<b>48(LLT)</b>
MPV	10.4(T)
RDW	<b>14.7(HT)</b>



Clear Grid	<b>MGH</b>
Print Grid	<b>10/24/16 15:56</b>
WBC	<b>2.92(L)</b>
RBC	<b>2.89(L)</b>
HGB	<b>9.3(L)</b>
HCT	<b>27.3(L)</b>
MCV	94.5
MCH	32.2
MCHC	34.1
PLT	<b>16(LL)</b>
MPV	10.4
RDW	<b>15.2(H)</b>

## Now what?



- A. HIV, HBC, HCV, CMV, EBV testing.
- B. Peripheral blood flow cytometry for PNH.
- C. Coombs test, LDH, Reticulocyte count.
- D. Bone marrow biopsy.
- E. Trial of steroids +/- IVIG.

Clear Grid	MGH
Print Grid	10/24/16 15:56
<b>WBC</b>	<b>2.92(L)</b>
<b>RBC</b>	<b>2.89(L)</b>
<b>HGB</b>	<b>9.3(L)</b>
<b>HCT</b>	<b>27.3(L)</b>
<b>MCV</b>	<b>94.5</b>
<b>MCH</b>	<b>32.2</b>
<b>MCHC</b>	<b>34.1</b>
<b>PLT</b>	<b>16(LL)</b>
<b>MPV</b>	<b>10.4</b>
<b>RDW</b>	<b>15.2(H)</b>

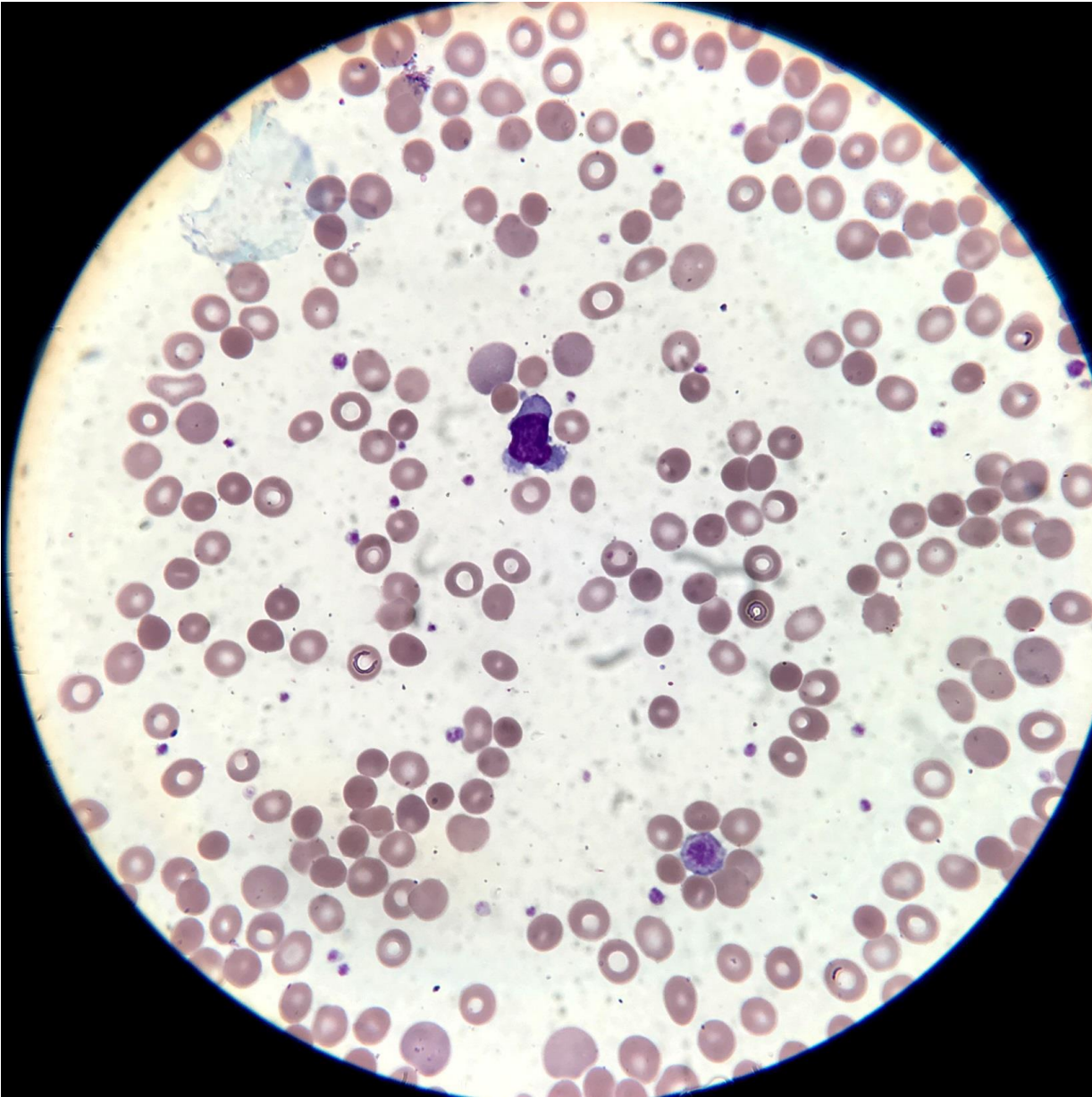
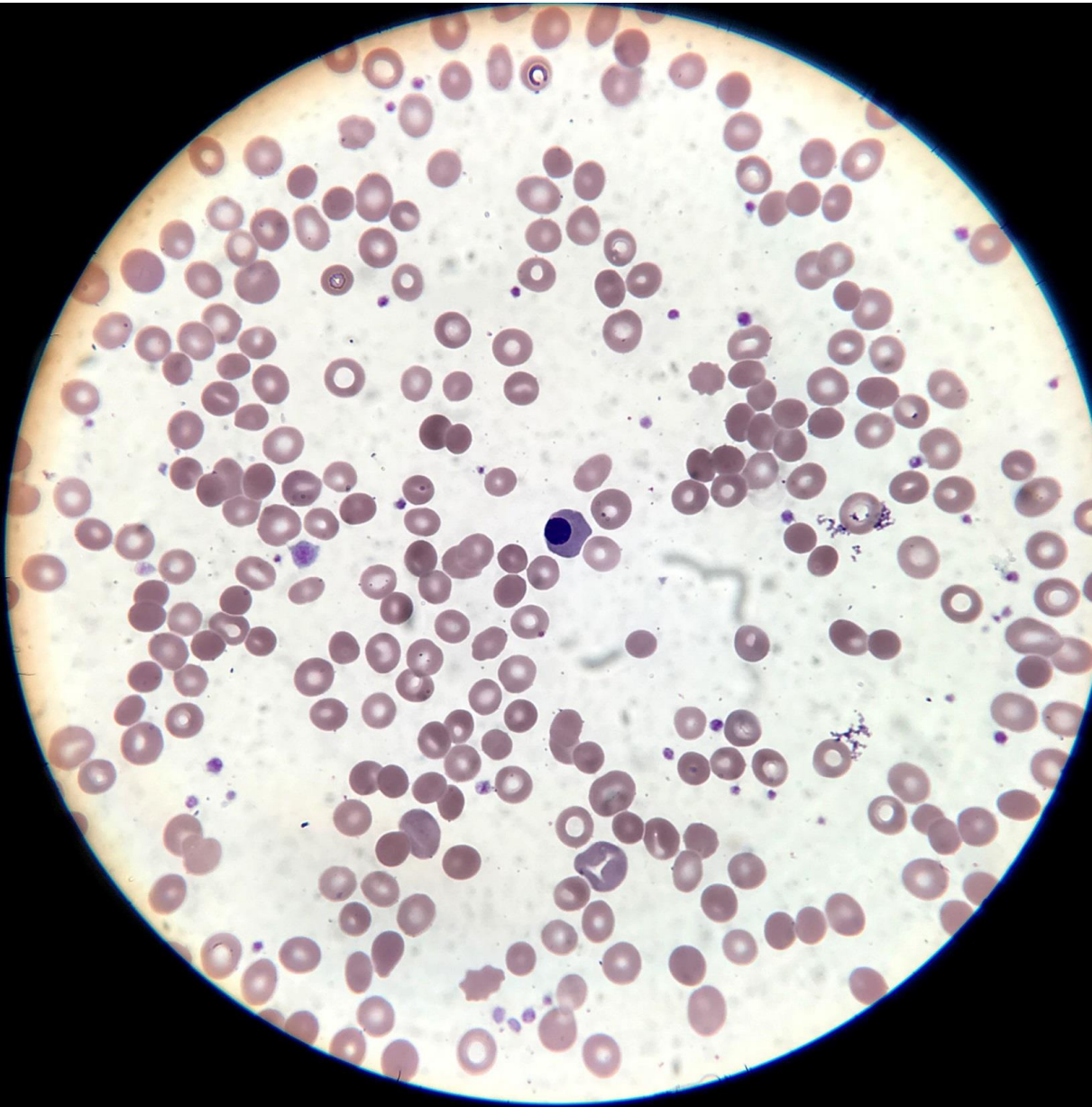
# Aplastic anemia

- A → D are all correct
- Aplastic anemia is caused by a toxic or autoimmune attack on the hematopoietic stem cell
- It leads to pancytopenia because of underproduction
  - LDH is typically LOW
  - RETIC is typically <0.5%
- Rule out destructive processes

Smears!!!



63F with melanoma and new anemia (nivolumab, PD1)



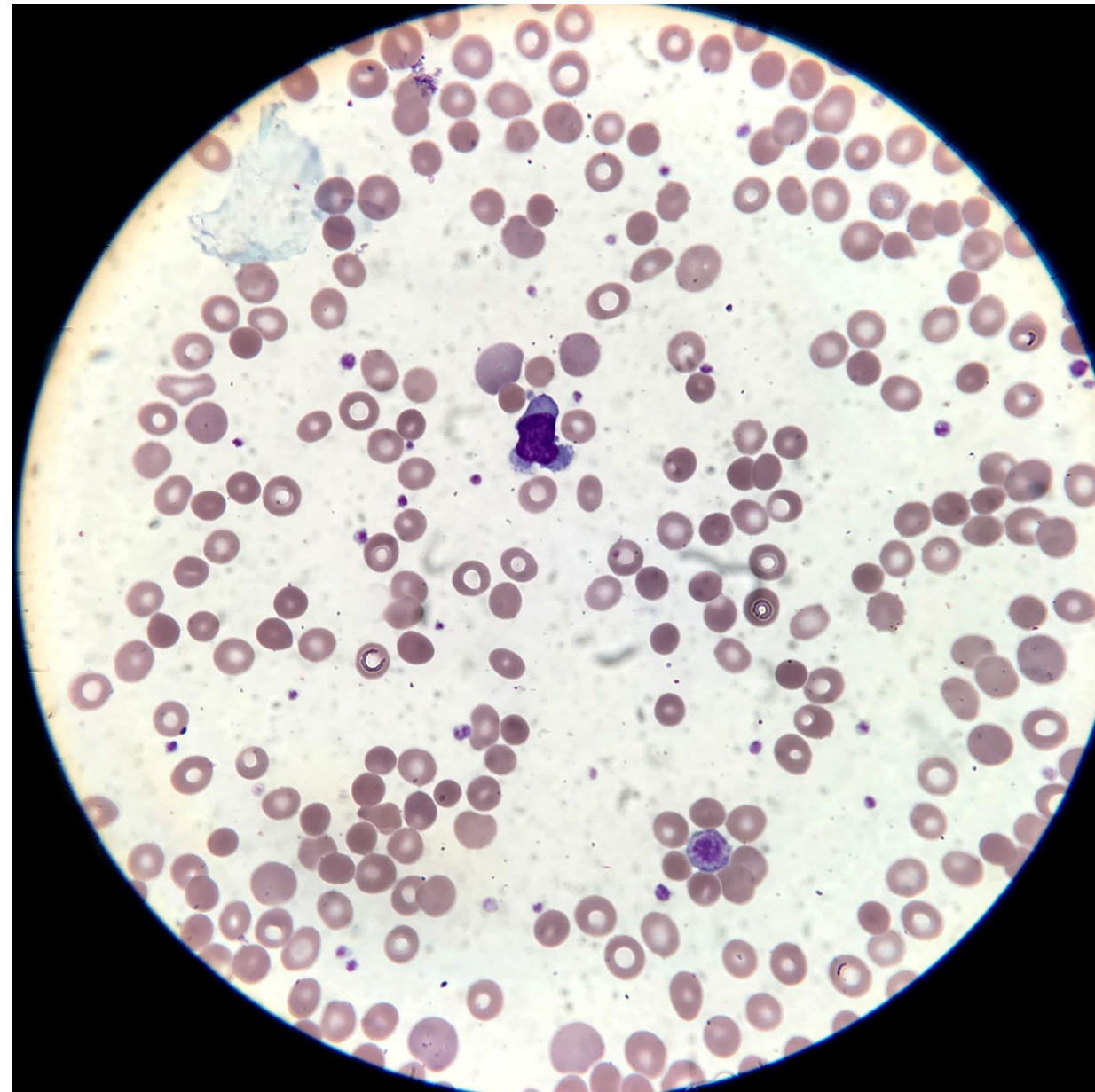
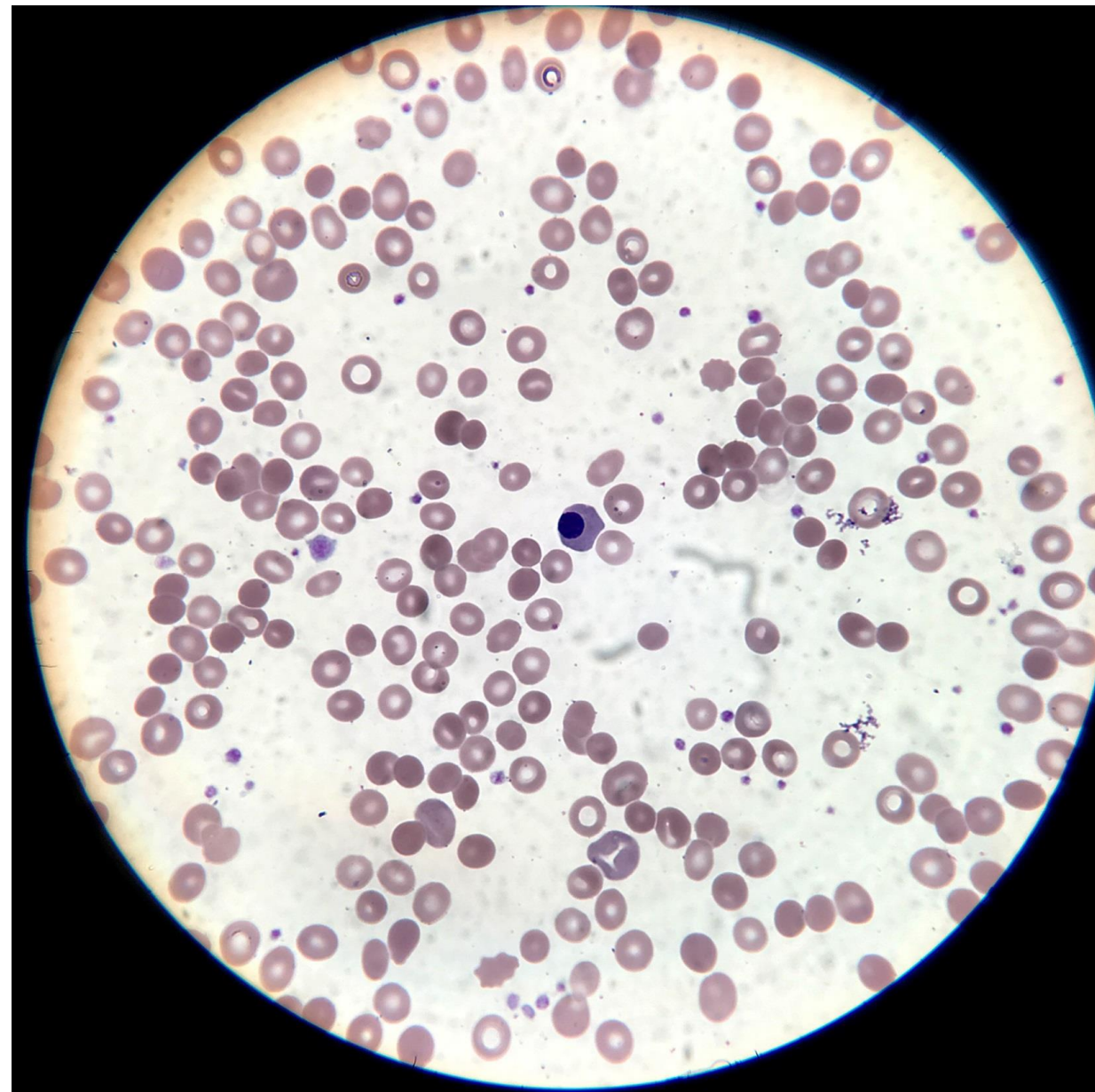


What do you see?

- A. Circulating melanoma cells
- B. Spherocytes
- C. Spherocytes and Schistocytes
- D. Spherocytes and nucleated red blood cells
- E. Spherocytes and nRBC and auto-antibodies (IgG)
- F. Cytokine release syndrome

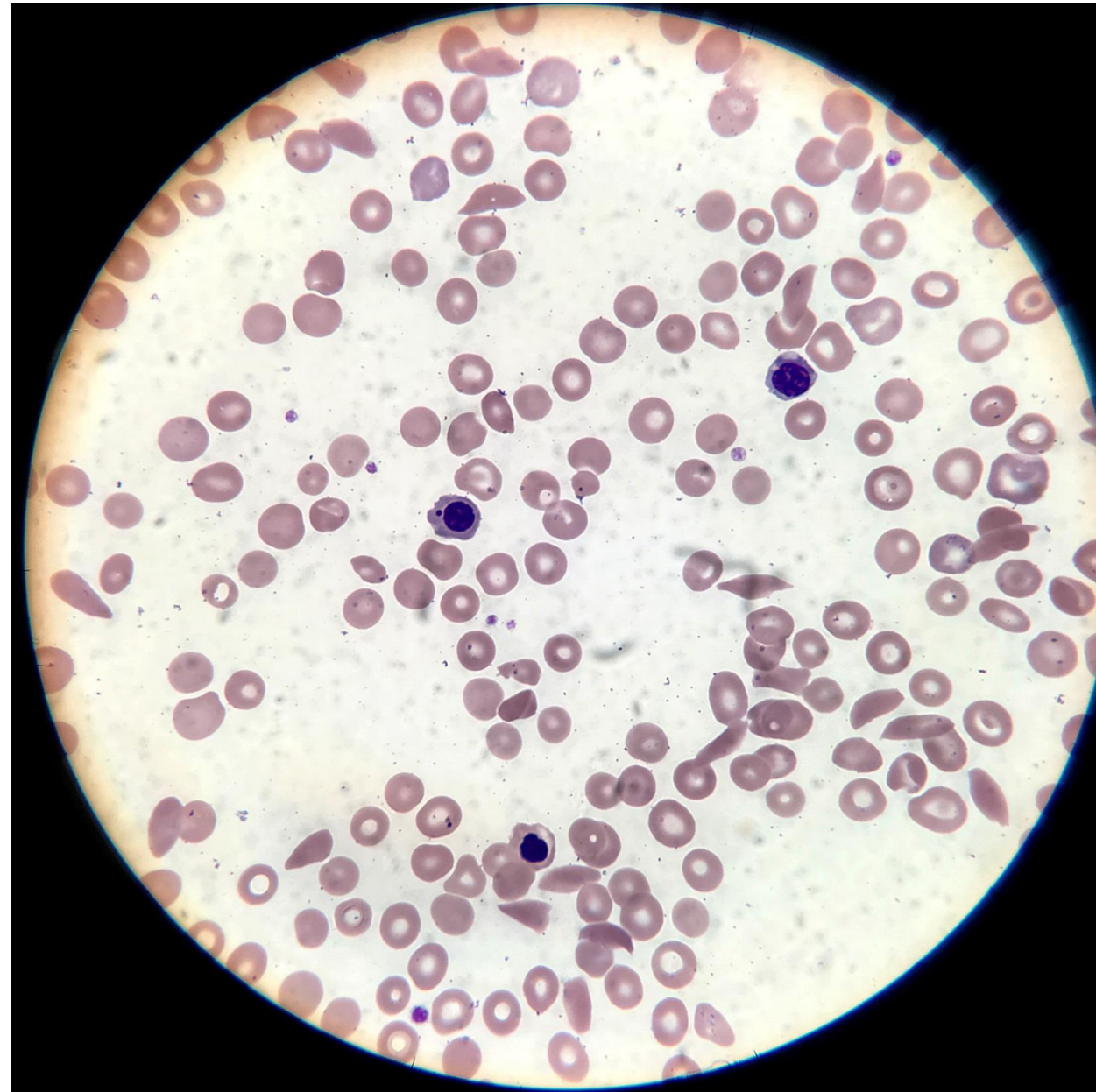
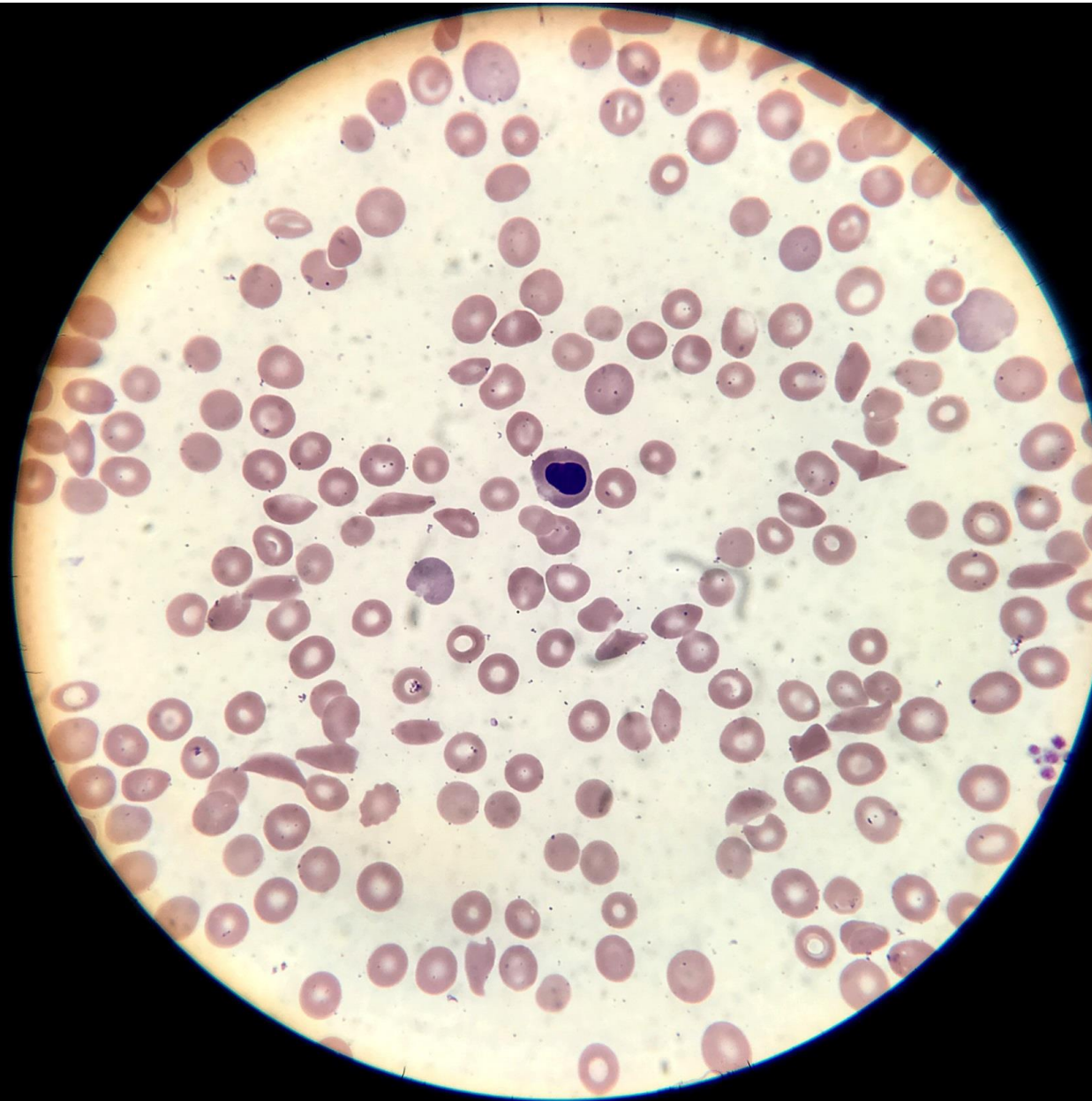


# Spherocytes – drug induced autoimmune hemolytic anemia





29M with chest pain and shortness of breath



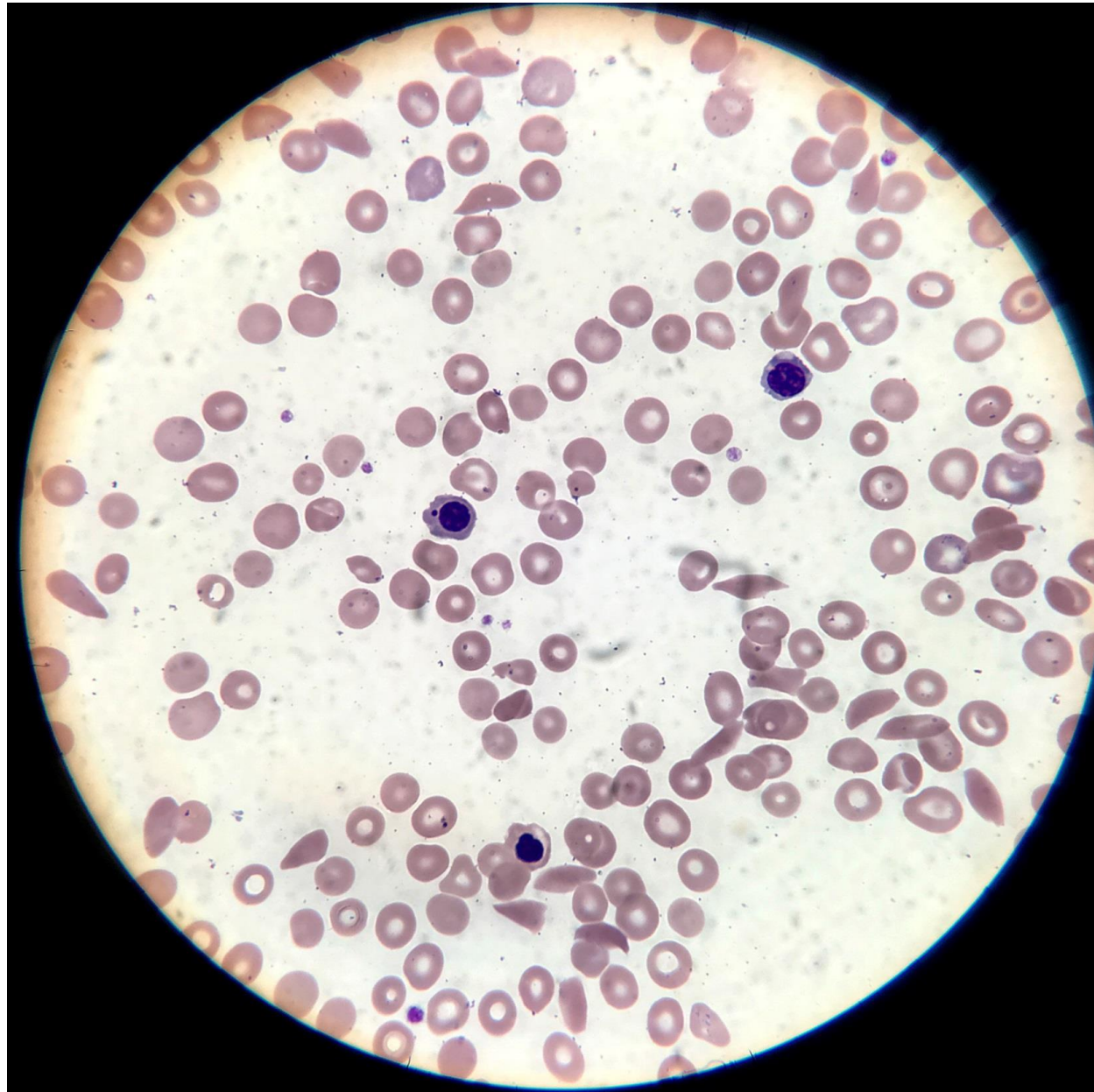
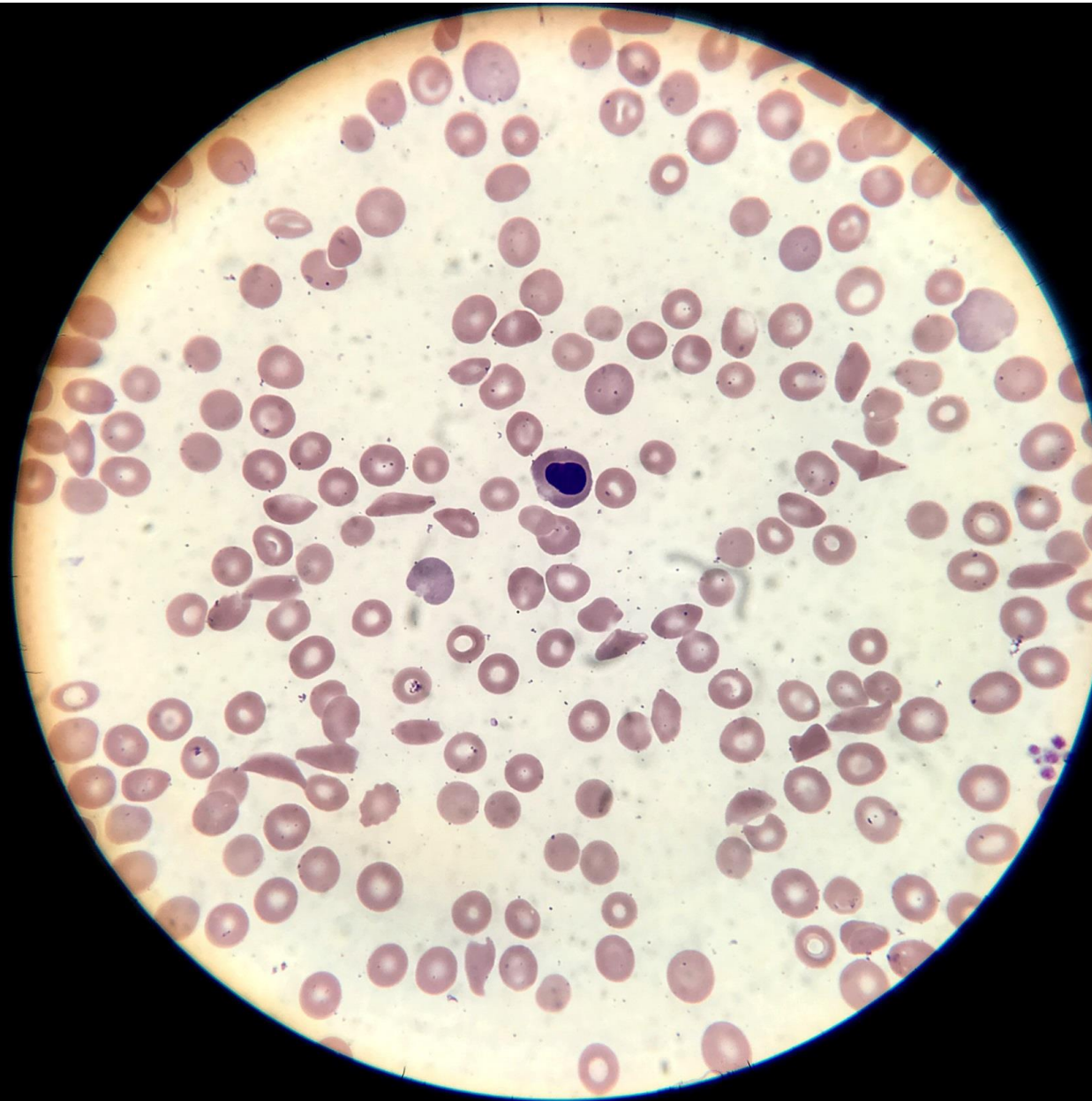
29M with chest pain and shortness of breath



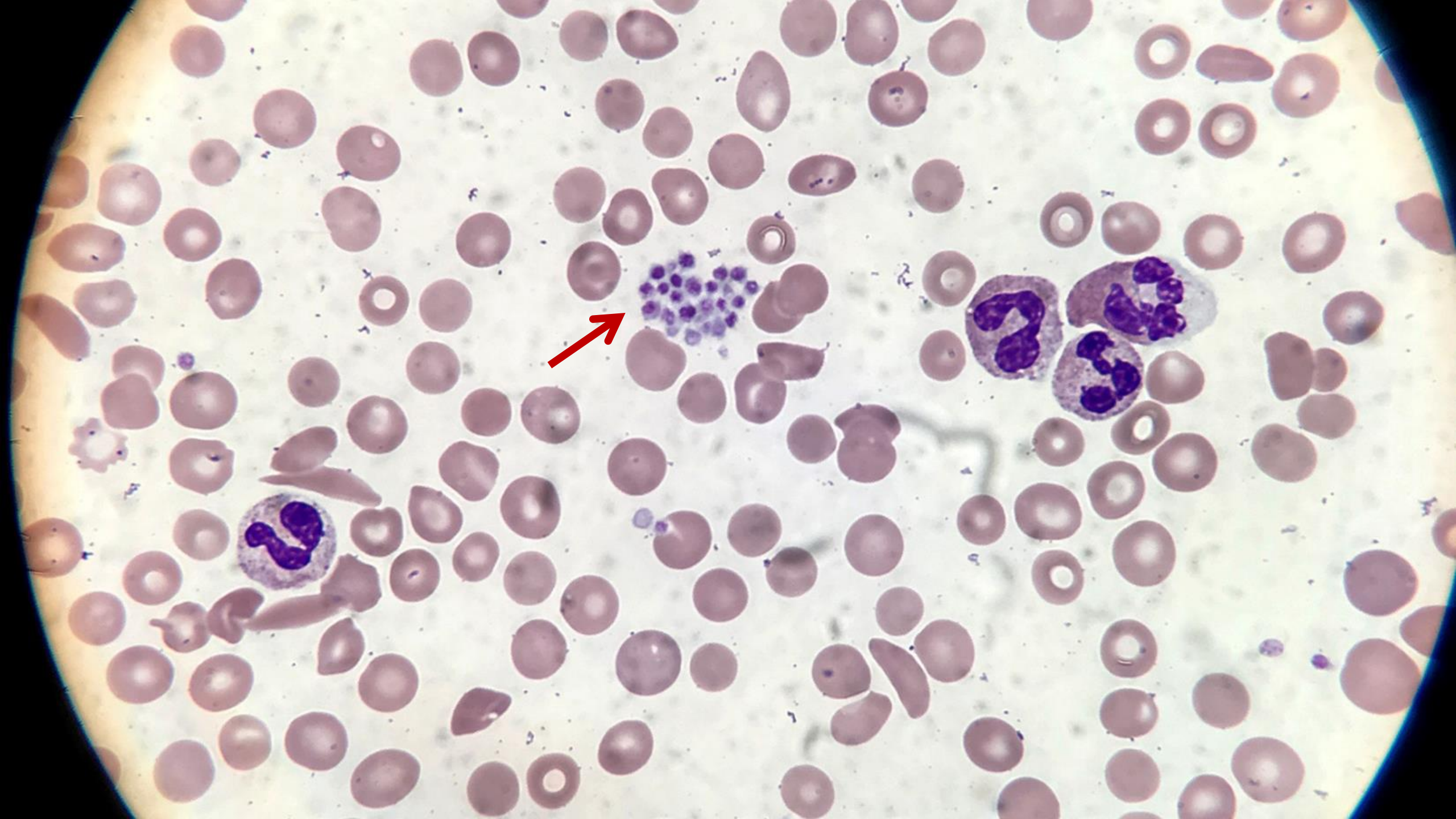
- A. TTP
- B. Sickle cell disease
- C. DIC
- D. HIT
- E. Thalassemia



# Sickle cell disease







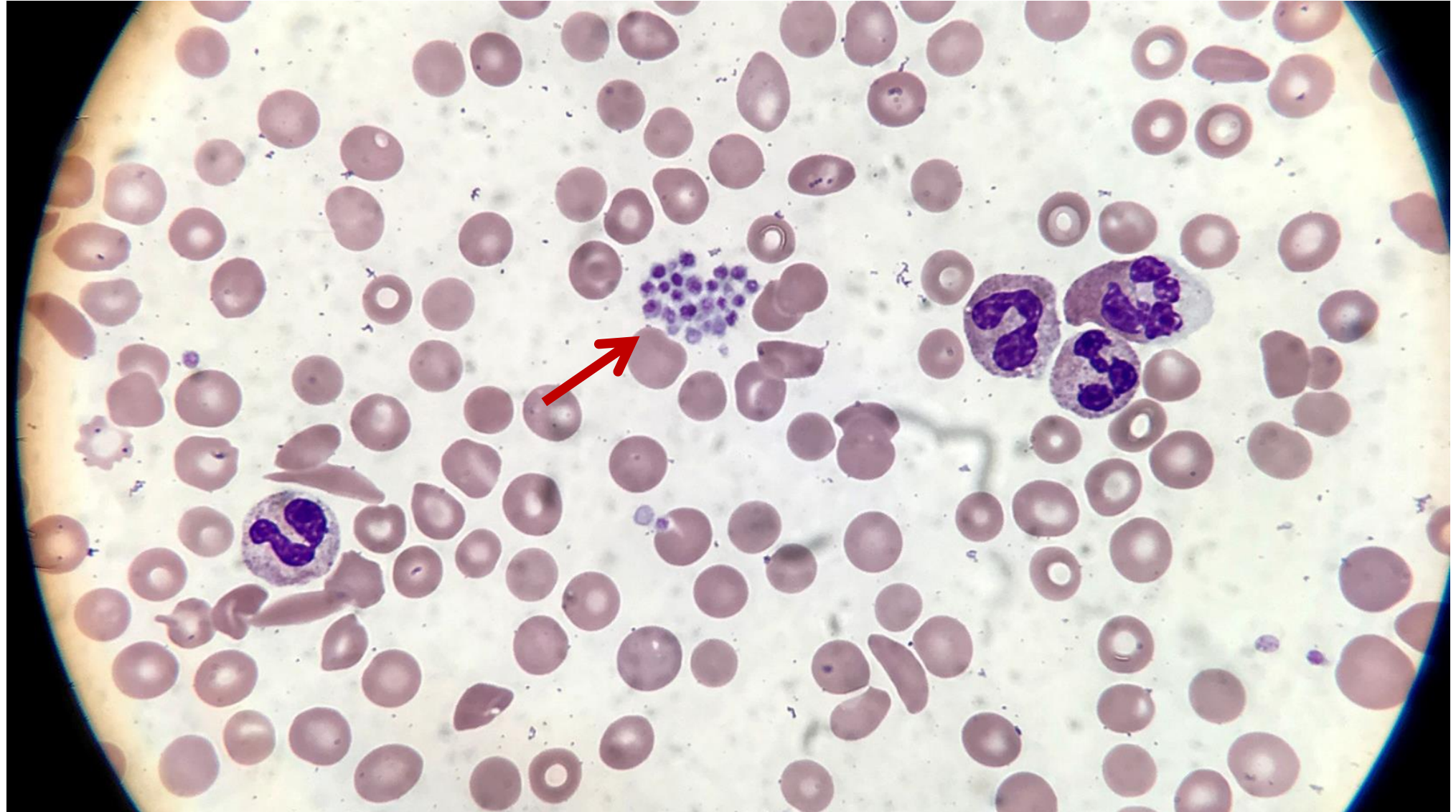
What is the arrow indicating?



- A. Red blood cell clumping
- B. Pseudo-thrombocytopenia
- C. Ehrlichia
- D. Burkitt's lymphoma
- E. Megakaryocyte
- F. Cryoglobulins

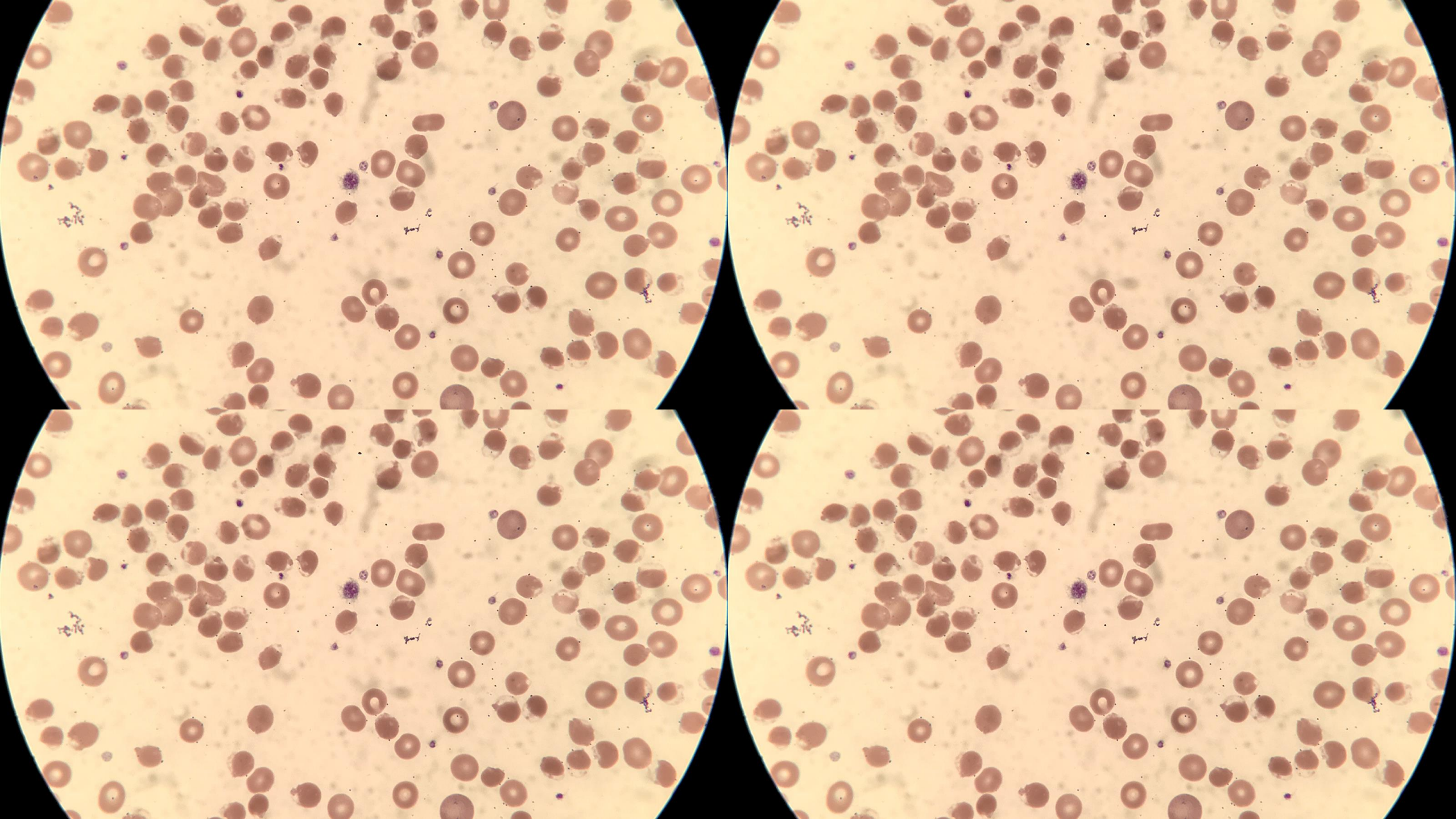


# Pseudothrombocytopenia



## 44M with anemia after rasburicase

- New diagnosis of multiple myeloma
- Acute renal failure with creatinine ~6
- Concern for tumor lysis with elevated LDH, K, PO<sub>4</sub>
- Uric acid ~16
- Decision made to give rasburicase









What are those cells?

- A. Staining artifact
- B. Blister cells in a patient with G6PD deficiency
- C. Bruise cells in a patient with Pyruvate Kinase deficiency
- D. Hereditary spherocytosis
- E. Gaucher disease in a patient with glucocerebrosidase deficiency
- F. Artifact due to hyper-viscosity secondary to myeloma

## G6PD deficiency: Bite & Blister cells





**I**  
  
**Hematology**

ASH Central  
Sales Pavilion

LOXO

Meeting Rooms 6-16  
Ground Level

6

Systemic-Based  
Hematology Education  
and Networking Seminar

Cases if there is extra time!



## 21M with anemia

	5/25/2020	
	0632	
<b>COMPLETE BLOOD COUNT</b>		
WBC	276.55 *	▲
RBC	3.16	▼
Hgb	9.5	▼
HCT	28.7	▼
MCV	90.8	
MCH	30.1	
MCHC	33.1	
PLT	259	
MPV	12.6	▲
RDW	18.3	▲

# 21M with anemia

	5/25/2020	
	0632	
<b>COMPLETE BLOOD COUNT</b>		
WBC	276.55 *	▲
RBC	3.16	▼
Hgb	9.5	▼
HCT	28.7	▼
MCV	90.8	
MCH	30.1	
MCHC	33.1	
PLT	259	
MPV	12.6	▲
RDW	18.3	▲

<b>BLOOD DIFF - ABSOLUTE</b>		
Neutrophil #	149.32 *	c ▲
Lymph#	8.30	▲
Mono#	8.30	▲
Eos#	8.30	▲
Baso#	16.59	▲
Myelocyte#	49.78	▲
Metamyelocyte#	8.30	▲
Promyelocyte#	19.36	▲
NRBC#	3	▲
NRBC#, auto	2.52	▲
Metamyelocytes	3.0	▲
Promyelocytes	7.0	▲
<b>SMEAR MORPHOLOGY</b>		
Anisocytosis	2+	!
Poikilocytosis	1+	!
Polychromasia	1+	!
Microcytes	1+	!
Ovalocytes	1+	!
PLT Estimate	NORMAL	
<b>OTHER HEMATOLOGY</b>		
Retics (%)		
<b>HEMATOLOGY MISCELL...</b>		
Other cells (Diff)	8.30	▲

5/25/2020  
0632

**LYTES/RENAL/GLUCOSE**

Sodium	143
Potassium	3.3 ▼
Chloride	103
Carbon Dioxide	23
BUN	11
Creatinine	0.98
GFR (estimated)	110 *
Glucose	109 ▲
Anion Gap	17

5/26/2020  
0820

**LIVER FUNCTION TESTS**

ALT (SGPT) (U/L)	14
AST (SGOT)	16
Alk Phos	67
Bilirubin (Total)	0.8
Bilirubin (Direct)	0.2
Albumin	4.3
Globulin	2.4

**US Abdomen Complete**

Performed: 5/26/2020 at 4:42 PM

**Reason For Exam**

new leukemia ? splenomegaly; \*Splenomegaly

**PAC**



**Impression**

Marked splenomegaly, measuring 22.5 cm craniocaudally.

5/25/2020  
0632

**ROUTINE COAGULATION**

PT	14.7 ▲
PT-INR	1.2 ▲
PTT	34.6 *
Fibrinogen	439

5/26/2020  
0820

5/26/2020  
0213

**GENERAL CHEMISTRIES**

Albumin	4.3	
Bilirubin (Direct)	0.2	
Bilirubin (Total)	0.8	
Calcium		9.0
Calcium, ionized		
LDH	805 ▲	
Magnesium	2.2	
Phosphorus		
Total Protein	6.7	
Uric acid		8.1 ▲

## 21M with anemia



- A. Acute myeloid leukemia (AML).
- B. Acute lymphoid leukemia (ALL).
- C. Chronic myeloid leukemia (CML).
- D. Chronic lymphoid leukemia (CLL).
- E. Polycythemia vera

	5/25/2020 0632
<b>COMPLETE BLOOD COUNT</b>	
WBC	276.55 * ▲
RBC	3.16 ▼
Hgb	9.5 ▼
HCT	28.7 ▼
MCV	90.8
MCH	30.1
MCHC	33.1
PLT	259
MPV	12.6 ▲
RDW	18.3 ▲

# 21M with chronic myeloid leukemia

- BCR/ABL (+), translocation between chromosomes 9 & 22
- Started on Dasatinib (PO)



	5/28/2020 0730	6/1/2020 1205	6/8/2020 1430	6/15/2020 1223	6/29/2020 1246	7/10/2020 1543	8/17/2020 1000
<b>COMPLETE</b>							
WBC	200.24 $\uparrow$	158.35 * $\uparrow$	69.7 $\uparrow$	7.00	3.95	5.3	5.97
RBC	3.17 $\downarrow$	3.20 $\downarrow$	3.21 $\downarrow$	3.45 $\downarrow$	3.85 $\downarrow$	4.18 $\downarrow$	4.92
Hgb	9.3 $\downarrow$	8.8 $\downarrow$	9.1 $\downarrow$	10.1 $\downarrow$	11.5 $\downarrow$	12.2 $\downarrow$	13.9
HCT	28.4 $\downarrow$	27.9 $\downarrow$	29.8 $\downarrow$	30.8 $\downarrow$	34.9 $\downarrow$	39.6	42.6
MCV	89.6	87.1	92.8	89.3	90.7	94.7	86.6
MCH	29.3	27.6	28.3	29.2	29.8	29.2	28.4
MCHC	32.7	31.7 $\downarrow$	30.5 $\downarrow$	32.6 $\downarrow$	32.8 $\downarrow$	30.8 $\downarrow$	32.8 $\downarrow$
PLT	237	227	209	125 $\downarrow$	86 $\downarrow$	175	101 $\downarrow$
MPV	12.6 $\uparrow$	10.1	11.9	9.9	8.8	10.8	8.5
RDW	17.9 $\uparrow$	18.3 $\uparrow$	19.7 $\uparrow$	21.6 $\uparrow$	20.4 $\uparrow$	16.7	15.4



What happens to the CBC during normal aging?



- A. Progressive anemia.
- B. Progressive increase in the MCV.
- C. Progressive increase in the RDW.
- D. Progressive neutropenia.
- E. Progressive monocytosis.

## 97M with “Old Blood”?

- Perfectly normal CBC.
- No such thing as ‘old age’ anemia.
- That does not mean that anemia is not common in aging of course, it is just not a normal part of the aging process.

	3/26/2019 1040
<b>COMPLETE BLOOD COUNT</b>	
WBC	5.83
RBC	4.59
Hgb	15.0
HCT	44.6
MCV	97.2
MCH	32.7
MCHC	33.6
PLT	202
MPV	11.8
RDW	13.8
<b>BLOOD DIFF - ABSOLUTE</b>	
Neutrophil #	3.23
Lymph#	1.33
Mono#	1.12
Eos#	0.29
Baso#	0.10