

Congestive Heart Failure

more interesting stuff...

by the end of this lecture

- you should be able to formulate a prioritised treatment plan for an animal with congestive heart failure

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congestive heart failure

- rest
- low salt diet
- diuretics
- vasodilators
- long acting inotropes
- (antiarrhythmics)

7 yr old Doberman

- cough
- lethargy / exercise intolerance
- anorexia
- ascites
- sudden onset 1 week ago

examination

- soft systolic murmur
- heart rate 148
- harsh lung sounds

positive inotropes

- sympathomimetics
- cardiac glycosides
- phosphodiesterase inhibitors

cardiac glycosides

- = digitalis



cardiac glycosides

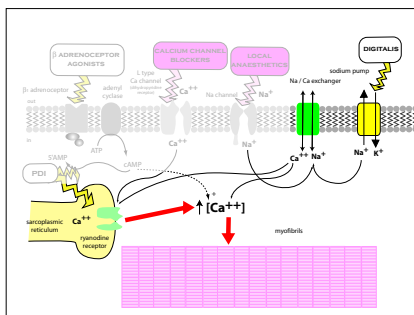
- digoxin
- digitoxin
- ouabain
- lanatoside C
- strophanthin
- squill
- convallotoxin
- some toads' skin

chemistry

- steroid nucleus
- lactone group
- 3 sugars

effects

- positive inotropic
- negative chronotropic



negative chronotropy

- vagal stimulation
- potentiation of ACh
- SA & AV node

indications

- congestive heart failure
 - especially DCM
- supraventricular tachycardias
 - atrial fibrillation

side effects

- cardiac
 - ventricular tachyarrhythmias
 - heart block
- generalised
 - nausea / anorexia
 - vomiting

contra-indications

- ventricular tachycardias
- pericardial disease

toxicity

- **mild**
 - reduce dose / withdraw drug
- **ventricular tachyarrhythmias**
 - lignocaine, phenytoin
 - Ca blockers
- **accidental overdose**
 - cholestyramine
 - digoxin antibodies

pharmacokinetics

- **half life**
 - dog 24 - 36h
 - cat 33 - 58h
- **elimination**
 - 85% renal

clinical use

- **loading dose then maintenance dose**
 - not recommended
- **small dose and work up**

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monitoring

- **nausea / vomiting**
- **plasma levels**

interactions

- **do not use with**
 - quinidine
 - verapamil
- **care with**
 - diuretics
 - altered K⁺ concentrations

positive inotropes

- **sympathomimetics**
- **cardiac glycosides**
- **phosphodiesterase inhibitors**

phosphodiesterase inhibitors

- **methylxanthines**
 - caffeine
 - theophylline
 - aminophylline
 - etamiphylline
 - theobromine
- **synthetic**

phosphodiesterase inhibitors

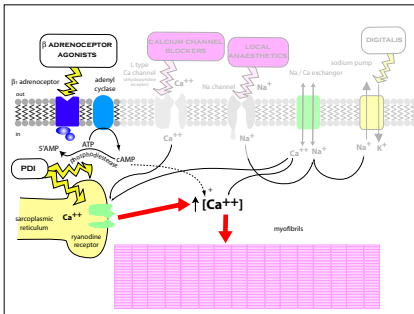
- **methylxanthines**
- **synthetic**
 - milrinone
 - oxpentifylline
 - sildenafil
 - pimobendan

phosphodiesterase

- PDE 3
 - milrinone
 - pimobendan?
- PDE 4
 - oxpentifylline
- PDE 5
 - sildenafil
- all & A2
 - theophylline

PDI effects

- positive inotropy
- vasodilatation
- bronchodilatation
- CNS stimulation
- diuresis



effects

- pimobendan
 - PDE inhibition
 - “calcium sensitisation”

indications

- mild - moderate CHF

side effects

- sudden death in people
- none obvious in dogs

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overdose

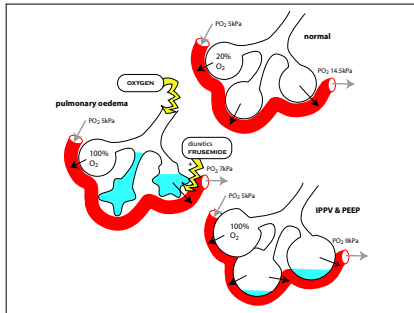
- tachyarrhythmias
- convulsions

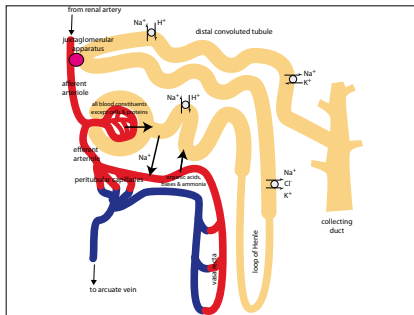
diuretics

- act on the kidney to increase urine flow
- most block reabsorption of ions from tubules
- water kept in tubules by osmotic pressure

diuretics & CHF

- reduce pulmonary oedema
- reduce preload



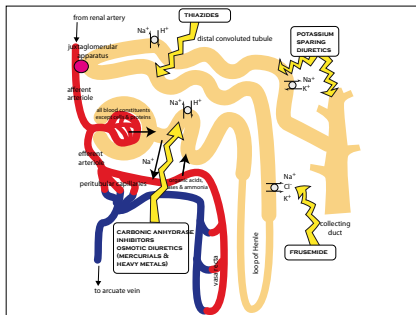


groups of drugs

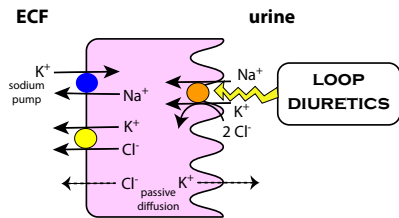
- loop diuretics
- thiazides
- osmotic diuretics
- potassium sparing diuretics
- carbonic anhydrase inhibitors (mercurials)

common drugs

- frusemide
- (hydrochlorothiazide)
- (mannitol)



loop of Henle



frusemide

- potent
 - up to 20% of filtered Na^+ excreted
- cheap
- very widely used

frusemide indications

- reduce oedema
- reduce cardiac preload
- (acute renal failure)

minor indications

- hyperkalaemia
- hypercalcaemia
- uraemia
- epistaxis
- hypertension

abuse

- speeding up / slowing racehorses

pharmacokinetics

- **iv**
 - onset minutes
 - peak 30 mins
 - duration 2 hours
- **po**
 - onset 30 - 60 mins
 - peak 2 hours
 - duration 4 - 6 hours

pharmacokinetics

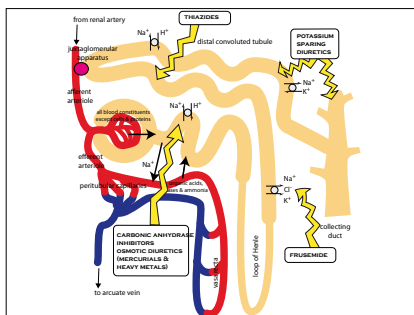
- **metabolism**
 - negligible
- **elimination**
 - secreted into PCT by anion pump
 - passes out in urine
 - horses which eat their bedding may take it in again

side effects

- **hypovolaemia**
 - reduced glomerular filtration
 - reduced excretion of other drugs
 - collapse
 - direct vasodilatation?
- **hypokalaemia**
- **metabolic alkalosis**
- **hypocalcaemia / hypomagnesaemia**
- **tolerance**

side effects

- **hypovolaemia**
- **hypokalaemia**
 - digoxin!!!
- **metabolic alkalosis**
- **hypocalcaemia / hypomagnesaemia**
- **tolerance**



side effects

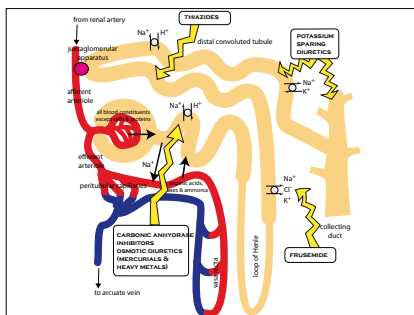
- hypovolaemia
- hypokalaemia
- metabolic alkalosis
- hypocalcaemia / hypomagnesaemia
- tolerance

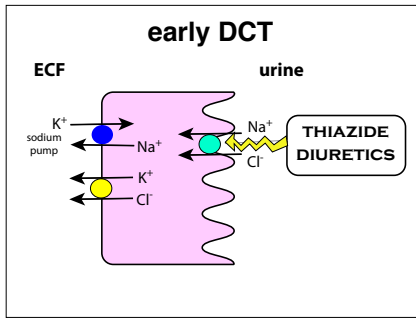
interactions

- increased PCT toxicity
 - aminoglycosides
 - out of date tetracyclines
 - some obsolete cephalosporins
- potentiates digoxin
- ACE inhibitors?

common drugs

- frusemide
- (hydrochlorothiazide)
- (mannitol)





thiazides

- **many drugs available**
 - hydrochlorothiazide
 - bendroflumazide, etc
- **moderately potent**
- **cheap**

thiazide side effects

- **hypokalaemia**
 - digoxin!!
- **metabolic alkalosis**
- **increased plasma uric acid**
- **hyperglycaemia**

kinetics

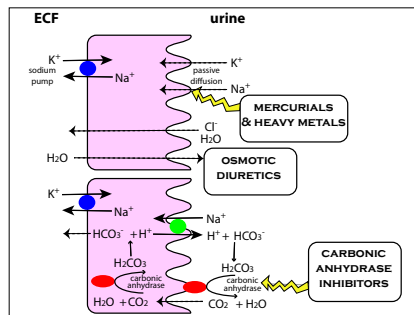
- **always given po**
- **onset 1 - 2 hours**
- **peak effect 4 - 6 h**
- **duration 8 - 12 h**

indications

- mild / moderate heart failure
- (diabetes insipidus)

osmotic diuretics

- mannitol
- glycerol
- glucose



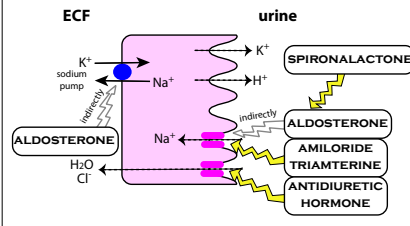
mannitol

- **indications**
 - glaucoma
 - cerebral oedema
 - acute renal failure
- **contraindications**
 - heart disease
- **caution**
 - **must** be given iv

K⁺ sparing diuretics

- amiloride
- triamterene
- spironolactone

late DCT

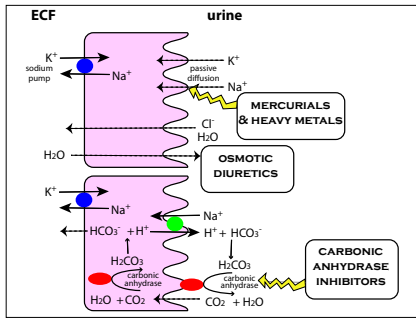


K⁺ sparing diuretics

- weak diuretics
- expensive
- caution with ACE inhibitors
- rarely used in animals

CA inhibitors

- acetazolamide
- (dorzolamide - eye drops only)



CA inhibitors

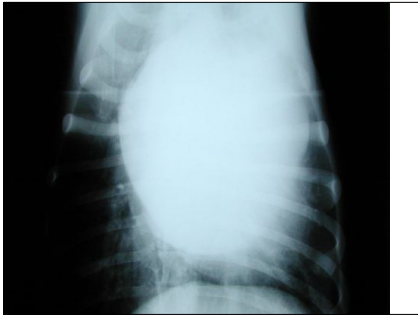
- weak diuretics
- rarely used as diuretics
 - used for glaucoma
- cause mild metabolic acidosis

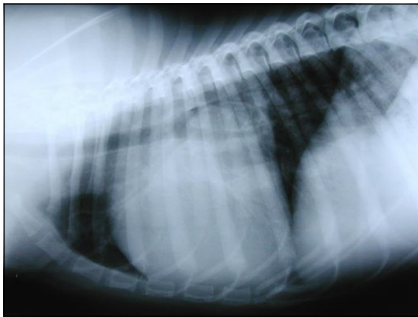
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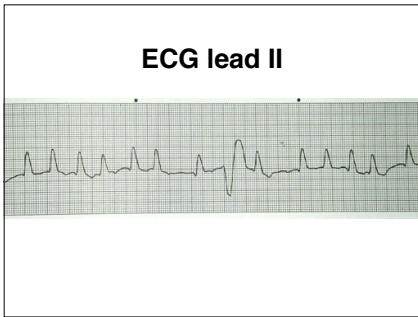
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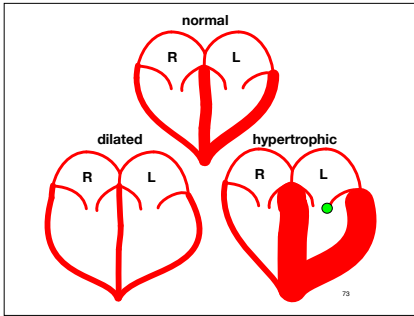






diagnosis

- dilated cardiomyopathy



Dobermann DCM

- frusemide
- digoxin
- pimobendan?
- beta blocker?

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congestive heart failure

- digoxin binds competitively to potassium binding site of sodium pump
- low potassium increases effect
- positive inotrope, negative chronotrope
- side effects - vomiting & anorexia, ventricular tachycardia
- indications - atrial fibrillation with tachycardia, congestive heart failure
- phosphodiesterase inhibitors are useful and safe in mild / moderate CHF
