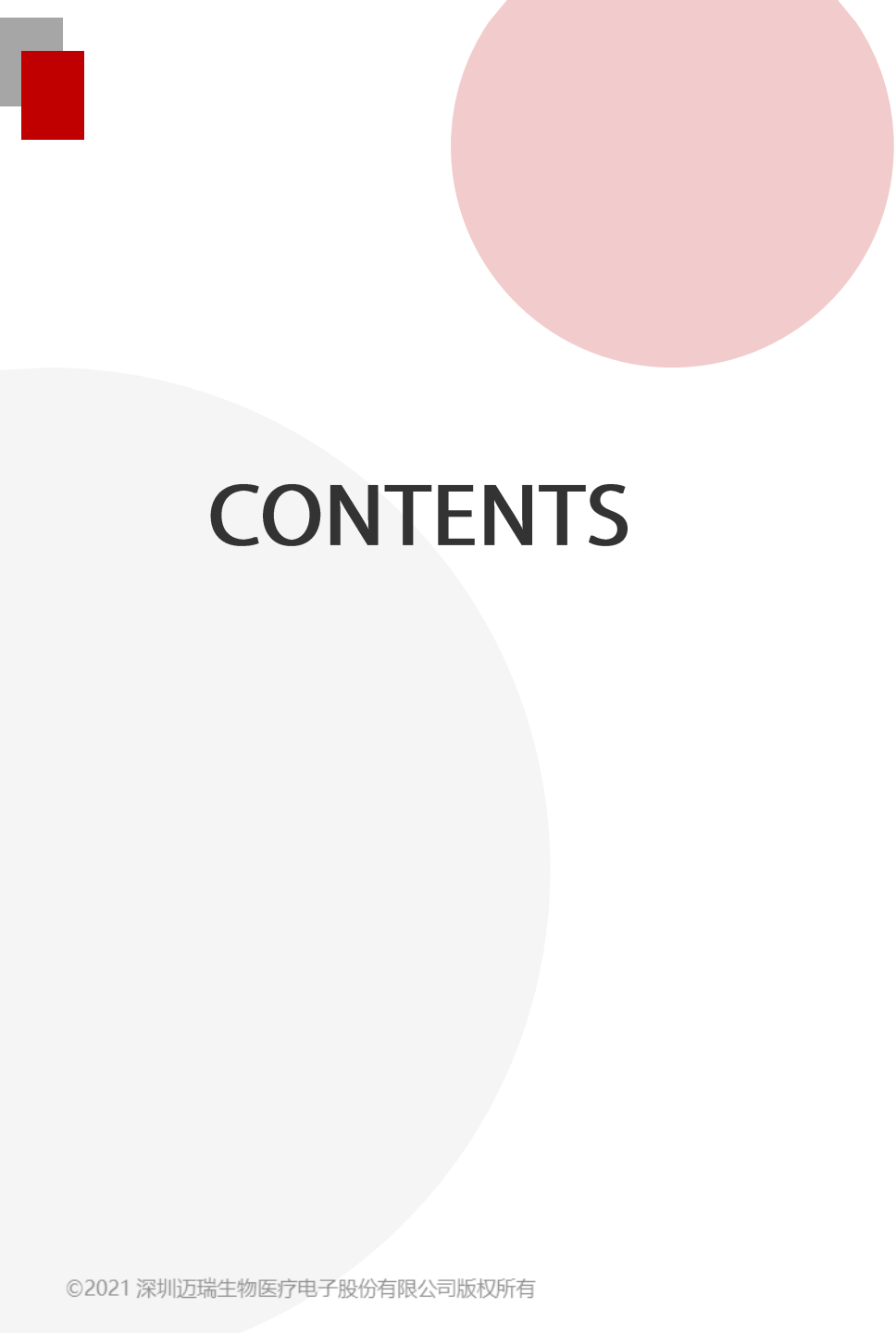


New parameter' s application---HF-MCV

IVD International Clinical Application Department Shirley

2024/06/24



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Case Background

Background

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Summary

Instrument: BC-6200 1/BC-6200 2

Background: Blood routine department work with Mindray BC6200. The daily sample quantity is 700-800/day. All samples will be checked with microscope.



Case Background

Background

Analysis

Solution

Summary

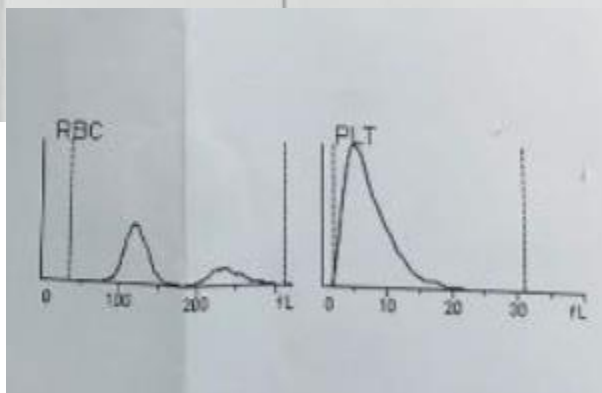
Main issue: the customer complain about for cold agglutination samples **they need to do the treatment to get more accurate results** like warm water incubation, plasma replacement ect,. And they found the similar results with CD and CDR mode. They need instrument to help them get more accurate results with cold agglutination samples.

BC-6200 1: RBC 0.80, HGB 8.9, HCT12.3%, MCV 153.9fL(CD Mode) instrument give alarm: RBC Agglutination?

BC-6200 2: RBC 0.69, HGB 9.0, HCT11.0%, MCV 158.9 fL(CDR Mode)

1 WBC	RL	4.42 $10^3/\mu\text{L}$	5.00 - 10.00
2 Neu%	RL	73.3 %	50.0 - 70.0
3 Lin%	RL	19.4 %	20.0 - 40.0
4 Mon%	R	6.2 %	3.0 - 10.0
5 Eos%	RL	0.4 %	0.5 - 5.0
6 Bas%	R	0.3 %	0.0 - 1.0
7 IMG%	R	0.4 %	0.0 - 100.0
8 Neu#	R	3.24 $10^3/\mu\text{L}$	2.00 - 7.00
9 Lin#	R	0.86 $10^3/\mu\text{L}$	0.80 - 4.00
1 Mon#	R	0.27 $10^3/\mu\text{L}$	0.12 - 1.00
1 Eos#	R	0.02 $10^3/\mu\text{L}$	0.02 - 0.50
1 Bas#	R	0.01 $10^3/\mu\text{L}$	0.00 - 0.10
1 IMG#	R	0.02 $10^3/\mu\text{L}$	0.00 - 999.99
1 RBC	RL	0.80 $10^6/\mu\text{L}$	4.00 - 5.50
1 HGB	RL	8.9 g/dL	12.0 - 16.0
1 HCT	RL	12.3 %	40.0 - 54.0
1 MCV	RH	153.9 fL	80.0 - 100.0
1 MCH	RH	111.1 pg	27.0 - 34.0
1 MCHC	RH	72.4 g/dL	32.0 - 36.0

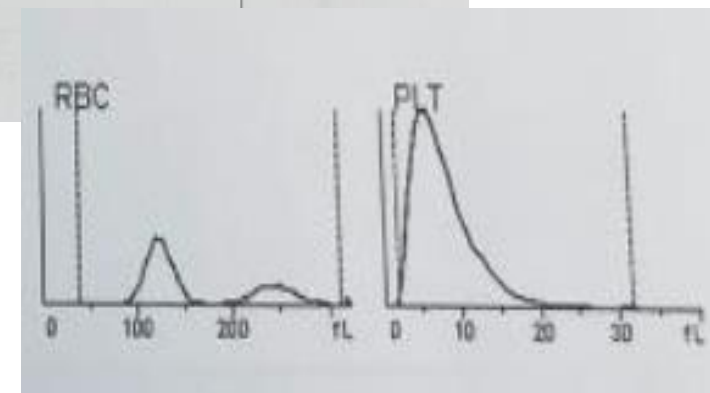
¿Turbidez/Interf. HGB?
¿Agglutinación RBC?
Población dimórfica
RBC Histograma anormal
Anisocitosis
Macrocitosis
Anemia



Analyzer 1

Modelo:	Cerral-WB-CDR/PLT-8X	Fecha nacim.:	
N.º serie:	TW-16001587	Posic. tubo:	
Diagnóstico:			
Parám.	Result	Unid	Intervalos de ref...
1 WBC	RL	4.68 $10^3/\mu\text{L}$	5.00 - 10.00
2 Neu%	RH	73.0 %	50.0 - 70.0
3 Lin%	RL	19.6 %	20.0 - 40.0
4 Mon%	R	5.9 %	3.0 - 12.0
5 Eos%	RL	0.4 %	0.5 - 5.0
6 Bas%	R	0.3 %	0.0 - 1.0
7 IMG%	R	0.8 %	0.0 - 3.0
8 Neu#	R	3.41 $10^3/\mu\text{L}$	2.00 - 7.00
9 Lin#	R	0.92 $10^3/\mu\text{L}$	0.80 - 4.00
1 Eos#	R	0.02 $10^3/\mu\text{L}$	0.02 - 0.50
1 Mon#	R	0.28 $10^3/\mu\text{L}$	0.12 - 1.20
1 Bas#	R	0.01 $10^3/\mu\text{L}$	0.00 - 0.10
1 IMG#	R	0.04 $10^3/\mu\text{L}$	0.00 - 3.00
1 RBC	RL	0.69 $10^6/\mu\text{L}$	4.00 - 5.50
1 HGB	RL	9.0 g/dL	11.0 - 15.0
1 HCT	RL	11.0 %	30.0 - 45.0
1 MCV	RH	158.9 fL	80.0 - 96.0
1 MCH	RH	130.4 pg	27.0 - 32.0
1 MCHC	RH	81.8 g/dL	32.0 - 36.0
2 RDW-CV	RH	43.3 %	11.5 - 14.5

¿Turbidez/Interf. HGB?
¿Agglutinación RBC?
Población dimórfica
RBC Histograma anormal
RET Diagrama de dispersión anormal
Anisocitosis
Macrocitosis
Reticulocitosis

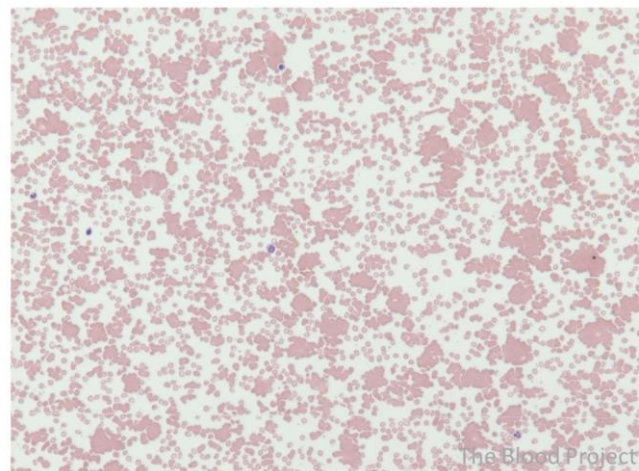


Analyzer 2

Cold agglutination caused by the RBC self-agglutination with vitro&low temperature higher agglutinin in body, which can be reversed under certain condition.
When sample happen cold agglutination, which will lead to RBC,HCT false decrease, MCV, MCH, MCHC false increase.

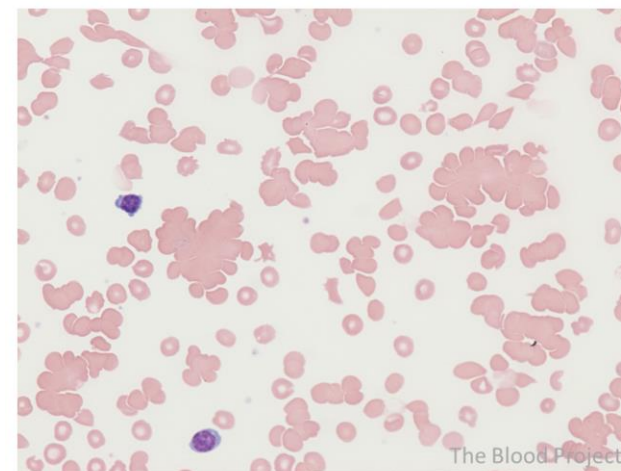


The appearance of cold agglutination



Low power view of a peripheral smear from a patient with cold agglutination disease shows typical appearance of red cell agglutination (10x).

Low power view of a peripheral smear from a patient with cold agglutination disease (10x)*

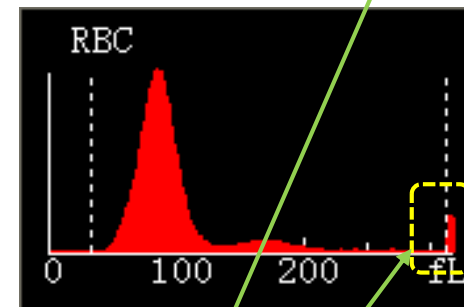
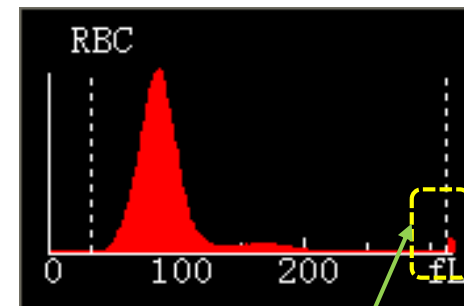
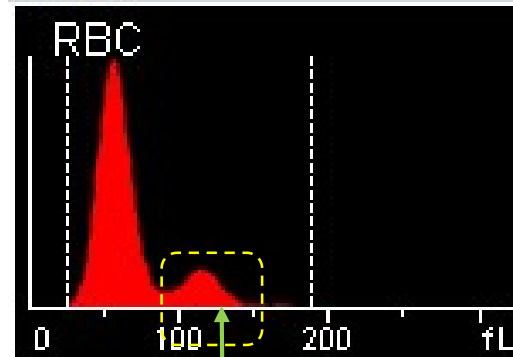
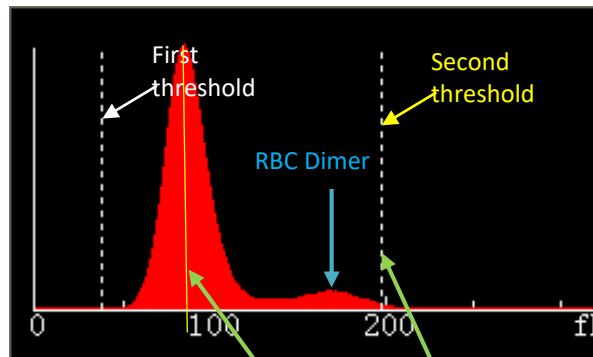
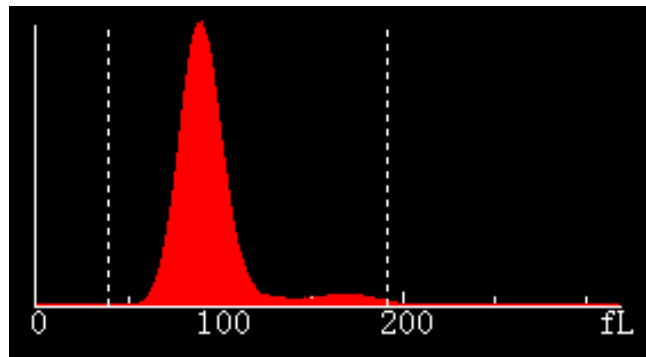


This blood film from a patient with cold agglutination disease shows typical appearance of red cell agglutination consisting of clumps of red cells, which have lost their central pallor owing to the effect of overlapping cytoplasm. Agglutinated masses of red cells of variable size are noted in this view (50x, oil).

This blood film from a patient with cold agglutination disease (50x)*

RBC agglutination

The appearance of blood	Uneven attachment of blocky or sand-like particles on the test tube wall (mild cases may not be visible in appearance).
The influence for results	RBC and HCT false decrease, MCV, MCH, MCHC false increase , especially for MCH and MCHC, RBC and HGB not in proportional(333 rules)
Flags/Histogram information for instrument	RBC agglutination? Turbidity/HGB Interfere? RBC Histogram Abnormal
Smear	Sand-like particles are visible on the blood smear, making it difficult to spread, resulting in an uneven blood smear.
The morphology of RBC with microscope	Red blood cells are unevenly distributed.
Correction action	1. Incubation under 37°C then re-test 2. Dilute with warm saline then re-test with pre-diluent mode 3. Plasma replacement with warm saline then re-test (severe cold agglutination)
Common causes	Primary cold agglutinin syndrome, chlamydial infection, infectious mononucleosis, autoimmune diseases, chronic lymphocytic proliferation diseases; can also be seen in liver diseases, malaria, etc.



- ✓ RBC histogram is in the normal distribution shape
- ✓ The RBC peak central axis is within 82~95fL
- ✓ The front and back area of peak without any other distribution
- ✓ There might be a tiny peak within 150~190fL due to RBC dimers.

RBC Agglutination?

Algorithm 1:

- $MCHC > 380g/L$ & $MCH > 40pg$ & $RBC < 3.50 \times 10^{12}/L$
or $MCHC > 380g/L$ & $MCH > 40pg$ & $RU\% > 6\%$

RU refer to the second threshold line

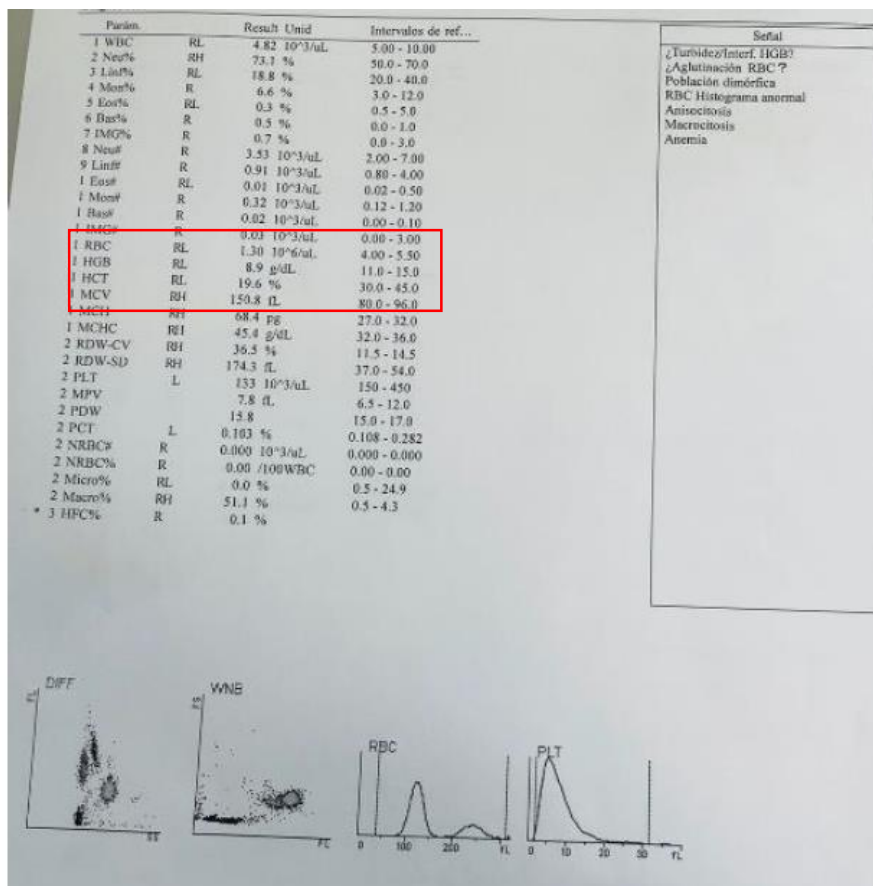
$$RU\% = 100 * \frac{RBCHist[RU]}{RBCHist[Peak]}$$

Algorithm 2:

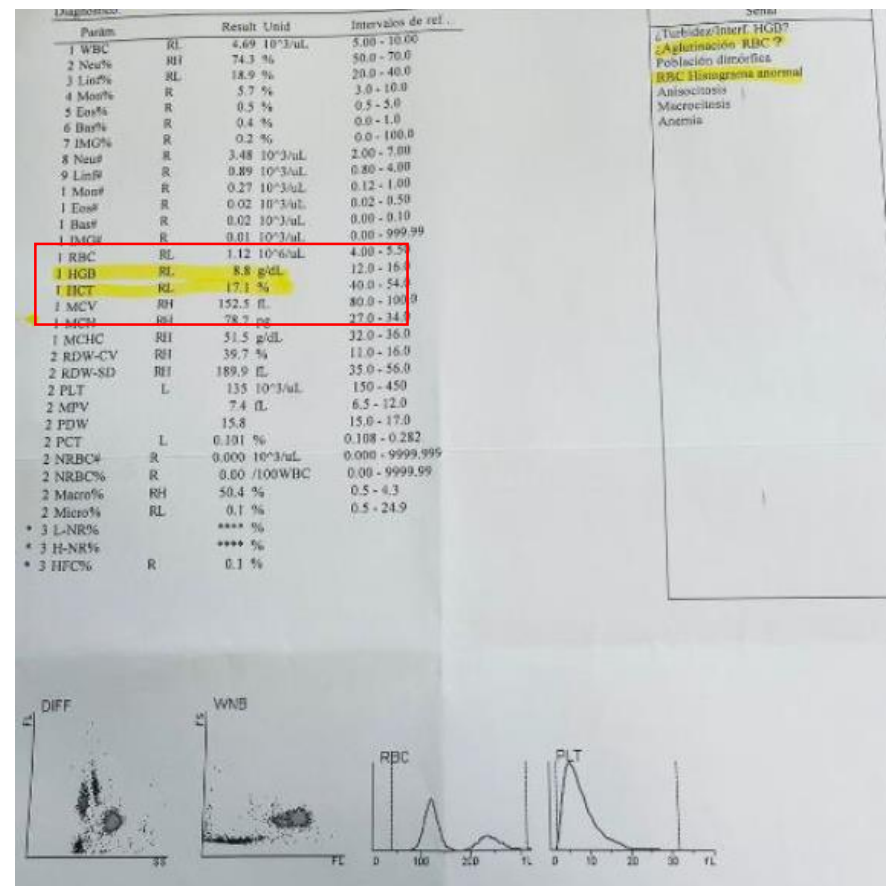
The are the tail in the end of tail (exceed the threshold)

Case Analysis

After incubation with warm water for 30 minutes



Instrument 1 RBC1.3 HGB8.9
HCT19.6% MCV150.8



Instrument 1 RBC1.12 HGB8.8
HCT17.1% MCV152.5

Case Analysis

Background

Analysis

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Summary

After incubation it improved but **did not make the correction**, perform the washes according to our protocol, centrifuging the sample at 2000rpm for 5 min and replacing the plasma with saline solution in the same proportion 3 times in that same order. The sample was processed on both analyzers

Analyzer 1: RBC 2.05, HGB 8.4, HCT 25.2%, MCV 123.1fL

Analyzer 2: RBC 2.04, HGB 8.5 HCT 24.4%, MCV 119.6fL

Parám.	Result	Unid	Intervalos de ref...	
1 WBC	RL	4.06 $10^3/\mu\text{L}$	5.00 - 10.00	Linfopenia ¿Aglutinación RBC? Macrocitosis Anemia Reticulocitosis Trombocitopenia
2 Neu%	RH	79.1 %	50.0 - 70.0	
3 Linf%	RL	14.1 %	20.0 - 40.0	
4 Mon%	R	4.6 %	3.0 - 12.0	
5 Eos%	R	0.7 %	0.5 - 5.0	
6 Bas%	R	0.6 %	0.0 - 1.0	
7 IMG%	R	0.9 %	0.0 - 3.0	
8 Neu#	R	3.21 $10^3/\mu\text{L}$	2.00 - 7.00	
9 Lin#	RL	0.57 $10^3/\mu\text{L}$	0.80 - 4.00	
1 Eos#	R	0.03 $10^3/\mu\text{L}$	0.02 - 0.50	
1 Mon#	R	0.19 $10^3/\mu\text{L}$	0.12 - 1.20	
1 Bas#	R	0.02 $10^3/\mu\text{L}$	0.00 - 0.10	
1 IMG#	R	0.04 $10^3/\mu\text{L}$	0.00 - 3.00	
1 RBC	RL	2.05 $10^6/\mu\text{L}$	4.00 - 5.50	
1 HGB	L	8.4 g/dL	11.0 - 15.0	
1 HCT	RL	25.2 %	30.0 - 45.0	
1 MCV	RH	123.1 fL	80.0 - 96.0	
1 MCH	RH	41.1 pg	27.0 - 32.0	

Parám.	Result	Unid	Intervalos de ref...	Señal
1 WBC	L	3.97 $10^3/\mu\text{L}$	5.00 - 10.00	Pancitopenia
2 Neu%	H	81.5 %	50.0 - 70.0	¿Granulocitos inmaduros?
3 Linf%	L	11.4 %	20.0 - 40.0	Linfopenia
4 Mon%		4.5 %	3.0 - 10.0	Macrocitosis
5 Eos%		0.8 %	0.5 - 5.0	Anemia
6 Bas%		0.5 %	0.0 - 1.0	Trombocitopenia
7 IMG%		1.3 %	0.0 - 100.0	
8 Neu#		3.24 $10^3/\mu\text{L}$	2.00 - 7.00	
9 Lin#	L	0.45 $10^3/\mu\text{L}$	0.80 - 4.00	
1 Mon#		0.18 $10^3/\mu\text{L}$	0.12 - 1.00	
1 Eos#		0.03 $10^3/\mu\text{L}$	0.02 - 0.50	
1 Bas#		0.02 $10^3/\mu\text{L}$	0.00 - 0.10	
1 IMG#		0.05 $10^3/\mu\text{L}$	0.00 - 999.99	
1 RBC	L	2.04 $10^6/\mu\text{L}$	4.00 - 5.50	
1 HGB	L	8.5 g/dL	12.0 - 16.0	
1 HCT	L	24.4 %	40.0 - 54.0	
1 MCV	H	119.6 fL	80.0 - 100.0	
1 MCH	H	41.5 pg	27.0 - 34.0	
1 MCHC		34.8 g/dL	32.0 - 36.0	

Case Analysis

Background

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Summary

RBC O	2.35	R	10^1...
HGB_O	20	R	g/L
Micro#	0.00	R	10^1...
Macro#	0.38	R	10^1...
HF MCV	117.5	R	fL
MRV	117.0	R	fL
FRC%	0.78	R	%
FRC#	0.0054	R	10^1...
RPI	1.1	R	

HGB	90	R	g/L
RBC	0.69	R	10^1...
HCT	11.0	R	%
MCV	158.9	R	fL
MCH	130.4	R	pg
MCHC	818	R	g/L
RDW_CV	43.3	R	%
RDW_SD	220.1	R	fL
HDW	48.1	R	g/L
Micro%	0.2	R	%

Mindray RBC-I:0.69

RBC-O:2.35

MCV: 158.9

HF-MCV:117.5

Case Analysis

Background

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Summary

The results comparison

Parameters	First time analyzer 1	First time analyzer 2	First incubation analyzer 1	First incubation analyzer 2	Plasma replacement analyzer 1(CDR)	Plasma replacement analyzer 2	Reference parameters
RBC	0.80	0.69	1.30	1.12	2.05	2.04	RBC-O 2.35
HGB	8.9	9.0	8.9	8.8	8.4	8.5	8.9
HCT	12.3	11.0	19.6	17.1	25.2	24.4	RBC-O*HF-MCV 27.6
MCV	153.9	158.9	150.8	152.5	123.1	119.6	HF-MCV 117.5
MCH	111.1	130.4	68.4	78.7	41.1	41.5	HGB/RBC-O 37.9
MCHC	72.4	81.8	45.4	51.5	33.3	34.8	HGB/HCT 32.2

How to quickly fine RBC cold agglutination?

- ✓ Set the auto-validation rules to help select the abnormal samples, like: $MCHC > 380\text{g/L}$ or higher than the reference range upper limit 20 g/L
- ✓ Set the special flag like RBC agglutination to select the samples
- ✓ Check the appearance of samples(**Uneven attachment of blocky or sand-like particles** on the test tube wall);RBC related parameters like the ration of RBC, HGB,HCT(333 rules); check the RBC histogram shape(two peaks?)

13	MCHC	>=2 units above upper limit of reference range	Check for lipemia, hemolysis, RBC agglutination, spherocytes.
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The screenshot displays the Mindray BC-6800Plus software interface. On the left, a sidebar contains navigation icons for Samples, QC, Consistency, More, System Setup, Validation Rules, Expert Tip Setup, and Digital. The main area is divided into two panels. The left panel, titled 'Rule Tree (Current Effective Rules)', shows a flowchart with nodes for 'Abnormal Sample Check', 'Panic Value Check', 'Parameter and Flag Check', 'Abnormal Range Delta Check', and 'Clinical Exception', all with 0.0% usage rates. The right panel, titled 'Default Config Group(0.0%)', contains two tables. The first table, 'Parameter Range', lists various parameters with their lower and upper limits, messages, and usage/pass rates. The second table, 'Flag', lists various flags with their messages and usage/pass rates. In both tables, the row for MCHC is highlighted with a red border.

Para.	Lower Limit	Upper Limit	MSG	Usage Rate	Pass Rate
WBC	4	25	Parameter range check-W...	0.0%	0.0%
Neu#	1	20	Parameter range check-N...	0.0%	0.0%
Lym#		5	Parameter range check-L...	0.0%	0.0%
Mon#	1.5		Parameter range check-M...	0.0%	0.0%
Eos#	2		Parameter range check-E...	0.0%	0.0%
Bas#		0.5	Parameter range check-B...	0.0%	0.0%
RBC	2.5	6	Parameter range check-R...	0.0%	0.0%
HGB	70	180	Parameter range check-H...	0.0%	0.0%
MCV	75	105	Parameter range check-M...	0.0%	0.0%
MCHC	300	380	Parameter range check-M...	0.0%	0.0%
RDW-CV		22	Parameter range check-R...	0.0%	0.0%
PLT	80	400	Parameter range check-P...	0.0%	0.0%
RET#		0.1	Parameter range check-R...	0.0%	0.0%
NRBC#		0	Parameter range check-N...	0.0%	0.0%

Flag	MSG	Usage Rate	Pass Rate
WBC Scattergram Abn	Flag check-WBC Scatter...	0.0%	0.0%
Immature Gran?	Flag check-Immature G...	0.0%	0.0%
Atypical Lymph?	Flag check-Atypical Ly...	0.0%	0.0%
RBC Lyse Resistance?	Flag check-RBC Lyse R...	0.0%	0.0%
Blasts?	Flag check-Blasts?	0.0%	0.0%
Abn Lymph/blast?	Flag check-Abn Lymph/...	0.0%	0.0%
NRBC?	Flag check-NRBC?	0.0%	0.0%
Infected RBC?	Flag check-Infected RBC?	0.0%	0.0%
RBC Agglutination?	Flag check-RBC Aggluti...	0.0%	0.0%
RET Scattergram Abn.	Flag check-RET Scatter...	0.0%	0.0%
Fragments?	Flag check-Fragments?	0.0%	0.0%
RBC Histogram Abn.	Flag check-RBC Histogram...	0.0%	0.0%
PLT Clump?	Flag check-PLT Clump?	0.0%	0.0%
PLT Histogram Abn.	Flag check-PLT Histogram...	0.0%	0.0%
PLT Scattergram Abn.	Flag check-PLT Scatter...	0.0%	0.0%

Case Summary

Background

Analysis

Solution

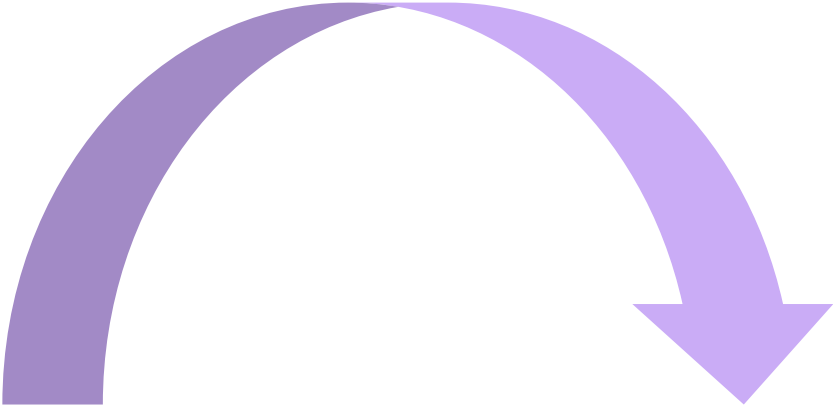
Summary

When we found the cold agglutination samples, how to deal with it?



37°C incubation: warm sample in 37°C water about 30mins-1h then test the samples, it's the common solution to solve the problem. But for severe agglutination samples, it can't be disaggregation

Plasma replacement: centrifuge samples with 3000r/min for 5mins, absorb the upper layer for plasma and discard it. Add DS diluent or saline to wash about 3-5 times, later mix the sample and test with instrument.



The calculation from parameters:
 $RBC = RBC-O$
 $HGB = HGB-O / HGB$
 $MCV = HF-MCV$
 $HCT = RBC * HF-MCV$
 $MCH = HGB / RBC-O$
 $MCHC = HGB / HCT$



Note: plasma replacement can correct RBC related parameters, but the procedure can loss WBC and PLT, which will lower the counting number, especially for PLT. So we suggest to use the first test results for PLT, WBC

Case Summary

How to release the report?

- ◆ Check the change for RBC and related parameters: after the treatment or the calculation, whether the parameters are different, or a big bias
- ◆ If use plasma replacement method, the RBC series parameter use after plasmas replacement results, and PLT, WBC should use before the RBC replacement
- ◆ It's recommend that note on the report: this sample have cold agglutination problem, the RBC series results are the corrected just for reference
- ◆ Can refer to HF-MCV(RUO) and the calculation results

Thanks!

mindray迈瑞