

Occupational Hematology

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Exposure to hematotoxin may cause

- Blood cell survival(Denaturation HB & Hemolysis)
- Metabolism(Porphyria)
- Formation(Aplasia)
- Morphology and Function(Preleukemia& leukemia)
- Coagulation(Thrombocytopenia)

Disorders Associated With Shortened Red Blood Cell Survival

- Methemoglobinemia and Hemolysis Produced By Oxidant Chemical
- Hemolysis Associated With Exposure To Heavy Metals
- The Porphyrrias

Disorders Associated With Decreased Oxygen Saturation

- Carbon monoxide poisoning

Disorders Affecting Blood Cell Formation & Morphology

- Aplastic anemia ; Benzene, Ionizing Radiation
- Myelodysplastic Syndromes
- Multiple Myeloma
- Toxic Thrombocytopenia

Methemoglobinemia and Hemolysis Produced By Oxidant Chemical

- Methemoglobin is formed by oxidation of ferrous Hb to ferric Hb (incapable of delivering oxygen to the tissues)
- An NADH-dependent enzyme, methaemoglobin reductase, reduces ferric iron back to ferrous Hb
- Oxidation of Hb was toxic to RBC and could be followed by an **acute hemolysis** known as **Heinz body anemia**
- Heinz body are RBC inclusions that represent precipitated Hb and are classically seen in individuals with a deficiency G6PD after exposure to an oxidant stress

Aniline

- Aniline use:
 - Dyes
 - Rubber industry
- Aniline properties:
 - Fat-soluble and readily penetrate the skin, even through clothing
 - Vapor form may enter the body through the lung

Clinical presentation

%Methemoglobinemia	Symptoms
10-30	Cyanosis, mild fatigue, tachycardia, blueness of lips & bed nails
30-50	Weakness, breathlessness Headache, exercise intolerance
50-70	Altered consciousness
>70-80	Coma, death

Para clinic finding

- CBC: Anemia, ↑ retic
- PBS:
 - Bite or blistered red cell (heinz body)
 - Reticulocytosis (Polychromasia, possibly nucleated red cells)

Prevention

- Screening for **G6PD deficiency** before a hemolytic episode or 1-2 month after the hemolysis

Treatment

- Removal of the offending agents & Decontamination
- Mild intoxication ($<20\%$) \longrightarrow observation
- Moderate to severe ($>30\%$) \longrightarrow oxygen 100% , methylene blue
 - solution 1% at a dose of 1-2 mg/kg over 10 minutes
- Exchange transfusion

Chemicals associated with methemoglobinemia or oxidative hemolysis

Chemical	Use
Aniline	Rubber,dyestuffs,production of MBI
Nitroaniline	Dyes
Toluidine	Dyes,organic chemicals
P-Chloraniline	Dyes,pharmaceuticals,pesticides
O-Toluidine	Laboratory analytic reagent,production of trypan blue stain,chlorine test kits,test tapes
Naohthalene	Fumigants used in clothing industry
Paradichlorobenzene	Fumigants used in clothing industry
Nitrates	Soil fertilizers
Trinitrotoluene	Explosives

Hemolysis Associated With Exposure To Heavy Metals

- Arsine
- Lead
- Mercury
- Copper
- Antimony
- Mechanism of hemolysis is unknown, but it is thought to be related to the affinity of these directly cytolytic metals to **thiol groups** such as are found on the surfaces of RBC

Arsine

- colorless, nonirritating gas
- Produced by the action of acid on a metal contaminated with arsenic: Smelting & refinery
- Preparation of conducting devices in the semiconductor industry
- Respiratory tract is the most important portal of entry

Clinical Presentation

- Acute arsine poisoning :
 - 2-24 h after exposure: acute and massive IV hemolysis
 - Nausea, vomiting, abdominal cramping, headache, malaise and dyspnea
 - Tea-colored urine
- garlicky odor , fever tachycardia, tachypnea and hypotension
- Jaundice, generalized nonspecific abdominal tenderness

Laboratory Findings

- Increased total & indirect bilirubin
- Hb uria
- DIC
 - low fibrinogen level
 - prolonged PT
 - schistocyte
 - thrombocytopenia →
- Altered renal function → increased serum Cr
 - Precipitated hemoglobin casts
 - Direct toxicity of arsine on renal tubular cells

Treatment

- Vigorous hydration
- Exchange transfusion if plasma Hb levels >400-500mg/dl
- Hemodialysis if ARF developed
- All survivors of acute arsine poisoning must be evaluated for **at least 1 years**

Lead

- Suppression erythropoiesis and **heme synthesis**
- Hemolytic **anemia**

Aplastic Anemia

- Idiopathic & secondary →
 - Drugs
 - Chemicals
 - Radiation
 - Infection
 - Immunologic
- Drugs(chloramphenicol,acetazolamide,phenylbutazone,phenytoin,sulfonamide,....)
- Benzene,Ionizing Radiation & cytotoxic drugs such as antimetabolites and alkylating agents

Benzene

- Workers at greatest risk of exposure: Rubber manufacturing, shoemaking, petroleum and
- BM → Hypocellularity with fatty replacement
- Prognosis:
 - Up to 40% patient may recover completely after removal of exposure
- Treatment :supportive (transfusion, EGF,GCSF,GMCSF), Androgens, Allogenic BM transplantation)

Other causes of aplastic anaemia

- Trinitrotoluene, which is absorbed readily through the skin, has been associated with aplastic anaemia in munition plants
- Pesticide lindane (gamma-benzene hexachloride)
- Ethylene glycol ethers
- Arsenic

Multiple myeloma

- MM involves predominantly bone (skull), bone marrow and kidney
- malignant proliferation of B-lymphocyte-derived cells that synthesize and secrete immunoglobulins
- Incidence of MM increases sharply with increasing age
- Male > Female

Multiple myeloma

- benzene (gasoline-exposed workers and refinery workers)
- Pesticides (farmers and farm workers)

Hematologic cancer:

- Radiation
- Benzene
- TYPES: AML, CML
- Clinical findings:
 - Weakness, malaise, anorexia, fever, easy bruisability, Pallor, hepatosplenomegaly, lymphadenopathy, anemia, thrombocytopenia, leukocytosis or leukopenia