# Prolonged Intermittent Renal Replacement Therapy (PIRRT) using the Fresenius 5008®

|---|---|
| **1. What it is** | • An explanation & definition of PIRRT and the standard use of the Fresenius 5008®.  
• Outlines the observations and management of a patient requiring PIRRT in the Intensive Care Unit at St George Hospital |
| **2. Risk rating** | Low |
| **3. Employees it applies to** | Nursing and Medical staff employed at St George Hospital (STG), Intensive Care Unit (ICU) |
| **4. When to use it** | When PIRRT is indicated for a patient using the Fresenius 5008® |
| **5. Why the rule is necessary** | To ensure safe and effective renal replacement therapy for this patient group |

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6. Process
6.1 Definitions

- Prolonged Intermittent Renal Replacement Therapy (PIRRT), also known as Extended Daily Dialysis and Filtration EDD-f, combines convective and diffusive dialysis within a shorter time frame. However PIRRT differs from Continuous Renal Replacement Therapy (CRRT) in that PIRRT dialysis flow rates can range from typical rates used presently in the Intensive Care Unit between 100 – 300mls/min. The substitution (filtration) rate can be set or automatically calculated dependant on patient – specific values (haematocrit, total protein etc) and the blood flow (usually 200 – 300mls/min) and the 6 – 12 hour treatment duration.²,⁶

- The dialysis rates used in PIRRT are less than those typically used in Intermittent Renal Replacement Therapy (IRRT or HD) and minimise any disequilibrium effects from rapid solute removal. However the dialyser flux is high efficiency.

- The positive features of PIRRT are:²
  - Intermittent treatments – facilitate patient movement, transport for investigations
  - Facilitate normal sleep pattern
  - Reduced need/duration of anticoagulation
  - Less circuit downtime compared to CRRT
  - On line water preparation – reduced cost – reduced OH & S lifting prepared bags of dialysis and dilution fluid.
  - Several treatments per day for > 1 patient with single machine
  - Variable Na⁺ and HCO₃⁻ concentrations in dialysis/substitution fluid.

- **ONLINE** Haemodiafiltration (HDF) in Intensive Care⁴
  - The high solute removal efficiency of Haemodiafiltration (HDF) is achieved through a combination of two solute removal principles, diffusion and convection. Fluid is removed through filtration. High efficiency filters are used.
  - In **diffusion** the removal of small substances occurs along a concentration gradient from the blood to the dialysate side (and vice versa)
  - Solute removal by **convection**, occurring along a pressure gradient, is a consequence of ultrafiltration of fluid across a highly permeable membrane: removal (flux) of large quantities of fluid from blood “drags” solutes with it.³
  - Through the dilution of blood, the filterable fraction is increased and enhanced convective clearances can be achieved. In HDF **Pre-Dilution**, the substitution fluid is administered before the dialyser. This leads to an improved membrane permeability, but also reduces the efficiency. The clearance of small solutes decreases with an increasing degree of pre–dilution. In HDF **Post-Dilution**, substitution fluid is administered after the dialyser. As a result, optimal clearances of small and middle ureamic toxins are obtained at substitute rates of around 80ml/min.³ Autosub function can be used for post dilution to reduce the risk of haemoconcentration.

- **ONLINEplus** Auto- Substitution (Auto Sub) Function
  - This function, if selected, automatically regulates the substitution rate in pre or post dilution in the HDF/HF treatment modes.
  - In **post dilution**, the substitution rate should be restricted to 20% of the actual blood flow or haemo-concentration will occur, so this is the reason to use the Autosub function in order for the machine to control automatically (see table 1)

- **Substitution fluid**
  - A **predilution** set rate of 50mLs/min -100mLs/min (3 Litres/hr – 6 Litres/hr) will be
used at STG ICU to select the filtration rate. This rate is sufficient to remove both middle and larger molecules and also allow good diffusion of the small molecular weight solutes.

- If high volume haemofiltration is required a predilution rate of 150 -200mLs/min (6Litres/hr – 9Litres/hr) can be selected.

- Filters

<table>
<thead>
<tr>
<th>Table 1: Performance and specifications of AV600S 7</th>
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<tbody>
<tr>
<td>Effective surface area (m2)</td>
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<tr>
<td>Blood filling volume (mls)</td>
</tr>
<tr>
<td>Recommended blood flow (ml/min)</td>
</tr>
<tr>
<td>Recommended filtrate flow (post dilution and if not autosub)</td>
</tr>
</tbody>
</table>

6.2 Precautions to be taken with PIRRT 2, 3

- Avoid use in patients with acute head or spinal cord injury due to risk of disequilibrium and rapid reduction in plasma urea.
- Rapid fluid removal in the haemodynamically unstable patient.
- Accelerated solute removal over short periods of time. Therefore dependant on frequency of treatments, phosphate depletion, amino acids and vitamin B₁₂ require closer monitoring and replacement. 6
- It is recommended that Vitamin B₁₂ and folate levels are checked weekly.
- Phosphate replacement will often be required, especially if the PIRRT treatment is daily 8.

6.3 Haemodiafiltration (HDF) Standard settings – Use of Fresenius 5008 HDF Pre-Dilution or HDF Post Dilution

6.3.1. Indications:
Haemodynamically stable patients requiring RRT for uraemia control
Haemodynamically unstable patients who do not require excessive fluid removal
Hyponatraemic patients requiring RRT
Lactic acidotic patient
Drug overdose e.g Na Valproate, Metformin,
Lithium toxicity 10

6.3.2. Treatment Duration:
4 – 8 hours
NOTE: No more than 12 hours of treatment at the rates below

6.3.3. Treatment Parameters:

| Blood flow | 200 to 300 ml/min |
| Dialysis flow | 200ml/min (if concern regarding a high risk of disequilibrium then consider 100mls/min). |

When dialysis flow is significantly lower than blood flow, dialysate is saturated with solutes, so using a higher as opposed to a lower blood flow makes no change to rate of solute shifts. 6

Consider:

- < 6 hrs treatment >300mls/min K+ 3mmols/l HCO3 28 -32mmols/l
- > 6 hrs treatment 200mls/min K+ 4mmols/l HCO3 24 -28mmols/l
Filtration rate /Substitution: 50 – 100mls /min (predilution)

or

Autosubstitution /Autosub. Dependant on patient specific haematocrit, total protein values and type of dialyser, blood flow rate, UF rate and treatment For use in post dilution to provide a maximum filtration fraction and prevent haemoconcentration of the circuit).

Comparison to CRRT (Continuous Renal Replacement Therapy)
Comparison with CRRT at renal dose 25mls/kg/hr @80kg = over 24 hours 48 litres (our current practice)
PI RRT over 6 hours
dialysate flow 200mls/min = approx 72 litres
substitution/filtration rate 50mls/min = approx 18 litres
Total = 90 litres Equivalent to 48 hrs of CRRT
PI RRT over 6 hours
dialysate flow 100mls/min = approx 36 litres
Substitution/filtration rate 40mls/min = approx 14 litres
Total = 50 litres Equivalent to 24 hours of CRRT

If patient is haemodynamically unstable and requires fluid removal, firstly consider CRRT then if PIRRT is considered then fluid removal can be spread over 8 -10 hours, however renal dose as above is not achieved.

6.4 Haemodialysis (HD)
- Only to be prescribed in consultation with ICU Staff Specialist
- Used for Chronic Kidney Injury patients
7. Documented prescription – Fresenius 5008®
   - All shaded areas must be completed by Medical Officer in CIS

<table>
<thead>
<tr>
<th>Dialysate:</th>
<th>Bibag 900g ✓</th>
<th>Part A HD/F2 ✓</th>
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<tbody>
<tr>
<td>Potassium</td>
<td>2mmols/l ✓</td>
<td>3mmols/l ✓</td>
</tr>
<tr>
<td>Dialyser</td>
<td>AV600</td>
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<tr>
<td>Blood flow</td>
<td>200mls/min</td>
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<table>
<thead>
<tr>
<th>Ultrafiltration Menu</th>
<th>Dialysate Menu</th>
<th>On line /Filtration Menu</th>
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</thead>
<tbody>
<tr>
<td>Total fluid removal goal</td>
<td>Sodium □ mmol/l (Range 129 -154) normal 140</td>
<td>See below</td>
</tr>
<tr>
<td>Treatment time 4 hours</td>
<td>Bicarbonate □ mmol/l (Range 24 -40)normal 32</td>
<td></td>
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<tr>
<td>6 hours</td>
<td>Temperature □ (Default 36.5)</td>
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<tr>
<td>8 hours</td>
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<td>Rate □ mls/min (Standard 50 – 100ml)</td>
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<td>rate:□□□□□□□□□</td>
<td>OR Post –dilution use AutoSub feature</td>
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<tr>
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<td>As above with:</td>
<td>Replacement/substitution Rate N/A</td>
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<td></td>
<td>Must only be prescribed in consultation with ICU Staff Specialist</td>
<td>Dialysate flow rate:□□□□□□□□□□</td>
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Anticoagulation Therapy

- Heparin Infusion No □ Yes ✓
  (Standard heparin 5,000 units in Sodium Chloride 0.9% 10mls Conc. 500 units/ml)
- Aim: APTT 10 – 20 seconds above or 1.5 times baseline/ 40 – 60 secs
- Initial bolus: □□□□□□□□ units if required (Administer bolus dose directly to patient immediately prior to treatment (1000units to 2000units))

- The initial rate of the heparin infusion on the Fresenius 5008 is 5 – 10units/kg/hr (e.g. For 80 kg 5 x 80 400units/hr or 10 x 80 units/hr 800units/hr).
- The APTT should be checked 2 hours after the commencement of dialysis and then 4 -6 hrly thereafter, depending on the patient’s coagulation status, and length of treatment.
- Aim the APTT 10 – 20 seconds above or 1.5 times baseline/ 40 – 60 secs and in accordance with TMP pressures.

**NOTE:** When changing heparin syringe during treatment always clamp line with red clamp attached.
8. Nursing Management & Documentation

8.1 Commencement of therapy

- Continuous monitoring of hemodynamic parameters.
- Optimise blood pressure prior to commencing therapy.
- Use of PPE and Aseptic Non Touch Technique ANTT on connection/disconnection of PIRRT circuit.

http://seslnweb/Clinical_Governance/National_Standards/Std_3_HAI/Aseptic_Tech/default.asp

8.2 Equipment for initiation of PIRRT:

- Sterile gloves.
- Dressing pack, chlorhexidine 0.5% in alcohol 70%.
- 2 x 5 ml syringes, 2 x 10ml syringes, 2 x 10 ml normal saline (sterile).
- Blue absorbent sheet.

- Rub hubs vigorously with chlorhexidine solution. Wrap Vas cathub with chlorhexidine-soaked gauze for 3 to 5 minutes
- Make sure both lumens are clamped, attach 5 ml syringe
- Withdraw 3mls of blood from red (access) lumen of vas cath and discard.
- Flush with 10mls of 0.9% Normal Saline using positive pressure lock. Keep syringe attached. Check patency.
- Withdraw 3mLs of blood from blue (return) lumen of vas cath and discard. Flush with 10mLs of 0.9% of Normal Saline using positive pressure lock. Keep syringe attached. Check patency.
- Attach circuit as described in workplace Instruction set up of Fresenius 5008®

8.3 Observations and documentation

- Continuous blood pressure monitoring, and heart rate.
- Hourly documentation on CIS of:
  - **Access pressure** should not be more negative than 200 mmHg. Troubleshooting may require observation of any mechanical obstruction to outflow from vas cath. If no visible mechanical obstruction to outflow consider aseptic access of vas cath and flush. Prepare equipment prior to ceasing blood pump. Blood pump should be ceased for a short period of time due risk of clotting.
  - **Venous pressure** should not exceed approx 250 mmHg. Troubleshooting may require observation of any mechanical obstruction to inflow to vas cath, kinking or clamped line. If no visible mechanical obstructions consider venous access line on vas cath or haemofilter. Use of pre-dilution substitution fluid will assist in prolonging clotting of the filter.
  - **Blood flow pump** – mls/min should not be < 200mls/min as it can reduce the effectiveness of treatment and can increase the risk of clotting of circuit and filter
  - **TransMembranous Pressure TMP** – The trending pressures will give information regarding the life expectancy and thus filter efficiency. TMP should not exceed 300 mmHg. If TMP has risen slowly, check APTT and ensure optimal anticoagulation. If
TMP has risen rapidly, check lines are not clamped or kinked.

**NOTE:** If TMP and venous pressures rise suddenly, prepare to reinfuse patient blood as soon as possible before the circuit clots.

- **Hourly anticoagulation dose on medication chart** – Ensures correct titration with APTT and information of coagulation status with thromboembolic deterrent regime.
- **Dialysate flow rate** – This figure will generally be fixed at commencement of treatment but if clearance of urea and creatinine is not effective, the dialysate flow rate can be changed during treatment. However increasing the dialysate flow above the blood flow will not improve solute clearance.
- **Predilution mode** – This is the mode used to deliver the substitution/filtration fluid to the patient and will be administered before the dialyser (as set up in Workplace instructions). The rate can vary and will require prescription order by attending MO in HDF mode.

- Check APTT at 2 hours, then 6/24 and adjust coagulation therapy accordingly and on instruction of Drs’ orders and maintain functional integrity of the filter whilst avoiding bleeding complications
- Keep access site visible throughout duration of therapy, maintaining patient dignity.
- Assess hourly ultrafiltration rate (fluid removal) and physiological effects and document total fluid removal goal at the end of treatment on the CIS.
- Creatinine and electrolytes can be checked using the ABG analyser 2 hours post commencement or prior if clinically indicated.
- Electrolytes, urea and creatinine (EUC) and calcium, magnesium and phosphate (CMP) should be checked post therapy in order to determine efficiency.
- Where electrolytes need replacing, do so in accordance to unit practice.
- Check neurovascular limb observations initially 1/24 on commencement of dialysis, then reduce in frequency to minimum 4/24 to record any signs of swelling, pulse strength, capillary refill, change in status to detect for signs of thrombosis and/or bleeding.
- Monitor patients’ temperature and ensure appropriate temperature setting has been entered on Fresenius treatment selection.

### 8.4 Discontinuation of therapy

- Follow the Fresenius set up, troubleshooting and disconnection workplace instruction.
- If treatment is unable to be completed due to high filter and TMP pressures then follow the pathway described in Workplace instructions “Clotting circuit”.
- If treatment has finished with no complications, the pathway to discontinue and cease treatment is by selecting ‘reinfusion’. Follow Workplace Instructions.
- Prepare equipment and use of Aseptic Non Touch Technique (ANTT) and PPE procedures on disconnection.
- After disconnection and discontinuation of PIRRT ensure both Vascath lumens are flushed with 10mls 0.9% normal saline through primed bungs with a positive pressure flush.
- Heparin lock with heparin concentration of 5000 units in 1 ml. Inject volume of concentrated heparin via each lumen as directed by individual volume documented on side of lumen and document on insertions chart on CIS for Vascath.
- Heparin lock and Vascath management as per Vascath Clinical Business Rule.
- Document total fluid removal goal at the end of treatment on the CIS.

7. Compliance evaluation

Q1: What group of patients should we avoid commencing PIRRT on?
A: Head injury, spinal cord injury.

Q2: What will happen if dialysate flow is greater than blood flow?
A: There will be no increase in solute clearance

Q3: Where do we find instructions on the set up and troubleshooting of the machine?
A: Fresenius Workplace Instructions
Other e.g. Audit Plan

8. Keywords
Fresenius, PIRRT, clotting

9. External references
4. Factsheet 5008S On line haemodiafiltration. Fresenius Medical Care 2008

10. Relevant
ICU QA Meeting
St George/Sutherland Hospitals
And Health Services (SGSHHS)

| committee approval | ICU Nursing Practice Committee
| Renal |
| 11. Patient information brochure (or related material) | N/A |
| 12. Who is responsible | All nursing and medical staff
| Nurse Manager Intensive Care unit
| Medical Director Intensive Care Unit |

I, Dawn Fowler Clinical Group Manager Medicine and Critical Care SGSHHS attest that this clinical business rule is not in contravention of any legislation, industrial award or policy directive.

Revision and approval history

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<td>0</td>
<td>Sarah Jones ICU CNC Dr Doris Lam ICU Staff Specialist</td>
<td>November 2016</td>
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Approved by: Clinical Governance Document Committee Date: October 2013