การศึกษาเปรียบเทียบการตรวจวัดระดับ cholesterol ในเลือด ด้วยวิธี cholesterol biosensor และ standard CHOD-PAP method

วิโรจน์ ไววานิชกิจ*

*ภาควิชาเวชศาสตร์ชันสูตรคณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย กรุงเทพมหานคร 10330

Comparative Study between Blood Cholesterol Determination between Cholesterol Biosensor and Standard CHOD-PAP Method

Wiwanitkit V*
*Department of Laboratory Medicine, Faculty of Medicine, Chulalongkorn University.

Objective: to compare between blood cholesterol determination between cholesterol biosensor and standard CHOD-PAP method

Study design: A laboratory method comparative study

Subjects: blood samples from 100 individual subjects.

Methods: For each subject, venipuncture was performed to collect venous blood specimen into 5 milliliters for standard venous cholesterol determination using cholesterol CHOD-PAP method and for new cholesterol determination using new cholesterol biosensor (Boehringer Manheim). Then comparison for both methods was performed.

Results: The average biosensor cholesterol level was 247.08 ± 124.82 mg/dL (range 55 - 445 mg/dL) and the average standard cholesterol level was 246.73 ± 124.65 mg/dL (range 55 - 445 mg/dL). From the study, the comparison-of-methods plot venous cholesterol CHOD-PAP standard method (X) VS cholesterol biosensor method (Y) gave the least square linear regression equation of $Y = 0.997 X \pm 0.382$ (r = 0.998)

Conclusion: The new cholesterol biosensor determination gave good correlation to the standard method. It seems to be an effective for cholesterol determination

Key Words: cholesterol determination

วัตถุประสงค์: เพื่อศึกษาเปรียบเทียบการหาระดับ cholesterol ในเลือดด้วยวิธี cholesterol biosensor และ standard CHOD-PAP

ตัวอย่าง: ตัวอย่างเลือด 100 ตัวอย่าง

วิธีการ: ได้เก็บตัวอย่างเลือดจากเส้นเลือดดำจำนวนตัวอย่างละ 5 มิลลิลิตร เพื่อส่งตรวจวัดระดับ cholesterol ด้วยวิธีมาตรฐาน cholesterol CHOD-PAP เปรียบเทียบกับวิธี cholesterol biosensor (Boehringer Manheim)

ผลการศึกษา: จากการตรวจวิธี biosensor ได้ระดับ cholesterol เฉลี่ยเท่ากับ 247.08 ± 124.82 mg/dL (พิสัย 55 - 445 mg/dL) และวิธีมาตรฐานได้ระดับ cholesterol เฉลี่ยเท่ากับ 246.73 ± 124.65 mg/dL (พิสัย 55 - 445 mg/dL) จากการศึกษานี้พบสมการความสัมพันธ์กำลังสองน้อยที่สุด ระหว่าง venous cholesterol CHOD-PAP standard method (X) VS cholesterol biosensor method (Y) แสดงได้เป็น Y = 0.997 X + 0.382 (r = 0.998)

สรุป: การตรวจวัดระดับ cholesterol ด้วยวิธี biosensor มีความสัมพันธ์ที่ดีกับวิธีมาตรฐาน

คำสำคัญ: การตรวจวัดระดับ cholesterol

Hypercholesterolemia[1,2] is a very important health problem in the present day. Monitoring of blood cholesterol has proved to be a valuable tool in screening for early stage of hypercholesterolemia and recommended for annual check up program of the population aged > 35 years old. [3,4]

However, taking venous blood test for cholesterol sometimes seem not comfortable for follow up the lipidemic patient. Due to the point-of-care concepts in the present day, blood cholesterol evaluation by cholesterol reagent strip with biosensor is a new technique even provides a rapid, inexpensive, sensitive and accurate measurement.

The new biosensor technique seems to be the new technology produced to solve the problem of measuring cholesterol. This study was set in order to test the new cholesterol biosensor comparing to the standard venous cholesterol determination.

Materials and method

This study was performed in Laboratory Medicine Department, King Chulalongkorn Memorial Hospital. All 100 individual subjects were included in this study. Venipuncture was performed on each subject to collect venous blood specimen into 5 milliliters plain tube (Beckton-Dickinson[R]) for venous cholesterol determination.

1. new cholesterol biosensor

The new cholesterol biosensor mentioned in this study is Accutrend Cholesterol (Boehringer Manheim), which is a dry chemistry analysis. Only one droplet of blood sample is required for each analysis. After applying blood sample onto the strip and inserting into the analyzer, Accutrend GCT (Boehringer Manheim). The result can be automatically shown on the analyzer screen with in 3 seconds.

2. standard venous cholesterol determination

Collected venous blood was separated for serum composition. Then the serum was analyzed using cholesterol CHOD-PAP standard method on a automated clinical chemistry analyzer, Hitachi 917. The CHOD-PAP method can briefly presented as using microorganism-derived lipoprotein lipase for hydrolysis of triglyceride to glycol then following by step by step oxidation to form a red dye stuff (Trinder endpoint reaction).

Result from each determination was collected and then analyzed. Precision analysis for the new cholesterol biosensor was performed. Comparison between new cholesterol biosensor and standard cholesterol determination was performed using linear regression analysis.

Results

Data from cholesterol and hematocrit determination was presented in Table 1. Precision analysis of the new cholesterol biosensor at each cholesterol level was shown in Table 2. The least-squares equation from comparing cholesterol biosensor (Y) to the venous cholesterol CHOD-PAP standard method (X) gave $Y = 0.997 X + 10.382$ ($r = 0.998$) (Figure 1).

Table 1. Data from cholesterol and hematocrit determination in this study.

Parameter	mean	SD	Maximum	Minimum
Cholesterol				
- Biosensor cholesterol (mg/dL)	247.08	124.82	445	55
- Standard cholesterol (mg/dL)	246.73	124.65	445	55

Table 2. Precision analysis of the new cholesterol biosensor.

Within run precision	Mean (mg/dL)	SD (mg/dL)	CV (%)
Low cholesterol (n = 5)	55.4	0.42	0.76
Medium cholesterol (n = 5)	186.0	1.41	0.76
High cholesterol (n = 5)	418.4	2.07	0.50
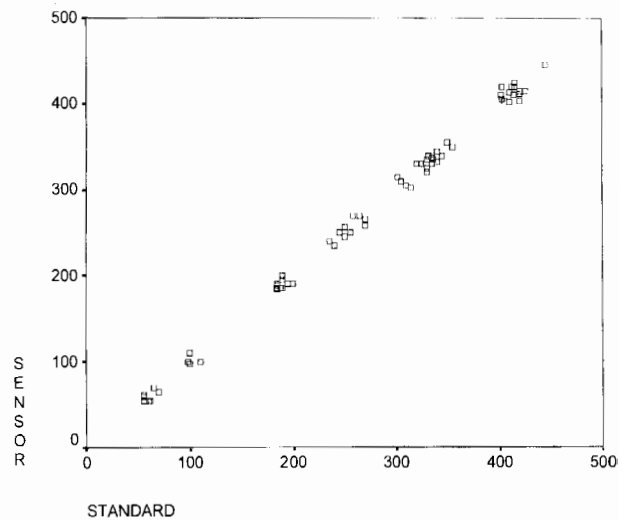
Figure 1. Comparison of new biosensor cholesterol and venous standard cholesterol levels.

Discussion

Cholesterol determination plays very important role in taking care of lipidemic patient. Because poor control of blood cholesterol level can result in many complications, especially for cardiovasculopathy [5]. Good control of blood cholesterol in the proper level is one factor in success in lipidemic control. Therefore, continuous and intensive blood cholesterol determination in lipidemic patient is necessary [6].

But it is impossible for the patient to get the daily venous cholesterol determination, therefore, biosensor cholesterol determination, which require microvolume of blood, is an useful tool for monitoring of patient. Furthermore, the biosensor cholesterol determination can be used as a home self-monitoring system for the patient .

In this study, the new cholesterol determination using cholesterol electrochemical biosensor was tested. The result showed that it correlated well with the standard venous cholesterol determination method (r = 0.998). Therefore, the new cholesterol biosensor is a useful tool one in monitoring the blood cholesterol level. However, the result from this study is limited due to the fact that the test blood sample was still venous blood specimen for both methods. Therefore, further comparative study using the capillary blood specimen for the biosensor should be done

References

1. Henry NG, IRA JG. Disorders of lipoprotein metabolism. In: Anthony SF, Eugene B, Kent JI, Jean DW, Joseph BM, Dennis LK, eds. Harrison's Principle of Internal Medicine. 14th ed. Singapore: McGraw-Hill, 1998: 2138 - 49
2. Theerasaksilp S, Wiwanitkit V. Lipoprotein cholesterol electrophoresis: another method for lipid studying. Chula Med J 2000 Mar; 44(3): 155 - 61
3. Wiwanitkit V. Errors in laboraotory requests in the In-Patient Depaertment, King Chulalongkorn Memorial Hospital. Chula Med J 1998 Sep; 42(9): 685 - 93
4. Wynder EL, Field F, Haley NJ. Population screening for cholesterol determination. JAMA 1986; 28: 2836 - 42
5. Joseph LW. Drugs used in treatment of hyperlipoproteinemias. In: Hardman JG, Limbrid LE, Molinof PB, Ruddon RW, Gilman AG, eds. Goodman & Gilman's the Pharmacological Basis of Therapeutics. 9th ed. Singapore: McGraw-Hill, 1996: 875 - 976
6. Viranuvati V. Blood cholesterol levels and the question of normal values. Siriraj Hosp Gaz 1972; 24: 1440 - 55