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Analysis of the Testing Value of Hierarchical Testing Methods in Clinical Blood Lipid Biochemical Testing

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Abstract: *Objective:* To analyze the testing value of hierarchical testing methods in clinical blood lipid biochemical testing. *Methods:* 120 subjects who required blood lipid biochemical testing received by our hospital from January 2024 to January 2025 were selected and divided into a hierarchical testing group (60 cases) and a routine testing group (60 cases) according to different testing methods. The routine inspection group adopts the full-item routine inspection method, and the graded inspection group adopts the graded inspection method, that is, the basic items of total cholesterol (TC) and triglycerides (TG) are first detected, and then high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C) and other items are selectively tested based on the results of the basic items. Compare the accuracy of test results, test time, test costs, and subject satisfaction between the two groups. *Results:* When comparing the test results of TC, TG, HDL-C, and LDL-C between the two groups, the difference was not statistically significant ($p > 0.05$); the inspection time of the graded inspection group was shorter than that of the conventional inspection group, the inspection cost was lower than that of the conventional inspection group, and the subject satisfaction was higher than that of the conventional inspection group ($p < 0.05$). *Conclusion:* The use of hierarchical testing methods in clinical blood lipid biochemical testing can shorten testing time, reduce testing costs, and improve subject satisfaction while ensuring testing accuracy, and has high clinical application value.

Keywords: Blood lipid biochemical test; Graded test; Test accuracy; Test time; Test cost

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1. Introduction

Disorders of blood lipid metabolism are key triggers of cardiovascular and cerebrovascular diseases such as atherosclerosis and coronary heart disease. Timely and accurate biochemical detection of blood lipids plays a very important role in the early detection, diagnosis and prognosis of diseases [1,2]. Most of the blood lipid biochemical tests commonly used in clinical practice at this stage are all-item routine testing, which means total cholesterol (TC), triglycerides (TG), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C) and other indicators are measured uniformly for all subjects. Although blood lipid-related data can be comprehensively obtained, the test is time-consuming and expensive. At the same time, some healthy subjects do not need to undergo all-item testing, which can easily lead to unnecessary

consumption of medical resources [3]. The hierarchical testing model is based on the principle of first basic and then targeted, and selectively implements subsequent project measurements based on the basic project testing results, which can achieve a reasonable allocation of testing resources [4]. Based on this situation, this study selected 120 subjects in our hospital who required blood lipid biochemical testing as research subjects to explore the clinical application value of the hierarchical testing model and provide scientific reference for optimizing blood lipid testing programs and improving testing service levels.

2. Materials and methods

2.1. General information

We selected 120 subjects who required blood lipid biochemical testing received by our hospital from January 2024 to January 2025, and divided them into a hierarchical testing group (60 cases) and a routine testing group (60 cases) according to different testing methods. There were 32 males and 28 females in the hierarchical examination group, aged from 22 to 68 years old, with an average age of (45.36 ± 8.24) years; including 35 healthy subjects and 25 suspected dyslipidemia subjects. In the routine examination group, there were 33 males and 27 females, aged 23–67 years old, with an average age of (45.82 ± 8.16) years; including 34 healthy subjects and 26 suspected dyslipidemia subjects. Comparison of general information such as gender, age, type of examination, etc. between the two groups of subjects showed no statistically significant difference ($p > 0.05$) and they were comparable.

2.1.1. Inclusion criteria

(1) Blood lipid biochemical test is required;
(2) Clear consciousness and voluntary participation in this study;
(3) Complete clinical data.

2.1.2. Exclusion criteria

(1) Combined with severe liver and kidney insufficiency;
(2) Recently taken drugs that affect blood lipid metabolism;
(3) Existence of blood system diseases;
(4) Refusal to cooperate in completing examinations and satisfaction surveys.

2.2. Method

2.2.1. Sample collection:

5 mL of venous blood was drawn from both groups of subjects on an empty stomach in the early morning. After centrifugation at a speed of 3000 rpm for 10 minutes, serum was extracted for subsequent testing.

2.2.2. Routine inspection on subject's blood lipid

The routine inspection team adopts a full-item routine inspection method and uses the fully automatic biochemical analyzer model Beckman AU5800 to uniformly measure the four core blood lipid indicators of TC, TG, HDL-C, and LDL-C for all subjects. The detection reagents are all supporting products for the instrument, and the measurement work was carried out in strict accordance with the instrument operation manual and testing standard procedures.

2.2.3. The hierarchical inspection team implements the hierarchical testing model.

The specific process is as follows: The first-level test first measures two basic blood lipid indicators, TC and TG, for all subjects. The detection method is consistent with the instrument and the routine test group; the second-level test determines whether to carry out follow-up project measurements based on the first-level test results. The grading standards refer to the Chinese Adult Dyslipidemia Prevention and Treatment Guidelines. 2023 version: First, if TC is less than 5.2 mmol/L

and TG is less than 1.69 mmol/L, it means that blood lipids are in the normal range, and HDL-C and LDL-C testing is not required; secondly, if TC is ≥ 5.2 mmol/L or TG is ≥ 1.69 mmol/L, it means that blood lipids are abnormal or suspected to be abnormal, and HDL-C and LDL-C indicators are further measured.

2.3. Observation indicators

Compare the TC, TG, HDL-C, and LDL-C test data of the two groups of subjects. Among them, the hierarchical inspection group only counts the values of those who completed the four indicator tests; the average testing time of the two groups of subjects is recorded, that is, the time from the receipt of the sample to the issuance of the report; the testing cost statistics of the two groups of subjects The average testing fee includes reagent fees, instrument usage fees, etc.; the subject's satisfaction is evaluated using a self-made satisfaction scale, which covers two dimensions such as testing time and cost rationality. The total score is 100 points, ≥ 85 is considered very satisfied, 60–84 is considered satisfied, and < 60 is considered dissatisfied.

2.4. Statistical methods

Data were analyzed using SPSS24.0 software. Measurement data are expressed as ($\bar{x} \pm s$), using t test; count data are expressed as [n (%)], using χ^2 test. $p < 0.05$ means the difference is statistically significant.

3. Results

3.1. Comparison of accuracy of test results between two groups

In the graded inspection group, a total of 28 subjects, accounting for 46.67%, required secondary inspection after the first-level inspection; in the routine inspection group, 60 subjects all completed the four index tests. Comparing the test results of TC, TG, HDL-C, and LDL-C between the two groups of people who completed the four index tests, there was no statistically significant difference ($p > 0.05$). See **Table 1** for details.

Table 1. Comparison of accuracy of test results between two groups ($\bar{x} \pm s$, mmol/L)

Group	n	TC	TG	HDL-C	LDL-C
Routine inspection team	60	4.86 ± 1.02	1.58 ± 0.64	1.28 ± 0.24	3.12 ± 0.86
Graded inspection team	28	4.92 ± 1.08	1.62 ± 0.68	1.30 ± 0.26	3.18 ± 0.82
t		0.252	0.268	0.355	0.309
p		0.801	0.790	0.724	0.758

3.2. Comparison of inspection time and inspection costs between the two groups

The average inspection time of the graded inspection group is shorter than that of the conventional inspection group, and the per capita inspection cost is lower than that of the conventional inspection group ($p < 0.05$). See **Table 2** for details.

Table 2. Comparison of inspection time and inspection cost between two groups ($\bar{x} \pm s$)

Group	n	Average inspection time (min)	Inspection cost per capita (yuan)
Routine inspection team	60	68.32 ± 10.46	128.64 ± 15.32
Graded inspection team	60	42.58 ± 8.62	86.32 ± 12.48
t		11.338	12.763
p		0.000	0.000

3.3. Comparison of satisfaction between the two groups of subjects

The total satisfaction of the subjects in the graded inspection group was higher than that in the conventional inspection group ($p < 0.05$). See **Table 3** for details.

Table 3. Comparison of satisfaction between the two groups of subjects [n (%)]

Group	n	Very satisfied	Satisfied	Not satisfied	Overall satisfaction
Routine inspection team	60	25 (41.67)	18 (30.00)	17 (28.33)	43 (78.33)
Graded inspection team	60	38 (63.33)	19 (31.67)	3 (5.00)	57 (95.00)
χ^2					11.760
p					0.001

4. Discussion

Blood lipid biochemical testing is an important way to clinically diagnose blood lipid metabolism disorders and evaluate the probability of cardiovascular and cerebrovascular diseases. The rationality of the testing method is directly related to the credibility of the testing results and the effectiveness of the use of medical resources. Although conventional full-item testing can comprehensively cover core blood lipid indicators and provide sufficient reference for clinical diagnosis, this method does not distinguish the basic blood lipid conditions of subjects. Full-item testing is still performed on healthy subjects or subjects with normal blood lipids. This not only increases the economic pressure on subjects but also prolongs the testing time. It reduces testing efficiency and also causes unnecessary consumption of medical resources such as reagents and instruments. With the continuous advancement of medical reform, the concepts of precision medicine and efficient medical care have gradually become popular, and exploring a blood lipid detection method that takes into account accuracy, economy, and efficiency has become the core direction of clinical research [5].

The hierarchical testing model focuses on the core idea of hierarchical screening and accurate detection, and divides blood lipid testing into two levels: basic project testing and targeted project testing. It uses the results of basic projects to screen out people who need in-depth testing to achieve differentiated deployment of testing resources [6]. The data of this study show that there is no significant difference in the test results of TC, TG, HDL-C, and LDL-C between the two groups of people who completed the four-index test, indicating that the hierarchical test model did not reduce the test accuracy due to the selective implementation of test items. The reason is that the testing instruments, reagents and operating procedures used in the hierarchical testing mode are completely consistent with conventional testing. Only the order and scope of testing items are optimized. The core testing principles have not changed, which can ensure the reliability of testing results [7]. For subjects with normal blood lipids, only completing basic items of testing can meet the health assessment needs, without the need for additional HDL-C and LDL-C testing; for subjects with abnormal or suspected abnormal blood lipids, further testing of all items can ensure that key diagnostic indicators are not missed, provide a comprehensive reference for subsequent clinical intervention, and achieve the goal of reducing the burden on healthy people and accurately detecting sick people.

In terms of testing efficiency and cost control, the average testing time of the hierarchical testing group was significantly shorter than that of the conventional testing group, and the per capita testing cost was also significantly lower than that of the conventional testing group. Both differences were statistically significant. From the analysis of the testing process, the conventional testing team needs to simultaneously measure four indicators for all subjects, and the heavy burden of sample testing leads to an increase in the time required to issue reports. The hierarchical testing team only conducts full-item testing on some subjects, reducing the workload of instrument testing and shortening the sample turnover time. It is especially suitable for scenarios with large sample volumes such as physical examination peaks. At the cost level, nearly half of the subjects in the hierarchical inspection group only need to pay for two basic items of testing,

and do not need to bear the expenses related to HDL-C and LDL-C testing, which greatly reduces economic pressure; at the same time, it reduces the use of unnecessary reagents and instrument losses, achieving medical resource savings, and is in line with my country's current development direction of rational allocation of medical resources [8]. In this study, 46.67% of the subjects in the grading test group required secondary testing, which is basically consistent with the incidence of common clinical dyslipidemia. It further shows that the grading standard has strong clinical applicability and can accurately screen out people who need key testing.

Subject satisfaction is an important basis for judging the level of testing services. The data of this study show that the total satisfaction of subjects in the graded inspection group reached 95.00%, which was significantly higher than the 78.33% of the conventional inspection group. The reason for analysis is that on the one hand, the hierarchical testing model shortens the testing time and reduces the waiting costs of the subjects, especially for those who are short of time. On the other hand, the reduction of testing costs effectively reduces the economic pressure and enhances the recognition of testing services. In addition, during the hierarchical testing process, medical staff will explain the principles, processes and advantages of hierarchical testing to the subjects in detail, thereby enhancing the subjects' understanding and trust of the testing plan, further improving the quality of nurse-patient communication and improving the medical experience. Some subjects in the routine examination group were dissatisfied due to the long testing time and high cost. The hierarchical examination group effectively solved these outstanding problems through process optimization and cost control, and significantly improved the subjects' satisfaction with medical treatment.

The application of hierarchical testing mode in clinical blood lipid biochemical testing fully demonstrates the subject-centered service concept. Its core advantage lies in taking into account testing accuracy, efficiency and economy, and achieving a balance between medical quality and medical cost. In clinical practice, the setting of grading testing standards must be combined with authoritative guidelines and the actual testing situation of our hospital to ensure the rationality and scientificity of grading. The grading standard used in this study refers to the 2023 version of the Chinese Adult Dyslipidemia Prevention and Treatment Guidelines. This standard has been verified by a large number of clinical trials, is highly authoritative and applicable, and can accurately distinguish between people with normal and abnormal blood lipids. At the same time, during the implementation of graded testing, professional training for medical staff needs to be strengthened so that they are proficient in the graded testing process, standards and communication skills, and can accurately explain the testing plan to the subjects to avoid misunderstandings caused by inadequate communication.

From the perspective of clinical promotion, the hierarchical detection mode has a simple operation process and does not require the addition of additional instruments and equipment. It only requires optimization and adjustment of the existing detection process, making it easy to promote and apply it in medical institutions at all levels. For primary medical institutions, the hierarchical testing model can effectively reduce testing costs, reduce the economic pressure on primary subjects, improve testing efficiency, and better meet the needs of primary medical services. For large hospitals, this model can reduce the burden of sample testing during peak physical examination periods, optimize the allocation of testing resources, and improve the overall testing service level. In addition, the grading testing mode can also be combined with information management methods to automatically identify grading standards with the help of the testing system to achieve automatic screening of testing items and report generation, further improving testing efficiency.

Clinical practice has also found that the use of hierarchical testing models requires attention to personalized adjustments. For high-risk groups with a history of hypertension, diabetes, and family genetic history, the hierarchical standards can be appropriately relaxed to directly carry out full-item testing to ensure that potential dyslipidemia is not missed. At the same time, it is necessary to strengthen the health education of subjects, popularize the advantages of graded blood lipid testing and the dangers of abnormal blood lipids, and increase the attention and cooperation of subjects to blood lipid testing. In addition, regular evaluation of the application effect of the grading detection model and timely adjustment of the grading standards and testing procedures based on clinical feedback can further enhance its clinical applicability.

In general, the use of hierarchical detection mode in clinical blood lipid biochemical testing can significantly shorten the testing time, reduce testing expenses, improve the acceptance of the subjects, and achieve reasonable allocation of

medical resources while ensuring the accuracy of testing, and has high clinical promotion value. In clinical testing work, we should actively promote the hierarchical testing model, optimize the testing plan based on the individual conditions of the subjects, continue to improve the accuracy, efficiency and economy of blood lipid testing services, and provide strong support for the early prevention and control of cardiovascular and cerebrovascular diseases.

Disclosure statement

The author declares no conflict of interest.

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