Diagnostic Value of Pleural Fluid Adenosine Deaminase in Tuberculous Pleuritis at Thammasat University Hospital

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Background: *Pleural fluid adenosine deaminase (ADAPF) is a diagnostic test for diagnosing the early tuberculous pleuritis (TBP). However, cutoff values vary widely in many studies.*
Objective: *To determine the optimal diagnostic value of ADAPF.*
Material and Method: *A prospective study was performed between August 2012 and August 2014. One hundred seventy-eight patients with pleural effusions; 29 TBPs, 63 malignant pleural effusions (MPEs), 40 parapneumonic effusions (PARAEs), 18 transudates, 5 empyemas, 19 other exudates, and 4 unknown causes, were investigated.*
Results: *Mean ± SD of ADAPF was 60.0±25.6 U/L with TBPs, 15.6±11.1 U/L with MPEs, 15.8±9.9 U/L with PARAEs, 6.6±5.7 U/L with transudates, 13.8±7.7 U/L with empyemas, 14.5±7.1 U/L with other exudates, and 17.8±4.6 U/L with unknown causes. The area under the ROC curve was 0.983 (95% CI: 0.969-0.998) for the best ADAPF cutoff value of 33.5 U/L, with 93.1% sensitivity, 94.6 % specificity, 77.1% positive predictive value, and 98.6% negative predictive. ADAPF level <30.5 U/L suggests that a TBP is highly unlikely.*
Conclusion: *Pleural fluid ADA assay is a helpful diagnostic tool with high sensitivity and specificity for the rapid diagnosis of TBP.*

Keywords: *Adenosine deaminase, Tuberculous pleuritis, Pleural fluid*

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Tuberculosis (TB) is a major public health problem in developing countries including Thailand. Although pulmonary disease is the most common form of TB, extra-pulmonary TB affecting mainly the lymph nodes and pleura is the initial presentation in about 25% of adults[1]. TB pleuritis accounts for 44% of causes of exudative pleural effusion in Malaysia[2] and 25% of causes of pleural effusion in Spain[3] which are areas with high incidence of TB. The definitive diagnosis of TB pleuritis depends on the demonstration of *Mycobacterium tuberculosis* in the sputum, pleural fluid, or pleural biopsy demonstrating granuloma in the parietal pleura[4]. The diagnosis can also be supported by elevated levels of adenosine deaminase (ADA) or interferon (IFN)-gamma in pleural fluid and a consistent clinical characteristic of TB[5].

Detection of *M. tuberculosis* using conventional culture or the polymerase chain reaction (PCR) usually allows definitive diagnosis; however, the positivity rate of pleural fluid culture for *M. tuberculosis* is low in TB pleuritis and requires several weeks to obtain a result[6-8]. Clinical diagnosis and therapeutic decisions often need to be made before culture results are available. Moreover, the sensitivity of pleural fluid culture, pleural biopsy culture, and histological examination of a pleural biopsy sample, are 8.5%, 11.7%, and 79.8%, respectively[7]. Another method, acid-fast staining of pleural effusion fluid which has the advantage of rapid and inexpensive but also has low sensitivity (<10%)[6,8] and is usually negative unless the patient has a TB empyema[7].

The inefficiency of conventional laboratory methods has resulted in the development and evaluation of alternative diagnostic strategies. In recent years, both ADA and IFN-gamma concentrations have

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been reported as useful diagnostic markers of TB pleuritis[9,10]. The long historical success of the ADA test in countries with a high prevalence of TB and the fact that it is simpler and less expensive than IFN-gamma test makes it the preferred test[10].

ADA is a predominant T-lymphocyte enzyme in the purine salvage pathway that catalyzes the conversion of adenosine and deoxyadenosine to inosine and deoxyinosine with the release of ammonia. A recent meta-analysis showed that diagnostic accuracy of ADA for diagnosing TB pleuritis with 92% sensitivity and 90% specificity. However, there are various cutoff ADA levels in many different studies, ranging from 20 to 71 U/L[11]. In Thailand, three studies demonstrated optimal ADA cutoffs at 17.5, 48 and 60 U/L for diagnosis of TB pleuritis[12-14].

The study aimed to determine the diagnostic value of pleural fluid ADA for diagnosis of TB pleuritis.

Material and Method

Study population and design

Between August 2012 and August 2014, a prospective study was conducted at Thammasat University Hospital, a 540-bed tertiary care teaching hospital on the outskirts of Bangkok, Thailand. Before any study procedures where commenced, signed informed consents where given to adults and written assent with a guardian present was given on behalf of children whom where participating into the study.

Patients aged 15 years or more with pleural effusions routinely underwent diagnostic thoracentesis to obtain pleural fluid specimens for cell count, cell differential count, cytology, Gram staining and Ziehl-Neelsen (acid-fast) staining, and bacterial and mycobacterial culture. Total protein and lactate dehydrogenase levels were obtained from serum and pleural fluid specimens to distinguish exudates from transudates according to Light's criteria[15]. In addition, based on their appearances, pleural effusions were classified as frank pus (empyema) or hemorrhagic (bloody). If pleural fluid parameters suggested malignant pleural effusions, suspected granulomatous diseases (tuberculosis, connective tissue disorders and others) or unexplained exudates, closed percutaneous pleural biopsy was performed with the Abrams needle. When the diagnosis was uncertain after thoracentesis or closed pleural biopsy, or the effusions persisted, or malignancy and tuberculosis were still suspected, the patient was referred for a thoracoscopy and/or thoracotomy.

Ethics approval was obtained from the Ethics Committee of Faculty of Medicine, Thammasat University, Thailand (IRB No. MTU-EC-IM-1-037/55).

Diagnostic criteria

The final diagnoses of the pleural effusions are shown (Table 1). The diagnosis of TB pleuritis was one or more than one of the following criteria: *M. tuberculosis* identified by culture or PCR testing from pleural fluid or pleural biopsy, caseous granuloma in the pleural biopsy with or without positive staining for acid-fast bacilli (AFB), positive sputum microscopy for AFB or sputum culture for *M. tuberculosis* with no alternative explanation for the cause of pleural effusion, clinical and radiological features were compatible with TB without any other cause and response to anti-TB treatment. The diagnosis of malignant pleural effusions (MPEs) was one or more than one of the following criteria: cytological evidence of a malignant effusion from pleural fluid, histological evidence of a malignant effusion from pleural biopsy, if the patient had known metastatic malignancy with no other explanation for the effusion. The definitions for the diagnosis of other effusions have been previously published[16,17]. An unknown cause of pleural effusion was identified as one for which a cause was not determined despite an initial workup that included repeated thoracenteses and pleural biopsy.

Laboratory method for ADA assay

Pleural fluids were immediately transferred to the laboratory in a cold box with ice pack at 4°C and were stored at -80°C until analysis. The total ADA activity in pleural fluids was measured by the conventional colorimetric method of Giusti[18]. Briefly, 25 μL of pleural fluid were incubated for 1 hour at 37°C in 475 μL of adenosine solution, buffered with 500 μL phosphate solution at pH 6.5. For the colorimetric determination of ammonia, 1.5 mL of phenol nitroprusside and 1.5 mL of alkaline hypochlorite was added, mixed and incubated for 30 minutes. The absorbance was measured at 630 nm. The results were expressed in international units per liter of pleural fluid (U/L).

Statistical analysis

Results are expressed as mean $\pm$ SD unless otherwise stated. The statistical analyses applied included the Chi-square test with Fisher's or Pearson correction to analyze the dependence between categorical variables, the non-parametric Mann-Whitney U-test for continuous variables with non-

Table 1. Etiologies of pleural effusions

Diagnoses	No. patients (%)
TB pleuritis	29 (16.3)
Clinical and radiological evidence of TB in the absence of other causes of pleural effusion and clinical improvement on anti-TB treatment	16
Caseous granuloma on pleural biopsy	8
Caseous granuloma on pleural biopsy with positive AFB staining	2
Caseous granuloma on pleural biopsy with positive PCR testing for TB	1
Positive PCR testing and culture for TB of the pleural fluid	1
Positive AFB staining on sputum	1
Malignant pleural effusions	63 (35.4)
Lung	31
Breast	6
Lymphoma	6
Colon	3
Prostate, HCC, thymus, ovary, melanoma	Each 2
Bladder, cervix, mesothelioma, stomach, pancreas, bile duct	Each 1
Cancer of unknown primary	1
Parapneumonic effusions	40 (22.5)
Other exudates	19 (10.7)
SLE	4
Uremia	4
Reaction due to RFA for HCC treatment	3
Post-CABG, reaction due to ruptured HCC	Each 2
Superior vena caval obstruction, iatrogenic pneumothorax, reaction due to retroperitoneal sarcoma surgery, hemothorax	Each 1
Empyema thoraces	5 (2.8)
Transudates	18 (10.1)
Congestive heart failure	8
Renal failure	3
Hepatic hydrothorax	3
Hypoalbuminemia due to SLE	2
Hypoalbuminemia due to liver cirrhosis, urinothorax	Each 1
Unknown causes	4 (2.2)

TB = tuberculosis; PCR = polymerase chain reaction; AFB = acid-fast bacilli; HCC = hepatocellular carcinoma; SLE = systemic lupus erythematosus; CABG = coronary artery bypass grafting; RFA = radiofrequency ablation

normal distribution and unpaired t-tests for those with normal distribution. The Shapiro-Wilks test was used to determine normal or non-normal distributions. The optimal ADA cutoff value was determined using the Receiver Operator Characteristic (ROC) curve. SPSS software version 16.0 (SPSS) was used.

Results

One hundred seventy-eight patients with pleural effusions were investigated. A diagnosis of TB pleuritis was made in 29 patients (16.3%). Of these patients, 16 (55.2%) were diagnosed by a clinical and radiological evidence of TB in the absence of other causes of pleural effusion and clinical improvement on anti-TB treatment, and others were diagnosed by various methods (Table 1).

One hundred forty-nine patients (83.7%) had non-tuberculous (non-TB) pleural effusions. Of these, four patients (2.2%) had effusions of unknown etiology. In the TB group, there were 16 (55%) males and 13 (45%) females. In the non-TB group, there were 97 (65%) males and 52 (35%) females. There was no statistically significant difference in sex distribution between the two groups (p = 0.21). The age of patients with TB pleuritis were significantly younger than patients with non-TB pleural effusions (TB patients vs. non-TB patients: 50.6$\pm$17.8 vs. 65.7$\pm$17.8 years, p<0.001).

The hematologic and biochemical analyses

Table 2. Biochemical and hematological analysis of pleural pluids in diagnoses subgroups

Variables	TBP n = 29	MPE n = 63	PARAE n = 40	Other n = 19	Empyema n = 5	Transudate n = 18	Unknown n = 4
ADA, U/L	60.0±25.6	15.6±11.1	15.8±9.9	14.5±7.1	13.8±7.7	6.6±5.7	17.8±4.6
Glucose, mg/dL	90.6±30.2	111.0±60.0	103.4±65.6	129.9±27.5	36.8±44.6	145.6±29.4	134.8±4.6
Protein, g/dL	5.3±1.2	4.2±1.1	3.7±1.5	3.8±1.2	3.4±1.7	1.5±1.0	4.4±1.4
LDH, U/L	3,585.9±9,386.9	1,848.4±3,298.7	2,492.7±5,192.2	595.2±342.5	4,864.8±3,383.6	188.5±76.5	319.7±75.3
PF/S protein	0.69±0.10	0.60±0.14	0.55±0.15	0.59±0.14	0.52±0.26	0.26±0.14	0.54±0.14
PF/S LDH	3.99±9.59	1.97±1.94	5.77±14.00	1.07±0.50	3.51±3.46	0.29±0.17	0.53±0.24
RBC, cells/uL	24,182±94,355	47,077±70,441	83,513±96,235	58,152±172,000	45,800±71,625	5,092±9,582	6,525±5,262
WBC, cells/uL	5,330±4,747	1,623±1,460	3,212±5,106	1,495±1,827	26,151±48,453	380±349	1,156±914
Lymphocyte %	79.64±25.34	66.46±25.06	50.05±33.67	72.80±23.65	9.06±13.18	65.54±21.50	87.98±8.72
Neutrophil %	20.36±25.34	32.49±24.91	49.97±33.68	27.19±23.65	90.94±13.18	34.46±21.50	12.03±8.72

Data are mean ± SD

TBP = tuberculous pleuritis; MPE = malignant pleural effusions; PARAE = parapneumonic effusions; Other = other exudative effusions; Empyema = empyema thoraces, Unknown = unknown causes; ADA = adenosine deaminase; LDH = lactate dehydrogenase; PF/S = pleural fluid to serum ratio; RBC = red blood cell; WBC = white blood cell

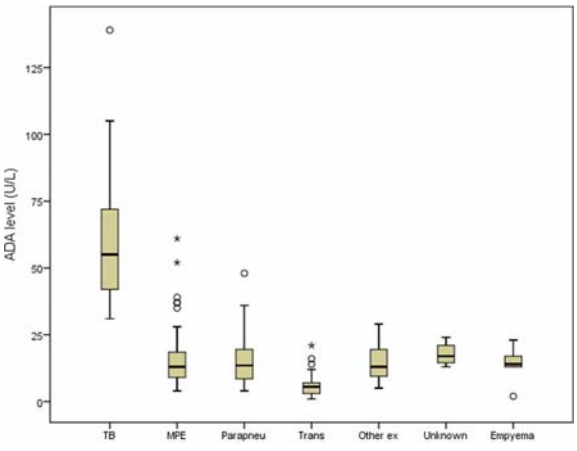
of the pleural fluid samples are shown (Table 2). The pleural fluid lymphocyte percentage, pleural fluid total protein level and pleural fluid to serum total protein ratio of patients with TB pleuritis were significantly higher than patients with non-TB effusion. Moreover, the pleural fluid glucose of patients with TB pleuritis were significantly lower than patients with non-TB effusion. There were no statistically significant differences between red blood cell count, leukocyte count, serum LDH level, pleural fluid to serum LDH ratio of TB and non-TB patients.

There were strong positive correlations between the ADA levels and the pleural fluid protein level ($r = 0.46$, $p<0.001$), pleural fluid LDH level ($r = 0.42$, $p<0.001$), pleural fluid to serum protein ratio ($r = 0.42$, $p<0.001$), and pleural fluid to serum LDH ratio ($r = 0.36$, $p<0.001$). There was a weak negative correlation between the ADA levels and the pleural fluid glucose level ($r = -0.25$, $p = 0.002$). However, no correlation was found between effusion ADA levels and the other hematologic parameters.

The mean ± SD of ADA level in the TB group and non-TB group are shown (Table 2). The distribution of the data is presented (Fig. 1). Using the ROC curve, the area under the ROC curve was 0.983 (Fig. 2) with a standard error of 0.007 (95% CI: 0.969-0.998). The best cutoff value for diagnosing TB pleuritis was 33.5 U/L, giving a sensitivity of 93.1% (95% CI: 75.8-98.8), and specificity of 94.6% (95% CI: 89.3-97.5). The positive predictive value was 77.1% (95% CI: 59.5-88.9) and the negative predictive value (NPV) was 98.6% (95% CI: 94.5-99.8). The false-positive rate was 5.37% and the false-negative rate was 6.98%. The positive likelihood ratio was 17.34 and the negative likelihood ratio was 0.07. The overall test accuracy was 94.38%. All TB pleuritic patients had pleural fluid ADA level ≥30.5 U/L (100% sensitive with 100% NPV and negative likelihood ratio was 0).

There were only two TB cases with pleural fluid ADA level <33.5 U/L: 1) a 35-year-old man presented with a moderate size pleural effusion and was diagnosed with clinical TB pleuritis. He had chronic inflammation shown by pleural fluid cytology. His effusion resolved after 6 months of anti-TB treatment, and 2) an 81-year-old woman presented with a massive pleural effusion and caseous granuloma. Both of them had ADA level of 31.0 U/L.

There were eight non-TB cases with pleural fluid ADA level equal to or more than 33.5 U/L. Of these, 6 patients had malignant pleural effusions (ADA level of 37 and 39 U/L in 2 cases of lung cancer, 37 and



TB = tuberculous pleuritis; MPE = malignant pleural effusions; Parapneu = parapneumonic effusions; Trans = transudates; Other ex = other exudative effusions; Unknown = unknown causes

Fig. 1 Boxplots of pleural fluid ADA level in 178 patients.

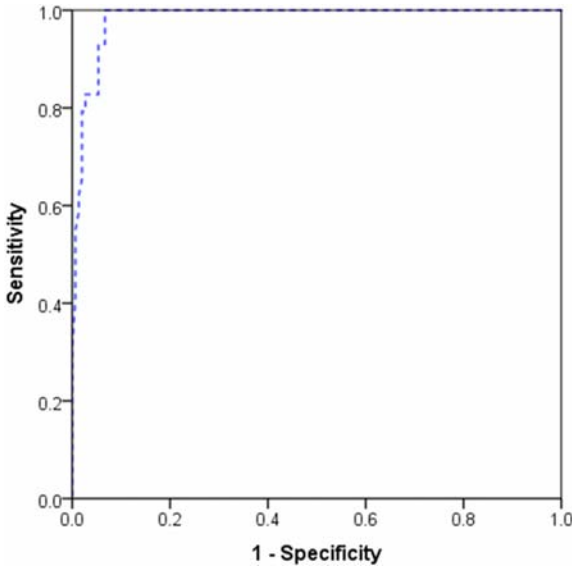


Fig. 2 ROC plot of pleural fluid ADA level. The area under the ROC curve: 0.983 (SE = 0.007, 95% CI: 0.969-0.998).

52 U/L in 2 cases of breast cancer, 61 U/L in 1 case of lymphoma, and 35 U/L in 1 case of thymic carcinoma), and 2 had parapneumonic effusions (ADA level of 36 and 48 U/L).

Discussion

The differential diagnosis between TB pleuritis and non-TB pleural effusion is a difficult clinical problem, and the conventional methods, such as direct examination of pleural fluid by Ziehl-Neelsen staining, culture of pleural fluid, and pleural biopsy, are not always helpful in making the diagnosis due to their limitations. Pleural fluid ADA activity has been found to be a helpful biomarker that has a high sensitivity and specificity for TB diagnosis, however its diagnostic usefulness depends on the local prevalence of TB and laboratory methodology[11]. Light[10] suggested that if the high fluid ADA level (>70 U/L) with a high lymphocyte-to-neutrophil (L/N) ratio (>0.75) in pleural fluid, the diagnosis of TB pleuritis is established. If the pleural fluid ADA level is intermediate (40-70 U/L) with a high L/N ratio, a presumptive diagnosis of TB pleuritis can be made. If the ADA levels are <40 U/L, the diagnosis of TB is unlikely.

The most widely accepted cutoff level of ADA for the diagnosis of TB pleuritis is 40 U/L[11,19]. A recent meta-analysis of 63 studies found that ADA assays in the diagnosis of TB pleuritis had an overall sensitivity of 92% (95% CI: 90-93%), specificity of 90% (95% CI 89-91%), positive likelihood ratio of 9.03 (95% CI: 7.19-11.35), and negative likelihood ratio of 0.10 (95% CI: 0.07-0.14). Of these 63 studies, 42 studies applied the Giusti method that used a cutoff value of 44.0$\pm$1.4 U/L (range: 30-70 U/L). This cutoff value was much higher than that of those using non-Giusti method (38.1$\pm$2.3 U/L, range: 20-57 U/L)[11].

We measured the pleural fluid ADA concentration using the Giusti method. Our cutoff level of 33.5 U/L was the lowest value in the ADA studies reported from most South African studies[20-22], European studies[23-26], North and South American studies[27-29] and Asian studies[30-32] including 2 studies in Thailand[12,13] (Table 3). The reason for our lower ADA level may be due to the lower percentage of lymphocytes in our pleural fluid (mean $\pm$ SD: 79.6$\pm$25.3%), which was less than the Riantawan et al[12] study (mean $\pm$ SD: 92$\pm$3.2%). Moreover, Neves et al[27] showed that if the percentage of lymphocytes in pleural fluid exceeded 81% was the best accuracy for TB diagnosis because lymphocytes are the source of ADA. However, our study found no association between ADA level and pleural fluid lymphocyte percentage ($r = 0.08$, $p = 0.26$) in TB group.

Our sensitivity of 93% and specificity of 95% were similar[12,29,30,33,34] or higher[13,35] compared to other studies (Table 3).

However, our study also found false-positive results (5%); therefore clinicians should rely on a combination of conventional methods like histopathology, culture of pleural fluid and pleural

Table 3. Studies using pleural fluid ADA assay by Giusti method for diagnosis of TB pleuritis

Investigators	Country (year)	No. of patients	ADA cutoff U/L	Sensitivity %	Specificity %	PPV %	NPV %
Riantawan, et al[12]	Thailand (1999)	216	60	95	96	96	95
Reechaipichitkul, et al[13]	Thailand (2001)	132	48	80	81	71	87
Diacon, et al[21]	South Africa (2003)	51	50	95	89	97	80
Neves, et al[27]	Brazil (2004)	215	39	95	83	84	95
Banales, et al[29]	Canada (1991)	218	70	98	96	94	99
Kalantri, et al[30]	India (2011)	204	44.75	79	92	97	59
Moon, et al[33]	Korea (2005)	111	45	81	94	94	82
Valdes, et al[34]	Spain (1996)	350	47	100	91	75	100
Yildiz, et al[35]	Turkey (2011)	196	55	87	87	90	83
Present study	Thailand (2016)	178	33.50	93	95	77	99

ADA = adenosine deaminase; PPV = positive predictive value; NPV = negative predictive value

biopsy specimens, and Ziehl-Neelsen staining or PCR for TB detection in pleural fluid. The combination of several methods can increase the diagnostic yield for TB pleuritis[21,28,30,31,36]. We suggest that ADA cutoff levels for diagnosis of TB pleuritis depend on the best diagnostic value in various regions. Our data suggest that the pleural fluid ADA cutoff level of 33.5 U/L is useful in the diagnosing TB pleuritis.

The limitation of the study is the small number of TB patients. Most of them are diagnosed by a clinical and radiological evidence of TB and clinical improvement on anti-TB treatment, which might result in falsely low ADA levels lead to the lower cutoff ADA value.

Conclusion

The best cutoff level of ADA for a diagnosis of TB pleuritis in this study was the lowest value among the ADA assay studies using Giusti method. The ADA assay remains a helpful diagnostic tool with high sensitivity and specificity for rapid diagnosis of TB pleuritis, although the cutoff value is lower than the widely accepted cutoff values.

What is already known on this topic?

The ability to distinguish between tuberculous (TB) pleuritis and non-TB pleural effusion remains a difficult clinical problem. Although there are several conventional methods e.g. Ziehl-Neelsen staining, culture of pleural fluid, and pleural biopsy, their limitations are found due to tests have not high sensitivity and specificity. Pleural fluid adenosine deaminase (ADA) activity is a rapidly helpful biomarker that has a high sensitivity and specificity for TB diagnosis, but the cutoff values vary widely in many studies.

What this study adds?

Our the best pleural fluid ADA cutoff value was 33.5 U/L, with 93.1% sensitivity, 94.6% specificity, 77.1% positive predictive value, and 98.6% negative predictive value. The ADA level <30.5 U/L suggests that a TB pleuritis is highly unlikely. Our cutoff was the lowest value in the ADA studies using the Giusti method. We concluded pleural fluid ADA assay is a helpful diagnostic test with high sensitivity and specificity for rapid diagnosis of TB pleuritis.

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Potential conflicts of interest

None.

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ค่าการวินิจฉัยของอะดีโนซีนดีอะมิเนสในน้ำเยื่อหุ้มปอดของวัณโรคเยื่อหุ้มปอดที่โรงพยาบาลธรรมศาสตร์เฉลิมพระเกียรติ

ณรงค์กร ซ้ายโพธิ์กลาง, อภิชาติ คณิตทรัพย์, พิชญาภา รุจิวิชชญ์

ภูมิหลัง: *อะดีโนซีนดีอะมิเนสในน้ำเยื่อหุ้มปอดเป็นวิธีการวินิจฉัยวัณโรคเยื่อหุ้มปอดอย่างรวดเร็ว แต่ค่าการวินิจฉัยยังมีความแตกต่างกันในแต่ละการศึกษา*

วัตถุประสงค์: *เพื่อหาค่าการวินิจฉัยที่เหมาะสมของอะดีโนซีนดีอะมิเนสในน้ำเยื่อหุ้มปอด*

วัสดุและวิธีการ: *เป็นการศึกษาไปข้างหน้าระหว่างเดือนสิงหาคม พ.ศ. 2555 ถึง เดือนสิงหาคม พ.ศ. 2557 ผู้ป่วยที่มีน้ำเยื่อหุ้มปอดรวม 178 คน เข้าร่วมการศึกษาเป็นวัณโรคเยื่อหุ้มปอด 29 คน มะเร็งเยื่อหุ้มปอด 63 คน น้ำเยื่อหุ้มปอดจากปอดอักเสบติดเชื้อ 40 คน น้ำเยื่อหุ้มปอดชนิดสิ่งซึมเยิ้มใส (transudate) 18 คน หนองในโพรงเยื่อหุ้มปอด 5 คน เยื่อหุ้มปอดชนิดสิ่งซึมเยิ้มข้น (exudate) อื่นๆ 19 คน และเยื่อหุ้มปอดชนิดไม่ทราบสาเหตุ 4 คน*

ผลการศึกษา: *ค่าเฉลี่ย ± ส่วนเบี่ยงเบนมาตราฐานของค่าอะดีโนซีนดีอะมิเนสในวัณโรคเยื่อหุ้มปอดเท่ากับ 60.0±25.6 ยูนิตต่อลิตร มะเร็งเยื่อหุ้มปอดเท่ากับ 15.6±11.1 ยูนิตต่อลิตร น้ำเยื่อหุ้มปอดจากปอดอักเสบติดเชื้อเท่ากับ 15.8±9.9 ยูนิตต่อลิตร น้ำเยื่อหุ้มปอดชนิดสิ่งซึมเยิ้มใส (transudate) เท่ากับ 6.6±5.7 ยูนิตต่อลิตร หนองในโพรงเยื่อหุ้มปอดเท่ากับ 13.8±7.7 ยูนิตต่อลิตร น้ำเยื่อหุ้มปอดชนิดสิ่งซึมเยิ้มข้น (exudate) อื่นๆ เท่ากับ 14.5±7.1 ยูนิตต่อลิตร และน้ำเยื่อหุ้มปอดชนิด ไม่ทราบสาเหตุเท่ากับ 17.8±4.6 ยูนิตต่อลิตร พื้นที่ใต้กราฟของ ROC curve เท่ากับ 0.983 (ช่วงความเชื่อมั่นร้อยละ 95 เท่ากับ 0.969-0.998) สำหรับค่าอะดีโนซีนดีอะมิเนสในการวินิจฉัยวัณโรคเยื่อหุ้มปอดที่ดีที่สุดเท่ากับ 33.5 ยูนิตต่อลิตร โดยมีความไวร้อยละ 93.1 ความจำเพาะร้อยละ 94.6 ค่าพยากรณ์ผลบวกร้อยละ 77.1 และค่าพยากรณ์ผลลบร้อยละ 98.6 หากค่าอะดีโนซีนดีอะมิเนสในน้ำเยื่อหุ้มปอดน้อยกว่า 30.5 ยูนิตต่อลิตรมีโอกาสความน่าจะเป็นวัณโรคเยื่อหุ้มปอดน้อยมาก*

สรุป: *การตรวจอะดีโนซีนดีอะมิเนสในน้ำเยื่อหุ้มปอดเป็นวิธีที่มีประโยชน์ในการวินิจฉัยวัณโรคเยื่อหุ้มปอดอย่างรวดเร็วด้วยความไวและความจำเพาะสูง*