

Woody Allen



“Everything you
always wanted to know
about sex ✖️

Renal Medicine for Finals

✖️ But were afraid to ask”



Anthony Warrens

PLY

FINA



SIMPLY

RENAL

Mr PA

- 54 years old
- Previously well
- Went to Thailand
- Developed serious diarrhoea and vomiting two days before coming home
- 24 hours after return, still unwell
- GP found:urea 24 mmol/L
creatinine 340 mcmmol/L



Mr PA

- Clinical assessment of hydration
 - Poor urine output
 - Sunken eyes
 - Moistness of mucosa
 - Cool peripheries
 - Reduction in weight
 - Postural hypotension



Mr PA

- Management
 - Fluid replacement
 - Electrolytes
 - Treatment of underlying cause (if possible)
- Natural history
 - Urine output picked up after 12 hours
- Expect complete recovery
 - No long-term implications

	D1	D2	D3	D4	D5
urea	24	15	12	8	4
creatinine	340	290	230	176	116

Mr PA

- Diagnosis:
 - Pre-renal renal failure
- Dreadful term
 - Kidneys working very well physiologically
 - “Renal failure” implies impaired glomerular filtration rate (GFR)



Mrs TP

- 63 years old
- Went on long walk on the beach
- Didn't drink very much
- Eat oysters in 'dodgy' bar that evening
- Spent the night and much of next day vomiting
- Didn't drink or eat much next two days
- Presented to A&E: urea 29 mmol/L
 creatinine 444 mcmmol/L

Mrs TP

- Clinically dehydrated
- Poor urine output
- Given appropriate fluids

	D1	D2	D3	D4	D5
urea	29	30			
creatinine	444	529			

- D3: no longer clinically dehydrated
 urine output still poor (320 mL past 24h)

Mrs TP

- Clinically dehydrated
- Poor urine output
- Given appropriate fluids
- D3: no longer clinically dehydrated
urine output still poor (320 mL past 24h)

	D1	D2	D3	D4	D5
urea	29	30	35	41	44
creatinine	444	529	614	688	721

- Does she need dialysis?

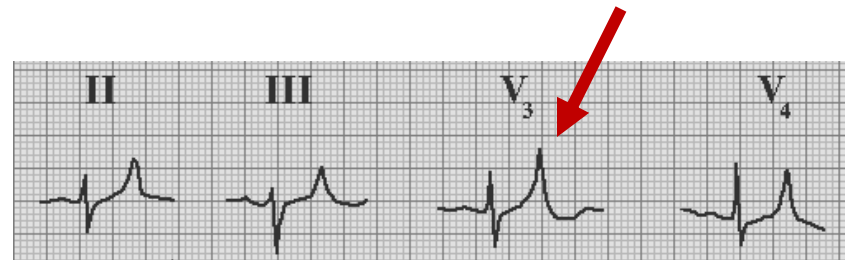
Indications for Acute Dialysis

- Hyperkalaemia
- Pulmonary oedema
- Pericarditis

- Symptomatic uraemia (azotaemia)
- Severe acidosis

Hyperkalaemia: ECG changes

- Initial changes:
 - peaked T waves



K⁺ = 6.1 mmol/l

- Late & life-threatening changes:
 - loss of P waves
 - broadening of QRS, slurred into T wave
 - becomes a “Sine Wave”



K⁺ = 8.5 mmol/l

Treatment of severe hyperkalaemia

- Is an emergency! Give:
 - **Intravenous Calcium**
 - (10ml 10% Calcium gluconate) to stabilise the heart
 - **Intravenous Dextrose + Insulin**
 - (50ml 50% Dextrose + 10u Actrapid)
 - to reduce the hyperkalaemia by driving K⁺ into cells
 - **Nebulised salbutamol**
 - **Consider dialysis**

Ion exchange resins (eg Calcium Resonium orally/rectally) work only slowly but may help sustain control

Mrs TP

- D6: urine output begins to improve

	D1	D2	D3	D4	D5	D6
urea	29	30	35	41	44	45
creatinine	444	529	614	688	721	748
Urine output	204	330	320	290	390	600

- D8: urine become inappropriately excessive

	D7	D8	D9	D10	D11	D12
urea	44	40	38	41	42	44
creatinine	750	760	740	783	802	744
Urine output	1,200	3,600	5,020	5,400	5,300	5,250

Mrs TP

- Now at risk of dehydration
- Challenge is to keep up with fluid replacement
- Classical ‘oliguria’ followed by ‘polyuria’
- Polyuric phase lasts a few days and settles down
- Expect complete recovery
 - No long term sequelae (probably)

Mrs TP

- Diagnosis
 - Acute 'renal' renal failure
 - i.e. 'renal' that is intrinsic to kidney tissue
 - Acute tubular necrosis (ATN)
 - Acute kidney injury



Mr DM

- 84 years old
- Presents in acute distress
 - Unable to pass urine
 - Suprapubic discomfort
- Urea 23 mmol/L
- Creatinine 312 μ mol/L



Mr DM

- Ultrasound
 - Bilateral hydronephrosis and hydroureter
 - Thickened bladder wall
 - Enlarged prostate

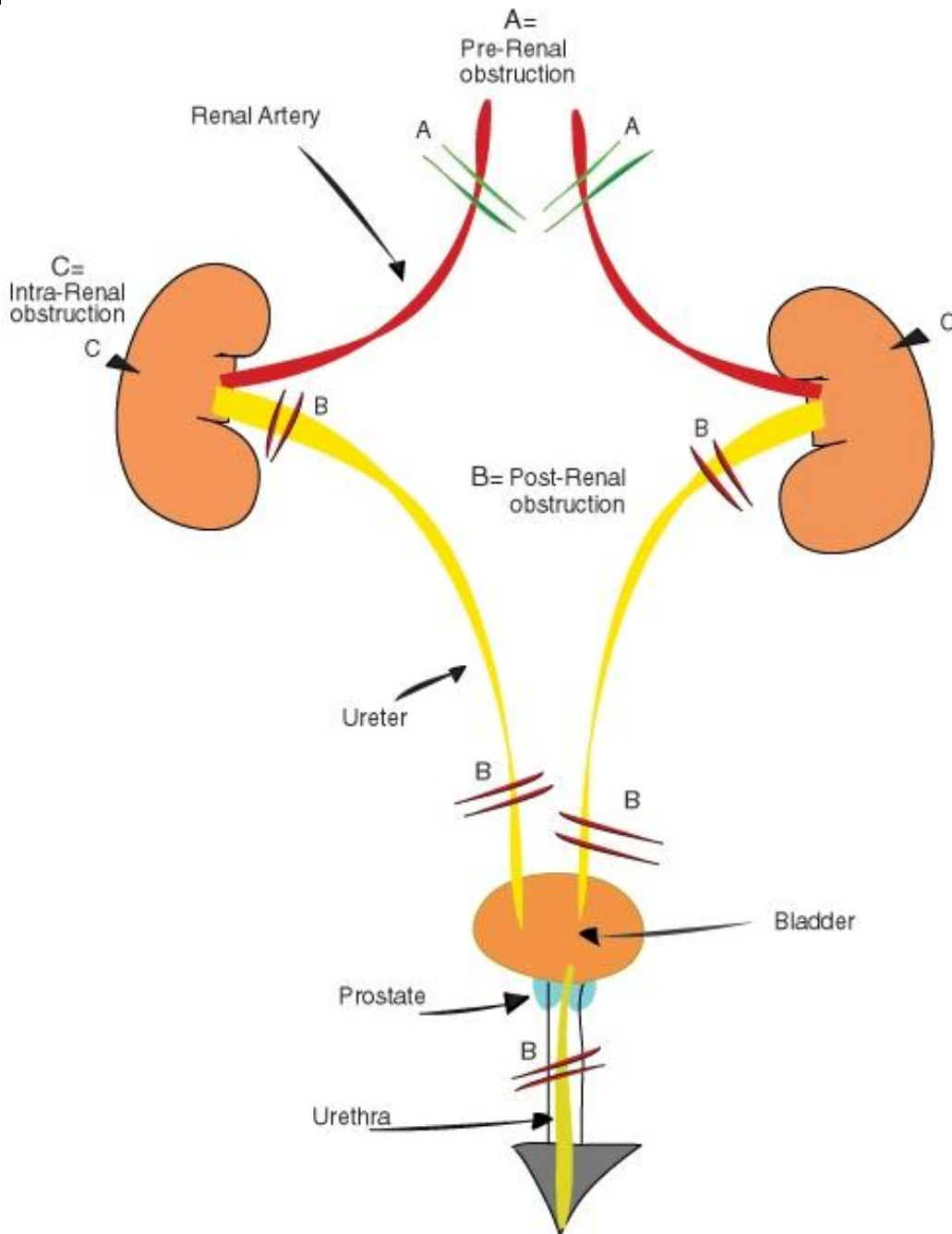


Mr DM

- Urinary catheter inserted
- Rapid flow of urine c 3L/d
- Creatinine settles to 135 $\mu\text{mol/L}$

Acute Renal Failure

Unilateral vs bilateral



Acute renal failure

- History
- Examination
 - Especially level of hydration
- Investigation
 - Ultrasound crucial



Mr DS

- 67 years old
- Hypertension – 24 years
- New GP found creatinine to be 262 $\mu\text{mol/L}$
- No previous history or data



Differentiation of ARF and CRF

- Recent record of normal function ARF
- Normal Hb ARF > CRF
- Long history of relevant symptoms, nocturia, evidence of sustained hypertension CRF > ARF
- Tolerating severely deranged biochemistry CRF > ARF
- Low calcium CRF > ARF
- **Small kidneys on ultrasound** CRF

Causes of chronic renal disease

- Congenital and inherited diseases
- Glomerular diseases
 - Primary
 - Secondary
- Tubulointerstitial disease
- Vascular disease
- Urinary tract obstruction



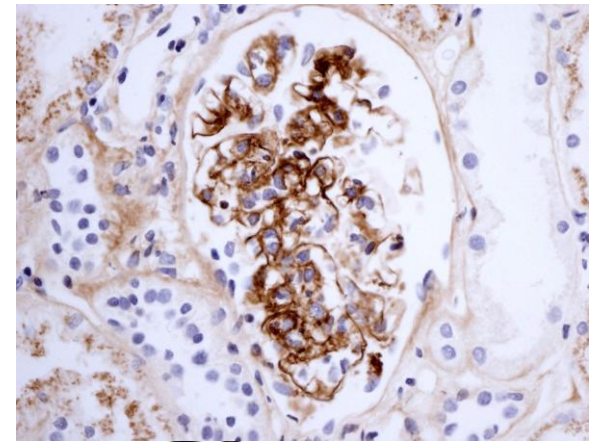
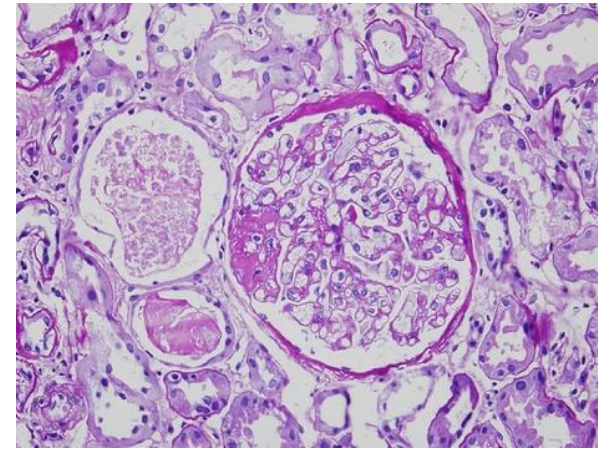
Causes of chronic renal disease

- Congenital and inherited diseases
 - Polycystic kidney disease
 - Medullary cystic disease
 - Tuberosc sclerosis
 - Oxalosis
- Glomerular diseases
 - Primary
 - Secondary
- Tubulointerstitial disease
- Vascular disease
- Urinary tract obstruction



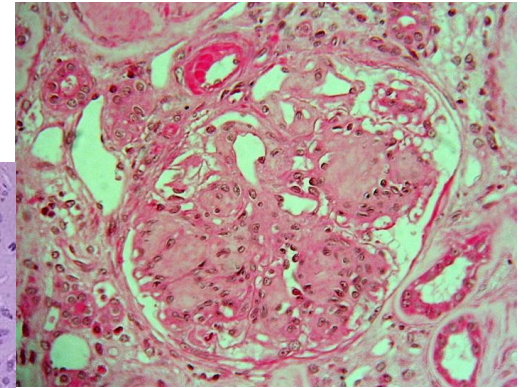
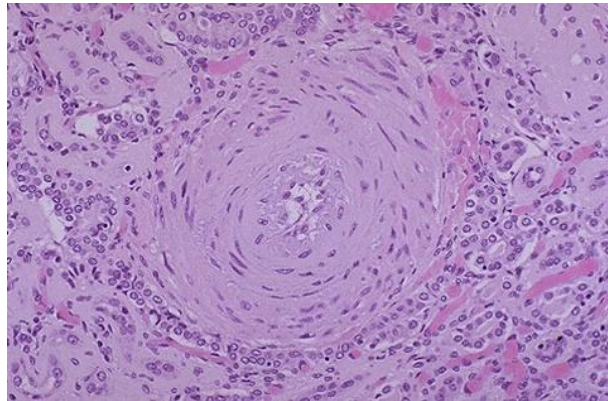
Causes of chronic renal disease

- Congenital and inherited diseases
- Glomerular diseases
 - Primary
 - Focal and segmental glomerulosclerosis
 - Membranous nephropathy
 - IgA nephropathy
 - Secondary
- Tubulointerstitial disease
- Vascular disease
- Urinary tract obstruction



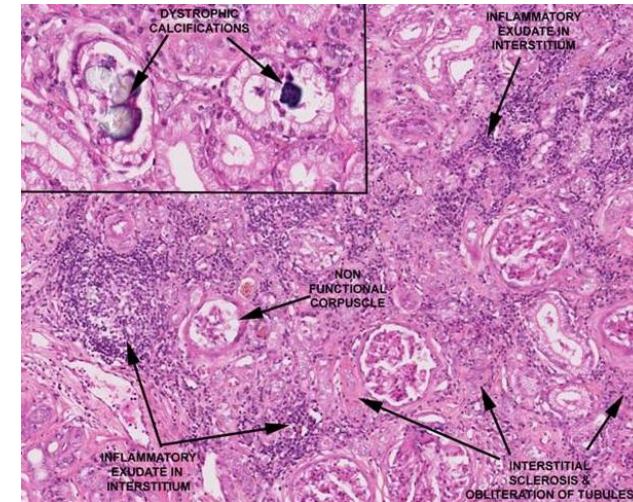
Causes of chronic renal disease

- Congenital and inherited diseases
- Glomerular diseases
 - Primary
 - Secondary
 - Diabetes
 - Vasculitis
 - SLE
 - Systemic sclerosis
 - Accelerated hypertension
 - Haemolytic-uraemic syndrome/thrombotic thrombocytopenic purpura
 - Sickle cell disease
- Tubulointerstitial disease
- Vascular disease
- Urinary tract obstruction



Causes of chronic renal disease

- Congenital and inherited diseases
- Glomerular diseases
 - Primary
 - Secondary
- Tubulointerstitial disease
 - Reflux nephropathy (chronic pyelonephritis)
 - TIN (tubulointerstitial nephritis)
 - Multiple myeloma
 - Papillary necrosis
- Vascular disease
- Urinary tract obstruction



Causes of chronic renal disease

- Congenital and inherited diseases
- Glomerular diseases
 - Primary
 - Secondary
- Tubulointerstitial disease
- Vascular disease
 - Hypertension
 - Vasculitis
- Urinary tract obstruction



Causes of chronic renal disease

- Congenital and inherited diseases
- Glomerular diseases
 - Primary
 - Secondary
- Tubulointerstitial disease
- Vascular disease
- Urinary tract obstruction
 - Stones (calculi)
 - Tumours
 - Retroperitoneal fibrosis



Causes of chronic renal disease

- Five commonest causes
 - Diabetes
 - Hypertension
 - Chronic glomerulonephritis
 - Reflux nephropathy
 - Polycystic kidney disease



Mr DS

- 67 years old
- Hypertension – 24 years
- New GP found creatinine to be 262 $\mu\text{mol/L}$
- No previous history or data

- Direction of
 - History?
 - Examination?
 - Investigation?



Mr DT

- 59 year old
- 20 years of diabetes; 25 years of hypertension
- Weak for the past three months
- Poor appetite
- Beginning to fee itchy
- Uncomfortable and very restless at night



Mr DT

- Ultrasound: small smooth kidneys
- Urea 44 mmol/L; creatinine 892 μ mol/L
- Hb 7.1 g/dL; MCV 77 fL
- Ca⁺⁺ (corrected) 1.79 mmol/L
- Inorganic phosphate 3.77 mmol/L
- Bicarbonate 18 mmol/L

Effects of renal failure

- Due to loss of normal functions of the kidney
 - Excretion of metabolic waste products
 - Regulation of fluid & electrolyte balance
 - Regulation of acid-base balance
- Secretion of hormones (erythropoetin, 1,25 hydroxycholecalciferol)
 - this becomes important in chronic renal failure



(1) Failure to excrete metabolic waste products

- Results in “uraemic” syndrome:
 - Occurs late (GFR <15 ml/min) – therefore ideally kidney disease should be detected in other ways
 - Nausea, anorexia, lethargy, itch, restless legs
 - And, as very late features, pericarditis, obtundation, neuropathy
 - Many retained chemicals appear to contribute
 - Symptoms exacerbated by anaemia of renal failure



(2) Failure to regulate fluid & electrolyte balance

- Results in:
 - Hyperkalaemia
 - Hyperphosphataemia
- and in the setting of slowly progressive chronic renal failure:
 - Nocturia due to loss of physiological nocturnal anti-diuresis
 - Polyuria and thirst due to loss of urine concentrating ability
 - Urine output is preserved until very late, although fluid overload is common
 - Volume-dependent hypertension

(3) Failure to regulate fluid balance

- In acute renal failure, the patient may become oliguric ($<0.5\text{ml/kg/hr}$) or anuric
 - Consequence is fluid overload unless fluid input is reduced to level of insensible + measured fluid losses
 - Intravascular and extravascular fluid overload



(4) Failure of acid-base homeostasis

- Decreased renal H^+ excretion ($<$ endogenous production), resulting in:
 - metabolic acidosis - ie reduced pH, low bicarbonate, base deficit, possible respiratory compensation (low pCO_2)
 - acidosis may be profound in renal diseases also causing bicarbonate wasting i.e. those which primarily affect the renal tubule

(5) Failure of erythropoetin production

- Resulting in:
 - normochromic anaemia of renal failure
 - particularly important in chronic renal failure



(6) Failure of vitamin D hydroxylation

Generation of active vitamin D needs:

- 25-hydroxylation in liver, 1-hydroxylation in kidney

Deficiency results in:

- hypocalcaemia
- osteomalacia
- secondary hyperparathyroidism
- combined picture of “renal osteodystrophy”
- particularly important in chronic renal failure

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- What are your treatment options?



Treatment of renal failure

- Replacing the normal functions of the kidney... or replacing the kidney! (transplantation)
- Dialysis and transplantation are often known as “renal replacement therapy”
- Some measures may be needed as an emergency in newly presenting renal failure



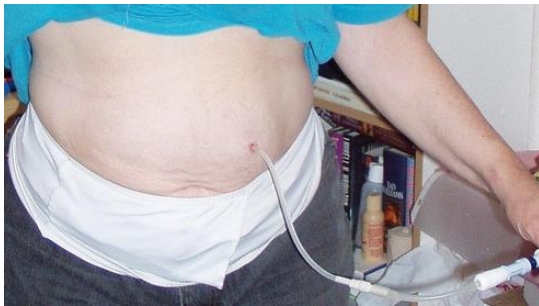
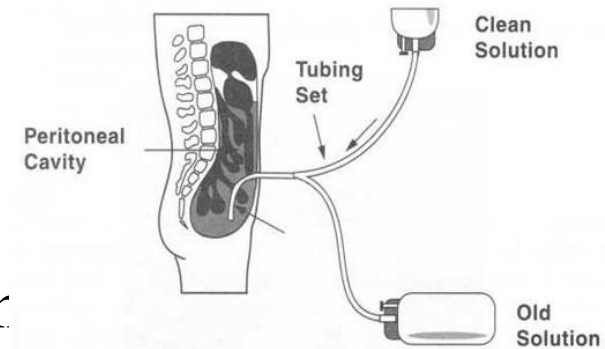
Excretion of metabolic waste products

- By dialysis
 - haemodialysis, peritoneal dialysis
 - less effective than normal renal function
 - measures to assess effectiveness based on urea removal as a marker illustrate that good long-term outcomes depend on “adequate” dialysis



Excretion of metabolic waste products

- By dialysis
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Regulation of fluid & electrolyte balance

- Dietary restriction
 - fluid intake
 - potassium
 - phosphate
- Diuretics
- Phosphate binders to stop phosphate absorption (calcium carbonate)
- Emergency measures to treat hyperkalaemia
- Dialysis



Regulation of acid-base balance

- Bicarbonate supplements in some cases
 - but sodium load contained in sodium bicarbonate may be a problem in renal failure
- Dialysis



Hormonal functions of the kidney

- Erythropoetin synthesis
 - recombinant erythropoetin injections 1-3 x per week
- Vitamin D activation
 - 1-alpha calcidol or calcitriol
 - aiming to normalize serum calcium and suppress parathormone levels to 2-3 x normal

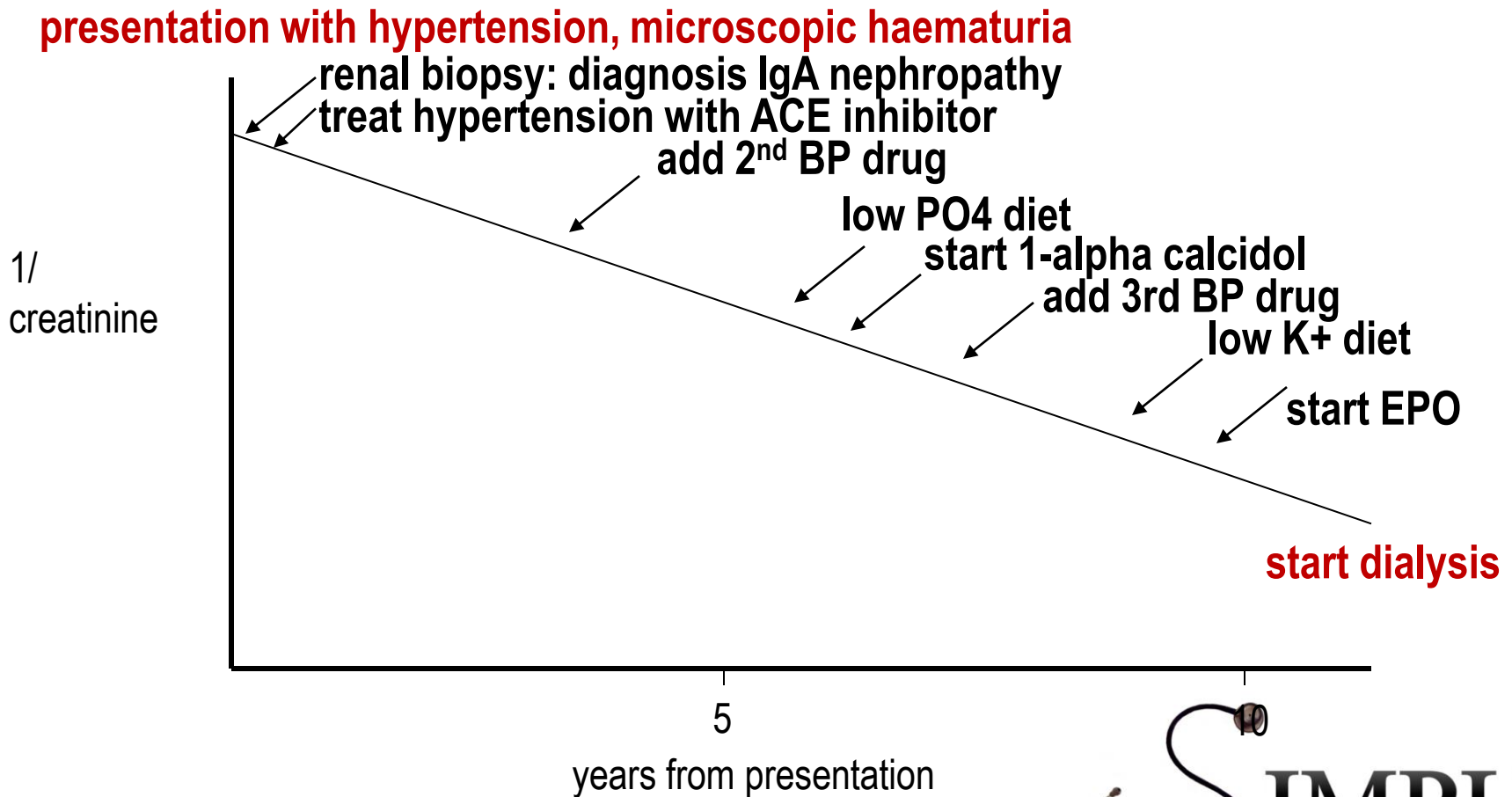


Modification of drug prescribing

- Drugs that are excreted by the kidney will otherwise accumulate
- Usually requires less frequent dosing, and may require reduction in dose size
- If in doubt look it up!



Intrinsic renal disease & CRF: example



Renal disease

- Very clinical specialty
- Getting it right makes a very significant difference
- Acute renal failure is often reversible
- Renal replacement therapy available in chronic renal failure
- Transplantation is the treatment of choice

