

# L'IDONEITA' DEL CAMPIONE PER L'EMATOLOGIA

M. BUTTARELLO

U.O.C. LABORATORIO ANALISI  
ULSS 19 ADRIA (RO)

## COMPLETE BLOOD COUNT SPECIMEN ACCEPTABILITY (Jones et al 1994)

### Reasons for CBC specimen rejection

(0.45% of 7.894.882)

- Clotted 64.8%
- Insufficient 10.1%
- Variance (delta check) 5.3%
- Labeled/unlabeled 5.1%
- Not received 2.9%
- Platelets clumped 2.2%
- Hemolyzed 2.0%
- Contaminated 1.6%
- (intravenous solution)
- Improper container 1.4%

## **VARIABILI PREANALITICHE**

**1) SOGGETTO DIPENDENTI**

**2) METODOLOGIA DIPENDENTI**

## **SOGGETTO DIPENDENTI**

- **ETA' E SESSO**
- **VARIABILITA' BIOLOGICA INTRAINDIVIDUALE**
- **RITMICITA FISIOLÓGICA**
- **ALTITUDINE**
- **ATTIVITA' FISICA E LAVORATIVA**
- **DIGIUNO**
- **ASSUNZIONE DI FARMACI O SOSTANZE VOLUTTUARIE**
- **PATOLOGIE IN ATTO O PREGRESSE**
- **POSTURA (ORTO vs CLINO)**

## **VARIABILI METODOLOGIA DIPENDENTI**

### **a) RACCOLTA DEL CAMPIONE**

- **SEDE, USO DEL LACCIO,  
DIAMETRO DELL'AGO**
- **PRELIEVO SOTTOVUOTO O CON  
SIRINGA**
- **TIPO DI ANTICOAGULANTE**
- **AGITAZIONE DEL CAMPIONE**

## **VARIABILI METODOLOGIA DIPENDENTI**

### **b) TRASPORTO E CONSERVAZIONE**

- **POSTA PNEUMATICA vs PEDONAGGIO**
- **TEMPO DI LATENZA**
- **TEMPERATURA DI CONSERVAZIONE  
(AMBIENTE vs 4° C)**

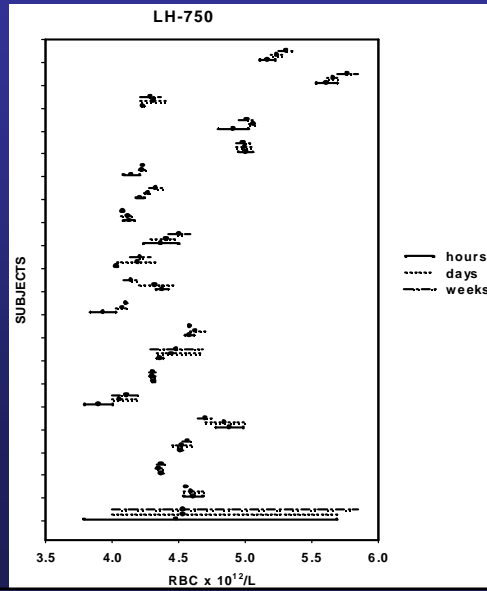
# VARIABILITA' BIOLOGICA INTRAINDIVIDUALE E RITMICITA' CIRCADIANA

TABELLA I. Variabilità biologica intraindividuale (day to day) in ematologia, dati percentuali

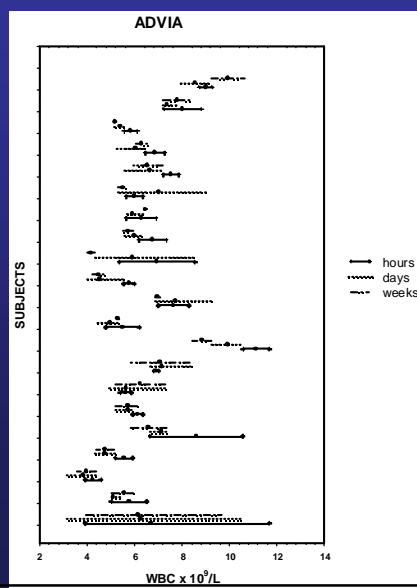
PARAMETRI	Statland (1977)	Costongs (1985)	Richardson-Jones (1996)	GdSE-SIMel* (2002)
Leucociti x 10 <sup>9</sup> /L	15.5	19.9	14.0	12.3
Eritrociti x 10 <sup>12</sup> /L	-	4.4	3.5	1.8
Emoglobina g/dL	2.6	4.3	3.0	1.9
MCV fl	-	-	0.5	0.6
Piastrine x 10 <sup>9</sup> /L	3.6	6.7	5.0	3.8
Neutrofilii x 10 <sup>9</sup> /L	23.2	15.1	22.0	18.3
Linfociti x 10 <sup>9</sup> /L	9.7	23.6	14.0	11.1
Monociti x 10 <sup>9</sup> /L	13.0	24.8	15.0	10.6
Eosinofili x 10 <sup>9</sup> /L	14.1	28.8	20.0	11.8
Basofili x 10 <sup>9</sup> /L	9.8	41.3	-	9.1
Reticolociti x 10 <sup>9</sup> /L	-	-	20.0	5.8

\*media dei risultati ottenuta con 4 diversi analizzatori

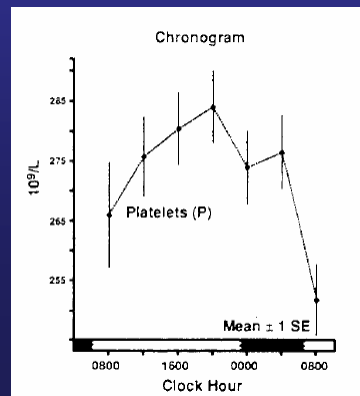
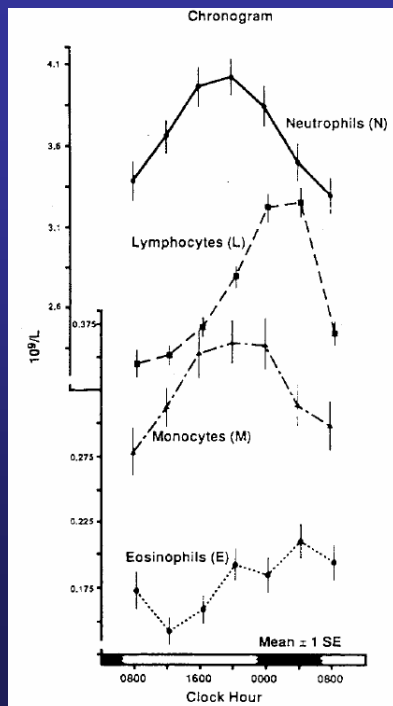
## Variabilità biologica intraindividuale: RBC



## Variabilità biologica intraindividuale: WBC



# RITMICITA' CIRCADIANA

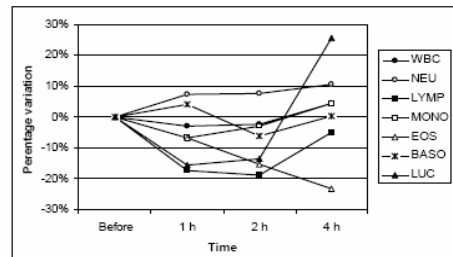
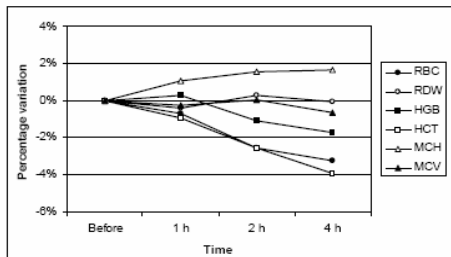


# DIGIUNO vs PASTO LEGGERO

## Influence of a light meal on routine haematological tests

Giuseppe Lippi<sup>1</sup>, Gabriel Lima-Oliveira<sup>2</sup>, Gian Luca Salvagno<sup>1</sup>, Martina Montagnana<sup>1</sup>, Matteo Gelati<sup>1</sup>, Geraldo Picheth<sup>3</sup>, Alberto José Duarte<sup>2</sup>, Massimo Franchini<sup>4</sup>, Gian Cesare Guidi<sup>1</sup>

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## EFFETTO DELLA POSTURA

**SUPINO** —————> **ERETTO**

<b>Emoglobina</b>	<b>+ 5-10%</b>
<b>Ematocrito</b>	<b>+ 10-15%</b>
<b>Eritrociti</b>	<b>+ 10-15%</b>
<b>Leucociti</b>	<b>+ 7-10%</b>

# SEDE DEL PRELIEVO, CALIBRO DELL'AGO, STASI VENOSA E AGITAZIONE DEL CAMPIONE

## EFFETTO DELLA STASI VENOSA

*Clin. Lab. Haem.*  
2006, 28, 332-337

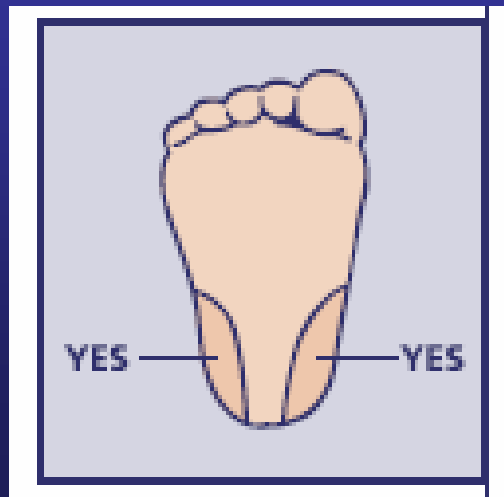
doi: 10.1111/j.1365-2257.2006.00818.x

### **Venous stasis and routine hematologic testing**

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**G. L. SALVAGNO\***, *Università degli Studi di Verona, Verona, Italy*  
**M. MONTAGNANA\***, *†Servizio di Immunematologia e Trasfusione, Azienda Ospedaliera di Verona, Verona, Italy*  
**M. FRANCHINI†,**  
**G. C. GUIDI\***

and 3 min (3-min stasis). Although the overall correlation between measures was globally acceptable, the mean values for paired samples were significantly different in all parameters tested, except MCV, MHC, PLT, MPV, eosinophils, basophils and large unstained cells after 1-min stasis and all parameters except MCV, MHC, MPV and basophils after 3-min venous stasis. As expected RBC, hemoglobin and hematocrit displayed a significant trend towards increase, whereas WBC and the WBC subpopulations were decreased. Difference between

## PRELIEVO PEDIATRICO DAL TALLONE



## PRELIEVO DAL TALLONE

a) SE SITO CALDO CON BUON FLUSSO EMATICO

RBC  
Hb  
WBC

} simili a sangue venoso

b) SE SITO FREDDO E CIANOTICO

RBC  
Hb  
WBC

} aumentati

## Phlebotomy Issues and Quality Improvement in Results of Laboratory Testing

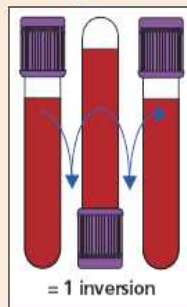
GIUSEPPE LIPPI<sup>1\*</sup>, GIAN LUCA SALVAGNO<sup>1</sup>, MARTINA MONTAGNANA<sup>1</sup>,  
MASSIMO FRANCHINI<sup>2</sup>, GIAN CESARE GUIDI<sup>3</sup>

In this perspective, a 21 G or slightly larger needle is recommended for easy accessible antecubital veins. In fact, 19-21 G needles allow appropriate flow into the collecting system, thus minimizing the probability of increasing preanalytic variability. The 23 G needle might be reserved for newborns and small children, small and fragile veins, provided that a small amount of blood is required (32).

### Processing (Mixing) of Tubes

#### Why

- Most tubes contain an additive or clot activator that needs to be mixed with the blood sample.
- Tubes with anticoagulants such as EDTA need to be mixed to ensure that the specimen does not clot.



#### How

- Holding tube upright, gently invert 180° and back.
- Repeat movement as prescribed for each tube.

#### When

- Immediately after drawing.

#### Consequences if not mixed properly

- Tubes with anticoagulants will clot.
- Specimen may need to be redrawn.



BD Vacutainer®  
Blood Transfer  
Device

Received 4.17.07 | Revisions Received 8.8.07 | Accepted 9.13.07

## Evaluation of Different Mixing Procedures for K2 EDTA Primary Samples on Hematological Testing

Giuseppe Lippi, MD,<sup>1</sup> Gian Luca Salvagno, MD,<sup>1</sup> Martina Montagnana, MD,<sup>1</sup> Giuseppe Banfi, MD,<sup>2</sup> Gian Cesare Guidi, MD<sup>1</sup>  
(<sup>1</sup>Sezione di Chimica Clinica, Dipartimento di Scienze Morfologico-Biomediche, Università di Verona, Italy; <sup>2</sup>Istituto Galazzi and Università di Milano, Italy)

**Table 1 Influence of Different Mixing Procedures of K2 EDTA Primary Tubes on Hematological Testing<sup>1</sup>**

	Desirable Bias	Specimens Inverted 6 Times	Unmixed Specimens		Specimens Inverted 12 Times	
				Percentage Bias		Percentage Bias
White blood cell count (10 <sup>9</sup> /L)	± 5.6%	7.19 ± 2.34	7.31 ± 2.33	+2.0%	7.10 ± 2.20	-0.9%
Red blood cell count (10 <sup>12</sup> /L)	± 1.7%	4.68 ± 0.35	4.62 ± 0.33 <sup>2</sup>	-1.1%	4.68 ± 0.35	+0.2%
Hemoglobin (g/dL)	± 1.8%	139 ± 12	137 ± 12 <sup>2</sup>	-1.0%	139 ± 12	0.0%
Hematocrit	± 1.7%	0.41 ± 0.03	0.40 ± 0.03 <sup>2</sup>	-1.2%	0.41 ± 0.03 <sup>2</sup>	+0.2%
Mean cell volume (fL)	± 1.2%	87 ± 3	87 ± 3	0.0%	87 ± 3	0.0%
Mean hemoglobin content (pg)	± 1.4%	29.6 ± 1.7	29.7 ± 1.7	+0.3%	29.6 ± 1.7	0.0%
Platelet count (10 <sup>9</sup> /L)	± 5.9%	275 ± 75	269 ± 75 <sup>1</sup>	-2.1%	277 ± 75 <sup>1</sup>	+0.8%
Mean platelet volume (fL)	± 2.3%	8.1 ± 1.0	8.2 ± 1.1 <sup>1</sup>	+1.5%	8.1 ± 1.0	-0.2%

<sup>1</sup>Results are shown as mean ± standard deviation. Differences between samples were evaluated by Wilcoxon's paired test, and percentage differences were compared with the current analytical quality specifications for desirable bias derived from biological variation.<sup>2</sup>

<sup>1</sup>P<0.05; <sup>2</sup>P<0.01.

# ANTICOAGULANTI

## **ANTICOAGULANT OF CHOICE**

**Recommendations of the International Council for Standardization in Haemathology for Ethylenediaminetetraacetic Acid Anticoagulation of Blood for Blood Cell Counting and Sizing (AJCP 1993)**

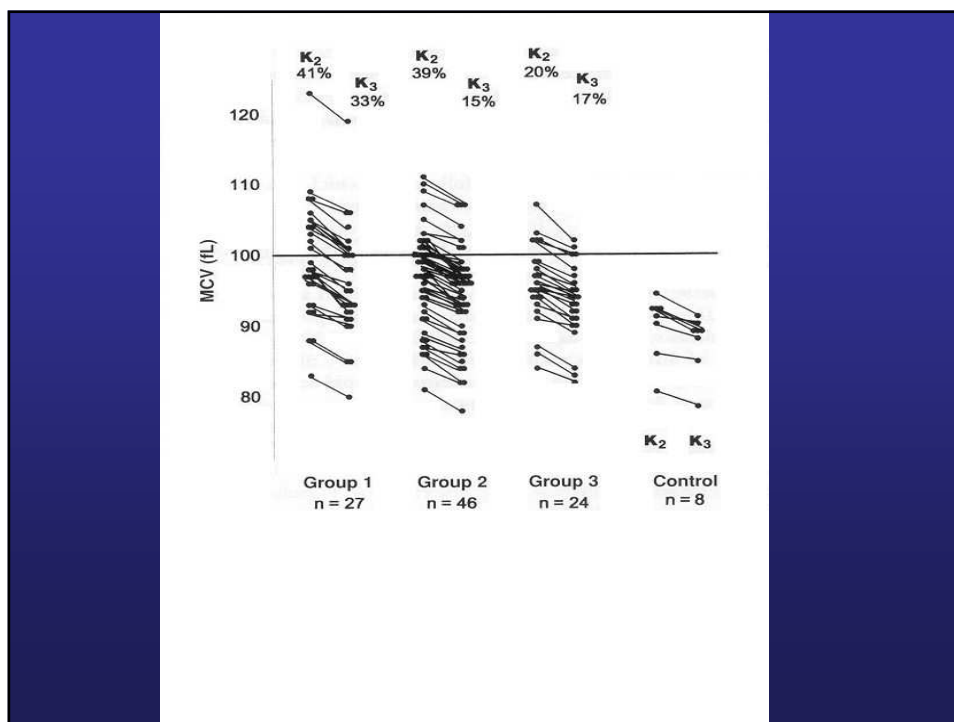
**“K2 EDTA HAS A LOWER INFLUENCE ON MEAN CELL VOLUME (AND MICROHEMATOCRIT) THAN K3 EDTA”**

## **RESULTS WITH AUTOMATED INSTRUMENTS**

**- NO SIGNIFICANT DIFFERENCE (*GOOSSENS 1991*)  
(ANALYSIS WITHIN 4 HOURS)**

**- EXCELLENT AGREEMENT (*PHILLIPS 1998*)  
(ORIFICE -IMPEDANCE INSTRUMENT WITHIN 5 HOURS)**

**- DIFFERENCE IN MCV RELATED TO BLOOD pH  
(HEMODIALYSIS PATIENT, WITHIN 0.5 HOURS)  
(*ASANUMA 2000*)**



## CTAD as a universal anticoagulant

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and T. Takubo

*Department of Clinical and Laboratory Medicine, Osaka City University Medical School, 1-4-3 Ashinachi, Abeno, Osaka 545-8585, Japan*

*The feasibility of CTAD (a mixture of citrate, theophylline, adenosine and dipyridamole) as a new anticoagulant for medical laboratory use was studied prospectively. Whole blood anticoagulated with CTAD exhibited results very similar to those of blood anticoagulated with EDTA on complete blood count and automated white cell differential except for a slight decrease in platelet count and mean platelet volume. Chemistry test data for plasma obtained from CTAD whole blood were close to those obtained for matched sera. Among coagulation tests, prothrombin time, activated partial thromboplastin time and fibrinogen concentrations were close to those obtained with citrate plasma. Based on the results, CTAD was judged to be a good candidate as a new anticoagulant.*

## Confronto fra EDTA e CTAD

Table 2a. Correlation between complete blood count profile parameters for EDTA and CTAD blood measured with SE-9000.

	EDTA: $y^*$	CTAD: $x^*$	$y = ax + b$	$r$	$p$
RBC ( $\times 10^6 \mu\text{l}^{-1}$ )	$4.36 \pm 0.51$	$4.42 \pm 0.52$	$y = 0.981x + 0.020$	0.994	<0.0001
Hb (g dl $^{-1}$ )	$13.3 \pm 1.51$	$13.4 \pm 1.60$	$y = 0.945x + 0.615$	0.996	<0.0001
Hct (%)	$40.0 \pm 4.26$	$40.8 \pm 4.38$	$y = 0.967x + 0.496$	0.994	<0.0001
MCV ( $\mu\text{m}^3$ )	$92.0 \pm 6.22$	$92.6 \pm 6.22$	$y = 0.997x - 0.288$	0.997	<0.0001
RDW (%)	$12.0 \pm 0.95$	$12.0 \pm 0.94$	$y = 1.010x - 0.087$	0.994	<0.0001
Platelet ( $\times 10^3 \mu\text{l}^{-1}$ )	$22.9 \pm 7.66$	$21.0 \pm 7.17$	$y = 1.044x + 1.013$	0.977	<0.0001
WBC ( $\times 10^3 \mu\text{l}^{-1}$ )	$6.28 \pm 1.92$	$6.24 \pm 1.91$	$y = 0.999x + 0.049$	0.993	<0.0001
Neutrophil ( $\times 10^3 \mu\text{l}^{-1}$ )	$4.00 \pm 1.75$	$3.99 \pm 1.84$	$y = 0.935x + 0.267$	0.981	<0.0001
Lymphocyte ( $\times 10^3 \mu\text{l}^{-1}$ )	$1.69 \pm 0.71$	$1.72 \pm 0.75$	$y = 0.902x + 0.144$	0.957	<0.0001
Monocyte ( $\times 10^3 \mu\text{l}^{-1}$ )	$0.34 \pm 0.11$	$0.27 \pm 0.13$	$y = 0.516x + 0.198$	0.618	<0.0001
Eosinophil ( $\times 10^3 \mu\text{l}^{-1}$ )	$0.21 \pm 0.20$	$0.23 \pm 0.21$	$y = 0.895x + 0.011$	0.988	<0.0001
Basophil ( $\times 10^3 \mu\text{l}^{-1}$ )	$0.03 \pm 0.02$	$0.03 \pm 0.02$	$y = 0.725x + 0.012$	0.606	<0.0001

$n = 46$ .

\* Each value is the mean  $\pm$  SD.

## ARTEFATTI DA ELEVATA CONCENTRAZIONE DI GLUCOSIO

## Prelievo eseguito in prossimità di una flebo glucosata (from Zandecki)

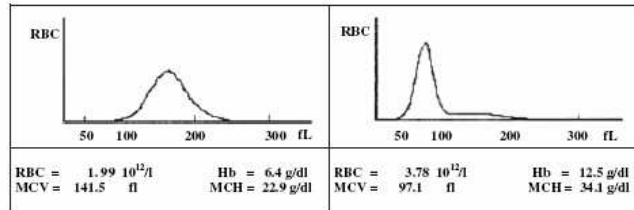
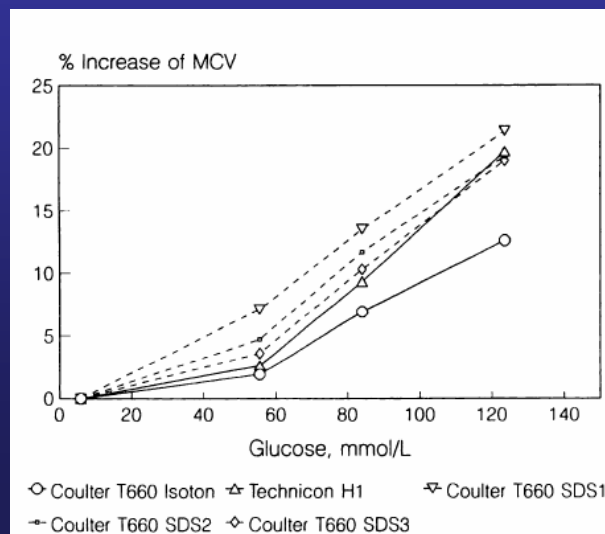


Figure 7. Venepuncture performed near a glucose infusion. Blood sample from that patient was diluted (Hb low) and excess of glucose led to a swelling of RBC: MCV was spuriously high and in turn MCHC spuriously low. Sample drawn correctly by the next morning showed normal values (no transfusion had been performed). RBC histogram on diluted sample (left) and on new sample (right; Beckman Coulter STKS II).

## MCV e concentrazione di glucosio (van Duijnhoven Clin Chem 1996)

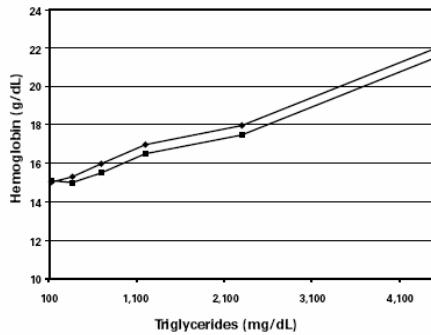


## **INTERFERENZA DA IPERLIPEMIA**

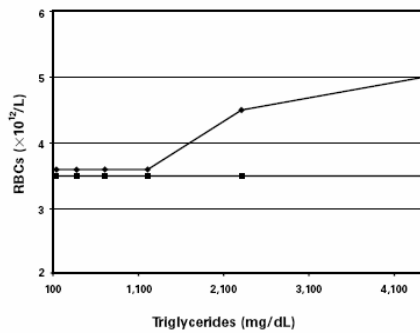
### **LIPIDI E IPERTRIGLICERIDEMIA**

- **Possono creare micelle delle dimensioni di una piastrina (raramente di un leucocita)**
- **Aumento spurio di Hb e MCHC (da torbidità)**
- **Hb corretta con metodi basati sulla misura diretta della concentrazione emoglobinica cellulare**

## Abbott cell-dyn 4000 e Siemens H2: ipertrigliceridemia e parametri eritrocitari (Grimaldi, AJCP 2000)

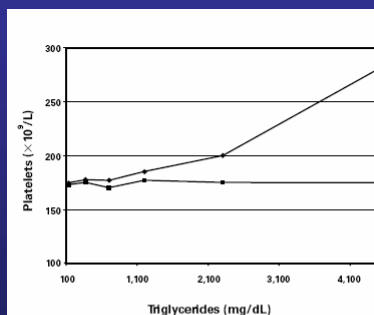


**Figure 3** Interference of hyperlipidemic samples on the hemoglobin determination. Both the Abbott CELLDYN 4000 (Abbott Diagnostics, Abbott Park, IL) (squares) and Bayer-Technicon H-2 (Bayer-Technicon, Tarrytown, NY) (diamonds) show significant overestimation (1 g/dL or more) starting from a triglyceride value of 450 mg/dL or more.



**Figure 4** Interference of hyperlipidemic samples on the RBC count. The RBC count is stable on both instruments (Abbott CELLDYN 4000, Abbott Diagnostics, Abbott Park, IL [squares]; and Bayer-Technicon H-2 Bayer-Technicon, Tarrytown, NY [diamonds]) up to a triglyceride value of 200 mg/dL. With higher lipid concentrations, only the H-2 analyzer shows an RBC count overestimation.

## Abbott cell-dyn 4000 e Siemens H2: ipertrigliceridemia e conteggio piastrinico (Grimaldi, AJCP 2000)



**Figure 5** Interference of hyperlipidemic samples on the platelet count. The platelet count performed by the Abbott CELLDYN 4000 (Abbott Diagnostics, Abbott Park, IL) (squares) is stable up to a triglyceride value of 4,500 mg/dL. The platelet count by the Bayer-Technicon H-2 (Bayer-Technicon, Tarrytown, NY) (diamonds) shows significant overestimation starting from a triglyceride value of 1,200 mg/dL.

## Lipidi e canale diff : XE-2100

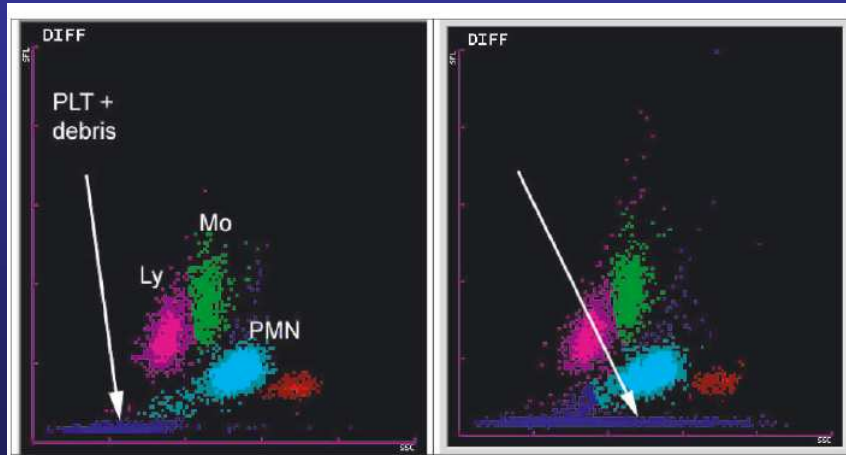
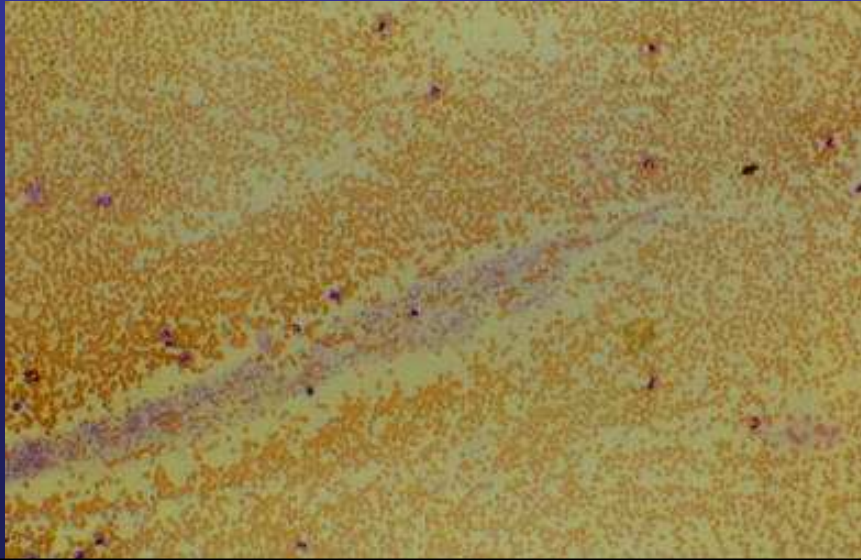


Figure 6. Lipids in a patient with liver disease. When compared with a normal scattergram (left), lipids generated here a strand of dots elongating PLT region (arrow; Sysmex XE2100).

**MICROCOAGULI, FIBRINA,  
AGGREGATI E SATELLITISMO  
PIASTRINICO**

## Microcoagulo da prelievo difficoltoso



## Filamenti di fibrina (M. Zandecki et al. 2006)

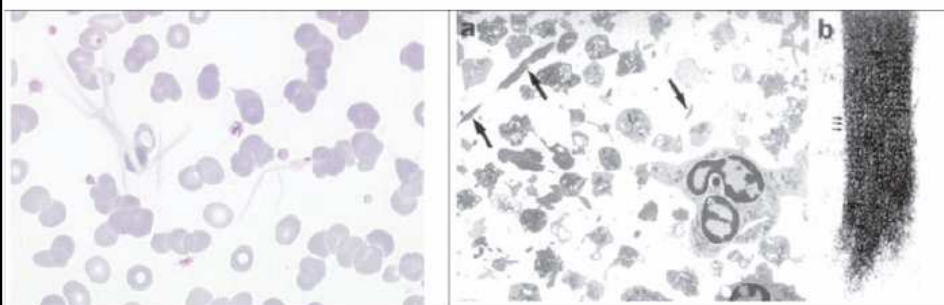


Figure 5. In some instances (see text), fibrin strands may be observed on peripheral blood smears (MGG staining; left); according to their size they may be enumerated as PLT or/and as WBC. Electron microscopic analysis (right; a) shows such strands intermixed with PLT and WBC (arrows), and inset (right; b) shows peculiar periodic ultrastructure corresponding to fibrin strands.

## Aggregati piastrinici e satellitismo (Zandecki et al.2006)

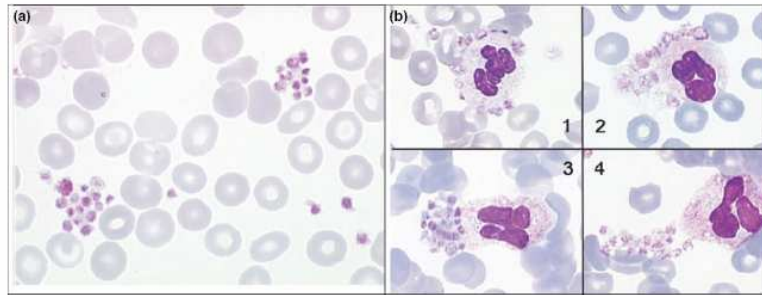


Figure 1. (a) EDTA-induced thrombocytopenia. Aggregates observed on peripheral blood smears may contain variable number of PLT within each clump. Some PLT clumps are large enough to be enumerated as WBC by HA. (b) Platelet satellitism around polymorphs (1). In some instances PLT satellitism is the first part of a peculiar phenomenon that develops within several hours into the sample: PLT migrate to one pole of the polymorph (2), clump together (3), and eventually leave the polymorph (4) (peripheral blood smear; MGG staining).

## Siemens ADVIA 120 e aggregati piastrinici

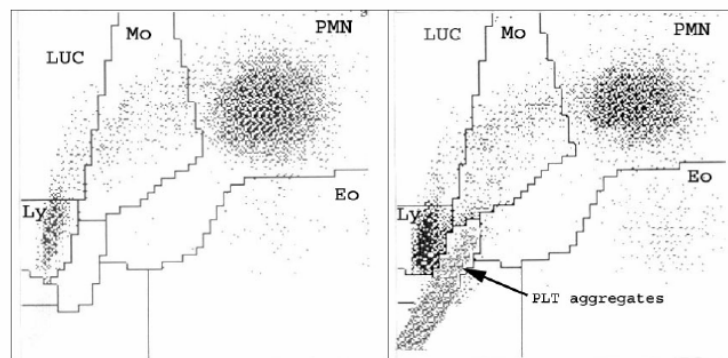


Figure 2. WBC scattergram form on normal patient (left) and another one showing EDTA-induced PLT aggregate (right). PLT aggregates generate a rocket of particles of small and intermediate size (outing from the origin from the X-Y display), leading to inability to perform accurate identification of WBC (Bayer Advia 120). Ly, lymphocytes; LUC, large unstained cells; Mo, monocytes; PMN, polymorphonuclear neutrophils; Eo, eosinophils.

## Satellitismo piastrinico

(Zandecki et al. 2006)

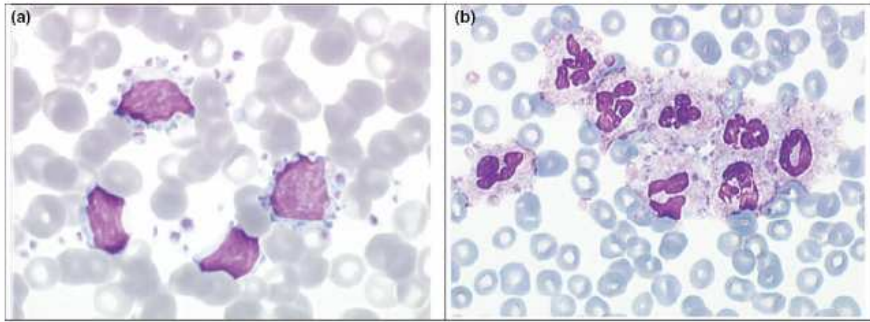
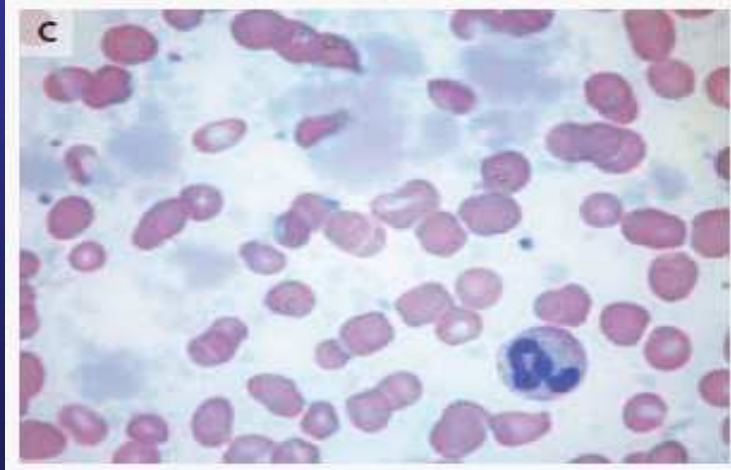


Figure 3. (a) Platelets surrounding lymphocytes in a patient known for chronic lymphocytic leukaemia. (b) Neutrophil-Platelet aggregates; that latter situation is related to PLT satellitism around polymorphs: PLT are 'bridges' between PLT-neutrophil rosettes, generating peculiar clumps, differing from neutrophil aggregates, as no PLT is observed within the latter (peripheral blood smears; MGG staining).

**ARTEFATTI DA  
CRIOGLOBULINE**

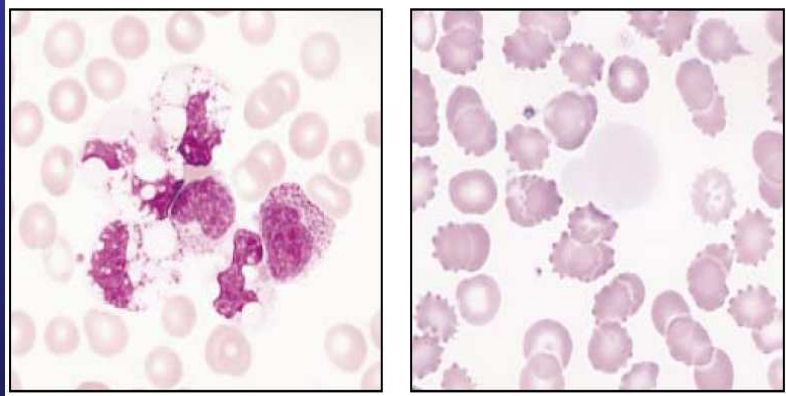
## Crioglobuline (Bain 2005)



## CRIOGLOBULINE

- Aumento spurio delle Plt
- Più evidenti con gli analizzatori che non preriscaldano il campione
- Se clusters di grandi dimensioni è possibile un falso aumento dei WBC
- In alcune situazioni possono formare un gel che rende impossibile l'aspirazione del campione

## Crioglobuline (Mc Kenna 1999)



## Crioglobuline (Zandecki et al. 2006)

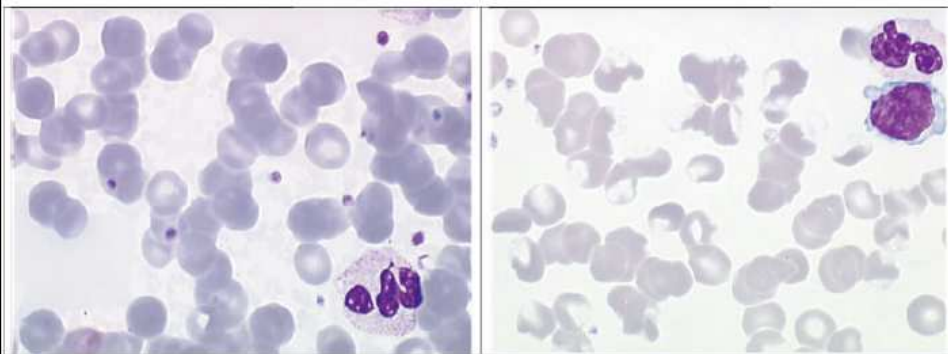


Figure 3. Several morphological aspects of cryoglobulins may be observed on peripheral blood samples, and two among them are shown here: small lucent precipitates scattered around RBC (left), or invisible precipitates that change morphology of RBC into a 'moth-eaten' aspect (right).

## Crioglobuline e conteggio piastrinico

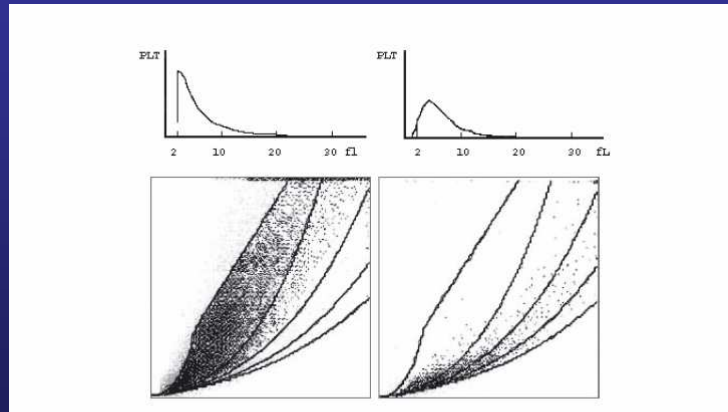


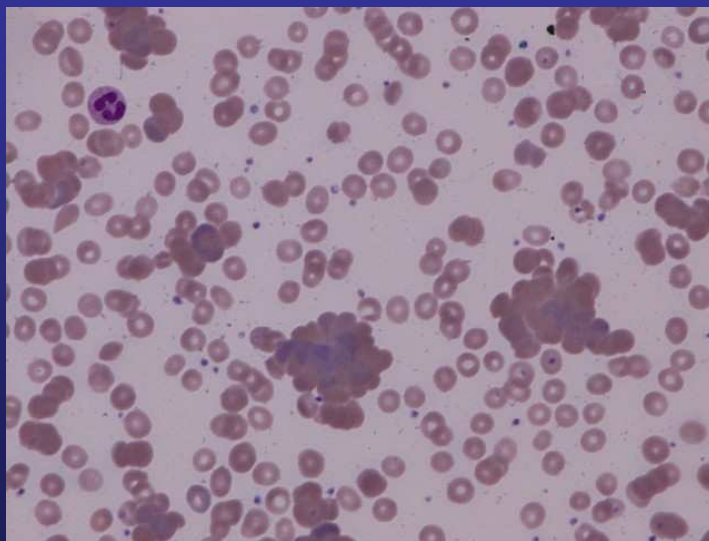
Figure 8. Cryoglobulins may precipitate during the dilution procedure into the HA, and the small particles are enumerated together with PLT. On impedance-type HA (Coulter STKS II) the small size of particles generates a shift to the left of the PLT histogram (up left). On laser-beam HA (Bayer ADVIA 120) the PLT scattergram is overloaded with particles of various sizes, the largest ones accumulating at the top of the scattergram (down left). After warming the sample at 37 °C cryoglobulin dissolves, and prompt analysis leads to full disappearance of abnormalities (up right and down right, for the relevant HA, respectively).

## CRIOAGGLUTININE E PARAMETRI ERITROCITARI

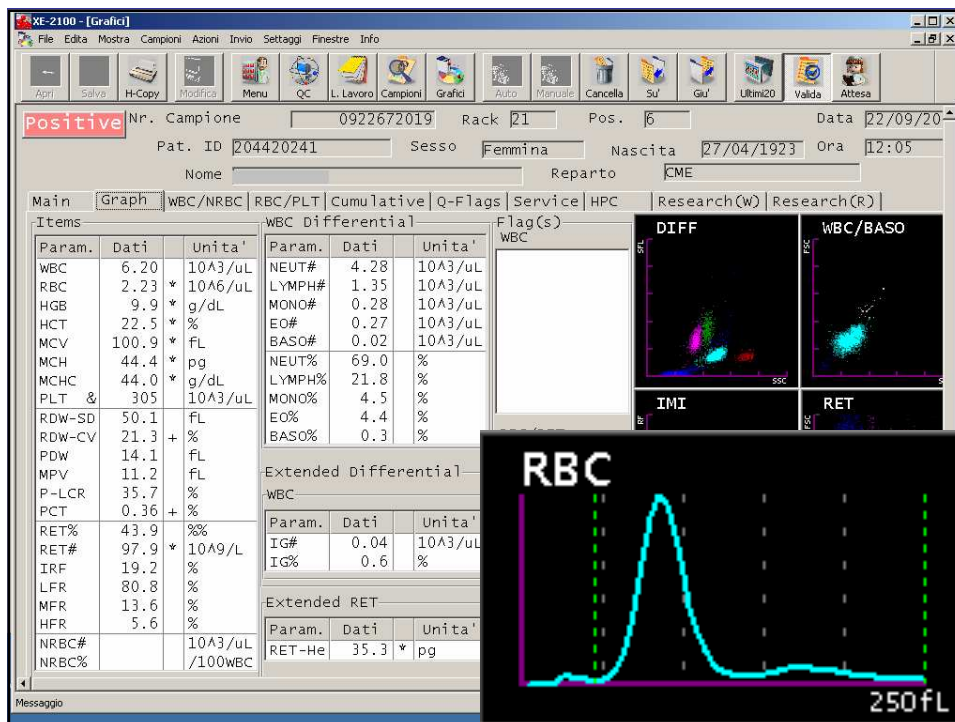
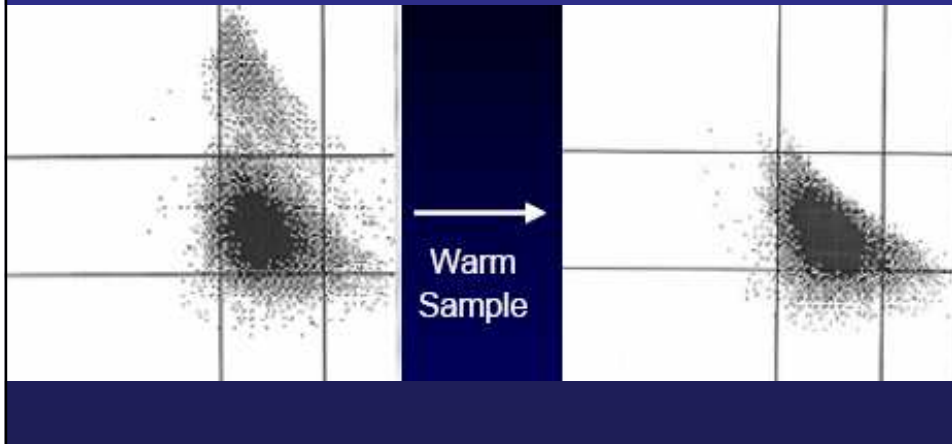
## CRIOAGGLUTININE

- **Riduzione RBC**
- **Riduzione Ht**
- **Aumento MCV**
- **Normale Hb**
- **Aumento MCHC ( di regola > di 360 g/L**

## Crioagglutinati eritrocitari



# Citogramma eritrocitario su ADVIA 120: crioagglutinine



## FRAMMENTI ERITROCITARI E CONTEGGIO PIASTRINICO

### Frammenti eritrocitari e conteggio piastrinico

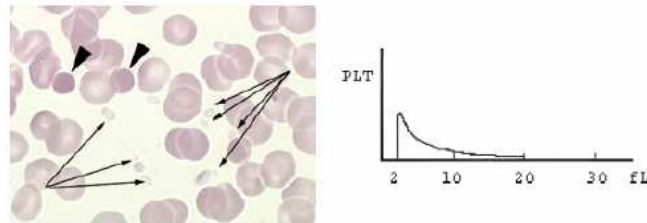
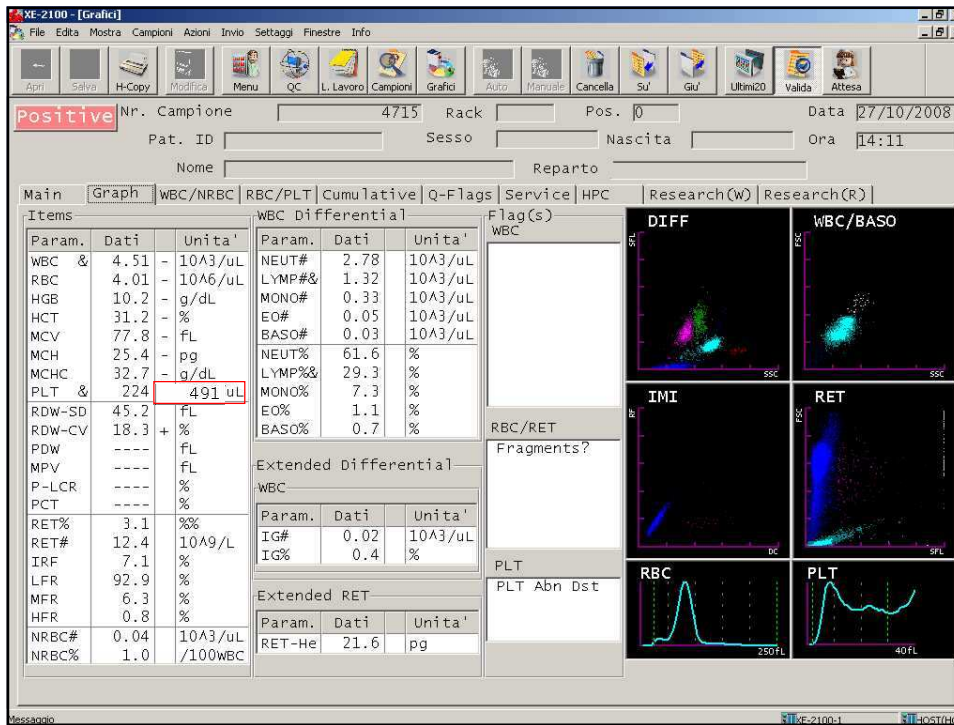


Figure 5. After acute burns several changes may be observed on RBC, including spherocytes (arrowheads) and very small RBC fragments (small schistocytes, arrows) (left; peripheral blood smear, MGG staining). Small schistocytes are enumerated together with PLT, leading to a peculiar PLT histogram showing an excess of small particles (right; Coulter counter STKS II).



# AGGREGAZIONE LEUCOCITARIA IN VITRO E PSEUDOLEUCOPENIA

## AGGREGAZIONE LEUCOCITARIA IN VITRO

- **In presenza di EDTA (più raramente in citrato o eparina)**
- **Mediata da IgM**
- **Malattie infiammatorie acute e croniche, epatopatie, patologie con crioagglutinine (es. malattie linfoproliferative)**
- **Il riscaldamento a 37 ° può ridurre il fenomeno (ma non sempre)**
- **Anticoagulanti diversi (es CPT possono prevenire il fenomeno)**

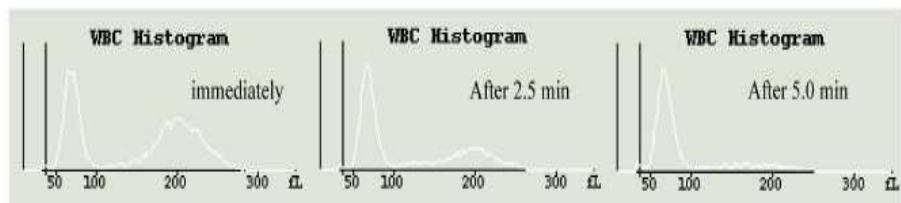
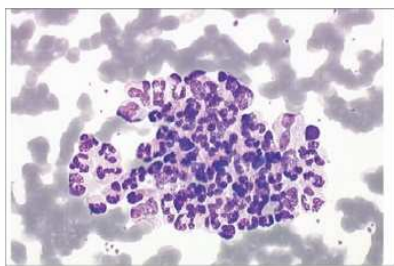
### Leukocyte Aggregation In Vitro as a Cause of Pseudoleukopenia

Dagan Yang, MS, Xichao Guo, BS, Yu Chen, MD, Genyun Xu, BS

**Table 1 Case 1 Complete Blood Cell Count Results**

Items	Immediately	2.5 min	5.0 min	7.5 min	15 min	After 37°C, 5 min
White blood cell count ( $10^9/L$ )	5.7	4.4	3.5	3.2	3.0	6.0
Neutrophils ( $10^9/L$ )	3.7	2.4	1.6	1.2	0.8	3.9
Lymphocytes ( $10^9/L$ )	1.7	1.7	1.7	1.7	1.8	1.8
Red blood cell count ( $10^{12}/L$ )	4.49	4.43	4.11	4.21	4.35	4.97
Hemoglobin (g/L)	146	148	146	148	148	148
Platelet count ( $10^9/L$ )	379	359	362	368	374	356
Mean channels of neutrophil volume	157	178	179	180	180	154
Neutrophil volume distribution width	29.34	48.17	51.31	48.26	50.21	22.85

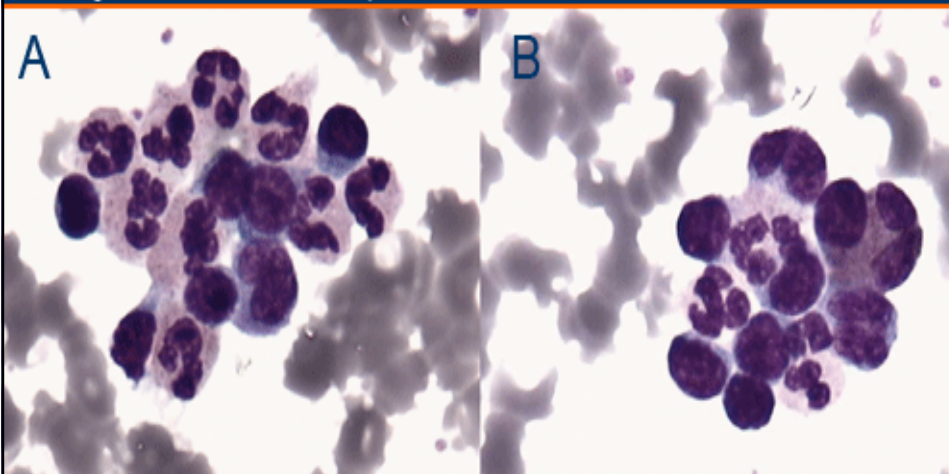
## Leucopenia spuria con prevalente coinvolgimento dei neutrofili



## Leucoagglutinazione mista

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Source: Lab Med © 2008 American Society for Clinical Pathology

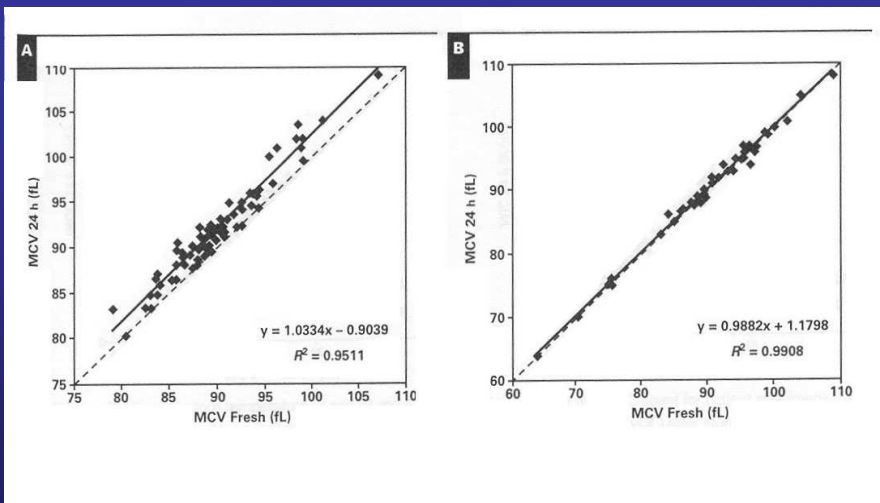
# TEMPO E TEMPERATURA DI CONSERVAZIONE

## STORAGE AND STABILITY (EDTA ANTICOAGULATED BLOOD)

### HOURS AFTER COLLECTION

	ROOM TEMPERATURE (18-22°C)	REFRIGERATED (4°C)
BLOOD SMEAR	2 (6)	12 (3,5) -24 (4)
COMPLETE BLOOD COUNT	6 (2,3)	24 (4)
DIFFERENTIAL COUNT	6 (2,3)	24 (4)
RETICULOCYTES	6 (1)	72 (1)

*1) NCCLS H44-A2, 2002; 2) ICSH, 1993; 3) NCCLS H35-P, 1989;  
4) WOOD, 1999; 5) LLOYD, 1982; 6) HOWEN, 2000*



FROM WOOD et al. AJCP 1999

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Stability of hematological analytes depends on the hematology analyser used: A stability study with Bayer Advia 120, Beckman Coulter LH 750 and Sysmex XE 2100

Fatime Imeri<sup>a</sup>, Roberto Herklotz<sup>a</sup>, Lorenz Risch<sup>b,c</sup>, Christine Arbeitsleitner<sup>d</sup>, Manfred Zerlauth<sup>d</sup>, Gerhard M. Risch<sup>d</sup>, Andreas R. Huber<sup>a,\*</sup>

**Table 1**  
Relative average deviations for erythrocytes, reticulocytes, hemoglobin and MCV between baseline and the storage times (4 h up to 72 h) at 4 °C and RT

Parameter (CV%)	Analyser temperature [°C]	ΔX					Stable until [h]
		4 h [%]	10 h [%]	24 h [%]	48 h [%]	72 h [%]	
<i>Erythrocytes (1.16)</i>							
Sysmex XE 2100	RT	0.14	0.13	0.30	0.26	0.33	72
	4	-0.03	0.10	0.02	-0.15	0.09	72
Advia 120	RT	-0.34	-0.21	-0.15	-1.03	-1.51	48
	4	-0.52	-0.46	-0.33	-0.19	-0.04	72
LH 750	RT	0.50	0.07	-0.07	-0.28	-0.26	72
	4	0.32	0.16	-0.20	-0.11	0.03	72
<i>Reticulocytes# (14.1)</i>							
Sysmex XE 2100	RT	-2.09	-5.08	-11.61	-7.12	14.47	48
	4	1.87	3.98	1.50	-0.30	-3.18	48
Advia 120	RT	-6.30	-5.61	-37.59	-63.81	-65.69	10
	4	1.39	0.45	1.34	6.27	-2.07	72
LH 750	RT	0.71	-1.29	-12.77	5.53	100.30	48
	4	0.15	-1.37	10.45	11.65	17.79	72
<i>Hemoglobin (0.92)</i>							
Sysmex XE 2100	RT	-0.12	0.03	-0.21	-0.31	0.06	72
	4	-0.31	-0.18	-0.24	-0.27	-0.11	72
Advia 120	RT	-0.01	-0.05	-0.06	0.26	-0.19	72
	4	-0.59	-0.31	-0.05	-0.39	0.38	72
LH 750	RT	0.28	0.03	0.10	-0.02	-0.05	72
	4	0.06	0.06	0.11	0.04	0.45	72
<i>MCV (0.49)</i>							
Sysmex XE 2100	RT	0.35	2.15	8.97	16.41	21.00	4
	4	-0.04	0.35	0.44	1.27	2.40	48
Advia 120	RT	0.17	1.93	7.78	11.74	12.84	4
	4	-0.25	0.33	0.84	1.67	2.52	24
LH 750	RT	0.58	0.96	2.39	5.09	6.12	10
	4	0.15	0.34	0.32	0.57	0.87	72

**Table 2**  
Relative average deviations for leukocytes, neutrophils, monocytes and lymphocytes between baseline and the storage times (4 h up to 72 h) at 4 °C and RT

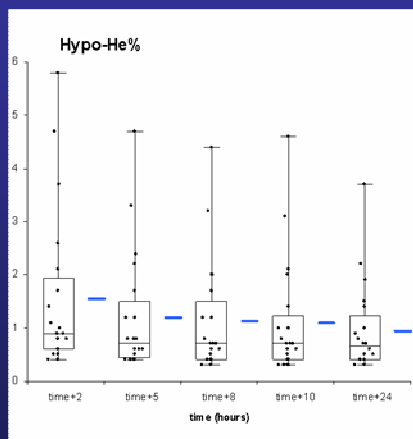
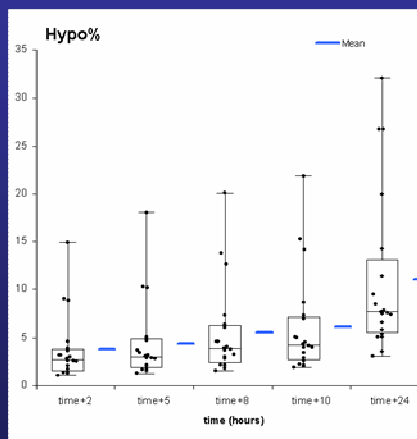
Parameter (CV%)	Analyser temperature [°C]	ΔX					Stable until [h]
		4 h [%]	10 h [%]	24 h [%]	48 h [%]	72 h [%]	
<i>Leukocytes (2.59)</i>							
Sysmex XE 2100	RT	-0.91	-0.87	-1.75	-3.71	-4.64	24
	4	-1.30	-1.11	-0.84	-0.52	-1.71	72
Advia 120	RT	1.59	1.95	0.13	-1.06	-5.14	48
	4	1.99	2.66	1.11	1.65	0.76	72
LH 750	RT	-0.40	0.35	-1.03	-1.88	-0.64	72
	4	-0.42	-0.96	-0.60	-1.00	-1.55	72
<i>Neutrophils# (3.37)</i>							
Sysmex XE 2100	RT	-0.62	0.48	0.50	0.87	2.64	72
	4	-0.85	0.00	0.38	1.28	1.35	72
Advia 120	RT	1.32	2.26	0.15	-2.13	-1.20	72
	4	1.03	2.08	1.14	1.94	3.95	48
LH 750	RT	-0.30	1.23	5.27	2.40	10.26	10
	4	0.88	2.84	6.07	8.79	9.37	10
<i>Monocytes# (9.30)</i>							
Sysmex XE 2100	RT	-2.73	-4.82	-8.14	-24.99	-27.54	24
	4	1.51	-2.88	-2.01	-2.56	-8.50	48
Advia 120	RT	4.21	9.47	37.31	36.58	31.05	10
	4	-0.42	6.40	18.09	21.93	21.43	10
LH 750	RT	-4.71	-13.56	-28.72	-62.02	-77.65	4
	4	-6.15	-11.12	-17.89	-38.27	-39.75	4
<i>Lymphocytes# (4.30)</i>							
Sysmex XE 2100	RT	-0.99	-1.91	-3.60	-5.11	-7.90	24
	4	-1.82	-2.41	-1.85	-2.27	-3.33	72
Advia 120	RT	2.10	0.71	-3.63	-5.01	-14.20	24
	4	1.25	1.47	-1.17	-4.03	-6.61	24
LH 750	RT	0.34	-1.28	-1.45	6.13	4.56	24
	4	-1.46	-4.79	-6.83	-7.31	-8.36	4

**Table 3**

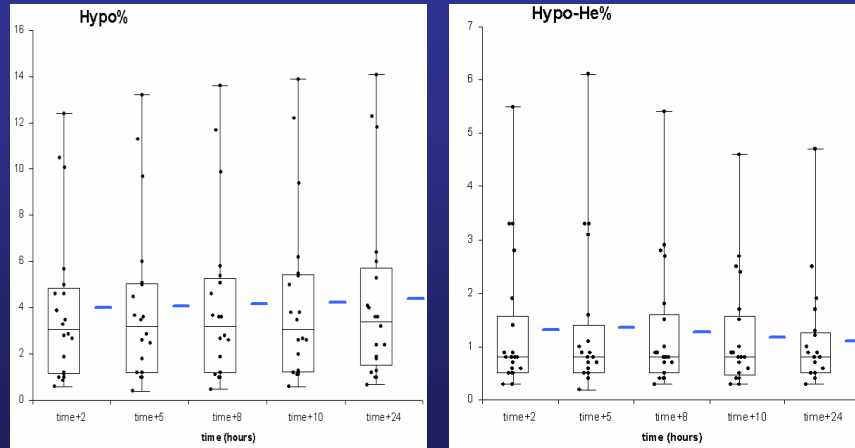
Relative average deviations for thrombocytes between baseline and the storage times (4 h up to 72 h) at 4 °C and RT

Parameter (CV%)	Analyser temperature [°C]	$\Delta X$					Stable until [h]
		4 h [%]	10 h [%]	24 h [%]	48 h [%]	72 h [%]	
<i>Thrombocytes (3.62)</i>							
Sysmex XE 2100	RT	2.87	3.38	1.17	-0.68	-5.83	48
	4	2.09	4.12	3.34	2.13	1.60	4
Advia 120	RT	1.87	1.75	-2.51	-9.95	-11.57	24
	4	2.08	3.40	2.35	2.18	0.40	72
LH 750	RT	0.04	-1.05	-1.35	-4.47	-7.96	24
	4	0.32	-0.18	-2.90	-4.19	-4.64	24

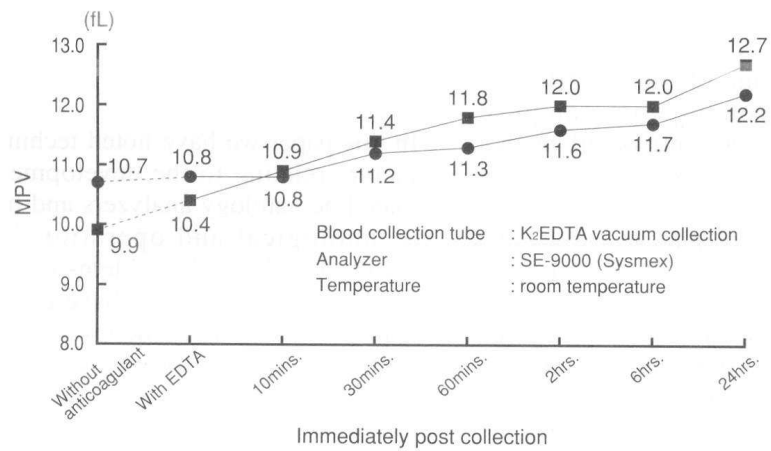
## STABILITÀ NEL TEMPO A TEMPERATURA AMBIENTE

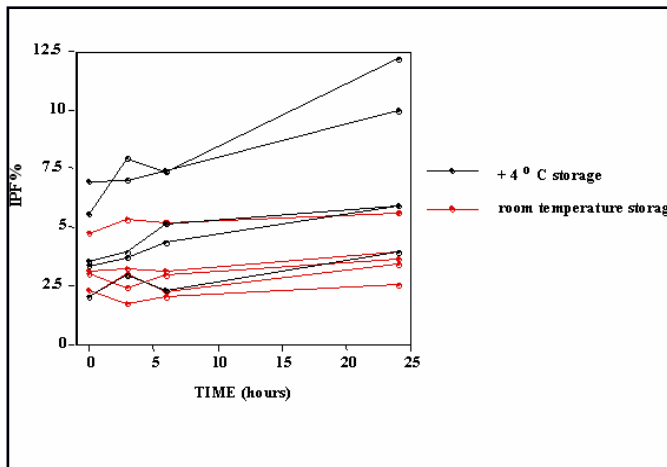


## STABILITÀ NEL TEMPO A 4° C



## RELAZIONE TRA MPV E TEMPO DI CONSERVAZIONE

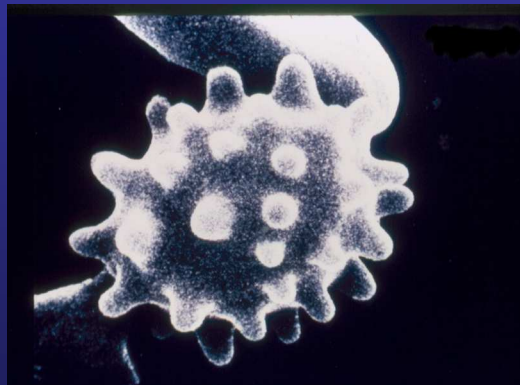
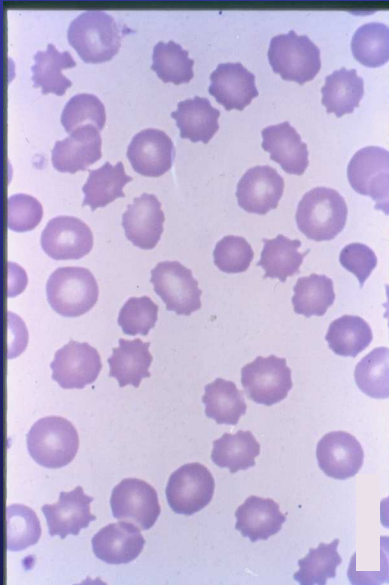




Time (Room)	Mean	P	+ 4°C Mean	P
0	3.02	-	4.24	-
3	3.12	NS	5.08	NS
6	3.08	NS	5.28	0.01
24	3.80	0.01	7.54	0.01

Fig 2c

Campione conservato 24 ore in EDTA: echinocitosi



# TRASPORTO DEL CAMPIONE

## Effects of a Pneumatic Tube System on Routine and Novel Hematology and Coagulation Parameters in Healthy Volunteers

*Alexander Kratz, MD, PhD, MPH; Raneem O. Salem, PhD; Elizabeth M. Van Cott, MD*

*Conclusions.*—Although further study regarding the mean platelet component may be required, transport through a pneumatic tube system has no clinically significant effect on hematology and coagulation results obtained with certain modern instruments in blood samples from healthy volunteers.

*(Arch Pathol Lab Med. 2007;131:293-296)*

## Preanalytical effects of pneumatic tube transport on routine haematology, coagulation parameters, platelet function and global coagulation

Olof Wallin\*, Johan Söderberg, Kjell Grankvist,  
P. Andreas Jonsson and Johan Hultdin  
Department of Medical Biosciences, Clinical  
Chemistry, Umeå University, Umeå, Sweden

**Conclusions:** Pneumatic tube transport does not introduce preanalytical errors when transporting samples for analysis of routine haematology, coagulation parameters and platelet function with the PFA-100®. We recommend manual transport of samples for analysis with thromboelastographic techniques.  
Clin Chem Lab Med 2008;46:1443–9.