Study Design & Methodology

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Role of kidneys in maintaining internal environment

- elimination of water soluble waste products of metabolism other than carbon dioxide.

- control of fluid and electrolyte homeostasis.
• Urine production:
• Glomerular blood flow
• Proximal tubule-reabsorption
• Loop of Henle
• Distal tubule-excretion
- Acute renal failure
- Chronic renal failure
• Sudden, normally reversible impairment of kidneys’ ability to excrete the body’s nitrogenous waste products of metabolism

  - Accompanied by oliguria.
• Fall in urine volume to less than 500ml per day.

• Rising plasma urea and creatinine concentrations

• Rising plasma potassium and phosphate plus falling calcium and venous bicarbonate.
### Stages of Chronic Kidney Disease

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>GFR (mL/min/1.73 m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kidney damage with normal or ↑ GFR</td>
<td>≥90</td>
</tr>
<tr>
<td>2</td>
<td>Kidney damage with mild ↓ GFR</td>
<td>60-89</td>
</tr>
<tr>
<td>3</td>
<td>Moderate ↓ GFR</td>
<td>30-59</td>
</tr>
<tr>
<td>4</td>
<td>Severe ↓ GFR</td>
<td>15-29</td>
</tr>
<tr>
<td>5</td>
<td>Kidney failure</td>
<td>&lt;15 (or dialysis)</td>
</tr>
</tbody>
</table>

Chronic kidney disease is defined as either kidney damage or GFR < 60 mL/min/1.73 m² for ≥3 months. Kidney damage is defined as pathologic abnormalities or markers of damage, including abnormalities in blood or urine tests or imaging studies.
Renal Replacement Therapy

Solutes which have accumulated in the uremic plasma, extracellular and intracellular fluid diffuse across a semipermeable membrane towards the low concentrations present in dialysis fluid, and this gradient is maintained by replacing used dialysis fluid with fresh fluid.
• Common in Europe 70% of patients receiving it in Europe.

• Advantage: short duration of treatment.

• Disadvantage: complexity of extracorporeal dialysis system and the need for vascular access.
Hemodialysis

Peritoneal dialysis
• Peritoneal membrane is more superior than membrane of hemodialysis
• Simple and less complex equipment
• Access to peritoneum is not difficult.
• Patients are less anaemic
• Slow correction of fluid and solute abnormalities is better tolerated in
• long duration of treatment.

• Peritonitis

• Expense of recurrent hospital admissions.

• Large volumes of commercially prepared fluid required.
• Uncontrollable hyperkalemia

• Severe sodium and water overload unresponsive to diuretics

• Severe uremia

• Acidaemia
• Pericarditis

• Fluid overload/pulmonary oedema refractory to diuretics

• Accelerated HTN poorly responsive to antiHTN medications

• Severe uremia
• Persistent nausea and vomiting

• Plasma creatinine concentration above 12mg/dl or blood urea nitrogen greater than 100mg/dl
• Possible indications for early dialysis.
  - estimation of GFR
  - nutritional status.
A) HEMODIALYSIS

Hypotension

Hemorrhagic
(hyponatremia, overheated diasylate,
chloromines, copper, formaldehyde)

Air embolism

Hypernatremia

Muscle cramps

Infection: cellulitis, edarteritis, septicaemia

Fluorosis

Hemolysis

Inadequate flow

b) VASCULAR ACCESS

Disequilibrium syndrome

Recirculation
• Disorder related to peritoneal dialysis

  Infection-peritonitis, tunnel abscess, cellulitis

  Catheter malfunction-obstruction, leaks, separation

  Loss of peritoneal ultrafiltration

  Sclerosing encapsulated peritonitis

  Obesity

  Pleural effusion
- Anaemia
- Abnormal bleeding
- HTN
- Hypotension
- Pericarditis
- Heart Failure
2002 EUROPEAN RENAL ASSOCIATION–EUROPEAN DIALYSIS AND TRANSPLANT ASSOCIATION.
• I.1.1

• Renal function should not be estimated from measurements of blood urea or creatinine alone. Cockcroft and Gault equation or reciprocal creatinine plots should not be used when the GFR is <30ml/min or to determine the need for dialysis.

• (Evidence level : A)
• 1.1.2

• To reduce confusion when communicating with general physicians and to encourage timely referral of patients with renal failure:

• Renal function should be reported as GFR equivalent (ml/min/1.73m²)

• Evidence level C
• I.1.3

• GFR should only be estimated using a method, which has been validated in patients with advanced renal failure. The preferred method for calculating GFR in advanced renal failure is the mean of urea and creatinine clearance. The latter is best calculated from a 24hr urine collection.
• **Other examples of validated GFR estimations are:**

• **MDRD equation**

• **Indicator decay methods** (*e.g.* iothalamate, EDTA, Inulin)

• **Creatinine clearance after oral cimetidine.**
• I.1.4

• To assist in the standard reporting of renal function in advanced renal failure, the preferred methods of estimating GFR in advanced renal failure are either:

  • MDRD equation (evidence level: B)

  • or

  • The mean of urea and creatinine clearance, calculated from 24 hr urine
• I.1.5

• A. To assist in the detection and timely referral of patients with renal failure, labs should be encouraged to report GFR using MDRD equation when serum creatine above the normal range is measured and there is insufficient data to calculate GFR more directly.
• B. If creatinine clearance is requested from a 24hr urine collection, the labs should also report GFR calculated from the mean of urea and creatinine clearance. The report should indicate that this GFR is not normalized for surface area and should show indicative normal ranges for different sized patients.

• (Evidence level:C)
• I.3A.

GFR < 15 ml/min and there is one or more of the following: symptoms/signs of uremia, inability to control hydration status or blood pressure, or a progressive deterioration in nutritional status. In any case, dialysis should be started before GFR has fallen to 6 ml/min/1.73 m², even if optimal pre-
• B. High risk patients e.g. diabetics may benefit from an earlier start.

(evidence level: C)

• C. To ensure dialysis is started before GFR is <6ml/min, clinics should aim to start at GFR 8-10ml/min

• (evidence level: C)
• Timing of dialysis and survival

• Netherlands cooperative study

• CANUSA

☐ No data supporting the safety of delaying dialysis until the patient is symptomatic with GFR<6mL/min.
• Dialysis should be initiated at any time after GFR has fallen to <15ml/min/1.73m² if there is no evidence of malnutrition, or fluid overload unresponsive to diuretics or clinical signs and symptoms of uremia. Based on opinion rather than evidence, the minimal level of GFR above which dialysis should be started regardless of symptoms is 6ml/min/1.73m².
• The cause of renal dysfunction must be determined and if possible treated.

• Renal replacement therapy should be started and tailored according to degree of biochemical derangements and underlying condition.

• GFR is of importance.