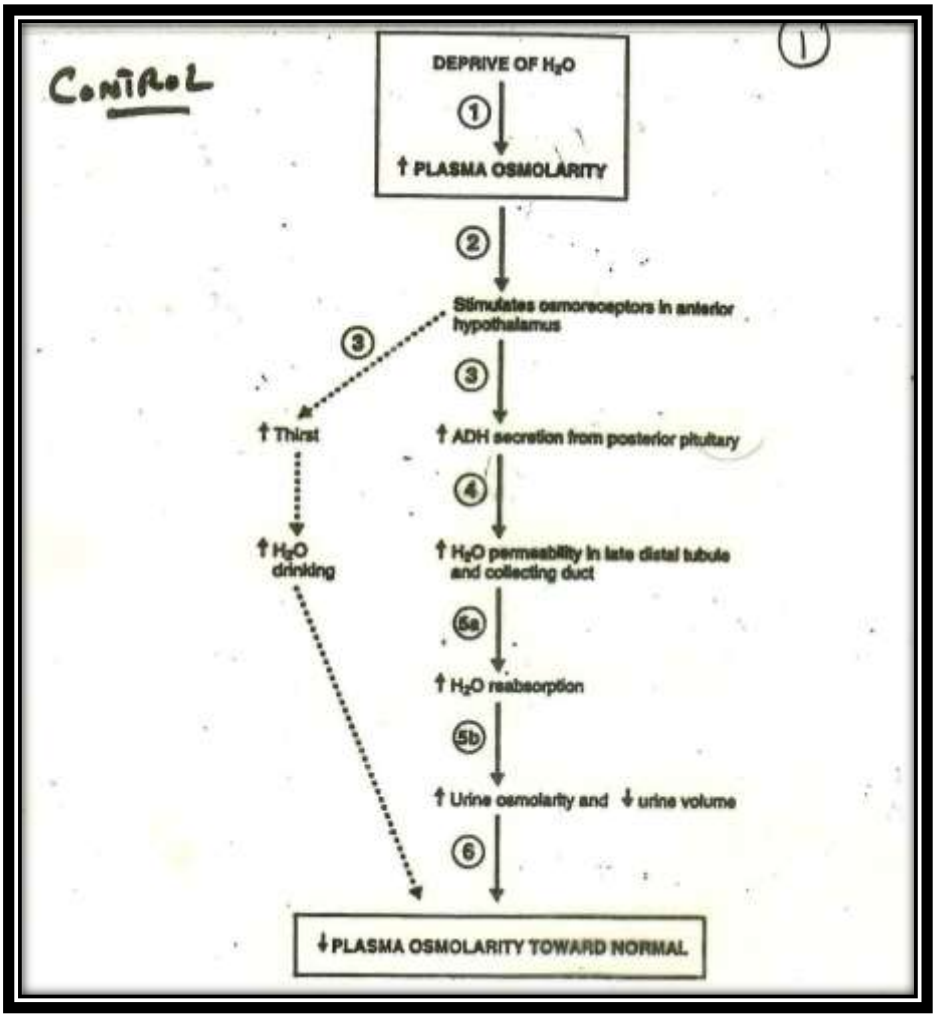
DIURESIS PRACTICAL

METHODS AND OBSERVATIONS:

Several students have volunteered to take an active part in this practical class. None of them have taken fluids or food after 8:00 am.

A. THOSE ACTING AS CONTROLS (TAKING NO FLUIDS):

We will find in these subjects that each subsequent urine sample is lesser in volume and darker yellow in color showing that the kidneys are trying to conserve water in the fasting state.



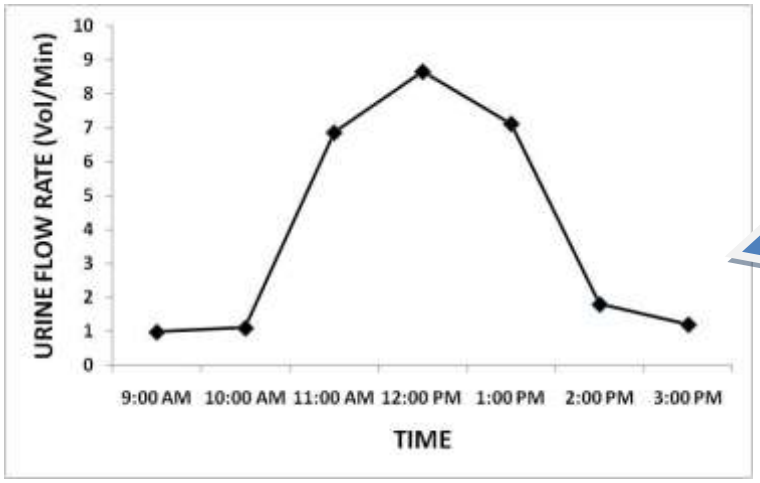
B. THOSE DRINKING 1 LITER OF WATER

We will find in these subjects that urine volume will be about the same in the first post-experimental sample as of the pre-experimental sample, but then will increase dramatically in the subsequent samples and will again decrease back to the level of pre-experimental sample in the last samples. It means that the healthy kidneys get rid of this 1 liter of water ingested by these volunteers in 3 hours and the mechanism starts after 30 minutes, as shown by the following graph:

You might be asked!

Why the water excretion is increased?

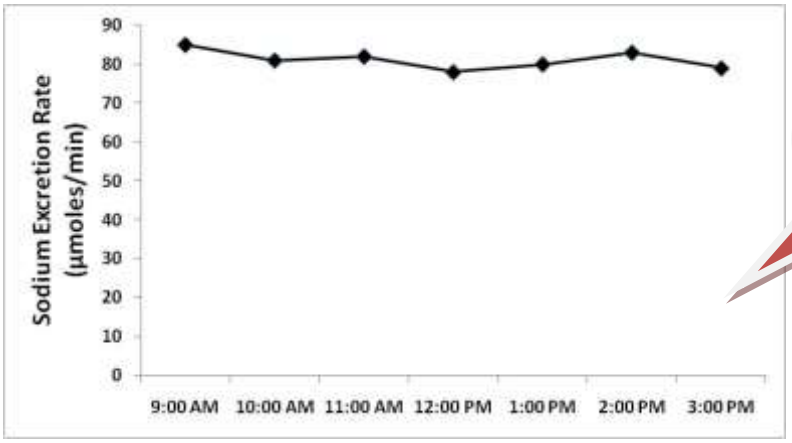
Due to decrease in the secretion of ADH



Water excretion increased

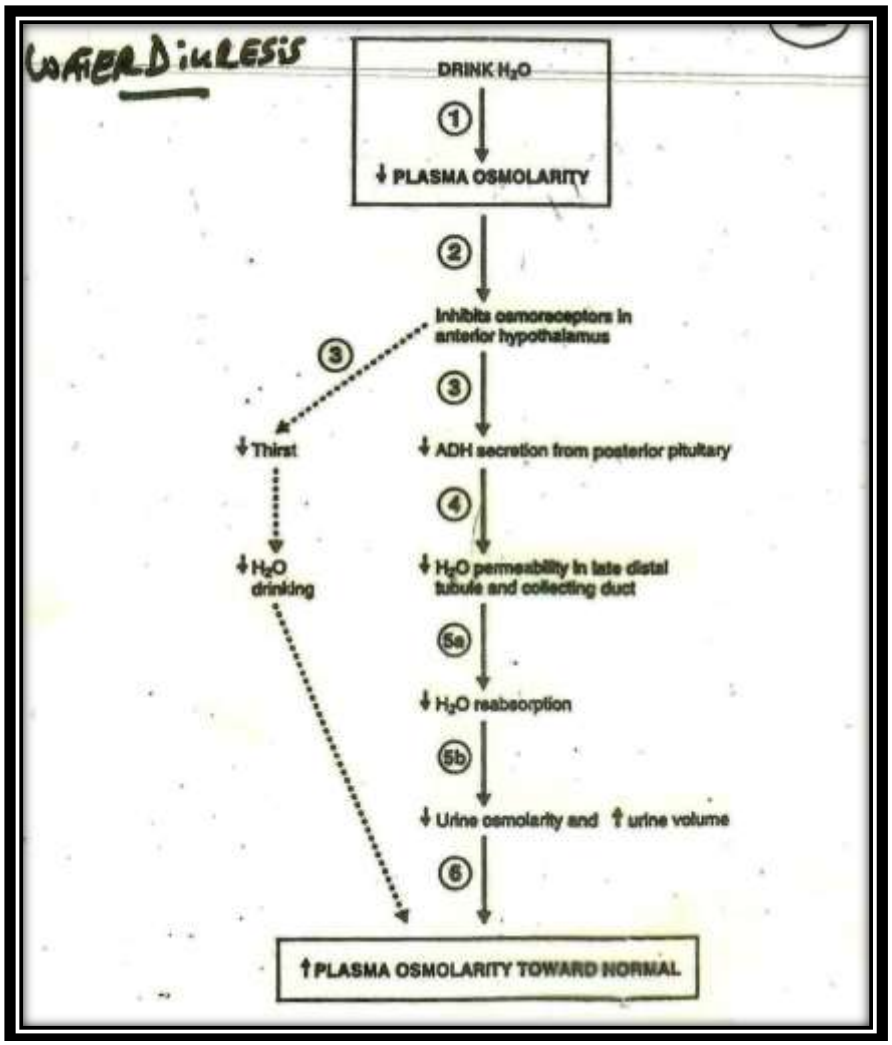
Start after 30 min - Finish within 3 hours

However sodium excretion in these volunteers will remain constant as shown by the following graph:



Na excretion remains the same

That will lead to decrease the osmolarity of urine and increase the volume of urine

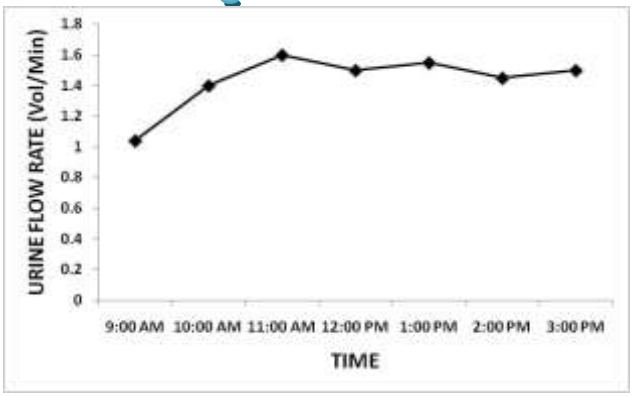


C. THOSE DRINKING 1 LITER OF ISOTONIC SALINE

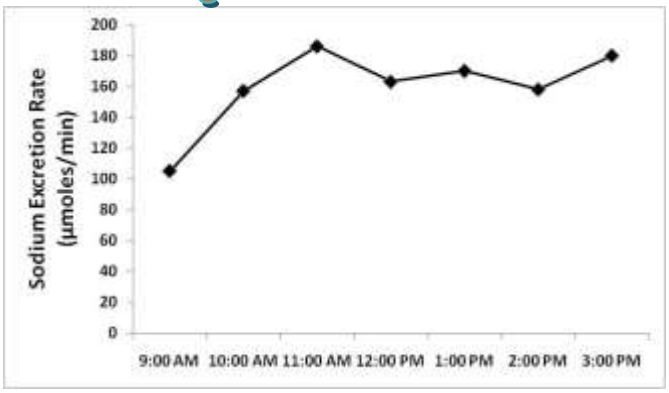
We will find in these subjects that urine volume and osmolality will remain slightly increased in the post-experimental samples as compared to pre-experimental samples. It means that the kidneys are trying to get rid of this extra sodium chloride and water that has been ingested by these volunteers, but slowly. As a matter of fact, it will take 24 hours to excrete 1 liter of isotonic saline ingested by them. You can see the slightly increased urine volume and sodium excretion in the following graphs:

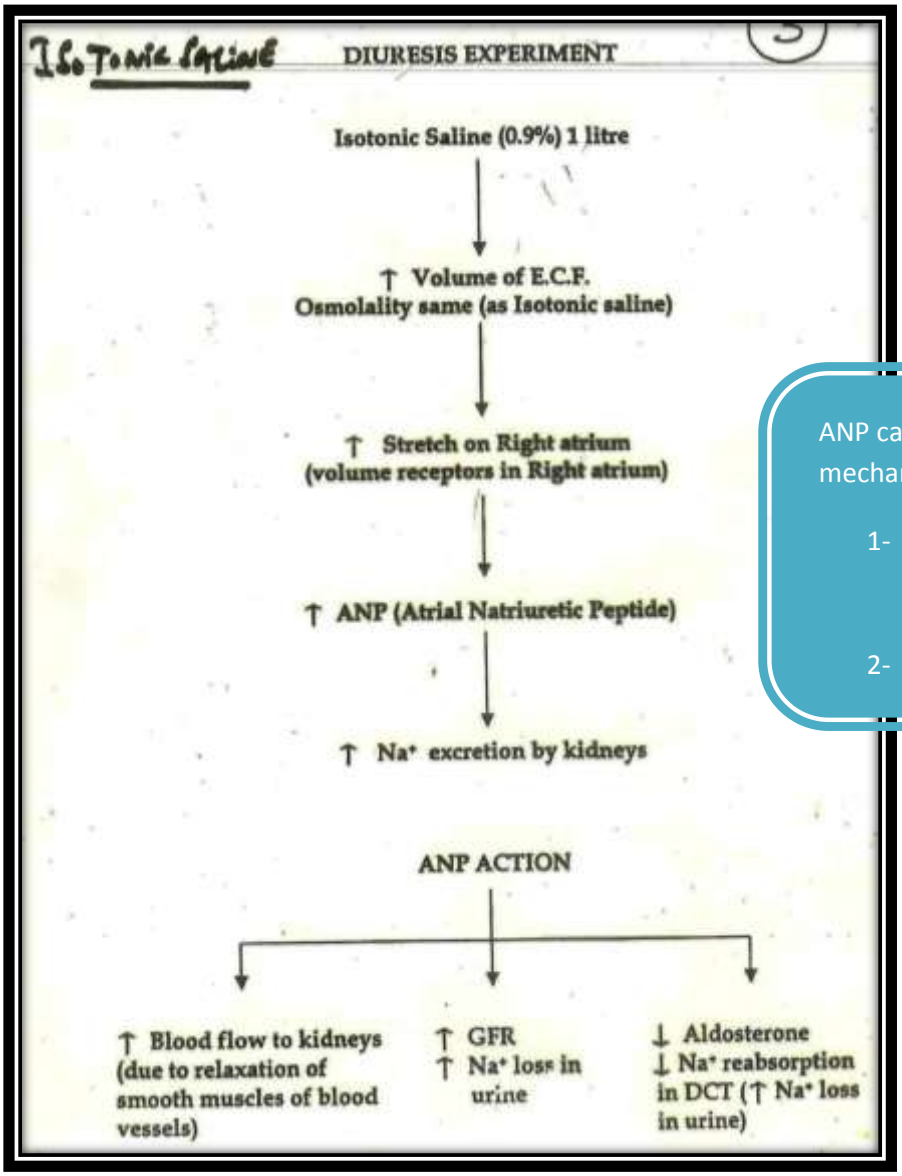
- **The osmolarity is the same**
- **Volume is increased**
- **No effect on ADH**
- **It's called osmotic diuresis**

Water excretion



Na excretion





Mechanism

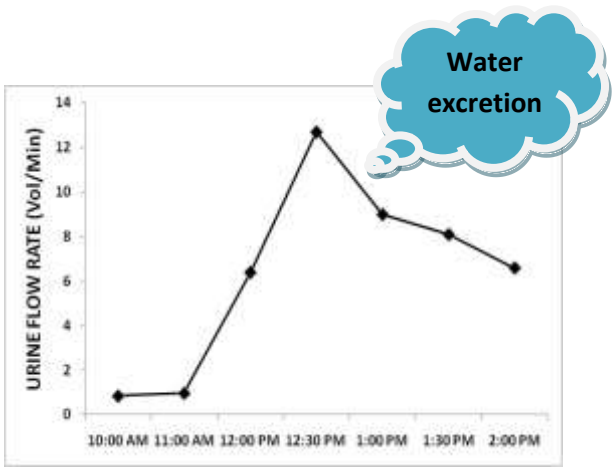
ANP can increase GFR by two mechanisms:

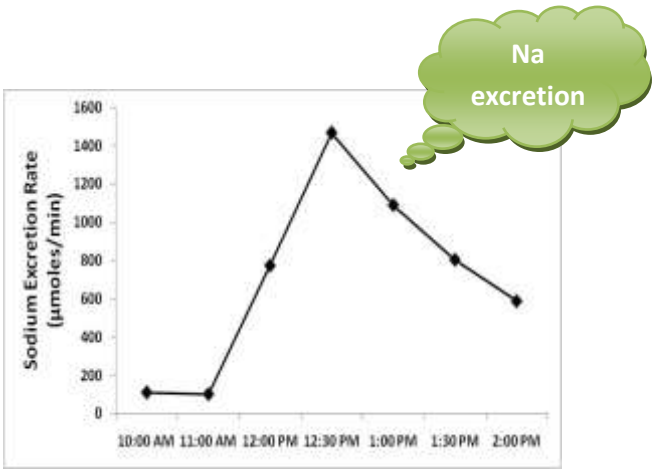
1- Increased blood flow (due to relaxation of smooth muscles of blood vessel)
2- Relaxation of mesengial cell

It's slower than ADH

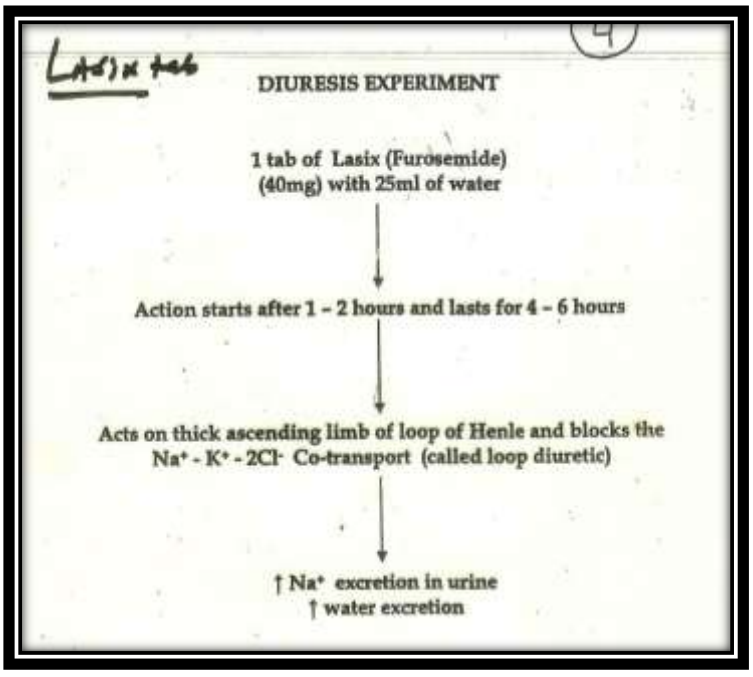
D. THOSE TAKING 1 TABLET OF LASIX

We will find in these subjects that urine volume and osmolality dramatically increased after 1 hour of taking Lasix tablet and remained increased for further duration of experiment. What we know about the effect of Lasix is that it usually starts 1-2 hours after ingesting it and lasts for 4-6 hours. Because in this experiment both urine volume and Na excretion will increase, this type of dieresis is called OSMOTIC DIURESIS, while the diuresis that occurred in those subjects who drank water is called WATER DIURESIS, as the increase in the urine volume was not accompanied by simultaneous increase in urine osmolality in those subjects. You can see the changes in urine volume and sodium excretion in these subjects taking Lasix tablet in the following graphs:





It is increased due to ↑ NA excretion



Mechanism

The following is a sample table that we fill out during these experiments:

SAMPLE NO.	1	2	3	4	5	6	7
COLLECTION TIME (minutes)	120	30	30	30	30	30	30
VOLUME OF URINE (ml)	118	33	200	280	240	60	50
URINE FLOW RATE (ml / min)	0.98	1.1	6.66	9.33	8	2	1.66
SODIUM CONCENTRATION (mmoles/liter)	87	65	12	10	8	30	40
TOTAL SODIUM EXCRETION (mmoles)	10.3	2.2	2.4	2.8	1.9	1.8	2.00
SODIUM EXCRETION RATE (µmoles/min)	85.6	71.5	80	93.3	64	60	66.7

- The sample no.1 is the pre-experimental sample and the remaining samples are post-experimental samples.
- The sodium concentration is obtained by an analyzer machine which is called flame photometer.
- Total sodium excretion is obtained by applying following equation:

$$\textbf{Sodium excretion} = \frac{\textbf{Sodium concentration x Volume of urine}}{\textbf{1000}}$$

- Sodium excretion rate is obtained by applying the following equation:

$$\textbf{Sodium excretion rate} = \frac{\textbf{Sodium concentration x Volume of urine}}{\textbf{Time}}$$

- On the next page, you will find the results of actual experiments performed on 3 subjects who volunteered to drink 1 litre of water, 1 litre of isotonic saline and take 1 tablet of Lasix respectively.

Example

SAMPLE NO.	1	2	3	4	5	6	7
COLLECTION TIME (minutes)	120	30	30	30	30	30	30
VOLUME OF URINE (ml)	118	33	200	280	240	60	50
URINE FLOW RATE (ml / min)	0.98	1.1	6.66	9.33	8	2	1.66
SODIUM CONCENTRATION (mmoles/liter)	87	65	12	10	8	30	40
TOTAL SODIUM EXCRETION (mmoles)	10.3	**A**	2.4	2.8	1.9	1.8	2.00
SODIUM EXCRETION RATE (µmoles/min)	85.6	71.5	**B**	93.3	64	60	66.7

Find A and B?

$$\mathbf{A} = \text{Sodium excretion} = \frac{\text{Sodium concentration x Volume of urine}}{1000}$$

$$= \text{Sodium excretion} = \frac{65 \text{ X } 33}{1000} = 2.145 = \mathbf{2.2} \text{ mmoles}$$

$$\mathbf{B} = \text{Sodium excretion rate} = \frac{\text{Sodium concentration x Volume of urine}}{\text{Time}}$$

$$= \text{Sodium excretion rate} = \frac{12 \text{ X } 200}{30} = \mathbf{80} \text{ µmoles/min}$$

Be careful when you choose the values!
Make sure you are in the right Column

To practice calculation, pick any values from these tables and try to find the sodium excretion and sodium excretion rate as in the previous page

Not important

SAMPLE NO.	1	2	3	4	5	6	7
COLLECTION TIME – mins	120	30	30	30	30	30	30
VOLUME (ml)	118	33	206	260	214	54	36
VOLUME/MINUTE (ml/min)	0.98	1.10	6.87	8.67	7.13	1.8	1.2
[Na^+] (mM)	87	56	12	9	10	25	53
TOTAL SODIUM EXCRETION – mmoles	10.3	1.8	2.5	2.3	2.1	1.4	1.9
SODIUM EXCRETION (µmoles/min)	85.6	61.6	82.4	78	71.3	45	63.6

SALINE

SAMPLE NO.	1	2	3	4	5	6	7
COLLECTION TIME – mins	120	30	30	30	30	30	30
VOLUME (ml)	125	39	50	42	47	32	45
VOLUME/MINUTE (ml/min)	1.04	1.30	1.67	1.40	1.57	1.07	1.50
[Na^+] (mM)	101	98	112	109	120	137	127
TOTAL SODIUM EXCRETION – mmoles	12.6	3.8	5.6	4.6	5.6	4.4	5.7
SODIUM EXCRETION (µmoles/min)	105.2	127.4	186.7	152.6	188.0	146.1	190.5

Lasix

Sample No.	1	2	3	4	5	6	7
COLLECTION TIME – mins	120	60	42	18	30	30	
VOLUME (ml)	102	58	269	230	270	125	
VOLUME/MINUTE (ml/min)	0.85	0.97	6.4	12.7	9.0	4.2	
[Na^+] (Conc) (mM)	132	107	121	115	121	117	
TOTAL SODIUM EXCRETION – mmoles	13.5	6.2	32.5	26.4	32.6	14.6	
SODIUM EXCRETION (µmoles/min) rate	112.2	103	774	1467	1089	487.5	

$\frac{132 \times 102}{1000}$

$\rightarrow \frac{Na^+(conc) \times Vol}{1000}$

$\rightarrow \frac{Vol \times conc\ Na^+}{time}$

$\frac{102 \times 132}{120}$

2 HOURS BEFORE TAKING LASIX

3 HOURS AFTER TAKING LASIX

DIURESIS EXPERIMENT

GFR (Glomerular Filtration Rate)

Definition:

- Is the volume of fluid filtered from the renal glomerular capillaries into the Bowman's capsule per unit time.

$$GFR = \frac{\text{Urine Concentration X Urine Flow}}{\text{Plasma Concentration}}$$

According to the National Kidney Foundation, normal results range:

- Between 90 - 120 mL/min/1.73 m2.
- GFR < 60 mL/min/1.73 m2 for 3 or more months → chronic kidney disease…. His blood pressure will be increased
- GFR < 15 mL/min/1.73 m2 → acute kidney failure….due to shock ⟶ decreased blood pressure

The test is recommended in case of:

- Diabetes
- Family history of kidney disease
- Frequent urinary tract infections
- Heart disease
- High blood pressure
- Urinary obstruction

Normal values are: "you might be asked to comment"

Male: 97 to 137 ml/min - Female: 88 to 128 ml/min

Thank you and Good Luck

Done By: Mohammed Jameel & Khulood Al-Raddadi

Physiology Team Leaders 432