

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











Photos 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 — "What the animal looks like"
Cachectic _ (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

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

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

THIN

100

DEA

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.

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

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

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



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 No SQ fat •No fat in omentum

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Serous atrophy of fat

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
- 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

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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







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



Thyroid- 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







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
 - Ψ Phos/Mg/K/Ca \rightarrow 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?



















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 Vcapacity for thermoregulation, 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 \rightarrow 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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