Haematology Practical Manual for Undergraduates

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The laboratory diagnosis of disorders in relation to red cell, white cell, haemostasis and aspects of transfusion medicine are discussed in a practical approach. Case studies form part of the integral approach to understand haematological diseases.

This book is a 'must' for the desk of a students in laboratory aspects of haematology.

Keywords: Haematology, transfucion, red cell, white cell, haemostasis

HAEMATOLOGY
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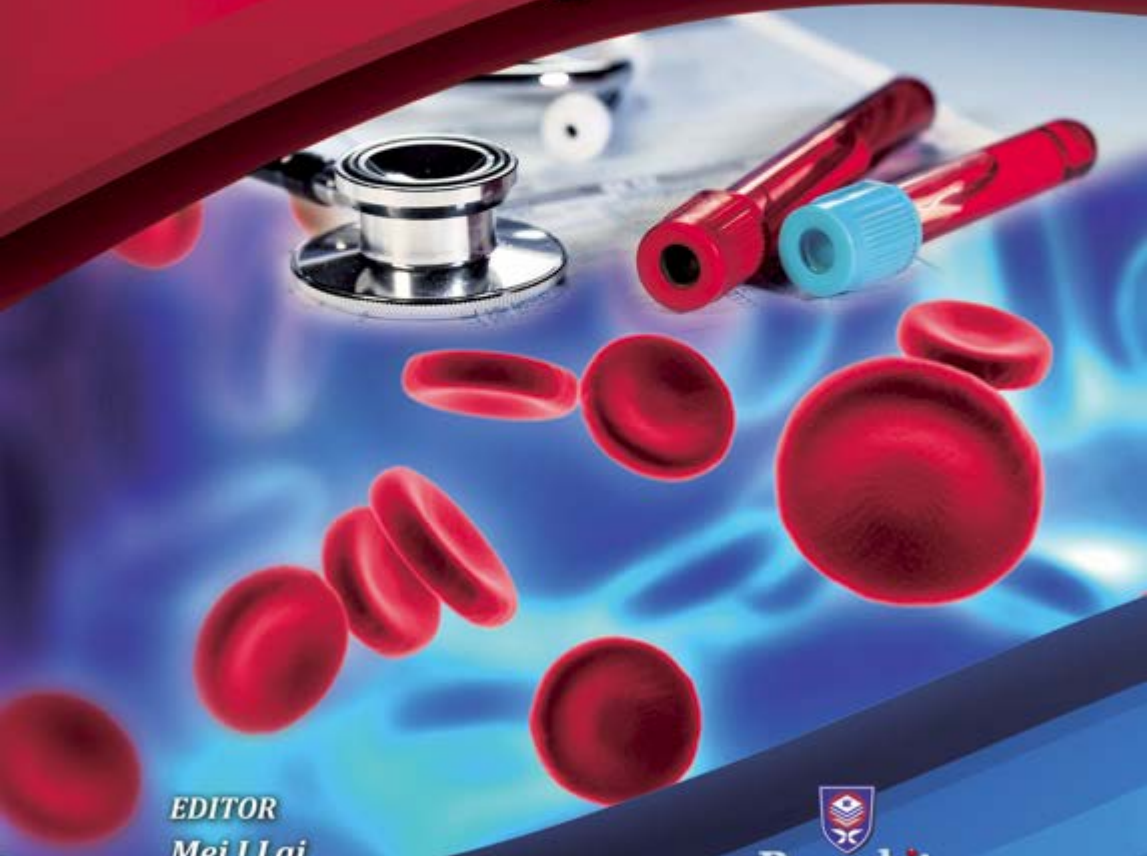

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Preface

This book "Haematology Practical Manual for Undergraduates" is intended to serve as a practical aid for students and an attempt to present haematology and transfusion medicine in a concise and simplified manner where areas of importance are highlighted. It is not aimed to replace for coverage of haematology available in text books but intended to assist students in understanding the laboratory aspects of haematology better. The reader should not expect to find comprehensive discussions of the topics dealt herein but importance of each laboratory test is highlighted including its practical aspects.

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This book is a `must` for the desk of a student in laboratory aspects of haematology.

Appreciation

"A journey of a thousand miles begins with the first step"

On that note, we would like to thank these individuals who have put their trust in us and are very supportive along the journey in making this book a reality.

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- Our students (past, present and future) for whom this book is meant for.

Our warmest appreciation and gratitude to everyone whom we may have not listed but trust us that your contribution is already counted by the Supreme being. May the Lord of the Universe accept our tiny contribution in educating His mankind.

Eusni Rahayu Mohd. Tohit
Head, Haematology Unit

Abbreviations & Symbols

β	beta
AA	arachidonic acid
ADP	adenosine diphosphate
Ag	antigen
AHG	antihuman globulin
AIHA	autoimmune haemolytic anaemia
APTT	activated partial thromboplastion time
BCB	brilliant cresyl blue
BM	bone marrow
BMA	bone marrow aspirate
BMT	bone marrow trephine
$CaCl_2$	calcium chloride
CBA	collagen binding assay
CCC	Coombs control cells
CML	chronic myeloid leukaemia
DAT	direct antiglobulin test
DCT	direct Coombs test
DIC	disseminated intravascular coagulation
dL	deciliter
DNA	deoxyribose nucleic acid
EDTA	Ethylenediaminetetraacetic acid
ESR	erythrocyte sedimentation rate
F	factor
FBC	full blood count
FBP	full blood picture

Red Blood Cells (RBC)

Elizabeth George and Mei I Lai

Introduction

In evaluating RBC (erythrocyte) disorders, it is necessary to have quantitative measurements of blood cells and to do an evaluation of a peripheral blood smear. The reticulocyte count is an indicator of the functional response of the bone marrow to anaemia. In some patients, a bone marrow study, biochemistry studies and more specialised tests are required.

The measurements of the RBC count, haematocrit (Hct) and haemoglobin (Hb) concentration are performed by an automated blood counter.

The Hb and Hct are used as indicators of the severity of the anaemia. The RBC indices, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC) are used mathematically to define cell size and concentration of Hb within the RBC.

Table 1: Description of MCV, MCH, MCHC and RDW.

Indices	Description	Calculation/Estimation
MCV	Average volume of a single RBC	Hct/RBC count = fL
MCH	Average Hb amount/concentration in each RBC	Hb (X10 g/dL) /RBC count = pg
MCHC	Average amount/concentration of Hb in a given volume of packed cells.	Hb/Hct = g/dL
RDW	Describes red blood cell distribution width and red cell anisocytosis.	SD of MCV / MCV x 100

- RDW = red cell distribution width, SD = standard deviation

Results and Interpretation

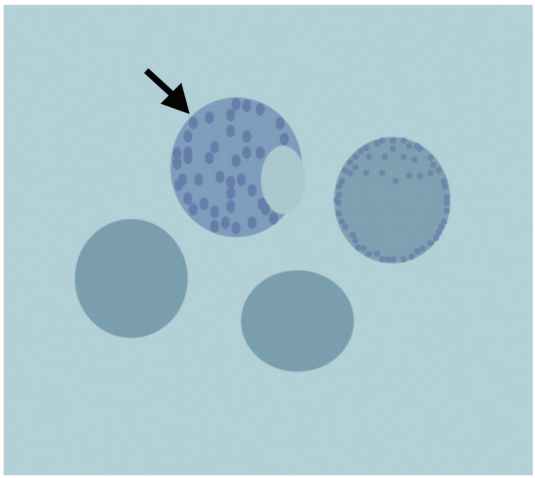

Figure 5: 'H' inclusions. 'H' inclusions are multiple blue-purple granules distributed in the RBCs that can be seen in Hb H disease.

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White Blood Cells (WBC)

Sabariah Md. Noor and Zainina Seman

Introduction

Clinical histories, physical examinations and laboratory investigations are important diagnostic formulations in a patient's care. Assessment of the WBC differential count and morphology are the fundamentals in screening, diagnosis and monitoring of disease progression and therapeutic response. Its diagnostic relevance has not been lessened by advances in haematology automation and molecular techniques. Additional supportive and diagnostic tools like bone marrow aspirate morphology and cytochemical staining are important to establish certain diagnosis.

At the end of the WBC section, students should be able to

a) Use the appropriate terms to describe various quantitative WBC abnormalities.

b) Relate quantitative WBC abnormalities to their possible causes.

c) Recognise the normal WBC subsets.

d) Recognise the pathological changes seen in WBC morphology.

e) Differentiate common diseases affecting WBCs.

f) Understand the importance of bone marrow examinations and different cytochemical staining used in diagnosing some WBC disorders.

White Blood Cell Morphology

Introduction

WBCs also known as leucocytes are a group of nucleated blood cells. They defend our body against infection and diseases by ingesting

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Haemostasis

Eusni Rahayu Mohd Tohit

Introduction

Haemostasis, arose from New Latin 'haemo' + Greek 'stasis' (halting). The haemostasis mechanism operates to serve three main functions:

a) To maintain blood in a fluid state.

b) To arrest bleeding at site of injury through the formation of a haemostatic plug.

c) To ensure removal of the plug when healing is complete.

The above is achieved through at least five essential elements in haemostasis;

i) Blood vessels.

ii) Platelets.

iii) Plasma coagulation factors.

iv) Natural inhibitors.

v) Fibrinolytic system.

Normal physiology involves a delicate balance of the system to maintain equilibrium as disturbance in any of the elements mentioned, leads to either bleeding or thrombosis within the body. An investigation of haemostasis is performed due to the following reasons;

a) A patient who is acutely bleeding.

b) A patient with suspected bleeding tendency.

c) As a precaution before any invasive procedure is performed.

d) A patient with history of thrombosis requiring further evaluation.

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Transfusion Medicine

Faridah Idris

Introduction

ABO and RhD blood group system is the most important of all blood groups in transfusion practice. Haemovigilance reports confirm that the majority of life threatening haemolytic reaction is mainly due to ABO incompatibility and clerical errors. Thus the skill of doing accurate ABO and RhD blood grouping is essential to all laboratory staff working in the transfusion service.

The safety of transfusion also relates to antibody detection in the recipient's serum. It is a key process in pre-transfusion compatibility testing. It is one of the principle tools for investigating potential haemolytic transfusion reaction and immune haemolytic anaemia.

The practical section will deal with basic tests which are routinely performed in a transfusion medicine laboratory. It will cover the ABO and RhD blood grouping test using several methods and how to interpret the results. It will also cover the test for pre-transfusion testing including antiglobulin test (or Coombs test), antibody screening, antibody identification and the crossmatching procedure. Exercises and a few case studies on the relevant tests are also included.

At the end of the transfusion medicine section, students should be able to:

a) Understand the theory, perform and interpret the ABO and RhD blood group testing using the tube method.

b) Understand the principle and interpret ABO and RhD blood group testing using a gel card.

c) Understand the principle, perform and interpret antiglobulin test (Coombs test).

d) Understand the principle and interpret simple antibody

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F. Comparison of full blood count parameter between normal and hypochromic microcytic anaemia

	Normal	Iron deficiency	Thalassaemia Major / Intermedia
Red Blood Cell Count (RBC)	normal	↓	↓
Haemoglobin	normal	↓	↓
Haematocrit (HCT) or Packed Cell Volume (PCV)	normal	↓	↓
Mean Corpuscular Volume (MCV)	normal	↓	↓
Mean Corpuscular Haemoglobin (MCH)	normal	↓	↓
Mean Corpuscular Haemoglobin concentration (MCHC)	normal	↓	↓
Red Cell Distribution Width (RDW)	normal	↑	↑

To differentiate the iron deficiency and thalassaemia major or thalassaemia intermedia, a serum ferritin and Hb analysis needs to be done:

	Iron deficiency anaemia	Thalassemia major
Serum ferrtin	<10µg/L	Raised >300 µg/L
Hb Analysis	-	Raised Hb F

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