Liver Function Tests Abnormality and Clinical Severity of Dengue Infection in Adult Patients

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Background: *The clinical manifestations of dengue infection in the adult are different from those in children, i.e. having less prevalence to bleeding, and more commonly, abnormal liver function tests.*
Objective: *The primary objective is to describe the clinical manifestations of dengue infection in adult patients. The secondary objective is to compare the clinical manifestations of dengue infection between the groups of normal and abnormal liver function tests in adult patients.*
Material and Method: *Retrospective study was done in adults (age ≥15 years) dengue patients admitted at the Hospital for Tropical Diseases from 2000-2002. Dengue infection diagnosed by WHO clinical criteria 1997 with serological tests confirmed by ELISA test or Rapid Immunochromatographic test. Liver function test was recorded by day of fever.*
Results: *There were 127 adult dengue patients with mean age 26.4±11.5 years. Classifications of dengue infection by WHO criteria were DF 4.7%, DHF grade 1 26.0%, DHF grade 2 63.0% and DHF grade 3 6.3%. Mean duration of fever clearance time was 6.0±1.9 days but the fever lasted longer in cases of high-level transaminases (>10 folds). The common presenting symptoms and signs were myalgia (95.9%), nausea/vomiting (87.7%), positive tourniquet test (77.2%), abdominal pain (42.7%), hepatomegaly (34.6%), and bleeding (20.5%). The ratio of AST and ALT was 1.8:1. Abnormal AST and ALT were found in 88.2% and 69.3% of the patients, respectively. Patients with nausea/vomiting, petechiae or duration of fever >7 days more frequently had abnormal transaminases. Abnormal AST during the febrile stage was associated with bleeding. High-level AST and ALT occurred in 11.0% and 7.0%, respectively. Shock was associated with high-level ALT during the febrile stage.*
Conclusion: *Adult dengue patients commonly showed abnormal liver function tests and accounted for at least two-thirds of them. High-level ALT during the febrile stage showed association with shock.*

Keywords: *Adult, Clinical, Dengue, Liver function test, Thailand*

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Dengue infection is the most common mosquito-borne viral disease in the world. Annually, 50 million infections occur with 500,000 cases of dengue hemorrhagic fever (DHF) and 22,000 deaths. DHF mainly occurs in children with the highest attack rate in the 5-9 years age group[1]. Particularly, young children may be less able than adults to compensate for capillary leakage, and are consequently at greater risk of dengue shock. In Thailand the peak age of DHF patients has shifted to 10-14 years of age[2,3]. Furthermore, overall incidence rates of dengue infection in adult patients (age ≥15 years) are up to one-third of the incidence rates in children. Clinical manifestations in adult patients may be different from children and the data are still limited. Some studies included children and adults but did not compare clinical manifestations and findings between these two groups[4-7]. Few studies showed different clinical manifestations between dengue infection in children and adult patients. In severe infection, DHF or dengue shock syndrome (DSS) was more prevalent in adults than in children[8-10].

Liver involvement is common in dengue infection, including hepatomegaly, jaundice, abnormal liver enzymes and liver failure. Previous studies showed more liver involvement in adult patients characterized by high rate of elevations in the transaminase level[11-15]. Abnormal transaminase level also showed the association with clinical bleeding in

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dengue patients[11-16].

The present study was conducted to describe the clinical manifestations of dengue infection in adult patients. The secondary objective is to compare the clinical manifestations of dengue infection between normal and abnormal liver function tests in adult patients.

Material and Method

A retrospective study was done at the Hospital for Tropical Diseases, Bangkok, Thailand, from 2000-2002. All medical records of patients admitted with dengue infection under the following criteria were reviewed: (1) adult (age greater than or equal to 15 years); and (2) AST (aspartate aminotransferase) and ALT (alanine aminotransferase) level was done at least one time within 7 days of the fever onset. Dengue infection was defined by the WHO criteria with serological confirmation by ELISA test or rapid immunochromatographic test. The WHO classification of 1997 was used to differentiate dengue patients from dengue fever (DF) or dengue hemorrhagic fever (DHF) grade 1-4[17].

Statistical analysis

Clinical manifestations and laboratory data of dengue patients were described by descriptive statistics. Comparisons of clinical and laboratory findings between defined groups of patients were analyzed by t-test or Mann-Whiney U-test for continuous data, and by Chi-square test or Fisher's exact test for categorical data. Statistical significance was set at $p<0.05$, with a two-tailed test. As for the statistical analyses, SPSS software version 17.0 for Windows (SPSS Inc., Chicago, IL, USA) was used.

Results

One hundred and twenty-seven adult dengue patients who met the study criteria were included. Male to female ratio was 1.05:1. Their mean age was 26.4±11.5 years. Dengue patients were classified as follows: DF 4.7%, DHF grade 1 26.0%, DHF grade 2 63.0% and DHF grade 3 6.3%.

Most patients had no underlying disease (96%), and they had no regular medication (97%). No patient had liver disease as the underlying disease. The mean duration of fever before admission was 5 days. Most patients received treatment before admission (84.3%). Other baseline characteristics are shown in the Table 1.

Clinical manifestations

All patients had fever before admission (Table 2). Other common manifestations were myalgia, nausea/vomiting and headache. Twenty-one percent of the patients had a history of minimal bleeding before admission; mucosal bleeding (50%) was the most common. Other sites were vaginal bleeding (23.1%), gastrointestinal bleeding (19.2%), microscopic hematuria (3.8%) and hemoptysis (3.8%). Nearly half of the patients had symptoms of upper respiratory tract infection. Tourniquet test was positive in 77.2% of the patients. Other positive signs on admission were hepatomegaly (34.6%), petechiae (26%) and injected pharynx (22.8%).

The mean duration of fever clearance time was 6.0 days (range 2-19 days). More than half of the patients had fever that subsided at 5-6 days after the

Table 1. Baseline characteristics of 127 adult dengue patients admitted at the Hospital for Tropical Diseases, Bangkok, Thailand

Baseline characteristics	Number of patients (%)
Age; mean (range), years	26.4 (15-60)
Sex; male: female	1.05:1
Underlying disease (n = 124)	5 (4)
Regular medication used (n = 106)	3 (2.8)
Alcohol drinking (n = 97)	19 (19.6)
Received treatment before admission (n = 121)	102 (84.3)
Received antibiotic before admission (n = 61)	34 (55.7)
Received NSAIDs before admission (n = 43)	3 (7.0)
Day of fever on admission; mean (range), days	5.0 (1-7)
Referred from other hospital	50 (39.4)

Note: NSAIDs = Non-steroidal anti-inflammatory drugs

fever onset (Fig. 1). Only 17% of the patients had fever more than 7 days. Two patients had co-infection with acute tonsillitis and urinary tract infection but their fever subsided 4 days after the onset.

Laboratory findings

Table 3 shows laboratory findings of dengue patients, separated by the day from onset of the fever to two periods: first week and second week. On average, complete blood counts (CBC) were done 3.4 times and transaminase enzymes were done 1.3 times. The mean white blood cell count was quite low on first week (3,983 cells/mm^3) and the level rising on the second week (6,432 cells/mm^3). Their mean platelet count was lower than100,000 cells/mm^3 on both weeks.

Transaminase enzymes were mostly taken on day 5-6 from the onset of the fever. Abnormal AST was found in 88.2% of the patients whereas abnormal ALT was found in 69.3%. Both mean AST and mean ALT were rising from first week to second week. The mean ratio of AST: ALT was 1.8: 1. There were 94.3% of patients that had AST: ALT more than 1.0. Some patients had high level of transaminase enzymes, defined as more than 10-fold elevations (400 IU/L), AST 11%, ALT 7%. None of the patients had clinically jaundice or hyperbilirubinemia.

Table 4 shows the mean of transaminase enzymes in each grade of dengue infection. Patients with DHF grade 3 had mean AST and mean ALT in the second week that was significantly higher than other groups (mean AST 8,143 IU/L, mean ALT 2,379 IU/L) as shown in Fig. 2.

Patients with abnormal AST were significantly older, longer duration of fever and lower platelet counts during the febrile period with more common of the following symptoms during the febrile period: high fever (>39°C), abdominal pain and bleeding. Patients with abnormal ALT also had significantly older age and longer duration of fever. Patients with abnormal AST or abnormal ALT more commonly had fever for more than 7 days, nausea/vomiting and petechiae during the febrile period. The percentages of patients with abnormal AST or ALT were not significantly different in each grade of dengue infection.

Patients with high-level AST (more than 10-fold elevations) more commonly had nausea/vomiting during the febrile period and had lower minimum platelet counts. Patients with high-level ALT (more than 10-fold elevations) was significantly more common than shock in those with low-level ALT (25% vs. 5%, respectively). Patients with high-level transaminases had a significantly longer duration of fever and rising hematocrit (Hct). The grade of dengue infection was not associated with high-level transaminases.

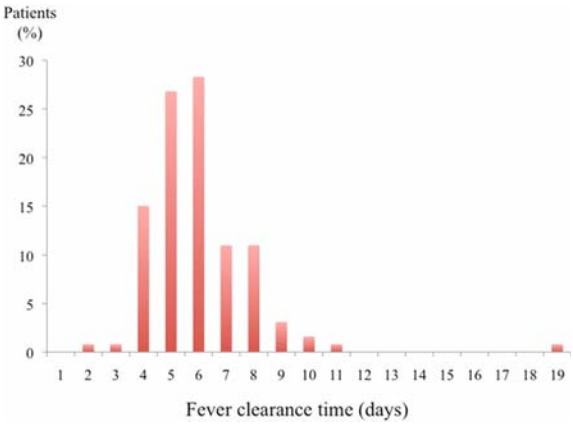


Fig. 1 Percentage of patients by fever clearance time.

Table 2. Clinical manifestations on admission of 127 adult dengue patients symptoms

	Number of patients (%)	Signs	Number of patients (%)
Fever (n = 127)	127 (100)	Jaundice (n = 127)	0 (0)
Myalgia (n = 74)	71 (95.9)	Petechiae (n = 127)	33 (26)
Nausea/vomiting (n = 122)	107 (87.7)	Injected pharynx (n = 127)	29 (22.8)
Headache (n = 127)	96 (75.6)	Cervical lymphadenopathy (n = 127)	4 (3.1)
Rash (n = 27)	20 (74.1)	Hepatomegaly (n = 127)	44 (34.6)
URI symptoms (n = 95)	44 (46.3)	Splenomegaly (n = 127)	1 (0.8)
Abdominal pain (n = 82)	35 (42.7)	Positive tourniquet test (n = 57)	44 (77.2)
Bleeding (n = 127)	26 (20.5)		
Diarrhea (n = 124)	18 (14.5)		

URI = Upper respiratory tract infection

Table 3. Laboratory findings of 127 adult dengue patients

Lab	Day 1-7			Day 8-14		
	n	Mean ± SD	Range	n	Mean ± SD	Range
Hematocrit (%)	126	42.75±5.19	21.1-56.7	80	41.53±5.74	21.6-55.5
WBC (cell/mm^3)	126	3,983.45±1,925.08	1,200-11,550	34	6,432.11±3,095.79	2,875-18,700
Neutrophil (%)	125	50.96±15.75	8-91	34	39.50±13.92	16-82
Lymphocyte (%)	125	31.32±10.91	3-56	34	41.12±11.60	10-63
Atypical lymphocyte (%)	125	5.81±7.98	0-40	34	8.05±6.87	0-32
Platelets (cell/mm^3)	126	61,905.95±39,561.33	10,000-234,500	76	76,555.92±65,200.58	12,500-355,000
AST (IU/L)	127	243.33±371.53	14-2,215	18	651.81±1,463.68	52-6,468
ALT (IU/L)	127	152.46±214.95	5-1,580	18	512.31±1,030.54	80-4,586

Day 1-7 = day 1 to day 7 from fever onset; Day 8-14 = day 8 to day 14 from fever onset; SD = standard deviation; WBC = white blood cell count; AST = aspartate aminotransferase; ALT = alanine aminotransferase

Table 4. Mean transaminase enzymes level by grade of dengue infection

	DF (n = 6)	DHF grade 1 (n = 33)	DHF grade 2 (n = 80)	DHF grade 3 (n = 8)	*p*-value
Mean AST d1-7 ±SD (IU/L)	119.83±118.31 (n = 6)	211.94±337.53 (n = 33)	266.38±399.62 (n = 80)	305.25±381.83 (n = 8)	0.711
Mean AST d8-14 ±SD (IU/L)	351 (n = 1)	439.25±280.97 (n = 4)	320.27±235.77 (n = 11)	8,143.00±11,309.47 (n = 2)	0.032*
Mean ALT d1-7 ±SD (IU/L)	89.00±99.76 (n = 6)	135.14±175.78 (n = 33)	159.31±228.46 (n = 80)	202.98±293.19 (n = 8)	0.074
Mean ALT d8-14 ±SD (IU/L)	249 (n = 1)	287.50±194.37 (n = 4)	278.45±190.35 (n = 11)	2,379.75±3,119.40 (n = 2)	0.041*

d1-7 = day 1 to day 7 from fever onset; d8-14 = day 8 to day 14 from fever onset; AST = aspartate aminotransferase; ALT = alanine aminotransferase; SD = standard deviation
* Significant ($p<0.05$)

Complications

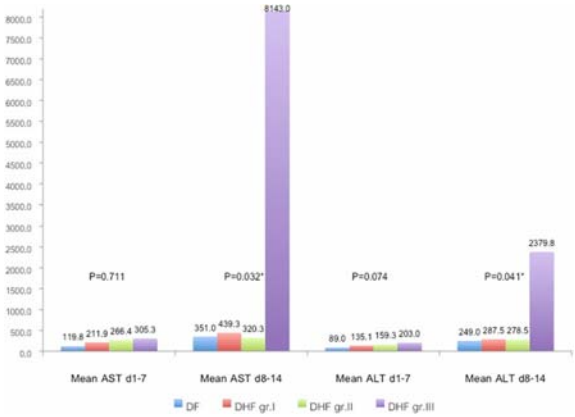
Minimal bleeding occurred in 43.3% of patients. The most common site was the mucosa (55.2%). Others were microscopic hematuria (15.5%), vaginal bleeding (13.8%) and gastrointestinal bleeding (6.9%).

Patients with bleeding had significant higher percentage of Hct rising (13.3% vs. 10.1%, $p = 0.014$), lower platelet counts during febrile period (57,327/mm^3 vs. 80,376/mm^3, $p = 0.003$) and lower minimum platelet counts (33,236/mm^3 vs. 50,236/mm^3, $p = 0.004$) than patients without bleeding. Bleeding was associated with abnormal AST during the febrile period.

Shock occurred in 6.3% of the patients after 5.6 days of fever in average. All patients recovered within 1 day of shock without vasopressor used. Pleural effusion occurred in 1.6%. No pulmonary edema was found. No patient died in this study.

Discussion

Fever with myalgia and nausea/vomiting were the common clinical manifestations of adult dengue infection in the present study. These symptoms were non-specific and could give many differential diagnoses especially tropical infections. Bleeding was found only in one-fifth of the patients at the day of



d1-7 = day 1 to day 7 from fever onset; d8-14 = day 8 to day 14 from fever onset; AST = aspartate aminotransferase; ALT = alanine aminotransferase. * Significance (p<0.05)

Fig. 2 Mean transaminase enzymes level by grade of dengue infection.

admission. Other symptoms such as URI symptoms and diarrhea, which was not uncommon, could lead to misdiagnosis as localized infection.

Eighty-three percent of the patients had fever clearance time less or equal to 7 days which was the same as in previous studies[9,15,16,18,19]. Patients who had fever more than 7 days should also be differentially diagnosed for other infections, i.e. autoimmune diseases or hematologic malignancies.

Positive tourniquet test was found in less than 80% of the adult dengue patients, even though it was done in average at 5 days after the fever onset. Injected pharynx was found in nearly one-fourth of the patients and could also be misleading of the diagnosis. Therefore, in the endemic areas of dengue infection, specific laboratory for the diagnosis of dengue infection should be done for investigation of acute febrile illness.

Three studies compared clinical manifestation of dengue infection between children and adults[8-10]. All studies showed that adults had the following symptoms that were more common than in children, i.e. headache, joint pain, and myalgia. Other symptoms, nausea/vomiting, retro-orbital pain, abdominal pain, petechiae and melena, were inconclusively more common in the adult. Hepatomegaly was significantly more common in the children than adults in 2 studies, 43% vs. 28% and 92% vs. 72%[8,9]. Severe dengue infection (DHF and DSS) was more common in the adult than in children in all studies; only two studies were statistically significant, however[8,10]. Two studies showed mean ALT were significantly higher in adult patients than in children[9,10]. In the present study, almost all patients were DHF (95.3%) which supports the evidence that severe dengue infection was more common in the adult.

Studies in adult dengue patients showed hepatomegaly varied from 8.6 to 47.6%[10,12,13,15,19,20]. The present study from Vietnam in 2010 also showed that patients with shock had hepatomegaly significantly more than patients without shock (74% vs. 27%, respectively)[15]. In the present study, hepatomegaly was found in 36.2% (62.5% in patients with shock vs. 34.5% in patients without shock, p = 0.110). The reason might be due to hepatomegaly was only the sign of liver involvement of dengue infection, not the marker of severity or low number of patients with shock in the present study.

Hyperbilirubinemia was found in 0.7-13.4% in the adult dengue infection but no significant association with severity[11-15,19,20]. High level of serum bilirubin was observed in patients with hepatic failure and caused mortality[11,14]. Minimal elevation of serum bilirubin was found without clinical jaundice or other morbidities. No patient in the present study had clinical jaundice but serum bilirubin was checked in only 10 patients.

Elevation of transaminases was common in adult dengue infection. From a previous study maximum transaminase levels occurred on the ninth day after the fever onset and gradually decreased to the normal levels within two weeks[11]. A recent study showed 7.6% of the patients still had elevation of transaminase after 2 months[18]. Elevated AST was found in 86-95% (only one study found 54%)[11,13,15,16,21]. Elevated ALT was found in lesser proportion in each study from 33-85.7%[11-13,15,16,21]. The present study found elevated AST 88.2% and elevated ALT 69.3%.

The characteristic of transaminase levels in dengue patients was that the levels of AST was frequently higher than ALT during the febrile period. This character can discriminate dengue infection from viral hepatitis. The present study showed 94.3% of patients had AST more than ALT levels during the febrile period. A previous study in adult patients found only 76%[13]. The elevated AST level tends to return to normal more rapidly than ALT levels possibly because AST has a shorter half-life than ALT. The lower rate in the previous study might be caused by an analyzed transaminase level after fever subsided.

Elevation of liver enzymes in the adult dengue infection did not show any association with severity as in child patients. DHF patients more commonly had

elevation of liver enzymes than DF patients, but these are not statistically significant[12,15]. The present study showed the same trend (elevation AST; 66.7% in DF vs. 90.1% in DHF, elevation ALT; 50.0% in DF vs. 71.1% in DHF). The present study also analyzed elevation of the liver enzymes during febrile period and whether it can be considered a surrogate marker for complications, which frequently occurred after fever subsided. Factors associated with elevation AST during febrile period were high fever, abdominal pain, bleeding and lower platelet counts during fever, whereas factors associated with elevations of AST or ALT were older age, nausea/vomiting, petechiae and longer duration of fever. Mean duration of fever in normal and abnormal liver enzymes were statistically different as follows: AST 5.2 days vs. 6.6 days, ALT 5.4 days vs. 6.7 days. Another study that used early liver enzymes showed an elevated liver enzyme on day 3 after the fever onset was significantly associated with plasma leakage and gallbladder thickening[16]. Increased ALT level on day 3 also was significantly associated with internal bleeding.

As the elevation of the liver enzymes is common in dengue infection, many studies used high-level liver enzymes to find association with the severity of dengue. Ten-fold elevation of AST was found in 10.2-11.1%[11,13] whereas 7.4-15% in ALT[11,13,15]. A study from Pakistan showed overall mortality, mortality in DF patients, mortality in DHF/DSS patients and all complications except shock were significantly higher in severe hepatitis group (ALT more than 10-fold elevation) as compared to mild to moderate hepatitis group[15]. The present study shows 11% and 7% of the patients who had AST and ALT levels more than 10-fold elevation, respectively. Factors associated with high-level AST and high-level ALT were longer duration of fever and higher risen hematocrit. Mean duration of fever in low-level and high-level liver enzymes were statistically different as follows: AST 5.8 days vs. 8.1 days, ALT 5.8 days vs. 9.0 days. Patients with shock more commonly had high-level ALT than in patients without shock (25% vs. 5%, respectively).

Transaminases levels were also shown associated with the severity of dengue infection. A previous study from Singapore showed that AST and ALT levels were significantly higher in patients with DHF or bleeding[13]. The latter study was analyzed by using both classifications of the severity of dengue severity[21]. According to the WHO 2009 classification, the median AST and ALT values were significantly higher in severe dengue compared to dengue with and without warning signs during both the febrile and critical phases but not the convalescent phase. However, according to the WHO 1997 classification, the median AST and ALT values were only significantly higher for DHF versus DF and DSS in the febrile phase but not in the critical and convalescent phases. The present study shows that patients with DHF grade 3 had mean AST and mean ALT in the second week significantly higher than other grades.

Bleeding is the most common complication of dengue infection. Transaminases levels were higher in patients with bleeding in many studies[11-14]. Patients with bleeding were more common to have elevated AST, higher hematocrit rising, and lower platelet counts during the fever and convalescent phases compared to patients without bleeding in the present study.

Shock is another important dengue complication that requires early detection and prompt treatment. In a previous study from Vietnam, factors associated with shock were younger age, bleeding, abdominal pain, hepatomegaly, lower platelet counts, longer prothrombin time, longer activated partial thromboplastin time, lower fibrinogen level, higher AST and ALT on day 4-6 after the fever onset, and higher AST on day 7-10 after the fever onset[14]. Another study from Thailand[20] showed different factors including history of nausea/vomiting, upper gastrointestinal bleeding, altered mental status on admission, right upper quadrant tenderness, pleural effusion, ascites, and white blood cell counts $\geq$6,000 cells/mm^3. In the present study, high-level ALT was significantly more common in patients with shock compared to patients without shock.

Limitation of the present study was the small number of patients and retrospective design. Liver function test was not performed serially on every patient.

Conclusion

Adult dengue infection presents with acute febrile illness with predominant myalgia, nausea/vomiting and headache. The fever usually subsides in 5-6 days after the fever onset. DHF is more common than DF in the present study. At least two-thirds of the adult dengue patients commonly show abnormal liver function tests. High-level ALT during the febrile stage shows association with shock.

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Potential conflicts of interest

None.

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การทดสอบการทำงานของตับและความรุนแรงทางคลินิกของการติดเชื้อเดงกี่ในผู้ใหญ่

ฉัตรพร กิตติตระกูล, อุดมศักดิ์ ศิลาจำรูญ, วีระพงษ์ ภูมิรัตนประพิณ, ศรีวิชา ครุฑสูตร, พลรัตน์ วิไลรัตน์, สมบัติ ตรีประเสริฐสุข

ภูมิหลัง: ลักษณะทางคลินิกของการติดเชื้อเดงกี่ในผู้ใหญ่แตกต่างจากเด็กในแง่ของแนวโน้มที่จะพบเลือดออกน้อยกว่าและพบความผิดปกติของการทดสอบการทำงานของตับได้มากกว่า

วัตถุประสงค์: วัตถุประสงค์ปฐมภูมิคือเพื่อบรรยายลักษณะทางคลินิกของการติดเชื้อเดงกี่ในผู้ใหญ่ วัตถุประสงค์ทุติยภูมิคือเพื่อเปรียบเทียบลักษณะทางคลินิกของการติดเชื้อเดงกี่ในผู้ป่วยผู้ใหญ่ระหว่างกลุ่ม ที่มีการทดสอบการทำงานของตับปกติและกลุ่มที่มีการทดสอบการทำงานของตับผิดปกติ

วัสดุและวิธีการ: การศึกษาวิจัยแบบย้อนหลังในผู้ป่วยติดเชื้อเดงกี่ที่เป็นผู้ใหญ่ (อายุตั้งแต่ 15 ปีขึ้นไป) ที่เข้ารักษาตัวในโรงพยาบาลเวชศาสตร์เขตร้อนตั้งแต่ปี พ.ศ. 2543-2545 การติดเชื้อเดงกี่วินิจฉัยตามเกณฑ์ขององค์การอนามัยโลกปี พ.ศ. 2540 ร่วมกับตรวจเลือดยืนยันการติดเชื้อโดยวิธี ELISA หรือ Rapid Immunochromatographic test การทดสอบการทำงานของตับจะถูกบันทึกผลตามลำดับวันที่มีไข้

ผลการศึกษา: มีผู้ป่วยติดเชื้อเดงกี่ที่เป็นผู้ใหญ่ 127 ราย อายุเฉลี่ย 26.4±11.5 ปี แบ่งกลุ่มตามเกณฑ์ขององค์การอนามัยโลกได้เป็น DF ร้อยละ 4.7, DHF grade 1 ร้อยละ 26.0, DHF grade 2 ร้อยละ 63.0 และ DHF grade 3 ร้อยละ 6.3 ค่าเฉลี่ยของระยะเวลาที่ไข้ลงอยู่ที่ 6.0±1.9 วัน แต่ไข้ลงช้าในรายที่มีค่าทรานส์อะมิเนสในระดับสูง (มากกว่า 10 เท่า) อาการและอาการแสดงที่พบบ่อยได้แก่ ปวดเมื่อยกล้ามเนื้อ (ร้อยละ 95.9) คลื่นไส้/อาเจียน (ร้อยละ 87.7) ทดสอบด้วยการทดสอบทูนิเกต์ได้ผลบวก (ร้อยละ 77.2) ปวดท้อง (ร้อยละ 42.7) ตับโต (ร้อยละ 34.6) และเลือดออก (ร้อยละ 20.5) อัตราส่วนของค่า AST ต่อ ALT เท่ากับ 1.8:1 ตรวจพบค่า AST และ ALT ผิดปกติ ร้อยละ 88.2 และ ร้อยละ 69.3 ตามลำดับ ผู้ป่วยที่มีคลื่นไส้/อาเจียน มีจุดเลือดออก หรือมีไข้มากกว่า 7 วัน มักจะตรวจพบค่าทรานส์อะมิเนสผิดปกติ ค่า AST ที่ผิดปกติในช่วงที่มีไข้สัมพันธ์กับการเกิดเลือดออก ตรวจพบค่า AST และ ALT ในระดับสูง เท่ากับ 11.0% และ 7.0% ตามลำดับ ภาวะช็อคสัมพันธ์กับค่า ALT ระดับสูงในระหว่างที่มีไข้

สรุป: ผู้ป่วยติดเชื้อเดงกี่ที่เป็นผู้ใหญ่มักจะพบ DHF และการทดสอบการทำงานของตับที่ผิดปกติ ค่าทรานส์อะมิเนสที่ผิดปกติสัมพันธ์กับระยะเวลาของไข้ การเกิดเลือดออกและภาวะช็อค