

Cost - effectiveness analysis of screening tests for acute pancreatitis in Thai patients, a study at King Chulalongkorn Memorial Hospital

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Objective : *To perform cost - effectiveness analysis of serum pancreatic alpha amylase, lipase and total alpha amylase levels as diagnostic markers in screening for acute pancreatitis in Thai patients*

Setting : *King Chulalongkorn Memorial Hospital*

Design : *Retrospective study*

Subjects : *Data of cost and effectiveness of three categories for screening for acute pancreatitis by serum pancreatic alpha amylase, lipase and total alpha amylase level.*

Methods : *Related literature was reviewed and economical-based cost-effective analysis was performed.*

Results : *Cost-effectiveness of serum total alpha amylase was 288.46 baht / diagnosis, of serum lipase was 571.43 baht/diagnosis and of serum pancreatic alpha amylase was 750.00 baht/diagnosis.*

Conclusion : *Serum total alpha amylase determination was the most cost-effective method for screening for acute pancreatitis.*

Key words : *Screening test, Cost-effectiveness, Acute pancreatitis.*

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นารา ผลิตโกตี, วิโรจน์ ไววานิชกิจ, ชัยพร บุญเฉลิมวิเชียร. การวิเคราะห์ต้นทุนและประสิทธิผลของการตรวจคัดกรองโรคตับอ่อนอักเสบแบบเฉียบพลันในผู้ป่วยชาวไทย, การศึกษา ณ โรงพยาบาลจุฬาลงกรณ์. จุฬาลงกรณ์เวชสาร 2544 ต.ค; 45(10): 865 - 70

- วัตถุประสงค์** : เพื่อศึกษาต้นทุนและประสิทธิผลของการตรวจคัดกรองโรคตับอ่อนอักเสบแบบเฉียบพลันในผู้ป่วยชาวไทย
- สถานที่ทำการศึกษา** : โรงพยาบาลจุฬาลงกรณ์
- รูปแบบการศึกษา** : การศึกษาแบบย้อนหลัง
- ตัวอย่างที่ทำการศึกษา** : ข้อมูลเกี่ยวกับต้นทุนและประสิทธิผลของวิธีการตรวจทางห้องปฏิบัติการในการตรวจคัดกรองโรคตับอ่อนอักเสบแบบเฉียบพลันจำนวน 3 วิธี ได้แก่ serum pancreatic alpha amylase, lipase and total alpha amylase level
- วิธีการศึกษา** : ทบทวนวรรณกรรมที่เกี่ยวข้อง นำมาวิเคราะห์ต้นทุนและประสิทธิผลทางเศรษฐศาสตร์
- ผลการศึกษา** : ต้นทุนต่อประสิทธิผลสำหรับการตรวจ total alpha amylase level เท่ากับ 288.46 บาท/การวินิจฉัย สำหรับ lipase เท่ากับ 571.43 บาท/การวินิจฉัย และสำหรับการตรวจ pancreatic alpha amylase เท่ากับ 750.00 บาท/การวินิจฉัย
- สรุป** : การตรวจ total alpha amylase level จัดเป็นวิธีตรวจที่คุ้มค่าที่สุดเมื่อวิเคราะห์ต้นทุนและประสิทธิผล ดังนั้นจึงควรใช้เป็นวิธีตรวจคัดกรองในโรคตับอ่อนอักเสบแบบเฉียบพลัน
- คำสำคัญ** : การตรวจคัดกรองโรค, ต้นทุนและประสิทธิผล, โรคตับอ่อนอักเสบแบบเฉียบพลัน

To the best of our knowledge, there are no official reports of the incidence or prevalence of pancreatic diseases in the Thai population. However, considering acute pancreatitis in the United States, there are about 5,000 new cases per year with a mortality rate of about 10 percent. These numbers may dramatically underestimate the true incidence and prevalence, since non alcohol-induced pancreatitis was largely ignored.⁽¹⁾

The lack of specificity of symptoms and signs of pancreatic diseases and the difficulty in direct examination of pancreas, may delay the precise diagnosis of pancreatic disease.⁽²⁾ To a certain extent, such a correct diagnosis is mainly dependent on elevation of blood amylase levels, which in turn are proven not to be a specific test, particularly when used as the sole diagnostic test.⁽³⁾ In certain circumstances a single blood test is proven to be especially unreliable for the diagnosis of pancreatic disease. For instance, in a patient with acute pancreatitis and renal failure, the blood amylase level is an unreliable diagnostic marker.⁽⁴⁾

The three common basic methods used for screening for acute pancreatitis are serum pancreatic alpha amylase, lipase and total alpha amylase level. Not only the efficacy of these screening tests, but also their economical aspects should be considered. This study was conducted to analyze the cost-effectiveness of laboratory tests for screening for acute pancreatitis. The results from this study can give guidelines to help physicians select the proper and economical method for screening for acute pancreatitis.

Materials and Methods

This study was set in order to perform cost-effectiveness analysis of serum pancreatic alpha

amylase, lipase and total alpha amylase level as a diagnostic marker in screening for acute pancreatitis in Thai patients using the model setting of King Chulalongkorn Memorial Hospital. Data about cost and effectiveness of three laboratory screening tests for acute pancreatitis; serum pancreatic alpha amylase, lipase and total alpha amylase level were reviewed.

First, cost identification for each test was performed. Cost in this study was set as customer cost of financial units and presented in baht. The prevalence of the disease detected in the population in a previous study⁽⁵⁾ was set as the utility. Results from each category were collected and analyzed using economical statistical methods. Second, the path probability of each alternative test was calculated. The probabilities for each path were determined from the test characteristics derived from our previous validation studies.⁽⁶⁾ Third, the expected cost of each strategy was derived by multiplying cost for branch with the probability of that branch and subsequently adding all such products derived from the branches of that strategy. Similarly the expected utility of each strategy was determined. Finally, the cost effectiveness was calculated using the equation "cost effectiveness = expected cost/ expected utility".

Results

Customer cost and utility of each screening method are shown in Table 1. The Decision tree depicting laboratory screening tests for acute pancreatitis strategies and associated probabilities, costs and utilities in Figure 1. Expected cost and utility of each method and cost-effectiveness of each method is presented in Table 2. Cost-effectiveness of serum total alpha amylase was 288.46 baht / diagnosis, of serum lipase was 571.43 baht/diagnosis and of serum pancreatic alpha amylase was 750.00

baht/diagnosis. The results shown that the most cost-effective method for screening for acute pancreatitis was determination of serum total alpha amylase levels.

Table 1. Costs and utilities of screening methods for acute pancreatitis.

Methods	Result	Path probabilities	Customer costs (baht)	Utilities (rate)
Serum alpha amylase	+	0.46	150	0.23
	-	0.54	150	0.77
Serum lipase	+	0.62	200	0.23
	-	0.38	200	0.77
Serum pancreatic alpha amylase	+	0.46	300	0.23
	-	0.54	300	0.77

Table 2. Cost-effectiveness analysis.

Strategies	Expected cost (baht)	Expected utility (rate)	Cost-effectiveness*(baht/diagnosis)
Serum alpha amylase	150	0.52	288.46
Serum lipase	200	0.35	571.43
Serum pancreatic alpha amylase	300	0.40	750.00

* cost effectiveness = expected cost/ expected utility

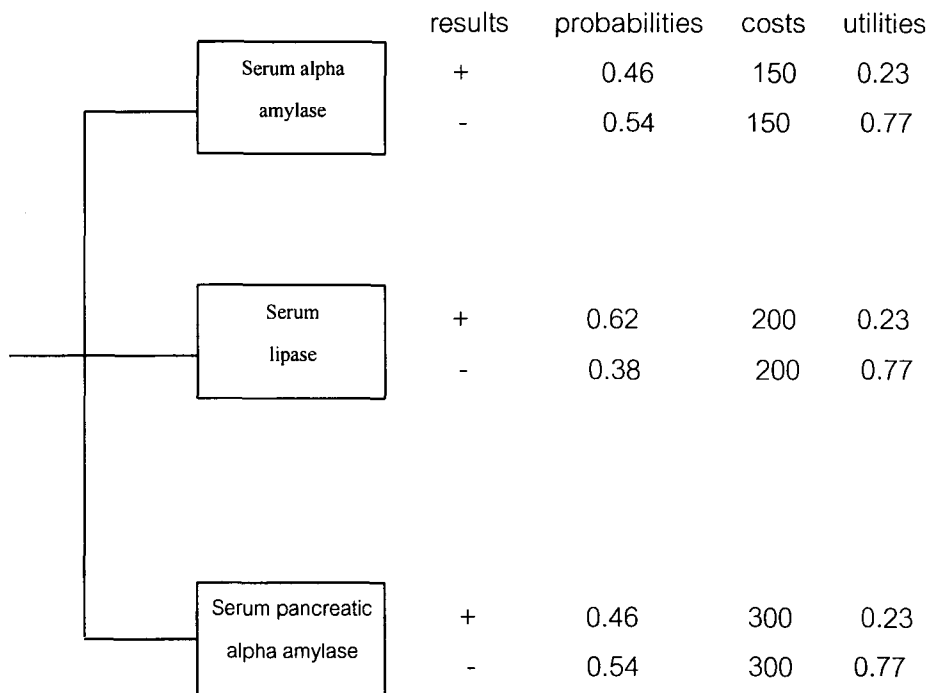


Figure 1. Decision tree depicting laboratory screening tests for acute pancreatitis strategies and associated probabilities, costs and utilities.

Discussion

From a clinical point of view, it is difficult to perform direct examination of pancreas and the nonspecific symptoms and signs of pancreatic diseases do not enable the physician to arrive at the correct diagnosis promptly. Therefore, there are many tests for screening for acute pancreatitis used in the present day. Each method has specific properties that differ from the others. Efficacy should also be considered. Furthermore, these days, the concept of health economics is widely discussed. Each laboratory test should be checked for its economical effectiveness. Therefore, this study should give good basic information for selection of screening methods for acute pancreatitis.

In this study, three common screening methods for acute pancreatitis were evaluated. In human serum, alpha amylase (1,4-D-glucaglucanohydrolase, EC:3.2.1.1) consists of many isoenzymes which are mainly produced in pancreas (pancreatic alpha amylase) and salivary glands (salivary alpha amylase). These two isoenzymes share some common properties, such as digestion of starch and glycogen, and possession of similar amino acids sequences, but contain different carbohydrate moieties, which is why they have unequal weight.⁽⁶⁻⁷⁾ In pathological processes which occur in the pancreas, the measurement of blood total alpha amylase or pancreatic alpha amylase levels can help physicians diagnose acute pancreatitis.

Another frequently used diagnostic marker for pancreatic diseases is Lipase which is a glycoprotein with 420-449 amino acids residues that is present in the pancreas, intestines and a variety of other tissues.⁽⁸⁻¹⁰⁾ The concentration gradient between

pancreatic tissue and serum lipase is roughly 20,000-fold.⁽⁸⁾ There are two molecular forms in the pancreas, giving rise to three electrophoretic bands with lipolytic activity.⁽⁸⁾ Therefore, lipase determination in pancreatitis is another common screening test.⁽¹⁰⁾

However, apart from the study of the test efficacy as sensitivity and specificity, the value of the test in the aspect of cost comparing to effectiveness should also be evaluated. In interest, although such mentioned screening tests for acute pancreatitis have been used in Thailand for years there is no study about cost-effectiveness analysis.

We shown that the expected cost of serum total alpha amylase determination was the lowest and serum pancreatic alpha amylase determination was the highest. Furthermore, the expected utilities of the tests seem to be similar. Therefore, the study revealed that serum total alpha amylase determination was the most cost-effective method. Therefore, selection of serum total alpha amylase determination as a screening test for acute pancreatitis among the Thais is most rational. In conclusion, we recommend using serum total alpha amylase determination due to its acceptable efficacy and cost-effectiveness.

This study made use of customer cost, in the analysis, thus the cost-effectiveness analysis in this study indicated the real effect to the patient who was the customers. Based on the principle that patient should get the most cost-effective laboratory test, therefore, cost-effectiveness analysis of present laboratory service should be continuously studied.

However, this study did not use total laboratory cost, which consists of direct and indirect cost and is difficult to ascertain. Some outliers of the lost due to misdiagnosis were not included into this study.

Furthermore, the setting was also limited to only one hospital, therefore, further studies in a multi center setting are recommended for the generalizability of the result.

Conclusion

Using serum total alpha amylase determination to screen acute pancreatitis seems to be most cost-effective.

References

1. Toskes PP, Greenberger NJ. Approach to the patient with pancreatic disease. In: Fauci AS, Braunwald E, Isselbacher KJ, Wilson JD, Martin JB, Kasper DL, Hauser SL, Longo DL, eds. *Harrison's Principles of Internal Medicine*. New York: McGraw-Hill, 1998: 1737 - 41
2. Toskes PP, Greenberger NJ. Approach to the patient with pancreatic disease. In: Fauci AS, Braunwald E, Isselbacher KJ, Wilson JD, Martin JB, Kasper DL, eds. *Harrison's Principles of Internal Medicine*. New York: McGraw-Hill, 1994: 1516 - 20
3. Williamson RC. Early assessment of severity in acute pancreatitis. *Gut* 1984 Dec; 25(12): 1331 - 9
4. Kazmierczak SC. Gastrointestinal and pancreatic function. In: Anderson SC, Cockayne S, eds. *Clinical Chemistry Concepts and Applications*. Philadelphia : W.B. Saunders, 1993: 570 - 94
5. Boonchalernvichain C, Wiwanitkit V, Paritpooke N, Chamnarnpai S. Pancreatic alpha amylase: How about its level in screening for acute pancreatitis. *Chula Med J* 2000 Mar; 44 (Suppl): 53
6. Moss DW, Henderson AR. Enzymes. In: Burtis CA, Ashwood ER, eds. *Tietz Fundamental of Clinical Chemistry*. Philadelphia: W.B. Saunders, 1996: 138 - 9
7. Stiefel DJ, Keller PJ. Preparation and some properties of human pancreatic amylase, including a comparison with human parotid amylase. *Biochim Biophys Acta* 1973 Apr 12; 302(2): 345 - 61
8. Tietz NW, Shuey DF. Lipase in serum - the elusive enzyme: an overview. *Clin Chem* 1993 May; 39(5): 746 - 56
9. Champe PC, Harvey RA. Cholesterol and steroid metabolism. In: Champe PC, Richard A, eds. *Harvey Lippincott's Illustrated Reviews: Biochemistry*. Philadelphia : Lippincott - Raven, 1994: 205 - 28
10. Soergel KH. Acute pancreatitis. In: Sleisenger MH, Fordtran JS, Scharschmidt BF, Feldman M, eds. *Gastrointestinal Diseases Pathophysiology/ Diagnosis / Management*. Philadelphia. : 10. W.B.Saunders, 1993: 1628 - 53