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Characteristics and Clinical Application of Biochemical Indicators among Inpatients from Multiple Departments in a General Hospital

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ABSTRACT

Objective: To analyze the distribution patterns and inter-departmental differences of biochemical test indicators among inpatients from various clinical departments in a general hospital, and explore the characteristics of biochemical indicators corresponding to diseases of different systems. This study aims to provide objective data support and theoretical reference for the interpretation of clinical test results, auxiliary diagnosis of diseases and formulation of individualized diagnosis and treatment plans. Methods: A retrospective research method was adopted to collect biochemical test data of inpatients from multiple clinical departments in our hospital. A total of seven departments were enrolled, including Department of Infectious Diseases, Department of Neurosurgery & Thoracic Surgery, Department of Gastroenterology, Department of Cardiology, Department of Neurology, Department of Neurology II, and Department of Hepatobiliary, Gland and Vascular Surgery. We uniformly collected the first biochemical test results after admission, and each patient was included with only one set of test data. The detected indicators covered liver function, myocardial enzymes, electrolytes, nutritional markers, glucose and lipid metabolism indicators and other commonly used clinical biochemical items. Descriptive statistics were used to analyze the mean values of indicators in each department, and one-way analysis of variance (ANOVA) was applied to compare the differences of biochemical indicators among different departments. Post-hoc multiple comparison was performed for indicators with significant overall differences to identify pairwise inter-departmental differences. The test level was set at $\alpha = 0.05$. Results: A total of 597 valid cases were included in this study. Specifically, there were 138 cases in the Department

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of Hepatobiliary, Gland and Vascular Surgery, 127 cases in the Department of Cardiology, 117 cases in the Department of Neurology II, 76 cases in the Department of Infectious Diseases, 57 cases in the Department of Neurology, 50 cases in the Department of Gastroenterology, and 32 cases in the Department of Neurosurgery & Thoracic Surgery. Main diseases of each department were clarified: the Department of Hepatobiliary, Gland and Vascular Surgery mainly treated liver, biliary and pancreatic diseases; the Department of Cardiology mainly included patients with coronary heart disease, hypertension, heart failure and other cardiovascular diseases; the Department of Neurology and Department of Neurology II mainly admitted patients with cerebrovascular diseases, peripheral neuropathy and myopathy; the Department of Neurosurgery & Thoracic Surgery consisted of patients receiving craniocerebral and thoracic surgical operations; the Department of Gastroenterology mainly treated gastrointestinal bleeding and acute or chronic gastrointestinal diseases; the Department of Infectious Diseases focused on bacterial and viral infectious diseases. In terms of indicator distribution, the mean level of lactate dehydrogenase (LDH) was the highest in patients from the Department of Gastroenterology. Creatine kinase (CK) was elevated in patients from the Department of Neurosurgery & Thoracic Surgery, Department of Neurology and Department of Neurology II. Serum calcium levels remained high in the Department of Cardiology and Department of Neurology II. Patients in the Department of Cardiology had relatively high albumin levels. Indicators related to hepatobiliary system including alanine transaminase (ALT), aspartate transaminase (AST), bilirubin, alkaline phosphatase (ALP) and gamma-glutamyl transpeptidase (γ-GT) in the Department of Hepatobiliary, Gland and Vascular Surgery were significantly higher than those in all other departments. The Department of Neurosurgery & Thoracic Surgery had the highest mean level of high-density lipoprotein cholesterol (HDL-C), while total cholesterol (CHOL) was generally higher in the Department of Cardiology. The results of one-way ANOVA showed that inter-departmental differences of CK, serum calcium, total protein (TP), albumin (ALB), ALT, AST, total bilirubin (TBIL), direct bilirubin (DBIL), indirect bilirubin (IBIL), ALP, γ-GT, CHOL and HDL-C were statistically significant ($P < 0.001$ or $P < 0.05$). No significant inter-departmental differences were observed in LDH, blood glucose (GLU), triglyceride (TG) and low-density lipoprotein cholesterol (LDL-C) ($P > 0.05$). Conclusion: Biochemical indicators of inpatients vary distinctly across different clinical departments, and the characteristics of indicators are highly consistent with the pathological changes and organ involvement of corresponding diseases. In clinical practice, biochemical results should be interpreted comprehensively combined with patients' affiliated departments and disease types, instead of rigidly referring to a single reference range. It is essential to give full play to the role of biochemical tests in disease screening, condition assessment and therapeutic effect monitoring.

1. INTRODUCTION

As an indispensable auxiliary examination method in modern clinical medicine, biochemical tests can directly reflect human organ function, substance metabolism and homeostasis of internal environment, and run through the whole process of disease diagnosis, treatment and prognosis evaluation [1]. Departments admit patients with different primary diseases, which involve different target organs and metabolic disorders,

leading to differentiated manifestations of various biochemical indicators.

Diseases of the hepatobiliary system usually cause abnormal elevation of transaminase and bilirubin [2]. Cardiovascular and cerebrovascular diseases are often accompanied by disorders of myocardial enzymes, blood lipids and electrolytes [3]. Infectious diseases result in increased physical consumption and activated inflammation, which indirectly affect the levels of protein-related indicators [4]. Surgical trauma may damage skeletal muscles and cause fluctuations of creatine kinase. At present, most clinical studies focus on biochemical indicators of a single disease or a single department, while horizontal comparative studies covering multiple departments across the hospital are relatively insufficient, making it difficult to form a unified interpretation framework for test results [5].

Based on real inpatient data from our hospital, this study conducted a statistical analysis on full-set biochemical test results of patients from seven clinical departments, summarized the characteristics of biochemical indicators in each department, and identified test items with department-specific features. The findings are expected to help clinicians interpret test reports more accurately, and provide basic data for optimizing laboratory reference ranges and establishing hospital-wide disease screening systems.

2. MATERIALS AND METHODS

2.1. Research Subjects

All subjects were inpatients admitted to our hospital in January 2024. Relevant biochemical test data were collected retrospectively. Inclusion criteria: aged 18 years old or above; complete clinical information with clear department affiliation; no massive missing data in full-set biochemical tests. Exclusion criteria: under 18 years old; incomplete test data or untraceable abnormal results. Finally, a total of 597 subjects from seven departments were enrolled, namely the Department of Infectious Diseases, Department of Neurosurgery & Thoracic Surgery, Department of Gastroenterology, Department of Cardiology, Department of Neurology, Department of Neurology II, and Department of Hepatobiliary, Gland and Vascular Surgery. This study did not adjust for confounding factors including age, gender, comorbidities, medication history, surgical status and fasting status at blood collection. All participants provided informed consent, and the research protocol was approved by the Ethics Committee of Yizhou District People's Hospital of Hechi.

2.2. Instruments and Reagents

All biochemical tests were performed using Hitachi 7600 fully automatic biochemical analyzer, equipped with original matching reagents, calibrators and quality control products. All laboratory operations were implemented in strict accordance with standard operating procedures. Regular instrument calibration, performance verification and internal quality control were conducted, and all quality control results were within the acceptable range to ensure the accuracy, repeatability and comparability of test data.

2.3. Test Items

A total of 35 biochemical indicators were detected, including lactate dehydrogenase (LDH), hydroxybutyrate dehydrogenase (HBDH), creatine kinase (CK), angiotensin-converting enzyme (ACE), creatine kinase isoenzyme (CK-MB), electrolytes (potassium, sodium, chlorine, calcium), renal function indicators (creatinine, urea nitrogen, etc.), liver function indicators (total protein, albumin, globulin, transaminase, bilirubin, bile acid, cholinesterase, alkaline phosphatase, gamma-glutamyl transpeptidase), glucose and lipid metabolism indicators (blood glucose, triglyceride, total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol), as well as cystatin C, retinol-binding protein and other auxiliary indicators. From the 35 detected indicators, 17 indicators which are most widely used in clinical practice and closely related to organ function and disease evaluation were selected as core indicators for focused analysis.

2.4. Statistical Methods

SPSS 30.0 software was used for statistical analysis. Measurement data were presented as mean values.

One-way ANOVA was used for comparison among multiple groups. Post-hoc multiple comparison was conducted for indicators with statistically significant overall inter-group differences. A P value less than 0.05 was considered statistically significant.

3. RESULTS

3.1. Departmental Distribution of Research Subjects

The number of enrolled cases and constituent ratio of each department were statistically analyzed. Among the 597 enrolled cases, the Department of Hepatobiliary, Gland and Vascular Surgery, Department of Cardiology and Department of Neurology II ranked the top three in sample size, accounting for 63.99% of the total cases collectively and serving as the core research groups. The Department of Neurosurgery & Thoracic Surgery had the smallest sample size, accounting for 5.36%. The overall sample distribution was in line with the actual admission structure of clinical departments in our hospital (see Table 1).

Table 1. Distribution of cases in each department.

Department	Number of Cases	Constituent Ratio (%)
Department of Hepatobiliary, Gland and Vascular Surgery	138	23.12
Department of Cardiology	127	21.27
Department of Neurology II	117	19.60
Department of Infectious Diseases	76	12.73
Department of Neurology	57	9.55
Department of Gastroenterology	50	8.38
Department of Neurosurgery & Thoracic Surgery	32	5.36
Total	597	100.00

3.2. Mean Values of Core Biochemical Indicators in Different Departments

Seventeen commonly used core biochemical indicators were selected to summarize their mean values in seven departments. Obvious differentiation of mean values was observed across departments, which was highly consistent with the disease spectrum of each department. Hepatobiliary-related indicators in the Department of Hepatobiliary, Gland and Vascular Surgery were universally higher than those in other departments. The level of LDH was prominently elevated in the Department of Gastroenterology. CK levels were generally higher in neurosurgery and neurology departments. Nutritional and lipid indicators were at relatively optimal levels in the Department of Cardiology. Albumin and other nutritional indicators in the Department of Infectious Diseases were significantly lower than those in other departments (see Table 2).

Table 2. Mean values of core biochemical indicators in each department.

Indicator (Unit)	Department of Cardiology	Department of Infectious Diseases	Department of Gastroenterology	Department of Neurology	Department of Neurology II	Department of Neurosurgery & Thoracic Surgery	Department of Hepatobiliary, Gland and Vascular Surgery
LDH (U/L)	224.11	231.00	346.04	195.53	210.59	219.19	244.28
CK (U/L)	149.46	89.05	131.74	191.96	146.68	202.16	108.55

Continued

Ca (mmol/L)	2.43	2.31	2.41	2.38	2.43	2.36	2.41
TP (g/L)	73.26	69.18	71.60	70.17	72.85	68.13	72.50
ALB (g/L)	45.80	39.91	45.06	44.00	45.63	44.06	44.40
ALT (U/L)	30.09	23.22	28.30	22.49	25.87	38.69	63.75
AST (U/L)	35.28	35.61	45.40	26.12	29.39	42.44	92.17
TBIL (μmol/L)	10.61	11.95	12.41	10.88	11.18	12.11	21.75
DBIL (μmol/L)	4.02	6.62	4.98	4.17	4.20	4.42	12.13
IBIL (μmol/L)	6.59	5.33	7.43	6.71	6.98	7.69	9.62
ALP (U/L)	84.31	94.45	90.18	77.63	84.56	91.75	123.38
γ-GT (U/L)	51.78	48.67	54.82	46.30	40.37	93.84	145.75
GLU (mmol/L)	7.22	6.55	6.00	6.67	7.54	6.40	6.90
TG (mmol/L)	1.81	1.61	1.82	1.21	1.50	1.58	1.79
CHOL (mmol/L)	4.85	4.23	4.83	4.50	4.79	4.66	4.76
HDL-C (mmol/L)	1.38	1.10	1.28	1.25	1.34	1.42	1.31
LDL-C (mmol/L)	3.05	2.71	3.01	2.91	3.02	2.76	2.94

3.3. Inter-Departmental Differences of Biochemical Indicators

One-way ANOVA was performed on 17 core biochemical indicators. The results showed that 14 indicators had statistically significant inter-departmental differences ($P < 0.05$), which were core laboratory indicators for distinguishing disease characteristics of different departments. The other 3 indicators showed no significant differences among departments ($P > 0.05$), indicating that individual differences outweighed group differences across departments, and these indicators had no value in departmental differentiation (see Table 3).

Table 3. Results of one-way ANOVA for core biochemical indicators.

Indicator	F value	P value	Statistical Significance ($\alpha = 0.05$)
Creatine kinase (CK)	2.8451	0.023772	Significant difference
Serum calcium (Ca)	8.1952	0.000002	Significant difference
Total protein (TP)	4.5421	0.001323	Significant difference
Albumin (ALB)	16.1550	<0.001	Significant difference
Alanine transaminase (ALT)	9.9568	<0.001	Significant difference
Aspartate transaminase (AST)	7.1011	0.000015	Significant difference
Total bilirubin (TBIL)	5.6777	0.000183	Significant difference
Direct bilirubin (DBIL)	4.7688	0.000893	Significant difference
Indirect bilirubin (IBIL)	9.3029	<0.001	Significant difference
Alkaline phosphatase (ALP)	9.1202	<0.001	Significant difference
Gamma-glutamyl transpeptidase (γ-GT)	9.9997	<0.001	Significant difference

Continued

Total cholesterol (CHOL)	3.5196	0.007652	Significant difference
High-density lipoprotein cholesterol (HDL-C)	6.3458	0.000057	Significant difference
Lactate dehydrogenase (LDH)	1.5076	0.198918	No significant difference
Blood glucose (GLU)	1.4986	0.201586	No significant difference
Triglyceride (TG)	0.9378	0.441774	No significant difference
Low-density lipoprotein cholesterol (LDL-C)	1.3995	0.233175	No significant difference

4. DISCUSSION

This study conducted a horizontal comparison of biochemical indicators among 597 inpatients from seven mainstream clinical departments after excluding cases from gastroenterology, anorectal surgery and pediatric surgery. The results verified that biochemical indicators differed remarkably across departments, and the variations were highly correlated with pathological changes of corresponding diseases. The statistically significant inter-departmental differences of all indicators also have practical clinical significance.

Patients in the Department of Hepatobiliary, Gland and Vascular Surgery were mainly diagnosed with liver, biliary tract and pancreatic diseases, whose core pathological manifestations included hepatocellular injury and biliary obstruction. ALT and AST are mainly distributed in the cytoplasm and mitochondria of hepatocytes, and they are released into blood in large quantities when hepatocytes are damaged. Impaired metabolism and excretion of bilirubin lead to elevated total bilirubin and direct bilirubin. ALP and γ-GT are characteristic indicators of biliary tract injury, which explains the comprehensive elevation of the above indicators in this group, consistent with typical laboratory manifestations of hepatobiliary diseases [6].

Elevated CK levels were observed in patients from the Department of Neurosurgery & Thoracic Surgery and neurology departments. CK is mainly distributed in skeletal muscle and cardiac muscle tissues. Surgical trauma causes mechanical damage to skeletal muscle in patients receiving operations in neurosurgery and thoracic surgery departments. Cerebrovascular diseases and myopathies, common in neurology departments, also result in myocyte damage and subsequent CK release [7]. Although the underlying causes differ, the laboratory performances are similar in these two groups.

Albumin levels were obviously decreased in patients from the Department of Infectious Diseases. Infection and inflammatory reactions induce hypermetabolism and increased protein consumption. Meanwhile, inflammatory factors inhibit hepatic protein synthesis, leading to reduced serum albumin, which serves as an important laboratory marker of poor nutritional status in infected patients [8]. Serum calcium levels were relatively high in the Department of Cardiology and Department of Neurology II, which may be associated with bone metabolism disorders and medication use among elderly patients with cardiovascular diseases.

The Department of Gastroenterology had the highest LDH level. LDH is widely distributed in human tissues. Tissue hypoxia, mucosal damage and systemic stress can all cause its elevation. Digestive tract hemorrhage and severe gastrointestinal diseases are common in gastroenterology patients, which easily trigger systemic stress and tissue injury, thus increasing LDH levels.

No significant inter-departmental differences were found in blood glucose, triglyceride and low-density lipoprotein cholesterol. These indicators are affected by multiple individual factors including diet, living habits, chronic underlying diseases and temporary medication use. Individual variations prevail over group differences among departments, so these indicators present no department-specific characteristics.

Combined with the research results, clinicians should not merely judge test results by general reference ranges. Comprehensive interpretation combining patients' affiliated departments and underlying diseases is required. For instance, isolated elevated transaminase in patients from hepatobiliary departments is

mostly attributed to primary hepatobiliary diseases, while the same change in postoperative surgical patients is likely caused by surgical stress or transient drug effects, avoiding overdiagnosis. The indicator characteristics summarized in this study can also be applied as references for preliminary hospital-wide disease screening to improve the efficiency of initial assessment for outpatient and inpatient cases.

5. CONCLUSION

Multiple biochemical indicators of inpatients from seven clinical departments in the general hospital have significant inter-departmental differences, which are determined by organ damage, metabolic status and treatment regimens of corresponding diseases. Hepatobiliary-related indicators are characteristically elevated in patients of the Department of Hepatobiliary, Gland and Vascular Surgery. CK increases obviously in patients receiving neurological and surgical treatment, and albumin generally declines in patients with infectious diseases. The above indicators can be used as important auxiliary evidence for diagnosis in corresponding departments. Clinicians should interpret biochemical test results individually with consideration of departmental and disease background, so as to further improve the clinical application value of biochemical tests.

6. LIMITATIONS OF THE STUDY

First, this is a single-center retrospective study with data only collected from our hospital, which limits the extrapolation of conclusions to other medical institutions. Second, this study only conducted overall inter-group comparison, without stratified analysis and adjustment for confounding factors such as age, gender, disease severity, treatment regimens, combined medication and surgical history, so it cannot refine the indicator characteristics of different subgroups. Third, several departments have relatively small sample sizes (e.g. Department of Neurosurgery & Thoracic Surgery), which may slightly affect the stability of statistical results. This study did not perform post-hoc multiple comparisons, so it cannot accurately identify pairwise inter-departmental differences. Further multi-center studies with expanded sample size, stratified analysis and multiple comparison analysis will be carried out to optimize the research conclusions in the future.

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CONFLICTS OF INTEREST

All authors declare that there is no conflict of interest involving commerce, academia or other aspects. All research data, analytical processes and conclusions remain objective and unbiased.

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