Approccio morfologico alle microangiopatie trombotiche

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Thrombotic microangiopathies

Occlusive microangiopathic disorders with

- Microvascular thrombosis
- Thrombocytopenia
- Red blood cell mechanical damage

History (I)

Moschcowitz (1924)

First description of a 16 year-old girl who died within 2 weeks after the abrupt onset and progression of petechial bleeding, pallor, fever, paralysis, hematuria and coma. Disseminated microvascular hyaline thrombi largely composed of platelets were detected at autopsy in arterioles and capillaries.

In January of 1924[1] and apparently for a second time in February,[2] Moschcowitz presented a case before the New York Pathological Society of "a hitherto undescribed disease (ref. 1 at 21)" that he felt was "remarkable, clinically and anatomically (ref. 2 at 89)." A healthy 16-year-old girl suddenly developed weakness in her arms, pain on moving her wrists and elbows, pallor, and fever (38°C-39°C). Her symptoms worsened and on the tenth day of illness she was admitted to the hospital with anemia, leukocytosis, a few petechiae on one arm, and occult blood in gastric contents and stool. The serum creatinine was normal. Four days later she developed mild left hemiparesis and facial paralysis. The next day she became comatose and died. A limited autopsy showed hyaline thrombi in terminal arterioles and capillaries of the heart, kidney, spleen, and liver; the lungs were spared. Moschcowitz did not obtain a platelet count and did not report schistocytes in the blood film, so we do not have a complete description from him of thrombocytopenia or microangiopathic hemolytic anemia. But based on the pathology at autopsy, we recognize this patient as the first published example of idiopathic thrombotic thrombocytopenic purpura (TTP).

History (II)

Singer (1947):
First introduction of the term Thrombotic Thrombocytopenic Purpura (TTP).

Symmers (1952):
First introduction of the term Thrombotic Micro-Angiopathy (TMA) to describe the vascular lesions observed in TTP.

Gasser (1955):
First introduction of the term Hemolytic Uremic Syndrome (HUS) in a child presenting with hemolytic anemia, thrombocytopenia and renal failure with diffuse bilateral cortical necrosis.

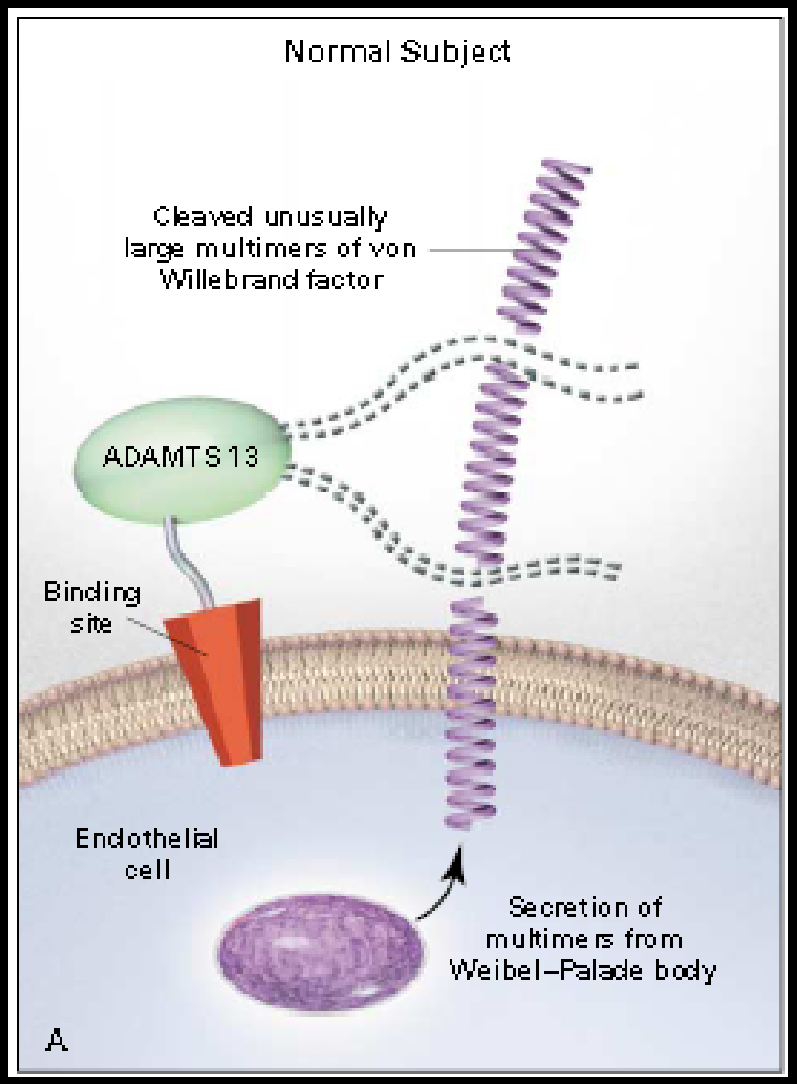
Moake (1982):
First pathogenetic hypothesis: patients with relapsed chronic TTP show plasmatic large amount of “vWF unusual large multimers” delivered by endothelial cells.

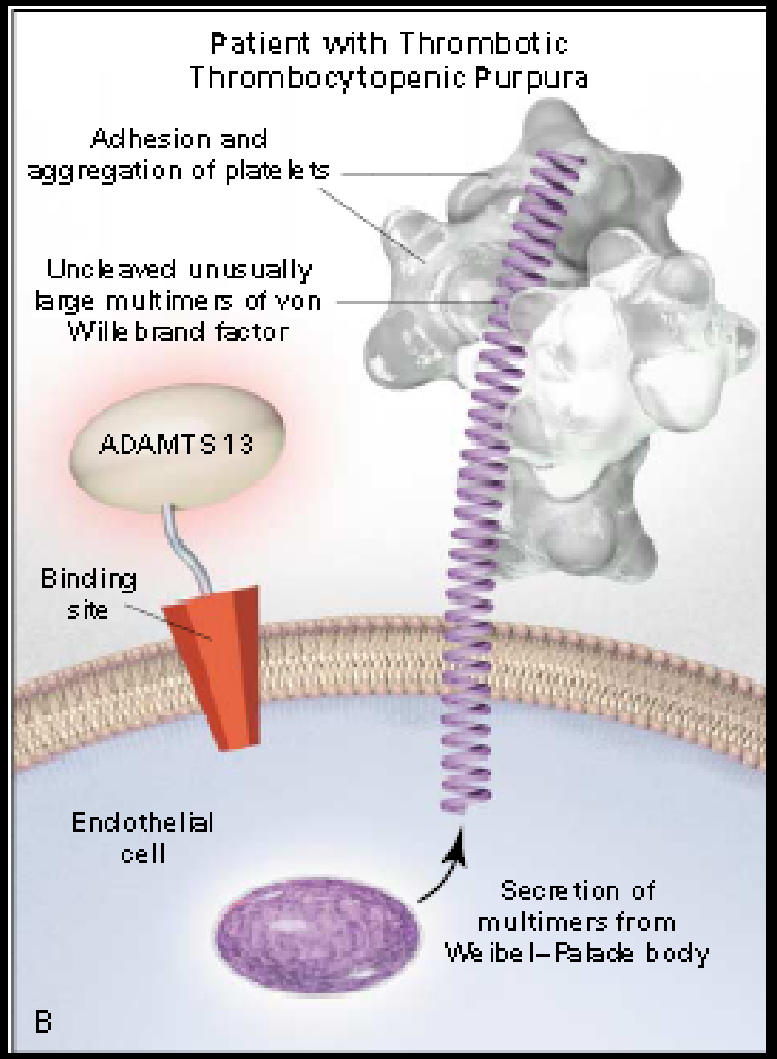
Karmali (1985):
First association between HUS and *Escherichia Coli* Shiga toxin.

Clinical & pathological manifestations

Microangiopathy	Pathogenesis	Clinical presentation
Systemic platelet thrombi	Reduced capability to cleave vWF large multimers	Thrombotic Thrombocytopenic Purpura (TTP)
Renal platelet thrombi	Shiga toxin Factor H plasmatic deficiency	Hemolytic Uremic Syndrome (HUS) associated to *E. Coli* infection (children) Familial/recurrent HUS
Systemic and renal thrombi	Transplant Drugs (mitomicin, cyclosporin)	HUS o TTP

TTP pathogenesis



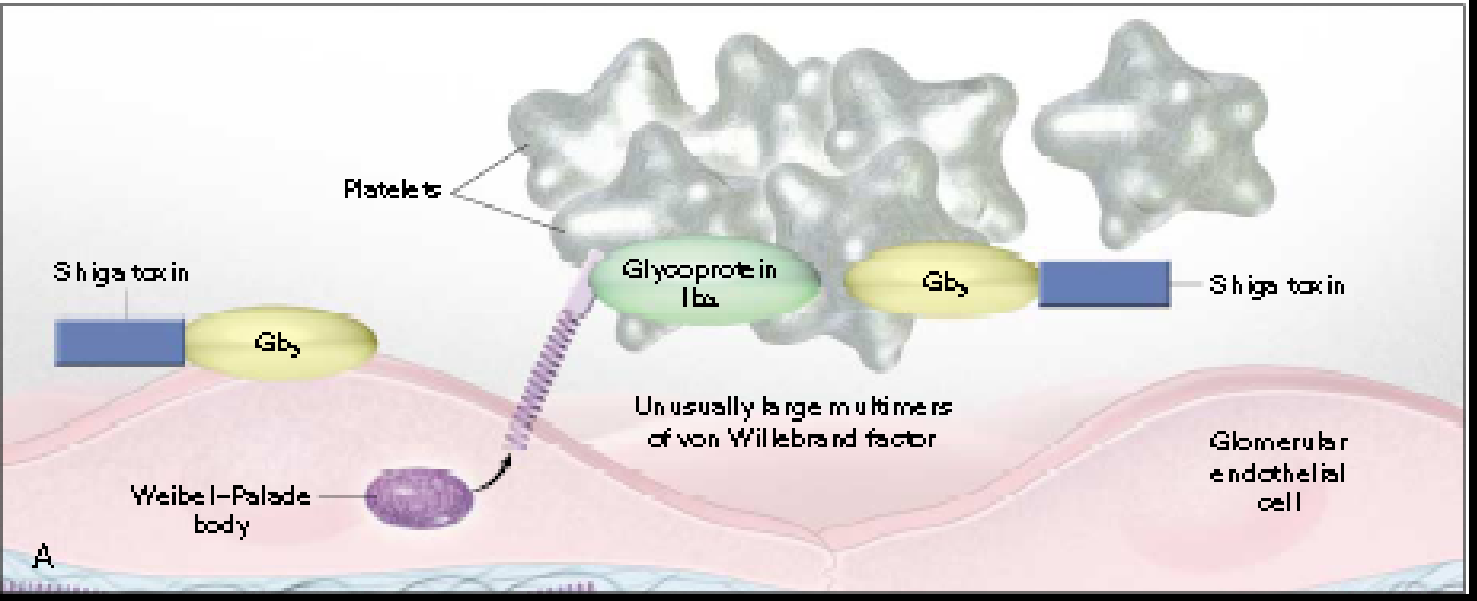


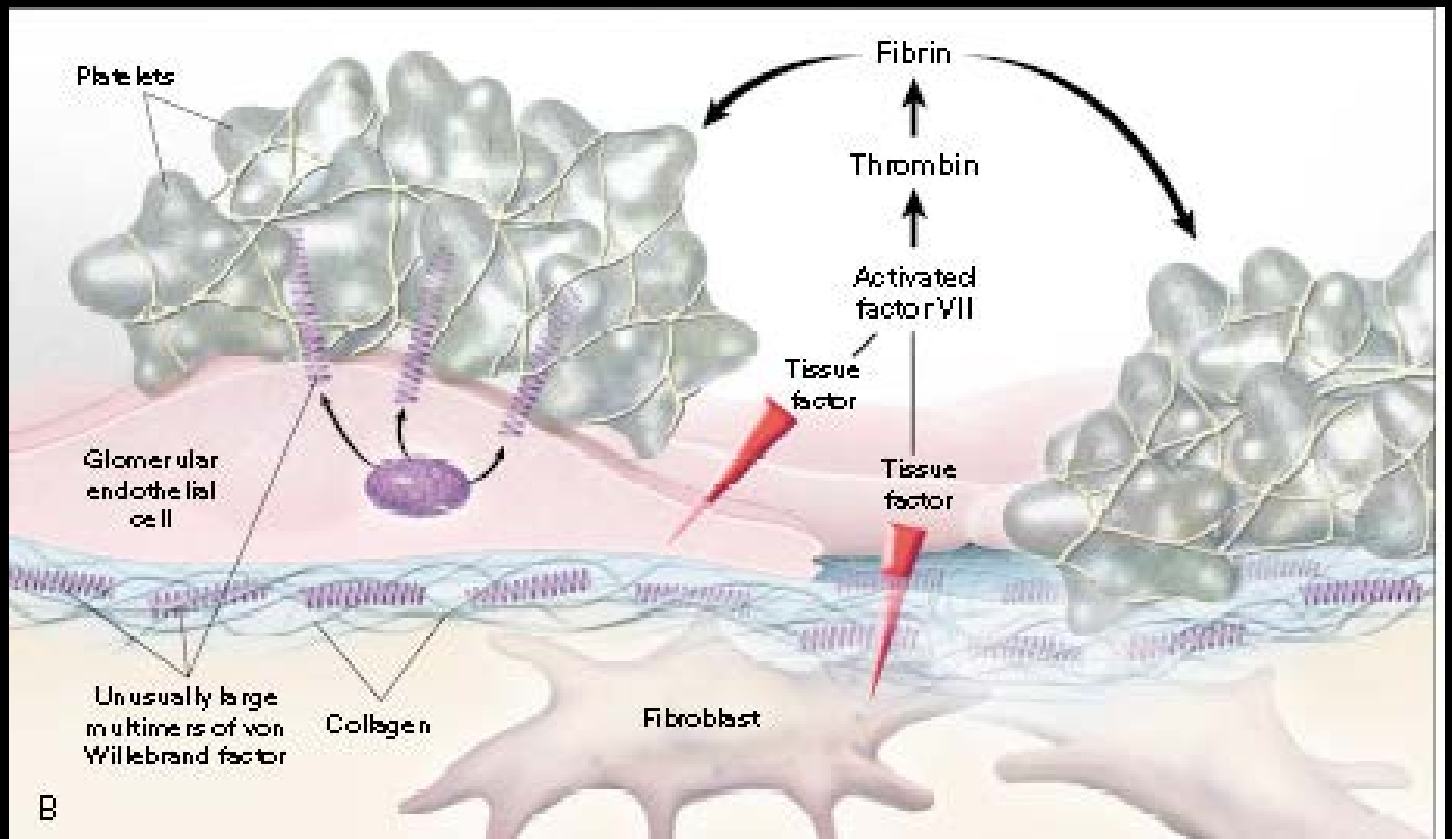
Moake JL 2002, NEJM

A Disintegrin And Metalloproteinase with a Thrombospondin type 1 motif, member 13

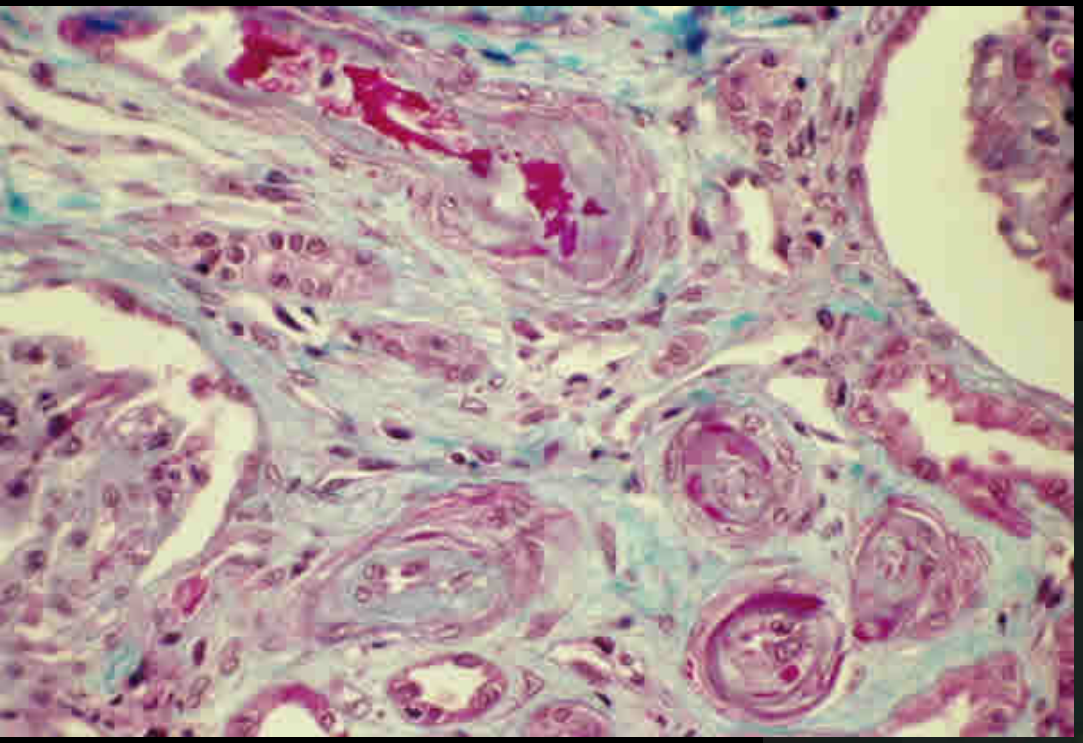
HUS pathogenesis (I)

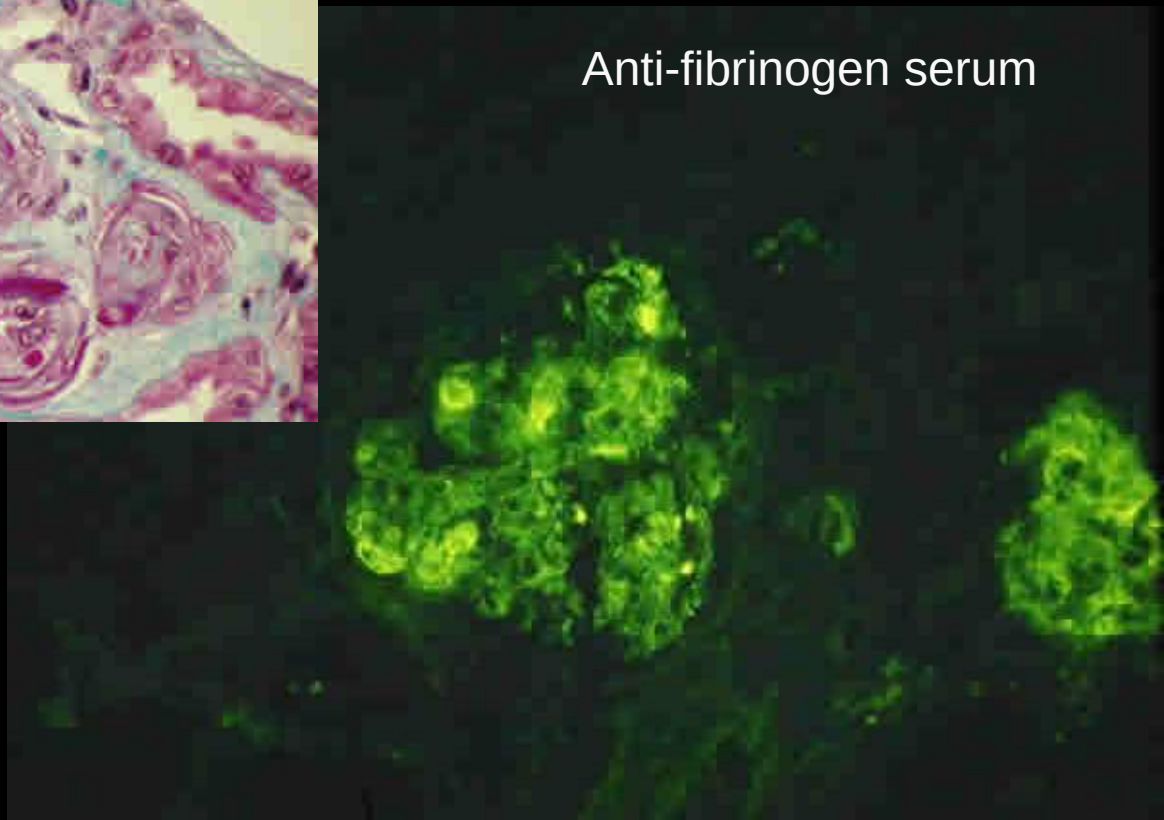
HUS pathogenesis (II)





Renal thrombotic microangiopathy with vessels occlusion





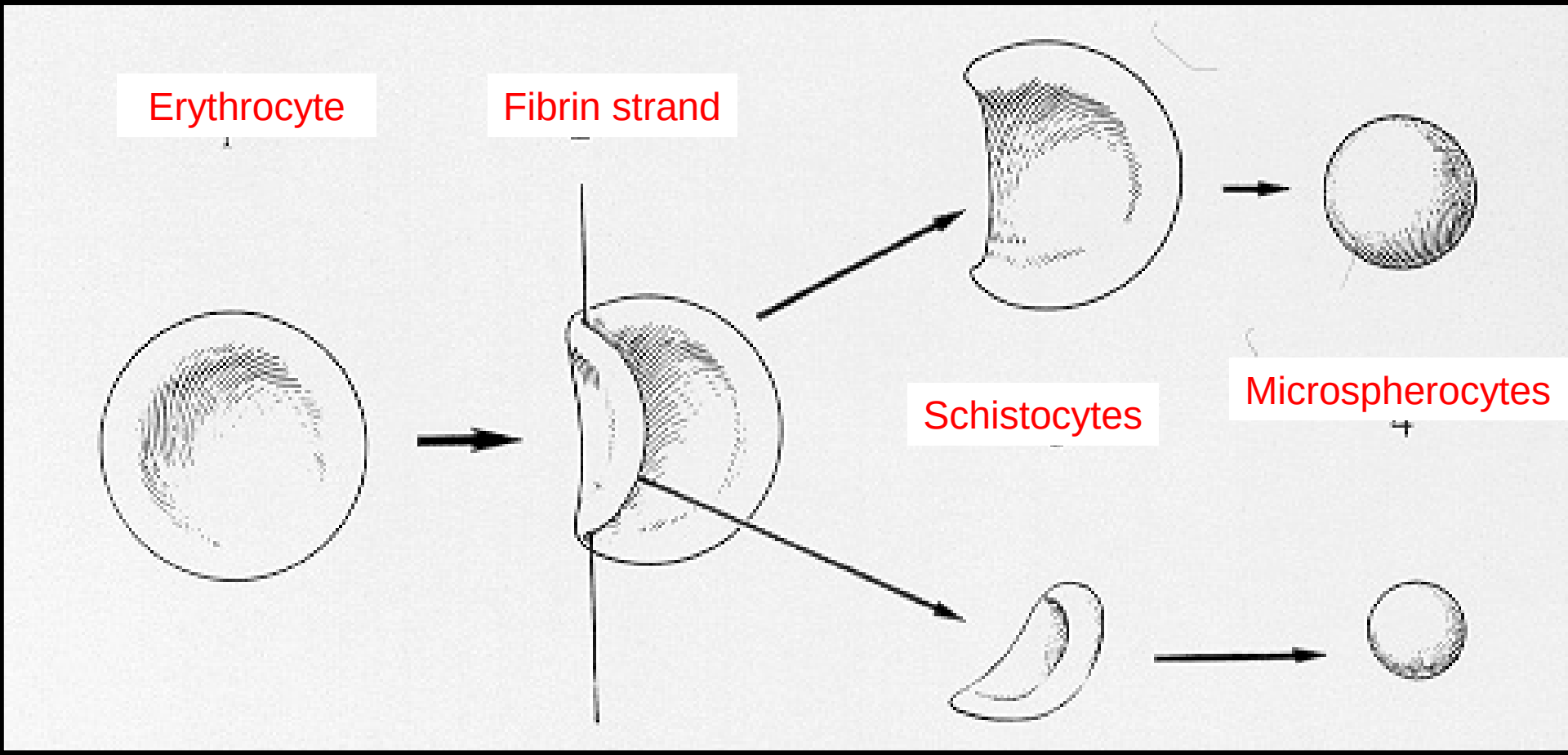
Clinical presentation

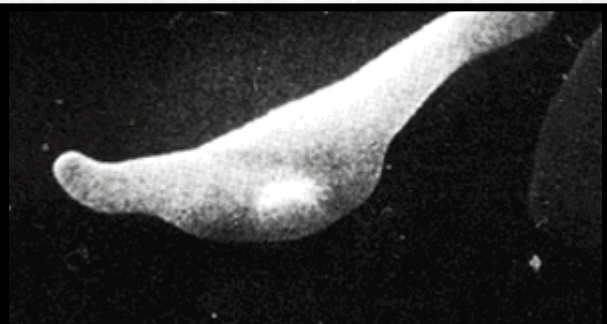
- Thrombocytopenia with increased megakaryocytes
- Red blood cell fragmentation
- Lactate dehydrogenase (LDH) increase

Clinic pentad

- Thrombocytopenia
- Microangiopathic hemolytic anemia
- Neurological disorders
- Renal failure
- Fever

Schistocyte genesis

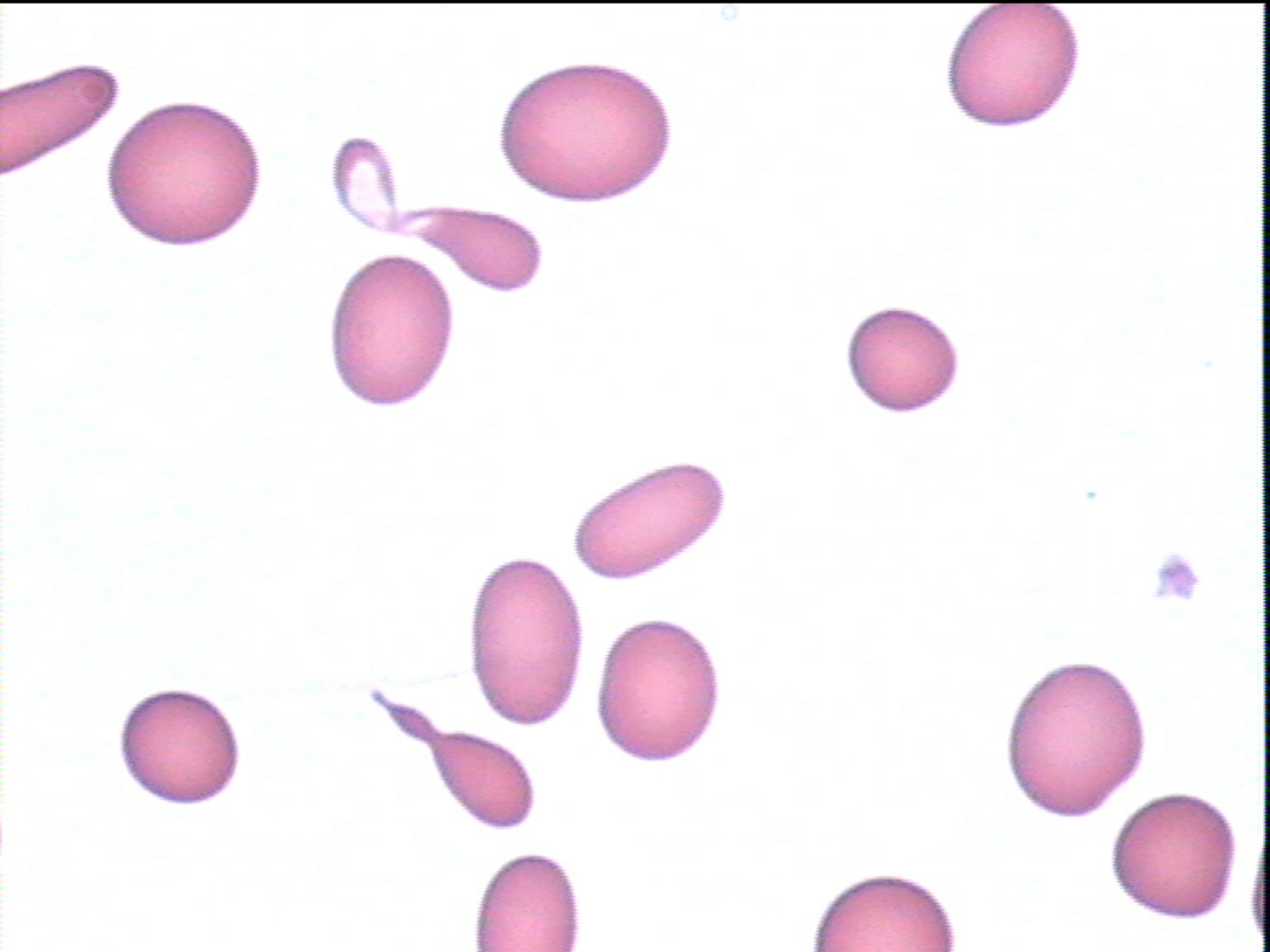


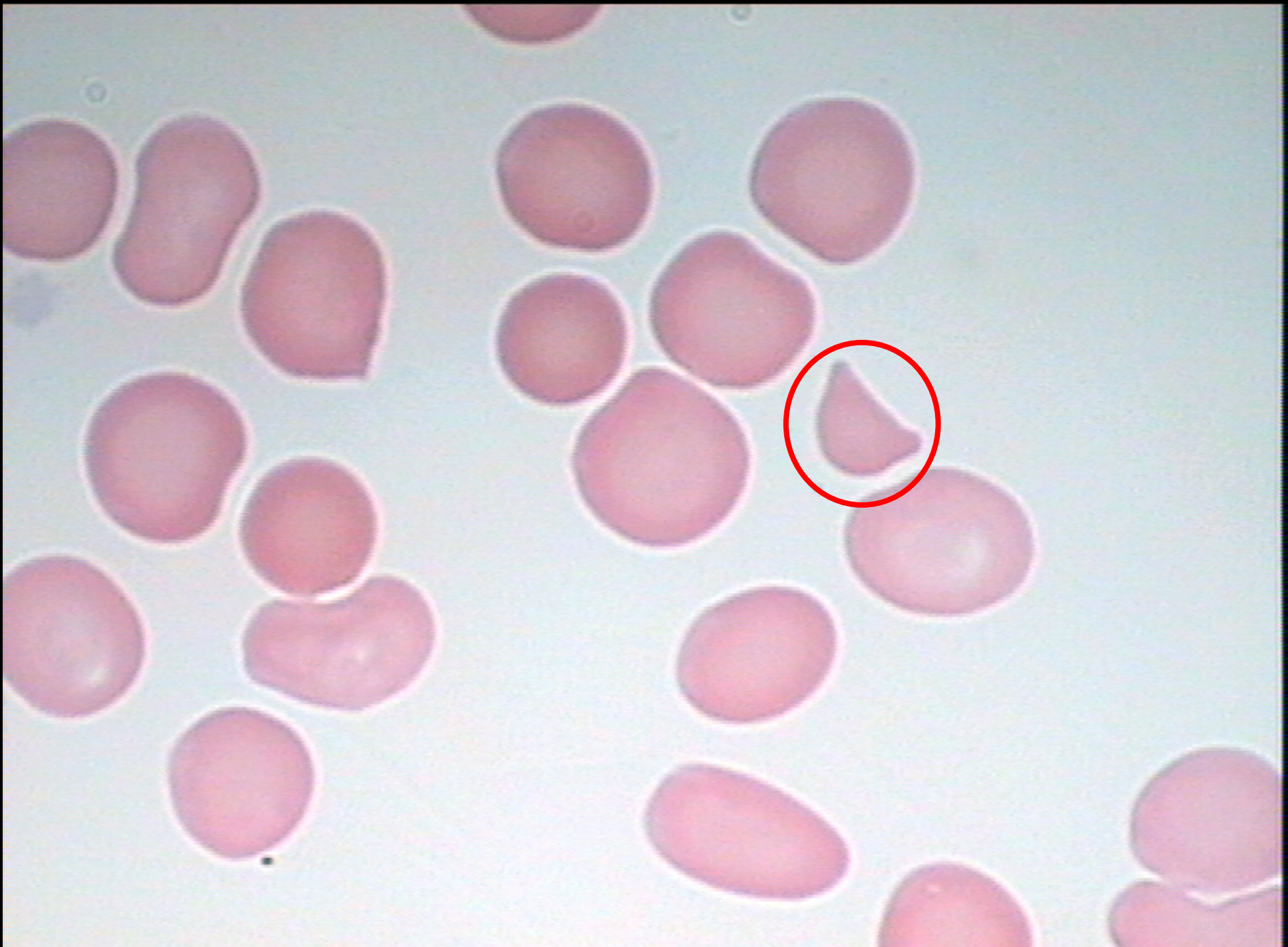


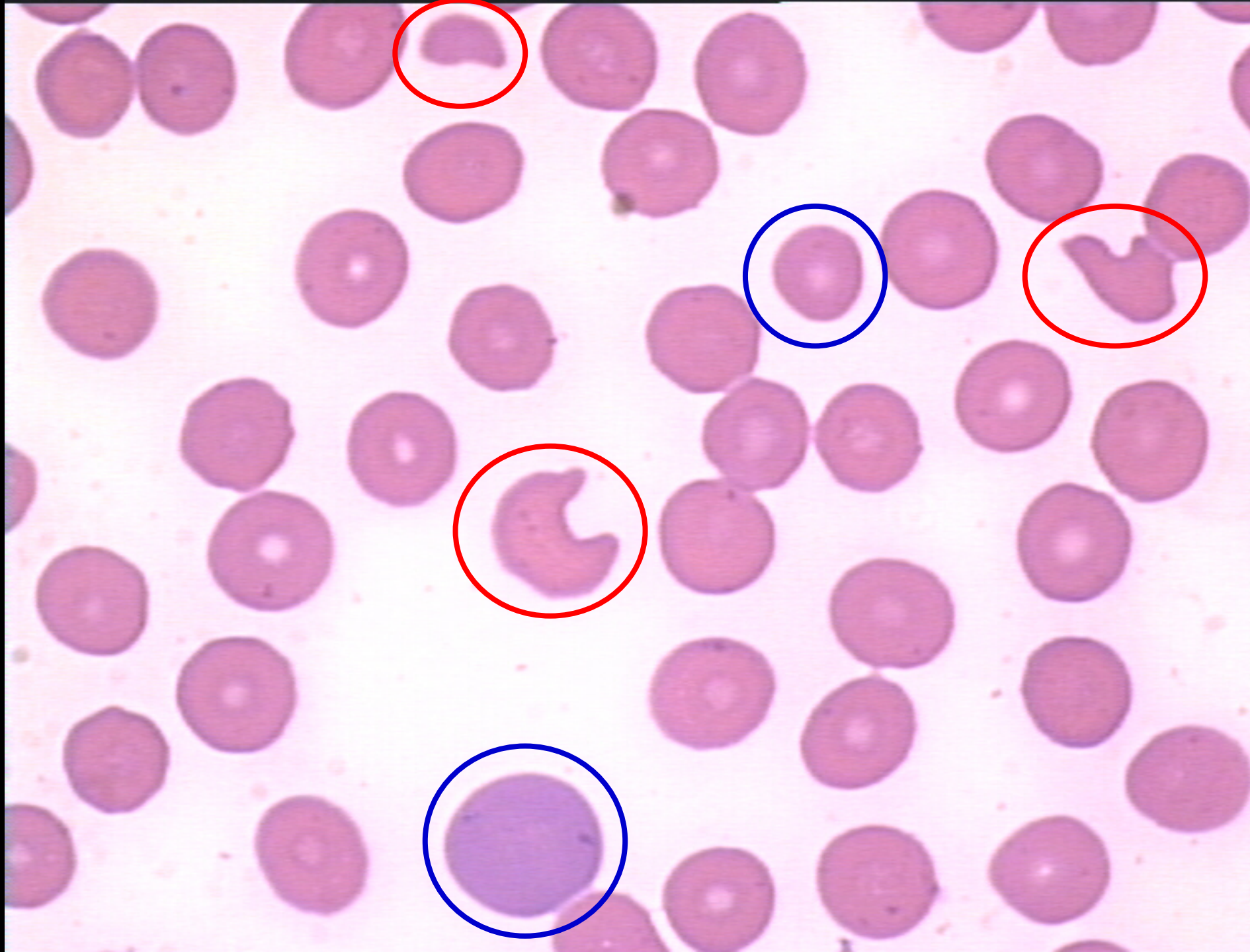
Bessis M: Blood Smears Reinterpreted, Springer-Verlag,1977

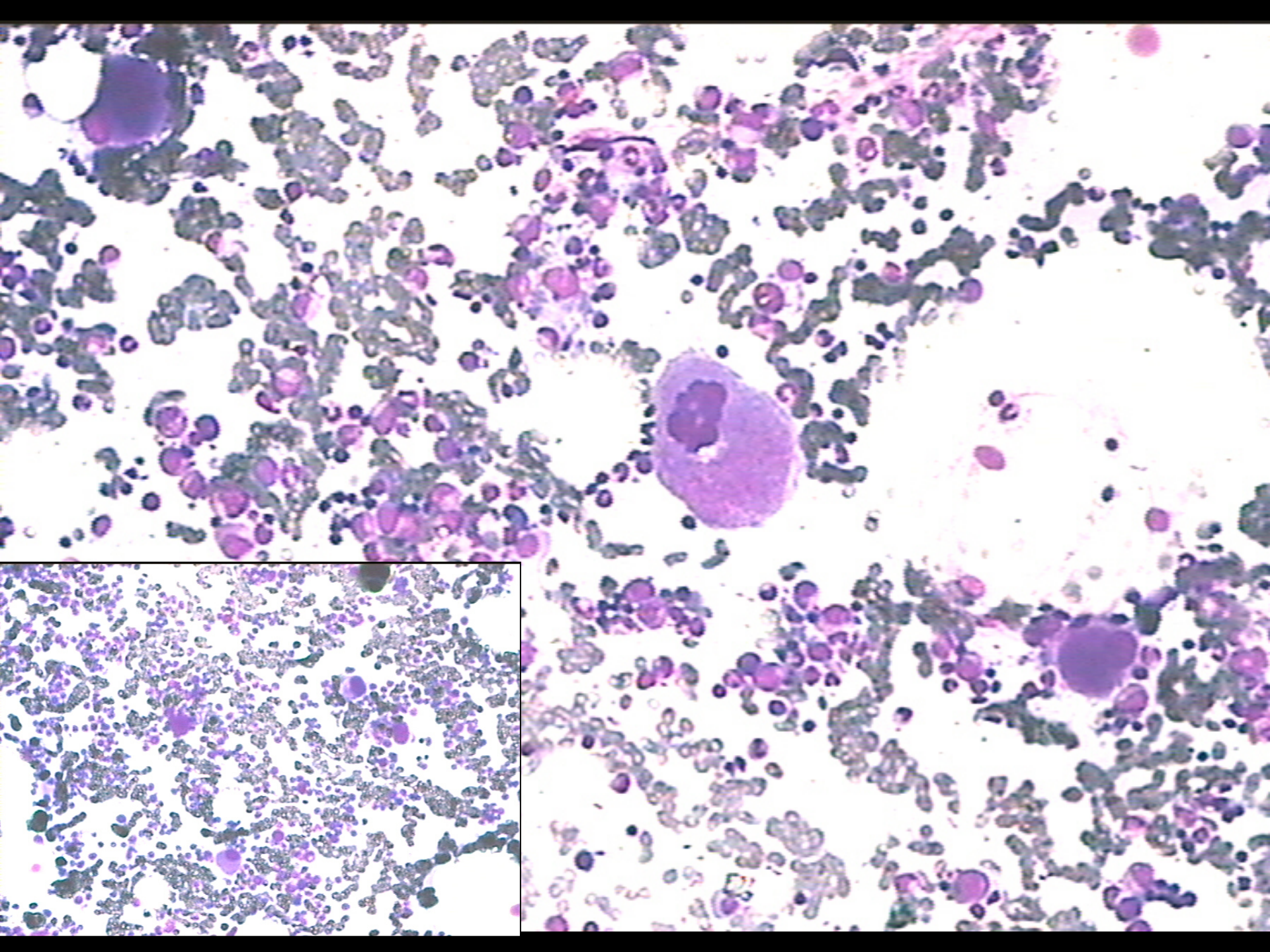
Schistocytes

- Red blood cells fragments of triangular/crescent/ helmet form with rectilinear profile segment testifying the zone of break
- Observed on blood smears
- They result from mechanical, toxic or heat-induced damage of normal RBC
- They appear under several conditions (after surgery, solid organ and/or bone marrow transplantation, HIV infection, in diseases with cardiac and vessel abnormalities, pre-eclampsia, severe renal diseases, gastric carcinoma)
- Often the earliest sign of thrombotic microangiopathy (TMA): detection and quantification are thus of primary importance
- Morphological identification requires well-trained hematologists/biologists









Diseases & Schistocytes

- Mechanical hemolytic anemias
- Microangiopathic hemolytic anemias
  - Disseminated Intravascular Coagulation (DIC)
  - Hemolytic Uremic Syndrome (HUS)
  - Thrombotic Thrombocytopenic Purpura (TTP)
- Other anemias
- Surgery
- Transplant Associated Microangiopathy (TAM)
- Vessels inflammatory diseases
- Vessels abnormalities
- Infectious diseases
- Bone marrow pathologies (primary and secondary)

Classical Reference values

Adults: ≤ 0.1%

Newborn: 0.3-1.9%

Preterms: ≤ 5.5%

- Schistocytes are usually

- specifically requested by clinicians
- counted on PB smears by optical microscope
- expressed as % of 500-1000 red blood cells

Table 7–3. Confidence Limits (95%) for Various Percentages of Blood Cells of a Given Type as Determined by Differential Counts

a	n = 100	n = 200	n = 500	n = 1,000	n = 10,000
0	0 – 3.6	0 – 1.8	0 – 0.7	0 – 0.4	0 – 0.1
1	0.0– 5.4	0.1– 3.6	0.3– 2.3	0.5– 1.8	0.8– 1.3
2	0.2– 7.0	0.6– 5.0	1.0– 3.6	1.2– 3.1	1.7– 2.3
3	0.6– 8.5	1.1– 6.4	1.7– 4.9	2.0– 4.3	2.6– 3.4
4	1.1– 9.9	1.7– 7.7	2.5– 6.1	2.9– 5.4	3.6– 4.5
5	1.6– 11.3	2.4– 9.0	3.3– 7.3	3.7– 6.5	4.5– 5.5
6	2.2– 12.6	3.1– 10.2	4.1– 8.5	4.6– 7.7	5.5– 6.5
7	2.9– 13.9	3.9– 11.5	4.9– 9.6	5.5– 8.8	6.5– 7.6
8	3.5– 15.2	4.6– 12.7	5.8– 10.7	6.4– 9.9	7.4– 8.6
9	4.2– 16.4	5.4– 13.9	6.6– 11.9	7.3– 10.9	8.4– 9.6
10	4.9– 17.6	6.2– 15.0	7.5– 13.0	8.2– 12.0	9.4– 10.7
15	8.6– 23.5	10.4– 20.7	12.0– 18.4	12.8– 17.4	14.3– 15.8
20	12.7– 29.2	14.7– 26.2	16.6– 23.8	17.6– 22.6	19.2– 20.8
25	16.9– 34.7	19.2– 31.6	21.3– 29.0	22.3– 27.8	24.1– 25.9
30	21.2– 40.0	23.7– 36.9	26.0– 34.2	27.2– 32.9	29.1– 31.0
35	25.7– 45.2	28.4– 42.0	30.8– 39.4	32.0– 38.0	34.0– 36.0
40	30.3– 50.3	33.2– 47.1	35.7– 44.4	36.9– 43.1	39.0– 41.0
45	35.0– 55.3	38.0– 52.2	40.6– 49.5	41.9– 48.1	44.0– 46.0
50	39.8– 60.2	42.9– 57.1	45.5– 54.5	46.9– 53.1	49.0– 51.0
55	44.7– 65.0	47.8– 62.0	50.5– 59.4	51.9– 58.1	54.0– 56.0
60	49.7– 69.7	52.9– 66.8	55.6– 64.3	56.9– 63.1	59.0– 61.0
65	54.8– 74.3	58.0– 71.6	60.6– 69.2	62.0– 68.0	64.0– 66.0
70	60.0– 78.8	63.1– 76.3	65.8– 74.0	67.1– 72.8	69.0– 70.9
75	65.3– 83.1	68.4– 80.8	71.0– 78.7	72.2– 77.7	74.1– 75.9
80	70.8– 87.3	73.8– 85.3	76.2– 83.4	77.4– 82.4	79.2– 80.8
85	76.5– 91.4	79.3– 89.6	81.6– 88.0	82.6– 87.2	84.2– 85.7
90	82.4– 95.1	85.0– 93.8	87.0– 92.5	88.0– 91.8	89.3– 90.6
91	83.6– 95.8	86.1– 94.6	88.1– 93.4	89.1– 92.7	90.4– 91.6
92	84.8– 96.5	87.3– 95.4	89.3– 94.2	90.1– 93.6	91.4– 92.6
93	86.1– 97.1	88.5– 96.1	90.4– 95.1	91.2– 94.5	92.4– 93.5
94	87.4– 97.8	89.8– 96.9	91.5– 95.9	92.3– 95.4	93.5– 94.5
95	88.7– 98.4	91.0– 97.6	92.7– 96.7	93.5– 96.3	94.5– 95.5
96	90.1– 98.9	92.3– 98.3	93.9– 97.5	94.6– 97.1	95.5– 96.4
97	91.5– 99.4	93.6– 98.9	95.1– 98.3	95.7– 98.0	96.6– 97.4
98	93.0– 99.8	95.0– 99.4	96.4– 99.0	96.9– 98.8	97.7– 98.3
99	94.6– 99.9	96.4– 99.9	97.7– 99.7	98.2– 99.5	98.7– 99.2
100	96.4–100	98.2–100	99.3–100	99.6–100	99.9–100

Adults: ≤ 0.1%

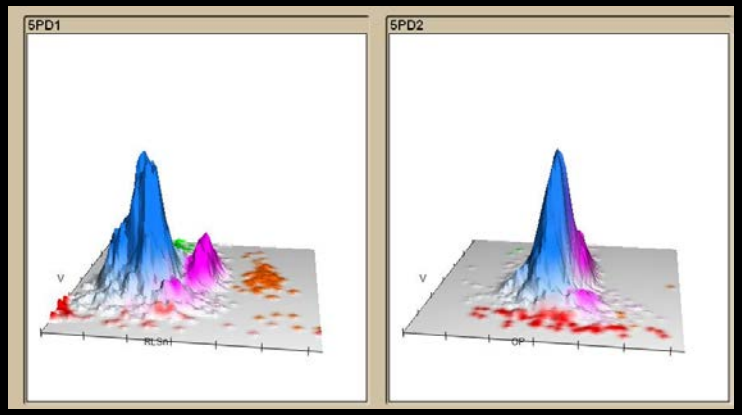
Newborns: 0.3-1.9%

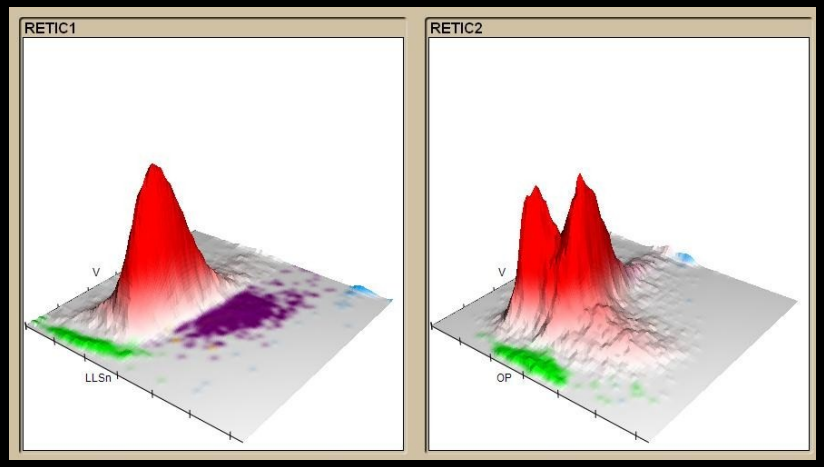
Preterms: ≤ 5.5%

Automated red cell fragments

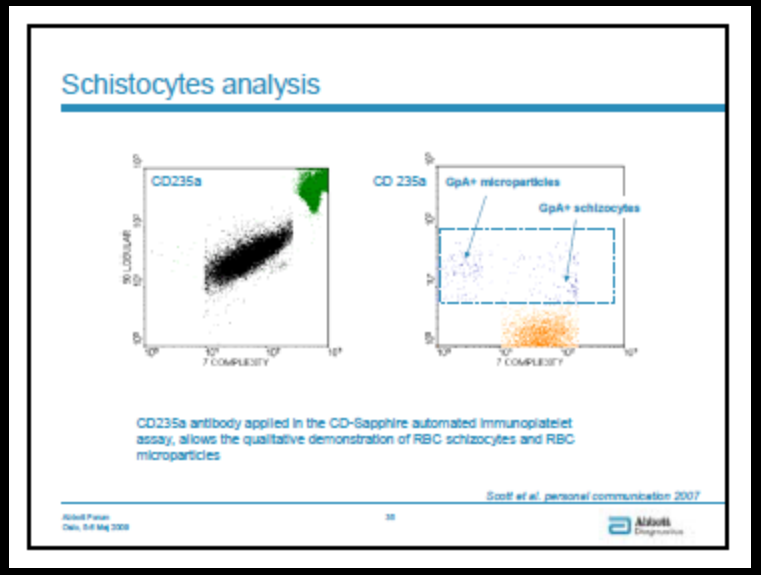
Automated Red Cell Fragment

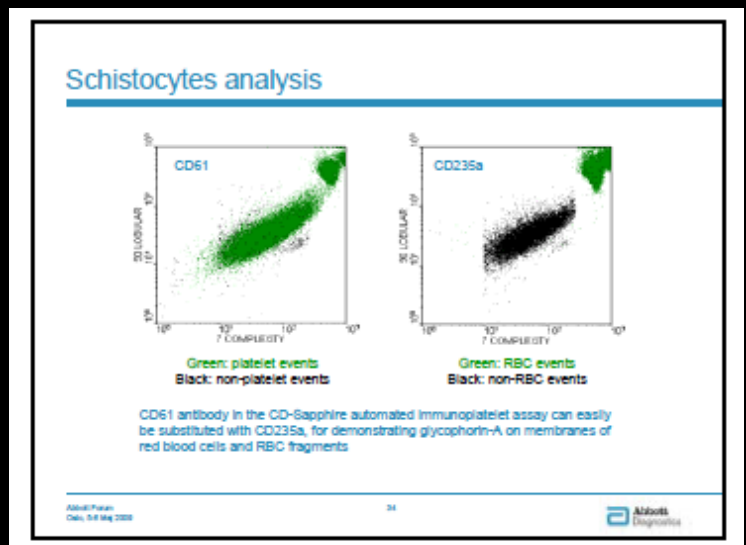
Coulter DXH800



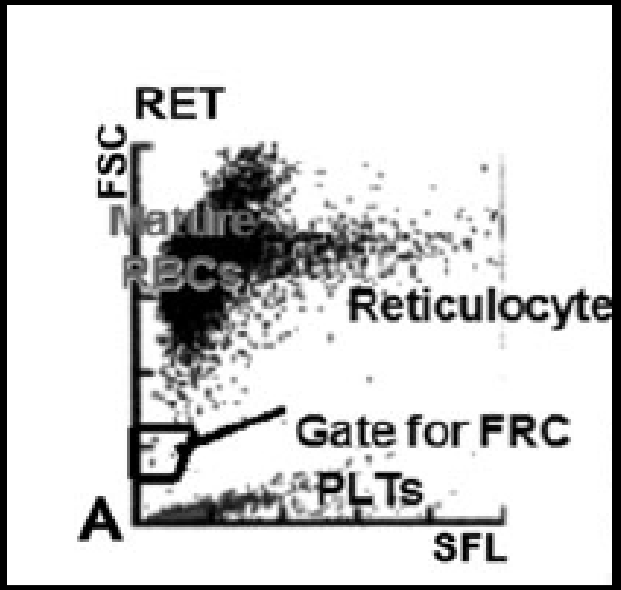


Abbott Sapphire





RBC fragments flag & quantitation: Sysmex XE-2100 method



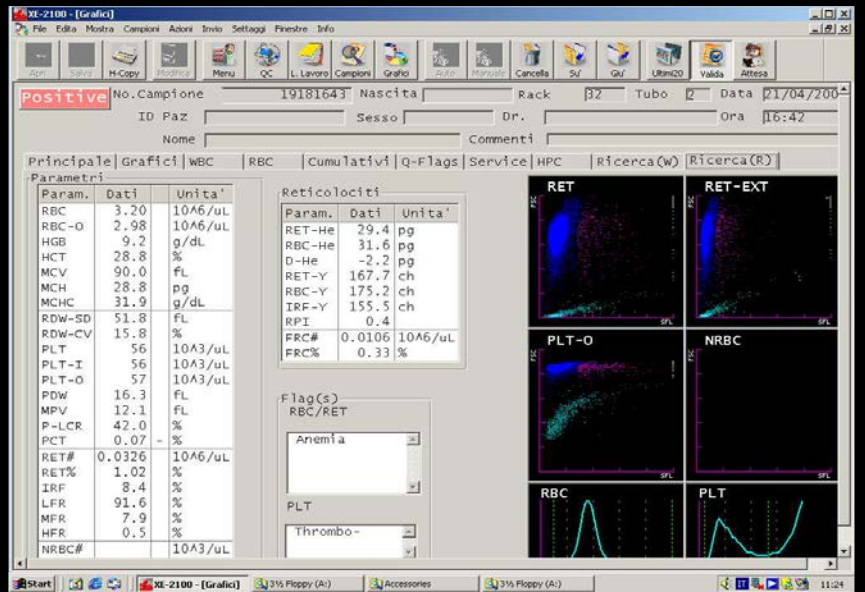
- Flag for presence of fragments is automatically provided by the XE-2100 analyser.

- The count is performed by gating an area on the Retics channel scattergram where whole blood is stained with a fluorescent dye.

- The forward scatter and the intensity of fluorescence allow identification and count of RBC fragments.

- They correspond to events with a volume smaller than RBC and with RNA content lower than platelets.

FRC#	0.0106	10^6/uL
FRC%	0.33	%

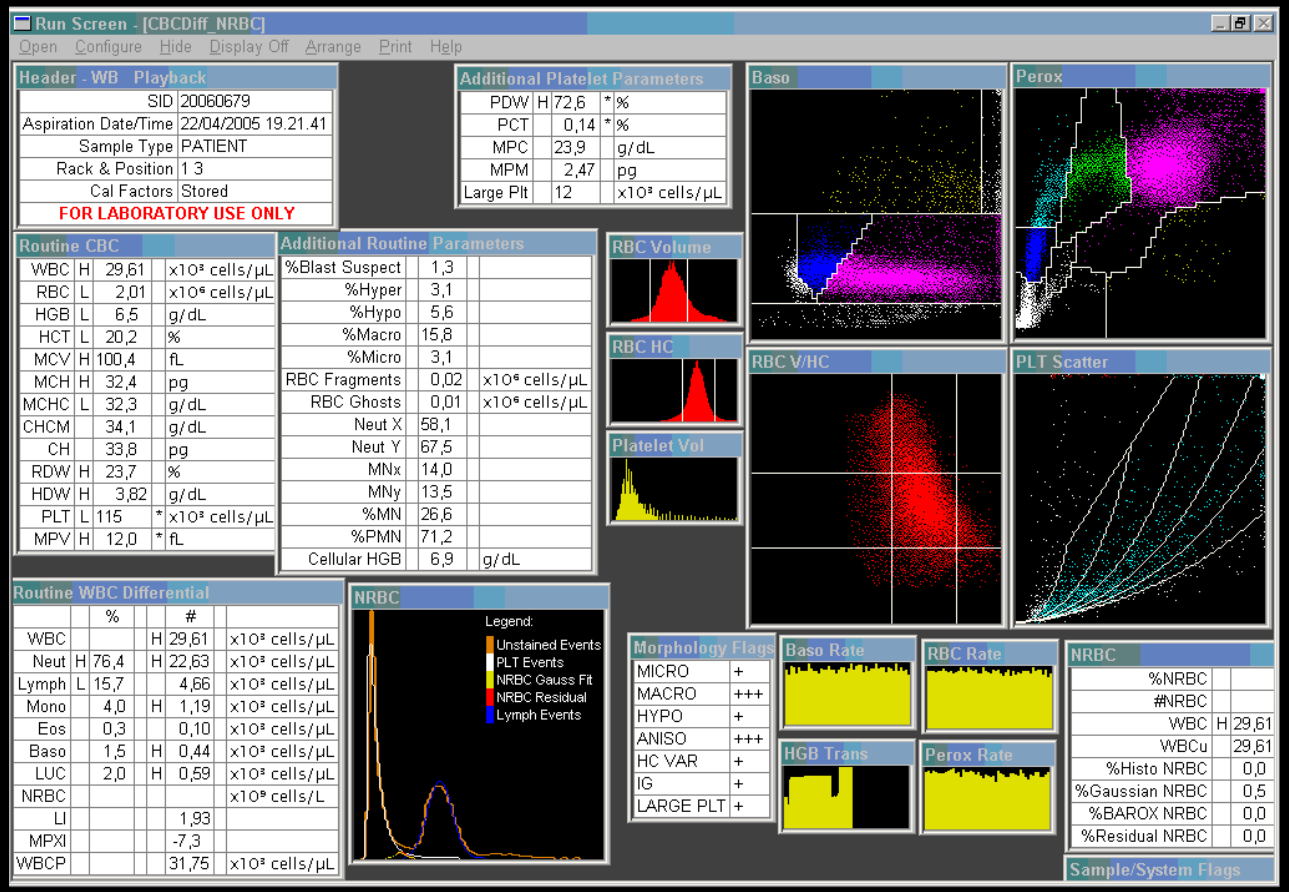


RBC fragments identification and enumeration with the ADVIA 2120 method

► integrated analysis of RBC and platelet count

► events with a volume smaller than 30 fL and with a refractive index greater than 1.4

► frequence of events above the threshold of 10,000/µL



RBC Fragments	0,02	x10⁶ cells/µL
RBC Ghosts	0,01	x10⁶ cells/µL

Automated FRC compared with visual count

Automated screening for schistocytes with two hematology analyzers.

All the 150 samples were smeared and stained with MGG panoptical stain and evaluated by two expert observers at microscope independently.

We found a fully concordance between the reference method and the automated enumeration with both the analyzers without any false negative **(Fig. 5 and 6)** .

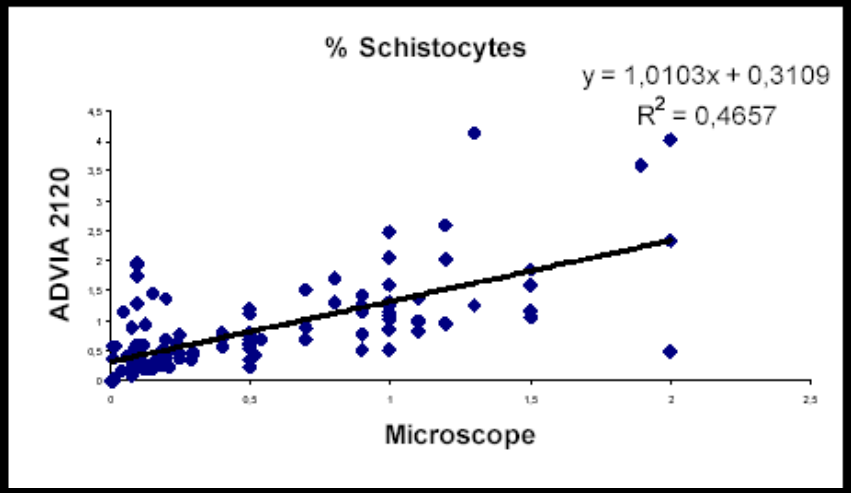
The range values of positive samples were as follow:
reference method :0,1-2,3%.
ADVIA 2120 method: 0,2-4,13%
XE-2100 method: 0,05-8,39 %

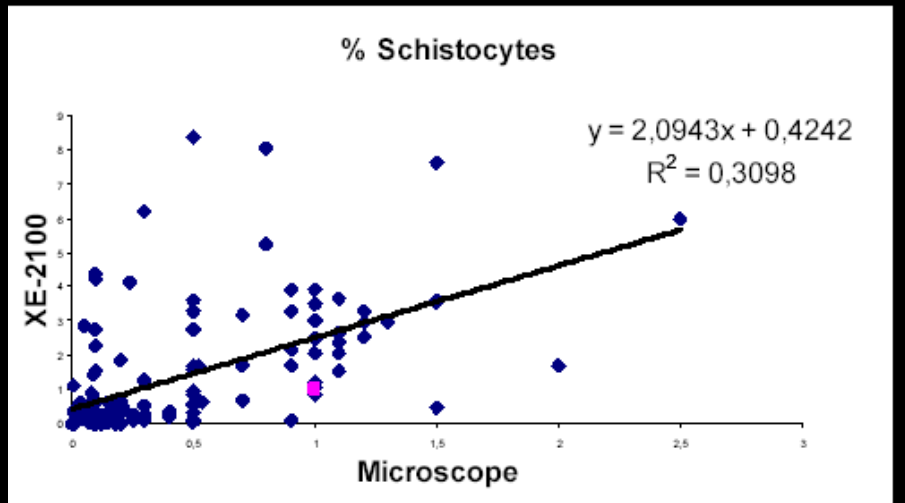
The overall correlation of the analyzers' count versus the reference method was as follows:
y= 2,0943x + 0,4242, R^2 = 0,3098 for the XE-2100 method **(Fig. 7)**
y= 1,0103x + 0,3109, R^2 = 0,4657for the ADVIA 2120 method **(Fig. 9)**.

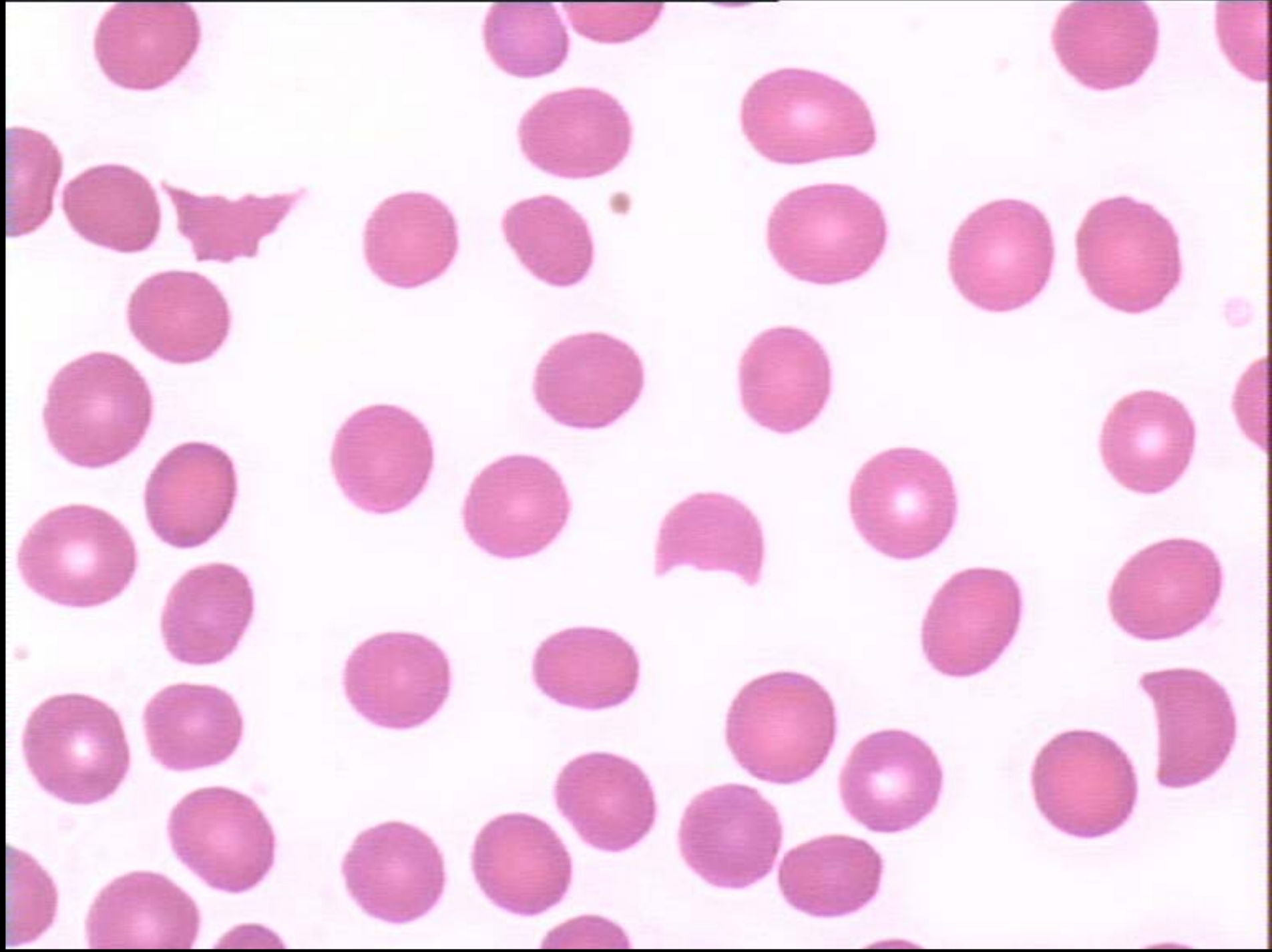
Both analyzers showed a trend toward an overestimation of RBC fragment count, apparently due to the inclusion into the count of microspherocytes, when present **(Fig. 8)**.

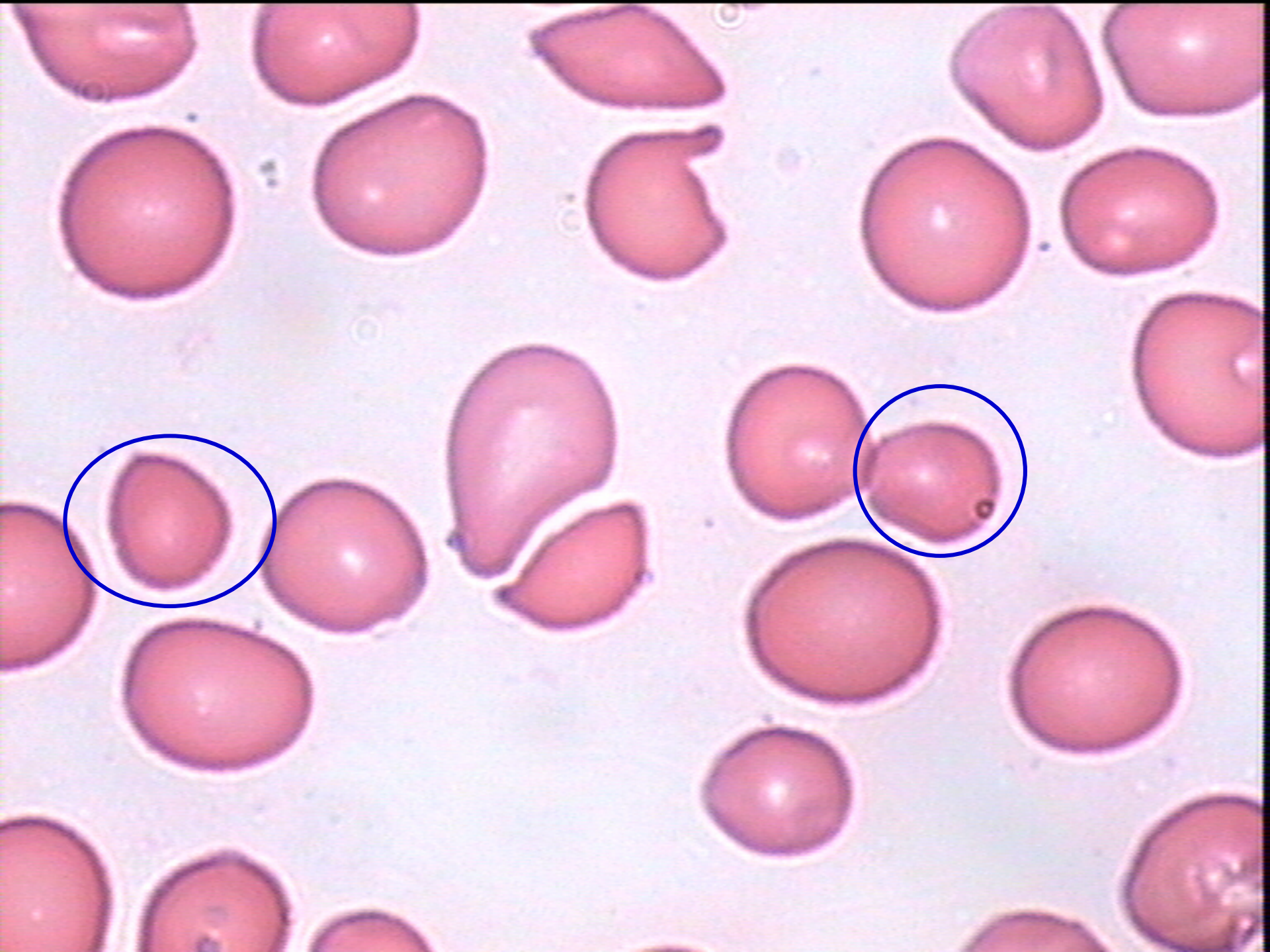
Authors: *2005, ISLH*

M. Garzia, A. Di Mario, E. Rossi, G. Massini, S. Bellesi, G. d'Onofrio, G. Zini

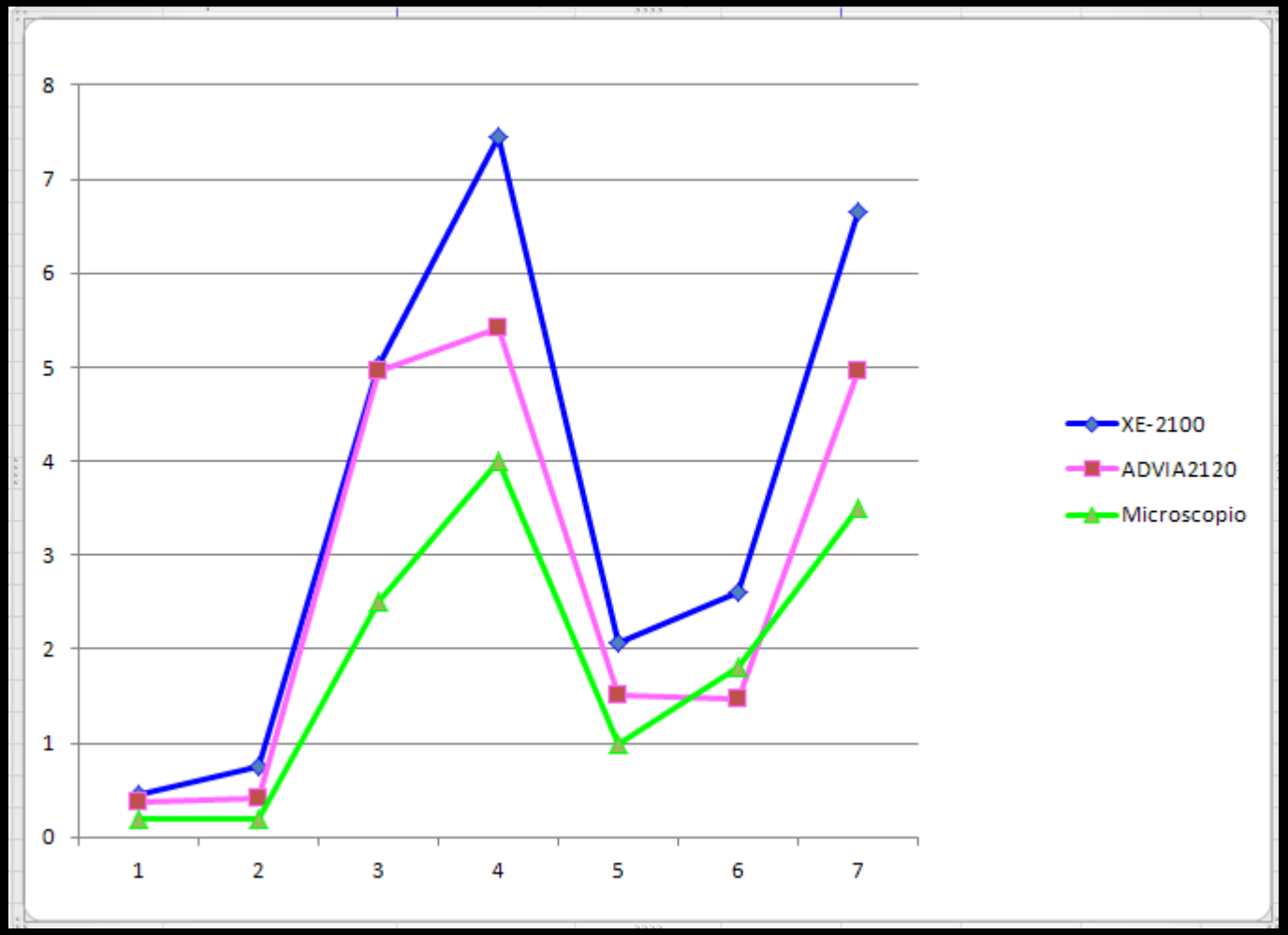








Follow- up



Main | Graph | WBC/NRBC | RBC/PLT | Cumulative | Q-Flags | Service | HPC | Research(W) | Research(R) | Rese.

Items

Param.	Dati		Unita'
RBC	2.25	-	10^6/uL
RBC-O	2.13		10^6/uL
HGB	6.3	-	g/dL
HCT	20.2	-	%
MCV	89.8		fL
MCH	28.0		pg
MCHC	31.2		g/dL
RDW-SD	113.8	+	fL
RDW-CV	35.0	+	%
PLT &	51	*	10^3/uL
PLT-I	46	*	10^3/uL
PLT-O	51		10^3/uL
PDW	----		fL
MPV	----		fL
P-LCR	----		%
PCT	----		%
RET#	0.5036	*	10^6/uL
RET%	22.38	*	%
IRF	10.4	*	%
LFR	89.6	*	%
MFR	7.1	*	%
HFR	3.3	*	%

Extended RET

Param.	Dati		Unita'
RET-He	36.9	*	pg
RBC-He	25.4	*	pg
D-He	11.5	*	pg
RET-Y	188.1	*	ch
RBC-Y	150.1	*	ch
IRF-Y	191.3	*	ch

Param.	Dati		Unita'
FRC#	0.2466		10^6/uL
FRC%	10.96		%

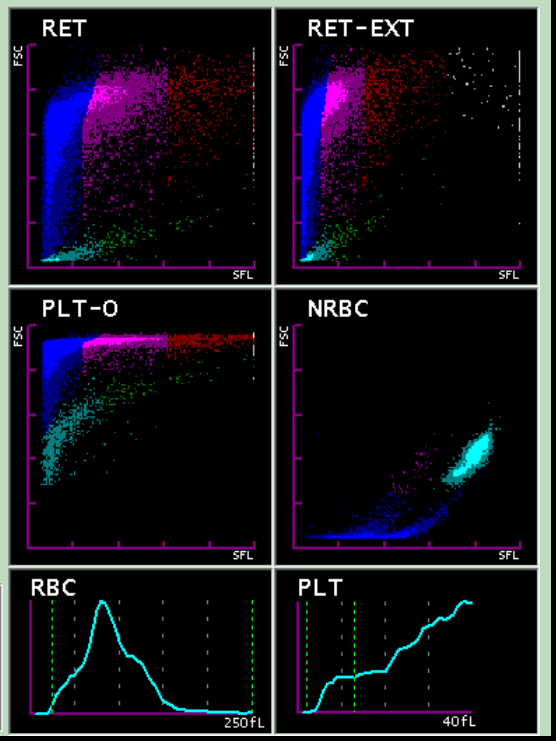
Items

Param.	Dati		Unita'
NRBC#	0.08		10^3/uL
NRBC%	0.9		/100WBC

Flag(s)

RBC/RET
- Fragments?
- RET Abn Scg
- Reticulo
- Aniso

PLT
- PLT Abn Dst
- Thrombo-



WBC

Param.	Dati		Unita'
WBC &	8.84		10^3/uL
NRBC+W	8.92		10^3/uL

NRBC

Param.	Dati		Unita'
NRBC#	0.08		10^3/uL
NRBC%	0.9		/100WBC

HPC area

Param.	Dati		Unita'
Area#	0.006		10^3/uL
Area%	0.07		%

Flag(s)

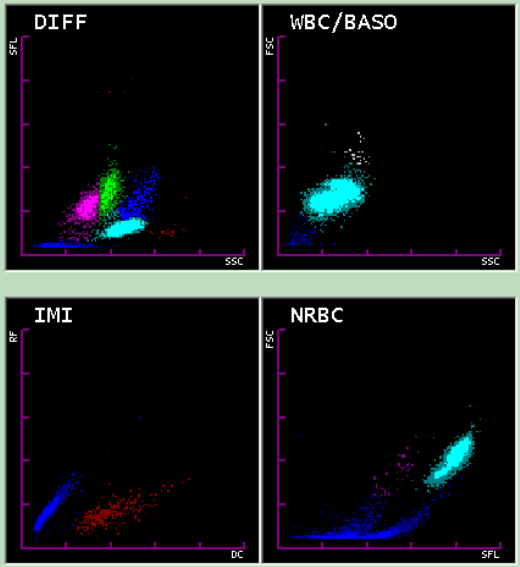
- Mono+
- IG Present

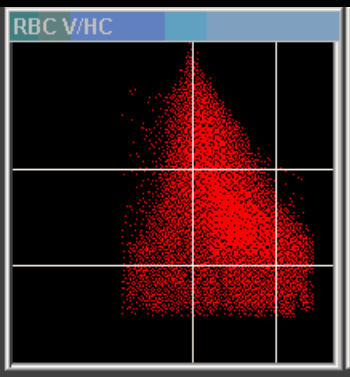
Extended Differential

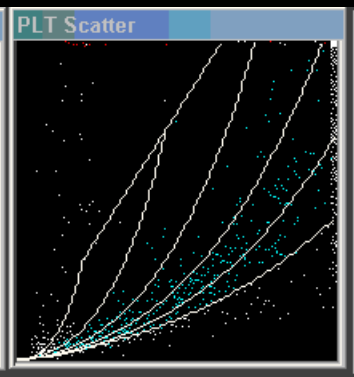
Param.	Dati		Unita'
IG#	0.37		10^3/uL
NEUT#&	5.07		10^3/uL
LYMP#&	1.69		10^3/uL
MONO#	1.65	+	10^3/uL
EO#	0.04		10^3/uL
BASO#	0.02		10^3/uL
OTHER#	0.00		10^3/uL

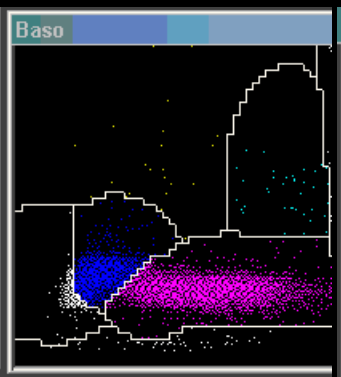
Param.	Dati		Unita'
IG%	4.2		%
NEUT%&	57.3		%
LYMP%&	19.1		%
MONO%	18.7	+	%
EO%	0.5		%
BASO%	0.2		%
OTHER%	0.0		%

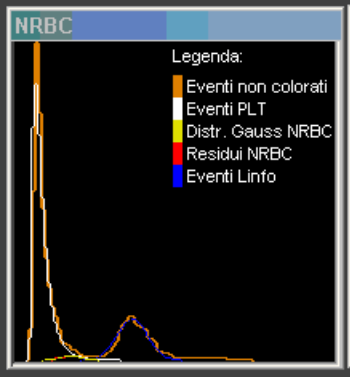
Param.	Dati		Unita'
IPF	12.4		%
H-IPF	5.1		%
IPF#	6.3		10^3/uL
PLT-X	24.8		ch

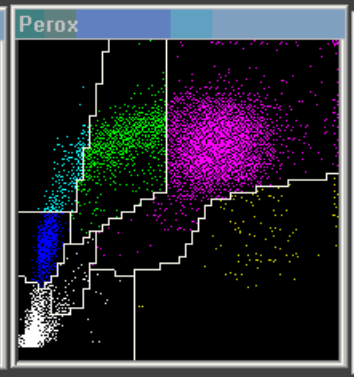


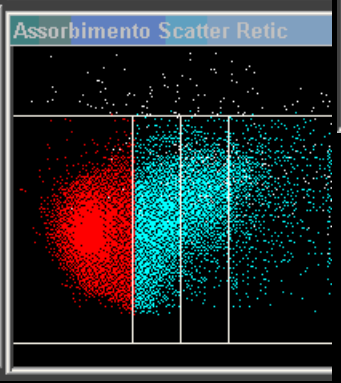












Emocromo di routine

WBC		9.11		x10³/µL
RBC	L	2.28	*	x10⁶/µL
HGB	L	6.8	*	g/dL
HCT	L	22.0	*	%
MCV		96.6	*	fL
MCH		29.7	*	pg
MCHC	L	30.8	*	g/dL
CHCM	L	33.0	*	g/dL
CH		31.3	*	pg
RDW	H	31.3	*	%
HDW	H	5.08	*	g/dL
PLT	L	51		x10³/µL
MPV		7.5		fL

%Blasti	2.7	
%Iper	5.7	
%Ipo	14.9	
%Macro	21.0	
%Micro	10.7	
Frammenti RBC	0.09	x10⁶/µL
Ombre RBC	0.04	x10⁶/µL
Neut X	61.2	
Neut Y	65.8	
MNx	12.2	
MNy	13.2	
%MN	38.0	
%PMN	60.8	
HGB Calc	7.3	g/dL

0,09x100/2.28= 3,94%

Formula WBC di routine

		%			#	
WBC					9.11	x10³/µL
Neutro		63.6			5.80	x10³/µL
Linfo	L	18.6			1.70	x10³/µL
Mono	H	13.0		H	1.19	x10³/µL
Eos		1.4			0.12	x10³/µL
Baso		0.3			0.03	x10³/µL
LUC		3.1			0.28	x10³/µL
NRBC						x10³/L
Indice Lobularità					2.09	
MPXI					-4.8	
WBCP					8.28	x10³/µL

Retic

		%			#		
RBC neg		63.61			13993		
Retic	H	36.39	*	H	830.5	*	x10⁹/L
Retic L		59.24			4742		
Retic M		29.23			2340		
Retic H		11.53			923		
IRF-H		11.53					
IRF-M+H		40.76					
Acquired Cells Retic					25231		
Analyzed Cells Retic					22293		
Gated Cells Retic					21998		
Retic Count					8005		

Allarmi morfolog...

Micro	+++
Macro	+++
IPOCROMIA	+++
IPERCROMIA	+
ANISO	+++
HC VAR	+++

Retic di routine

		%			#		
Retic	H	36.39	*	H	830.5	*	x10⁹/L
CHr				H	34.9	*	pg
CHm					27.5		pg

Fragmented red blood cells automated measurement is a useful parameter to exclude schistocytes on the blood film

J.-F. LESESVE*, V. ASNAFI†, F. BRAUN‡, G. ZINI§,¶

Table 1. Reference range for fragmented red cells (FRC)

Reference	Center	Analyzer	No. of tests	Population	Fragmented red cells (%) Mean	Min-max	SD	95% CI	Median
Lesesve 2004	Nancy, Fr	ADVIA 120	69	Adults		<0.25			
Lesesve 2007	Nancy, Fr	ADVIA 120	120	Adults	0.258	0.18–0.49	0.089	0.213–0.257	0.22
This study	Nancy, Fr	ADVIA 2120	1 984	Adults	0.247	0.15–0.48	0.08		0.23
This study	Roma, It	ADVIA 2120	80	Adults	0.30	0.17–0.48	0.13		0.34
This study	Roma, It	ADVIA 2120	10	Preterm newborns	0.80	0.19–1.24			
Jiang 2001	Kobe, Jpn	XE-2100	762	Adults		0.03–0.56			
Abe 2009	Mie, Jpn	XE-2100	120	Adults				0–0.205	0.04
This study	Roma, It	XE-2100	146	Adults	0.69	0.2–2.83	0.74		0.33
This study	Paris, Fr	XE-2100	1405	Adults		<0.50			
This study	Nancy, Fr	XE-2100	232	Adults	0.36	0.05–0.65	0.125	0.31–0.37	0.34
This study	Thionville, Fr	XE-5000	111	Adults	0.33	0–2.96	0.148		1.1
This study	Roma, It	XE-2100	17	Preterm newborns	3.44	0.12–11.65			

Results: Reference range for FRC was <0.3% for the ADVIA and <0.5% for the XE-2100. The presence of FRC below a threshold determined at 1% (ADVIA and XE-2100) had a negative PV close to 100% to exclude the presence of schistocyte on the blood smear, but in relationship with a poor PV value.

Table 3. Sensitivity, specificity, and predictive value of FRC

Counter	Question assessed	Number and type of patients	Center	FRC %	Sensitivity	Specificity	Positive predictive value	Negative predictive value
ADVIA 2120	Occurrence of TAM	69, post BMT	Nancy	0.25	1	0.734	0.227	1
				1	0.80	0.953	0.571	0.984
	Presence of schistocyte on the blood smear/TAM	131, unselected	Nancy	0.25	1	0.171	0.23	1
				1	0.885	0.876	0.639	0.968
	Presence of schistocyte on the blood smear	100, unselected	Roma	0.2	0.918	0.576		
XE-2100	Presence of schistocyte on the blood smear	300, unselected	Paris	0.5	0.925	0.457	0.268	0.966
	Presence of schistocyte on the blood smear	574, suspicion of TAM	Paris	0.5	0.952			0.987
	Presence of schistocyte on the blood smear	831, unselected	Paris	0.5	0.967			0.993
	Presence of schistocyte on the blood smear	100, unselected	Roma	0.2	0.959	0.695		
	Occurrence of TAM	230	Mie, Jpn	1.2	0.9	0.96	0.9	0.9

International Journal of Laboratory Hematology
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ORIGINAL ARTICLE INTERNATIONAL JOURNAL OF LABORATORY HEMATOLOGY

ICSH recommendations for identification, diagnostic value, and quantitation of schistocytes

G. ZINI*, G. D'ONOFRIO†, C. BRIGGS‡, W. ERBER§, J. M. JOU¶, S. H. LEE**, S. MCFADDEN††, J. L. VIVES-CORRONS¶, N. YUTAKA‡‡, J. F. LESESVE§§

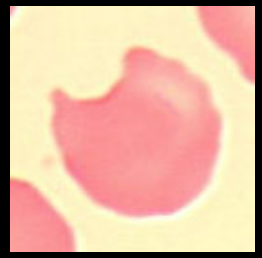
Int J Lab Hematol. 2011 Nov 15

ICSH International Council for Standardization in Haematology

Consensus on morphological description/identification (I)

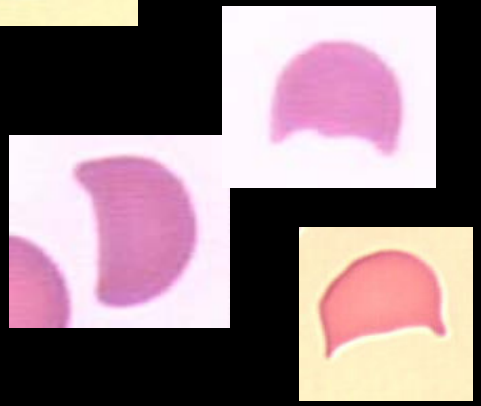
Bitten erythrocyte:

Normal size, shape irregular with a defective amputated zone



Schistocyte (keratocyte):

Helmet shape: decreased size (surface/area), irregular shape with a defective amputated zone highlighted by a rectilinear border ending with usually 2 (1 or 3 possible) angulated spicules. Pale central zone is not observed.



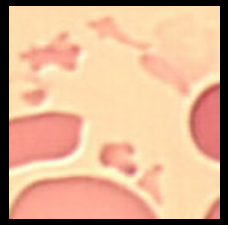
Schistocyte

Triangular shape: reduced size, irregular shape with a defective amputated zone highlighted by a rectilinear sometime spiculated border, ending with 2 angulated spicules. Pale central zone is not observed.

Consensus on morphological description/identification (II)

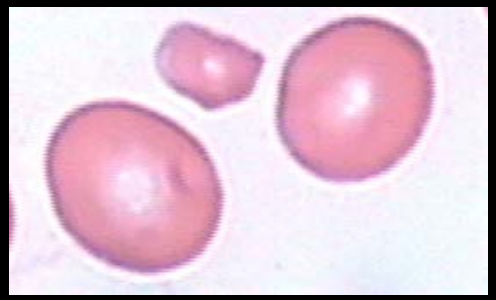
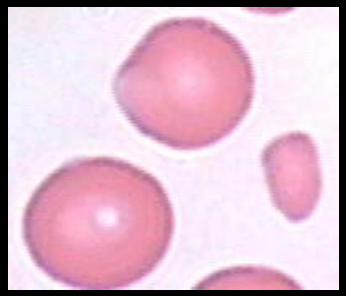
Fragment

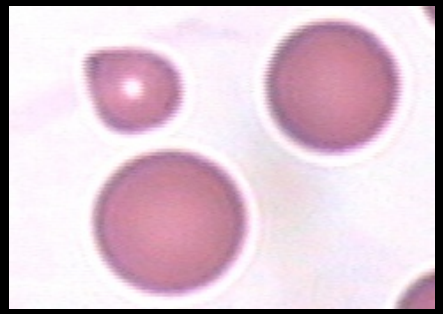
Small/very small size, highly irregular shape



Microspherocytes

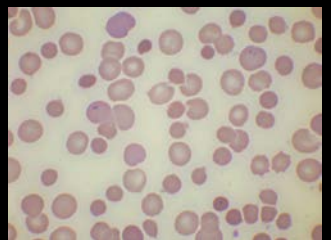
Small size, round shape, hyperdensity (increased staining)



Irregularly contracted cells

Small size, hyperdensity, irregular outline sometimes with small protrusions and Heinz bodies

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ICSH recommendations for identification, diagnostic value, and quantitation of schistocytes

G. ZINI*, G. D'ONOFRIO†, C. BRIGGS‡, W. ERBER§, J. M. JOU¶, S. H. LEE**, S. MCFADDEN††, J. L. VIVES-CORRONS¶, N. YUTAKA‡‡, J. F. LESESVE§§

Table 1. International Council for Standardization in Haematology recommendations for schistocyte counting

1. Schistocytes should be evaluated on peripheral blood smears using an optical microscope at medium magnification and estimated as a percentage after counting at least 1000 red blood cells
2. A schistocyte count should be requested and carried out when a diagnosis of thrombotic microangiopathies caused by red cell mechanical damage is suspected, usually in patients with thrombocytopenia
3. Schistocytes should be identified by specific positive morphological criteria. Schistocytes are always smaller than intact red cells and can have the shape of fragments with sharp angles and straight borders, small crescents, helmet cells, keratocytes, or microspherocytes*
4. A schistocyte count should be considered clinically meaningful if schistocytes represent the main morphological red blood cells abnormality in the smear (other than signs of erythropoietic regeneration)
5. A robust morphological indication for the diagnosis of thrombotic microangiopathic anemia in adults should be recognized when the percentage of schistocytes is above 1%
6. Fragmented red cell enumeration by automated blood cell counters should be considered a useful complement to microscopic evaluation, as it provides rapid results with a high predictive value of negative samples. A microscope check is needed for positive and macrocytic samples†

*Microspherocytes only in the presence of other mentioned RBC shapes.
†Macrocytic samples are at risk of underestimation or absence of flag ('false-negative' test).

Int J Lab Hematol. 2011 Nov 15

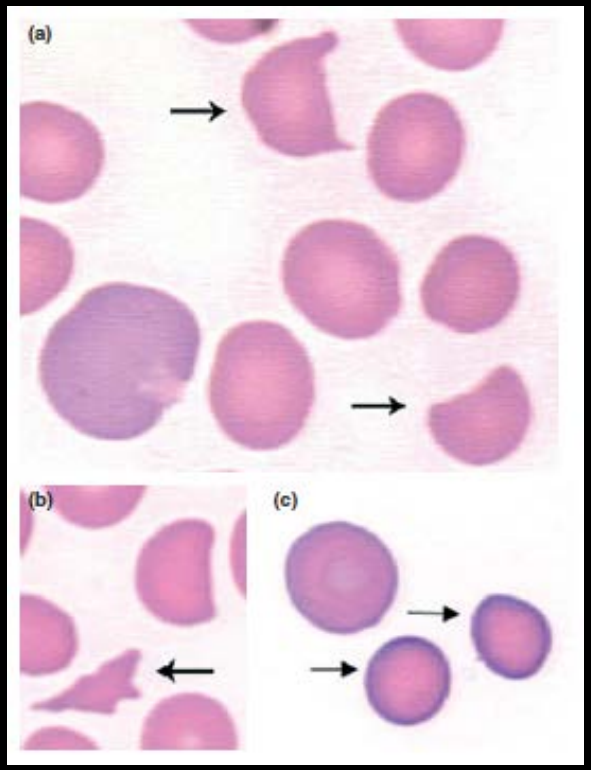
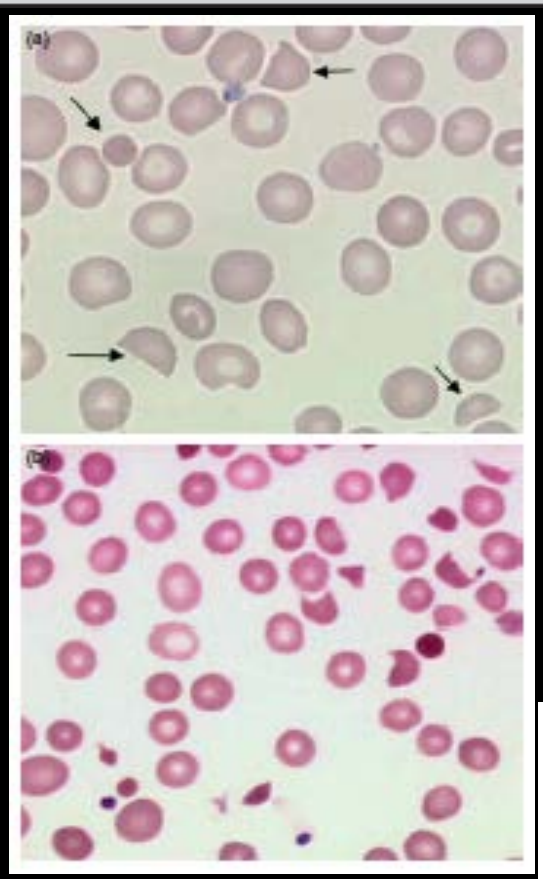


Figure 1. Typical shapes for specific identification of schistocytes. (a) keratocyte (upper arrow) and helmet cell (lower arrow), close to a polychromatophilic erythrocyte in the left lower corner; (b) a triangle schistocyte (arrow) with a helmet cell on the upper right; (c) two microspherocytes (arrows); they are derived, in a context of thrombotic microangiopathic anemia, from schistocytes.

Figure 2. Peripheral blood smear from a case of thrombotic thrombocytopenic purpura. (a) arrows indicate a helmet cells (lower left), a microspherocyte (upper left), a keratocyte (center top), and a microcrescent (lower right angle); (b)morphological abnormalities include microspherocytes, keratocytes, helmet cell, and several crescent and triangular schistocytes.



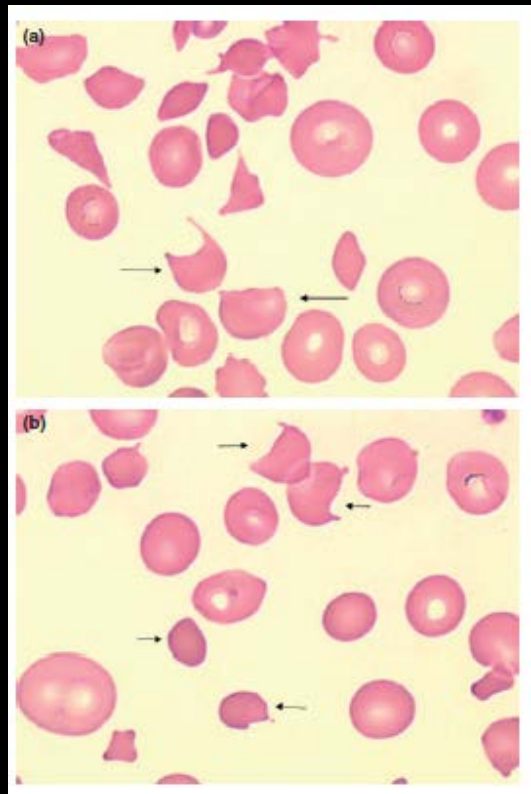
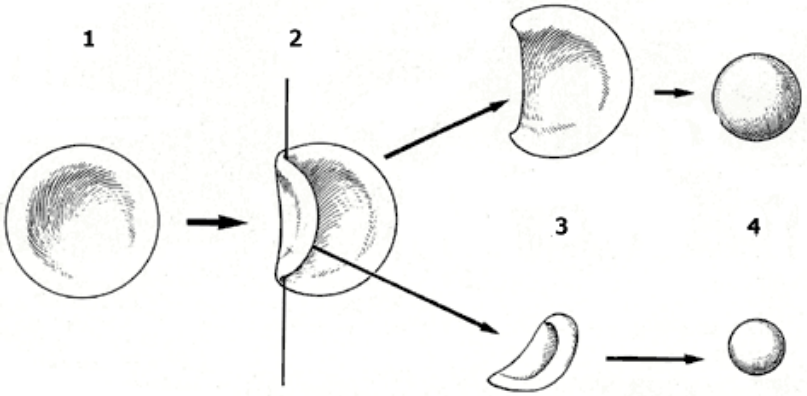
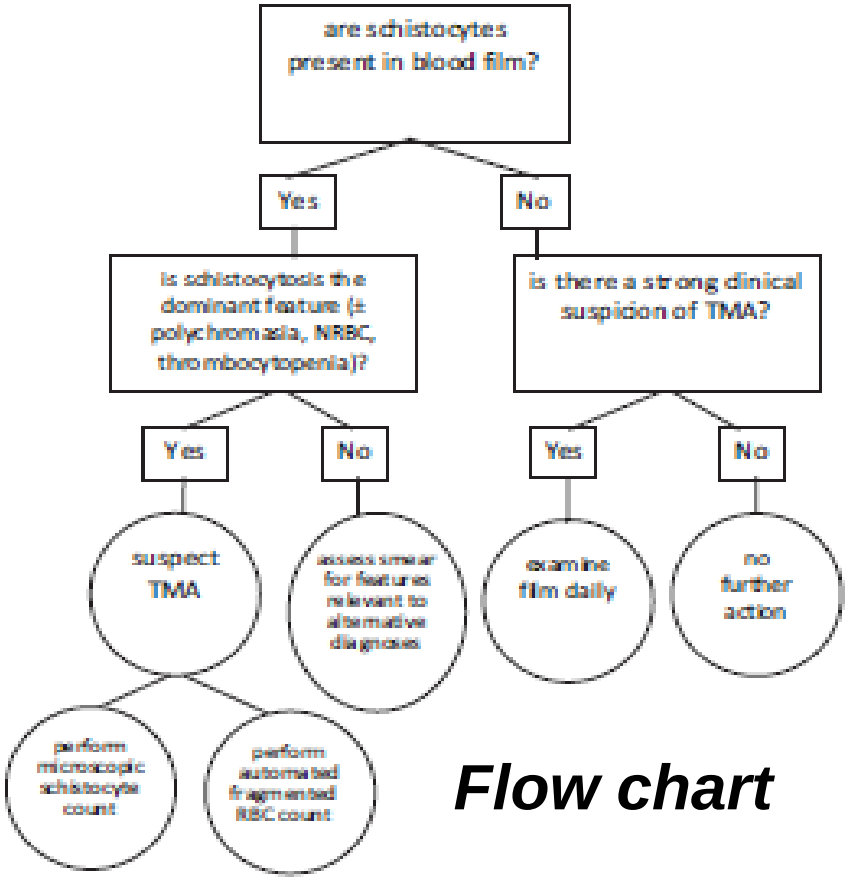
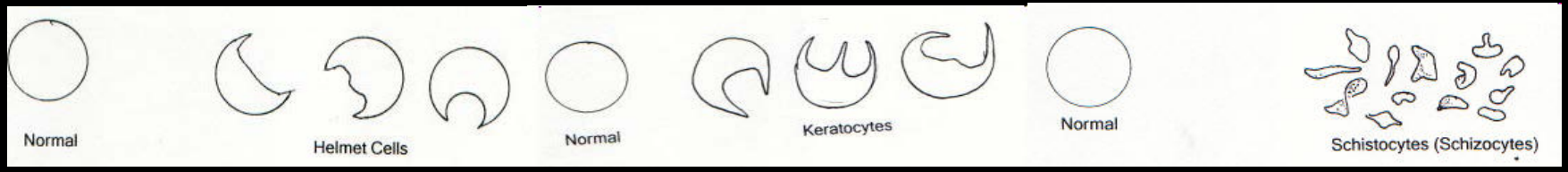


Figure 3. Peripheral blood smear from a case of post-transplant thrombotic microangiopathic anemia. (a) a keratocyte (left arrow), a helmet cell (right arrow), and several hyperchromatic triangular erythrocytes are present; (b) two keratocytes (upper arrow) and two deformed microspherocytes (lower arrow) are present, together with more bizarre red cell fragments.


1
2
3
4


are schistocytes present in blood film?
Yes
No
Is schistocytosis the dominant feature (± polychromasia, NRBC, thrombocytopenia)?
is there a strong clinical suspicion of TMA?
Yes
No
Yes
No
suspect TMA
assess smear for features relevant to alternative diagnoses
examine film daily
no further action
perform microscopic schistocyte count
perform automated fragmented RBC count

Flow chart


Normal
Helmet Cells
Normal
Keratocytes
Normal
Schistocytes (Schizocytes)

BMC Hematol. 2015 Dec 1;15:16. doi: 10.1186/s12878-015-0036-2. eCollection 2015.

Therapeutic dilemma in the management of a patient with the clinical picture of TTP and severe B12 deficiency.

Walter K[1], Vaughn J[2], Martin D[3].

Table 1

Characteristics of pseudo-TTP patients individually reported in the literature and averages from a case series

Case	Year	Sex	Age	WBC (×10^9/L)	HCT	HGB	PLT (nadir) (×10^9/L)	LDH (IU/L)	MCV (fL)	Retic × 10^9/L	TPE	Ref
1	1998	F	38	3.6		39	260	5700	102	20	NO	[22]
2	1999	F	68	3.2		32	110	7900	112	34	YES	[23]
3	2003	M	38	2.2		45	50	19,384	90	10	YES	[24]
4	2008	M	48	6.3		50	380	8988	80	13	YES	[14]
5	2009	M	52	3.6	27		960	4604	107	31	NO	[25]
6	2011	F	31	4.2		57	420	4579	110	NR	YES	[26]
Mean values from seven patients												
Series			72	3.4		42	73	7310	111	13		[10]

Arch Med Res. 2015 Aug;46(6):479-83. doi: 10.1016/j.arcmed.2015.07.003. Epub 2015 Jul 26.

Morphological changes of red blood cells in peripheral blood smear of patients with pregnancy-related hypertensive disorders.

Hernández Hernández JD[1], Villaseñor OR[1], Del Rio Alvarado J[1], Lucach RO[1], Zárate A[2], Saucedo R[2], Hernández-Valencia M[3].

RESULTS: A total of 119 samples were analyzed; 74% showed abnormal morphology of erythrocytes and the most frequent abnormality was the presence of schistocytes in up to 39% of samples. Descriptive analysis showed a degree of association to independent variables with Cramer's V = 0.41 value ($p < 0.05$).

CONCLUSIONS: A high percentage of patients with hypertensive disorders of pregnancy show some morphologic alterations of erythrocytes in peripheral blood smear.

Int J Lab Hematol. 2015 Oct;37(5):588-96. doi: 10.1111/ijlh.12363. Epub 2015 Apr 28.

Evaluation of schistocyte analysis by a novel automated digital cell morphology application.

Hervent AS[1], Godefroid M[1], Cauwelier B[1], Billiet J[1], Emmerechts J[1].

RESULTS: Within-run, between-run and between-observer coefficients of variation were lower when counted with the CellaVision compared to the manual microscopic count. The very high sensitivity but rather poor specificity implicates the need for reclassification by the operator, following automated analysis. After reclassification, method comparison studies revealed good agreement with the manual microscopic method, with however slightly higher values of schistocytes for the automated analysis.

CONCLUSION: The CellaVision Advanced RBC Software Application provides a sensitive and reproducible measurement of schistocytes in peripheral blood, but still requires manual revision. Furthermore, it is an easy-to-use software and an excellent teaching tool that might contribute to standardization in the investigation of schistocyte-related conditions.