NEGLECT, STARVATION, HYPER- & HYPO-THERMIA

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OVERVIEW

- Neglect
  - Definition
  - Lesions
- Emaciation
  - What to examine
  - Determining COD
  - Duration of weight loss
  - Refeeding syndrome
- Heat stroke / Hyperthermia
- Hypothermia

NEGLECT

- Definitions & legal criteria vary, but typically…
- **Failure to provide**
  - Food & Water
  - Shelter
  - Basic husbandry
  - Medical care
- Pathologists document lesions
- Lawyers / Law Enforcement prove neglect

CONSEQUENCES OF NEGLECT

- **Insufficient Food**: Emaciation, hypothermia/ frostbite
- **Insufficient Water**: Dehydration, Hyperthermia
- **Insufficient Shelter**: Hypothermia/ Frostbite, Hyperthermia, Sunburn
- **Poor husbandry / medical care**
  - Lesions vary
  - Should be immediately obvious to laymen

POOR HUSBANDRY*

*** Not an exhaustive list!**

- Embedded collars / harnesses
  - **Measure circumference of item & adjacent normal tissue**
  - "How long was X embedded?"
    - Opinion only; Hard to standardize growth/ healing in face of infection +/- poor nutrition
- Matted hair
  - **Shave→ note skin lesions, asses BCS**
  - Weigh mats (total); Often a sig % of body weight
  - Keep! (evidence)
- Hoof / nail overgrowth
  - Significant if accompanied by soft-tissue damage or interferes with ambulation

Photo Dr. Rob Reisman

Photos Dr. Rob Reisman

Photo Dr. Rob Reisman


Photo Dr. Rob Reisman

Ischemic necrosis of the distal limb

FAILURE TO PROVIDE WATER

- Lesions subtle
  - Clinical (subjective); ~Dependent on % body fat
  - **Affected by PM conditions** (freezing, drying)**& autolysis**

% dehydration	Clinical Signs
< 5	None
5 - 6	Mild loss of skin turgor
6 - 10	Moderate loss of skin turgor ; +/- Sunken eyes +/- Dry "tacky" mucous membranes
>10	Severe loss of skin turgor; Sunken eyes Dry "tacky" mucous membranes
12 – 15	Usually fatal

STARVATION

(PM EVALUATION OF EMACIATED ANIMALS)

DEFINITIONS

- Starvation
- Inanition
- Anorexia
- Cachexia

"What's going on" (Physiology)

- Emaciated
- Cachectic

"What the animal looks like" (Appearance)

3 MOST USEFUL TERMS & HOW I USE THEM

EMACIATION, STARVATION, & CACHEXIA

EMACIATION

- **Abnormally, severely, & dangerously** thin, with diffuse loss of ***fat & muscle***
  - **Abnormal**: Loss of muscle (sarcopenia) is **not** due to breed / individual variation
  - **Severe**: Immediately apparent to laymen
  - **Dangerous**: Life threatening
- Emaciation is the end point of both (chronic, severe) starvation & cachexia.

STARVATION

- Negative energy balance caused by **involuntary** decrease in caloric intake
- **Fat >>> Muscle** catabolized for energy
- Correctable with nutritional support
  - Appropriate diet in sufficient amount = Cure
- Due to environment / **circumstances**
- Can imply **willful** withholding of food or **negligent** feeding

CACHEXIA

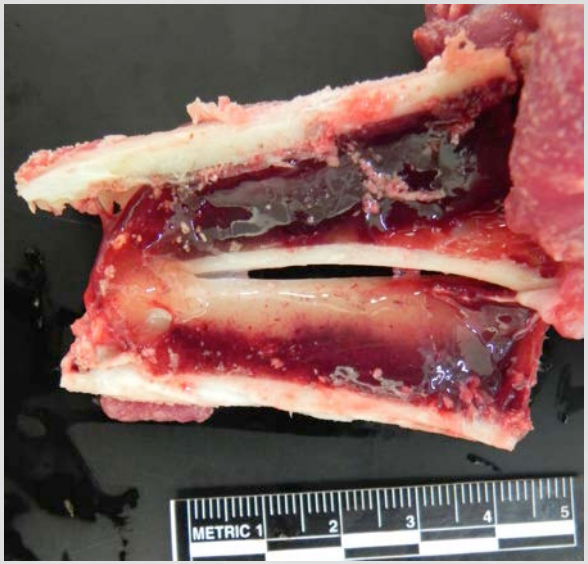
- Cytokine mediated, Dz-associated *voluntary* reduction in caloric intake (anorexia)
- Fat & muscle lost concurrently
- Refractory to nutritional support
- Occurs with many (but not all) diseases
  - Cancer
  - Organ failure
    - Heart, Liver, Kidney, etc.
  - Severe GI disease

EMACIATION

- **Emaciation** = Loss of fat & skeletal muscle
- Cause: endogenous **Dz &/ or** exogenous **conditions**
  - Regardless of cause, **failure to seek medical help** is neglectful
- Law enforcement suspects food was **intentionally withheld** (i.e., the animal was ***starved***)
- Pathologist's role
  - Document extent (severity)
  - Determine COD
    - Rule in/ out endogenous Dz
      - **If no natural Dz** to explain degree of emaciation, COD = **Starvation**

DOCUMENTING EMACIATION

- Document-- photos & report
  - Gross **fat** loss +/- **serous atrophy** (gross/ histo)
    1. Subcutis
    2. Omentum
    3. Peri-renal
    4. Epicardial
    5. Bone marrow
  - Gross **muscle** loss
    - # & location of palpable / visual bony prominences
    - Purina BCS-- dogs & cats; Hennecke – horses; Others for other species



Nestlé PURINA

Body Condition System

TOO THIN

1 Ribs, lumbar vertebrae, pelvic bones and all bony prominences evident from a distance. No discernible body fat. Obvious loss of muscle mass.

2 Ribs, lumbar vertebrae and pelvic bones easily visible. No palpable fat. Some evidence of other bony prominence. Minimal loss of muscle mass.

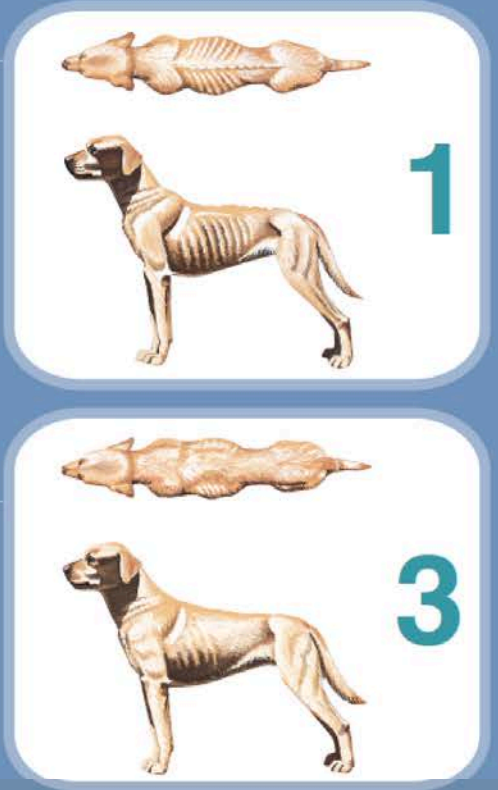
3 Ribs easily palpated and may be visible with no palpable fat. Tops of lumbar vertebrae visible. Pelvic bones becoming prominent. Obvious waist and abdominal tuck.

IDEAL

4 **Ribs easily palpable, with minimal fat covering. Waist easily noted, viewed from above. Abdominal tuck evident.**

5 **Ribs palpable without excess fat covering. Waist observed behind ribs when viewed from above. Abdomen tucked up when viewed from side.**

6 Ribs palpable with slight excess fat covering. Waist is discernible viewed from above but is not prominent. Abdominal tuck apparent.



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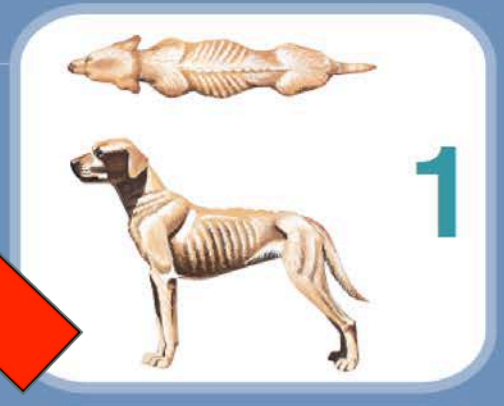
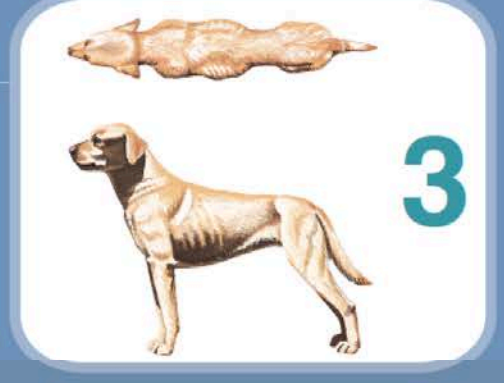
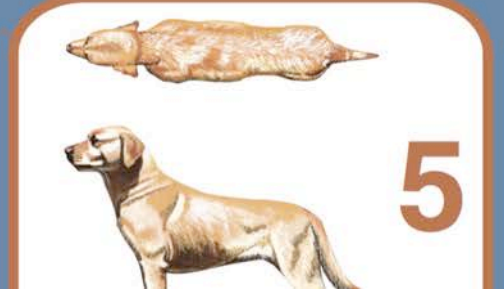
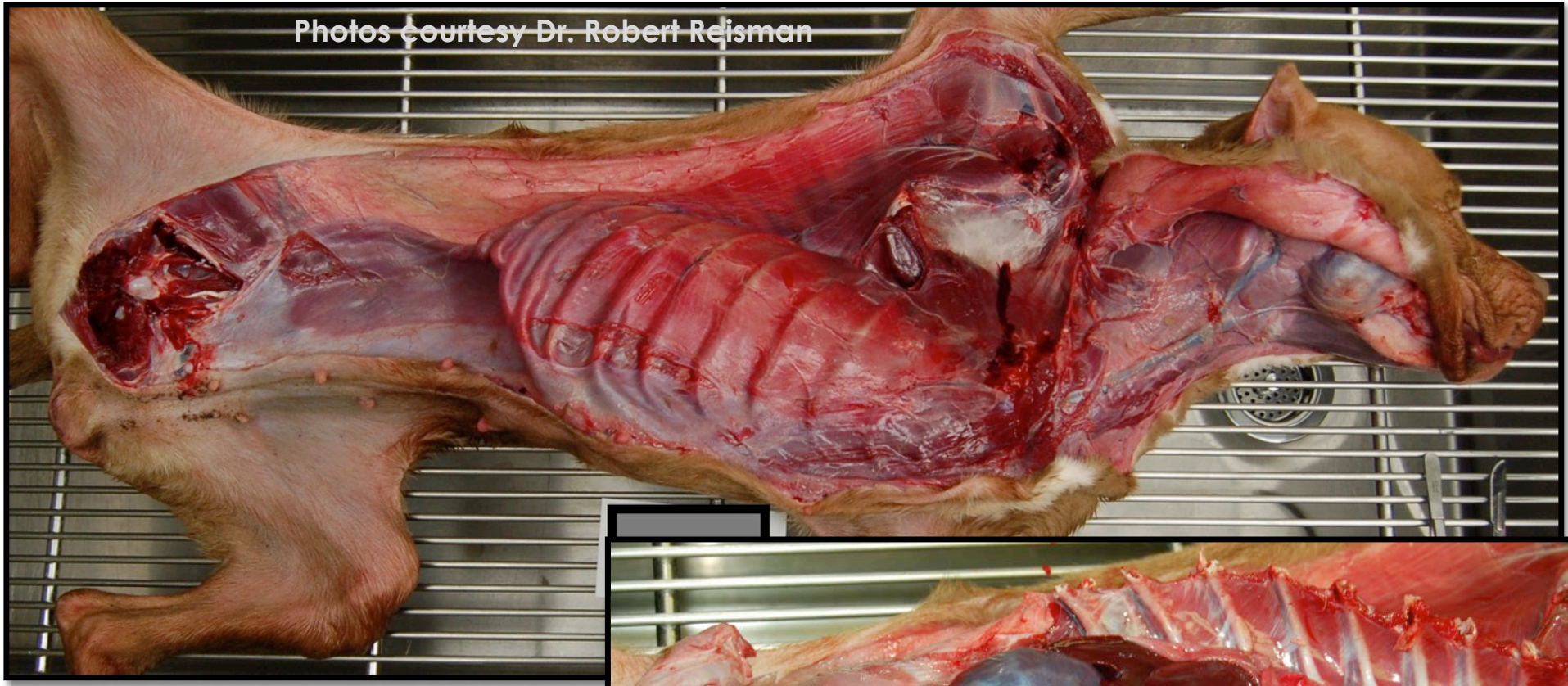
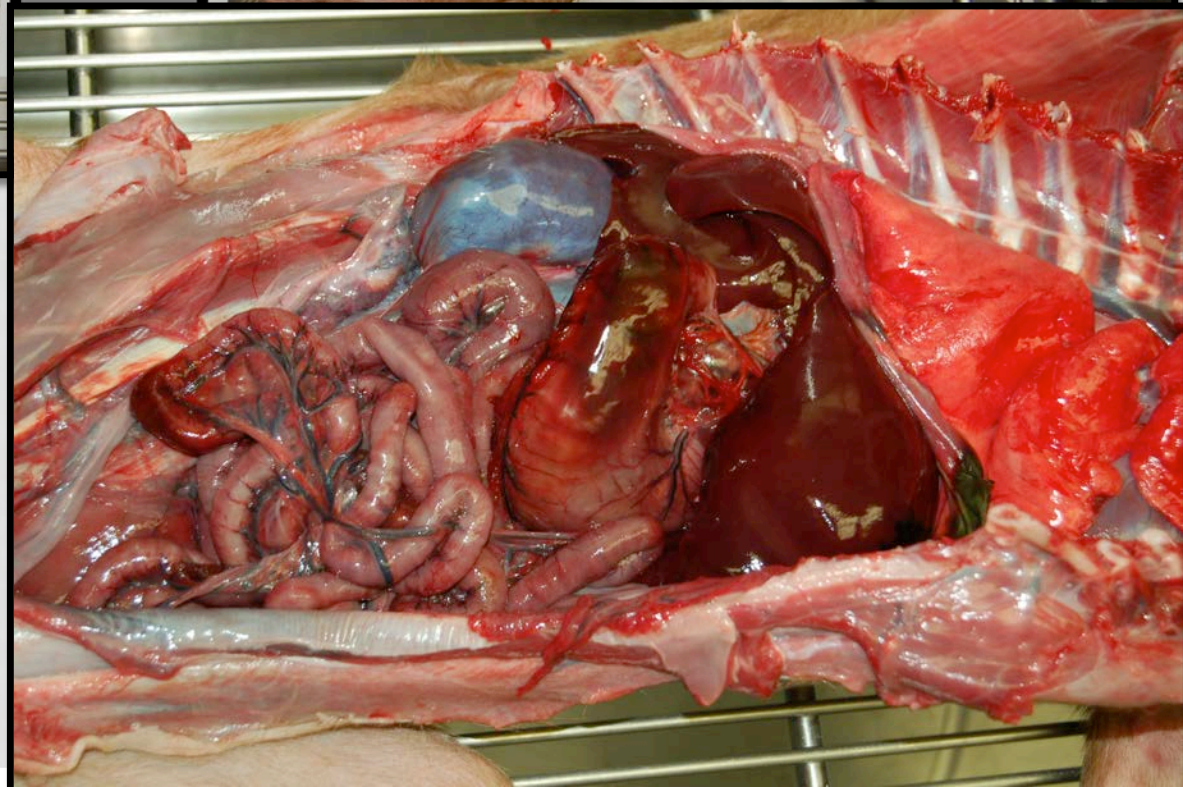







BCS?





- No SQ fat
- No fat in omentum

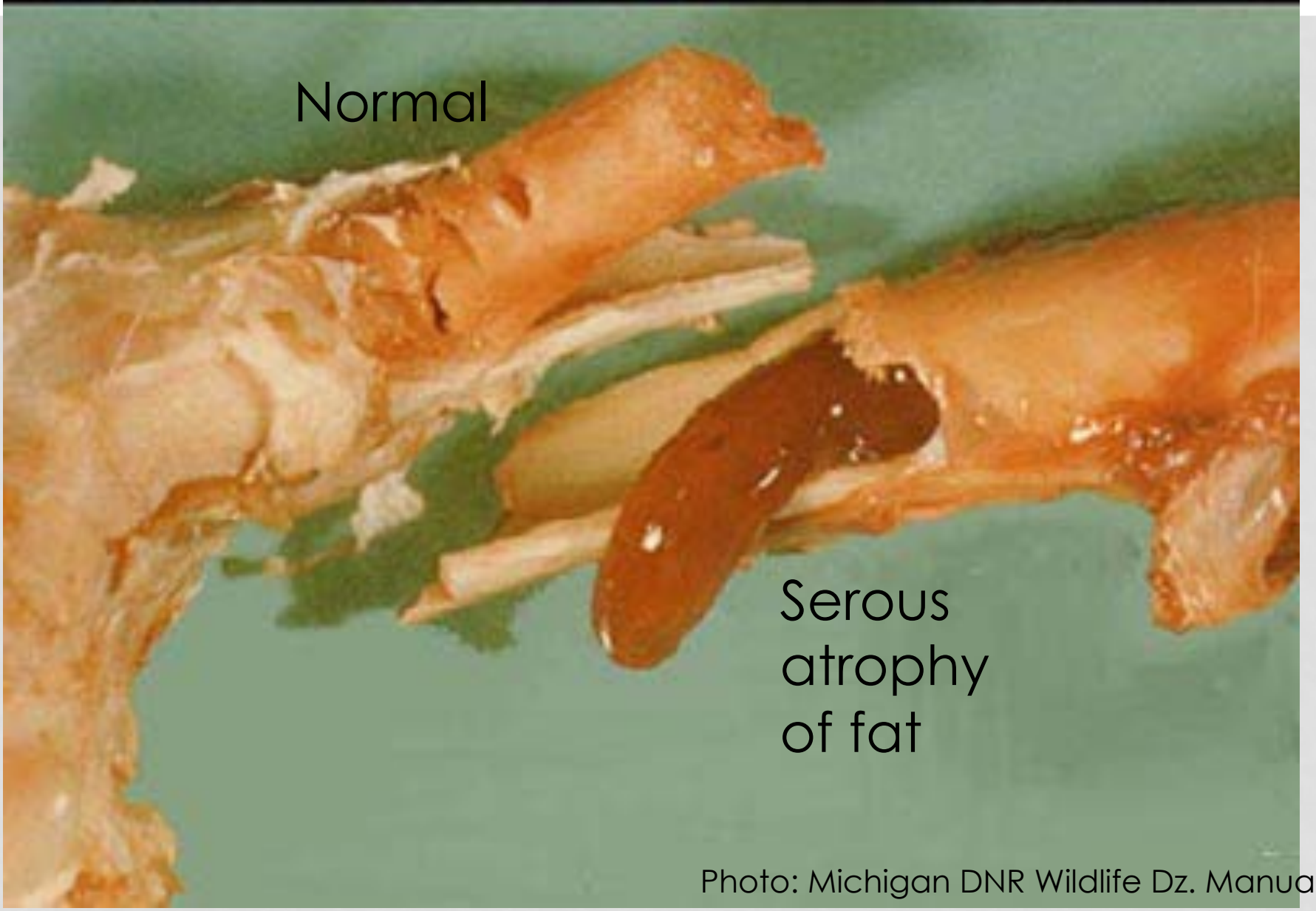
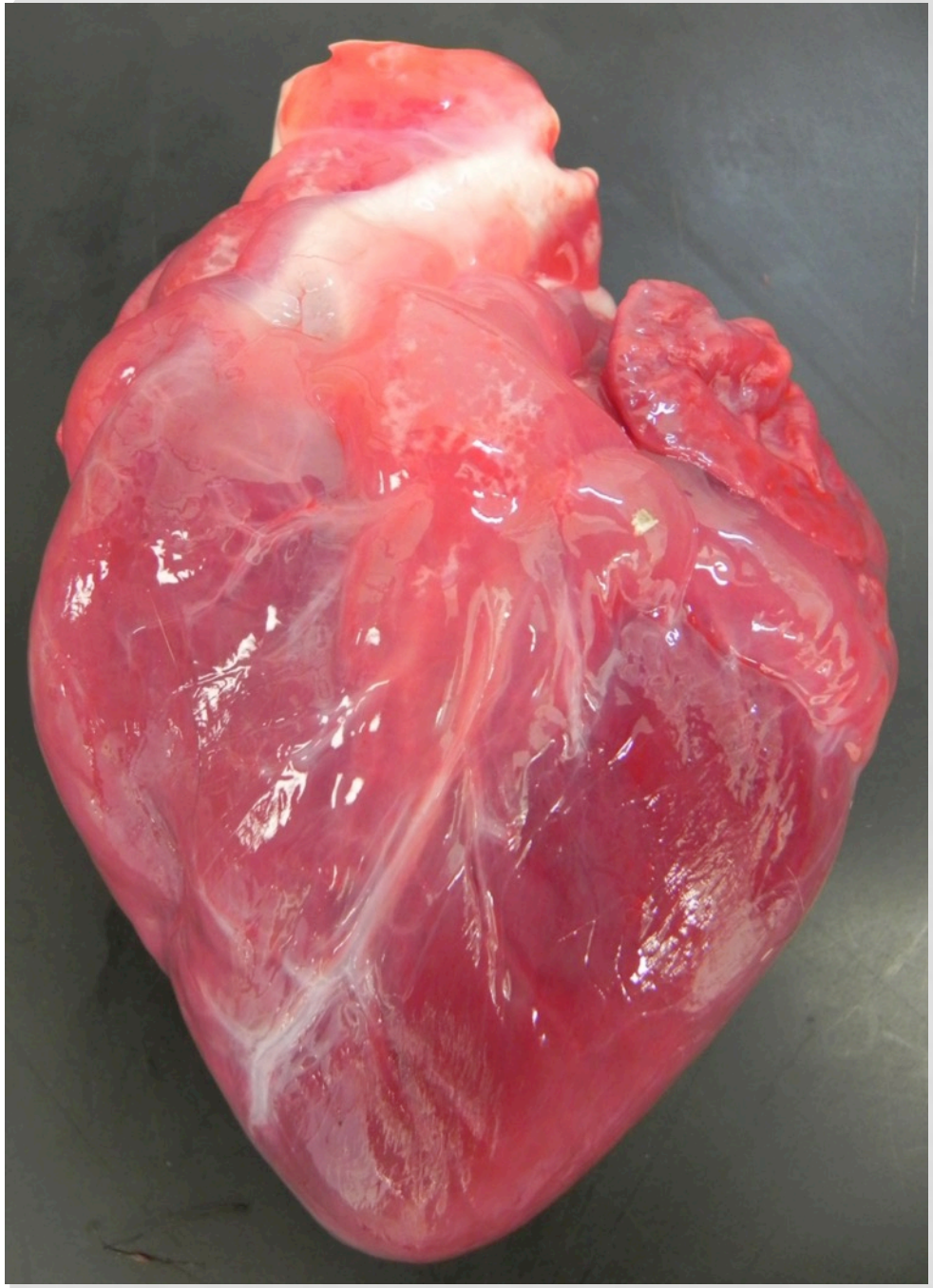


Photo: Michigan DNR Wildlife Dz. Manual

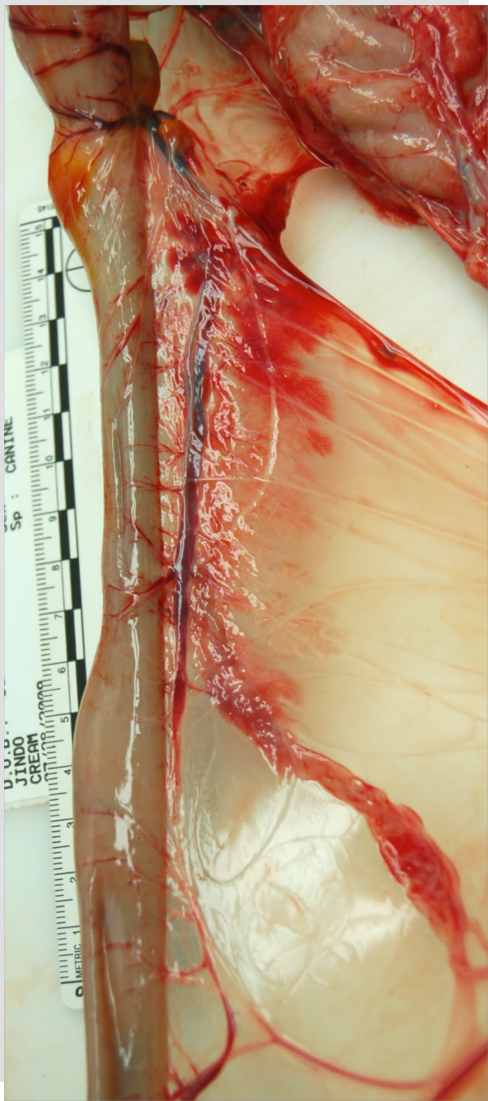
Femoral bone marrow from 2 different white tail deer, 1 that died of starvation (right) & one that didn't (left).



Alpaca heart with ***serous atrophy*** of epicardial fat: translucent, jelly-like material (left). Normal opaque, white to yellow fat in the cow heart (below).

EMACIATION: NX GOALS

- **Examine entire GI**, mouth to anus
  - May see: Gastric ecchymoses & petechia, melena, ulcers & FBs
- Rule out **systemic Dz**
- Rule out **Dz that results in emaciation** (species specific)
  - Dogs: Masticatory myositis, Exocrine pancreatic insufficiency
  - Cats: Hyperthyroidism, chronic renal failure
  - Cows: Johne's Dz



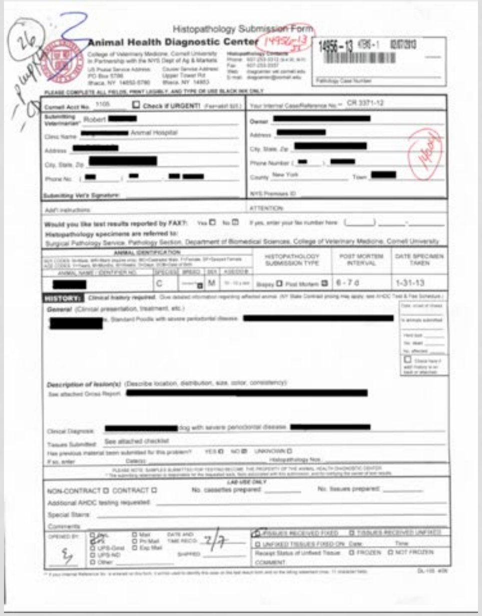
EMACIATION: NX TASKS

- Examine & document **stomach contents**
  - Use a strainer / colander
- ***Anything*** in the stomach, including FBs, proves recent ***willingness & ability*** to ingest
- (In contrast) Anorexia is a hallmark of **cachexia**
  - Cachexia = Inflammatory, cytokine mediated syndrome of appetite loss, ↑basal metabolism, & muscle & fat loss
- Ruminants & hindgut fermenters retain some material in rumen / cecum despite prolonged anorexia

NX FINDINGS IN EMACIATED DOGS

Gerdin JA, et al. Circumstances, Descriptive Characteristics, and Pathologic Findings in Dogs Suspected of Starving. Vet Path. 2015.

- Retrospective
- All dogs seized for suspected starvation
- Necropsied at Cornell or ASPCA, 2007-2013
  - All autopsy reports & photos reviewed by JG
- All histology performed at Cornell
  - All slides reviewed by JG
- Examined:
  - Case history
  - Population characteristics
  - Gross & histologic changes



Histopathology Submission Form

Animal Health Diagnostic Center 14956-13

College of Veterinary Medicine, Cornell University

14956-13

Pathology Case Number

Cornell Acct No. 1105 ☐ Check if URGENT!

Your Internal Case/Reference No. CR 3371-12

Submitting Veterinarian: Robert [redacted]

Owner: [redacted]

Clinic Name: [redacted] Animal Hospital

Address: [redacted]

City, State, Zip: [redacted]

Phone No.: [redacted]

Phone Number: [redacted]

County: New York Town: [redacted]

Submitting Vet's Signature:

NYS Premises ID

Add'l instructions

ATTENTION:

Would you like test results reported by FAX? Yes ☐ No ☐

Histopathology specimens are referred to:

Surgical Pathology Service, Pathology Section, Department of Biomedical Sciences, College of Veterinary Medicine, Cornell University

ANIMAL NAME / IDENTIFIER NO.	SPECIES	BREED	SEX	AGE/DOB	HISTOPATHOLOGY SUBMISSION TYPE	POST MORTEM INTERVAL	DATE SPECIMEN TAKEN
[redacted]	C		M		Biopsy ☐ Post Mortem ☒	6 - 7 d	1-31-13

HISTORY: Clinical history required.

General (Clinical presentation, treatment, etc.)

[redacted], Standard Poodle with severe periodontal disease. [redacted]

Description of lesion(s) (Describe location, distribution, size, color, consistency)

See attached Gross Report. [redacted]

Clinical Diagnosis: [redacted] dog with severe periodontal disease. [redacted]

Tissues Submitted: See attached checklist

Has previous material been submitted for this problem? YES ☐ NO ☒ UNKNOWN ☐

LAB USE ONLY

NON-CONTRACT ☐ CONTRACT ☐ No. cassettes prepared: No. tissues prepared:

Additional AHDC testing requested:

Special Stains:

Comments:

OPENED BY: ☐ Mail ☐ Pri Mail ☐ Exp Mail ☐ UPS-Grnd ☐ UPS-ND ☐ Other

DATE AND TIME REC'D: 2/7

SHIPPED:

TISSUES RECEIVED FIXED ☐ TISSUES RECEIVED UNFIXED

☐ UNFIXED TISSUES FIXED ON: Date: Time:

Receipt Status of Unfixed Tissue: ☐ FROZEN ☐ NOT FROZEN

COMMENT

NX FINDINGS IN EMACIATED DOGS

- 40 dogs total: 34 starvation & 6 disease
  - EPI, neoplasia, infectious disease (parvo virus) and organ disease
- 32 found dead; 8 dogs euthanized
- Median BCS= 1/9 (Purina)
- 22 Male- 3 neutered; 18 Female- 4 spayed
- Age range: ~3 mo. to geriatric
  - 25% puppy to ~1yr; 50% adult; 25% aged dogs
- 10 small-breed, 14 large-breed & 16 Pit bulls

NX FINDINGS IN EMACIATED DOGS

- **Circumstances** found exclusively with starvation
  - Found in a vacated residence (6)
  - Died in extreme weather: Heat, cold, & hurricane (6)
- No significant differences between starved & Dz:
  - BCS, sex, neuter status, age or size(breed)
- **Gross findings** found exclusively with starvation
  - Severe hair matting (3)
  - Traumatic wounds (6)

NX FINDINGS IN EMACIATED DOGS

- Common findings in both Dz & starved dogs*
  - **Gross**: Gastric ecchymoses, ulceration, hemorrhage, & gastric foreign bodies
  - **Histo**: Serous atrophy of fat of bone marrow, atrophy of the liver, skin, & thyroid gland

* And 2 starved cats (JG, pers experience)

Photo courtesy
Dr. Robert Reisman

Photo courtesy
Dr. Robert Reisman

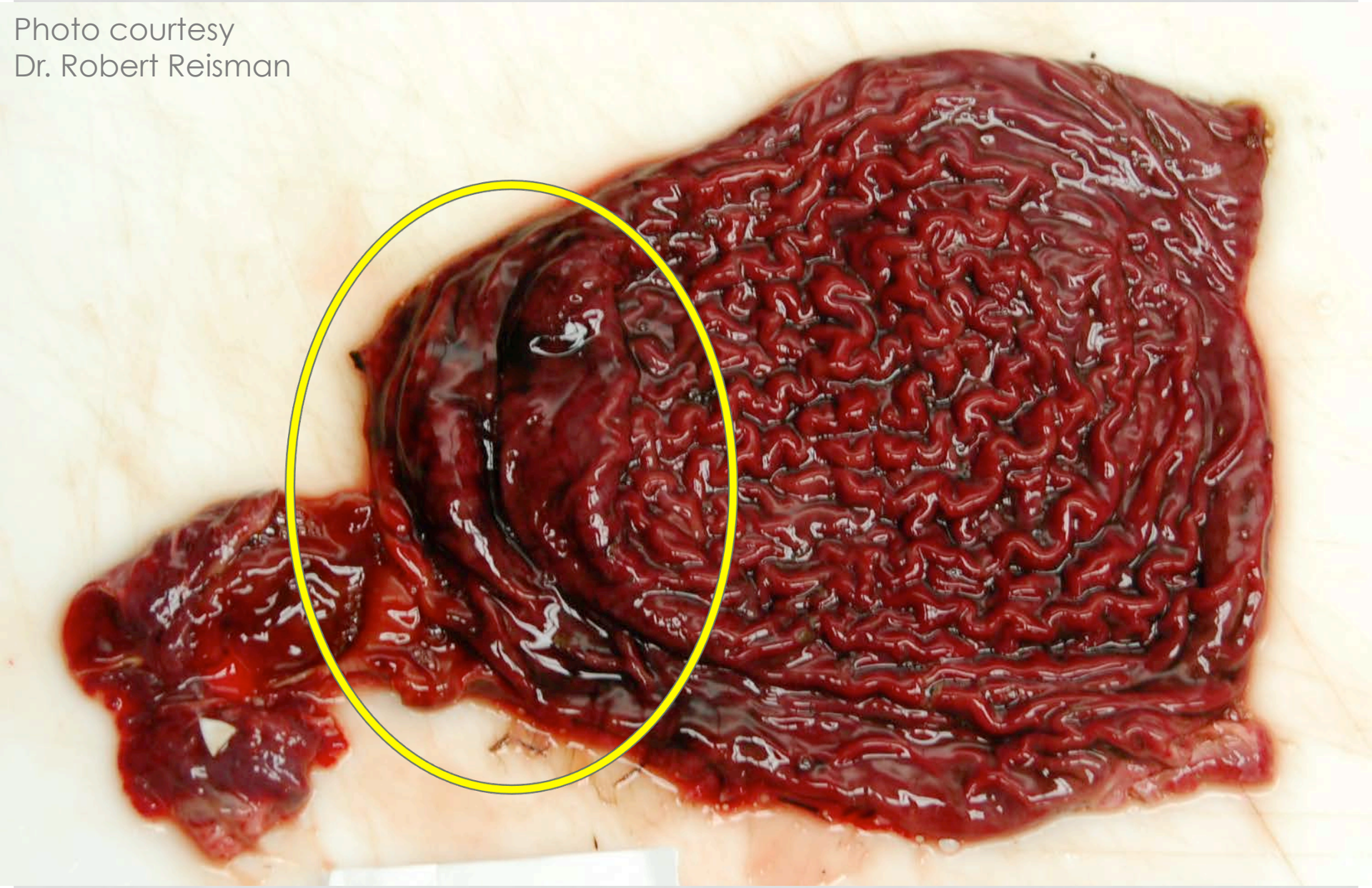


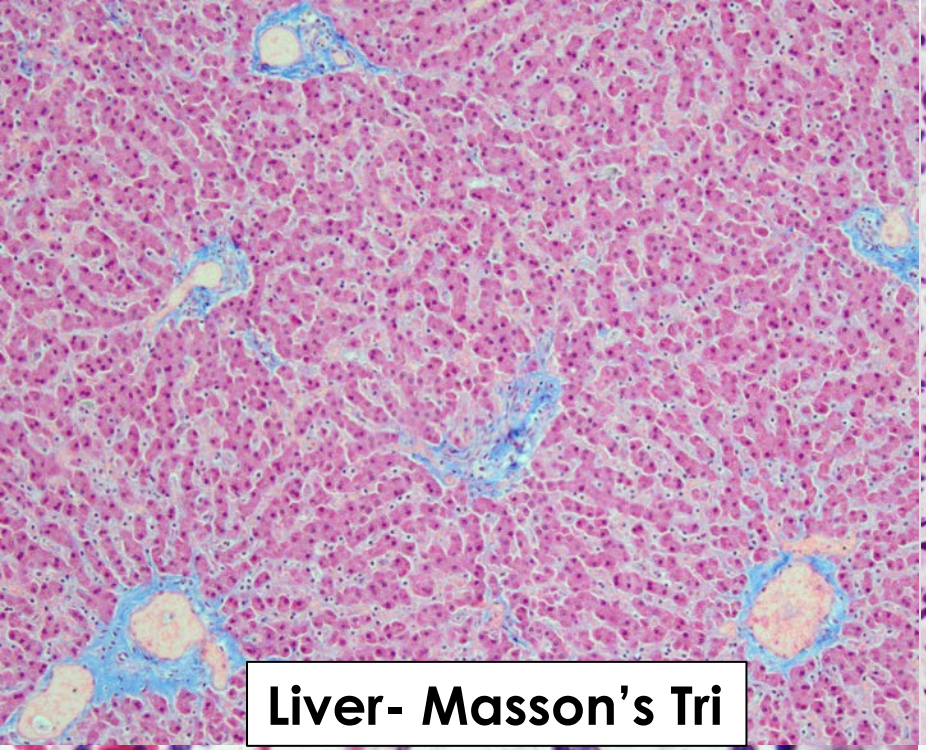
Photo courtesy Dr. Robert Reisman

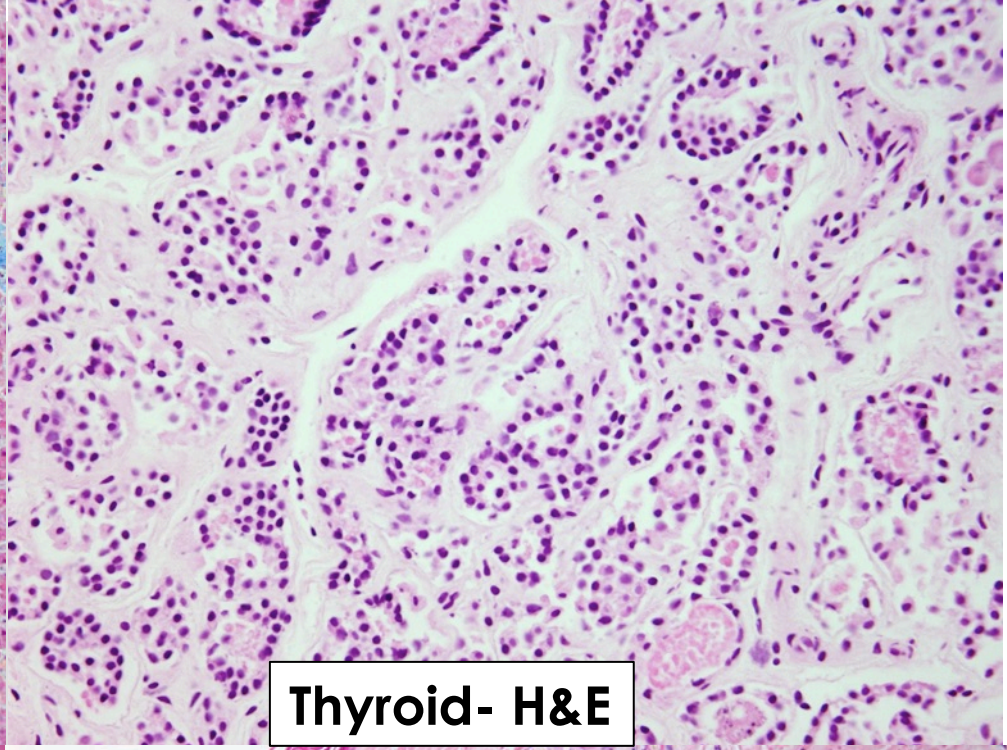

Photo courtesy Dr. Robert Reisman
METRIC

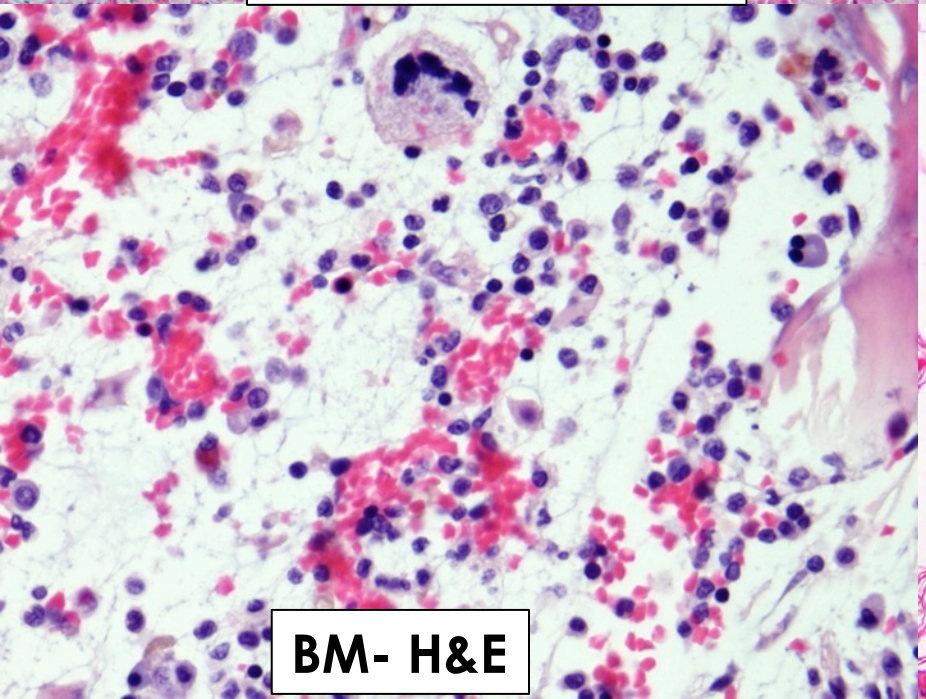
Photo courtesy Dr. Robert Reisman

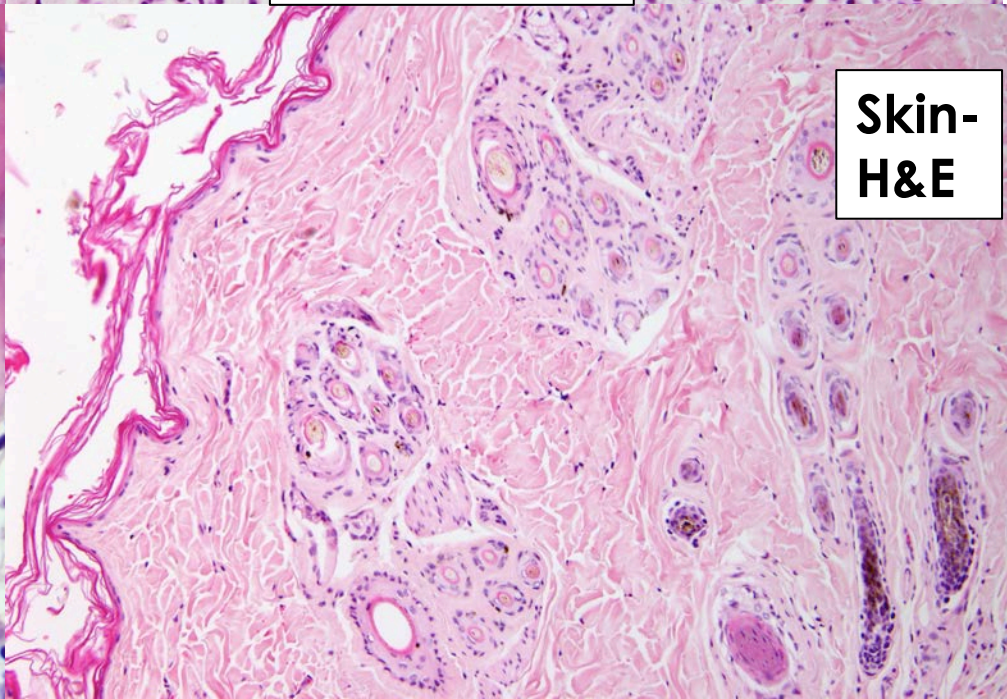
EMACIATED DOGS: HISTOLOGY

- **#1 Serous atrophy of fat**
- Other possible (inconsistent) findings:
  - **Splenic hemosiderophages**
    - Cause/ mechanism unknown
    - Also noted in starved reindeer (Josefsen, 2007)
  - Dogs: **Hepatic, thyroid, & testicular atrophy**
- Dogs, cats & horses: Atrophy of the **skin**, inc. epidermis & sebaceous glands; telogen predominance with mild orthokeratosis


Liver- Masson's Tri


Thyroid- H&E


BM- H&E


Skin-
H&E

EMACIATION: 4 OUTCOMES

- **Pathologist's task:** Determine the contribution, if any, of endogenous Dz to the emaciated state.

4 possible outcomes:

1. **No significant findings**
   - **COD = Starvation**

EMACIATION: 4 OUTCOMES

2. **Dz present**, but unlikely to cause of emaciation
   - **Dz = incidental or immediate COD**
   - Ex: Emaciated dog with intestinal perforating FB
     - Immediate COD = Gastric perforation
     - Underlying COD= Starvation

STARVATION: 4 NECROPSY OUTCOMES

3. Dz that ***could*** cause emaciation

- Unknown which came 1st, Dz or emaciation
- COD: Dz ***and*** emaciation
  - Ex: 16 wk emaciated puppy with parvo virus

4. *Dz that causes* emaciation

- COD: The Dz

DURATION OF EMACIATION

***How long* did it take to become emaciated?**

- Cannot know with 100% certainty
  - Too many individual-animal & environmental variables
- Inform courts of starvation in **people**
  - **Death ~35-50% loss of ideal body weight**
    - % BW that other species can loose is unknown
    - Experience & 1 study (Pointer, 2013)- similar for **dogs**
- Inform courts of **experimental starvation in dogs**

D

Pointer, 2014

Top:
Admission
11.3 Kg

Bottom:
After 30 days,
18.6 kg
(ideal)

- 7.3 kg difference
- **39% loss of ideal BW**

DURATION OF EMACIATION

Starvation "experiments," summarized by Lusk, 1928

- 1 dog nearly died after **15 days**
  - 3.4→1.6 kg; **47% BW loss**
- 1 dog *almost* died after **27 days**
- 2 dogs died in **30 & 38 days**
- 1 dog fasted for **117 days** & lived; **62% BW loss**

Weight loss experiments

- Lemiux, 1968: 10 dogs, water only 12 days
  - BW Loss = 11-15%
- De Bruijne, 1979: 18 dogs, water only 21 days
  - **12 Obese** dogs: Avg BW loss = 18%
  - **6 Non-obese** dogs: Avg BW loss = 24%

DURATION OF EMACIATION

- **JG's opinion**: For healthy adult **non-obese** dogs, it likely takes **2 weeks to 2+ months** to starve to death, assuming 0 calorie intake, & free access to water. Obese dogs might survive even longer. Small breed dogs may not survive as long.

RE-FEEDING SYNDROME

- Clinical syndrome of electrolyte & fluid imbalances occur in emaciated people in 2 weeks after nutrition
  - ↓**Phos/ Mg/ K/ Ca** → arrhythmias & pulm edema
- Documented in horses & 1 cat, but ***not*** dogs
  - Horse w/ ↓Ca, Phos, Mg; No lesions at Nx
- Vets with extensive experience re-feeding emaciated dogs (>200 cases) have **not** noted refeeding syndrome, despite some similar blood work abnormalities
  - Dogs: ↓Ca, ↓ALB (Pointer, 2013)

SUMMARY

- **Starvation**, an involuntary reduction in calories, is distinct from **cachexia**, a Dz-assoc voluntary reduction
- **Emaciation** is an abnormal state of fat & muscle loss
- Feeding (living) patients distinguishes starvation from cachexia
- Nx of emaciated animals:
  - Document **fat & muscle loss– photos & report**
  - Examine entire **GI**
  - R/O **endogenous Dz**
- **Duration** of starvation is difficult to determine
    - Healthy, non-obese adult dog, 0 calories, *ad lib* H2O = Weeks to months

Heat Stroke

HEAT STROKE/ HYPERTHERMIA

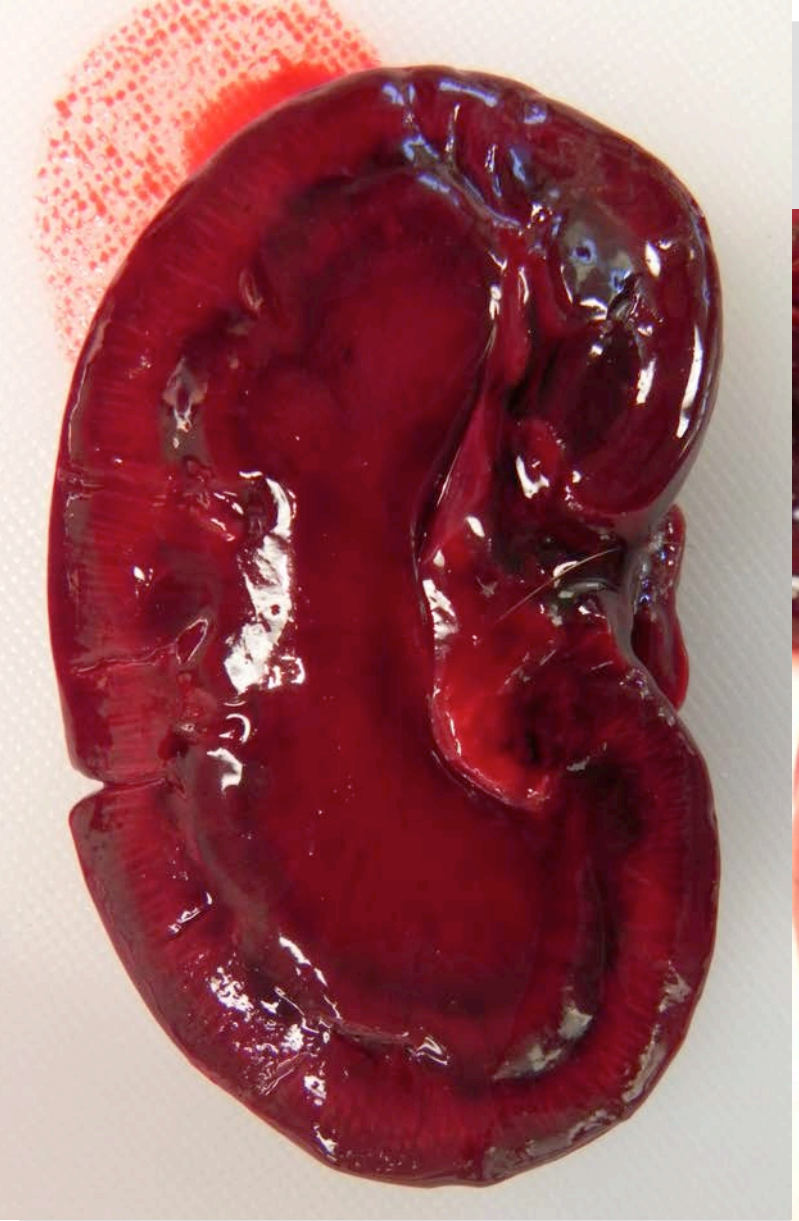
- ↑Temp→ DIC & systemic inflammatory response syndrome (SIRS)→multiorgan failure (MOF)→ **death**
- 2 forms of heat stroke
  - **Classic**: Hot environment
  - **Exertional**: Exercising in heat
- This discussion is limited to ***dogs***
  - Clinical exertional heat-related illness well described in horses; No published cases of heat stroke lesions.
  - No published cases of heat stroke in cats

HEAT STROKE

- 11 dogs w/classic or exertional heat stroke (Bruchim 2009)
  - 10 died,1 euthanized. Survival 4-30 hrs
  - Histo: **All kidneys had lesions** inc. "**congestion, interstitial hemorrhage** & tubular degeneration & necrosis"
- Review of lesions & pathophysiology (Romanucci 2013)
  - **Generalized tissue congestion**
  - **Hemorrhage** of the skin, lungs, mesentery, mucous membranes, muscle, & GI +/- bloody intestinal contents
  - **Necrosis** of SI & LI mucosa, renal tubular epithelium, hepatic centrilobular necrosis & brain neuronal necrosis
- Lesions non-specific; Not all lesions present in every dog
- Is this population & their lesions representative of dogs ***found dead in cars***?

ARE DOGS LEFT IN CARS DIFFERENT?

- Do dogs that die in cars, without medical treatment, have the same lesions?
  - Are some lesions time-dependent?
- Do dogs that die in cars die of the same mechanism (DIC & SIRS) as hospitalized dogs?
  - Could direct thermal injury to **CNS** be the mechanism?

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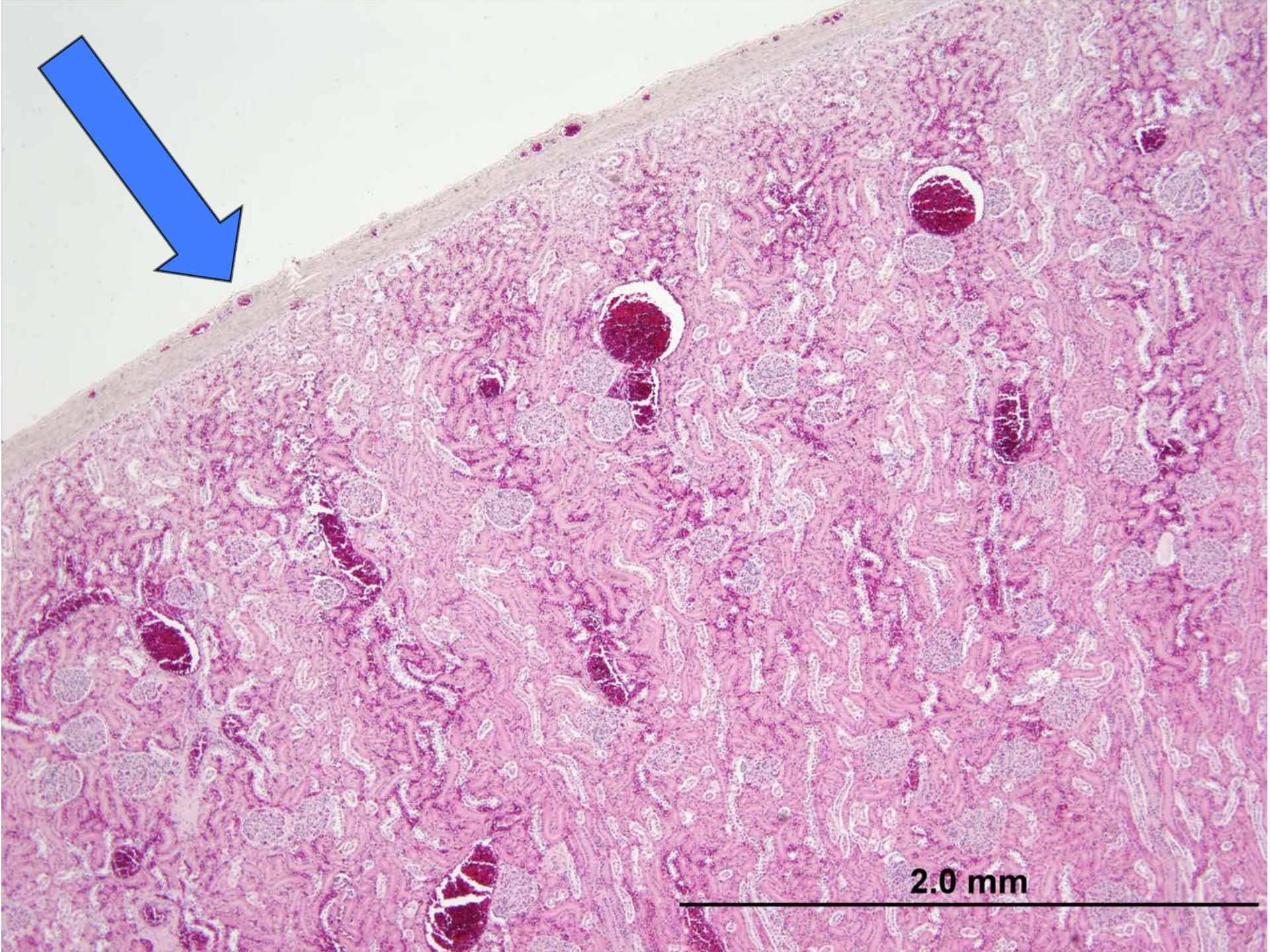
2.0 mm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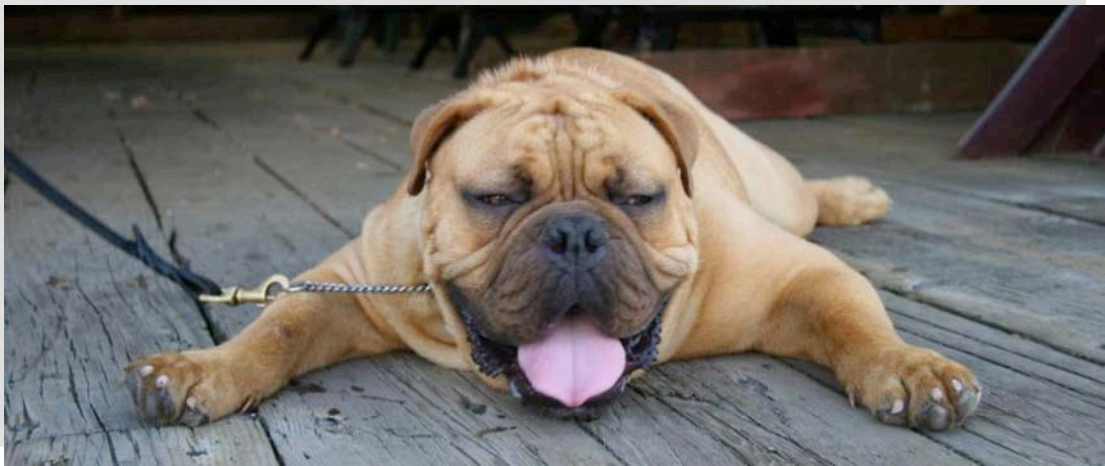
POSTMORTEM DIAGNOSIS OF HEAT STROKE

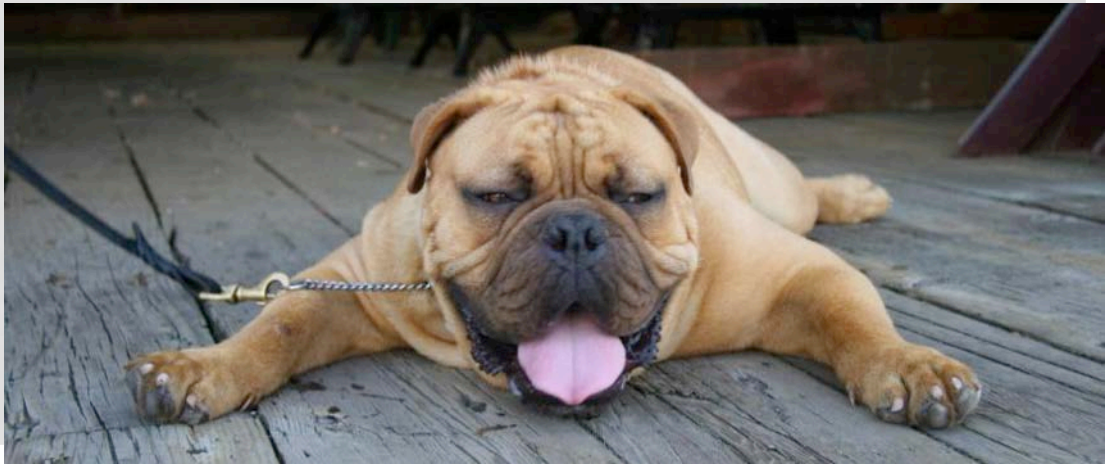
- In people (US Nat'l Assoc Medical Examiners)
  - **"Heat-related death"**: High temp causes or significantly contributes to death
    - Based on circumstances / weather reports
  - **"Heat stroke" "Hyperthermia"**: body temp at the time of collapse ≥105°F (≥40.6°C)



POSTMORTEM DIAGNOSIS OF HEAT STROKE

Davis, 2017- JAVMA: effect of brachycephaly & BCS on respiratory thermoregulation

- As BCS ↑, body temp ↑, independent breed type
- BCS is negatively assoc with tidal volume
- Brachycephalics have a ↓capacity for thermo-regulation, but **BCS is a greater determinant of body temperature than breed type.**



HYPOTHERMIA

- Dx of exclusion (people)
- Few, non-specific lesions
  - Gastric mucosal ecchymoses, Bright red or pink lividity, Pancreatic hemorrhages, Large muscle hemorrhages (ex: epaxial)

HYPOTHERMIA

- Experimental fatal hypothermia in 54 dogs (Fisher 1957)
  - No lesions in lungs, heart, liver or adrenal glands
  - 5 dogs - pancreatic petechia
- **Hypothermia = Dx of exclusion**, dependent on circumstances

SUMMARY

- Lesions of neglect should be obvious to laymen
- Dehydration is subtle, affected by BCS & autolysis
- For emaciated animals:
  - Document **fat & muscle loss**
  - **Assign a BCS** (published scale)
  - Determine is any **endogenous Dz**
  - **Starvation = COD** in the absence of Dz
  - Duration of starvation starve difficult to determine
    - Death in a previous **healthy, non-obese adult dog** takes **2 weeks to 2 months**

SUMMARY

- Heat stroke: DIC→ congestion & hemorrhages
- In people:
  - COD = "**heat-related death"** if circumstance supports
  - **"Heat stroke"** based on **antemortem** body temp
- Death due to **hypothermia is a Dx of exclusion**; lesions non-specific & uncommon

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