Interpretation of RBCs Count (Polycythemia or Erythrocytosis)

By

Prof. Mahmoud Rushdi
Assiut University
Egypt

1

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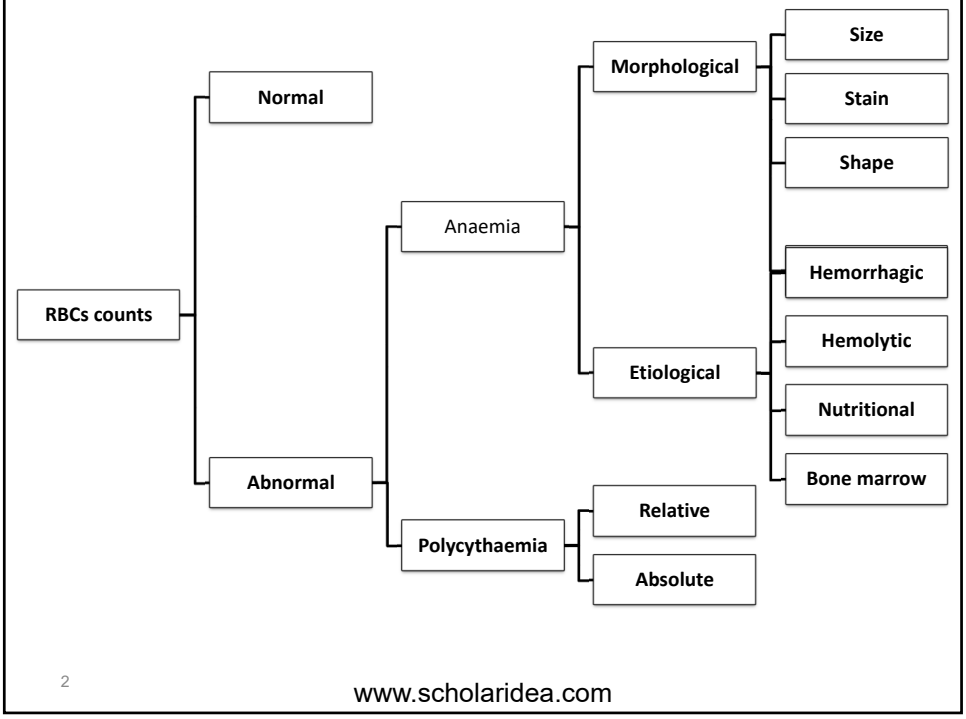

2

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2

Polycythemia

Red blood cell (RBC) production typically is in part regulated by the hormone erythropoietin (EPO). When oxygen sensors located in the renal cortex become hypoxic, hypoxia – inducible factors are generated and incite EPO gene transcription.

The resultant EPO then stimulates erythroid precursors in the bone marrow to increase RBC numbers, thereby enhancing the oxygen carrying capacity of the blood.

3

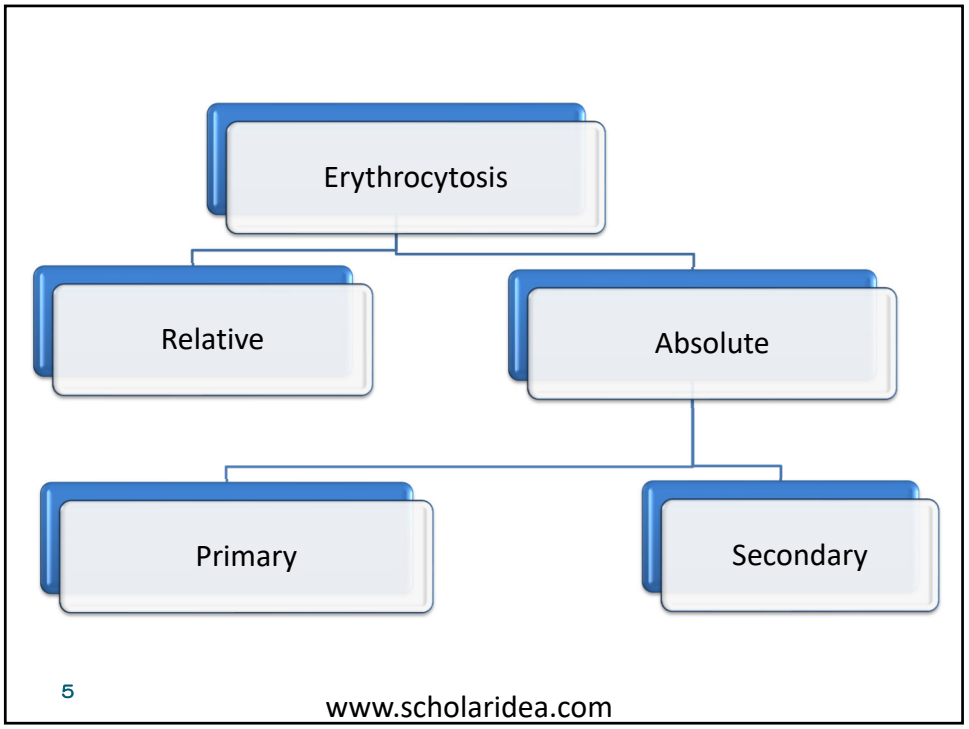
Erythrocytosis

Erythrocytosis is defined as an increase in peripheral RBC numbers, hemoglobin concentration, and calculated hematocrit or packed cell volume (PCV) above established reference intervals.

Polycythemia sometimes denotes not only erythrocytosis, but also concurrent increases in white blood cell and platelet counts.

Based on pathogenesis, erythrocytosis can be classified into relative or absolute categories. Absolute erythrocytosis can be further characterized as primary (polycythemia vera) or secondary

4


Erythrocytosis
Relative
Absolute
Primary
Secondary
5
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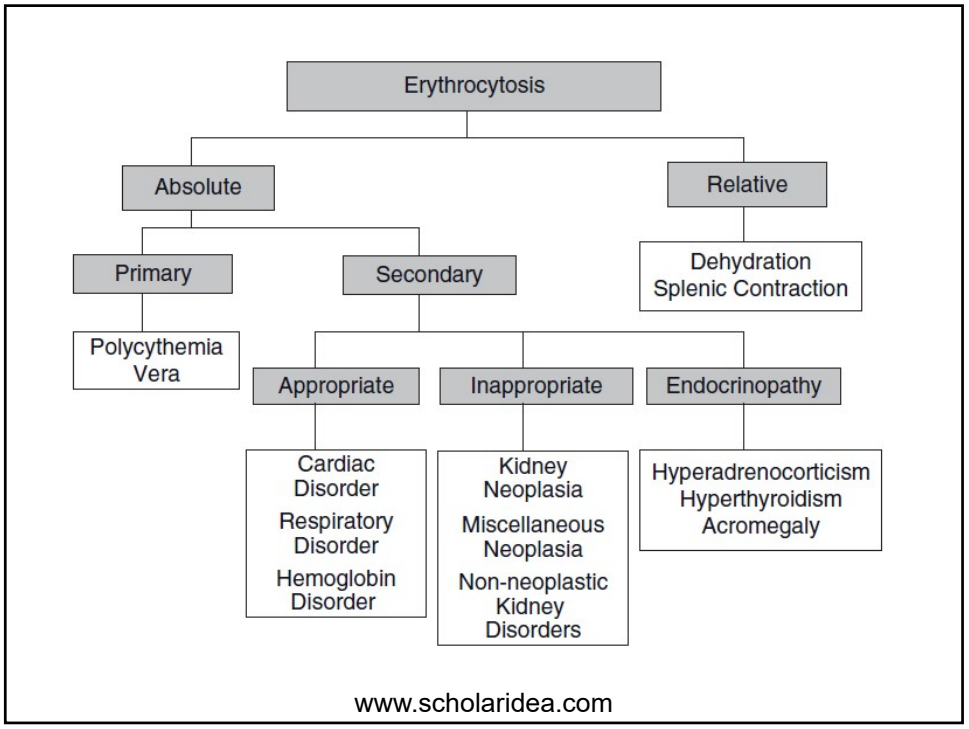
5


Erythrocytosis
Absolute
Relative
Primary
Secondary
Dehydration
Splenic Contraction
Polycythemia Vera
Appropriate
Inappropriate
Endocrinopathy
Cardiac Disorder
Respiratory Disorder
Hemoglobin Disorder
Kidney Neoplasia
Miscellaneous Neoplasia
Non-neoplastic Kidney Disorders
Hyperadrenocorticism
Hyperthyroidism
Acromegaly
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6

1. Relative (apparent) Erythrocytosis

It is an apparent or relative increase of RBCs count due to loss of fluids from the body.

The increase of RBCs count in case of relative Erythrocytosis is temporary, as the RBCs count is returned to normal after correcting the loss of body fluids.

7

7

Causes of relative Erythrocytosis:

1. Hemoconcentration as in cases of diarrhea, diuresis, excessive vomiting or Polyuria.
2. Excitement, which results in release of epinephrine that stimulate contraction of the spleen.

8

Laboratory findings in relative Erythrocytosis:

1. Increase RBCs count, hemoglobin concentration and PCV %.
2. Decrease plasma volume.
3. Increase plasma protein, urea and creatinine levels.
4. Normal erythropoietin level.

9

II. Absolute (true) Erythrocytosis

It is a persistent increase in RBCs count. Absolute Erythrocytosis may be primary or secondary.

It may be either:

1- Primary erythrocytosis.

2- Secondary erythrocytosis.

10

10

1- Primary Erythrocytosis

(Polycythemia Vera or erythremia)

Definition

Primary Erythrocytosis occurs due to hyperplasia of the bone marrow, or presence of tumor at the bone marrow, which results in increased synthesis of RBCs.

Causes

- Excessive erythroplastic activity of the bone marrow (hyperplasia of hemopoietic tissues of the bone marrow).
- Unknown causes.

11

11

Laboratory findings in Primary Erythrocytosis:

1. Increase RBCs count, hemoglobin concentration and PCV %.
2. Normal plasma volume.
3. Normal plasma protein, urea and creatinine levels.
4. Normal erythropoietin level.
5. Normal pO_2.

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12

Secondary Erythrocytosis

Secondary erythrocytosis develops from excessive production of EPO. If EPO is secreted in response to systemic hypoxia, then the resultant erythrocytosis represents an *appropriate* compensatory response.
If, on the other hand, the increased EPO secretion is not associated with systemic tissue hypoxia, then the response is *inappropriate*.
Endocrinopathy – associated erythrocytosis is another type of secondary erythrocytosis resulting from hormonal (other than solely EPO -mediated) stimulation of erythropoiesis.

13

Appropriate Secondary Erythrocytosis

- Appropriate erythrocytosis occur in any case characterized by hypoxia or hinder the proper oxygenation of blood.
- Erythrocytosis should be regarded as a conservative vital reaction i.e. an effort on the part of the organism to compensate for some difficulty in the oxygenation of blood and tissues of the body.

14

14

Appropriate secondary erythrocytosis appears following hypoxic stimulation of the bone marrow under the following conditions:

- Exposure to high altitude.
- Any disease that interferes with the oxygenation of the erythrocytes as in obstructive lesion in air passage.
- Chronic diseases of the heart.
- Impaired oxygen transport from chronic methemoglobinemia in dogs and cats with methemoglobin reductase deficiency may cause mild erythrocytosis.

15

Laboratory findings in appropriate secondary erythrocytosis:

1. Increased total RBCs count, hemoglobin concentration and PCV %.
2. Normal blood total protein level and its fractions.
3. Normal blood urea nitrogen level.
4. High erythropoietin level.
5. Decrease Po_2 in case of hypoxia.

16

Inappropriate Secondary Erythrocytosis

Excess production of EPO in the absence of systemic hypoxia, termed physiologically inappropriate erythrocytosis, is caused by EPO - secreting tumors of the kidneys.

17

Laboratory findings in inappropriate secondary erythrocytosis:

1. Increased total RBCs count, hemoglobin concentration and PCV %.
2. High erythropoietin level.
3. Tumors of the kidneys.

18

Endocrinopathy - Associated Erythrocytosis

Hormones other than EPO, such as cortisol, androgen, thyroxine, and growth hormone, also may stimulate erythropoiesis either directly, or indirectly through increased production of EPO.

19

Laboratory findings in Endocrinopathy - Associated Erythrocytosis

1. Increased total RBCs count, hemoglobin concentration and PCV %.
2. Normal blood total protein level and its fractions.
3. Normal blood urea nitrogen level.
4. High erythropoietin level.
5. Elevated level of specified hormone.

20

Clinical signs of erythrocytosis

The clinical signs of both primary and secondary erythrocytosis include erythema (brick-red or ruddy color) of mucous membranes, neurologic disturbances (ataxia, weakness, blindness, behavioral change), bleeding episodes (epistaxis, hematemesis, hematochezia, melena, hematuria), or polyuria and polydipsia.

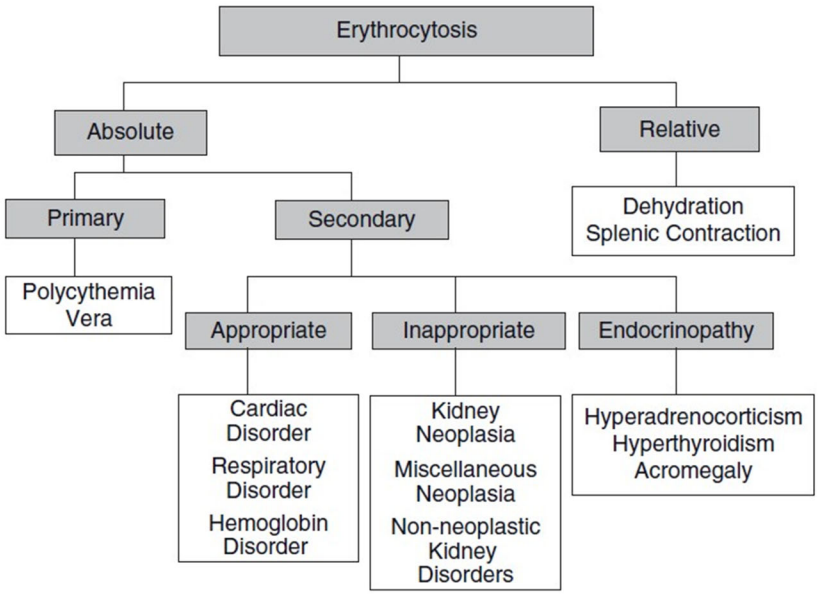
21

Most of these clinical manifestations are attributed to increased blood viscosity from the expanded RBC mass.

The hyperviscosity slows blood flow, distends capillaries and small vessels, may increase the likelihood of thrombosis and rupture of these vessels, and may impair tissue oxygen delivery.

22

Diagnostic approach



23

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24