

Successful diagnosis and treatment of feline infectious peritonitis in a household cat with remdesivir



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By:

Md. Saidur Rahman

Roll No: 17/43

Reg No: 01873

Intern ID: 35

Session: 2016-17

Faculty of Veterinary Medicine

Chattogram Veterinary and Animal Sciences University

Khulshi, Chattogram – 4225, Bangladesh

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Approved by:

(Dr. Mohammad Mejbah Uddin)

Professor

Department of Anatomy and Histology

Faculty of Veterinary Medicine

Chattogram Veterinary and Animal Sciences University

Khulshi, Chattogram – 4225, Bangladesh

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List of Abbreviation

CVASU	Chattogram Veterinary and Animal Sciences University
TTPHRC	Teaching and Training Pet Hospital and Research Center
FCoV	Feline Corona Virus
FIP	Feline Infectious Peritonitis
ALT	Alanine Aminotransferase
AST	Aspartate Aminotransferase
ALP	Alkaline Phosphatase

Abstract

Domestic and wild cats alike may be exposed to the virus that causes Feline Infectious Peritonitis, or FIP. Chini, an 11-month-old, 3.8-kilogram domestic male longhair crossbreed, presented to the Teaching and Training Pet Hospital and Research Center (TTPHRC) in Purbachal, Dhaka, with a 21-day treatment history of stress, lacrimation, conjunctivitis, anorexia, weight loss, and recurring fever. Total protein (TP), albumin, bilirubin, SGPT, SGOT, and alkaline phosphatase (ALP) were measured after a blood sample was collected from the patient. The patient had an X-ray as well as an ultrasound to check on his kidney, chest, and abdominal structure. Serum total protein and albumin-globulin (AG) ratio was low, and the cat tested positive for FIP Ab, confirming that the animal had non-effusive feline infectious peritonitis based on the clinical history and symptoms. FIP has always been thought of being a deadly disease. Considering the recent COVID-19 epidemic, scientists have been more interested in the pathogenesis and potential therapies for coronaviruses. As a useful side result, we now have a cure for FIP that is widely available. A household cat at TTPHRC with FIP Ab rapid test confirmed non-effusive FIP was successfully treated with remdesivir (10mg/kg body wt. daily for 84 days), and the disease was cured.

Keywords: recurrent fever, conjunctivitis, non-effusive, FIP Ab rapid test, AG ratio, diagnosis

1. Introduction

Feline coronavirus (FCoV) is a substantial group of viruses that belong to the family Coronaviridae. This family can infect a wide variety of hosts, which can result in diseases such as Covid-19 in humans, Feline Infectious Peritonitis in cats, gastroenteritis in dogs, and Infectious Bronchitis in chickens (Sifa-Shaida et al., 2020). It has a significant capacity for mutation, which makes it difficult to treat the host when it does occur. Studies on the epidemiology of FIP have shown that the disease is most common in young cats (between three months and three years) and that the majority of cases (75%) occur in households with several cats (Pesteanu-Somogyi et al., 2006). Feline infectious peritonitis, often known as FIP, is a deadly illness that affects the whole body and is brought on by a modified form of the feline coronavirus (FCoV) (Vennema et al., 1998). The condition, which wasn't identified until the 1950s (Holzworth, 1963), is distinguished by an inflammation that ranges from perivascular granulomatous to pyogranulomatous and is associated with vasculitis (Kipar et al., 2005). In a clinical setting, feline infectious peritonitis may manifest itself in either the "wet" or "dry" form; however, some cats may exhibit symptoms that are a combination of the two (Hartmann, 2005). In the so-called "dry" variant of the illness, ocular involvement often develops (Tsai et al., 2011).

(Doherty, 1971) first described the ocular manifestations of FIP in 1971. These symptoms include pyogranulomatous pan uveitis with fibrinous exudate in the anterior chamber, keratic precipitates, perivascular cuffing of retinal vessels, exudative retinal detachment, and optic neuritis. Doherty was the first researcher to describe the ocular manifestations of FIP. There are just three descriptions of dermatological lesions in conjunction with spontaneous FIP in the body of veterinary literature (Cannon et al., 2005; Declercq et al., 2008; Gross, 1999). This indicates that these conditions are quite uncommon. Clinical lesions that have been reported in the past include truncal papules to nodules that are characterized by pyogranulomatous vasculitis and folliculitis, small nodules over the neck and proximal forelimbs that are characterized by pyogranulomatous phlebitis in a cat that has concurrent feline corona virus (FCoV) infection (Cannon et al., 2005), and papular lesions over (Gross, 1999). It is difficult to diagnose FIP, and in most situations, an antemortem diagnosis of FIP may be tough as well, particularly in cases that are non-effusive and 'dry' (Pedersen, 2009). Histopathologic evaluation of biopsy or necropsy samples is regarded to be the gold standard test. In addition, immunohistochemistry (IHC), which involves the identification

of intracellular FCoV antigens in macrophages, is often necessary to confirm the illness (Addie et al., 2004; Giori et al., 2011; Hartmann, 2005; Pedersen, 2009). The condition known as feline infectious peritonitis is often misdiagnosed. It is not uncommon for its vague general clinical symptoms to be present. Some examples of these symptoms are prolonged fever, weight loss, anorexia, and malaise. Some examples of clinicopathologic abnormalities in FIP that do not serve as pathognomonic indicators include lymphopenia, neutrophilia, anemia, hyperproteinemia, and hypergammaglobulinemia (Paltrinieri et al., 2001). We provide a case of antemortem diagnosis of feline infectious peritonitis (FIP) in a Sphinx cat with bilateral pan uveitis based on positive immunostaining for intracellular FCoV in several skin lesions in the affected animal.

2. Materials and Methods

2.1. Study Area:

Instructional Activities the Purbachal suburb of Dhaka is now home to Teaching and Training Pet Hospital and Research Centre (TTPHRC), the country's first hospital dedicated to treating companion animals under Chattogram Veterinary and Animal Sciences University (CVASU). The veterinary teaching hospital was built to give veterinary interns and graduate students practical experience. It features a fully functioning OT, X-ray, US, and lab. Treatment, vaccination, deworming, health check, and surgery are just a few of the services provided for both birds and the animals who share our homes. In addition to domestic pets, this institution also treats and examines zoo and exotic animals. As such, it serves as a great repository of a wide range of animal-related clinical scenarios.

2.2. Clinical History:

A male Domestic longhair cross breed of Tamanna Hasin of 1 year three months of 3.8 kg cat was brought to Teaching and Training Pet Hospital and Research Center with a complaint of ocular lesions from Mohammadpur, Dhaka. Other history was anorexia, weight loss, and recurrent fever after surgical intervention of Neutering for the last 21 days. The patient was reported to a few veterinary clinics before consulting TTPHRC, Purbachal, Dhaka.

2.3. Clinical Signs:

The patient was brought to the hospital with clinical signs of anorexia, mild dehydration, and conjunctivitis (Ziółkowska et al., 2017). Conditions were as follows: a fluctuating body temperature of 102.4 degrees Fahrenheit (Horhoge et al., 2011), a respiration rate of 30 breaths per minute, and a heart rate of 140 beats per minute.

2.4. Sample Collection:

To determine whether FIP was present, blood samples were collected from left femoral vein using a 23gauge butterfly needle connected with a 5 mL syringe and then placed in vacutainers that did not include anticoagulants (Fig.1). These were then used to test total protein (TP), albumin, and globulin.



Figure 1: Blood collection for Tests

2.5. Laboratory Investigation of Blood:

To conduct a biochemical test, anticoagulant-free blood was inverted and left to coagulate at an angle for thirty minutes. After that, the serum and the supernatant were separated appropriately. After that, the HumaLyzer 3000 carried out the biochemical test by the specified protocol as well as the guidelines provided by the manufacturer.

According to Table 1, the findings of the blood biochemical examination showed that the total protein level (11.8 gm/dl) is greater than the reference value, however, the albumin level (2.3 gm/dl) is lower than the reference value. Additionally, the value of globulin was determined using the values of TP and albumin. The level of globulin in the blood was measured at 9.5 gm/dl. The proportion of albumin to globulin in the sample was 0.24 which is positive for FIP (Pedersen, 2014). The level of bilirubin was determined to be 0.4, while the level of SGPT was 54.4 and the level of SGOT was 48. The level of ALP was determined as 22.1 which was within the normal range.

Table 1: Biochemical parameters of blood serum

Blood analysis	Result	Reference value
Total protein	11.8(gm/dl)	5.2-8.8(gm/dl)
Albumin	2.3(gm/dl)	2.5-3.9(gm/dl)
Bilirubin	0.4(mg/dl)	0.1-0.4(mg/dl)
AIT/SGPT	54.4(u/l)	10-100(u/l)
AST/SGOT	48(u/l)	10-100(u/l)
ALP	22.1(u/l)	10-50(u/l)

2.6. Radiological tests:

A USG of the ventral lower abdomen was performed to obtain information regarding the anatomy of the abdomen as well as both kidneys. Shaving the ventral lower belly of the animal using a disposable razor in preparation for this procedure helped the animal. After the animal had been appropriately restrained, an ultrasound probe was placed on the animal's ventral lower abdomen to detect the cortex of both kidneys and evaluate the internal state of the abdomen. This was done using ultrasound. The USG procedure was performed at a frequency of 4.0MHz and 15A.

In addition, an X-ray was taken to determine how the chest and abdomen were affected by the disease. After the animal had been secured, it was turned on its side and placed under the light in a ventral position as well as a lateral position so that photographs of the abdomen and chest could be taken.

If there was fluid found in the body cavity and thus considered an effusive FIP (Pedersen, 2009).

2.7. Feline Infectious Peritonitis Antibody Rapid Test (FIP Ab):

The FIP Ab rapid test is both the quickest and most accurate approach to diagnosing whether a cat has feline infectious peritonitis (FIP). A test cassette was utilized to confirm the presence of FIP in cats using the FIP Ab rapid test kit. Before conducting any tests, it was first necessary to let all the components of the kit (Testsealabs) and the samples (blood) adjust to room temperature. Following a delay of thirty to sixty seconds, one drop of serum was subsequently added to the sample well. After placing three drops of buffer into the sample well, the result may be read within eight to ten minutes. In this instance, the result of the test kit was positive (Fig.2).

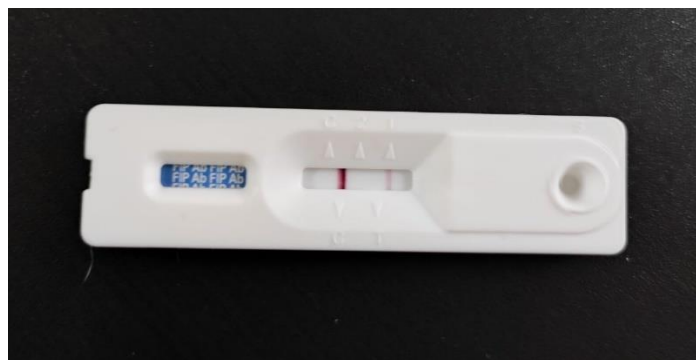


Figure 2: FIP Ab Rapid Test (Positive)

2.8. Treatments:

An antiviral drug was administered named Inj. Remivir – 5mg/ml, Eskayef Pharmaceuticals Ltd. (Remdesivir 10mg/kg body weight) as 7ml daily in subcutaneous route for 84 days. An antibiotic was administered for the restriction of secondary bacterial growth which was Cap. Doxin – 50mg, Opsonin Pharma Ltd. (Doxycycline – 5mg/kg body weight) as 1 capsule mixed with 5 ml drinking water and feed 2 ml orally twice a day for 10 days. A dexamethasone injection was administered subcutaneously in the dose (0.25mg/kg body weight) of 0.2ml once a day for 7 days and the drug was found in the market as named with Inj. Roxadex – 5mg/ml, Nuvista Pharma Ltd. Sus. Losectil – 20mg, Eskayef Pharmaceuticals Ltd. (Omeprazole 1mg/kg body weight) was used as 4mg orally before diet once a day for 10 days. Cyanocobalamin 50mcg/kg body weight was administered as trade, Inj. Cynomim – 1mg/ml, Jayson Pharmaceuticals Ltd. 0.2 ml subcutaneously in 2 alternative days for 5 doses (Maximum total dose 250mcg/cat).

3. Results and Discussion

The premortem diagnosis of FIP can be difficult, which is why the clinical signs and symptoms, in addition to diagnostic help, are required to make a diagnosis of FIP.

The diagnosis of FIP relies heavily on analyzing the biochemical characteristics of the patient's blood. In this instance, the results of the biochemical test on the blood showed elevated levels of total protein, bilirubin, SGPT, and SGOT, while albumin levels were discovered to be lower than expected (Table1). A common result in the laboratory of FIP is an increase in the concentration of total serum proteins (Paltrinieri et al., 2002). This rise in concentration is mostly attributable to an increase in gamma globulins. Although a rise in liver enzymes and bilirubin is possible, it is not always helpful in reaching a diagnosis. This is because it depends on the extent of the organ damage as well as the location of the damage. The presence of reduced liver enzyme activity and elevated levels of bilirubin in the absence of hemolysis should raise the probability of feline infectious peritonitis (FIP) (Hartmann, 2005). Another significant discovery made in this investigation was that the ratio of albumin to globulin was 0.24. The albumin-globulin ratio has a better diagnostic value when compared to total blood protein concentration or gamma globulin concentration. This is due to the fact that if the liver is harmed, both albumin and globulin levels will fall at the same time (Rohrer et al., 1993). Low albumin is thought to be frequently accompanied by protein loss brought on by immune complex-induced glomerulopathy or by the extravasation of protein-rich fluid during vasculitis. Both of these processes are thought to be associated with vasculitis (Hayashi et al., 1982). If the ratio of serum albumin to globulin is less than 0.8, there is a significant likelihood that the cat has feline infectious peritonitis (FIP).

The FIP Ab rapid test is an essential piece of equipment for FIP diagnosis. Cats that are otherwise healthy and have had their antibody tests come back negative are not likely to be FCoV excretors or carriers. Since it is based on highly specific and recombinant FCoV antigens, the Rapid FIP test is the screening test that is used for the accurate identification of FCoV antibodies in the entire blood, plasma, serum, and effusion of the cat. The test cassette has two separate lines of information. The first line is the control line, while the second line is the test line. The presence of both lines within 10 minutes of each other suggests the presence of FIP, regardless of the clarity or haziness of the T line. If there is only a C line, the result of the test is considered to be negative (TESTSEALABS) (Soma & Ishii, 2004).

One thing that couldn't be done because to the circumstances of this case was the CBC (complete blood count). CBC abnormalities seen in FIP-infected cats include normocytic, normochromic, non-regenerative anemia; neutrophilic leukocytosis with lymphopenia; eosinopenia; and monocytosis (Diaz & Poma, 2009).

The feline infectious peritonitis, often known as FIP, is brought on by a feline enteric coronavirus biotype that has been altered. In situations of non-effusive sickness, the FIP virus that is produced consequently is known to typically induce damage to the central nervous system (CNS) and the eyes. Despite the many therapies that have been developed over the years, over 95% of cats diagnosed with FIP will die from the illness within days to months of receiving a diagnosis. Recent antiviral medicines have shown potential in the treatment of neurological FIP; nonetheless, there is a paucity of evidence derived from neurological FIP patients (Dickinson et al., 2020).

Remdesivir was administered subcutaneously once daily at a dose of 10 milligrams per kilogram of body weight for 84 days in order to achieve outstanding outcomes in the treatment of non-effusive FIP at Teaching and Training Pet Hospital and Research Center (Bohm, 2022). If the animal is very dehydrated, the first few doses of remdesivir should be given intravenously with a saline (Ringer's lactate solution). Other medical professionals have effectively treated FIP using the prodrug GS-441524 at a dosage of 5-10 milligrams per kilogram of body weight for a period of at least 80 days, however there are ethical concerns over its administration (Bohm, 2022). In order to avoid a subsequent bacterial infection and favorable respiratory symptoms, the antibiotic doxycycline was ordered to be taken orally at a dosage of 5 milligrams per kilogram of body weight twice daily for ten days (Bacek & Macintire, 2011; Dunowska & Ghosh, 2021). In order to treat recurrent fever, the steroidal anti-inflammatory medicine dexamethasone was injected subcutaneously at a dose of 0.25 milligrams per kilogram of the patient's body weight once per day for seven days (Addie et al., 2020; Ishida et al., 2004). As symptomatic and supportive treatment, an antacid such as omeprazole was given orally at a dosage of 4 milligrams per kilogram of body weight before each meal for a period of 10 days (Marks, 2016; Meazzi et al., 2019). Additionally, cyanocobalamin (Vitamin B12) at a dosage of 50 milligrams per kilogram of body weight was given subcutaneously on two alternate days for a total of 5 doses (Jones et al., 2021; Winzelberg Olson & Hohenhaus, 2019).

3.1. Follow Up and Outcome:

For a total of eighty-four days in a row, the cat was given a treatment with remdesivir (Inj. Remivir – 5mg/ml, Eskayef Pharmaceuticals Ltd.), at a dosage of seven milliliters each dose. During this period, he did not get any further antiviral therapy.

Within seven days, she had a discernible improvement in her state of health and a lower risk of infection. The symptoms of diarrhea originally became worse before becoming better. After one month of medication, her owner noticed that she was more active, that her hunger had returned to

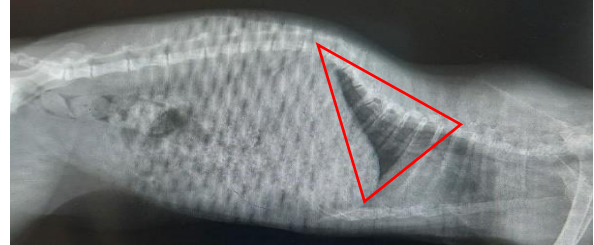


Figure 3: Lordosis formed in thoracic region

normal after it had gone from being insatiable to normal, and that her cat seemed to be acting like a regular cat. There was no discomfort during the injection, and there were no detectable responses at the injection site. Both his coat and his muscular mass improved as time went on. At the follow-up examination that took place three months after the beginning of treatment, he weighed 4.5 kilograms, had a body condition score of 3.5 out of 5, a slightly rapid heartbeat, a normal respiration rate, normal muscling, an x-ray, there is formed lordosis in the thoracic region (Fig. 3), and hematological value that was better than normal compared to the earlier

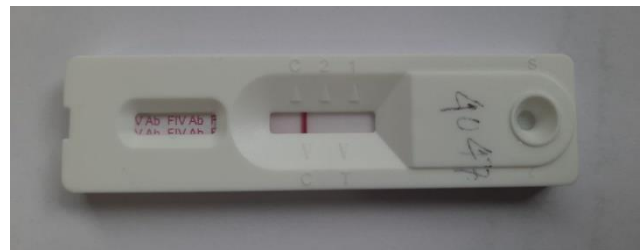


Figure 4: FIP Ab Rapid Test (Negative)

examination (Table-2). In addition to the negative result of the FIP Ab fast test (Figure 4), a clinical examination did not reveal any additional abnormalities. At the time this was written, he continued to exhibit no symptoms and had stopped receiving therapy five months earlier.

Table 2: Biochemical parameters of blood serum.

Blood analysis	Result	Reference value
Total protein	7.1(gm/dl)	5.2-8.8(gm/dl)
Albumin	3.5(gm/dl)	2.5-3.9(gm/dl)
Bilirubin	0.3(mg/dl)	0.1-0.4(mg/dl)
AIT/SGPT	97(u/l)	10-100(u/l)
AST/SGOT	54(u/l)	10-100(u/l)
ALP	46(u/l)	10-50(u/l)

According to Table 2, the results of the blood biochemical analysis revealed the total protein level to be (7.1 gm/dl), as well as the albumin level, which was (3.5 gm/dl). In addition, the value of globulin was calculated by combining the results of the TP and albumin calculations. The amount of globulin that was found in the blood was determined to be 3.6 gm/dl. The sample had an albumin-globulin ratio of 0.97, which is highly suggested to be negative for FIP. This ratio measures the percentage of albumin to globulin. The level of bilirubin was found to be 0.3, whereas the level of SGPT was 97, and the level of SGOT was 54. Both numbers are much higher than the amount of bilirubin. It was discovered that the level of ALP was 46, which was within the normal range.

4. Conclusion

The doctor needs to start combining diagnostic tests that will help and lead them toward a more definitive diagnosis as the index of FIP suspicion grows. It is important to evaluate the diagnostic test's limits in addition to its sensitivity and specificity. Researchers found that preventing FCoV shedding in naturally infected cats required administering remdesivir subcutaneously at a rate of 10 mg/kg for 84 days. In addition to existing measures of cleanliness, keeping cats in small groups, and utilizing virus-inhibiting cat litter, this therapy might be effective in building FCoV-free homes of cats.

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Biography of Author

This is Md. Saidur Rahman, the child of A. Malek and Sahena Khatun, doing his graduation on Doctor of Veterinary Medicine (DVM) at Chattogram Veterinary and Animal Sciences University under the Faculty of Veterinary Medicine. He passed the Secondary School Certificate Examination (SSC) in 2013 from Moricha Kandi D.T. Academy, Bancharampur – Brahmanbaria, and got a GPA of 5.00 and then Higher Secondary Certificate Examination (HSC) in 2015 from Hazi Abed Ali College, Narsingdi and got GPA 4.67 out of 5.00. Currently, he is doing his yearlong internship. He has great enthusiasm in his study area to develop day-one skills and gain more practical knowledge to be prepared for the modern era of science.