

# **Methemoglobinemia**

**Presented**

**By**

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# Learning Objectives

1. Definition of Methemoglobinemia.
2. Types of Methemoglobinemia.
3. Common agents inducing Met Hb.
4. Clinical presentation of Met Hb.
5. How to diagnose a case of Met Hb.
6. How to treat a case of Methemoglobinemia.

# Introduction

- Methemoglobin is altered hemoglobin.
- Ferrous iron is oxidized into ferric iron that has not ability to bind with oxygen
- The remaining ferrous iron in hemoglobin increases its oxygen affinity →→ abnormal hemoglobin production.
- The first part becomes unable to carry oxygen while the second hemoglobin part increases its ability of oxygen affinity and then the oxygen dissociation curve is shifted to the left to impair oxygen delivery into tissues.
- Normally, **0.5 - 3%** of hemoglobin is converted into methemoglobin every day at a slow rate.
- There is methemoglobin reduction to maintain steady level of methemoglobin around **1%** in normal persons.

# Types of Methemoglobinemia

## 1- Congenital Type

It is produced by a decrease in enzymatic reduction of methemoglobin.

There are two types of congenital Methemoglobinemia:-

- **A-Type 1** : represents most congenital cases whereas deficiency of cytochrome b5 reductase is restricted to red cells and cyanosis is considered the only symptom.
- **B- Type 11** : deficiency of cytochrome b5 reductase is presented in all cells leading to severe cyanosis and developmental defects inducing death in the most affected infants in the first year of life.

## 2- Acquired Type

It is caused by drugs or specific agents' intakes leading to methemoglobin production.

- ☐ Most common agents inducing methemoglobinemia are dapsons, lidocaine, benzocaine, nitric oxide, nitrates, and aniline.

## Cont.

### Congenital Met Hb

- It is manifested by cyanosis when methemoglobin level exceeds 8-12 % of total normal concentration of Hb .
- Cyanosis is considered the only symptom of congenital type 1.

### Congenital Met Hb (Type 11)

- It is manifested by neurological disorders such as seizure, opisthotonus, microcephaly, mental retardation, and developmental delay leading to failure to thrive.

# Clinical Presentation of Methemoglobinemia

- Manifestations of acquired methemoglobinemia appear after ingestion of specific drugs or agents that induce methemoglobin.
- Cases of acute Methemoglobinemia are asymptomatic if methemoglobin level is lower than 20% .
- Some individuals have a genetic risk factor such as heterozygous for cytochrome b5 reductase enzyme deficiency (autosomal recessive disease) that reduces methemoglobin into hemoglobin, but these individuals are usually asymptomatic because of a compensatory mechanism that increases erythrocytes, but they become symptomatic when they have specific agents' exposure.
- **Early clinical picture of intoxication :-**  
Headache, fatigue, dyspnea, and lethargy.
- **If Met Hb level exceeds 30-40% of total hemoglobin:-**  
Cyanosis, respiratory depression, coma, shock, seizure, and death.

# How to diagnose a case of Met Hb?

- Suspect Met Hb clinically if there is **cyanosis** although arterial  $po_2$  is within **normal limit**.
- Confirm Met Hb by lab analysis for blood that may be **dark red, chocolate, or brown to blue colour** whereas its colour doesn't change with oxygen supply.
- Pulse oximetry suspect diagnosis when measured oxygen saturation is different from calculated oxygen saturation by arterial blood gases assay.
- It should use a fresh blood sample because the storage increases Met Hb level to get the most accurate diagnosis of Met Hb.

# Treatment of Acquired Met Hb

**A-** Removal of causative agent for asymptomatic patients who have Met Hb level less than **20 %** .

## **B- Methylene blue:-**

- It is life-saving and drug of choice if Met Hb level exceeds **30%** of total hemoglobin.
- It reduce Met Hb level by NADPH dependent pathway.
- Dose of methylene blue is 1-2 mg/kg / IV over 5 minutes.
- It is repeated after 1 hour from initial dose if high level of Met Hb is still.
- Dose of methylene blue should not exceed **7 mg /kg** because it leads to hemolysis, dyspnea, and chest pain.
- Monitoring of Met Hb during treatment to detect response to methylene blue.

# Treatment of congenital Met Hb

Treatment of congenital Met Hb (type 1 and 11):-

1. Oral administration of **methylene blue** (100-300 mg /day)
2. Or, oral administration of **ascorbic acid** (300- 1000 mg/day) in divided doses.
3. The use of 20-30 mg of riboflavin per day is still limited for these cases.
4. Methylene blue and ascorbic acid reduce cyanosis without any efficacy on neurological abnormalities, especially in **congenital type 11**.

# Alternative Treatment

## **1- Ascorbic acid (Vit . C) :-**

For patients who have a glucose 6-phosphate dehydrogenase deficiency with Met Hb whereas methylene blue administration may deteriorate patient's condition.

## **2- Exchange transfusion or hyperbaric oxygen:-**

For severe cases of Met Hb.

**Thank you**