# How to interpret medical test results (Haematology).

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# Looking at Laboratory Results

- Dr or consultant who requested the test.
- Date (and time) Sample taken
- Date (and time) Sample received in lab
- Date (and time) Report issued

- Signature or initials of who approved report and entered any specific comments.

# Basic Haematology Test Range (1)

- Full Blood Count
  - basic parameters
  - WBC differential
  - blood film comments/flags
  - comments of lab staff
- Other related tests
  - reticulocyte count
  - ESR
  - glandular fever “monospot”
- Hb Electrophoresis
  - studies for haemolytic anaemia
- Blood Group & Antibody Screen

# Basic Haematology Test Range (2)

- Coagulation Screen
  - PT/INR
  - APTT (APTT Ratio)
  - TT
  - fibrinogen
  - D-dimer
- Thrombophilia Screen
- Coagulation Factor Assays

# Blood Count Normal Adult Ranges

| | |
|---|---|
| Hb | 13.0-18.0 (F 11.5-16.0) g/dl |
| HCT | 0.40-0.50 (F 0.38-0.47) |
| MCV | 80-100 fl |
| | |
| WBC | 4.0-11.0 x $10^9$/l |
| Neutrophils | 2.0 - 7.5 |
| Lymphocytes | 1.5 - 4.0 |
| Monocytes | 0.2 - 0.8 |
| Eosinophils | 0.04 - 0.4 |
| Basophils | <0.2 |
| | |
| Platelets | 150-400 x $10^9$/l |
| MPV | 8-11 fl |
| | |
| Reticulocytes | 0.2 – 2.0% |
| ESR | 0 – 10 mm/hr |

THE DOCTORS LABORATORY

**TDL PATHOLOGY REPORT**
60 Whitfield Street, London W1T 4EU
Telephone: 020 7307 7171
Fax: 020 7307 7374
E-mail: tdl@tdlpathology.com
Website: www.tdlpathology.com

Request received : 10/08/12
Sample dated : 10/08/12 Time: 10

PROFESSOR S.J. MACHIN
60 WHITFIELD STREET
LONDON
.
W1T 4EU

**Lab Ref No. : 12T415214**
**Reference :**
**Ward :**
**Fax copy to :**

| | | | | |
|---|---|---|---|---|
| HAEMATOLOGY | | | | |
| HAEMOGLOBIN | 14.5 | | g/dL | 13.0 - 17.0 |
| HCT | 0.429 | | | 0.37 - 0.50 |
| RED CELL COUNT | * 4.19 | | x10^12/L | 4.40 - 5.80 |
| MCV | * 102.4 | | fL | 80 - 99 |
| MCH | * 34.6 | | pg | 26.0 - 33.5 |
| MCHC | 33.8 | | g/dL | 30 - 35 |
| RDW | * 15.2 | | | 11.5 - 15.0 |
| PLATELET COUNT | * 546 | | x10^9/L | 150 - 400 |
| MPV | 10.2 | | fL | 7 - 13 |
| WHITE CELL COUNT | 6.70 | | x10^9/L | 3.0 - 10.0 |
| Neutrophils | 61.4% | 4.11 | x10^9/L | 2.0 - 7.5 |
| Lymphocytes | 25.7% | 1.72 | x10^9/L | 1.2 - 3.65 |
| Monocytes | 10.1% | 0.68 | x10^9/L | 0.2 - 1.0 |
| Eosinophils | 2.2% | 0.15 | x10^9/L | 0.0 - 0.4 |
| Basophils | 0.6% | 0.04 | x10^9/L | 0.0 - 0.1 |
| BLOOD FILM REPORT | Macrocytic<br>Anisocytosis<br>Platelet count verified by film.<br>Suggest Haematinic studies. | | | |
| ESR | 4 | | mm/hr | 1 - 20 |
| | Note ref range raised in patients over 40 | | | |

FC

Authorised by:Clinical Pathology, TDL

Printed Fri 10/08/12 15:11

# Case A

- 36yr old Caucasian male
- visual disturbance
- 42yrs  dizziness, headache + nystagmus ?labyrinthitis
- 43yrs haematuria, raised BP

Referred ENT surgeon

# Case A cont..

- Hb 14.6
- MCV 87

- WBC 6.9
- Normal differential
- Platelets 68**
- ESR 35**

Film comment : Genuine thrombopenia with occasional giant platelets.

Phoned GP to discuss, no-one available-left message – stamp in records says “dealt with”.

# Case A cont….

- no follow up of abnormal FBC
- treated by ENT
- 2yrs later repeat FBC by GP

| | |
|---|---|
| Hb | 14.0 |
| WBC | 11.45 |
| Platelets | 31** |

Referred to A&E

continuing haematuria + now purpura on arms

# Case A ……

- Investigations show diagnosis of SLE
- visual disturbances have continued with associated personality changes affecting his employment
- MRI brain scan shows multiple arterial small infarcts

# Case B

GP FBC result, routine.

Caucasian female 54yrs

| | |
|---|---|
| Hb | 12.5 |
| HCT | 0.37 |
| MCV | 101** |
| | |
| WBC | 4.99 |
| Platelets | 262 |

GP noted slightly raised MCV and discussed possible excess alcohol intake as a contributing factor

# Case B cont..

2yrs later repeat FBC, patient just returned from 4 weeks holiday at altitude.

| | |
|---|---|
| Hb | 14.1 |
| HCT | 0.44 |
| MCV | 112** |
| WBC | 5.35 |
| Platelets | 354 |

Film comment – macrocytosis ++, vit $B_{12}$, folate normal : reticulocytes 6%

# Case B cont….

2 yrs later again, chest pain

| | |
|---|---|
| Hb | 20.5** |
| HCT | 0.65** |
| MCV | 102** |
| | |
| WBC | 10.1 |
| Platelets | 310 |
| Reticulocytes | 1% |

MI on investigation.Raised Hb diagnosed as primary polycythemia rubra vera (PRV)

Could this have been predicted from FBC's over previous 4 yrs????

# PT

The PT test (secs) is always compared to a control plasma sample with a normal range.

| | |
|---|---|
| PT | = 13 secs |
| Control | = 12 secs |
| Normal Range | = 11-14 secs |

# Warfarin 2012

- cheap; widely available for 50+ years
- narrow therapeutic window
- numerous food/drug interactions
- high morbidity rates; mainly bleeding, teratogenic
- clinical use widely recognised, numerous guidelines etc
- monitoring and reversal reasonably defined
- different methods of service delivery
- documentation for patient, clinic and lab extremely variable

# INR

For Warfarin control, the PT result is always expressed as an International Normalised Ratio (INR)

| | |
|---|---|
| Normal INR | 0.8-1.2 |
| Overall therapeutic range | 2.0-4.5 |

Usually for warfarin control an INR target with desired range is stated.

| | |
|---|---|
| INR target | 2.5 |
| Desired range | 2.0-3.0 |

# CASE 1

- 76 m, acute upper GI bleed
- On W for AF, 5 yrs, INR 2.0-3.0
- Yellow book, INR 2.7 5 wks before on 6mg W (stable on dose 9 mths)
- Resuscitation blood, FFP, gastrectomy as INR 9.0, Hb 5.3
- Pharmacist 5wks before prescribed on label 2x3mg tablets daily
- However 5mg pink tabs in bottle

# CASE 2

- 60yrs m, long term W mechanical mitral valve, INR 2.0-3.0 range
- Control erratic, hypertension, epistaxis, TIA's
- Previous 4 clinic visits every 3wks:- 2.5, 7mg:- 2.2,7.5mg:-2.1,7.5mg:-1.9,7.5mg
- Going to France, drinking more
- 17 days later admitted extensive arterial stroke INR 1.6

# CASE 3

- 30yrs Ind F, on long term W metallic mitral valve
- Erratic attendee at clinic, issued yellow book, INR 3.0-4.0 range
- Last clinic 6mths earlier stable at 3.4
- Next visit 4mths pregnant, after counselling had elective termination
- 1yr later solicitors issue proceedings failure to warn risks of W during pregnancy

# CASE 4

- 30yrs F on W post cardiac surgery for septal defect
- GP gets 2 separate discharge forms with different stated INR levels of first 2.5-3.5,then 2.0-3.0
- 1wk later INR 2.3, GP increases W from 10 to11mg daily
- 1wk later INR 7.1, W stopped, 2 days later headache, admitted pm INR 3.5
- No scan available, next morning found dead, massive intracerebellar bleed

# Risk Assessment
# Anticoagulant Treatment Process

- The NPSA contacted the medical and pharmacy defence organisations as well as the NHS Litigation Authority
- There have been 480 reported cases of harm or near harm from the use of anticoagulants in the UK from 1990-2002.
- In addition there have been 120 deaths reported over the same time period
- Deaths from the use of warfarin is responsible for 77% (92 reports) and heparin is responsible 23% (28 reports)

# Alert 18: Actions That Can Make Anticoagulant Therapy Safer

NHS
National Patient Safety Agency

**Patient safety alert** 18

**Alert**

28 March 2007

| | |
|---|---|
| Immediate action | ☐ |
| Action | ☑ |
| Update | ☐ |
| Information request | ☐ |

Ref: NPSA/2007/18

**Actions that can make anticoagulant therapy safer**

Anticoagulants are one of the classes of medicines most frequently identified as causing preventable harm and admission to hospital[1-3] Managing the risks associated with anticoagulants can reduce the chance of patients being harmed in the future.

This patient safety alert has been developed in collaboration with the British Society for Haematology (BSH) and a broad range of other clinical organisations and individual clinicians, patients and patient groups.

**Action for the NHS and the independent sector**

The National Patient Safety Agency (NPSA) is recommending that NHS and independent sector organisations in England and Wales take the following steps:

1 Ensure all staff caring for patients on anticoagulant therapy have the necessary work competences. Any gaps in competence must be addressed through training to ensure that all staff may undertake their duties safely.

2 Review and, where necessary, update written procedures and clinical protocols for anticoagulant services to ensure they reflect safe practice, and that staff are trained in these procedures.

3 Audit anticoagulant services using BSH/NPSA safety indicators as part of the annual medicines management audit programme. The audit results should inform local actions to improve the safe use of anticoagulants, and should be communicated to clinical governance, and drugs and therapeutics committees (or equivalent). This information should be used by commissioners and external organisations as part of the commissioning and performance management process.

4 Ensure that patients prescribed anticoagulants receive appropriate verbal and written information at the start of therapy, at hospital discharge, on the first anticoagulant clinic appointment, and when necessary throughout the course of their treatment. The BSH and the NPSA have updated the patient-held information (yellow) booklet.

5 Promote safe practice with prescribers and pharmacists to check that patients' blood clotting (International Normalised Ratio, INR) is being monitored regularly and that the INR level is safe before issuing or dispensing repeat prescriptions for oral anticoagulants.

- Training and work competences
- Review procedures
- Use safety indicators
- Better information for patients
- INR checks by prescribers and dispensers
- Guidance for dental practitioners
- Standardise range of anticoagulant products
- Safe procedures in care homes

# Feedback from patients – Anticoagulation Europe

- 65% of patients do not remember receiving a leaflet or seeing a video
- 18% did not understand the importance of regular monitoring
- 36% never provided with information on interactions or food or drink
- 26% did not realise they should not take aspirin or aspirin based products

# Feedback from patients – Anticoagulation Europe

- 1 in 4 patients say they regularly miss a dose
- 22% say they have taken wrong dose at least twice in the last year
- 37% had their dose changed 8 times or more in the last year
- 33% received no explanation why their dose was changed

# Case H

- May 2006, 35yrs, female, Caucasian, 2 children a&w.
- Diagnosed narrow complex tachycardia with atrial flutter then recurrent AF.
- non-smoker, alc. Soc, exercise average, no personal/family history thrombosis

# Case H cont..

- Cons →GP, being anticoagulated INR 2.0-3.0, needs to be stably AC for at least 3 wks before cardioversion.

| | |
|---|---|
| 8/6/06 | 1.5 |
| 13/6/06 | 1.7 |
| 22/6/06 | 2.2 cardioverted |
| 25/7/06 | warfarin stopped |

# BCSH Guidelines 2005 (BJHaem 132, 277-285)

- a target INR of 2.5 is recommended for 3 wks before and 4 wks after cardioversion. To minimise cancellations due to low INR on the day, a higher target of 3.0 can be used prior to the procedure

# Case H cont…

- July 2007 referred Univ. cardiologist
- because paroxysmal atrial arrhythmia, ablation was planned with a trans thoracic echo.
- TTE showed a grossly dilated L atrium, ablation cancelled as risk of thromboembolism too high
- restarted Warfarin and ablation rebooked 4 wks later

# Case H cont….

- 26/7/06 10mg W referred to GP then 5mg daily

| | |
|---|---|
| 28/7 | 1.8 |
| 31/7 | 2.6 |
| 03/8 | 2.8 |
| 07/8 | 2.6 |
| 13/8 | 2.0 |
| 03/9 | next appt booked |

# Case H cont…..

- 24/8/07 Day case INR 1.3
- TOE showed NO thrombosis but large L atrium + R atrium
- cardioverted into sinus rythmn, that evening stable, 5mg W, discharged home 25/8/07
- received Heparin (10.30 & 11.40hrs) to cover procedure, reversed by Protamine (13.18hrs)

# Case H cont….

- 26/8/07 saw GP as emergency, pain in R thigh/groin
- felt due to nerve irritation at site of catheter insertion; reassured, no INR done but continuing on 5mg W daily

- collapsed 6am 28/8/07 : DIED massive PE

# Post Mortem

- PM cause of death
  1. (a) occlusion of left coronary artery by a thromboembolus

     (b) atrial fibrillation and cardiac catherisation procedure on 24/8/07 and contributing conditions were
  2. hypertrophic cardiomyopathy.

# Examination of heart

*both atria were mildly dilated and hypertrophic. There were small residue of thrombi in the left atrial appendage not adhering. The trunk of the left main coronary artery was completely blocked by a non-adherent irregularly shaped thrombus. Sections from the thrombus retrieved from the left atrial appendage and the left main coronary artery both show very early but definite organising thromi.*

# LEGAL POINTS (Discuss)

1. Was inadequate anticoagulation responsible for her death 4 days after ablation?
2. What would or should her INR have been on 26/8, 27/8 and 6am 28/8?
3. Should she have been referred back to her GP for anticoagulant control (it was a rural practice)?
4. Communication between consultant and anticoagulant clinic seemingly FAILED. Why?

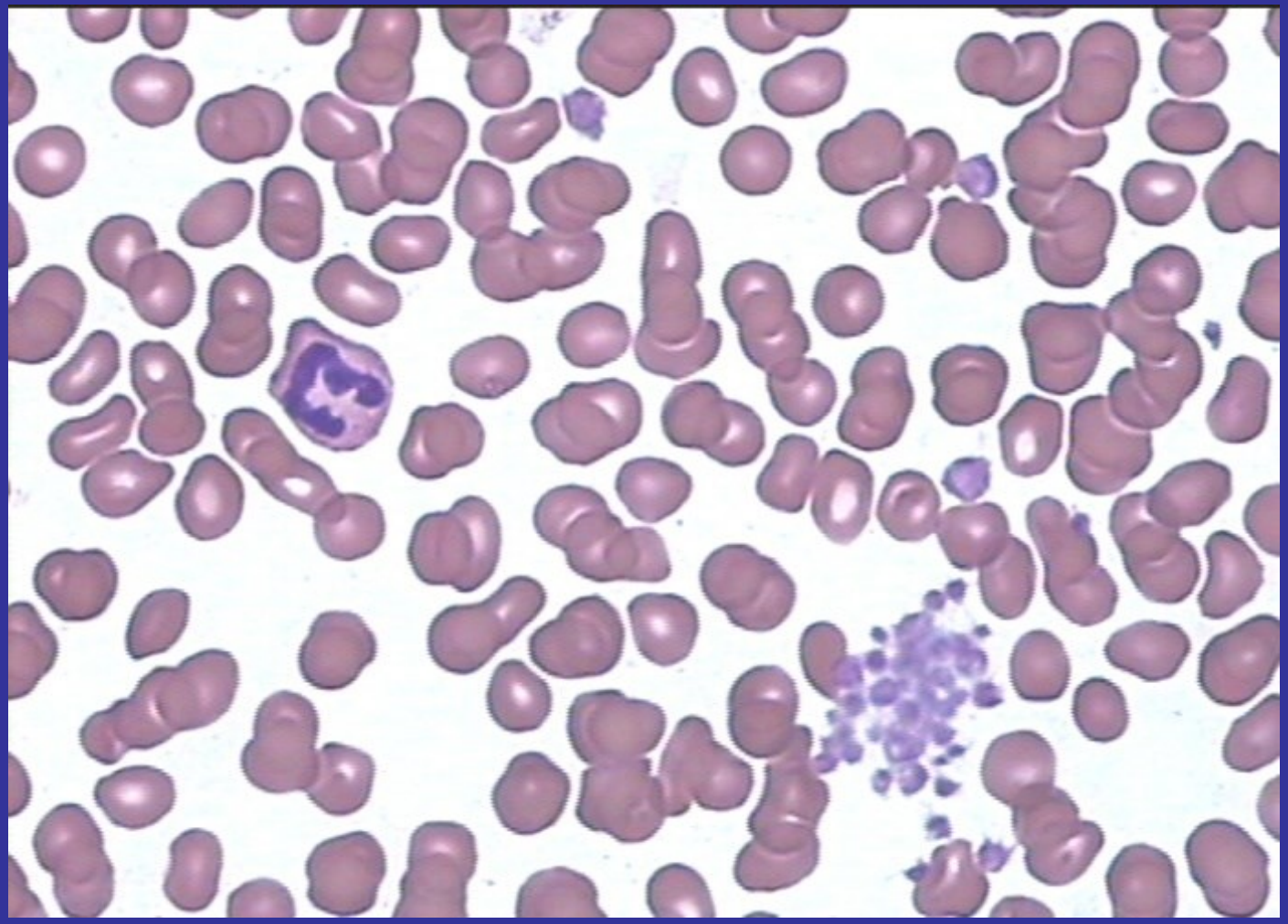
# Clinical Presentation Case X

- March 2009: a 79-year-old man went to hematological consultation for anemia.
- Clinical history reported surgical removal of epithelioma of the thorax in 2003.
- He also assumed antihypertensive drugs.
- A previous FBC 4yrs ago was “normal”
- No detectable organomegaly.
- No lymph node enlargement.

# Automated Full blood count

| | | | |
|---|---|---|---|
| Hb | | 10.1 g/dl | |
| WBC | | 7.7 x $10^9$/l | |
| Platelets | | 228 x $10^9$/l | |
| RBC | | 2.92 x $10^{12}$/l | |
| MCV | | 104.2 fl | |
| Neutrophils | 59% | 4.54 x $10^9$/l | (1.8 – 8.0) |
| Eosinophils | 4.2% | 0.32 x $10^9$/l | (0.04 – 0.5) |
| Lymphocytes | 21.1% | 1.62 x $10^9$/l | (1.0 – 4.0) |
| Basophils | 1.8% | 0.13 x $10^9$/l | (0.0 – 0.10) |
| Monocytes | 13.5% | 1.03 x $10^9$/l | (0.2 – 0.8) |

# PB smear



# PB Smear

The blood film showed mild macrocytosis.

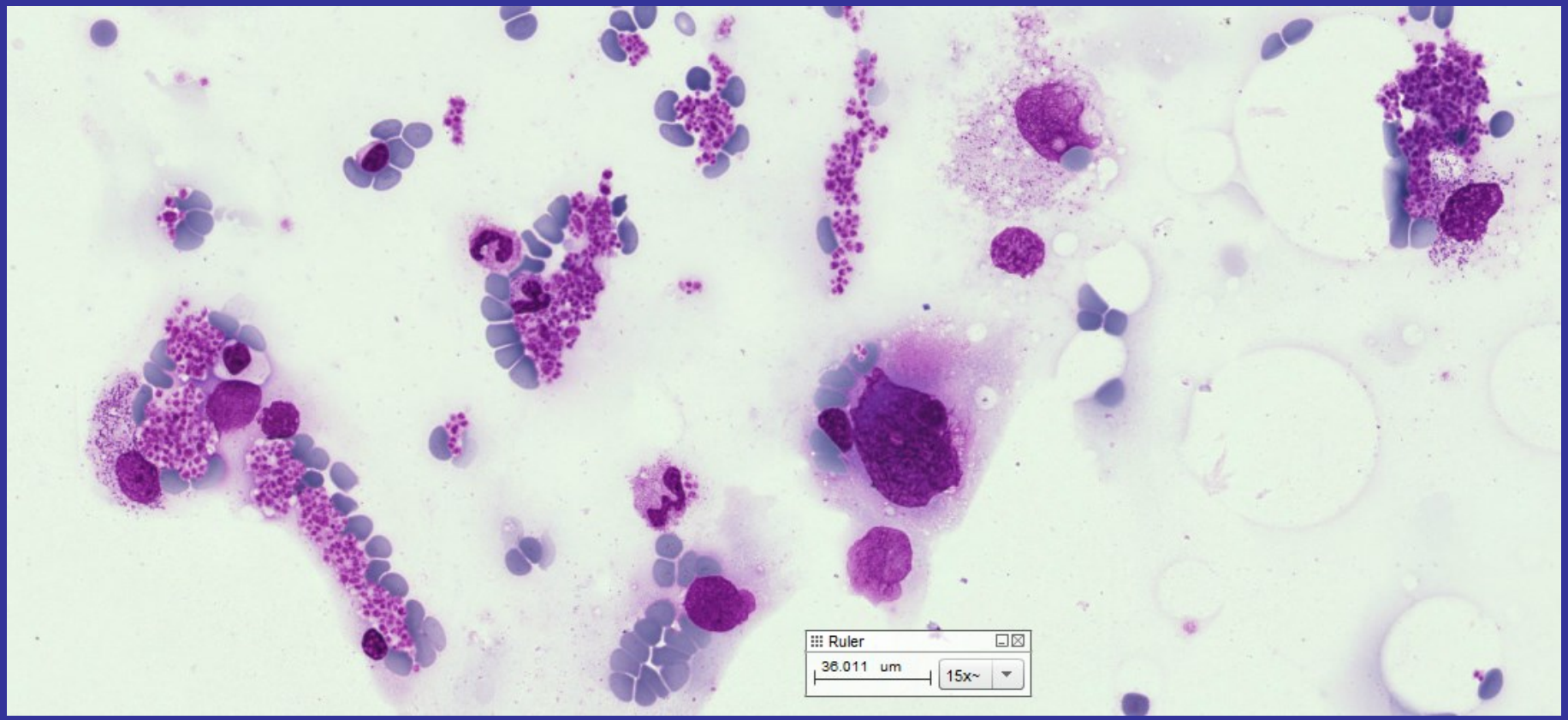
Hypo/agranular neutrophils 5%.

Several medium to large platelet clumps:

- underestimated platelet count.

Platelet count in sodium citrate: 678 x $10^9$/l

# Bone marrow aspirate smear: MGG (II)



# Bone marrow report

Hypercellular bone marrow.

Megakaryocytes increased in number, large, atypical.

Dyserythropoiesis >10%

Unremarkable granulocyte morphology.

Blasts 3%.

Increased iron stores.

Ring sideroblasts > 15% (~60%).

# OUTCOME

- probable that FBC 3yrs before had given an erroneous platelet count
- had developed essential thrombocythemia with acquired defects in iron metabolism

# CONCLUSION

- retrospectively critically analysing and understanding laboratory reports is often challenging and sometimes “impossible”
- nowadays laboratories do not always issue a printed report
- access to the laboratory IT computer records is often not readily available
- experts inspection of released medical records often does not include all laboratory reports