Tubular Reabsorption of Phosphate

Test Name: TUBULAR REABSORPTION PHOSPHATE (PANEL - URINE AND BLOOD)

Principle

Many factors affect the renal tubular reabsorption of phosphate including PTH, diet, ECF volume, acid-base status. Calculation of the ratio of the renal tubular maximum reabsorption rate of phosphate to glomerular filtration rate (TmP/GFR) is much more useful than measurement of urine phosphate alone. It is independent of GFR and has replaced earlier indices of renal phosphate handling (phosphate excretion index).

Indication

- Investigation of persistent unexplained hypophosphataemia or assessment of renal tubular function.

Precautions

- None

Side Effects

- N/A

Preparation

- The test should ideally be carried out in the morning, after an overnight fast, as there is a significant diurnal variation.
- Stop phosphate supplements prior to the test.

Protocol

1. After waking the patient should empty the bladder – discard urine. The patient may drink water during the test.
2. Collect the next urine passed and send to the lab straight away for acidification. Record the time of collection.
3. Collect a blood sample for U&E, phosphate and creatinine (1.2 mL Lithium Heparin – orange top) and record the time of collection. The ***blood must be collected within 2 hours of the urine sample***. Capillary samples are unsuitable due to the effect on phosphate concentration.

Samples

U&E, phosphate and creatinine 1.2 mL lithium heparin (orange top)

Urine phosphate and creatinine 10 mL urine Sarstedt tube

Interpretation

Calculation of TmP/GFR in children

TmP/GFR = Pphosphate - (Uphosphate x Pcreatinine/ Ucreatinine)

P= plasma concentration U= urine concentration
All concentrations in mmol/L

Age	TmP/GFR in mmol/L
Newborns	1.55 – 2.97
1 month – 2 yrs	1.07 – 2.23
2 - 12 yrs	1.10 – 1.88
12 - 16 yrs	0.93 – 1.71
>16 yrs	0.88 – 1.26

In general, when hyperphosphataemia is due to increased phosphate flow from gut, cells or bone there is a decrease in TmP/GFR i.e. a decrease in phosphate reabsorption. Hypophosphataemia due to decreased phosphate flow results in an increased TmP/GFR.

A decreased TmP/GFR is found in hypophosphataemia due to renal tubular dysfunction e.g. Fanconi syndrome, X-linked hypophosphataemic rickets. There is also a renal component to the hypophosphataemia which can follow glucose infusion/refeeding after starvation and respiratory alkalosis, leading to a decreased TmP/GFR, despite a decrease in phosphate flow. Hyperparathyroidism (primary and secondary) can also cause a decrease in TmP/GFR.

Note on use in adults

N.B. Use of this formula in adults may require a correction factor, α, when the TRP is ≥0.86.

TRP = 1- (Uphosphate x Pcreatinine/ Pphosphate x Ucreatinine)

If TRP ≥0.86 then:
α = 0.3 x TRP/ {1-(0.8 x TRP)}
TmP/GFR = α x Pphosphate

If TRP <0.86 then:
TmP/GFR = TRP x Pphosphate (mathematically the same as the equation on the previous page).

References

1. Payne RB. Renal tubular reabsorption of phosphate (TmP/GFR): indications and interpretation. *Ann Clin Biochem* 1998; **35**: 201-206
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3. Brodehl J, Krause A, Hoyer PF. Assessment of maximal tubular phosphate reabsorption: comparison of direct measurement with the nomogram of Bijvoet. *Pediar Nephrol* 1988; **2**: 183-189.
4. Alon U, Hellerstein S. Assessment and interpretation of tubular threshold for phosphate in infants and children. *Pediar Nephrol* 1994; **8**: 250-251