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Case Study: Degenerative Joint Disease in Canines

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Case Study: Degenerative Joint Disease in Canines

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Abstract: Degenerative joint disease (DJD) is the gradual degeneration of cartilage in joints, resulting in pain for the affected areas. This case study illustrates how a case of DJD in canines was managed and provides several recommendations for future treatment plans. This study specifically focused on Lacy (name changed for privacy), a 10-year-old spayed female chihuahua mix, that was clinically diagnosed for DJD and treated by Dr. Rogers over a period of 15 months. DJD is typically treated through a combination of pharmacological management, nonpharmacological treatment, and changes in lifestyle. Pharmacological treatment utilized pain medications, such as Gabapentin and Tramadol. Nonpharmacological treatment and changes in lifestyle involve methods, such as maintaining an ideal body weight, to decrease pain and increase mobility. However, during treatment Lacy's weight continued to increase. Lacy's treatment significantly improved her quality of life and decreased the amount of pain she was experiencing due to DJD. Future patients can benefit from more frequent visits, lab testing, lifestyle changes, and nonpharmacological treatment.

Keywords: degenerative joint disease, veterinary treatment, osteoarthritis, veterinary case study

I. Objectives

To analyze how a specific canine was treated for DJD and investigate how changes in lifestyle coupled with pharmacological and nonpharmacological treatment can be used improve treatment plans for future patients.

II. Degenerative Joint Disease Background

Degenerative joint disease (DJD), commonly referred to as osteoarthritis, is the gradual degeneration of cartilage in joints. In both canines and humans, DJD is the most common arthritis derivative, occurring due to strenuous exercise, injury, and/or biological predisposition (Bland, 2015). Cartilage covers the ends of bones and provides a cushion where the bones articulate. At the joints, healthy cartilage typically cushions joint motion, minimizing friction between bones. Synovial cells lining the joint secrete synovial fluid which distend the joint and provide another level of support. Many senior canine and feline patients have DJD, which can progress as an animal ages. Therefore, DJD eventually results in bone directly rubbing on bone, causing pain in affected areas. Severity of pain is relative to the progression of disease. The disease can be mild to severe.

Signs that this disease is developing in canines include avoidance of being touched, decreased mobility (especially in jumping), and altered sleeping patterns (Robertson, 2008). Early pain intervention may help patients decrease pain and improve quality of life. Inactivity leads to muscle atrophy and more pain. For this reason, DJD patients should be kept moving long term. In an acute injury or sprain, rest and restricted activity are especially important during the first two weeks.

The joint and ligaments are inflamed in patients with DJD. Typical treatments used to decrease inflammation in the joint are non-steroidal anti-inflammatories (NSAIDs): galliprant, carprofen and meloxicam. Other pain medications like gabapentin and amantadine can work synergistically with NSAIDs to reduce pain and increase activity in the patient.

III. Introduction to the Case

Lacy (name changed for anonymity) is a spayed female (Fe/sp) chihuahua mix that was born on June 6, 2011. Lacy was treated by Dr. Rogers over a period of 15 months. Dr. Rogers conducted multiple physical examinations and ordered multiple blood works, urine analyses, and x-rays as diagnostic tests. At the initial visit (June 3, 2020), Lacy exhibited joint pain, intermittent coughing, and allergies. Lacy was moderately obese, weighing 23 pounds with a body condition score (BCS) of 7 out of 9. Ideal BCS for canines is 4-5 (Porsani et al., 2020). On physical exam, Lacy experienced pain on extension of the hips and pain on palpation of the stifles (knees). The pain was primarily in the rear limbs.

Most other canine geriatric patients that develop DJD typically display similar symptoms in the aforementioned body regions. Lacy was diagnosed with DJD, which was managed by various nonsteroidal anti-inflammatory (NSAID) medications: gabapentin, galliprant, and rimadyl, which is typical for this disease. Kidney and liver health was monitored while taking NSAIDs. Tramadol and cosequin were also used in treating Lacy's DJD. During treatment Lacy was also afflicted with excessive sneezing and uncontrollable coughing which was treated and solved with medication.

IV. Case Timeline - Treatment and Monitoring

Day 0: June 3, 2020 – Initial visit; Dr. Rogers performed physical exam and found right shoulder pain. – diagnosed DJD and prescribed 50 mg of gabapentin once a day (anticonvulsant and nerve pain medication), 20 mg of galliprant once a day (nonsteroidal anti-inflammatory drug (NSAID) to control pain and inflammation, and a blood test.

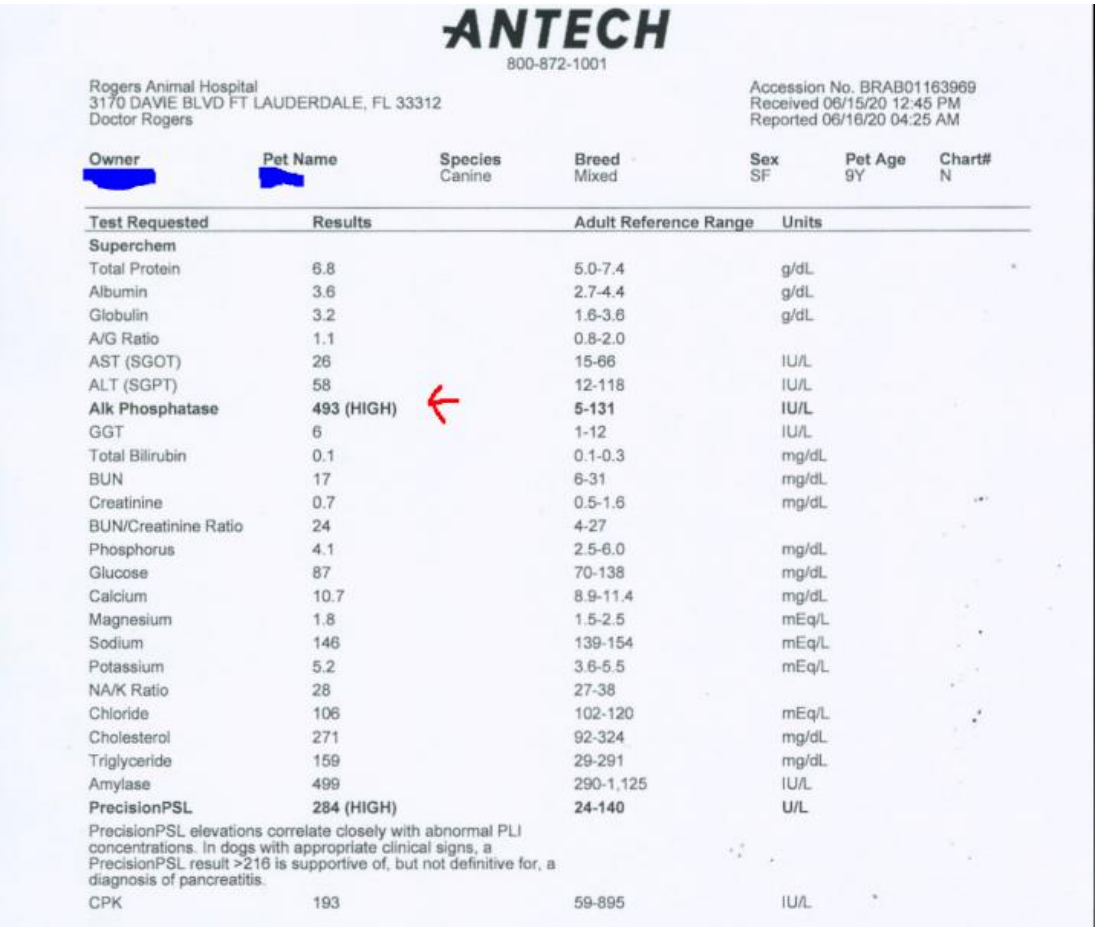
Patient weight: 16 lb. 15 oz

Day 6: Refilled Gabapentin.

Day 8: Phone call revealed Lacy was coughing uncontrollably but appetite was fine. Prescribed 100 mg of doxycycline once a day and ½ a tablet of 5 mg of hycodan twice or three times a day as needed.

Day 12: June 15, 2020 – bloodwork (Figure 1) displayed high ALK Phosphatase (493 IU/L) and platelet count (480 10^3 platelets / μL). Cough resolved on medication.

Figure 1: Results of bloodwork on Lacy – June 15, 2020. Note high ALK phosphatase and platelet count indicated with a red arrow.



ANTECH
800-872-1001

Rogers Animal Hospital
3170 DAVIE BLVD FT LAUDERDALE, FL 33312
Doctor Rogers

Accession No. BRAB01163969
Received 06/15/20 12:45 PM
Reported 06/16/20 04:25 AM

Owner	Pet Name	Species	Breed	Sex	Pet Age	Chart#
[redacted]	[redacted]	Canine	Mixed	SF	9Y	N

Test Requested	Results	Adult Reference Range	Units
Superchem			
Total Protein	6.8	5.0-7.4	g/dL
Albumin	3.6	2.7-4.4	g/dL
Globulin	3.2	1.6-3.6	g/dL
A/G Ratio	1.1	0.8-2.0	
AST (SGOT)	26	15-66	IU/L
ALT (SGPT)	58	12-118	IU/L
Alk Phosphatase	**493 (HIGH)**	**5-131**	**IU/L**
GGT	6	1-12	IU/L
Total Bilirubin	0.1	0.1-0.3	mg/dL
BUN	17	6-31	mg/dL
Creatinine	0.7	0.5-1.6	mg/dL
BUN/Creatinine Ratio	24	4-27	
Phosphorus	4.1	2.5-6.0	mg/dL
Glucose	87	70-138	mg/dL
Calcium	10.7	8.9-11.4	mg/dL
Magnesium	1.8	1.5-2.5	mEq/L
Sodium	146	139-154	mEq/L
Potassium	5.2	3.6-5.5	mEq/L
NA/K Ratio	28	27-38	
Chloride	106	102-120	mEq/L
Cholesterol	271	92-324	mg/dL
Triglyceride	159	29-291	mg/dL
Amylase	499	290-1,125	IU/L
PrecisionPSL	**284 (HIGH)**	**24-140**	**U/L**
PrecisionPSL elevations correlate closely with abnormal PLI concentrations. In dogs with appropriate clinical signs, a PrecisionPSL result >216 is supportive of, but not definitive for, a diagnosis of pancreatitis.			
CPK	193	59-895	IU/L

Test Requested	Results		Adult Reference Range	Units
Complete Blood Count				
WBC	8.6		4.0-15.5	10^3/uL
RBC	7.4		4.8-9.3	10^6/uL
HGB	17.7		12.1-20.3	g/dL
HCT	53		36-60	%
MCV	72		58-79	fL
MCH	24.0		19-28	pg
MCHC	33		30-38	g/dL
Platelet Count	**480 (HIGH)**		**170-400**	**10^3/uL**
Platelet Estimate	Increased			
Differential	**Absolute**	**%**		
Neutrophils	5,676	66	2,060-10,600	/uL
Bands		0	0-3	
Lymphocytes	2,150	25	690-4,500	/uL

Day 36: July 9, 2020 – refilled Gabapentin.

Day 55: Physical examination. Recommended x-ray of thorax for intermittent coughing and shoulder for pain.

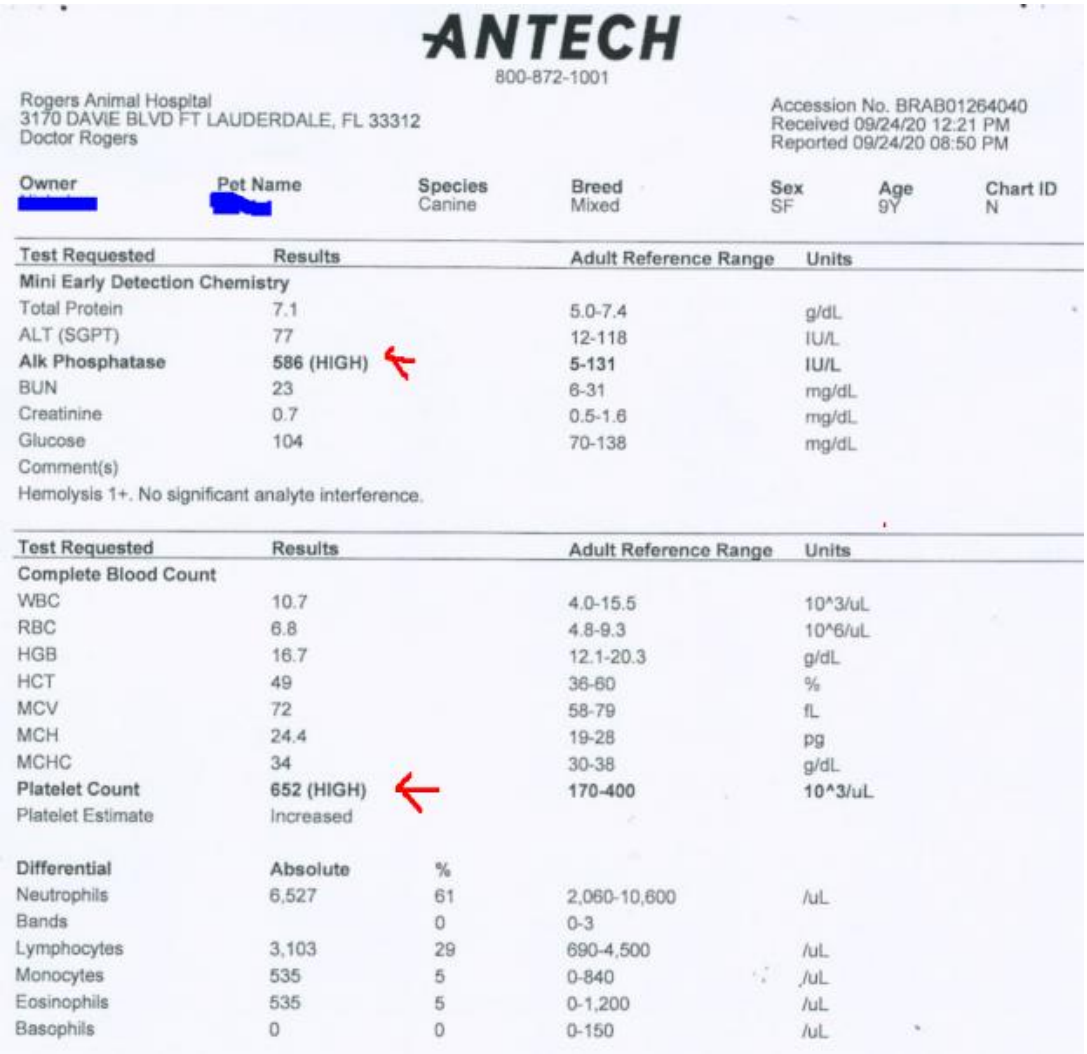
Patient weight: 18 lb. 2 oz (weight gain noted)

Day 85: August 27, 2020 – Lacy returned for a physical exam – still had joint pain in shoulder and elbow. X-ray revealed trachea was not collapsing and no bone abnormalities were seen in the right forelimb. Continued with 20 mg Galliprant and added on ½ a tablet of 50 mg of Tramadol twice to three times a day as needed. Discontinued Gabapentin for the time being.

Patient weight: 19 lb (~two-pound weight gain; ~12% change in body weight during an 85-day time period)

Day 113: September 24, 2020 – blood results higher than those in June: 586 ALK Phosphatase and 652 Platelet Count (Figure 2).

Figure 2: Results of bloodwork on Lacy – September 24, 2020. Note high ALK phosphatase and platelet count indicated with a red arrow.



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Rogers Animal Hospital
3170 DAVIE BLVD FT LAUDERDALE, FL 33312
Doctor Rogers

Accession No. BRAB01264040
Received 09/24/20 12:21 PM
Reported 09/24/20 08:50 PM

Owner	Pet Name	Species	Breed	Sex	Age	Chart ID
[redacted]	[redacted]	Canine	Mixed	SF	9Y	N

Test Requested	Results	Adult Reference Range	Units
Mini Early Detection Chemistry			
Total Protein	7.1	5.0-7.4	g/dL
ALT (SGPT)	77	12-118	IU/L
Alk Phosphatase	**586 (HIGH)**	**5-131**	**IU/L**
BUN	23	6-31	mg/dL
Creatinine	0.7	0.5-1.6	mg/dL
Glucose	104	70-138	mg/dL
Comment(s)			
Hemolysis 1+. No significant analyte interference.			

Test Requested	Results	Adult Reference Range	Units
Complete Blood Count			
WBC	10.7	4.0-15.5	10^3/uL
RBC	6.8	4.8-9.3	10^6/uL
HGB	16.7	12.1-20.3	g/dL
HCT	49	36-60	%
MCV	72	58-79	fL
MCH	24.4	19-28	pg
MCHC	34	30-38	g/dL
Platelet Count	**652 (HIGH)**	**170-400**	**10^3/uL**
Platelet Estimate	Increased		

Differential	Absolute	%		
Neutrophils	6,527	61	2,060-10,600	/uL
Bands		0	0-3	
Lymphocytes	3,103	29	690-4,500	/uL
Monocytes	535	5	0-840	/uL
Eosinophils	535	5	0-1,200	/uL
Basophils	0	0	0-150	/uL

Patient weight: 20lb 5oz (1 pound weight gain; (~5% change in body weight in 1 month)

Day 146: October 27, 2020; Phone call – Client indicated that Lacy was now taking Cosequin (nutritional supplement to support cartilage and joint health in canines) along with the previously prescribed 20 mg Galliprant and 50 mg Tramadol. Client stated that Lacy was still limping and experiencing intermittent coughing, so Dr. Rogers additionally prescribed 5 mg Hycodan as a cough suppressant, resumed 50 mg Gabapentin, and continued 50 mg Tramadol. Discontinued Galliprant.

Day 148: October 29, 2020 – Patient continued to gain weight (**21.1 lb)**

Day 194: December 14, 2020 – refilled 50 mg Gabapentin and 50 mg Tramadol for pain, no complaints about coughing.

Day 215: January 4, 2021 – Bloodwork results: Both the ALK Phosphatase (787) and Platelets (836) continued to rise (Figure 3); and additional weight gain **22.3 lb.**

Figure 3: Results of bloodwork on Lacy – January 4, 2021. Note high ALK phosphatase and platelet count indicated with a red arrow.

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Rogers Animal Hospital
3170 DAVIE BLVD FT LAUDERDALE, FL 33312
Doctor Rogers

Accession No. BRAB01359395
Received 01/04/21 12:10 PM
Reported 01/05/21 04:15 AM

Owner	Pet Name	Species	Breed	Sex	Age	Chart ID
[redacted]	[redacted]	Canine	Chihuahua	SF	9Y	N

Test Requested	Results	Adult Reference Range	Units
Superchem			
Total Protein	7.3	5.0-7.4	g/dL
Albumin	3.9	2.7-4.4	g/dL
Globulin	3.4	1.6-3.6	g/dL
A/G Ratio	1.1	0.8-2.0	
AST (SGOT)	32	15-66	IU/L
ALT (SGPT)	65	12-118	IU/L
Alk Phosphatase	**787 (HIGH)** ←	**5-131**	**IU/L**
GGT	2	1-12	IU/L
Total Bilirubin	0.1	0.1-0.3	mg/dL
BUN	27	6-31	mg/dL
Creatinine	0.6	0.5-1.6	mg/dL
BUN/Creatinine Ratio	**45 (HIGH)**	**4-27**	
Phosphorus	4.1	2.5-6.0	mg/dL
Glucose	115	70-138	mg/dL
CALCIUM	10.8	8.9-11.4	mg/dL
Magnesium	2.2	1.5-2.5	mEq/L
Sodium	145	139-154	mEq/L
Potassium	5.1	3.6-5.5	mEq/L
NA/K RATIO	28	27-38	
Chloride	102	102-120	mEq/L
Cholesterol	**389 (HIGH)**	**92-324**	**mg/dL**
TRIGLYCERIDE	**538 (HIGH)**	**29-291**	**mg/dL**
Amylase	504	290-1,125	IU/L
PrecisionPSL	**160 (HIGH)**	**24-140**	**U/L**
In dogs with appropriate clinical signs, this mildly elevated PrecisionPSL result is equivocal for a diagnosis of pancreatitis. In dogs without clinical signs of pancreatitis, a mild PrescisionPSL elevation is an insignificant finding.			
CPK	272	59-895	IU/L
Comment(s)			
The specimen has been centrifuged at high speed to decrease lipemia. Lipemia 1+. No significant analyte interference. Hemolysis 2+, , Lipemia 1+ No significant interference.			

Test Requested	Results	Adult Reference Range	Units
Complete Blood Count			
WBC	14.1	4.0-15.5	10^3/uL
RBC	6.6	4.8-9.3	10^6/uL
HGB	17.3	12.1-20.3	g/dL
HCT	49	36-60	%
MCV	75	58-79	fL
MCH	26.3	19-28	pg
MCHC	35	30-38	g/dL
Platelet Count	**836 (HIGH)** ←	**170-400**	**10^3/uL**
Platelet Estimate	Increased		

Day 237: January 27, 2021 – refilled 50 mg of Tramadol. Discontinued Gabapentin.

Day 246: February 4, 2021 – Started coughing again, so resumed 5 mg of hycodan; **22 lb. 8 oz**

Day 281: March 11, 2021- Right hip still painful on extension **and additional weight gain 22 lb 14 oz**

Day 286: March 16, 2021 – Refilled 50 mg Tramadol

Day 294: March 24, 2021 – X-rays performed but showed no abnormalities again.

Prescribed 75 mg Rimadyl (NSAID)

Day 321: April 20, 2021 – Phone call: client updated that Lacy had received acupuncture, but that it did not help much.

Day 322: April 21, 2021 – Refill 50 mg of Gabapentin once a day, ½ a tablet of 75 mg of Rimadyl once a day, and ½ a tablet of 50 mg of Tramadol two to three times a day.

Day 337: May 6, 2021 – Client was considering euthanasia for Lacy and asked to increase dosage of medication.

Day 344: May 13, 2021 – Refilled Rimadyl and Tramadol.

Day 358: May 27, 2021 – Refilled Tramadol.

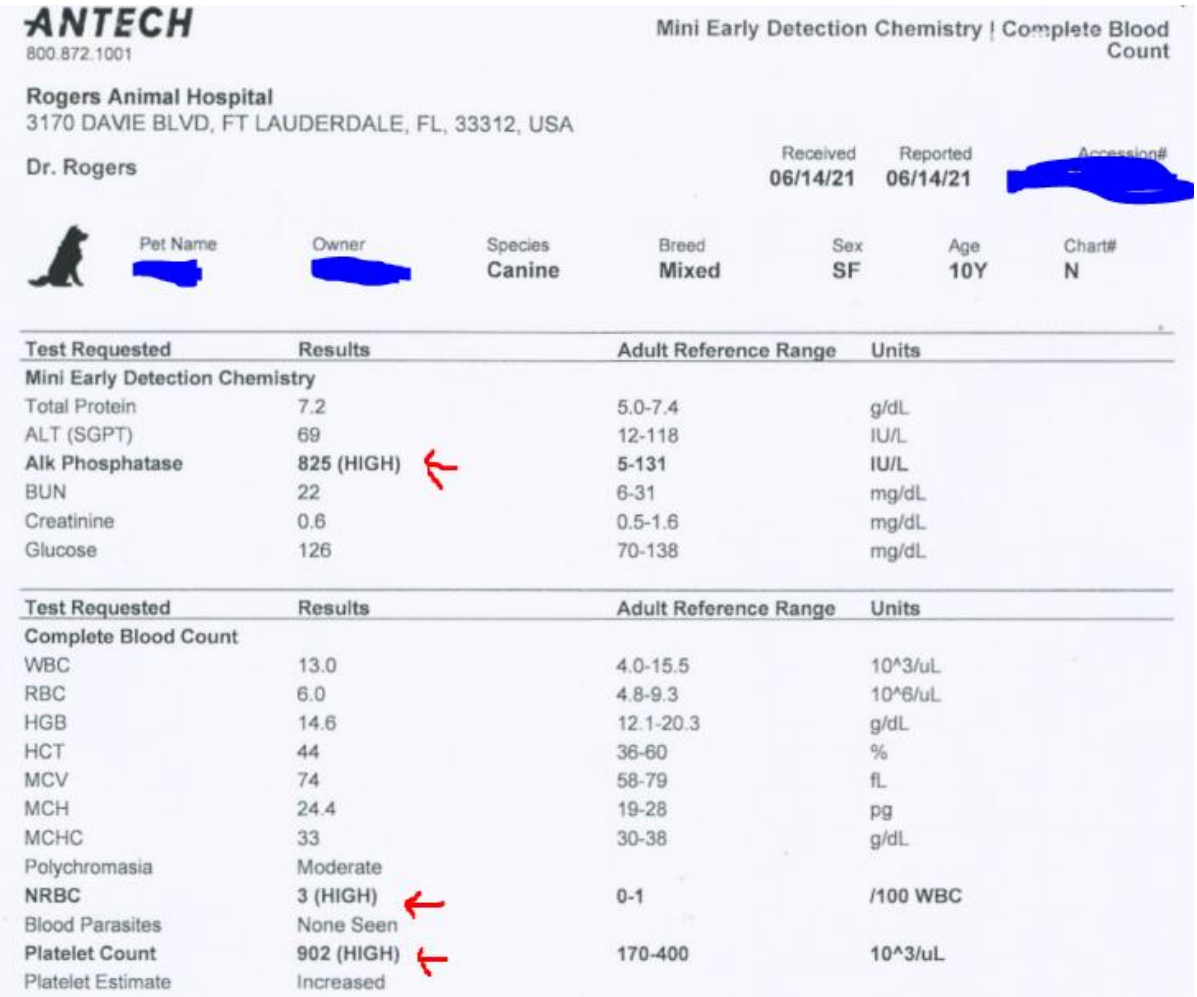
Day 365: June 3, 2021 – **22 lb 3 oz.** Refilled Rimadyl.

Day 373: June 11, 2021 – Refilled Tramadol.

Day 376: June 14, 2021 – bloodwork ALK Phosphatase = 825, Platelet count = 902, NRBC = 3. High levels of nucleated red blood cells (NRBC) indicate a possible hematological disorder.

Thus, a subsequent complete blood count (CBC) blood test was ordered (Figure 4). Patient weight recorded as **22 lb 1 oz.**

Figure 4: Results of bloodwork on Lacy – June 14, 2021. Note high ALK phosphatase and platelet count, as well as high NRBC levels indicated with a red arrow.



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Mini Early Detection Chemistry | Complete Blood Count

Rogers Animal Hospital
3170 DAVIE BLVD, FT LAUDERDALE, FL, 33312, USA

Dr. Rogers

Received 06/14/21 Reported 06/14/21 Accession# [redacted]

Pet Name	Owner	Species	Breed	Sex	Age	Chart#
[redacted]	[redacted]	Canine	Mixed	SF	10Y	N

Test Requested	Results	Adult Reference Range	Units
Mini Early Detection Chemistry			
Total Protein	7.2	5.0-7.4	g/dL
ALT (SGPT)	69	12-118	IU/L
Alk Phosphatase	**825 (HIGH)**	**5-131**	**IU/L**
BUN	22	6-31	mg/dL
Creatinine	0.6	0.5-1.6	mg/dL
Glucose	126	70-138	mg/dL

Test Requested	Results	Adult Reference Range	Units
Complete Blood Count			
WBC	13.0	4.0-15.5	10^3/uL
RBC	6.0	4.8-9.3	10^6/uL
HGB	14.6	12.1-20.3	g/dL
HCT	44	36-60	%
MCV	74	58-79	fL
MCH	24.4	19-28	pg
MCHC	33	30-38	g/dL
Polychromasia	Moderate		
NRBC	**3 (HIGH)**	**0-1**	**/100 WBC**
Blood Parasites	None Seen		
Platelet Count	**902 (HIGH)**	**170-400**	**10^3/uL**
Platelet Estimate	Increased		

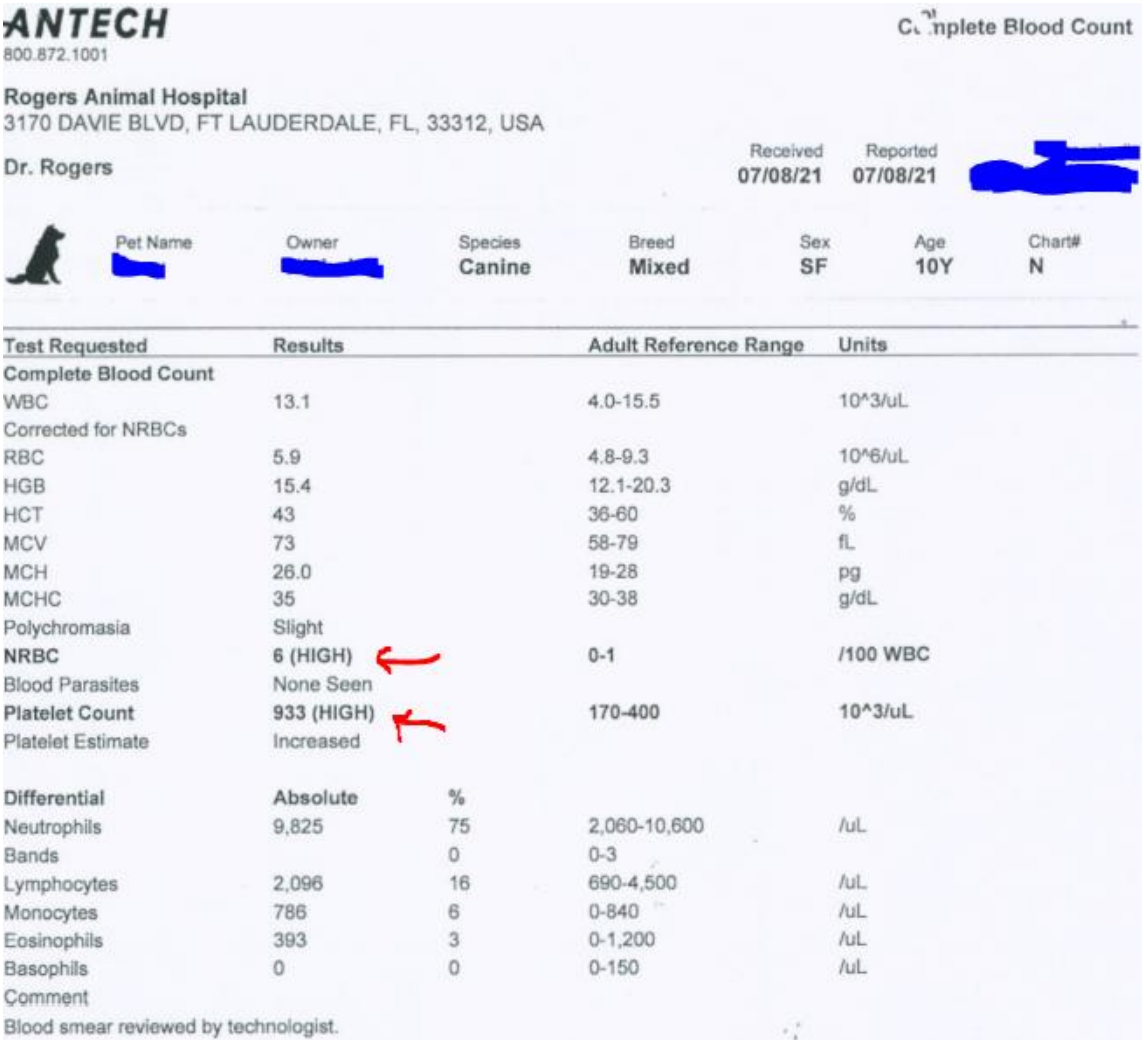
Day 385: June 23, 2021 – refill Rimadyl

Day 391: June 29, 2021 – refill Tramadol

Day 400: July 8, 2021 – CBC test displayed a Platelet count of 933 and NRBC of 6. Increased appetite.

Switched Tramadol for 100 mg Gabapentin ½ tablet 2-3 times a day as needed for seven days. Refilled Hycodan for respiratory cough.

Figure 5: Results of bloodwork on Lacy – July 8, 2021. Note high platelet count and NRBC levels indicated with a red arrow.



ANTECH
800.872.1001

Complete Blood Count

Rogers Animal Hospital
3170 DAVIE BLVD, FT LAUDERDALE, FL, 33312, USA

Dr. Rogers

Received 07/08/21 Reported 07/08/21 [redacted]

Pet Name	Owner	Species	Breed	Sex	Age	Chart#
[redacted]	[redacted]	Canine	Mixed	SF	10Y	N

Test Requested	Results		Adult Reference Range	Units
Complete Blood Count				
WBC	13.1		4.0-15.5	10^3/uL
Corrected for NRBCs				
RBC	5.9		4.8-9.3	10^6/uL
HGB	15.4		12.1-20.3	g/dL
HCT	43		36-60	%
MCV	73		58-79	fL
MCH	26.0		19-28	pg
MCHC	35		30-38	g/dL
Polychromasia	Slight			
NRBC	**6 (HIGH)**		**0-1**	**/100 WBC**
Blood Parasites	None Seen			
Platelet Count	**933 (HIGH)**		**170-400**	**10^3/uL**
Platelet Estimate	Increased			
Differential	**Absolute**	**%**		
Neutrophils	9,825	75	2,060-10,600	/uL
Bands		0	0-3	
Lymphocytes	2,096	16	690-4,500	/uL
Monocytes	786	6	0-840	/uL
Eosinophils	393	3	0-1,200	/uL
Basophils	0	0	0-150	/uL
Comment				
Blood smear reviewed by technologist.				

Day 407: July 15, 2021 – plan to gradually decrease Gabapentin dosage to decrease excessive sedation.

Day 412: July 20, 2021 – Switched back to Tramadol 50 mg 2-3 times a day as needed for pain. Gabapentin was knocking Lacy out even at lower doses.

Day 420: July 28, 2021 – **22 lbs 9 oz**

Day 428: August 5, 2021 – Refill Tramadol

Day 439: August 16, 2021 – **22 lbs 11 oz**

Day 442: August 19, 2021 – Lacy was crying all day, so owner asked Dr. Rogers to perform a euthanasia. Before doing so, Dr. Rogers applied anesthesia to stop uncontrollable agitation and thoroughly examined the patient. He found and removed three fleas on Lacy. Lacy had severe flea allergy dermatitis (FAD). Once fleas were removed, Lacy was calm and her behavior improved. Weight had stabilized and was recorded at: **22 lbs 5 oz**

Day 454: August 31, 2021 – Refilled Tramadol.

Final visit because the patient moved to another location.

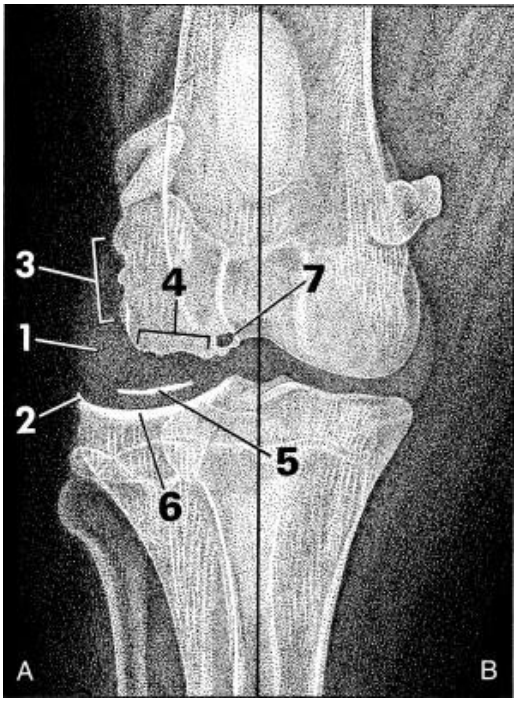
V. Test Results, Treatment Plan, Monitoring

Lacy was treated by Dr. Rogers from June 3, 2020 to August 19, 2021 (1 year and 3 months). Pain due to DJD was controlled with several different medications and dosages based on feedback from the client. Ultimately, Lacy's pain was maintained on 50 mg Tramadol 2-3 times a day as needed. Her weight increased by ~32% during the entire treatment period: 16 pounds 15 ounces to 22 pounds 5 ounces. X-rays were taken and showed no abnormalities. Bloodwork showed steady increases in ALK phosphatase (493 IU/L to 825 IU/L) and platelet count (480 10^3 platelets/μL to 933 10^3 platelets/μL). Bloodwork on July 8, 2021 displayed high NRBC (6 NRBC/100 WBC), so the doctor planned to decrease dosage of Gabapentin and eventually switched to Tramadol. Near the end of her treatment with Dr. Rogers, on August 19, 2021, Lacy was hysterical and crying all day, causing the owner to consider euthanasia. Dr. Rogers found and removed fleas from Lacy. Lacy then resumed pain medicine and her DJD seemed to be under control.

VI. Discussion

Lacy was clinically diagnosed with DJD, but subsequent radiographic imaging did not display signs of the disease. Radiography is typically used to definitively diagnose DJD since it is relatively simple to use and access. Yet, DJD is not always seen on x rays because animals display varying signs during different stages (Allan & Davies, 2018). Furthermore, although plain radiography is highly regarded within primary veterinary care, it has been correlated with a high number of false-negative diagnoses in large canines displaying lameness in the elbow (O'Neill et al., 2020). Therefore, it is advised to utilize advanced imaging methods in uncertain cases: ultrasonography, CT, MRI (Kanthavichit, 2020).

Figure 6: X ray of healthy joint (B, to the right of the solid black line) compared to joint disease (A, to the left of the solid black line) (Allan & Davies, 2018). Note the damage to the joint visible on the left size of the image below (region A).



DJD is commonly treated through a combination of three methods: pharmacological management, nonpharmacological treatment, and changes in lifestyle (Robertson, 2008).

Pharmacological management is used to both treat pain and inhibit progression of degenerative joint disease. Lacy took Tramadol and Gabapentin, which is a commonly used chronic pain medication (O'Neill et al., 2020). Long term use of these medications may have contributed to Lacy's high levels of ALK Phosphatase, Platelet count, and NRBC. High Platelet count and NRBC can be indicative of a bleed or some type of hematological disorder (De Carolis et al., 2016). Thus, blood tests are typically taken before and 10-14 days after NSAID use. If tested enzyme concentrations are high, treatment commonly replaces NSAIDs with other medications such as Tramadol. Internal bleeding can occur within the GI tract due to NSAIDs such as rimadyl, galliprant, and metacam. High platelet count and NRBC may also be signs of a splenic disease. These two disorders would be viewable via ultrasound (Andrews, 2000). In this case, the client declined an ultrasound. The use of ultrasound can be quite problematic for many patients as ultrasounds can cost between $400-$900.

Nonpharmacological treatment can be used to regain mobility, treat chronic pain, and slow the progression of DJD. Lacy was subjected to acupuncture outside of the animal hospital. Another method involves maintaining an ideal body weight, especially in older pets predisposed to obesity (McGreevy, 2018). Overweight canines tend to be less active and DJD tends to progressive with inactivity. In these situations, pain increases which leads to more inactivity and weight gain, resulting in a debilitating, positive feedback loop. Maintaining an ideal body weight via diet and exercise is critical to breaking this cycle and calming joint inflammation. Veterinary prescription diets such as Purina Om and Royal Canin Satiety are typically used to aid weight loss (Roudebush, 2008). Unfortunately, Lacy was not on this recommended diet.

Lifestyle changes aim to decrease pain and increase ability to reach areas that the patient likes to reside in and rest comfortably. Gentle exercise such as walking in grass is preferred over running or jumping, which can cause an acute injury (Bland, 2015). If injury or severe pain is observed, confinement and keeping the patient on a leash are recommended for the first 2 weeks. Gradual time of exercise can be extended at 2-week intervals from 10 minutes twice daily up to 30 minutes twice daily. Slow repetitive movements or non-weight bearing exercises, such as swimming, can be utilized for patients with DJD.

Lacy's condition significantly improved over the span of 1 year and 3 months and an efficient method of managing pain through Tramadol was established. Future patients afflicted with DJD can greatly benefit from the aforementioned methods and suggestions. Furthermore, veterinarians can promote clients to implement lifestyle changes in their canines by relaying specific approaches for recovery and exercise along with statistics on each approach's positive impacts. Veterinarians can also refer clients to purchase healthier food options and utilize nonpharmacological treatments such as acupuncture and physical therapy.

VII. Limitations

This case study was limited simply by the amount of information available. Thus, it is recommended that future cases of this disease include ultrasounds and further x-rays of affected areas. However, as mentioned previously, imaging techniques such as ultrasounds and x-rays can be unaffordable for certain clients. This barrier can be alleviated as technology advances to make these techniques less costly and more accessible to veterinarians.

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