

Renal Function Tests

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Objective of the lecture.

- For the students to learn the laboratory investigations requested in assessing functional status of the kidneys.

Format of the lecture:

1. Functions of the kidneys
2. Threshold
3. Renal damage and renal function
4. Interpretation of Renal function tests results.
5. Types of RFTs
6. Choice of RFTs

Functions of the kidney*.

1. Maintenance of the *milieu interieur*
2. Vasoconstriction.
3. Erythropoiesis

Threshold*.

- Important in understanding **Renal excretion**

➤ Definitions of:

1. **Threshold** of a given **constituent** of plasma.
2. **Threshold substance.**
3. **Non-threshold substance (Zero threshold):**
 - **Examples of Zero threshold***

Threshold of any substance may be altered by*:

Renal damage and renal function*.

- Effects of renal impairment dependent on:
Glomerular or tubular function.
- **Damage to Glomerular function** leads to a **reduction** in the **glomerular filtration rate**.
- **Damage to Tubular function** leads to :
 1. **Failure of Reabsorption.**
 2. **Loss of renal compensation*.**

The tests*.

Two main reasons for requesting **RFT**:

- i. **Detection** of possible kidney damage.
- ii. Determination of **degree** of functional damage of the kidneys (**monitoring**)

Interpretation of RFTs*.

1. Investigate Loss of function.
2. May reveal the principal site and degree of the disturbance but rarely the cause.
3. About **2/3** of the renal tissue functionally damaged for RFTs to show any abnormality.
4. **Renal failure** occurs when inability to maintain homeostasis.

5. **Hereditary or surgical** possession of one healthy kidney shows **normal** RFTs results.
6. Partial damage to **all** or **most** of the nephrons more likely to show **impaired** RF than **complete** destruction of some nephrons.
7. Clinical findings or simple urine examination indicates renal damage, RF assessed by tests of **excretory function**.

Types of RFTs.

- i. Urine specific gravity test.
- ii. Vasopressin test.
- iii. Urine dilution test.
- iv. Dye excretion tests.
- v. Creatinine clearance test.
- vi. Urea clearance test .
- vii. Urinary acidification test.
- viii. Plasma analyses

Urine specific gravity test*

(Water deprivation test).

- **Simple and sensitive**
- Depends both on **Antidiuretic hormone** response and responsiveness of renal tubules
- Detects impairment of **tubular function**.
- Contra-indicated if **high plasma urea** or clinical signs of **renal failure**.

Procedure.

- **Day before:** Lunch & no water, no water after lunch, supper & no water, **empty bladder.**
- **Day of test:** void 1st urine, 60 minutes later void 2nd urine, and 60 minutes later void 3rd urine.
- Then do **specific gravity.**
- Normal SG of urine: **1.016-1.022.**

Results:

- Normal reading: > **1.026** (at least one sample)
- Abnormal:
- Serious renal damage: **1.010-1.015**

Vasopressin test*.

- More pleasant than full water deprivation.

Procedure:

- **Day before:** Patient has no drinks after 18.00hrs, at 20.00hrs injected subcutaneously 5 units of **vasopressin**, all urine collected until 09.00hrs following day.
- **Do specific gravity**

Result:

Normal SG: >1.020

Abnormal:

- **Implication for normal Water deprivation test or Vasopressin test and no proteinuria***

Urine dilution test*

- (Water load test).
- Very simple but **less** sensitive.
- Not often used.

Procedure:

- **Day before:** Overnight fast
- **Day of test:** Empties the bladder, given **1l** of water to drink, urine collected for the next **4 hrs**-complete emptying.
- **Specific gravity** done

Result:

Normal SG: <1.016

Abnormal:

Dye excretion test*.

- Excretion of dyes and measurement of their **concentration in urine** (measure of **renal function**).
- After **parenteral injection**.

Procedure:

- IM or IV injection of 6 mg of dye (**phenol red**)

Result:

Normal: **60-85% in 2hrs**

Abnormal: **< 50% in 2hrs**

Creatinine clearance test*

- **Quantitative measure of glomerular damage** when simpler tests have detected **renal impairment**.
- The test lacks **sensitivity** as 1st diagnostic test.

Procedure:

- 24 hrs. urine collection
- **Plasma creatinine** determine during the day,
- Creatinine clearance as a measure of **glomerular filtration rate**.

Result:

- Test may be normal in **early** renal damage detected by **WD/VT & proteinuria**.

Normal rate: **100-130ml/min**

Abnormal rate: **< 90ml/min**

Urea clearance test (van Slyke)*.

- **Formerly** popular test
- Measures mainly for **glomerular function**.
- Replaced by **Creatinine clearance test**.

Procedure:

- Two successive complete **60** minutes urine,
- **Plasma urea** measured in the test.
- Clearance = Mean of the two levels of urea and expressed as a % of the average normal clearance.

Results:

Normal clearance: **75 ml/min**

Abnormal reading: **< 70%**

Urinary acidification test*.

- Ability to **form acid and excrete ammonia** by renal tubules.

Procedure:

- Patient **fasts** from midnight,
- Following day patient empties the bladder **completely** and urine collected.
- Patient given 0.1g (1.9mmol)/ kg body weight of **ammonium chloride** and drinks **1l** of water
- At 2hrs, 4hrs, and 6hrs, complete urine samples collected.
- **pH** determined.

Results:

- Normal pH (in at least one specimen): ≤ 5.3
- Abnormal pH: > 5.3

Plasma analyses(Blood tests)*.

- As renal function tests.
- Frequently helpful assessment of **known** renal disease.
- **No** plasma constituent whose concentration depends **solely** on the functional state of the kidneys.
- All **non-protein nitrogen (NPN)** constituents **retained** in renal failure.
- NPN constituents are **urea, amino acids, uric acid, creatinine, creatine, ammonia.**

Tests:

1. Plasma urea
2. Plasma creatinine
3. Others: electrolytes, acid-base, proteins

Plasma urea & creatinine*.

- Both **raised** in renal failure, chronic renal disease, and post renal obstruction.
- Used to assess the **severity** and **progress** of these conditions (**monitoring**).

Other plasma analyses:

- Valuable and often necessary in the assessment of **known** renal diseases
- Show **changes** in a wide variety of Other disorders.

Other Plasma analyses.

1. Electrolytes (K, P₀₄, mg, Na, Ca²⁺)
2. Plasma protein (albumin)
3. Plasma acid/base

Findings of plasma electrolytes, proteins, acid/base in renal failure*.

1. ↑-K, P, M. ↓N,C
2. ↓PP
3. Anion gap metabolic acidosis*

Choice of RFTs*.

Facts to consider:

1. **Urinalysis** (presence of **proteins**).
2. **Water deprivation (or vasopressin) test**
3. **Creatinine clearance.**
4. **Plasma urea or creatinine.**

FIN