

Textbook of Medical Biochemistry

9th
Edition

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TOC & Sample Chapter

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Key Features

- A fully revised and updated text.
- Written in simple and lucid language as per the MCI syllabus.
- Presents an intelligent and comprehensive study.
- Enriches with relevant subject information of medical biochemistry.
- Covers basics of biochemistry with clinical approach.
- Highlights important portions like clinical aspects/significance for better understanding.
- Provides colour photographs to make the book more attractive.
- Includes MCQs, essay and short type questions at the end of each chapter to help the students for examination.
- Covers all the topics of current interests for the undergraduate and postgraduate students, teachers, and biochemists.

Present the major concepts and specific objectives at the beginning of the chapter to provide a brief introduction and overview.



Major Concepts

- A. To know various functions of liver.
- B. To classify the liver function tests and their interpretations.
- C. To learn how to use various tests collectively to evaluate the liver dysfunction.

Specific Objectives

- A.
 1. Review anatomy and physiology of liver. (Not included in the text, but students are advised to do so before studying this chapter.)
 2. Learn in detail, various functions of liver such as metabolic functions, secretory functions, excretory functions, hematologic functions, protective functions, storage functions.
- B.
 1. Learn the classification of various liver function tests based on different functions of the liver.
 - Learn the details of van den Bergh test; and total direct bilirubin estimation and its interpretation.
 - Classify jaundice and learn the liver function tests associated with it and their usefulness.
 - Study glucose, galactose, fructose and epinephrine tolerance tests and the implication of these tests in assessing liver dysfunction.
 - Learn the tests of protein, albumin estimation, fibrinogen estimation, and flocculation and turbidity tests.
 - Study the tests based on lipid metabolism such as cholesterol-cholesterol ester ratio and the interpretation.
 - Learn hippuric acid test and its importance and detoxication functions of the liver.
 - Learn details of excretory function tests such as BSP retention test, Rose-Bengal dye test, bilirubin-tolerance test and their interpretations.
 - Study the details of tests based on hematological functions of liver such as, prothrombin time, prothrombin index and its interpretation.
 - Learn the details of tests based on amino acid catabolism such as estimation of ammonia, ammonia tolerance test, glutamine estimation in CSF and their importance in assessment of liver function.
 - Activities of several enzymes are elevated in liver dysfunction, such as ALP, GPT, OCT, GGT, etc. How these can be useful in differential diagnosis.
- C. Normally more than one test is indicated to assess the liver function. Learn how different tests can be employed and used collectively for assessment of liver function.

Provide a detailed, box-wise classification of each topic to enhance understanding

JAUNDICE

In jaundice, there is yellow colouration of conjunctivae, mucous membrane and skin due to increased bilirubin level. **Jaundice is visible when serum bilirubin exceeds 2.4 mg/dl.**

Classification of Jaundice:

- I. **Rolleston and McNee (1929)**, as modified by Maclagan, (1964): They classified jaundice in **three groups**:
 - (a) **Haemolytic or pre-hepatic jaundice**: In this, there is increased breakdown of Hb, so that liver cells are unable to conjugate all the increased bilirubin formed.

Causes: Principally there are **two categories**:

CLASSIFICATION OF LFTs

Tests used in the study of patients with liver and biliary tract diseases can be classified according to the specific functions of the liver involved.

- I. **Tests based on abnormalities of bile pigment metabolism**:
(N.B: Students must revise their knowledge on haem catabolism)
 - Serum bilirubin and VD Bergh reaction
 - Urine bilirubin
 - Urine and faecal urobilinogen
- II. **Tests based on liver's part in carbohydrate metabolism**:
 - Galactose tolerance test
 - Fructose tolerance test
- III. **Tests based on changes in plasma proteins**:
 - Estimation of total plasma proteins, albumin and globulin and determination of A:G ratio.
 - Determination of plasma fibrinogen
 - Various flocculation tests
 - Amino acids in urine
- IV. **Tests based on abnormalities of lipids**:
 - Determination of serum cholesterol and ester cholesterol and their ratio.
 - Determination of faecal fats
- V. **Tests based on detoxicating function of liver**:
 - Hippuric acid synthesis test.
- VI. **Excretion of injected substances by the liver (excretory function)**:
 - Bromsulphthalein test (BSP retention test)
 - ^{131}I -Rose Bengal test
- VII. **Formation of prothrombin by liver**:
 - Determination of prothrombin time and index
- VIII. **Tests based on amino acid catabolism**:
 - Determination of blood NH_3
 - Determination of glutamine in CS fluid (**Indirect liver function test**)
- IX. **Tests based on drug metabolism**:
 - MEGX test
 - Antipyrine breath test
- X. **Determination of serum enzyme activities.**

drugs, hormones and convert them into less toxic substances for excretion
7. Storage Function
Liver stores glucose in the form of glycogen. It also stores vit. B_{12} , vit. A, etc.

Bergh's diazo-reagent
VD Bergh Reaction
Consists of two parts: Direct reaction and indirect reaction. The latter serves as the basis for a quantitative estimation of serum bilirubin (given ahead).

Functions of liver
Bilirubin is formed in the reticulo-endothelial system of the body and is normally excreted in the urine. In jaundice, it is excreted in the urine and also forms blood in adult.

CLASSIFICATION OF LFTs
Study of patients with liver and biliary tract diseases according to the specific functions of the liver involved.

abnormalities of bile pigment metabolism
must revise their knowledge on haem catabolism and VD Bergh reaction

Urine and faecal urobilinogen
Urine urobilinogen
Urine urobilinogen
Urine urobilinogen
Urine urobilinogen

carbohydrate metabolism
Galactose tolerance test
Fructose tolerance test

changes in plasma proteins
Estimation of total plasma proteins, albumin and globulin and determination of A:G ratio.
Determination of plasma fibrinogen
Various flocculation tests
Amino acids in urine

abnormalities of lipids
Determination of serum cholesterol and ester cholesterol and their ratio.
Determination of faecal fats

detoxicating function of liver
Hippuric acid synthesis test.

Excretion of injected substances by the liver (excretory function)
Bromsulphthalein test (BSP retention test)
 ^{131}I -Rose Bengal test

Formation of prothrombin by liver
Determination of prothrombin time and index

Tests based on amino acid catabolism
Determination of blood NH_3
Determination of glutamine in CS fluid (Indirect liver function test)

Tests based on drug metabolism
MEGX test
Antipyrine breath test

Determination of serum enzyme activities.

ON ABNORMALITIES OF BILE PIGMENT METABOLISM
Serum Bilirubin and Urine Bilirubin
for detecting and estimating bilirubin and on the formation of a purple colour where bilirubin in serum is diazotized by the diazo-reagent.

Table 37.2: Differentiation of three types of jaundice

	Haemolytic or prehepatic jaundice	Hepatic or parenchymatous jaundice	Obstructive or posthepatic jaundice
I. Causes:	Due to excessive haemolysis (a) Intrinsic defects in RB cells (b) Extrinsic causes external to RB Cells	Disease of parenchymal cells of liver viz. Viral hepatitis, toxic jaundice Cirrhosis of the liver	Due to obstruction of biliary passage (a) Extrahepatic gallstones, tumors, enlarged lymph nodes, etc (b) Intrahepatic cholestasis.
II. Clinical findings:			
(a) Degree of jaundice	Usually low +	Marked jaundice ++ to +++	Marked Jaundice ++ to +++
(b) Faeces	Dark coloured	Variable, usually pale	Clay coloured
III. Biochemical findings:			
Based on bile pigment metabolism:	Indirect, may be delayed positive	Biphasic	Direct
1. VD Bergh reaction	Unconjugated bilirubin	Mixture of conjugated and unconjugated bilirubin	Conjugated bilirubin
2. Type of bile pigment in circulation			
3. Serum bilirubin	Usually low 3 mg to 5 mg%	High, up to 20 mg%	Very high, may be up to 50 mg%
4. Bile Pigments in urine:			
• Bilirubin	Not detected	Present	Present ++
• Urobilinogen	Increased ++	May be increased + or normal	Decreased or Absent
5. Faecal Stercobilinogen	Increased ++	Decreased	Decreased or Absent
IV. Statorrhoea:	Not present	Present	Present
V. Other biochemical features:			
1. Prothrombin time (PT)	Normal	Increased	Increased, After parental vit K becomes normal
2. Turbidity and flocculation tests			
• Thymol turbidity	Negative	++ to +++	Negative
3. Enzyme assays:			
• Amino transferase activity ALT (S-GPT)	Usually normal	Marked increase +++ to ++++ (goes in thousand units). Usually 500 to 1500 IU/L or may be more	Increased to ++. Usually 100 to 300 IU/L. Do not exceed 300 IU/L
• Alkaline Phosphatase (ALP)	Normal	Increased slightly (+) usually less than 30 KA Units %	Marked increase 30 to 100 KA units %, more than 35 KA units % suggests obstructive jaundice.
• 5'-Nucleotidase	Normal	Increased (+) Slight	Marked increase ++ to +++

Include tables with detailed information on each disease, covering all relevant aspects.

Each chapter includes multiple-choice, short answer, and essay questions to aid students in exam preparation.

II. MCQs (Give one correct answer)

- In a case of jaundice, there is no trace of bile pigments in urine, the most probable diagnosis is:
 - Infectious hepatitis
 - Obstructive jaundice
 - Serum hepatitis
 - Haemolytic jaundice
- The following enzyme activities are often increased along with the diseases as mentioned in each:
 - Hepatic bilirubin, UDP-Glucuronyl transferase and Gilbert's syndrome
 - Gamma-glutamyl oxidase and viral hepatitis
 - Alkaline phosphatase and cholestatic and obstructive jaundice
 - Gamma-glutamyl transferase and obstructive jaundice
- Jaundice is clinically detected in sclera when serum bilirubin concentration reaches above:
 - 0.5 to 1 mg/100 ml
 - 1 to 2 mg/100 ml
 - 2 to 3 mg/100 ml
 - >5 mg/100 ml
- When jaundice results from hepatitis, the unconjugated fraction of total serum bilirubin is usually:
 - < 2 to 3 mg/100 ml
 - 2 to 3 mg/100 ml
 - 3 to 4 mg/100 ml
 - 4 to 5 mg/100 ml

Liver Function Tests

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Table 37.2: Differentiation of three types of jaundice

Haemolytic or prehepatic jaundice Hepatic or parenchymatous jaundice Obstructive or posthepatic jaundice

Due to excessive haemolysis Disease of parenchymal cells of liver viz. Due to obstruction of biliary passage

(a) Intrinsic defects in RB cells Viral hepatitis, toxic jaundice (a) Extrahepatic gallstones, tumors, enlarged lymph nodes, etc

(b) Extrinsic causes external to RB Cells Cirrhosis of the liver (b) Intrahepatic cholestasis.

II. Clinical findings:

(a) Degree of jaundice Usually low + Marked jaundice ++ to +++ Marked Jaundice ++ to +++

(b) Faeces Dark coloured Variable, usually pale Clay coloured

III. Biochemical findings:

Based on bile pigment metabolism:

Indirect, may be delayed positive Biphasic Direct

1. VD Bergh reaction Unconjugated bilirubin Mixture of conjugated and unconjugated bilirubin Conjugated bilirubin

2. Type of bile pigment in circulation

3. Serum bilirubin Usually low 3 mg to 5 mg% High, up to 20 mg% Very high, may be up to 50 mg%

4. Bile Pigments in urine:

• Bilirubin Not detected Present Present ++

• Urobilinogen Increased ++ May be increased + or normal Decreased or Absent

5. Faecal Stercobilinogen Increased ++ Decreased Decreased or Absent

IV. Statorrhoea: Not present Present Present

V. Other biochemical features:

1. Prothrombin time (PT) Normal Increased Increased, After parental vit K becomes normal

2. Turbidity and flocculation tests

• Thymol turbidity Negative ++ to +++ Negative

3. Enzyme assays:

• Amino transferase activity ALT (S-GPT) Usually normal Marked increase +++ to ++++ (goes in thousand units). Usually 500 to 1500 IU/L or may be more

• Alkaline Phosphatase (ALP) Normal Increased slightly (+) **usually less than 30 KA Units %** Marked increase 30 to 100 KA units %, **more than 35 KA units % suggests obstructive jaundice.**

• 5'-Nucleotidase Normal Increased (+) Slight Marked increase ++ to +++

I. Question (Essay type and short notes)

SECTION FIVE

- Enumerate various functions of the liver. Describe any one test based on its detoxication function in details.
- What are the various liver function tests? Describe any one test based on conjugation mechanism.
- Enumerate various functions of liver. Describe the liver function tests based on excretion of bilirubin.
- Classify liver function tests. Describe the tests based on bile pigment metabolism.
- Classify the liver function tests. Describe the liver function test based on either
 - Excretory function or
 - Detoxication function
- Describe briefly the liver function tests.
- What are the conjugation tests performed for the assessment of liver function? Give details of the oral and the IV procedure.
- Enumerate the diverse metabolic tests performed for the assessment of liver function.

Name liver function tests and give an account of certain enzyme estimations used as liver function tests.

26. Enumerate the tests performed to assess liver function and discuss the excretory tests.

Short Notes

- Liver function test based on detoxication.
- Hippuric acid test
- Vanden Bergh test
- Direct and indirect Van den Bergh test
- Prothrombin time and vit K.
- Hippuric and synthesis test
- Galactose tolerance test
- BSP retention test
- Liver function tests based on protein metabolism
- Biochemical tests for obstructive liver disease
- Liver function tests, related to carbohydrate metabolism
- Bilirubin metabolism and the measurement of serum bilirubin
- Use of enzyme estimations as liver functions tests.

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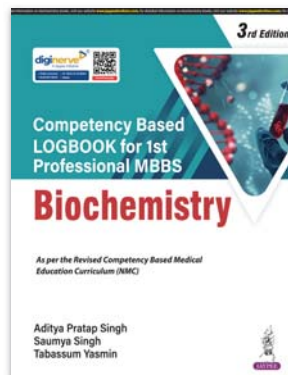
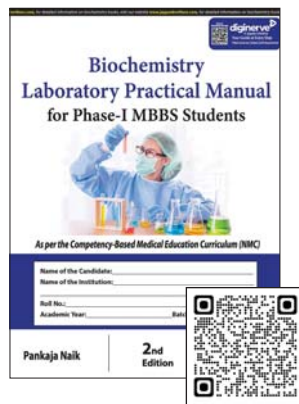
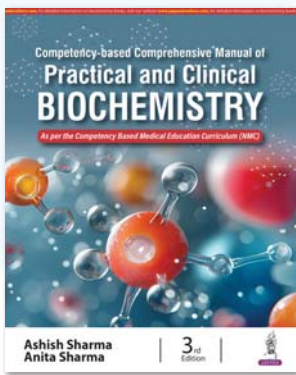
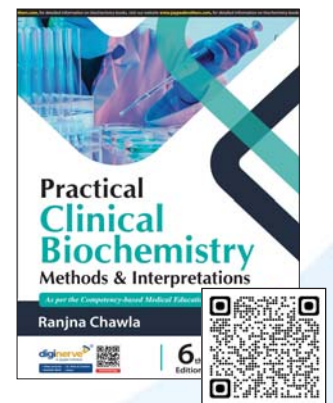
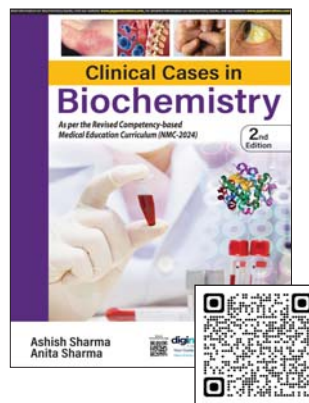
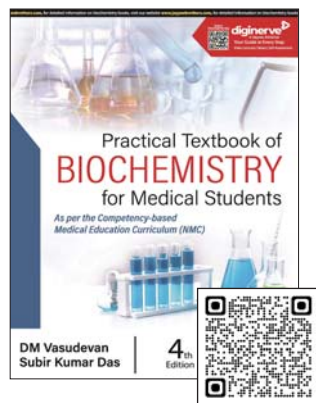
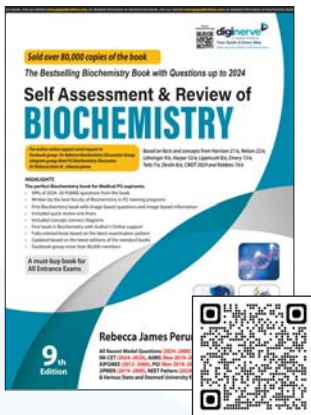
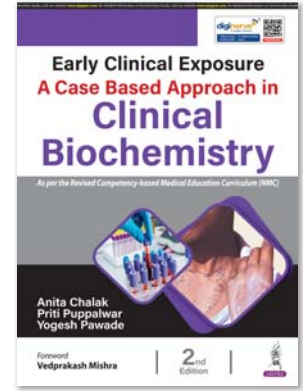
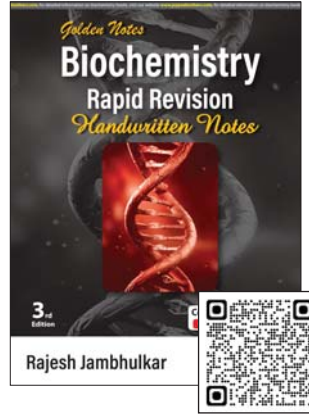
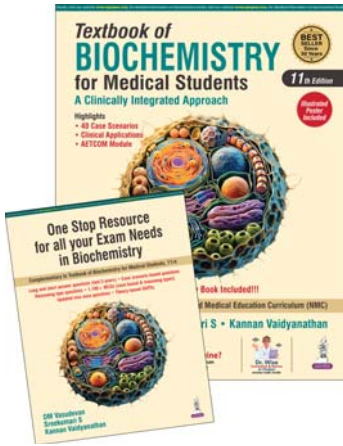
Short Notes

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- Liver function tests, related to carbohydrate metabolism
- Bilirubin metabolism and the measurement of serum bilirubin
- Use of enzyme estimations as liver functions tests.

Fill in the blanks

- The purple colored complex formed in Vanden Bergh test is called _____.
- Certain drugs such as chlorpromazine cause _____ jaundice while gall stones may cause _____ jaundice.
- Presence of bilirubin in urine without the presence of _____ is strongly suggestive of obstructive jaundice.
- In advanced parenchymal liver diseases and cirrhosis of liver albumin is _____ and globulins are _____.
- A complete absence of faecal _____ is strongly suggestive of malignant obstruction.
- In parenchymal liver, diseases in fall in blood galactose in galactose tolerance test takes place _____.
- Epinephrine tolerance test is of much use in glycogen storage disease specially _____.
- In advanced parenchymal liver diseases and in cirrhosis liver the albumin is grossly _____.

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