Short Communication

Clinic-Based PCR Detection of *Anaplasma platys* (16S rRNA) in Domestic Cats from Can Tho City, Vietnam: Hematological and Biochemical Alterations

Nguyen Thang Long[1], Dang Thi Tham[2], Luu Dac Gia[2], Nguyen Tran Phuoc Chien[2], Tran Thi Thao[2]*

[1]Master's Program in Veterinary Medicine, Faculty of Veterinary Medicine, College of Agriculture, Can Tho University, Can Tho, Vietnam; [2] Faculty of Veterinary Medicine, College of Agriculture, Can Tho University, Can Tho, Vietnam.

Abstract | This study reports clinic-based detection of *Anaplasma platys* (*A. platys*) DNA in domestic cats from Can Tho City, Vietnam, using smear morphology and nested PCR targeting the 16S rRNA gene. Platelet-associated inclusions indicative of *A. platys* were identified on smears exhibiting variable parasitemia, and all cases were validated as PCR-positive. In these five PCR-confirmed cats, thrombocytopenia was the most consistent finding, while other hematological and biochemical abnormalities varied between individuals. Hematology showed that all of the cats had severely reduced platelet counts 5/5 (70–210 $\times 10^9$/L), and their hematocrit levels were often low (23–28%), which is a sign of mild to moderate anemia. Biochemical abnormalities were diverse, prominently featuring elevated transaminases (AST/ALT), cholestatic enzyme increases accompanied by hyperbilirubinemia in one instance, and dysproteinemia characterized by hyperglobulinemia, hypoalbuminemia, and diminished albumin-to-globulin ratios. These findings document PCR detection compatible with *A. platys* infection and describe associated clinicopathologic alterations, expanding preliminary evidence of feline exposure/infection in southern Vietnam. This case series provides an index signal that *A. platys* infection may be relevant to feline vector-borne disease in Vietnam and warrants consideration in clinically compatible cases; systematic studies with sequence confirmation and co-infection testing are needed.

Keywords | *Anaplasma platys*, Domestic cats, Thrombocytopenia, Nested PCR, 16S rRNA, Vietnam

Received | January 16, 2026; **Accepted** | March 04, 2026; **Published** | April 15, 2026
***Correspondence** | Tran Thi Thao, Faculty of Veterinary Medicine, College of Agriculture, Can Tho University Campus II, 3/2 Street, Ninh Kieu ward, Can Tho City, Vietnam; **Email:** ttthaoty@ctu.edu.vn
Citation | Long NT, Tham DT, Gia LD, Chien NTP, Thao TT (2026). Clinic-based PCR detection of *Anaplasma platys* (16S rRNA) in domestic cats from Can Tho City, Vietnam: Hematological and biochemical alterations. Adv. Anim. Vet. Sci., 14(4):839-846.
DOI | https://dx.doi.org/10.17582/journal.aavs/2026/14.4.839.846
ISSN (Online) | 2307-8316

INTRODUCTION

Anaplasmosis is a vector-borne disease caused by obligate intracellular, Gram-negative bacteria of the genus *Anaplasma*. In dogs, infection is primarily attributed to *Anaplasma phagocytophilum* (*A. phagocytophilum*) and *Anaplasma platys* (*A. platys*). Most naturally infected dogs exhibit mild or no clinical abnormalities; however, clinical disease can occur and may include fever, lethargy, pale mucous membranes, inappetence, weight loss, mucopurulent nasal discharge, lymphadenomegaly, and uveitis (Granick *et al.*, 2021). When thrombocytopenia develops, hemorrhagic manifestations such as petechiae, ecchymoses, and epistaxis are frequently observed. *Anaplasma platys* was first described in Florida (USA) in 1978 and is now reported across North and South America, southern Europe, Asia, the Middle East, Australia, the Caribbean, and Africa (Matei *et al.*, 2016;

Granick *et al*., 2021; Gospodinova *et al*., 2024).

In cats, most published work has focused on *A. phagocytophilum*; nonetheless, recent studies have also detected *A. platys* less commonly in feline populations from multiple geographic regions (Hegarty *et al*., 2015; Lima *et al*., 2010; Qurollo *et al*., 2014; Salakij *et al*., 2012). Among feline *Anaplasma* species, *A. phagocytophilum* is considered the most clinically relevant, whereas *A. platys* infection appears sporadic and remains poorly characterized in cats (Lima *et al*., 2010; Salakij *et al*., 2012).

Anaplasma platys preferentially infects circulating platelets. Transmission is presumed to involve ticks, and the brown dog tick (*Rhipicephalus sanguineus* s.L.) is frequently implicated as a vector in prior studies (Granick *et al*., 2021; Wongtawan *et al*., 2024). Reported clinical presentations in cats are often nonspecific and may include anorexia, apathy, pallor, fever, and lymphadenomegaly; persistent infection has been associated with thrombocytopenia (Lima *et al*., 2010; Salakij *et al*., 2012). Many infected cats may remain asymptomatic or display only subtle clinicopathologic changes.

Microscopic detection of intraplatelet inclusions on peripheral blood smears can support a presumptive diagnosis; however, definitive confirmation requires molecular testing. PCR amplification with sequencing of the conserved 16S rRNA gene remains the reference approach for species-level identification in *Anaplasma* infections (Piratae *et al*., 2017; Sarker *et al*., 2021; Granick *et al*., 2021; Gospodinova *et al*., 2024).

To date, data on *A. platys* infection in cats in Vietnam are lacking. Therefore, this study aimed to report clinic-based detection of *A. platys* like DNA in domestic cats from Can Tho, Vietnam, using smear evaluation and nested 16S rRNA PCR, and to describe the associated clinical and clinicopathologic findings.

MATERIALS AND METHODS

Animals and clinical examination

This study was conducted between January 2025 and April 2025 on five domestic cats (*Felis catus*) of different ages, sexes, and breeds that had been presented to the Veterinary Teaching Clinic, Faculty of Veterinary Medicine, Can Tho University, Vietnam, with clinical signs suggestive of hemoparasitic infection, including fever, anorexia, lethargy, pale mucous membranes, and epistaxis. A complete physical examination was performed according to the standard diagnostic protocol of the clinic, with special attention to rectal temperature, mucous membrane color, and lymph node status. Abdominal ultrasonography (or other diagnostic imaging) was not performed; therefore, primary hepatobiliary or renal disease could not be excluded. Given the case-series design and limited sample size, analyses were descriptive and were not intended to establish a disease-specific clinical profile or causality.

Sample collection

Approximately 2 mL of whole blood was collected aseptically from the cephalic vein of each cat using EDTA-coated vacutainer tubes for hematological analysis and molecular assays. An additional 2 mL of blood was collected into plain tubes, allowed to clot, and centrifuged at 3,000 rpm for 10 min to obtain serum for biochemical profiling. All samples were processed within 2 h of collection.

Complete blood count (CBC) was performed using an automated veterinary hematology analyzer (Dymind DF50, China). Parameters measured included total white blood cells (WBC), differential leukocyte count (neutrophils, lymphocytes, monocytes, eosinophils, basophils), red blood cells (RBC), hemoglobin (HGB), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), platelets (PLT), mean platelet volume (MPV), red cell distribution width-coefficient of variation (RDW-CV).

Serum biochemical parameters, including aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (ALP), gamma-glutamyl transferase (GGT), total protein (TP), albumin (ALB), globulin (GLOB), albumin/globulin ratio (A/G), blood urea nitrogen (BUN), creatinine (CREA), glucose (GLU), and total bilirubin (TBIL), were determined using a semi-automated biochemistry analyzer (MNCHIP Pointcare M4, China).

No inferential statistics were performed due to the very small sample size and the descriptive nature of this case series; results are presented as proportions outside reference intervals and ranges.

Microscopic examination

Thin blood smears were prepared from EDTA blood, air-dried, fixed with absolute methanol for 2 min, and stained with 10% Giemsa solution (Merck, Germany) for 30 min. Slides were examined under oil immersion at 1000× magnification using a light microscope (Olympus CX43, Japan). *Anaplasma platys* was identified by the presence of basophilic, round to oval morulae within the cytoplasm of circulating platelets, often appearing as single or multiple small inclusions (De Tommasi *et al*., 2014; Matei *et al*., 2016; Granick *et al*., 2021). Parasitemia was semi-quantitatively graded for descriptive purposes at 1000× oil immersion by examining 50 consecutive fields per smear

and recording the number of infected platelets per field. Infection intensity was classified as low (+): 1–5 infected platelets/field; moderate (++): 6–20 infected platelets/field and high (+++): >20 infected platelets/field, following previously described platelet-counting approaches (Matei *et al*., 2016; Galvan *et al*., 2018; Granick *et al*., 2021; Allison and Little, 2013). This grading scheme has not been formally validated for *A. platys* in cats and was not used to infer a parasitemia–severity relationship in the present case series. All smears were evaluated by a single observer; inter-observer agreement was not assessed.

Molecular detection by nested PCR

Genomic DNA was extracted from 200 µL of EDTA–anticoagulated blood using the TopPURE® DNA Extraction Kit (ABT, Vietnam) according to the manufacturer's protocol. A nested PCR assay targeting the 16S rRNA gene of *Anaplasma platys* was employed to enhance sensitivity of detection, as previously described (Piratae *et al*., 2017; Sarker *et al*., 2021). The first amplification was carried out using primers: ECC (forward) 5'-AGAACGAACGCTGGCGGCAAGCC-3' and ECB (reverse) 5'-CGTATTACCGCGGCTGCTGGC-3'. PCR reactions (25 µL) contained 12.5 µL of GoTaq® Green Master Mix (Promega, USA), 1 µL of each primer (10 µM), 2 µL of DNA template, and nuclease-free water. The cycling protocol was: initial denaturation at 94°C for 3 min; 35 cycles of denaturation at 94°C for 1 min, annealing at 60°C for 1 min, extension at 72°C for 1 min; followed by a final extension at 72°C for 5 min. The expected product size was 478 bp.

The nested PCR was performed using *A. platys*-specific primers targeting the internal fragment of the 16S rRNA gene PLATYS-F (forward): 5'-TTTGTCGTAGCTTGCTATG-3' and GA1UR-R (reverse): 5'-GAGTTTGCCGGGACTTCTTCT-3'. The reaction mix was identical to the primary PCR, except that 1 µL of the first-round PCR product was used as template. Cycling conditions were: 95°C for 2 min; 35 cycles of 95°C for 1 min, 62°C for 1 min, 72°C for 1 min, and 72°C for 5 min. The expected amplicon size was 402 bp. Positive amplicons were visualized by electrophoresis on a 1.5% agarose gel stained with GelGreen® (ABT, Vietnam) and compared with a 100 bp DNA ladder (Phusa genomics, Vietnam). PCR testing for other feline haemoparasites (*M. haemoplasmas*, *Bartonella* spp., *Babesia* spp.) was not performed. In this case series, PCR was performed on smear-positive samples to confirm the presumptive cytologic diagnosis; smear-negative cats were not PCR-tested

RESULTS

A total of 22 cats presenting with clinical signs suggestive of hemoparasitic infection were examined. Platelet-associated inclusions morphologically consistent with *Anaplasma platys* were observed on Giemsa-stained blood smears in 5/22 cats, corresponding to a microscopic smear detection rate among clinically suspected cats of 22.72% (Figure 1). Nested 16S rRNA PCR was subsequently performed on these smear-positive samples, and all 5/5 yielded the expected 402-bp amplicon (Figure 2), providing PCR confirmation among smear-positive cases. Because PCR was not applied to smear-negative cats in this series, a PCR-based positivity proportion among the full suspected group could not be estimated.

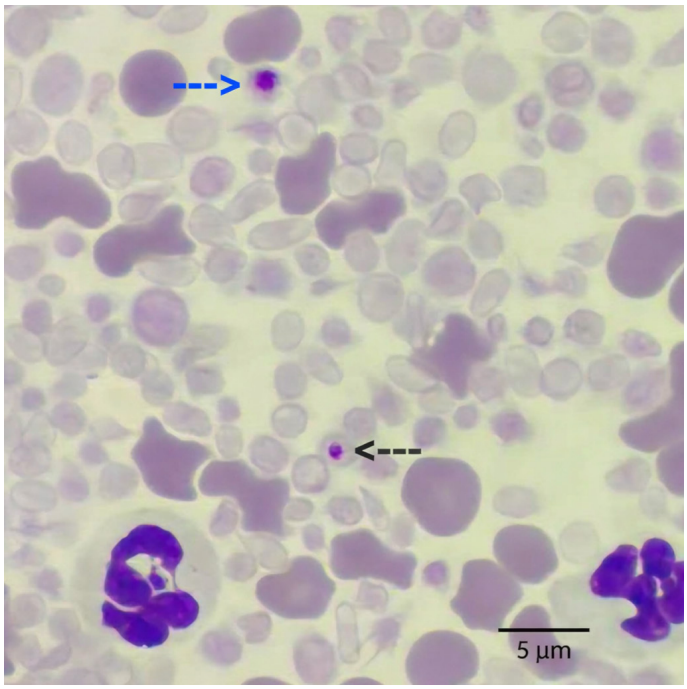

Figure 1: Intraplatelet inclusions consistent with *Anaplasma platys* infection in cats (Arrows) on a Giemsa-stained peripheral blood smear (oil immersion, ×1000).

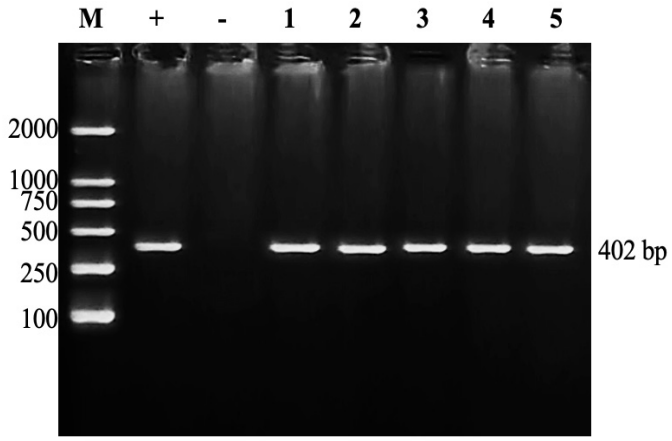

Figure 2: Agarose gel electrophoresis of nested (round-2) 16S rRNA PCR amplicons showing the expected 402-bp band in smear-positive cats. M, molecular size marker; (+), positive control; (–), negative control; lanes 1–5, feline samples (CatCT01–CatCT05).

Table 1: Signalment, clinical signs, parasitemia, and nPCR results of cats naturally infected with *Anaplasma platys* in Can Tho, Vietnam.

Cat ID	Location	Breed	Age (years)	Sex	Management	Clinical signs	Parasitemia (*Giemsa smear*)
Cat 1	Ninh Kieu, Can Tho	Local	2	Male	Free-roaming	Fever, pale mucous membranes, lethargy	+
Cat 2	Cai Rang, Can Tho	Mixed breed	3	Female	Household pet	Anorexia, lymphadenopathy, mild epistaxis	++
Cat 3	Ninh Kieu, Can Tho	Local	5	Male	Free-roaming	Chronic weight loss, pale mucosa, jaundice, fever	++
Cat 4	Phong Dien, Can Tho	Siamese mix	4	Female	Free-roaming	High fever, depression, petechiae on ear pinnae	+++
Cat 5	Ninh Kieu, Can Tho	Mixed breed	1.5	Male	Household pet	Anorexia, lethargy, enlarged lymph nodes, pale mucosa	+

Note: Parasitemia semi-quantitative grading on Giemsa-stained smears: (+) = 1–5 infected platelets/field; (++) = 6–20 infected platelets/field; (+++) >20 infected platelets/field at 1000× magnification. This grading is descriptive and not validated for feline *A. platys*. All five cats tested nPCR-positive for *Anaplasma platys* using a nested 16S rRNA assay.

Table 2: Hematological parameters of cats naturally infected with *Anaplasma platys* in Can Tho, Vietnam.

Parameter	Unit	Reference	Cat 1	Cat 2	Cat 3	Cat 4	Cat 5
WBC	10^9/L	5.5–19.5	4.2↓	16.8	12.1	6.5	14.2
Neutrophils	%	35–75	62	78↑	70	66	75
Lymphocytes	%	20–55	25	15↓	18↓	22	16↓
Monocytes	%	1–4	7↑	5↑	6↑	8↑	5↑
Eosinophils	%	0–6	4	2	3	3	2
Basophils	%	0–1	1	0	1	1	1
RBC	10^{12}/L	5.0–10.0	5.1	6.3	5.5	4.9↓	6.0
HGB	g/dL	8.0–15.0	8.5	11.2	9.3	7.9↓	10.5
HCT	%	30–45	26↓	34	28↓	23↓	32
MCV	fL	39–55	50	54	51	47	52
MCHC	g/dL	30–36	33	32	32	34	33
PLT	10^9/L	300–700	95↓	180↓	130↓	70↓	210↓
MPV	fL	8–14	13.5	12.2	13.0	12.8	11.8
RDW-CV	%	14–18	16.5	15.0	16.0	17.2	15.5

Note: WBC = white blood cells; RBC = red blood cells; HGB = hemoglobin; HCT = hematocrit; MCV = mean corpuscular volume; MCHC = mean corpuscular hemoglobin concentration; PLT = platelets; MPV = mean platelet volume; RDW-CV = red cell distribution width (coefficient of variation); Reference intervals are based on The Merck Veterinary Manual (Aiello *et al.*, 2016); ↓ indicates values below the reference range, and ↑ indicates values above the reference range.

Table 1 summarizes the signalment and clinical features of the five cats with platelet-associated inclusions consistent with *A. platys* on Giemsa-stained smears, all of which were confirmed by nested 16S rRNA PCR. Cases originated from three districts in Can Tho (Ninh Kieu, Cai Rang, and Phong Dien), with Ninh Kieu accounting for 3/5 infections. Three cats were free-roaming and two were household pets; ages ranged from 1.5 to 5 years, and males predominated (3/5). Clinical presentation was nonspecific and variably included fever (3/5), depression (3/5), anorexia (2/5), pale mucous pallor (4/5), lymphadenopathy (2/5), petechiae (1/5), mild epistaxis (1/5), jaundice (1/5), and chronic weight loss (1/5). Smear parasitemia ranged from low (+) to high (+++), with one cat exhibiting high-grade parasitemia (+++), two cats showing moderate parasitemia (++), and two cats showing low parasitemia (+).

Table 2 highlights universal thrombocytopenia in all PCR-confirmed cats (5/5), with platelet counts markedly decreased to 70–210 $\times 10^9$/L (reference: 300–700 $\times 10^9$/L). Anemia was also common, with reduced HCT in 3/5 cats (23–28%), including one case showing concurrent decreases in RBC (4.9 $\times 10^{12}$/L) and HGB (7.9 g/dL). Despite these deficits, erythrocyte indices remained largely preserved (MCV 47–54 fL; MCHC 32–34 g/dL), indicating a predominantly normocytic, normochromic profile.

Table 3: Serum biochemical alterations in cats naturally infected with *Anaplasma platys* in Can Tho, Vietnam.

Parameter	Unit	Reference	Cat 1	Cat 2	Cat 3	Cat 4	Cat 5
AST	U/L	8.9–48.5	42	58↑	35	72↑	46
ALT	U/L	8.3–52.5	44	66↑	40	95↑	49
ALP	U/L	10–90	55	78	62	120↑	70
GGT	U/L	1–10	4	6	5	14↑	5
Total protein	g/dL	5.4–8.9	7.6	9.2↑	7.9	9.5↑	8.4
Albumin	g/dL	2.2–5.4	3.2	3.0	3.4	2.0↓	3.1
Globulin	g/dL	1.5–5.7	4.4	6.2↑	4.5	7.5↑	5.3
A/G ratio	–	0.8–1.2	0.9	0.5↓	0.9	0.3↓	0.8
Urea (BUN)	mg/dL	15.4–31.2	24	28	22	38↑	26
Creatinine	mg/dL	0.5–1.5	1.1	1.2	1.0	1.7↑	1.1
Glucose	mg/dL	60.8–124.2	92	132↑	88	78	101
Bilirubin (total)	mg/dL	0.1–0.9	0.4	0.6	0.3	1.2↑	0.5
P	mg/dL	3.1–8.5	4.8	5.5	4.6	6.2	5.0
Ca	mg/dL	7.8–11.8	9.6	9.2	9.8	9.0	9.4
CK	U/L	50–450	180	520↑	140	680↑	210
AMY	U/L	200–1800	820	900	760	1100	880
CHOL	mg/dL	65–225	160	175	150	140	190

Note: AST = aspartate aminotransferase; ALT = alanine aminotransferase; ALP = alkaline phosphatase; GGT = gamma-glutamyl transferase; BUN = blood urea nitrogen (urea); CREA = creatinine; TP = total protein; ALB = albumin; GLOB = globulin; A/G ratio = albumin to globulin ratio; GLU = glucose; TBIL = total bilirubin; P= phosphorus; Ca= calcium; CK= creatine kinase; AMY=amylase; CHOL=cholesterol; Reference intervals are based on The Merck Veterinary Manual (Aiello *et al.*, 2016); ↓ indicates values below the reference range, and ↑ indicates values above the reference range.

Leukocyte parameters were less consistently affected: total WBC was mostly within range with one leukopenic cat (4.2 $\times 10^9$/L), while differential counts showed lymphopenia in 3/5, neutrophilia in 1/5, and monocytosis in all cats (5/5; 5–8%). Monocytosis may reflect non-specific inflammation or stress and was not considered specific to *A. platys*.

Table 3 indicates that the most prominent biochemical abnormalities involved hepatobiliary enzyme increases and protein fraction disturbances. Two cats (Cats 2 and 4) showed elevated transaminases (AST 58–72 U/L; ALT 66–95 U/L) compared with reference intervals, and Cat 4 additionally exhibited a cholestatic pattern with increased ALP (120 U/L) and GGT (14 U/L), accompanied by hyperbilirubinemia (total bilirubin 1.2 mg/dL). Protein alterations were characterized by hyperproteinemia in Cats 2 and 4 (total protein 9.2–9.5 g/dL) driven by hyperglobulinemia (globulin 6.2–7.5 g/dL) and a markedly decreased A/G ratio (0.5 and 0.3, respectively); Cat 4 also had hypoalbuminemia (2.0 g/dL). Evidence of azotemia was present in Cat 4 with increased BUN (38 mg/dL) and creatinine (1.7 mg/dL). No diagnostic imaging was performed to further characterize hepatobiliary or renal involvement in Cat 4. Finally, Creatine kinase (CK) activity was elevated in Cats 2 and 4 (520–680, reference 50–450 U/L), while most other analytes (phosphorus, calcium, amylase, and cholesterol) remained within reference ranges across cats.

DISCUSSION

In this clinic-based case series, we report five cats with platelet-associated inclusions on blood smear and nested 16S rRNA PCR positivity in all smear-positive cases, providing evidence of PCR detection compatible with *Anaplasma platys* infection in Can Tho City, Vietnam. Importantly, because PCR testing was restricted to smear-positive cats, these findings should be interpreted as PCR confirmation among smear-positive cases rather than an estimate of infection frequency in the broader suspected population. Further studies applying PCR to smear-negative cats and incorporating amplicon sequencing and co-infection testing are required to confirm species-level identity and clarify the clinical spectrum.

The smear-based detection rate of platelet-associated inclusions (22.72%; 5/22) among clinically suspected cats, together with nested 16S rRNA PCR positivity in all smear-positive cases (5/5), supports clinic-based detection compatible with feline platelet-associated anaplasmosis in Can Tho City. Similar molecular evidence has been reported sporadically in cats, starting with the first PCR-confirmed naturally infected cat in Brazil (Lima *et al.*, 2010) and continuing with studies that show that PCR

can still determine feline infections even when blood-smear sensitivity is low (Correa *et al*., 2011; Granick *et al*., 2021). The low level of positivity seen here is also in line with data from multiple centers showing that cats can get *A. platys*, but it's not as common as other vector-borne agents. When tests only look at smears, the number of clinically ill cats may be underestimated (Hegarty *et al*., 2015). Because smear microscopy is insensitive, PCR testing of all clinically suspected cats (including smear-negative cases) and retroviral status (FeLV/FIV) would be required to estimate a PCR-based positivity proportion; therefore, the present series should be interpreted as PCR confirmation among smear-positive cats rather than a prevalence estimate.

Parasitemia grades ranged from low (+) to high (+++), which is consistent with fluctuating bacteremia over time; moreover, smear cytology has limited sensitivity for detecting platelet morulae. Feline field studies indicate that PCR positivity is higher than the percentage of smear-positive cases, which highlights this diagnostic gap (Correa *et al*., 2011; Granick *et al*., 2021; Ferraz *et al*., 2023). The increasing recognition of *A. platys*-like variants in cats complicates species-level inference based solely on 16S rRNA assays. Zobba *et al*. showed that there are different *A. platys*-like variants and described cell tropism patterns that support true infection instead of incidental contamination (Zobba *et al*., 2015). In the absence of amplicon sequencing, species-level identification remains provisional and should be interpreted as PCR detection compatible with *A. platys* or closely related *A. platys*–like variants; sequencing will be addressed in a subsequent larger study.

The infected cats had nonspecific clinical signs like fever, depression, anorexia, and pallor, as well as occasional bleeding clinical signs like petechiae and mild epistaxis, and jaundice. This range of clinical signs is similar to what has been seen in cats with the disease, where the illness can be mild or have vague systemic signs, making it difficult to identify cases without specific testing (Hegarty *et al*., 2015). It is also similar to case reports from Brazil and Thailand where pallor, jaundice, and variable thrombocytopenia were reported (Lima *et al*., 2010; Salakij *et al*., 2012; Ferraz *et al*., 2023). The predominance of free-roaming cats among PCR-positive cases is epidemiologically plausible, given their greater likelihood of ectoparasite exposure, as does the fact that surveys have found tick-borne agent DNA in domestic cats in different endemic settings (Sasaki *et al*., 2012).

Universal thrombocytopenia (70–210 $\times 10^9$/L) was the most consistent abnormality in the blood. This supports the characteristic platelet tropism of *A. platys* and is similar to the central laboratory phenotype seen in dogs with PCR-confirmed infection (Salakij *et al*., 2012; Bouzouraa *et al*., 2016; Granick *et al*., 2021; Ferraz *et al*., 2023). Three out of five cats had anemia, but their other blood tests were mostly normal. This suggests that the anemia was mostly normocytic and normochromic, which is consistent with inflammation-related anemia, blood loss, hemolysis, or concurrent disease, rather than obvious regenerative macrocytosis at the times we sampled. There were different changes in leukocytes (lymphopenia in 3 out of 5 cases and monocytosis in 5 out of 5 cases), which is what you would expect from an inflammatory leukogram and chronic antigenic stimulation. These leukogram patterns are non-specific and may reflect stress or concurrent inflammation; causality cannot be attributed to *A. platys* in this case series. This has been seen in both feline and canine anaplasmosis, depending on the stage of the disease and any other infections (Correa *et al*., 2011; Bouzouraa *et al*., 2016; Granick *et al*., 2021; Salakij *et al*., 2012).

Biochemically, two cats had higher levels of hepatocellular enzymes, and one had a cholestatic pattern with high bilirubin levels, high globulin levels, and a low A/G ratio. These changes could be attributed to systemic inflammation, a disease of the liver and bile ducts, ineffective clearance of red blood cells, or co-circulating vector-borne pathogens, not just *A. platys* infection. Co-infections are important to understand because there are many documented cases of cats with *A. platys* along with hemoplasmas and *Bartonella* spp. This makes it much harder to interpret clinicopathologically (Sasaki *et al*., 2012; Qurollo *et al*., 2014). Although thrombocytopenia was the most consistent hematologic abnormality in this series, concurrent biochemical abnormalities particularly hyperglobulinemia and hepatobiliary enzyme increases should be interpreted cautiously because co-morbidities and co-infections were not systematically assessed, and future studies should include more vector-borne co-testing and sequence-based confirmation.

Limitations of this report include the small sample size and clinic-based recruitment, resulting in selection bias. PCR was applied only to smear-positive cats; therefore, PCR-based positivity among the full clinically suspected group could not be estimated. Co-infections with other feline vector-borne pathogens (*M. hemoplasmas*, *Bartonella* spp., *Babesia* spp.) and retroviral status (FeLV/FIV) were not systematically assessed, and diagnostic imaging was not performed; thus, causality for biochemical abnormalities cannot be attributed to *A. platys* alone. Finally, smear interpretation was performed by a single observer and inter-observer agreement was not evaluated.

CONCLUSION

In this clinic-based case series of five cats with nested 16S rRNA PCR detection compatible with *A. platys*–like

infection, thrombocytopenia was the most consistent hematologic abnormality, whereas other hematologic and biochemical changes varied and may reflect concurrent inflammatory or comorbid conditions. Larger studies incorporating sequence confirmation and co-infection testing are needed to better define the clinicopathologic spectrum and epidemiologic relevance in Vietnam.

ACKNOWLEDGMENTS

The authors thank the cat owners in Can Tho for their cooperation and assistance with sample collection. We also acknowledge the staff of the Faculty of Veterinary Medicine, College of Agriculture, Can Tho University, for technical support in blood smear preparation, hematology and biochemistry testing, and molecular analyses.

NOVELTY STATEMENT

This study provides clinic-based evidence of nested 16S rRNA PCR detection compatible with *Anaplasma platys* infection in domestic cats in Can Tho, Vietnam, and describes associated clinical and clinicopathologic findings. Thrombocytopenia was the most consistent abnormality, supporting consideration of *A. platys* in the differential diagnosis of feline vector-borne disease in Vietnam.

AUTHOR'S CONTRIBUTION

All authors contributed to the conception and design of the study. TTT and NTL performed sample collection and clinical examinations. NTL, NTPC, and LDG supervised the laboratory analyses and data interpretation. DTT and LDG assisted with sample collection. All authors participated in drafting and critically revising the manuscript and approved the final version for submission.

Abbreviations

A/G, albumin-to-globulin ratio; ALP, alkaline phosphatase; ALT, alanine aminotransferase; AST, aspartate aminotransferase; BUN, blood urea nitrogen; Ca, calcium; CK, creatine kinase; DNA, deoxyribonucleic acid; GGT, gamma-glutamyl transferase; HCT, hematocrit; HGB, hemoglobin; MCV, mean corpuscular volume; MCHC, mean corpuscular hemoglobin concentration; MPV, mean platelet volume; PCR, polymerase chain reaction; PLT, platelet count; RBC, red blood cell count; RDW-CV, red cell distribution width (coefficient of variation); WBC, white blood cell count.

Funding

This research received no external funding.

Ethics approval and consent to participate

Written informed consent was obtained from all owners prior to sample collection. All examinations and sample collection were performed in accordance with animal welfare principles. This study involved naturally infected client-owned cats, and all specimens were collected during routine clinical evaluation; no experimental infections or additional invasive procedures beyond standard care were performed. The study protocol was reviewed and approved by the Can Tho University Animal Ethics Committee (approval no. CTU-AEC26001).

Generative AI and AI assisted technology statement

The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

Conflict of interest

The authors have declared no conflict of interest.

REFERENCES

Aiello SE, Moses MA, Allen DG (2016). The Merck veterinary manual. Merck and Company, White Station, NJ, USA, pp. 3325.

Allison RW, Little SE (2013). Diagnosis of rickettsial diseases in dogs and cats. Vet. Clin. Pathol., 42(2): 127-144. https://doi.org/10.1111/vcp.12040

Bouzouraa T, René-Martellet M, Chêne J, Attipa C, Lebert I, Chalvet-Monfray K, Cadoré JL, Halos L, Chabanne L (2016). Clinical and laboratory features of canine *Anaplasma platys* infection in 32 naturally infected dogs in the Mediterranean basin. Ticks Tick-borne Dis., 7(6): 1256-1264. https://doi.org/10.1016/j.ttbdis.2016.07.004

Correa ES, Paludo GR, Scalon MC, Machado JA, Lima ACQ, Pinto ATB, Thiebaut JTL, Albernaz AP (2011). Molecular investigation of *Ehrlichia* spp. and *Anaplasma platys* in domestic cats: Clinical signs, hematological and biochemical alterations. Pesq. Vet. Bras., 31(10): 899-909. https://doi.org/10.1590/S0100-736X2011001000011

De Tommasi AS, Baneth G, Breitschwerdt EB, Stanneck D, Dantas-Torres F, Otranto D, De Caprariis D (2014). *Anaplasma platys* in bone marrow megakaryocytes of young dogs. J. Clin. Microbiol., 52(6): 2231-2234. https://doi.org/10.1128/JCM.00395-14

Ferraz A, da Fonseca Sapin C, Ongaratto RF, de Almeida Capella G, Dallmann PRJ, Spagnol P, Moreira TFB, Ribeiro CM, Cunha RC, Schuch LFD, Nizoli LQ (2022). Anaplasmosis in domestic feline (*Felis cattus*) on South of Brazil: A case report. Ensaios e Ciênc.: Ciênc. Biol. Agrár. Saúde, 26(4): 398-401. https://doi.org/10.17921/1415-6938.2022v26n4p398-401

Galván C, Miranda J, Mattar S, Ballut J (2018). *Babesia* spp. in dogs from Córdoba, Colombia. Kafkas Univ. Vet. Fak. Derg., 24(6): 829-834.

Gospodinova K, Petrov V, Stanilov I, Miteva L, Tsachev I, Baymakova M (2024). First molecular evidence of *Anaplasma platys* infection in a dog (*Labrador retriever*) from Bulgaria. Open Vet. J., 14(12): 3656-3664. https://doi.org/10.5455/

OVJ.2024.v14.i12.47

Granick J, Lappin MR, Waner T, Harrus S, Mylonakis ME (2021). Anaplasmosis. In: Sykes JE (ed), *Greene's infectious diseases of the dog and cat*, 5th ed. Elsevier, St. Louis, USA, pp. 542-554. https://doi.org/10.1016/B978-0-323-50934-3.00045-8

Hegarty BC, Qurollo BA, Thomas B, Park K, Chandrashekar R, Beall MJ, Thatcher B, Breitschwerdt EB (2015). Serological and molecular analysis of feline vector-borne anaplasmosis and ehrlichiosis using species-specific peptides and PCR. Parasite Vector, 8: 320. https://doi.org/10.1186/s13071-015-0929-8

Lima MLF, Soares PT, Ramos CAN, Araújo FR, Ramos RAN, Souza IIF, Faustino MAG, Alves LCA (2010). Molecular detection of *Anaplasma platys* in a naturally-infected cat in Brazil. Braz. J. Microbiol., 41(2): 381-385. https://doi.org/10.1590/S1517-83822010000200019

Matei IA, D'Amico G, Yao PK, Ionică AM, Kanyari PW, Daskalaki AA, Dumitrache MO, Sándor AD, Gherman CM, Qablan M, Modrý D (2016). Molecular detection of *Anaplasma platys* infection in free-roaming dogs and ticks from Kenya and Ivory Coast. Parasite Vector, 9(1): 157. https://doi.org/10.1186/s13071-016-1443-3

Piratae S, Sae-chue B, Sukumolanan P, Phosri A (2017). Molecular detection of blood pathogens and their impacts on levels of packed cell volume in stray dogs from Thailand. Asian Pac. J. Trop. Dis., 7(4): 233-236. https://doi.org/10.12980/apjtd.7.2017D6-370

Qurollo BA, Balakrishnan N, Cannon CZ, Maggi RG, Breitschwerdt EB (2014). Co-infection with *Anaplasma platys*, *Bartonella henselae*, *Bartonella koehlerae* and 'Candidatus *Mycoplasma haemominutum*' in a cat diagnosed with splenic plasmacytosis and multiple myeloma. J. Feline Med. Surg., 16(8): 713-720. https://doi.org/10.1177/1098612X13519632

Salakij C, Lertwatcharasarakul P, Salakij J, Nunklang K, Rattanakunuprakarn J (2012). Molecular characterization of *Anaplasma platys* in a domestic cat from Thailand. Comp. Clin. Pathol., 21(3): 345-348. https://doi.org/10.1007/s00580-011-1378-1

Sarker BR, Mitpasa T, Macotpet A, Bupata PA, Sangmaneedet S, Taweenan W (2021). First report on molecular prevalence and identification of *Anaplasma platys* in dogs in Khon Kaen, Thailand. Vet. World, 14(10): 2613-2619. https://doi.org/10.14202/vetworld.2021.2613-2619

Sasaki H, Ichikawa Y, Sakata Y, Endo Y, Nishigaki K, Matsumoto K, Inokuma H (2012). Molecular survey of *Rickettsia*, *Ehrlichia*, and *Anaplasma* infection of domestic cats in Japan. Ticks Tick-borne Dis., 3(5-6): 308-311. https://doi.org/10.1016/j.ttbdis.2012.10.028

Wongtawan T, Sontigun N, Boonchuay K, Chiawwit P, Wongtawan O, Hayakijkosol O, Boonhoh W (2024). Improvements in blood profiles of canines naturally infected with triple blood pathogens (*Babesia vogeli*, *Ehrlichia canis*, and *Anaplasma platys*) subsequent to doxycycline monotherapy. Animals, 14(24): 3714. https://doi.org/10.3390/ani14243714

Zobba R, Anfossi AG, Visco S, Sotgiu F, Dedola C, Pinna Parpaglia ML, Battilani M, Pittau M, Alberti A (2015). Cell tropism and molecular epidemiology of *Anaplasma platys*-like strains in cats. Ticks Tick-Borne Dis., 6(3): 272-280. https://doi.org/10.1016/j.ttbdis.2015.01.008