

A microscopic view of a neonatal blood smear. The background is filled with numerous pale pink, oval-shaped red blood cells. Scattered throughout are several larger, more prominent cells with dark purple nuclei and varying amounts of light purple cytoplasm, representing different types of white blood cells (leukocytes).

# Neonatal Haematology

## A Practical Guide

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Barbara J. Bain

WILEY Blackwell

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# Neonatal Haematology: A Practical Guide

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## Preface

This neonatal haematology guide aims to fill a gap in an important, but often poorly understood, area of diagnostic haematology by focusing particularly on common blood problems in this unique group of patients, although not neglecting the rarities that can also be important. We specifically chose to use a text-atlas format because the starting point for so many haematological problems in neonates is the information to be found through careful evaluation of a blood film in conjunction with an automated blood count. Given that many neonates with haematological abnormalities weigh less than 1000 g at birth and have an estimated blood volume at birth of 40–80 ml with very precarious vascular access, there is huge practical value in being able to extract the maximum amount of diagnostic information from a single drop of blood.

The book has been organised into four chapters based on the most frequently occurring clinical problems: interpretation of normal results and blood film appearances ([Chapter 1](#)); anaemias and haematological causes of jaundice ([Chapter 2](#)); diagnosis of systemic disorders, such as infection, and less common leucocyte disorders, such as leukaemia and storage disorders ([Chapter 3](#)); and disorders of coagulation and thrombosis, including common causes of thrombocytopenia and their investigation ([Chapter 4](#)). We hope that this handbook will be a core resource for haematologists on call in any hospital with a maternity unit who may not be neonatal experts, and that it will act as a core text for neonatal and paediatric haematologists. It is very much aimed to be a practical resource, based on real-life experience of neonatal haematology in large teaching hospitals and contains algorithms, tables and illustrative

cases with full colour images. While the focus is on common problems, we also describe when to look for, and how to spot, rare haematological disorders presenting in the neonatal period.

Almost all the images and cases described in this book derive from more than 25 years' experience as a 'neonatal haematologist', which involved daily examination of blood films from neonates in a number of neonatal intensive care units and special care baby units and daily conversations with the clinical teams responsible for their care. This was only possible with the support, open-mindedness and enthusiasm of the neonatologists on the one hand and the dedication and rigour of the highly skilled biomedical scientists of the diagnostic haematology labs on the other. Particular thanks go to David Roper, Andrew Osei-Bimpong and the late Corinne Jury of the Hammersmith and Queen Charlotte's Hospitals Haematology Laboratories, who made possible the delivery of a daily 'baby films' service in the face of increasing NHS demands; to David Roper and the late Dr David Swirsky, former consultant haematologist at Hammersmith Hospital, for their help with the photomicrographs in the earliest years of the neonatal haematology service; to countless biomedical scientists whose pride in delivering the highest quality 'baby films' on a daily basis was an inspiration to me; to paediatric haematology colleagues in London and Oxford who posed fascinating questions to keep me on my toes; and to the long-suffering haematology trainees who usually managed to look interested in this niche subject and helped to deliver the clinical advice.

This book would never have been written without the help and support of a number of other people. Above all, I am hugely indebted to my co-author, Professor Barbara Bain. She brought to the book her 50 years' experience of diagnostic haematology. Her expertise, experience,

diligence and patience, as well as her friendly advice, were invaluable. I am similarly hugely grateful to Mandy Collison at Wiley who never gave up on the project despite repeated delays on my part. Finally, I have to thank my family (Allan, Duncan and Ewan), who accepted the neonatal haematology geek in their midst, and supported the whole project from the beginning.

Irene Roberts

# Abbreviations

## **2,3-DPG**

2,3-diphosphoglycerate

## **ADA**

adenosine deaminase

## **ADP**

adenosine diphosphate

## **AGM**

aorto-gonado-mesonephros

## **aHUS**

atypical haemolytic uraemic syndrome

## **AIHA**

autoimmune haemolytic anaemia

## **ALL**

acute lymphoblastic leukaemia

## **ALPS**

autoimmune lymphoproliferative syndrome

## **AML**

acute myeloid leukaemia

## **APTT**

activated partial thromboplastin time

## **ATD**

asphyxiating thoracic dystrophy

## **ATRU**

amegakaryocytic thrombocytopenia and radio-ulnar synostosis

## **BCG**

bacille Calmette-Guérin

## **BCSH**

British Committee for Standards in Haematology

**BHFS**

Bart's hydrops fetalis syndrome

**BPI**

bactericidal/permeability-increasing protein

**BSS**

Bernard-Soulier syndrome

**CAMT**

congenital amegakaryocytic thrombocytopenia

**CDA**

congenital dyserythropoietic anaemia

**CHS**

Chédiak-Higashi syndrome

**CMV**

cytomegalovirus

**CNS**

central nervous system

**COVID-19**

coronavirus disease 19

**DAT**

direct antiglobulin test

**DBA**

Diamond-Blackfan anaemia

**DIC**

disseminated intravascular coagulation

**DNA**

deoxyribonucleic acid

**ECMO**

extracorporeal membrane oxygenation

**EDTA**

ethylene diaminetetra-acetic acid

**ELP**

early lymphoid progenitor

**EMA**

eosin-5-maleimide

**EOS**

early-onset sepsis

**EPO**

erythropoietin

**ERFE**

erythroferrone

**FFP**

fresh frozen plasma

**FNAIT**

fetal/neonatal alloimmune thrombocytopenia

**FPD/AML**

familial platelet disorder with propensity to acute myeloid leukaemia

**FRC**

fragmented red cell

**G6PD**

glucose-6-phosphate dehydrogenase

**G6PT1**

glucose-6-phosphate transporter 1

**G-CSF**

granulocyte colony-stimulating factor

**Gp**

glycoprotein

**GPI**

glucose phosphate isomerase

**Hb**

haemoglobin concentration

**HDFN**

haemolytic disease of the fetus and newborn

**HELLP**

haemolysis, elevated liver enzymes and low platelets

**HIE**

hypoxic ischaemic encephalopathy

**HIV**

human immunodeficiency virus

**HK**

hexokinase

**HLH**

haemophagocytic lymphohistiocytosis

**HNA**

human neutrophil antigen

**HPA**

human platelet antigen

**HPFH**

hereditary persistence of fetal haemoglobin

**HPLC**

high performance liquid chromatography

**HPP**

hereditary pyropoikilocytosis

**HS**

hereditary spherocytosis

**HSC**

haemopoietic stem cell

**HUS**

haemolytic uraemic syndrome

**IBMFS**

inherited bone marrow failure syndromes

**ICH**

intracranial haemorrhage

**IG%**  
immature granulocyte percentage

**IGF**  
insulin-like growth factor

**IgG**  
immunoglobulin G

**IgH**  
immunoglobulin heavy chain

**IgM**  
immunoglobulin M

**IL-6**  
interleukin-6

**IPF**  
immature platelet fraction

**IRF**  
interferon regulatory factor

**ITP**  
autoimmune thrombocytopenia

**IUGR**  
intrauterine growth restriction

**IUT**  
intrauterine transfusion

**IVH**  
intraventricular haemorrhage

**IVIg**  
intravenous immunoglobulin

**JAK2**  
Janus kinase 2

**JMML**  
juvenile myelomonocytic leukaemia

**KHE**  
Kaposiform haemangioendothelioma

**KMP**

Kasabach-Merritt phenomenon

**LAD**

leucocyte adhesion deficiency

**LDH**

lactate dehydrogenase

**LOS**

late-onset sepsis

**MAHA**

microangiopathic haemolytic anaemia

**MAIPA**

monoclonal antibody-specific immobilisation of platelet antigens

**MCA**

middle cerebral artery

**MCH**

mean cell haemoglobin

**MCHC**

mean cell haemoglobin concentration

**MCV**

mean cell volume

**MDSC**

myeloid-derived suppressor cell

**ML-DS**

myeloid leukaemia of Down syndrome

**MPAL**

mixed phenotype acute leukaemia

**MPV**

mean platelet volume

**NA**

not applicable

**NADPH**

nicotinamide adenine dinucleotide phosphate

**NEC**

necrotising enterocolitis

**NETs**

neutrophil extracellular traps

**NICE**

National Institute for Health and Care Excellence

**NICU**

neonatal intensive care unit

**NLR**

neonatal leukaemoid reaction

**NRBC**

nucleated red blood cell

**NS/MPD**

Noonan syndrome-associated myeloproliferative disorder

**PCC**

prothrombin complex concentrate

**PCR**

polymerase chain reaction

**PFK**

phosphofructokinase

**PGK**

phosphoglycerate kinase

**PK**

pyruvate kinase

**PMN**

polymorphonuclear

**PT**

prothrombin time

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ribonucleic acid

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