

The background of the cover features a microscopic view of red blood cells, appearing as reddish, biconcave discs against a dark, blurred background. The cells are scattered across the frame, with some in sharp focus and others blurred, creating a sense of depth.

# **IRON DEFICIENCY ANAEMIA**

**CURRENT CONCEPTS**

Noor Fadzilah Zulkifli  
Methil Kannan Kutty

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## List of Abbreviations

6-PGDH	6-Phosphogluconate dehydrogenase
ALAS2	ALA-synthetase 2
ABCB7	ATP-binding cassette subfamily B7 genes
Bmpr1a	Bone morphogenetic protein receptor type 1a
DMT1	Divalent metal iron transporter 1
DCytb	Duodenal cytochrome b
FTH1	Ferritin heavy polypeptide 1
FTL	Ferritin light polypeptide
G6PDH	Glucose-6-phosphate dehydrogenase
GRLX5	Glutaredoxin 5
HCP1	Haem carrier protein 1
H&E	Haematoxylin and eosin
Hfe	Haemochromatosis

Hjv	Hemojuvelin
IF gamma	Interferon gamma
IL1	Interleukin 1
IL6	Interleukin 6
IRP1	Iron regulatory protein 1
IRP2	Iron regulatory protein 2
JAK/STAT	Janus kinase/signal transducer and activator of transcription
MCH	Mean corpuscular haemoglobin
MCHC	Mean corpuscular haemoglobin concentration
MCV	Mean corpuscular volume
PCV	Packed cell volume
rhEPO	Recombinant human erythropoietin
RDW	Red cell distribution width
EP	Erythrocyte protoporphyrin
RARS	Refractory anaemia with ring sideroblast
IRE	Iron responsive elements
sTfR	Serum transferrin receptor
SI-LfR	Small intestine lactoferrin receptor
TIBC	Total iron binding capacity
TNF-alpha	Tumour necrosis factor alpha
UIBC	Unsaturated iron binding capacity
ZPP	Zinc protoporphyrin

## P R E F A C E

With the advent of spectacular advances and recent break throughs in various facets of diseases including molecular aspects, genetics epigenomics immunology, and revolutionary changes in diagnostic armamentarium, we were prompted to review the global public health problem of iron deficiency anaemia. This millennium has witnessed amazing strides that have inundated medical literature by colossal breathtaking advances contributing to enhanced comprehension of molecular profiles and mechanisms of hematologic diseases. As Hematology is a discipline that alliances pathology, molecular genetics and medicine, we have endeavoured to incorporate a wide field in the interest of integration. Despite nay because of the accelerating pace of the advances in the cutting edge technology and molecular profile of diseases, in the opinion of the authors the subject of iron deficiency anaemia has not received the attention it truly deserves. In this context, we are primarily concerned with the welfare of the patients and their families and the main focus of our efforts is for successful therapeutic outcomes. As pathologists, we felt deeply committed to deliver useful information in its best light in any way possible. Hence, we have selected an excellent showcase which will hopefully pave the way for students and residents for continued studies of this very consuming global problem of iron deficiency anaemia. Much of what is embodied herein may demand rethinking in future as hematology analogous to Medicine is changing incessantly. We are deeply indebted to the numerous esteemed experts whose publications were freely consulted and quoted and needless to reiterate that this has infused in us enormous confidence in the preparation of this book. Our heartfelt thanks to Puan Adibah, Chief in charge of publications in USIM for her

unstinted cooperation in processing this publication. Any expression of special thanks to Associate Professor Rosline Hassan and Dr. Prashanta Kumar Das will be insufficient to convey our sincere gratitude for their remarkable and ungrudging help for sparing their precious time for reviewing this piece of work. Admittedly it is well nigh impossible for a book of this nature to be wholly free from human errors, and particularly typographical errors. Nevertheless we hope that readers will find it useful, interesting, illuminating and inspiring. We would also appreciate feedback from the readers for further enhancement of the book.

# CHAPTER 1 :

## Introduction

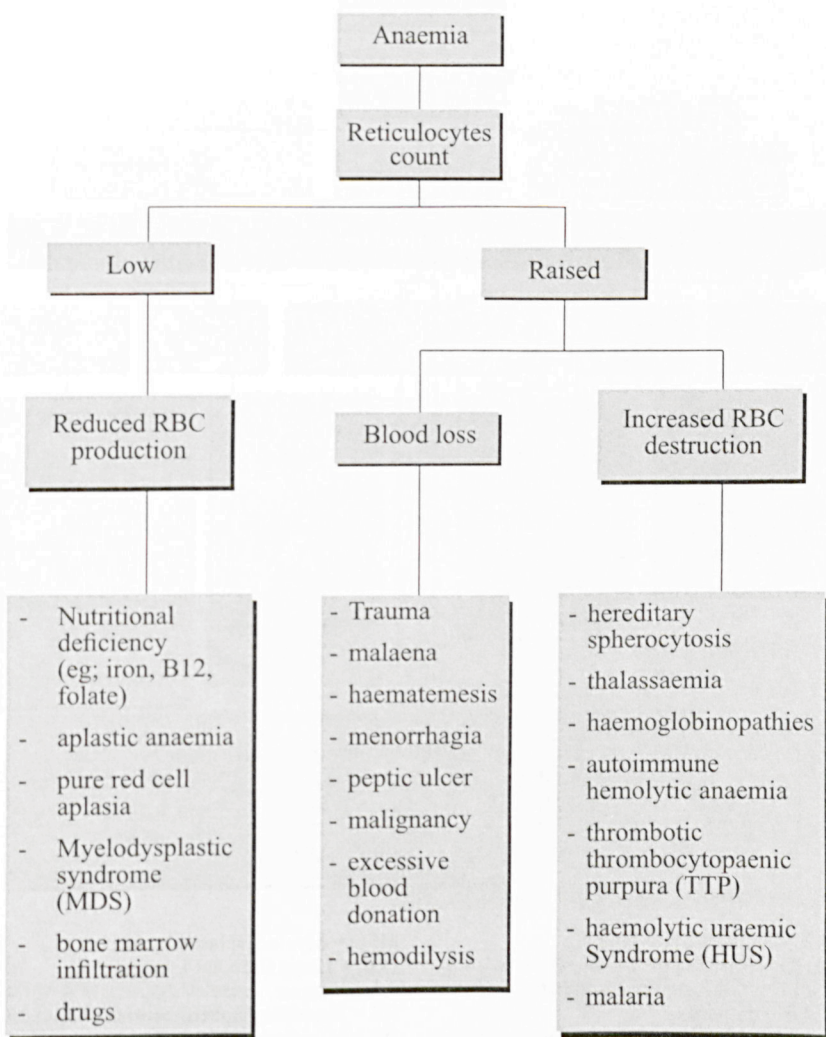
The impetus for presentation of this micro-review is to re-look at the common problem of iron deficiency anaemia with particular reference to current concepts of its pathogenesis, historical perspective and impact on health in human population. Hence this warrants a critical appraisal of the subject. It is appropriate therefore to look into its historical perspective in addition to clearly defining the concept of iron deficiency anaemia as a significant public health problem. It calls for an apt definition of iron deficiency anaemia as it is generally conceived today.

There has been a paradigm shift from the early terminology and concept of nutritional anaemia which was defined by World Health Organisation (WHO) in 1968. It was referred to as a condition in which the haemoglobin content of the blood is lower than normal as a result of deficiency of one or more essential nutrients regardless of the cause of the deficiency. WHO studies in determining the cause of anaemia concluded that iron deficiency which was present in 40% to 90% of pregnant women is the most common cause of nutritional anaemia. This particular shift in emphasis in the concept of iron deficiency was further confirmed by Baker and Demayer (1979). Nutritional anaemia assumed great significance as a large component of global anaemia prevalence and iron deficiency anaemia is now being considered as the most common cause of nutritional anaemia. World Health Organization (WHO) in 1989 stated clearly that iron deficiency is by far the commonest cause of nutritional anaemia; it may be associated with folate deficiency especially during pregnancy (WHO/UNICEF/ICCIDD, 2007).

According to the current definition, anaemia is a condition when the haemoglobin concentration is less than 13.0g/dl in males or less than 11.5g/dl in females (Walter, 1994). It obviously causes a decline

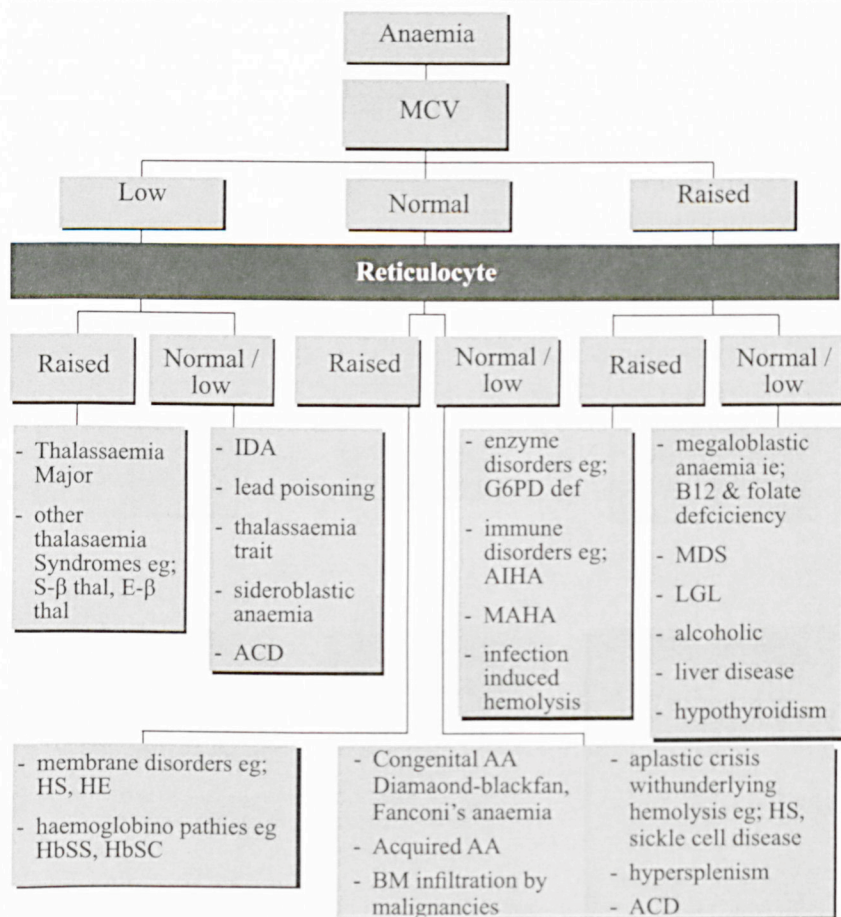
# APPENDIX 1

## Kinetic approach in the management of patient with anaemia



# APPENDIX 2

## Morphological approach in the management of patient with anaemia

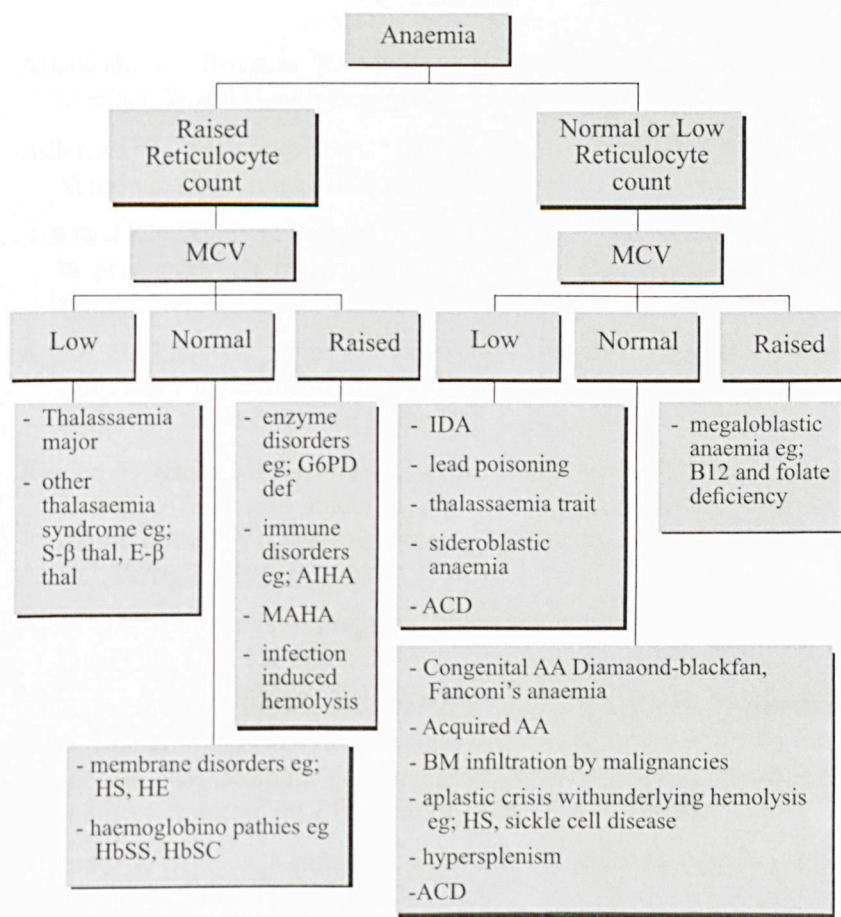


MCV = Mean Cell Volume  
 ACD = Anaemia of Chronic Disease  
 G6PD = Glucose - 6 - Phosphate Dehydrogenase  
 AIHA = Autoimmune Hemolytic Anaemia  
 MAHA = Microangiopathic Hemolytic Anaemia

MSD = Myelodysplastic Syndrome  
 LGL = Large Granular Lymphocyte Leukaemia  
 HS = Hereditary Spherocytosis  
 HE = Hereditary Elliptocytosis  
 AA = Aplastic Anaemia

# APPENDIX 3

## Diagnostic approach to children with pallor



MCV = Mean Cell Volume  
 ACD = Anaemia of Chronic Disease  
 G6PD = Glucose - 6 - Phosphate Dehydrogenase  
 AIHA = Autoimmune Hemolytic Anaemia

MAHA = Microangiopathic Hemolytic Anaemia  
 HS = Hereditary Spherocytosis  
 HE = Hereditary Elliptocytosis  
 AA = Aplastic Anaemia

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# IRON DEFICIENCY ANAEMIA : CURRENT CONCEPTS

This book was written with the aim of presenting the subject of iron deficiency anemia oriented primarily towards the academic needs of students of medicine and trainees; it provides an easy access to current knowledge of the subject. This book attempted to cover comprehensively many facets including the epidemiology, normal iron homeostasis in human body, aetiology, pathology, differential diagnosis, and diagnostic investigations; in addition management, prevention and clinical approach to a patient with suspected iron deficiency anaemia have also been alluded to. Hopefully this book will serve useful for all interested in iron deficiency anemia including researchers.

*"This book is an extensive compilation of the author on iron deficiency anaemia. Iron deficiency anaemia is a very common haematological disorder and has been a public health problem in this region. It gives an invaluable understanding about the disease and it is a useful reference for researchers, graduates and public. I wish to recommend it to all who are interested in this area."*

Assoc. Professor Dr. Rosline Hassan,  
Head, Department of Haematology, School of Medical Sciences, USM

*"The contents of this book have been outlined under clear and distinct headings and the matter has been presented in a lucid and easily understandable manner suitable for local environment. Although the disease is an old entity, the authors have searched through the recent developments including Molecular Biology to unravel the mystery of the mechanism. Several line diagrams and tables incorporated in the manuscript are appropriate and helpful in better understanding. The colour plates of blood films are of good quality and appropriate. The reference is extensive and the indexing is easier.*

*I am certain that the book will be popular and beneficial for the undergraduate and post graduate students in Pathology and Medicine. The Clinicians will find it an easy readable reference".*

Dr. Prashanta Kumar Das (M.D, FRCPA)  
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