Ultrasonography of Shoulder in Dropped Iditarod Sled Dogs

LTC Clint George, DVM, DACVPM
US Army
UGA Radiology Resident

Funded by Army Research Office
and
Defense Advanced Research Projects Agency

Research Team Members

CoPI - Clint George, DVM Dipl. ACVPM (Radiology Resident)

CoPI - Scott Secrest DVM Dipl. ACVR

Mike Davis, DVM Dipl. ACVIM, ACVMSR

Dirsko von Pfeil, DVM Dipl. ACVS, ECVS, ACVMSR

William Liska, DVM Dipl. ACVS

Stu Nelson, DVM (Chief Veterinarian, Iditarod Trail Race)

Receiving team/major supporting roll:

SFC Thom Sager

Dr. Erika Friedrich

Objectives

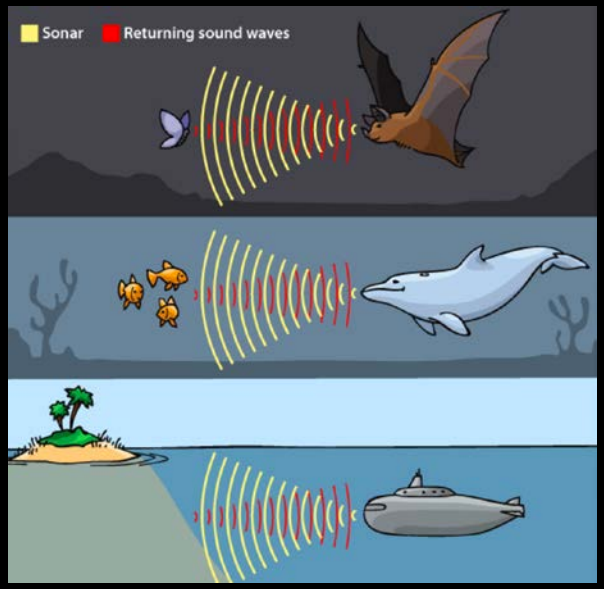
- Ultrasound – How it works
- Canine shoulder anatomy
- Shoulder Ultrasonography
- Iditarod study

Ultrasound – How it works

- Ultrasound imaging, also called sonography, involves using a probe (transmitter and reciever) to send high frequency sound waves into the body and record the reflection of the sound waves to produce a multidimensional image on a computer monitor.

Other examples

- Imagine how a bat or a dolphin utilizes ultra high frequency to “See” (echolocation)
- Sonar from a submarine



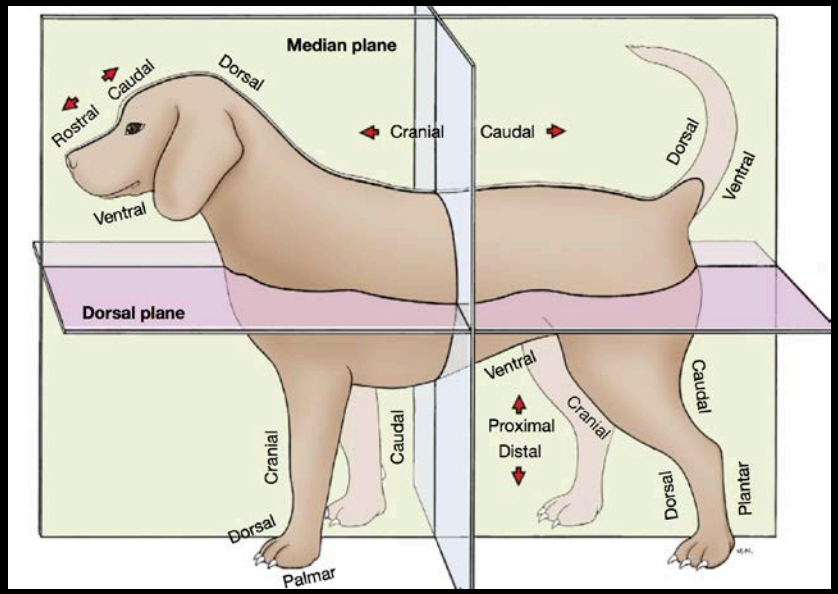
Pros and cons

- Increased resolution
- Non invasive
- Real time (instant)
- Dynamic (motion)
- Assess blood flow
- Cost effective
- Minimal sedation

- Limitations due to operator experience and artifacts.

Ultrasound and Anatomy Definitions

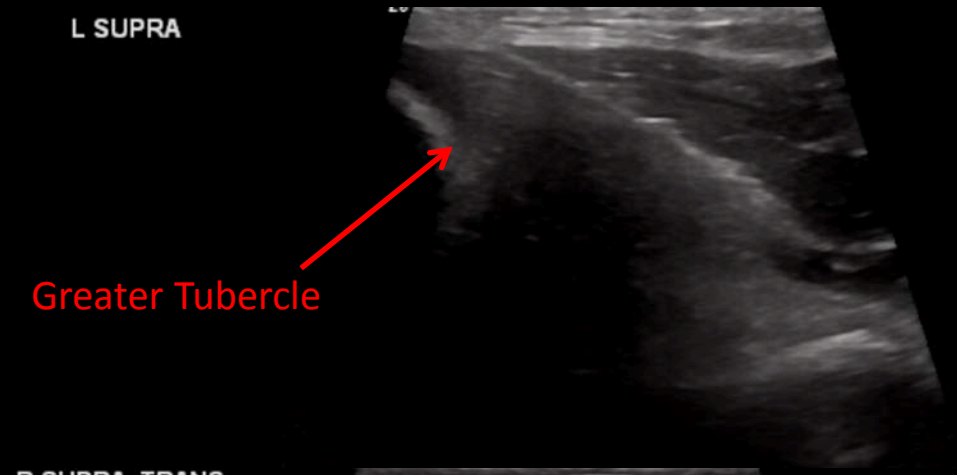
- Attenuation – the amount of signal that is absorbed or reflected
- Hyperechoic – tissue that is brighter (white) on the monitor
- Hypoechoic – tissue that is darker (grey to black) or absent
- Sagittal – lengthwise
- Transverse – cross section
- Origin – where the tendon or ligament begins
- Insertion – where the tendon or ligament ends on a bone



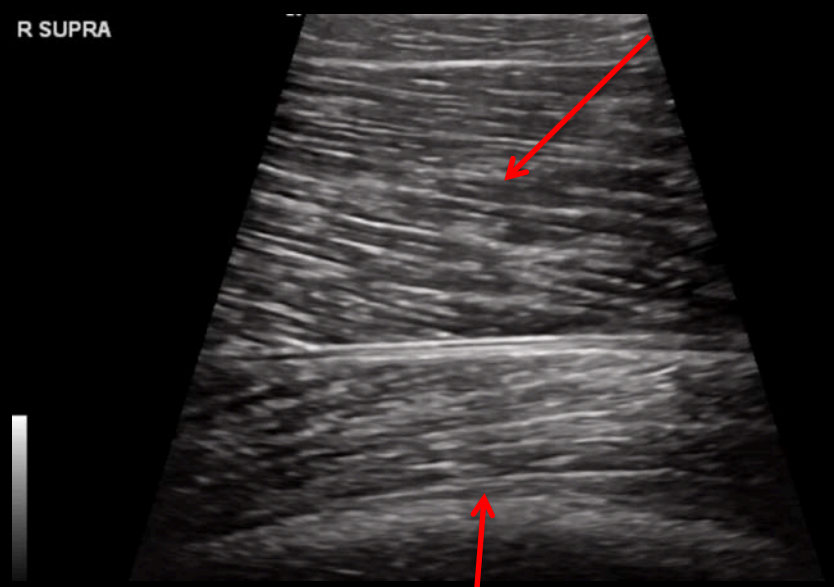
Normal Canine Shoulder Anatomy

- Supraspinatus
  - Origin - supraspinous fossa
  - Insertion – greater tubercle
- Infraspinatus
  - Origin - infraspinous fossa
  - Insertion – minor tubercle
- Teres minor
  - Origin – infraglenoid tubercle
  - Insertion – greater tubercle
- Biceps brachii
  - Origin – supraglenoid tuberosity
  - Insertion – ulnar and radial tuberosity

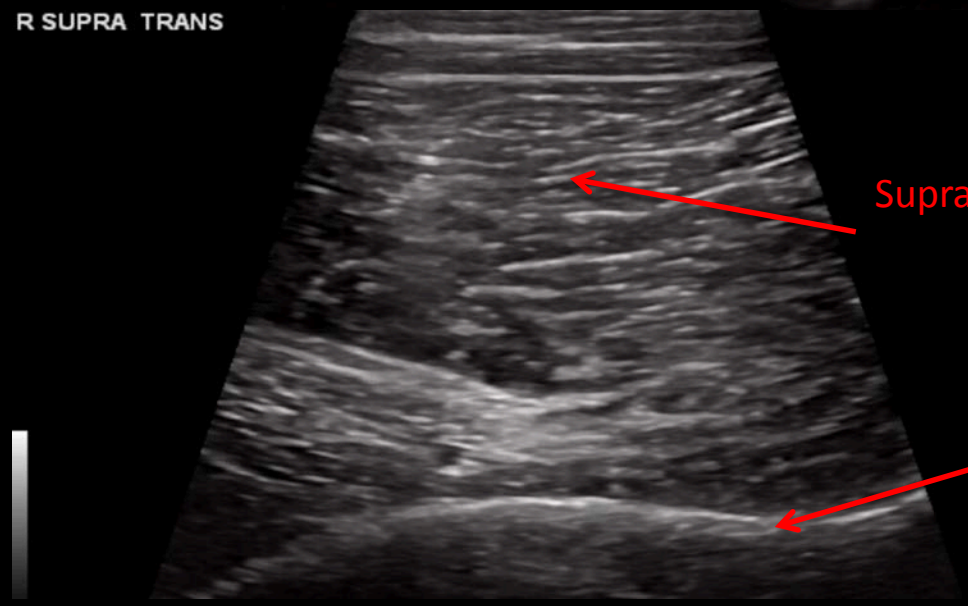
Normal Canine Ultrasonographic Anatomy - Supraspinatous



Greater Tubercle



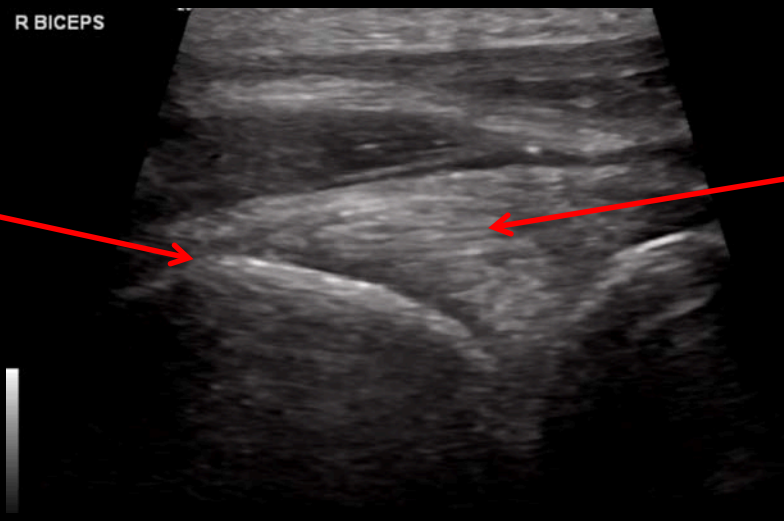
Supraspinatous



Supraspinatous

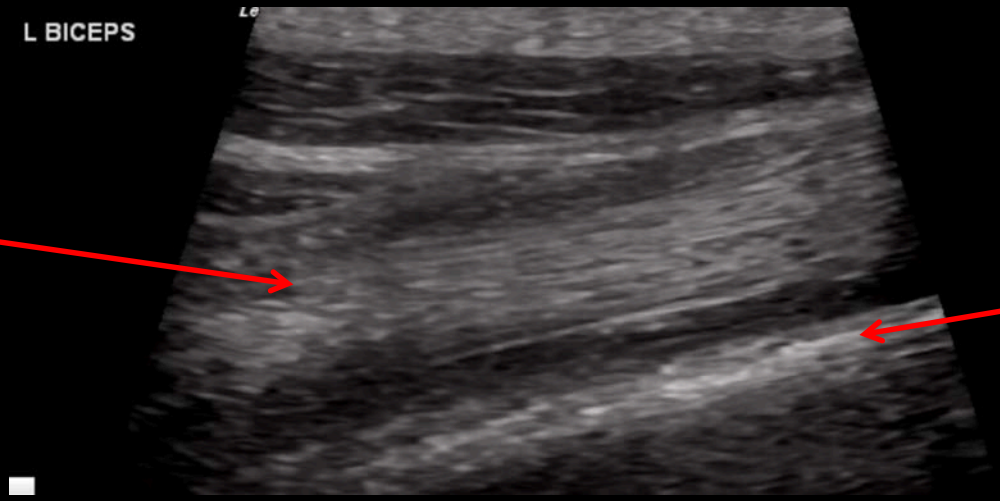
Scapula

Normal Canine Ultrasonographic Anatomy - Biceps



Supragenoid tuberostity

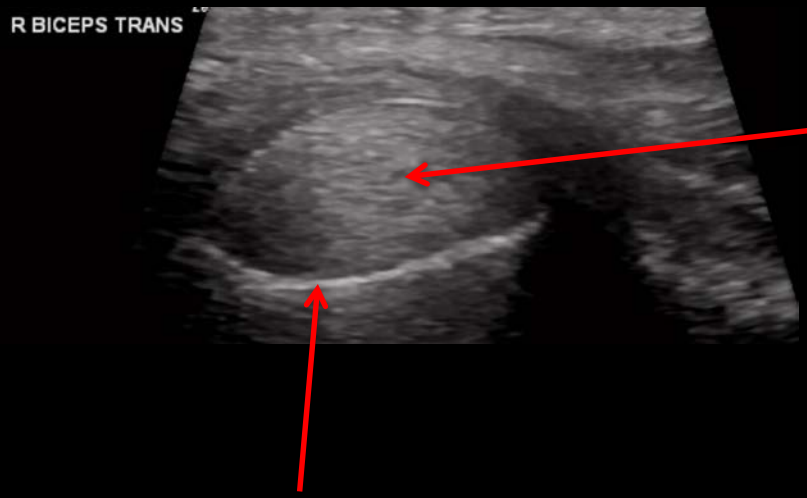
Biceps



Biceps

Humerus

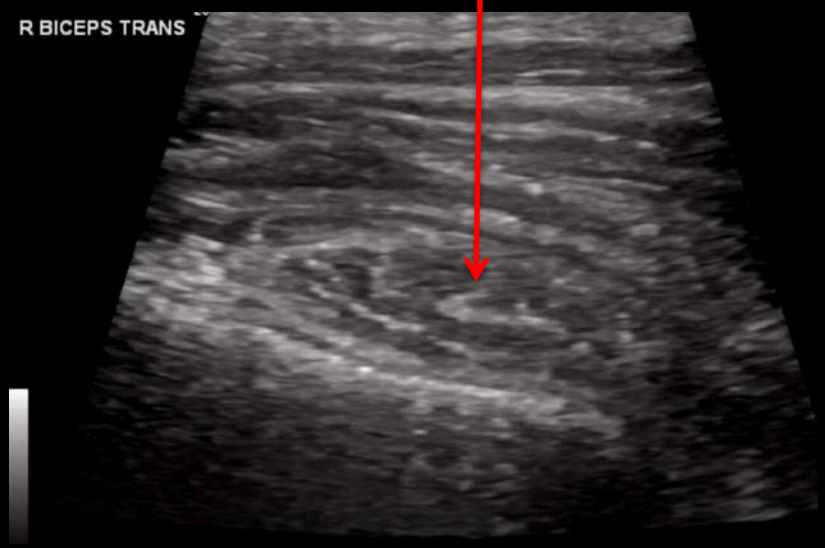
Transverse images biceps



Biceps

Bicipital groove

Biceps muscle and tendon



2017 Iditarod Study

- Suspected to find chronic changes in all dropped dogs.
- Suspected to see acute on chronic changes such as rupture or partial tear with mineralization (periarticular and periosteal).

- A large athletic population with reported abnormalities and a similar control group

2017
Iditarod Objectives

- To identify, describe, and quantify ultrasonographic abnormalities of the shoulder in dropped sled dogs.
- Identify and document shoulder instability in dropped sled dogs.

Materials and Methods

- Dogs were enrolled if:
  - Mushers consent
  - Dogs were dropped
- Dogs were excluded if:
  - System illness
  - Unstable or unfit for sedation

- An orthopedic exam (boarded surgeon) determined whether dropped dogs had lameness or pain associated with the shoulder.

Materials and methods

- LOGIQ e Vet NEXTGen
- L10-22-RS High Frequency Linear Transducer
- Preparation of the shoulder
- Described and quantified ultrasonic abnormalities of the shoulder

Materials and methods

- Abduction angles under sedation was needed to rule out instability.
- Recovered and released once stable

Results

- 65 Total dogs (130 total shoulders)
  - 41 control (dogs w/out lameness)
  - 24 study (dogs w/ lameness)
- Dog demographics
  - Alaska husky (20-25kg)
    - Good appetite, good feet, love to run
  - 68% male
  - 434 average miles
    - Min 161 /max 808
  - 68 hr average delay between dropped and US exam
    - Min 12 hrs /max 120 hrs

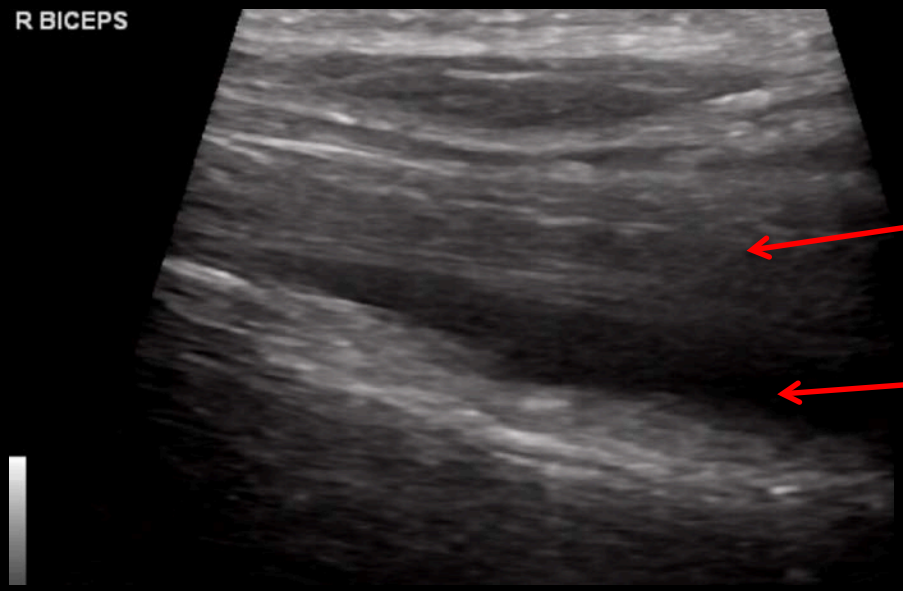
Results

- 65 dogs
  - 24 of these were diagnosed w/ shoulder abnormalities by field vets or mushers
  - 24 dropped dogs received analgesics
- Orthopedic exam
  - 31 shoulder abnormalities or 24 dogs (37%)
  - But, the field vets only agreed with the Surgeon 38% of those dogs
  - 9/24 dogs received analgesics

Results

- Ultrasonography
  - 24/23 (96%)
  - We found an additional 35 dogs
    - Total 58 dogs or 107 shoulders
  - 24/58 (41%)
  - 31/107 (29%)
    - 95 were biceps abnormalities(89%)
    - Mineralizing biceps tenosynovitis in 18 shoulders (14 dogs) indicating chronic and or prior disease
    - No teres minor abnormalities
- Instability of any shoulder was not identified
- Acute rupture or tear was not identified

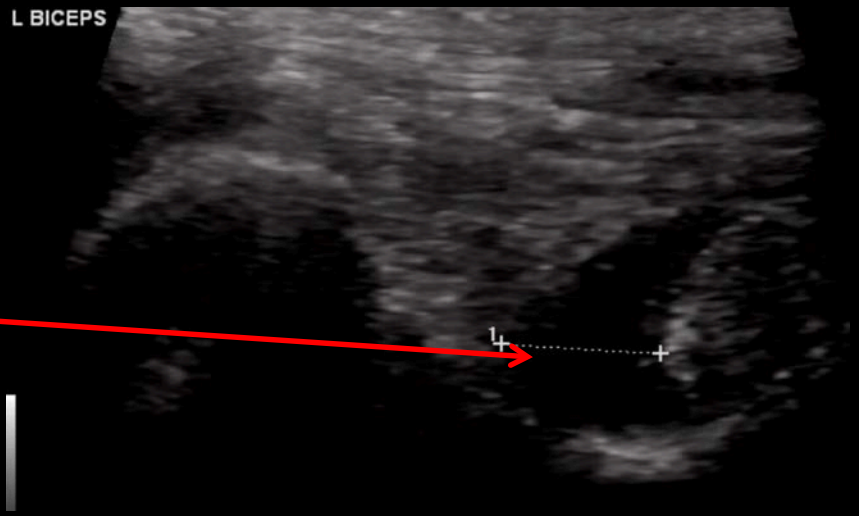
Biceps



Biceps

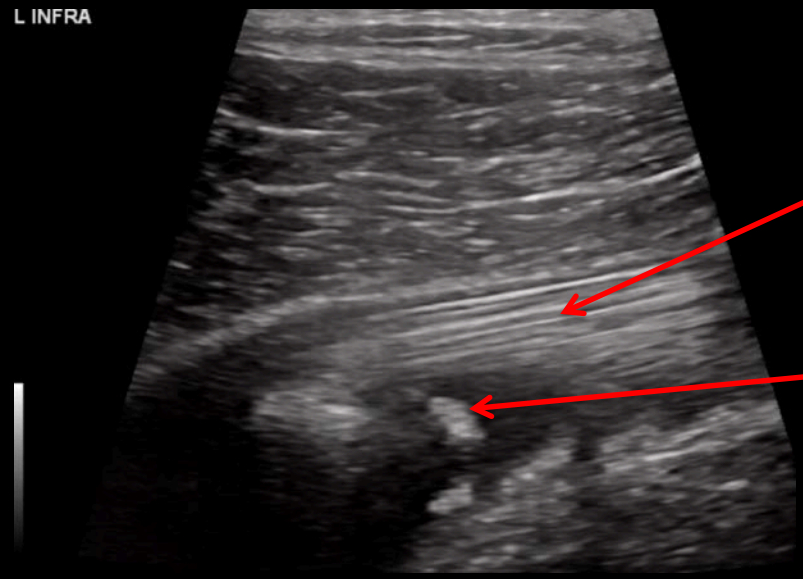
Adjacent fluid

Normal



Biceps with adjacent fluid

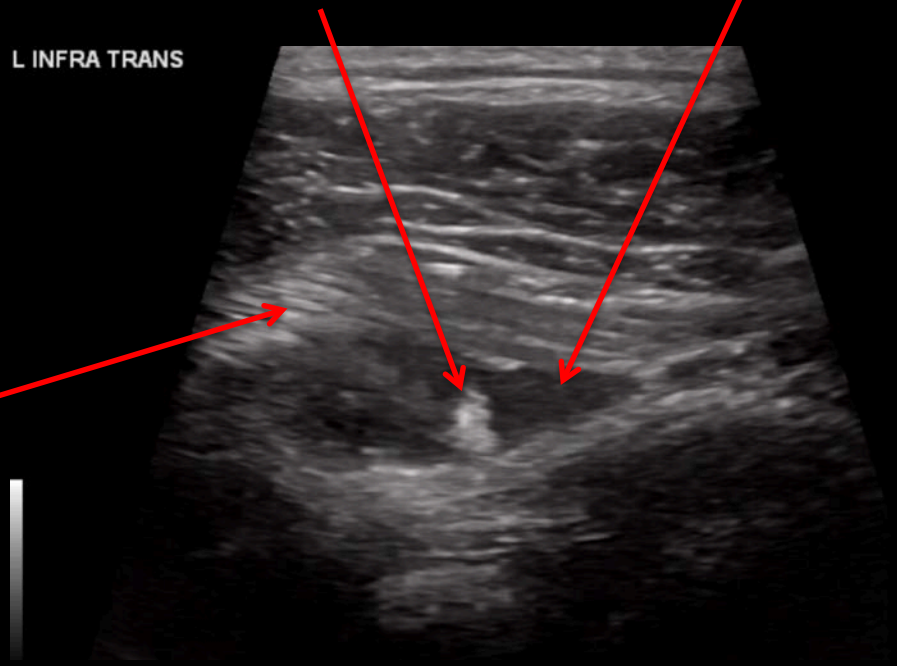
Infraspinatous Abnormalities



Infraspinatous

Mineral

Fluid



Infraspinatous

Discussion

- Biceps abnormality
  - Fluid around the biceps was the most common
  - Normal physiologic response for prolonged endurance
  - Or a true inflammatory condition
  - Harness rub

Discussion

- Discrepancies in findings b/w field vets, orthopedic exam, and US exam
  - Field vet lack of experience and/or limitations
    - Time, environment, knowledge
  - Time delay from time of being dropped to exam
    - Rest
    - Decreased inflammation
    - Elbow disease masking lameness
  - Analgesics
  - Field vets may have identified lameness

Limitations

- Limitations
  - Time delay from being dropped to US exam
  - As per Iditarod regulations and requirements, dogs dropped for lameness were given analgesics at dropped checkpoints
  - Physical exam found lameness localized to the triceps (of which we did not examine)
  - Lack of cytology/histopathology

Conclusion

- The most common US abnormality – fluid surrounding biceps
  - Follow on study
- There is no evidence of acute rupture or tear
- No shoulder instability identified
- A low incidence of chronic or prior abnormalities on US

Thank you and Questions

References

- Sanders RC. Sonography of fat. In: Sanders RC, Hill M, editors. Ultrasound annual. New York: Raven; 1984. p. 71-79
- Weller R, Phau T, Ferrari M, et al. The determination of muscle volume with a freehand 3D ultrasonography system. Ultrasound Med Bio 2007; 33: 402-7.
- Chau CL, Griffith JF. Musculoskeletal infections: ultrasound appearances. Clin Radiol 2005;60:149-59.
- Armbrust LJ, et al. Ultrasonographic diagnosis of foreign bodies associated with chronic draining tracts and abscess in dogs. Vet Radiol Ultrasound 2003;44(1): 66-70
- Guilherme S, Benigni L. Ultrasonographic anatomy of the brachial plexus and major nerves of the canine thoracic limb. Vet Radiol Ultrasound 2008;49:577-83.
- Myers SL, Dines K, Brandt DA, et al. Experimental assessment by high frequency ultrasound of articular cartilage thickness and osteoarthritic changes. J Rheumatol 1995;22:109-16.
- Long CD, Nyland TG. Ultrasonographic evaluatoin of the canine shoulder. Vet Radiol Ultrasound 1999;40:372-9.
- Vandevelde B, Van Ryssen B, Saunders JH, et al. Comparison of the ultrasonographic appearance of osteochondrosis lesions in the canine shoulder with radiography, arthrography, and arthroscopy. Vet Radiol Ultrasound 2006;47:174-84.
- Martinoli C, Derchi LE, Pastorino C, et al. Analysis of echotexture of tendons with US. Radiology 1993:186:839-43.
- Fitch RB, Jaffe MH, Montgomery RD. Muscle injuries in dogs. Compend Contin Educ Pract Vet 1997:19:947-57.
- Schaefer L, Baumel C, et al. Direct Magnetic resonance arthrography of the canine shoulder. Vet Radiol Ultrasound 2010:51:391-396.
- Barthez P, Morgan J, Bicipital tenosynovitis in the dog. Evaluation with positive contrast arthrography. Vet Radiol Ultrasound 1993:34:325-330.
- Cook J, Renfro D, et al. Measurement of angles of abduction for diagnosis of shoulder instability in dogs using goniometry and digital image analysis. Vet Surgery 2005:34:463-468
- Bardet J, Diagnosis of shoulder instability in dogs and cats: a retrospective study. J Am Anim Hosp Assoc 1998;34:42-45
- Corey R, Cook C, et al. Diagnostic sensitivity of radiography, ultrasonography and magentic resonance imaging for detecting shoulder osteochondrosis/osteochondritis dissecans in dogs. Vet Radiol Ultrasound 2014;56:3-11