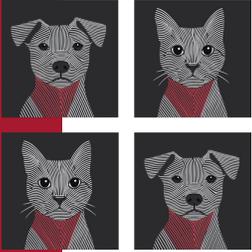


Pyometra: The Unwanted Guest in the Womb

Nicole VanSant, BS, LVT, VTS (ECC)




1

Overview

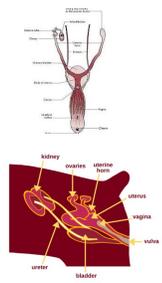
- Introduction
- Risk Factors
- Normal Estrus Cycle
- Hormonal and Pathological Mechanisms
- Bacterial Involvement
- Clinical Signs
- Diagnostics
- Treatment Options
- Prevention
- Case Example
- Research




2

Introduction

- Pyometra
 - Pyo = pus
 - Metra = uterus
- Reproductive disease of intact female dogs
 - Less common in cats
- Hormonal mediated bacterial infection of the uterus
 - Diestrus
 - Progesterone
- Frequently present to the ER as septic/shock
- Life threatening emergency




3

Epidemiology

- Common in intact, middle-aged to older female dogs
 - Approximately 25% intact females by the age 10
- Can occur in any breed
 - Commonly in Cavaliers, Golden Retrievers, Dobermans, Poodles
- Risk factors
 - Age
 - Repeated estrus cycles
 - Exogenous hormonal treatment – progesterone, estrogen
 - Cystic endometrial hyperplasia (CEH)
- Cats
 - Less common (2% -5% > 5-7years)
 - Induced ovulation = reduced progesterone exposure
 - Common in DSH, but more associated with reproduction management than breed



Cornell University
Veterinary Specialists EDUCATION

4

Classification: Cervix Patency

Closed - Cervix

Uterus expands with purulent material



Open - Cervix

Infection escapes the body



Both forms are life-threatening and require prompt intervention

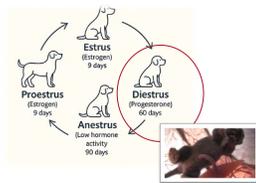
Cornell University
Veterinary Specialists EDUCATION

5

Normal Estrous Cycle

- Proestrus
 - Swollen vulva
 - Bloody discharge
 - Females will *not* stand for breeding
- Estrus
 - Ovulation occurs
 - Cervix open, bacteria may ascend
 - Discharge straw colored/lighter
 - Female will stand to breed
- Diestrus
 - Uterus maintains pregnancy
 - Cervix is closed
 - No signs of estrus
 - No interest in breeding
- Anestrus
 - Uterus repairs itself - involution

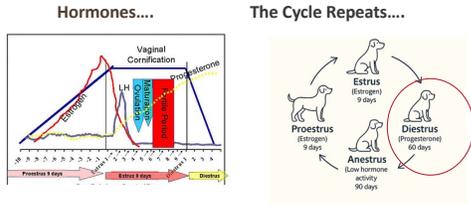
The Cycle Repeats....



Cornell University
Veterinary Specialists EDUCATION

6

Normal Estrous Cycle: Hormones



Cornell University
Veterinary Specialists

7

Progesterone Effects

- Endometrial changes
 - Thickening of uterine lining
 - Increases glandular secretions and mucus
 - Increases cell adhesion substances – promote implantation
- Muscle relaxation
 - Suppresses uterine contractions
 - Keeps cervix closed
- Vascolarization
 - Increased blood flow to support implantation
- Hormonal control
 - Inhibits the release of follicular stimulating hormone (FSH)
 - Prepares the endometrium to mature and secrete nutrients
- Immune response
 - Limits leukocyte activity in uterus
 - Establishes a barrier to ascending infections

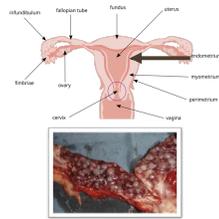


Cornell University
Veterinary Specialists

8

Cystic Endometrial Hyperplasia (CEH)

- Chronic progesterone exposure → endometrial gland proliferation
- Repeated estrous cycles without pregnancy increases risk
- Endometrial glands become cystic and fluid filled
- Decreases uterine contractility and local immune defenses
- Environment suitable for bacterial growth
- Often precedes or coexists with pyometra

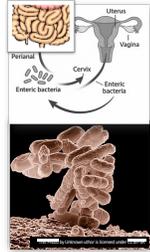


Cornell University
Veterinary Specialists

9

Pathogenesis: Bacterial Ascension

- Ascending bacterial infection of the uterus
 - Access > Estrus > open cervix > Diestrus > uterine changes
- Normal microflora of lower reproductive & GI tract
- Predominant pathogen: Escherichia coli (Gram -) (60-70%)
 - Streptococcus spp. (Gram +)
 - Enterobacter spp. (Gram -)
 - Pseudomonas spp. (Gram -)
 - Klebsiella spp. (Gram -)
- Normal defenses
 - Cervical patency
 - Uterine contraction
 - Local immune defenses
- Progesterone + CEH effects = bacteria proliferation

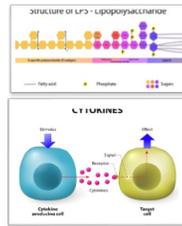


Cornell University
Veterinary Specialists Continuing EDUCATION

10

Pathophysiology: Bacterial Overgrowth

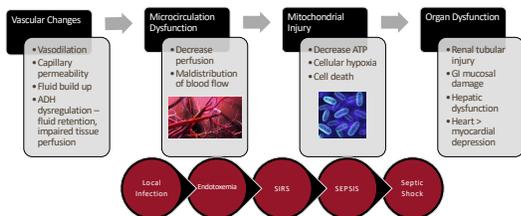
- Gram negative bacteria multiple & release endotoxins; Lipopolysaccharides (LPS)
- LPS enter circulation and binds to receptors on immune and vascular cells throughout the body
 - Macrophages
 - Neutrophils
 - Endothelial cells
- Triggers release of massive inflammatory cytokines
 - TNF- α > fever, vascular leakage
 - IL-1, IL-6 > fever, stimulate acute phase proteins
 - Prostaglandins > pain, vasodilation
 - Nitric oxide > vasodilation, blood flow regulation
- Initiates **systemic inflammatory response**
- Effects on uterus: inflammation, edema, ischemia



Cornell University
Veterinary Specialists Continuing EDUCATION

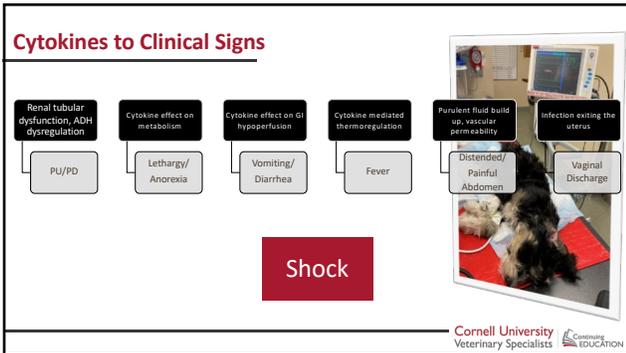
11

Hemodynamic & Cellular Consequences



Cornell University
Veterinary Specialists Continuing EDUCATION

12



13

Early Risk Recognition: Identifying SIRS

Systemic Inflammatory Response

- Criteria
 - Temp < 100.6 or > 102.6
 - HR > 120 bpm
 - RR > 20 bpm or PaCO₂ < 32 mmHg
 - WBC < 6,000/uL or > 16,000/uL or 3% bands
- Interpretation:
 - Is positive if 2 or more criteria are met
- Sensitive but not specific on source
- Supports early sepsis recognition

Infection + SIRS = Sepsis

Cornell University Veterinary Specialists Continuing EDUCATION

14

Early Risk Recognition: Quantifying Severity

- APPLE (Acute Patient Physiologic and Laboratory Evaluation) Score**
 - Objective illness severity scoring system for dogs
 - Provides prognostic information for survival
- Use 10 routine collected physiologic and laboratory variables in most ER workups
- Score range: 0-50
- Higher scores correlate with increased mortality risk
- Monitor trends
- Recognition of deterioration early on

Mentation	Creatinine
Heart Rate	Platelets
Respiratory Rate	Total Bilirubin
Temperature	Lactate
Blood Pressure	Albumin

SIRS identifies systemic inflammation; illness severity scores help determine risk and trajectory

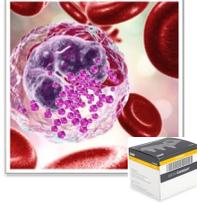
Cornell University Veterinary Specialists Continuing EDUCATION

15

Biomarkers of Inflammation: Trends Matter

Acute Phase Proteins (APP)

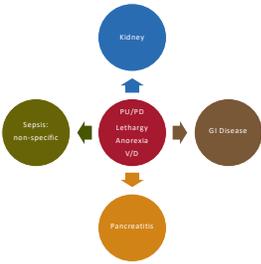
- Produced by the liver in response to inflammation
- **Positive APP: Increase with inflammation**
 - C-Reactive Protein (CRP)
 - Major acute phase protein in dogs
 - Stimulated by IL-6 (pro-inflammatory cytokine)
 - Limit tissue injury
 - Make bacteria recognizable to immune cells
 - Serum Amyloid A (SAA)
 - Rise rapidly, often earlier than CRP
 - Can be more sensitive than CRP (cats)
- **Negative APP: Decrease with inflammation**
 - Albumin, transferrin



Cornell University
Veterinary Specialists EDUCATION

16

Clinical Signs: Non-Specific



Reproductive history + intact status changes the differential entirely

History Recent Estrus
(1 – 4 months)

Cornell University
Veterinary Specialists EDUCATION

17

Uterine Stump Pyometra: Don't Be Fooled

Stump Pyometra

- Infection of residual uterine or ovarian tissue after OHE
 - Remnant tissue reacts to progesterone
 - Most cases develop months - years post spay
- *Purulent vaginal discharge in spayed female*
 - canine vs feline (fastidious groomers)
- Similar clinical signs to classic pyometra
 - Abdominal distention may be absent
- Abdominal US is the diagnostic tool



Cornell University
Veterinary Specialists EDUCATION

18

Priority: Stabilization



Sepsis protocols apply regardless of the source!

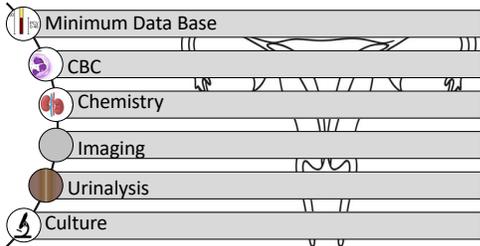
Rapid Patient Assessment

- Perfusion
IVC, fluids, BP, oxygen
- Diagnostics
labs, imaging
- Antibiotics
broad coverage
- Pain/Comfort
opioids and antiemetics

Cornell University
Veterinary Specialists
Continuing EDUCATION

19

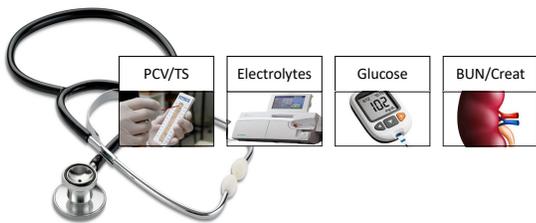
Diagnostics



Cornell University
Veterinary Specialists
Continuing EDUCATION

20

Minimum Data Base



Cornell University
Veterinary Specialists
Continuing EDUCATION

21

Diagnosis → Decision: To Cut or Not to Cut

- ✓ Patient stability
- ✓ Open vs closed cervix
- ✓ Breeding animal

Cornell University
Veterinary Specialists EDUCATION

25

Management Options: Risks

 <div style="border: 1px solid gray; padding: 5px; width: fit-content; margin: 0 auto;">Medical</div> <ul style="list-style-type: none"> <li style="background-color: black; color: white; padding: 2px; margin-bottom: 2px;">No definitive source control <li style="background-color: black; color: white; padding: 2px; margin-bottom: 2px;">Reoccurrence likely (50-70%) <li style="background-color: black; color: white; padding: 2px; margin-bottom: 2px;">Costly long term <li style="background-color: black; color: white; padding: 2px; margin-bottom: 2px;">May increase morbidity - closed cervix 	<div style="border: 1px solid gray; padding: 5px; width: fit-content; margin: 0 auto;">Surgical</div>  <ul style="list-style-type: none"> <li style="background-color: black; color: white; padding: 2px; margin-bottom: 2px;">Anesthetic risk for unstable patients <li style="background-color: black; color: white; padding: 2px; margin-bottom: 2px;">Costly upfront <li style="background-color: black; color: white; padding: 2px; margin-bottom: 2px;">Repetitive complications
---	--

Cornell University
Veterinary Specialists EDUCATION

26

Medical Management: Goals

- Infection control
- Induce luteolysis
- Open the cervix > drainage
- Evacuation of uterine contents
- Preserve fertility, if optional

Cornell University
Veterinary Specialists EDUCATION

27

Medical Management: Antibiotic Therapy

- Control the infection
 - Target Gram-negative enteric bacteria (E.coli)
 - Good tissue penetration
 - Adjust based on culture
 - Prevent systemic progression > sepsis, shock
- Antibiotic choices – culture pending
 - Ampicillin-sulbactam (+/- & anaerobic)
 - Cephalosporines (++)
 - Fluoroquinolones; enrofloxacin (-)
 - Enrofloxacin + ampicillin (empiric coverage = broad coverage)
- Efficacy
 - Dependent on perfusion
 - Penetration into infected environment

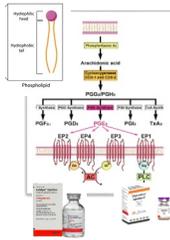


Cornell University
Veterinary Specialists Continuing EDUCATION

28

Medical Management: Prostaglandins (PGF_{2a})

- Stimulates uterine contraction
 - Expels uterine contents
- Causes regression of corpus luteum
 - Lowers progesterone levels
 - Ends diestrus
- Low dose, frequent SC or IM administration
 - Dinoprost (natural PGF_{2a})
 - Cloprostenol (synthetic analog)
- Effects
 - Increased vaginal discharge
 - Improvement 48 hours
- Side effects: emesis, V/D, salivation
- *Not recommended in Closed Pyometra*

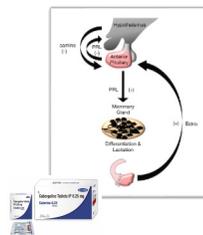


Cornell University
Veterinary Specialists Continuing EDUCATION

29

Medical Management: Dopamine Agonist

- Stimulates dopamine receptors in the pituitary
- Dopamine inhibits prolactin release
- Prolactin normally supports the corpus luteum by maintaining progesterone
- Reduce prolactin > reduce progesterone effects
 - Uterine regression & luteolysis
- Used in conjunction with PGF_{2a} & antibiotics
 - Cabergoline
- Not suitable in closed cervix – risk of uterine rupture



Cornell University
Veterinary Specialists Continuing EDUCATION

30

Monitoring

- Hospitalization
 - IV fluids - treat dehydration and support perfusion
 - Frequency of medication administration
 - GI support - treat anorexia, V/D
 - Close monitoring
 - patient stability
 - treat medication side effects
- Improvement 24-48 hours
- Worsening signs → change plans



Cornell University
Veterinary Specialists 

31

Surgical Management: Source Control

- Ovariohysterectomy
 - Removal of ovaries and uterus
 - More complicated OHE
 - uterine enlargement
 - blood vessel enlargement
- Risks
 - Hemorrhage - enlarged blood vessels
 - Uterine rupture - large delicate uterine walls
 - Peritonitis - septic abdomen
- Prognosis
 - 90 – 100 % survivable: uterus intact, stable P.
 - 60 – 75 % survivable: uterine rupture, timing
 - Age and comorbidities play a factor
 - DM, Cushings, Cardiac, DIC



Cornell University
Veterinary Specialists 

32

Surgical Management: Post-op Care

- Fluids
- Continuance of antibiotics
- Blood pressure monitoring
- Lactate trends
 - CRP trends
- Peritonitis: if rupture occurs
- PCV/TS: if hemorrhage occurs
- Pain control
- Incision monitoring



Cornell University
Veterinary Specialists 

33

The Good Discharge: Home Care

- Activity restrictions 10-14 days
- Medications
 - Continue antibiotics for 2 weeks
 - Pain management as directed
- Incisional monitoring
 - Redness, swelling, discharge
 - E-collar always
- Monitoring
 - Lethargy
 - Inappetence/vomiting/diarrhea
 - Fever
- Recheck appointment
 - +/- suture removal
 - Culture results



34

Prevention & Client Education

- Primary Prevention – Ovariohysterectomy
 - Eliminates risk
 - Removed progesterone influence
 - Prevents reoccurrence
- Spay Timing
 - Early spay in large breed dogs
 - Link to certain cancers
 - Not universally across all breeds
- Early Detection – best outcomes
 - Monitor intact females: recent estrus
 - lethargy
 - PU/PD
 - vaginal discharge
- Take reproductive histories – last heat cycle



https://www.akc.org/expert-advice/news/study-links-sterilization-certain-health-risks/?utm_source=twitter&utm_medium=social
https://www.frontiersin.org/articles/10.3389/fvets.2025.1532039/full?utm_source=frontiersin&utm_medium=article_html

35



Case Example:

- ✓ 8-year-old female intact Yorkie
- ✓ Presented to rDVM for vaginal discharge, PU/PD. Patient was stable.
- ✓ Diagnosis – *Suspected Open Pyometra*
 - History + clinical signs of discharge
 - No BW or imaging performed
- ✓ Medical management – Amoxicillin-clavulanate, Maropitant
- ✓ Home care - monitoring

36

48 Hours Later...



- ✓ Lethargy++
 - ✓ Anorexia
 - ✓ Painful, distended abdomen
- } **Closed Pyometra**
- Triage**
- 5-7% dehydrated
 - Weight: 4.90 kg
 - Temp: 102.8
 - HR: 168
 - RR: 44
 - MM: pale pink, tacky
 - CRT: 1-2 seconds
 - BP: 92 mmHg
 - Pain: 2/5
- } **SIRS Criteria**
- } **Septic Shock**

37

Initial Treatments: Stabilization



- IV access: 20 g cephalic IVC
 - Bloodwork
- Hypoperfusion: 100 ml P-Lyte bolus IV
- Dehydration: Crystalloid fluids: P-Lyte 2 ml/kg/hr.
- Pain control: Methadone 0.2 mg/kg IV
- GI support: Maropitant 1 mg/kg IV
- Antimicrobial support: Unasyn 50 mg/kg IV, Enrofloxacin 15 mg/kg IV

38

Diagnostics

- POCUS - distention of uterine horns and body, no free fluid
- Minimum data base (PCV/TS, Electrolytes)
 - Hypoperfusion
 - Dehydration: illness vs anorexia
 - Dextrose bolus 1 ml/kg diluted 1:3
 - Added 2.5 % Dextrose to IVF
- NIBP
 - Elevated: pain/perfusion
- CBC
 - Monocytosis: r/o inflammation vs infectious
 - Thrombocytopenia: r/o consumptive vs DIC
- Chem
 - Low BUN: r/o enteropathy, low protein intake
 - Hyperglobulinemia: r/o inflammatory vs infection

PCV/TS	47/7.5
NIBP	162 mmHg Post Bolus
Electrolytes	Na - 147.8 mmol/L K - 3.62 mmol/L BG - 62 mg/dL Lactate - 4.1 mmol/L
CBC	WBC - 12 K NEU - 7.5 K (bands) MON - 1.97 K Plt - 82 K/uL
Chemistry	Creat - 0.6 BUN - 6 ALB - 2.7 ALT - 99 ALP - 72 GLOB - 4.9

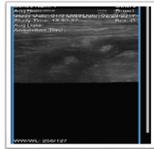
39

Imaging

Radiographs: 3 view AXR



Ultrasound



Cornell University
Veterinary Specialists 

40

Hospitalization

Emergency Surgery: ASA 4

- Patient prep
 - Placed central line left jugular
 - Placed arterial catheter tail
- Drug protocols
 - TAP Block (regional anesthesia)
 - Bupivacaine & Dexmedetomidine
 - Fentanyl CRI
 - Vasopressin
- Intraoperative findings
 - Uterine rupture - purulent fluid in abdomen
 - Septic abdomen
 - No intraoperative hemorrhage

Hospitalization Goals

- Restore perfusion
 - Fluid balance
 - BP Monitoring
- Prevent ongoing endotoxin impact
 - Antibiotic therapy
 - Electrolytes monitoring
- Patient assessments – monitor for deterioration
 - Watch for peritonitis
 - Pain/comfort
- Incision care & monitoring
- Nutritional support



Cornell University
Veterinary Specialists 

41



Outcome

- Sepsis progression – HR, RR, BG
- Persistent anorexia
- Decreased mentation
- Ataxia
- CXR - pneumonia
- R/O vascular event
- Humane euthanasia



Cornell University
Veterinary Specialists 

42

Research Areas



- ✓ Arendt M., et al. (2021). The ABCG4 gene is associated with pyometra in Golden Retriever dogs. Scientific Reports. <https://www.nature.com/articles/s41598-021-95936-1>
- ✓ Ybáñez A., et al. (2023). Bacteria associated with canine pyometra and concurrent bacteriuria: A prospective study. Veterinary Microbiology. <https://doi.org/10.1016/j.vetmic.2023.110362>
- ✓ Raeha M.F.G., et al. (2022). Antimicrobial susceptibility and production of virulence factors by bacteria recovered from bitches with pyometra. Reproduction in Domestic Animals. <https://onlinelibrary.wiley.com/doi/10.1111/rda.14624>
- ✓ Barreira A., et al. (2024). Antimicrobials administration, treatment outcome and bacterial susceptibility in canine pyometra cases. The Veterinary Journal. <https://onlinelibrary.wiley.com/doi/10.1111/vj.12674>
- ✓ Köster LS, Fosgate GT, Suchodolski J, Lidbury J, Steiner JM. Comparison of biomarkers adiponectin, leptin, C-reactive protein, S100A12, and the Acute Patient Physiologic and Laboratory Evaluation (APPLE) score as mortality predictors in critically ill dogs. Journal of Veterinary Emergency and Critical Care. 2019 Mar 1.

Cornell University
Veterinary Specialists  EDUCATION

43



Thank you!

Cornell University
Veterinary Specialists  EDUCATION

44
