



## "HOW TO KEEP THE FLOW": THE KIDNEY FROM ACUTE TO CHRONIC DIAGNOSTICS AND THERAPIES

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CVMA SPRING SESSION 2019  
COAST HOTEL, VICTORIA, BC







## OVERVIEW

- DEFINITIONS
- WHY HYPOREXIA?
- UREMIC GASTRITIS
- IRIS STAGING AND SDMA
- ACUTE VS CHRONIC
- HOW/WHEN TO USE DIETS
- MANAGING PROTEINURIA
- SUPPLEMENTS & INFLAMMATION



## AKI- ACUTE KIDNEY INJURY

- INFECTIONS
- TOXIN
- OBSTRUCTION
- DEHYDRATION
- A/CKD
- NEOPLASIA

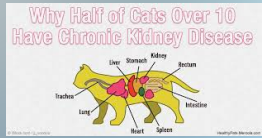

## AKI THERAPY

- IVFT- WATCH INS AND OUTS- BW
- ANTIBIOTICS
- ALWAYS ULTRASOUND
- OLIGURIC/ANURIC- DIALYSIS
- FUROSEMIDE THE BIG DEBATE
- RENAL FNA
- SUB/STENT VS. PYELOCENTESIS
- MONITOR BP, RR, BW (OFTEN)
- AVOID U-CATHS (NO ABX IF IN)
- NEED NUTRITION (NOT RENAL DIET)



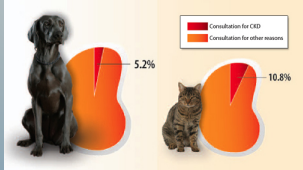

## CHRONIC KIDNEY DISEASE

- DEFINITION
  - KIDNEY DAMAGE PRESENT  $\geq 3$  MONTHS WITH OR WITHOUT  $\downarrow$  IN GFR
  - BKLK
  - PALPATION IMPORTANT

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■ Consultation for other reasons

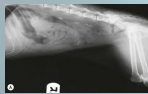

## CHRONIC KIDNEY DISEASE

- DEFINITION
  - KIDNEY DAMAGE PRESENT  $\geq 3$  MONTHS WITH OR WITHOUT  $\downarrow$  IN GFR
- SPECIFIC TREATMENT
  - ELIMINATE CAUSE (E.G. INFECTION) IF KNOWN & TREATMENT EXISTS

■ Consultation for CKD  
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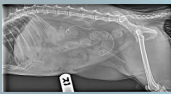

## RULE OUTS

- URINARY ULTRASOUND NECESSARY- PART OF MDB
- CAN HAVE SUBCLINICAL OBSTRUCTIONS
- NEED TO RELIEVE OBSTRUCTIONS
- URINE CULTURE
- UPC (POOL 3 SAMPLES)
- BLOOD PRESSURE AT EVERY VISIT
- IF STONES U/S T EACH VISIT

## URETERAL OBSTRUCTIONS

- CAT- SUB (SUBCUTANEOUS URETERAL BYPASS)
- DOG: ENDOSCOPIC STENTING VS. SURGICAL
- DOG: STENT
- 15% RESOLVE WITH MEDICAL MANAGEMENT
- PLEASE ULTRASOUND!

## CRF CHIEF COMPLAINT

- ANOREXIA / HYPOREXIA

## CKD CHIEF COMPLAINT

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- WEIGHT LOSS

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- HALITOSIS



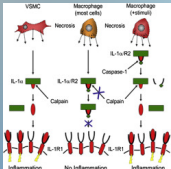
### CLINICAL CONSEQUENCES CKD

- WHY?
- HYPOREXIA
- VOMITING
- WEIGHT LOSS


### CLINICAL CONSEQUENCES CKD-HYPOREXIA

- ANOREXIA/HYPOREXIA
- $\uparrow$  IL-1  $\Rightarrow$  SATIETY CYTOKINE, INFLAMMATORY CYTOKINE



### HYPOREXIA

- Anorexia/hyporexia
  - ↑ IL-1 ⇒ satiety cytokine, inflammatory cytokine
  - ↑ Leptin

Leptin ↓ Suppresses appetite

↑ Ghrelin Increases appetite

### HYPOREXIA

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    - ↑ Anorectic factors - ↓ appetite

### APPETITE STIMULANTS

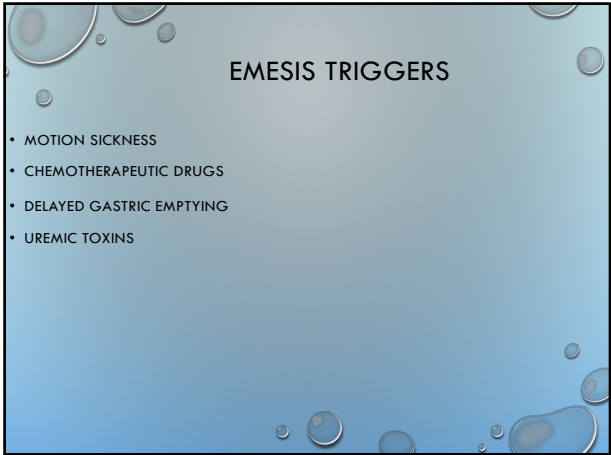
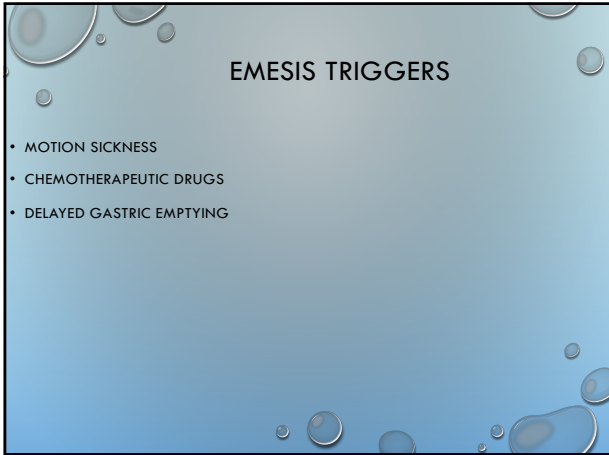
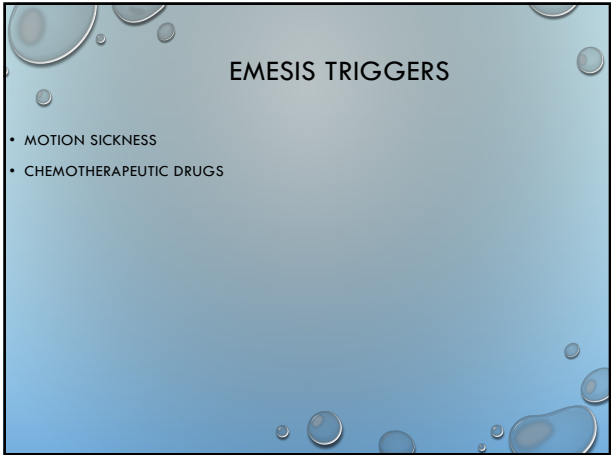
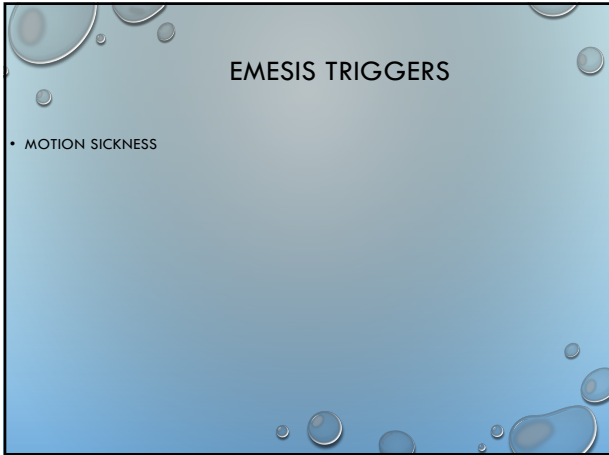
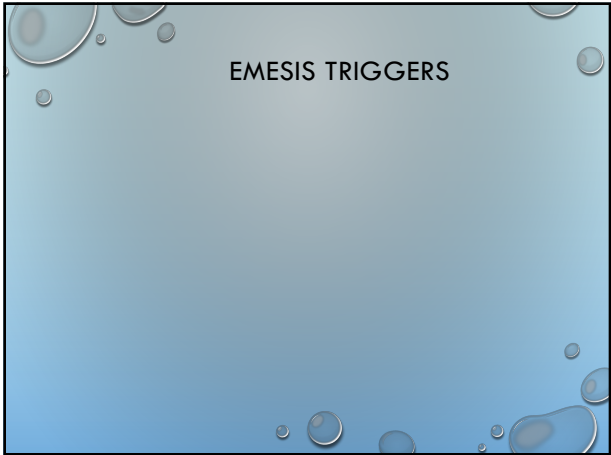
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  - TRANSDERMAL IN CATS (3 MG/0.1 ML) - 0.5 ML
  - T 1/2 IN DOGS 6H SO MAYBE BID?

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- CAPROMORELIN - GHRELIN STIMULANT IN DOGS



### PHYSIOLOGY OF VOMITING



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- EMETIC CENTER
  - ALL STIMULI ULTIMATELY CONVERGE IN EMETIC CENTER

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- VESTIBULAR APPARATUS

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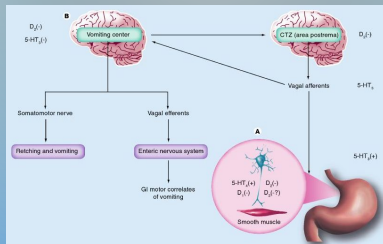
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  - ENTIRE GI TRACT & PERITONEAL CAVITY

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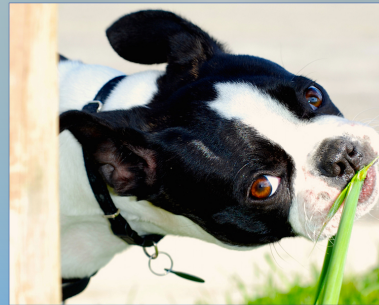
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- CHEMORECEPTOR TRIGGER ZONE (CRTZ)
  - MEDIATES VOMITING ASSOCIATED WITH DRUGS, TOXEMIAS, METABOLIC DISEASE

### CLINICAL CONSEQUENCES CRF

- VOMITING
  - EFFECTS UREMIC TOXINS ON CRTZ
  - GASTROENTERITIS



### ANTIEMETICS



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  - M1-MUSCARINIC CHOLINERGIC ANTAG (CHLORPROMAZINE)

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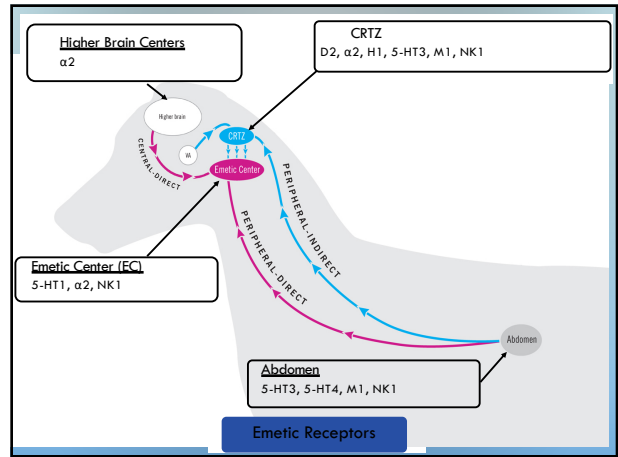
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## ANTIEMETICS

- 5-HT<sub>3</sub> SEROTONERGIC ANTAG (DOLASETRON)
- 5-HT<sub>4</sub> SEROTONERGIC AGONIST (CISAPRIDE)
- MOTILIN AGONISTS (ERYTHROMYCIN)
- NEUROKININ (NK-1) RECEPTOR (MAROPITANT)



## SPECIES DIFFERENCES

- DIFFERENCES NT-R SYSTEMS DOGS/CATS

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  - MEDIATED BY OPIATE TYPE RECEPTOR?

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  - ALPHA-2 ANTAGONISTS MORE USEFUL ANTIEMETICS CATS?

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  - HISTAMINE POTENT EMETIC DOGS
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- SPECIES DIFFERENCES AND MULTIMODAL THERAPY

### GI COMPLICATIONS OF CKD

- NAUSEA, VOMITING, ORAL STOMATITIS, ULCERATION, DIARRHEA



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- PPI – 1 MG/KG BID; WEAN








### UREMIA

- CENTRAL AND PERIPHERAL COMPONENTS

### CENTRAL UREMIA

- TOXINS ACTIVATE CRTZ D2-DOPAMINERGIC-R

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- TREAT
  - D2-DOPAMINERGIC ANTAGONIST
  - NK-1 RECEPTOR ANTAGONIST

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- UREMIC GASTRITIS
  - TREAT
    - H2-HISTAMINERGIC ANTAGONIST
    - FAMOTIDINE, ETC.

### GI & NUTRITIONAL COMPLICATIONS

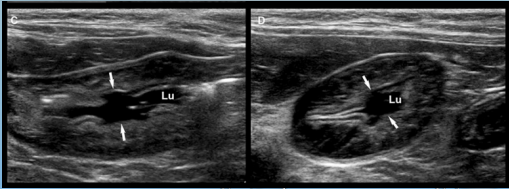
- METOCLOPRAMIDE 1–2 MG/KG/DAY IV CRI
- CHLORPROMAZINE: A-ADRENERGIC ANTAGONIST
  - CAN CAUSE **HYPOTENSION**, SEDATION
  - ONLY IN WELL HYDRATED PATIENT
- 5-HT3--R ANTAGONIST
  - ONDANSETRON
  - GRANISETRON
  - TROPISETRON
- MAROPITANT CITRATE





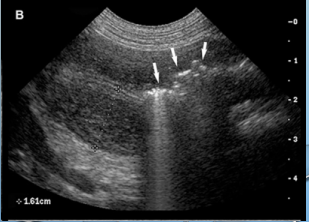
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- UREMIC GASTROPATHY
  - GLANDULAR ATROPHY
  - LAMINA PROPRIA EDEMA



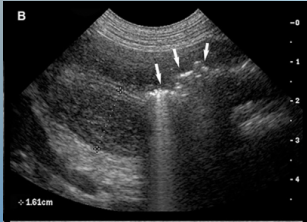
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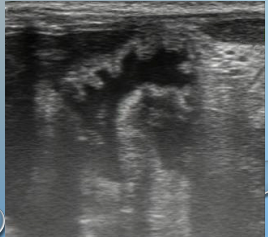
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  - ULCERS (MORE THE CASE IN DOGS)




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- UREMIC GASTROPATHY
  - GLANDULAR ATROPHY
  - LAMINA PROPRIA EDEMA
  - MAST CELL INFILTRATION
  - MINERALIZATION (MORE THE CASE IN CATS)



### CLINICAL CONSEQUENCES CRF

- UREMIC GASTROPATHY
  - HYPERACIDITY ⇒ GI HEMORRHAGE, NAUSEA, & VOMITING
  - BACK DIFFUSION HCL & PEPSIN INTO STOMACH WALL ⇒ HEMORRHAGE, INFLAMMATION




### CLINICAL CONSEQUENCES CRF

- UREMIC GASTROPATHY - OTHER MECHANISMS




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- UREMIC GASTROPATHY - OTHER MECHANISMS
  - ↑ STRESS FROM ILLNESS



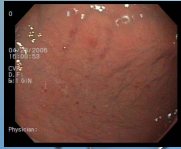
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  - ↑ UREA ⇒ ↑ PROTON BACK DIFFUSION



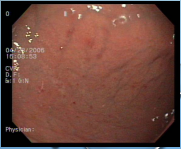
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  - AMMONIA INDUCED EROSIONS
    - BACTERIAL UREASE LIBERATES BY ACTING ON UREA



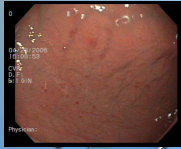
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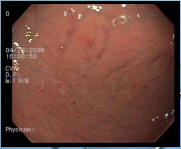
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  - ↓ CONCENTRATION & TURNOVER OF MUCOUS



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  - ISCHEMIA FROM VASCULAR LESIONS
  - ↓ CONCENTRATION & TURNOVER OF MUCOUS
  - PYLORIC INCOMPETENCE ⇒ BILIARY REFLUX



### GI COMPLICATIONS

- **SUCRALFATE** (MUCOSAL PROTECTANT) - LITERALLY A BAND-AID
  - NEEDS ACIDIC STOMACH TO ACTIVATE
  - INTERFERE WITH OTHER DRUG ABSORPTION?
  - WEAK PHOSPHATE BINDER

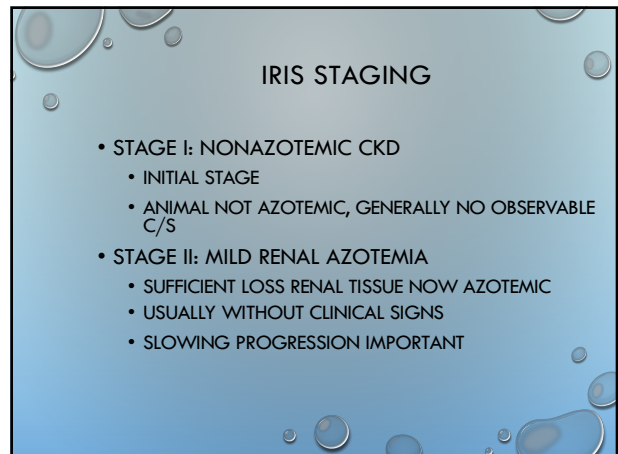
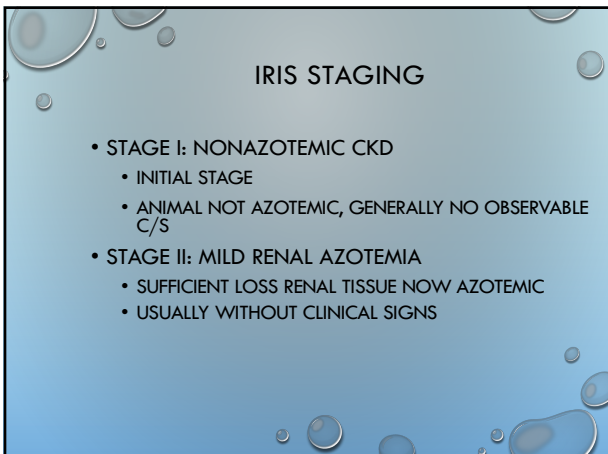
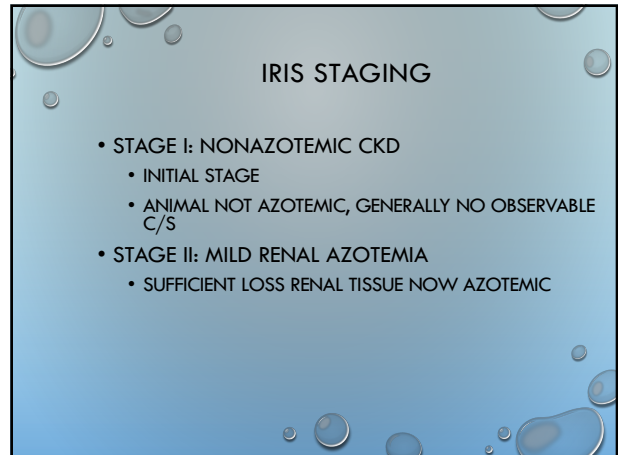
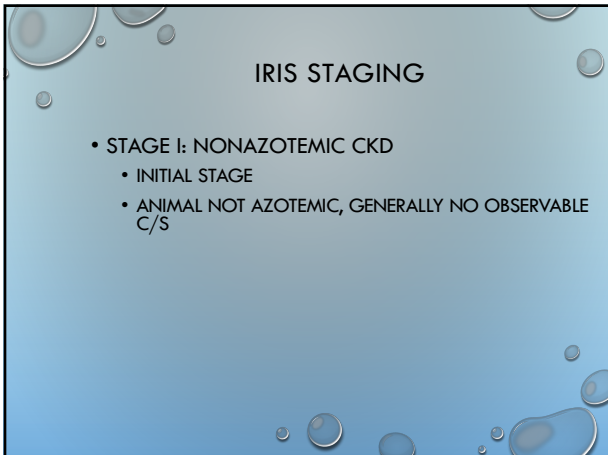
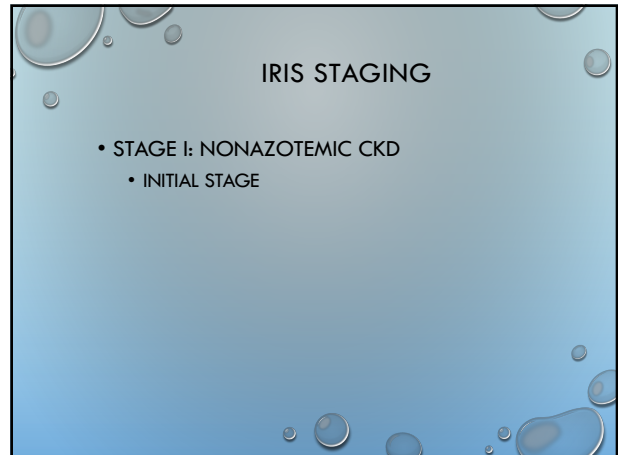




### CLINICAL CONSEQUENCES CRF

- POOR ORAL HYGIENE & DENTAL DISEASE EXACERBATE ONSET/SEVERITY UREMIC STOMATITIS





## IRIS STAGING

- STAGE I: NONAZOTEMIC CKD
  - INITIAL STAGE
  - ANIMAL NOT AZOTEMIC, GENERALLY NO OBSERVABLE C/S
- STAGE II: MILD RENAL AZOTEMIA
  - SUFFICIENT LOSS RENAL TISSUE NOW AZOTEMIC
  - USUALLY WITHOUT CLINICAL SIGNS
  - SLOWING PROGRESSION IMPORTANT
  - RATE USUALLY SLOW IN CATS (MONTHS TO YEARS); ERRATIC AND MORE RAPID IN DOGS (WEEKS TO MONTHS)

## IRIS STAGING

- STAGE III: MODERATE RENAL AZOTEMIA

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  - CLINICAL SIGNS PRESENT
    - UREMIC SYNDROME

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  - REFLECTS EFFECTS FURTHER DECLINE GFR
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- **STAGE IV: SEVERE RENAL AZOTEMIA**
  - CLINICAL SIGNS PRESENT
    - UREMIC SYNDROME
  - PROSPECTIVELY IDENTIFYING AND ALLEVIATING THESE COMPLICATIONS

### IRIS CLASSIFICATION CANINE CKD

Stage	I	II	III	IV
	Non-azotemic CKD	Mild renal azotemic	Moderate renal azotemia	Severe renal azotemia
Creatinine:				
(mmol/L)	< 125	125 to 180	181 to 440	>440
(mg/dl)	<1.4	1.4-2.0	2.1 to 5.0	>5.0

### IRIS CLASSIFICATION FELINE CKD

Stage	I	II	III	IV
	Non-azotemic CKD	Mild renal azotemic	Moderate renal azotemia	Severe renal azotemia
Creatinine:				
(mmol/L)	< 140	140 to 250	251 to 440	>440
(mg/dl)	<1.6	1.6-2.8	2.9 to 5.0	>5.0

### SDMA AND IRIS STAGING

- SYMMETRIC DIMETHYLARGININE (SDMA)

### SDMA AND IRIS STAGING

- SYMMETRIC DIMETHYLARGININE (SDMA)
- PERSISTENT SDMA >14  $\square$ G/DL = REDUCED RENAL FUNCTION?

### SDMA AND IRIS STAGING

- SYMMETRIC DIMETHYLARGININE (SDMA)
- PERSISTENT SDMA  $>1.4$   $\square$ G/DL = REDUCED RENAL FUNCTION?
- MAYBE CONSIDER DOG OR CAT WITH CREATININE VALUES  $<1.4$  OR  $<1.6$  MG/DL STAGE I

### SDMA AND IRIS STAGING

- IRIS STAGE 2 PATIENTS WITH LOW BCS, SDMA  $\geq 25$   $\square$ G/DL

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### SDMA AND IRIS STAGING

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### PROTEIN REQUIREMENTS IN DOGS AND CATS IN IRIS STAGE I KIDNEY DISEASE

- PROTEIN REQUIREMENTS IN CATS SIMILAR TO SENIOR CATS

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  - KCAL AND MLS H2O/DAY EFFECTIVELY THE SAME

### PROTEIN REQUIREMENTS IN DOGS AND CATS IN IRIS STAGE I KIDNEY DISEASE

- 30% NON-AZOTEMIC CATS PROGRESS TO AZOTEMIA WITHIN YEAR
- ALL PATIENTS WITH IRIS STAGE I AT RISK OF PROGRESSION

### PROTEINURIA AND PROGRESSION



### PROGRESSION CRD



- RELATED IN PART TO

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- RELATED IN PART TO
  - INTRAGLOMERULAR HYPERTENSION

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- RELATED IN PART TO
  - INTRAGLOMERULAR HYPERTENSION
  - GLOMERULAR HYPERTROPHY

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  - GLOMERULAR HYPERTROPHY
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  - PROTEINURIA

## PROGRESSION CRD



- RELATED IN PART TO
  - INTRAGLOMERULAR HYPERTENSION
  - GLOMERULAR HYPERTROPHY
  - SYSTEMIC HYPERTENSION
  - PROTEINURIA
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  - GLOMERULAR HYPERTROPHY
  - SYSTEMIC HYPERTENSION
  - PROTEINURIA
  - TUBULOINTERSTITIAL DISEASE
  - INTRARENAL PRECIPITATION CALCIUM PHOSPHATE

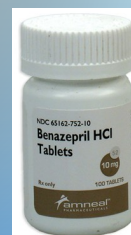
## MINIMIZING PROGRESSION

- ACE INHIBITORS



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- ACE INHIBITORS
  - RENOPROTECTIVE EFFECTS



### MINIMIZING PROGRESSION

- ACE INHIBITORS
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  - SYSTEMIC BLOOD PRESSURE
    - PRETTY WIMPY



### MINIMIZING PROGRESSION

- ACE INHIBITORS
  - RENOPROTECTIVE EFFECTS
  - SYSTEMIC BLOOD PRESSURE
    - PRETTY WIMPY
  - REDUCE LEVELS ANGIOTENSIN II BLUNTING:



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  - SYSTEMIC BLOOD PRESSURE
    - PRETTY WIMPY
  - REDUCE LEVELS ANGIOTENSIN II BLUNTING:
    - GLOMERULAR HYPERTENSION



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  - RENOPROTECTIVE EFFECTS
  - SYSTEMIC BLOOD PRESSURE
    - PRETTY WIMPY
  - REDUCE LEVELS ANGIOTENSIN II BLUNTING:
    - GLOMERULAR HYPERTENSION
    - IMPAIRED GLOMERULAR PERMEABILITY/SELECTIVITY




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  - RENOPROTECTIVE EFFECTS
  - SYSTEMIC BLOOD PRESSURE
    - PRETTY WIMPY
  - REDUCE LEVELS ANGIOTENSIN II BLUNTING:
    - GLOMERULAR HYPERTENSION
    - IMPAIRED GLOMERULAR PERMEABILITY/SELECTIVITY
    - MESANGIAL CELL PROLIFERATION



### ACE INHIBITORS

- SELECTIVE ALDOSTERONE BLOCKADE



## ACE INHIBITORS

- SELECTIVE ALDOSTERONE BLOCKADE
  - REDUCES PROTEINURIA AND GLOMERULAR INJURY



## ANGIOTENSIN INHIBITORS

- TELMISARTAN
  - ANGIOTENSIN II RECEPTOR BLOCKER



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  - HIGH AFFINITY FOR ANGIOTENSIN II RECEPTOR TYPE I (AT<sub>1</sub>)



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  - BLOCKS RAS
  - REDUCES INTRAGLOMERULAR PRESSURE → ↓ PROTEINURIA
  - MAYBE COMBO ANG II AND ACE BLOCKERS SYNERGISTIC?





### HYPERTENSION CATS

- AMLODIPINE
- CALCIUM CHANNEL BLOCKER



### HYPERTENSION CATS

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- CALCIUM CHANNEL BLOCKER
- DOSE CATS
  - 0.625-1.25 MG (1/4 TO 1/2 TABLET) ONCE DAILY



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- CALCIUM CHANNEL BLOCKER
- DOSE CATS
  - 0.625-1.25 MG (1/4 TO 1/2 TABLET) ONCE DAILY
- DOSE DOGS
  - 0.1 – 0.5 MG/KG ONCE DAILY



### FOOD



### DIETARY TREATMENT OF CKD



### DIETARY TREATMENT OF CKD



### TIPS TO IMPROVE TRANSITION

- NEW AND OLD SIDE BY SIDE



### TIPS TO IMPROVE TRANSITION

- NEW AND OLD SIDE BY SIDE
- USE APP STIMULANT DURING TRANSITION



### TIPS TO IMPROVE TRANSITION

- NEW AND OLD SIDE BY SIDE
- USE APP STIMULANT DURING TRANSITION
- DIFFERENT FOOD BOWLS



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- NEW AND OLD SIDE BY SIDE
- USE APP STIMULANT DURING TRANSITION
- DIFFERENT FOOD BOWLS
- DIFFERENT LOCATIONS



### TIPS TO IMPROVE TRANSITION

- NEW AND OLD SIDE BY SIDE
- USE APP STIMULANT DURING TRANSITION
- DIFFERENT FOOD BOWLS
- DIFFERENT LOCATIONS
- PATIENCE!





### DIETARY TREATMENT OF CKD

- DIETARY THERAPY
  - COMPONENTS INCLUDE



### DIETARY TREATMENT OF CKD

- DIETARY THERAPY
  - COMPONENTS INCLUDE
    - ↓ PROTEIN



### DIETARY TREATMENT OF CKD


- DIETARY THERAPY
  - COMPONENTS INCLUDE
    - ↓ PROTEIN
    - ↓ PHOSPHORUS




### DIETARY TREATMENT OF CKD

- DIETARY THERAPY
  - COMPONENTS INCLUDE
    - ↓ PROTEIN
    - ↓ PHOSPHORUS
    - ↓ NA





### DIETARY TREATMENT OF CKD

- DIETARY THERAPY
  - COMPONENTS INCLUDE
    - ↓ PROTEIN
    - ↓ PHOSPHORUS
    - ↓ NA
    - ↑ B-VITAMIN CONTENT




### DIETARY TREATMENT OF CKD

- DIETARY THERAPY
  - COMPONENTS INCLUDE
    - ↓ PROTEIN
    - ↓ PHOSPHORUS
    - ↓ NA
    - ↑ B-VITAMIN CONTENT
    - ↑ CALORIC DENSITY


### DIETARY TREATMENT OF CKD

- DIETARY THERAPY
  - COMPONENTS INCLUDE
    - ↓ PROTEIN
    - ↓ PHOSPHORUS
    - ↓ NA
    - ↑ B-VITAMIN CONTENT
    - ↑ CALORIC DENSITY
  - NEUTRAL EFFECT ACID-BASE



### DIETARY THERAPY


- PROTEIN RESTRICTION RATIONALE



A cartoon showing a doctor in a white coat talking to a large, red, bean-shaped kidney. The doctor says, "Hoo...mm". The kidney replies, "Doctor, I want a diet that restricts protein. I have protein diet!"

### DIETARY THERAPY

- PROTEIN RESTRICTION RATIONALE
  - LOWERED BUN CONCENTRATION & PROTEIN CATABOLITES
  - ↑ WELL-BEING



A cartoon showing a doctor talking to a man. The doctor says, "Well, I would've got far on to stop your body in a hospital, none of us treatment groups..."

### DIETARY THERAPY

- PROTEIN RESTRICTION RATIONALE
  - LOWERED BUN CONCENTRATION & PROTEIN CATABOLITES
  - ↑ WELL-BEING
  - ROLE IN DELAYING PROGRESSION?

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- PROTEIN RESTRICTION RATIONALE
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    - ALTER GLOMERULAR HEMODYNAMICS

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    - REDUCE RENAL AMMONIA GENESIS

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    - REDUCE RENAL AMMONIA GENESIS
    - AMELIORATE ACIDOSIS
      - REDUCE DIETARY ACID LOAD

### PROTEIN RESTRICTION RATIONALE

- CONCURRENT REDUCTION PHOSPHATE AIDS CONTROL HYPERPHOSPHATEMIA

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- CONCURRENT REDUCTION PHOSPHATE AIDS CONTROL HYPERPHOSPHATEMIA
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- CONCURRENT REDUCTION PHOSPHATE AIDS CONTROL HYPERPHOSPHATEMIA
- HIGH-QUALITY PROTEIN TO FULFILL PROTEIN REQUIREMENT
  - EGGS, LIVER, COTTAGE CHEESE, PLANT PROTEINS
  - SKELETAL MUSCLE REALLY "DIRTY"



### DIETARY THERAPY

- SODIUM RESTRICTION



### DIETARY THERAPY

- SODIUM RESTRICTION
  - RATIONALE



### DIETARY THERAPY

- SODIUM RESTRICTION
  - RATIONALE
    - ↓ BP HYPERTENSIVE ANIMALS
    - MAINTAIN BP NORMOTENSIVE ANIMALS



### DIETARY THERAPY

- SODIUM RESTRICTION
  - RATIONALE
    - ↓ BP HYPERTENSIVE ANIMALS
    - MAINTAIN BP NORMOTENSIVE ANIMALS
  - REDUCTION DIETARY SODIUM LEVELS DONE GRADUALLY (2 TO 4 WEEKS)



### DIETARY THERAPY

- SODIUM RESTRICTION
  - RATIONALE
    - ↓ BP HYPERTENSIVE ANIMALS
    - MAINTAIN BP NORMOTENSIVE ANIMALS
  - REDUCTION DIETARY SODIUM LEVELS DONE GRADUALLY (2 TO 4 WEEKS)
    - ALLOW KIDNEYS ADJUST AMOUNT SODIUM EXCRETED



### DIETARY THERAPY

- SODIUM RESTRICTION
  - RATIONALE
    - ↓ BP HYPERTENSIVE ANIMALS
    - MAINTAIN BP NORMOTENSIVE ANIMALS
  - REDUCTION DIETARY SODIUM LEVELS DONE GRADUALLY (2 TO 4 WEEKS)
    - ALLOW KIDNEYS ADJUST AMOUNT SODIUM EXCRETED
    - MORE RAPID ↓ RESULT DEHYDRATION & FURTHER ↓ RENAL FUNCTION



### DIETARY THERAPY

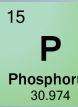
- PHOSPHORUS RESTRICTION

15

P

Phosphorus

30.974



## DIETARY THERAPY

- PHOSPHORUS RESTRICTION
  - RATIONALE
    - ↓ PHOSPHATE TO ↓ PLASMA PTH

15  
**P**  
 Phosphorus  
 30.974

## DIETARY THERAPY

- PHOSPHORUS RESTRICTION
  - RATIONALE
    - ↓ PHOSPHATE TO ↓ PLASMA PTH
    - FEWER SIGNS UREMIA?

15  
**P**  
 Phosphorus  
 30.974

## DIETARY THERAPY

- PHOSPHORUS RESTRICTION
  - RATIONALE
    - ↓ PHOSPHATE TO ↓ PLASMA PTH
    - FEWER SIGNS UREMIA?
  - ORAL PHOSPHATE-BINDING GELS

15  
**P**  
 Phosphorus  
 30.974

## DIETARY THERAPY

- PHOSPHORUS RESTRICTION
  - RATIONALE
    - ↓ PHOSPHATE TO ↓ PLASMA PTH
    - FEWER SIGNS UREMIA?
  - ORAL PHOSPHATE-BINDING GELS
    - ADJUST PRN TO MAINTAIN PHOSPHATE 4-6 MG/DL

15  
**P**  
 Phosphorus  
 30.974

## DIETARY THERAPY

- PHOSPHORUS RESTRICTION
  - RATIONALE
    - ↓ PHOSPHATE TO ↓ PLASMA PTH
    - FEWER SIGNS UREMIA?
  - ORAL PHOSPHATE-BINDING GELS
    - ADJUST PRN TO MAINTAIN PHOSPHATE 4-6 MG/DL
  - DIETARY RESTRICTION MAY NOT SHOW REDUCTION FOR 4-7 WEEKS

15  
**P**  
 Phosphorus  
 30.974

## DIETARY THERAPY

- PHOSPHORUS RESTRICTION
  - RATIONALE
    - ↓ PHOSPHATE TO ↓ PLASMA PTH
    - FEWER SIGNS UREMIA?
  - ORAL PHOSPHATE-BINDING GELS
    - ADJUST PRN TO MAINTAIN PHOSPHATE 4-6 MG/DL
  - DIETARY RESTRICTION MAY NOT SHOW REDUCTION FOR 4-7 WEEKS
    - PHOSPHORUS LEACHING FROM TISSUES

15  
**P**  
 Phosphorus  
 30.974

### FEEDING TUBES

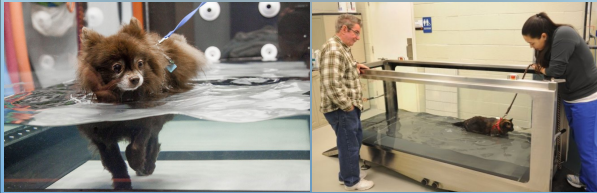


### MUSCLE AND THE GERIATRIC PATIENT

- ALL RENAL FOODS MAINTAIN MUSCLE MASS IN GERIATRICS

### MUSCLE AND THE GERIATRIC PATIENT

- ALL RENAL FOODS MAINTAIN MUSCLE MASS IN GERIATRICS
- PHYSICAL THERAPY?



### SUPPLEMENTS

- CARNITINE



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- CARNITINE
- HOMEOSTASIS CONTROLLED THROUGH KIDNEYS



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- CARNITINE
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- HELPS ANIMALS USE FAT AS ENERGY





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- CARNITINE
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  - HELPS ANIMALS USE FAT AS ENERGY
  - ANTIOXIDANT



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- CARNITINE
  - HOMEOSTASIS CONTROLLED THROUGH KIDNEYS
  - HELPS ANIMALS USE FAT AS ENERGY
  - ANTIOXIDANT
  - MAY SPARE LBM?



### SUPPLEMENTS

- CARNITINE
  - HOMEOSTASIS CONTROLLED THROUGH KIDNEYS
  - HELPS ANIMALS USE FAT AS ENERGY
  - ANTIOXIDANT
  - MAY SPARE LBM?
    - DOGS – 1 GM PO Q 12H
    - CATS/SMALL DOGS – 250 MG Q 24H



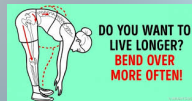
### SUPPLEMENTS

- OMEGA 3 POLYUNSATURATED FATTY ACID



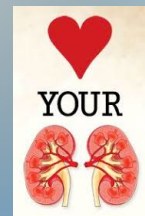
### SUPPLEMENTS

- OMEGA 3 POLYUNSATURATED FATTY ACID
  - LOWER MORTALITY





### SUPPLEMENTS

- OMEGA 3 POLYUNSATURATED FATTY ACID
  - LOWER MORTALITY
  - BETTER RENAL FUNCTION




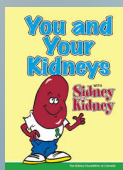
### SUPPLEMENTS

- OMEGA 3 POLYUNSATURATED FATTY ACID
  - LOWER MORTALITY
  - BETTER RENAL FUNCTION
  - FEWER RENAL LESIONS



### SUPPLEMENTS

- OMEGA 3 POLYUNSATURATED FATTY ACID
  - LOWER MORTALITY
  - BETTER RENAL FUNCTION
  - FEWER RENAL LESIONS
  - LESS PROTEINURIA

### SUPPLEMENTS

- OMEGA 3 POLYUNSATURATED FATTY ACID
  - LOWER MORTALITY
  - BETTER RENAL FUNCTION
  - FEWER RENAL LESIONS
  - LESS PROTEINURIA
  - LOWER CHOLESTEROL LEVELS

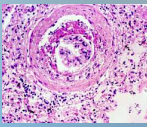
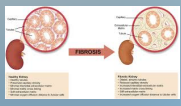



### SUPPLEMENTS

- OMEGA 3 POLYUNSATURATED FATTY ACID
  - DIMINISH
    - LESIONS OF GLOMERULOSCLEROSISTUBULOINTERSTITIAL FIBROSIS

### SUPPLEMENTS

- OMEGA 3 POLYUNSATURATED FATTY ACID
  - DIMINISH
    - LESIONS OF GLOMERULOSCLEROSISTUBULOINTERSTITIAL FIBROSIS
    - INTERSTITIAL INFLAMMATORY INFILTRATES

### SUPPLEMENTS

- FISH OIL
  - [HTTPS://LARDOR.COM/](https://lardoor.com/)
  - 790 MG/10# BODY WEIGHT
  - HALF DOSE FOR 2-3 WEEKS, THEN FULL
    - LOWER GI SIDE EFFECTS



