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Blood and Immunity Module

1st Year MBBS(SKL)

Hemin Crystals

H.O.D
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Rawalpindi Medical University
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(Senior Demonstrator)

Date: 17-04-25

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Motto, Vision, Dream

- To impart evidence based research oriented medical education
- To provide best possible patient care
- To inculcate the values of mutual respect and ethical practice of medicine

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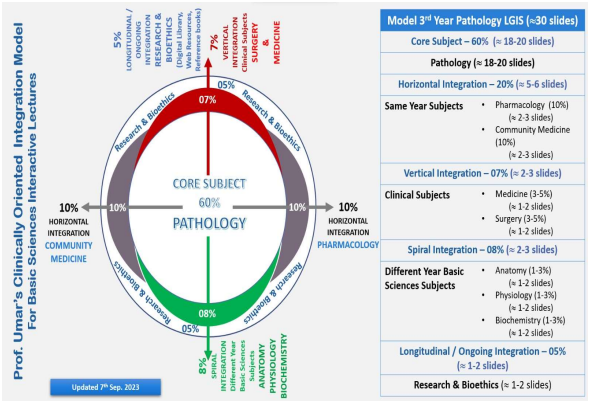
Professor Umar Model of Integrated Lecture



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Skill Lab Assessment

1. **The Hemin crystal test is primarily used to detect:**
   A. Urobilinogen in urine
   B. Blood in cerebrospinal fluid
   C. Heme in feces
   D. Blood in gastric contents
   E. Bacteria in sputum

2. **The crystals formed in the Hemin crystal test are described as:**
   A. Cuboidal and blue
   B. Hexagonal and yellow
   C. Needle-shaped and brown
   D. Irregular and red
   E. Rod-shaped and green

3. **Which acid is responsible for converting hemoglobin to acid hematin in the stomach?**
   A. Sulfuric acid
   B. Acetic acid
   C. Nitric acid
   D. Hydrochloric acid
   E. Carbonic acid

4. **A positive Hemin crystal test most directly supports the diagnosis of:**
   A. Lower GI bleed
   B. Appendicitis
   C. Upper GI bleed
   D. Gallstones
   E. Diverticulitis

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Skill Lab Assessment

5. **In a patient with suspected upper GI bleeding, the Hemin crystal test is performed on:**
   A. Saliva
   B. Pleural fluid
   C. Gastric aspirate
   D. Stool
   E. CSF

6. **The most common cause of peptic ulcer disease is:**
   A. Gallstones
   B. Helicobacter pylori infection
   C. Low acid secretion
   D. High-fiber diet
   E. Intestinal tuberculosis

7. **A major complication of untreated peptic ulcer disease includes:**
   A. Chronic pancreatitis
   B. Intestinal volvulus
   C. Rectal prolapse
   D. Gastric outlet obstruction
   E. Portal vein thrombosis

8. **Which of the following drugs is most commonly associated with causing peptic ulcers?**
   A. Metformin
   B. Ibuprofen
   C. Amlodipine
   D. Furosemide
   E. Simvastatin

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Skill Lab Assessment

9. **A 45-year-old man presents with epigastric pain relieved by eating. What is the likely diagnosis?**
   A. Gastric ulcer
   B. GERD
   C. Duodenal ulcer
   D. Acute pancreatitis
   E. Functional dyspepsia

10. **In a patient with coffee-ground vomiting and hemin crystals in the gastric aspirate, the next best step is:**
    A. Upper GI endoscopy
    B. Liver biopsy
    C. Abdominal X-ray
    D. Fecal occult blood test
    E. Colonoscopy

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Key

1. D
2. C
3. D
4. C
5. C
6. B
7. D
8. B
9. C
10. A

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Learning Objectives

At the end of the Skill Lab, students will be able to:

1. Prepare, observe and draw the shape of Haemin crystals.
2. Learn the Medicolegal importance of the Haemin crystals test.

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Interactive Session

A 27-year-old male is brought to the emergency department after being found unconscious in an alleyway. He has multiple bruises, appears malnourished, and has dried blood around his nose and mouth. His past medical history is unknown. A basic physical exam shows a disoriented, febrile patient with a blood pressure of 90/60 mmHg and pulse of 112 bpm. There is no active bleeding, but he is confused and unable to provide a coherent history.

You perform a **nasogastric lavage**, which reveals **"coffee-ground" material**. You suspect **upper gastrointestinal bleeding** and order a complete blood count, coagulation profile, and abdominal imaging.

- To confirm the source and nature of bleeding, you decide to perform a **microscopic examination of the gastric aspirate**.
- Under the microscope with saline preparation, you observe dark-brown, needle-shaped crystals that are birefringent under polarized light.

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Core Knowledge

Haemin Crystals

- Precipitated solid structures obtained from a saturated solution.
- Have a characteristic and specific Rhombic shape for the given substance.
- Formed from the Haem part of Haemoglobin.

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Core Knowledge

Purpose of Haemin Crystal Test

- Medicolegal Significance

it is a confirmatory test to differentiate between an ordinary red stain and blood.

Core Concept

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Core Knowledge

Principle of Haemin Crystal Formation

- When heated with acid, haemoglobin is denatured.
- Heam is oxidized to Haematin.
- Chloride from KCl converts Haematin to Haemin Crystal (Haemin).

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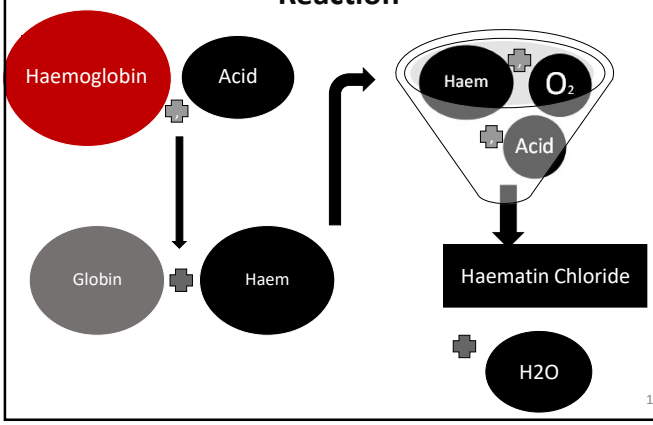
Core Knowledge

Reaction



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Core Knowledge

Procedure of Haemin Crystal Formation

Reagents:

- Distilled water
- 0.1% KCl solution in Glacial Acetic Acid

Equipment:

- Microscope

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Core Knowledge

Procedure of Haemin Crystal Formation

Method:

- Take a drop of blood on a glass slide and add 2-3 drops of distilled water.
- Hemolyze the RBC with Glass rod and heat the slide over low flame gently, until it dries.
- Add 1 drop of 0.5% KCl in Glacial Acetic Acid.
- Put cover slip
- Again heat gently over low flame until gas bubbles form.
- Cool the slide and observe under the microscope.

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Core Knowledge

Interpretation of Haemin Crystal Test

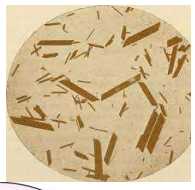
- Crystals under the microscope

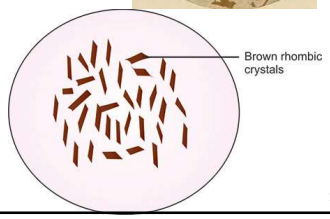
Shape:

Rhombic

Color:

Dark Brown





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Core Knowledge

Limitation of Haemin Crystal Test

- Origin Source cannot be differentiated.

It cannot detect the Haem source being an animal or human in origin since the Globin part is different for every species but Haem is the same.

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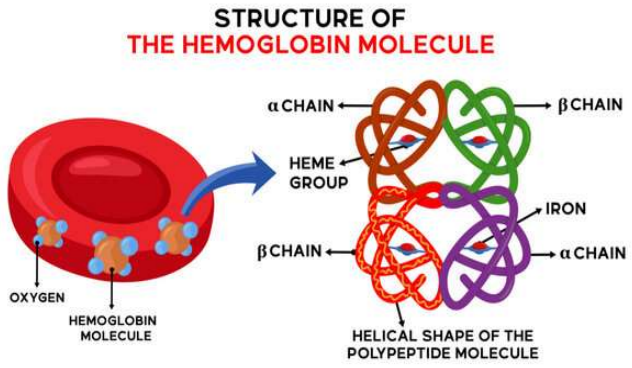
Horizontal Integration Anatomy



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Horizontal Integration

Physiology of Haemoglobin

- Each red blood cell (RBC) comprises approximately 280 million molecules of Haemoglobin
- There are more than 350 types of abnormal hemoglobin
- An average adult is said to have close to 1.74 pounds or 790 grams of Hb.
- Our red blood cells are red due to the heme groups in haemoglobin. Heme contains iron imparting a red colour to the molecule.
- Haemoglobin forms an unstable and reversible bond with oxygen. It is referred to as oxyhaemoglobin in the oxygenated state and is bright red in colour and is purplish blue in shade in the reduced state.

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Vertical Integration

Peptic Ulcer Disease

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Spiral Integration — Family Medicine

Management of PUD

Family Medicine plays important role in following manner:

- Diagnosis through medical history ,physical examination and laboratory tests
- Education and counselling of patient and family
- Refer to Specialists
- Monitoring and follow-up

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Spiral Integration — Artificial Intelligence

Role of AI in Management

Artificial Intelligence plays role in following aspects:

- Diagnosis by Using AI algorithms
- AI algorithms can suggest personalized treatment plans
- Continuously monitor patients and predict potential complication
- Can be used to accelerate research by analyzing large datasets

Spiral Integration 23

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Spiral Integration — Bioethics

Ethical Consideration

- Informed Consent
- Health care must allocate sources fairly, transparently and equitably
- Maintaining patient's confidentiality
- Research ethics

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Spiral Integration Research Article

Hematin- and Hemin-Induced Spherization and Hemolysis of Human Erythrocytes Are Independent of Extracellular Calcium Concentration

Diana M. Mikhailova , Elisaveta Skverchinskaya, Julia Sudnitsyna ,Kirill R. Butov, Ekaterina M. Koltsova, Igor V. Mindukshev, Stepan Gambaryan.

Cells
ISSN: 2073-4409

https://www.mdpi.com/2073-4409/13/6/554

Abstract

Pathologies such as malaria, hemorrhagic stroke, sickle cell disease, and thalassemia are characterized by the release of hemoglobin degradation products from damaged RBCs. Hematin (liganded with OH−) and hemin (liganded with Cl−)—are the oxidized forms of heme with toxic properties due to their hydrophobicity and the presence of redox-active Fe3. In the present study, using the original LaSca-TM laser particle analyzer, flow cytometry, and confocal microscopy, we showed that both hematin and hemin induce dose-dependent RBC spherization and hemolysis with ghost formation. Hematin and hemin at nanomolar concentrations increased [Ca2+]i in RBC; however, spherization and hemolysis occurred in the presence and absence of calcium, indicating that both processes are independent of [Ca2+]i. Both compounds triggered acute phosphatidylserine exposure on the membrane surface, reversible after 60 min of incubation. A comparison of hematin and hemin effects on RBCs revealed that hematin is a more reactive toxic metabolite than hemin towards human RBCs. The toxic effects of heme derivatives were reduced and even reversed in the presence of albumin, indicating the presence in RBCs of the own recovery system against the toxic effects of heme derivatives.

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How to use HEC Digital Library

Steps to Access HEC Digital Library

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3. A page will appear showing the universities from Public and Private Sector and other Institutes which have access to HEC National Digital Library (HNDL).
4. Select your desired Institute.
5. A page will appear showing the resources of the institution
6. Journals and Researches will appear
7. You can find a Journal by clicking on JOURNALS AND DATABASE and enter a keyword to search for your desired journal.

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Learning Resources

- Journal of Practical Biochemistry Vol 1
- Google scholar
- Google images

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