

## Dialysis

Dialysis is a method of removing plasma waste products and excess fluid, and maintaining normal electrolyte concentrations. It is used when the kidney is no longer able to perform this function.

### Indications

Mnemonic: **AEIOU**

Intractable....

- **A**cidosis
- **E**lectrolyte abnormalities (hyperkalaemia, hyponatraemia, hypercalcaemia)
- **I**ntoxicants (methanol, lithium, salicisim)
- **O**verload
- **U**raemia

In chronic renal failure, dialysis is required when the GFR is <15ml/minute

### Types of dialysis

- **Haemodialysis:** via:
  - Arterio-venous fistula: [see notes below]
  - Central venous catheter in SVC (via internal jugular)
    - Non-tunnelled: lasts up to 10 days
    - Tunnelled (“Dual lumen tunnelled cuffed catheter”): tunnelled under the skin from the arm to reduce infection rates. Lasts weeks/months.

Haemodialysis is performed in hospital using a haemodialysis machine. Blood is removed from a vein, passed along a semi-permeable membrane with dialysate fluid being passed in the opposite direction on the other side. The dialysate is a purified fluid with similar solutes to plasma (but without toxins). Toxins in the blood are removed due to the concentration-gradient. Haemodialysis is performed in acute situations with a non-tunnelled CVC catheter, or in chronic renal failure with an AV fistula or tunnelled CVC catheter.

In chronic renal failure, haemodialysis is performed for 4 hours 3 times a week. Several **lifestyle modifications** are needed: reduced fluid intake (overload risk), potassium restriction (kidneys cannot remove potassium), phosphate restriction

- **Peritoneal dialysis:** via a Tenckhoff catheter [see notes below]. Types of peritoneal dialysis:
  - Continuous ambulatory peritoneal dialysis: patient replaces peritoneal dialysate manually with fluid bags 3-5 times daily.
  - Automated peritoneal dialysis: machine automatically replaces peritoneal dialysate 3-5 times overnight.

Peritoneal dialysis is an alternative option to haemodialysis for patients with chronic renal failure. The peritoneum is used as a semi-permeable membrane. A Tenckhoff catheter is installed so dialysate can be delivered to the peritoneum. The dialysate is exchanged for fresh dialysate 3-5 times daily. This can be done at home.

- **Continuous veno-venous haemofiltration:** only really used in the intensive care unit for acute renal failure  
This approach causes less haemodynamic instability than haemodialysis so is used for critically ill patients. Haemofiltration involves filtering blood through a high-pressure column with a semi-permeable membrane. Small molecules are passed across the membrane and removed. Fluid is replaced with a fluid of optimal biochemical composition.

### Complications of dialysis itself

- Common, non-severe effects: headache, itching, muscle cramps
- Disequilibrium syndrome: osmotic brain changes lead to cerebral oedema
- Hypotension
- Hyperkalaemia
- Problems with fluid balance

# Arterio-Venous Fistula

## Examining an AV fistula

- **LOOK**
  - Generally**
    - Patient stable
    - In pain
  - Fistula**
    - Type of fistula
      - Radiocephalic (most) = at wrist
      - Brachiocephalic = at elbow crease
      - Upper arm transposed basilica fistula
    - Scars
    - Signs of inflammation: rash, erythema, swelling
    - Arm elevation test (for outflow obstruction): fistula should collapse on arm elevation
  - Veins**
    - Accessory veins
  - Hands**
    - Oedema
    - Ischaemia (Steal syndrome = vascular insufficiency secondary to AV fistula)
- **FEEL**
  - Thrill: shouldn't be pulsatile
  - Consistency: should be soft and easily compressible
  - Augmentation test (for anastomotic stenosis): occlude vein 1-2 cm above anastomosis. If arterial pressure is adequately conducted (i.e. there is no anastomotic stenosis), a pulsation in the vein will be seen. NB. if vein is pulsatile anyway, there is venous outflow stenosis.
- **LISTEN**
  - Bruit: should be soft thrill (high pitched = stenosis)

## Notes on AV fistulas

### What is it?

A surgically created anastomosis between an artery and a vein. Main use is to dilate a vein so that it can be used for performing regular haemodialysis.

### Why is it needed?

The blood volume that needs to be removed and returned during haemodialysis is too great for a normal vein to cope with. If a vein and an artery are joined, the pressure of arterial blood entering the vein dilates it and increases the flow rate. After the vein is sufficiently dilated, it can be used for haemodialysis.

### How long for an AV fistula to become patent?

It takes 4-6 weeks to sufficiently dilate the vein.

### How is it used?

Once the vein is dilated, two needles are inserted each time they are needed to perform dialysis (usually done in hospital for 4 hours three times weekly):

- Afferent needle: takes blood from the vein to the haemodialysis machine (placed distally)
- Efferent needle: returns blood from the haemodialysis machine to the vein (place proximally)

### What are the complications of an AV fistula?

1. Thrombosis
2. Venous stenosis
3. Aneurysm
4. Infections
5. Steal syndrome (distal ischaemia)

### Special instructions for the patient

- Do not let anyone take blood from or cannulate the arm on the side of the AV fistula

### What are the alternative methods of performing haemodialysis?

- Central venous catheter in SVC (via internal jugular)
  - Tunnelled ("Dual lumen tunnelled cuffed catheter"): lasts weeks/months
  - Non-tunnelled: lasts up to 10 days

### What are the advantages of an AV fistula?

Advantages

- Lower re-circulation rate: afferent and efferent needles can be placed quite far apart up the vein, so only a tiny proportion of the blood returned to the patient (via the efferent needle) is taken back up again (by the afferent needle). CVC haemodialysis has a higher re-circulation rate because the afferent and efferent tubes are very close to one another.
- Lower infection rate: than leaving a CVA *in situ*.
- Higher blood flow rate (therefore, more efficient dialysis)
- Lower incidence of thrombosis

# Tenckhoff Catheter/ Peritoneal Dialysis

## Examining a Tenckhoff catheter

- **LOOK**
  - Generally**
    - Patient stable
    - In pain
  - Abdomen**
    - Signs of acute abdomen / peritonitis
    - Scars
  - Tenckhoff catheter**
    - Patency
    - Signs of inflammation
- **FEEL**
  - Abdomen**
    - Brief abdominal exam to determine if any signs of peritonitis or areas of tenderness
  - Skin around catheter**
    - Temperature
    - Swelling

## Notes on Tenckhoff catheters/ peritoneal dialysis

### What is a Tenckhoff catheter?

A catheter placed through the abdominal wall which provides access to the peritoneum.  
It is used to perform peritoneal dialysis.

### What are the types of peritoneal dialysis?

- **Continuous ambulatory peritoneal dialysis:** patient replaces peritoneal dialysate manually with fluid bags 3-5 times daily.
- **Automated peritoneal dialysis:** machine automatically replaces peritoneal dialysate 3-5 times over night.

### What are the contraindications to peritoneal dialysis?

- Peritoneal adhesions
- Stoma
- Hernia

### What are the complications of peritoneal dialysis?

1. Peritonitis
2. Infection around catheter site
3. Constipation
4. Pleural effusions

### What are the advantages of peritoneal dialysis?

- Can be done at home
- Easier to go on holiday abroad