

Recommendations for Nocturnal Home Haemodialysis (NHHD)

For Review July 2021

Introduction/Benefits

The following document produced by Association Nephrology Nurses UK (ANNUK) Home Haemodialysis Special Interest Group (HHD SIG) is intended to be a helpful guide for use by healthcare professionals when considering Nocturnal Home Haemodialysis (NHHD). These recommendations provide the minimum standards and safety precautions required for all adults undertaking this treatment.

INTRODUCTION

National Institute of Health and Care Excellence (NICE) (2018) guidelines recommend that all suitable patients should be offered the choice between home haemodialysis or haemodialysis in a hospital/ satellite unit.

Typically, patients undertaking NHHD dialyse for approximately 6-8 hours from every other night to 5 nights a week with slower blood pump speeds. This allows for a slow and gentler removal of fluid and waste products, improving middle weight molecule removal.

Benefits of Nocturnal HHD

Freedom to dialyse overnight means that treatment does not interfere with the person's normal daytime activities and relieves pressure/burden through increased freedom gained from home haemodialysis.

The benefits include:

- Reduced chance of hypotensive episodes and cramping
- Treatment is more gentle and easier for the body to tolerate
- Improved recovery time
- May increase the ability to continue in employment, school, childcare and spending time with family and friends
- A greater amount of waste and fluid is removed from the blood
- Potassium and phosphates may be better controlled
- A less strict diet and fluid restriction
- A feeling of wellbeing with improved appetite
- Fluid management may be easier
- Better control of haemoglobin (hb) and less risk of renal anaemia

National Kidney Foundation (2015).

There are perceived barriers when undertaking home haemodialysis and this is also true of NHHD and may include:

- fears of self-cannulation
- a catastrophic event such as dislodgement of access while sleeping
- burden on family
- inability to sleep

Careful screening patients for interest in NHHD needs to take place to mitigate these concerns. (Cafazzo, J A; Leonard, K; Easty E C; Rossos, P G; Chan C T. 2009). National Kidney Foundation (2015).

2. EDUCATION AND TRAINING.

As with all people who wish to dialyse at home, a full assessment prior to training is necessary. Once a person is fully independent with their home dialysis, transition to NHHD can be considered.

2:1 Checklist prior to converting to NHHD

- a. The patient must have the machine installation set up in a bedroom or somewhere they are able to sleep.
- b. There is a useful dosing calculator that can be used with some dialysis machines for a nocturnal prescription. A standard prescription for low flow dialysate machines can be found online in a Nurses Guide to Implementing Best Practice in Home Haemodialysis. (2017)
- c. Additional supplies are required for NHHD e.g. extended cyclor base and filter holder, fluid leak detection, blood leak detector.
- d. Standard stock requirements.

2:2 Training schedule

Arrange for the patient to come to the centre for a 'nocturnal session'. Normally an extended session of 6 hours minimum dialysis. It is not necessary to perform an overnight treatment as this may not be possible in a training unit.

- a. Set up any specific additional equipment
- b. Explain adjusted dialysis prescription/regimen, including ultrafiltration (UF) rates and parameters which may need reducing particularly if a solo dialysis patient.
- c. Activated Clotting Time (ACT's) or Anti Xa monitored and anticoagulation adjusted accordingly (dose may need increasing to cover extended hours treatment).

3. Vascular Access

3:1 All types of vascular access can be used for NHHD.

3:2 Both rope ladder or buttonhole needling technique can be used.

3:3 Single needle or double needling can be utilised for NHHD.
NB. Not all dialysis machines have a single needle option.

3:4 A period of in-centre competency based training on needling/central venous catheter (CVC) access, and securing the access for NHHD should be undertaken, following the organisational policy/guidelines.

3:5 Highlight risks associated with vascular access, and securing the access. Consideration should be given to the use of commercially available monitoring systems (Renal Association, 2009, Guideline HD 8.4.).

See appendix 1 for examples of securing venous access for NHHD

4. NHHD prescription

High dose haemodialysis (HD) has been associated with a 45% reduction in mortality vs. conventional HD due to superior clearances. (Nesrallah, et al, JASN 2012). According to Renal Association (2019) most observational studies also report improved outcomes with longer treatment times, and slower ultrafiltration rates, and include ;

- lower all-cause and cardiovascular mortality rates
- improved blood pressure control and slower ultrafiltration
- improved anaemia control
- improved phosphate control
- improved nutritional status

Renal Association (2019) recommends that the review of dialysis prescription should be undertaken routinely quarterly, or when prompted by clinical circumstance to ensure control is maintained.

4:1 Dialysate

- a. As NHHD is associated with superior clearances compared to conventional dialysis, there is an increased risk of biochemistry imbalance. (Renal Association, 2019).
- b. Careful consideration is required to the dialysate concentrate before starting nocturnal haemodialysis treatment. The Frequent Hemodialysis Network Nocturnal Trial (Rocco et al 2011) found that higher potassium and calcium levels were required, but no increase in sodium levels were needed to maintain recommended biochemistry. (Renal Association, 2019.)
- c. Dialysate concentrate, which forms part of the dialysis prescription will be reviewed by the clinician prompted by clinical circumstance or quarterly. (Renal Association, 2019)

4:2 Potassium

- a. Conversion to a high potassium dialysate may be required, due to the increased clearance of potassium. The patient should understand the risks of hypo/hyperkalaemia and the importance of routine blood testing.
- b. They should be advised to look out for symptoms such as muscle weakness/hyporeflexia and cramps.
- c. Optimal pre dialysis serum potassium range 4.0 – 6.0 mmol/L is recommended. (Renal Association Guideline 5.1, 2019)

4:3 Phosphate

- a. Be aware with superior phosphorous clearances, depending on treatment regime, there is a risk of Hypophosphatemia, signs and symptoms can include

- Muscle weakness
- Bone pain
- Altered mental state

And in severe cases

- Disorientation
- Seizures
- Muscle pain
- Focal neurological deficits
- Can be asymptomatic

- b. Sodium phosphate supplementation maybe required to maintain normal pre/post phosphate concentrations. (Renal Association, 2019)

- c. Extra consideration should be paid to pregnant patients and those with hungry bone syndrome. A review of phosphate dietary restrictions and phosphate binders should be considered.

- d. Serum phosphate levels 1.1 - 1.7mmol/L. Renal Association Clinical Practice Guideline 3.2 (2015)

4:4 Calcium

- a. The concentration of calcium in the acid can be adjusted to maintain pre dialysis serum calcium levels within normal ranges and parathyroid hormone levels (PTH) within the desirable range. Extra consideration should be paid to pregnant patients.

- b. Signs and symptoms of hypocalcaemia;

- Intermittent muscular spasms/twitching
- Painful cramps, and tingling in the extremities
- Laryngeal spasm may cause stridor, obstructed respiration
- Convulsions may occur as hypocalcaemia lowers the seizure threshold
- Chronic hypocalcaemia may cause psychiatric effects

- c. Aim for Serum Calcium 2.2 -2.5 mmol/l and target range for parathyroid hormone between 2 and 9 times the upper limit of normal for the assay used (Renal Association Clinical Practice Guidelines 2015)

4:5 **Blood and dialysate flow rate**

- a. Local guidelines should be followed, but for units who are new to NHHD it is advised that low blood flow rates of 300 ml/min or less are generally suitable for most patients on NHHD. (Kidney Disease Outcomes Quality Initiative [KDOQI] Clinical Practice Guidelines, 2015).
- b. Dialysate flow rates should be set to reflect, individual clearance / blood chemistry, and vascular access (single or double needle). Low dialysate flow rates of 500 ml/min or less are generally suitable for most patients on NHHD. (KDOQI Clinical Practice Guidelines, 2015).

4:6 **Session timing**

Consider long hemodialysis, 6-8 hours, 3 to 6 nights per week (KDOQI Clinical Practice Guidelines, 2015).

As NHHD is carried out whilst the patient sleeps, the duration of treatment should match the sleeping habits of the patient.

4:7 **Anticoagulation**

Renal Association (2019) recommends that unfractionated heparin is used as the standard anticoagulant worldwide in view of its proven efficacy, ease of use and long safety record unless the patient has recent or active bleeding, thrombocytopenia, heparin allergy or heparin induced thrombocytopenia. Heparin is usually administered as a loading dose of 1000-2000 IU followed by a continuous infusion of 500-1500U/h that is discontinued approximately 30 minutes before the end of the dialysis session. Patients who dialyse via AVF/AVG will usually discontinue heparin infusions 30 minutes before the end of dialysis. In practice the bolus dose, infusion rate and stopping times are adjusted empirically, according to clot formation in the dialysis circuit, and the time for needle sites to stop bleeding. Heparin dose may need to be increased with higher haematocrit, or reduced / withdrawn in patients at risk of haemorrhage, those with thrombocytopenia or on long term anticoagulation.

Alternatively, a low molecular weight heparin may be used, having a longer half-life, given as a single 'arterial limb' bolus at the start of dialysis. There is no difference in the incidence of bleeding complications, post-dialysis access bleeding, or thrombosis of the extracorporeal circuit.

Patients without increased bleeding risk should be given unfractionated or low- molecular-weight heparin during dialysis to reduce clotting of the extracorporeal system. Systemic anticoagulation should be omitted or minimised in patients with increased bleeding risk and patients with heparin allergies should be prescribed a non-heparin form of anticoagulation.

Method of administration.

- Initial bolus
- Initial bolus and maintenance dose
- Maintenance dose
- Intermittent doses
- Infusion

A useful table for anticoagulation can be found online in a Nurses Guide to Implementing Best Practice in Home Haemodialysis (appendix 2).

5. Safety and Risk Management

Safety and risk management is covered in depth with 'Home Haemodialysis – A nurse's guide to Implementing Best Practice in Home Haemodialysis' (2017).

Patients should be confident and competent with troubleshooting and be encouraged to discontinue dialysis if concerned over their safety or feel unwell.

Patients should have access to a telephone to seek support from medical or technical support/advice or the emergency services if required. Each unit will have different systems in place for overnight support, e.g. on-call service, telephone support from the renal ward.

Specific Safety and risk concerns;

- Blood loss
- Anticoagulation - see NHHD prescription
- Access complications
- Air embolism
- Intradialytic hypotension
- Biochemistry imbalance - see NHHD prescription

5:1 Blood loss and venous needle dislodgement/CVC dislodgement

- a. One of the main risk factors for NHHD, although relatively rare, is dislodgement of access. This can apply to both AVF access or central venous catheter access (CVC).
- b. There are a number of proprietary venous blood leak detectors available, as blood loss from the venous line may not trigger the venous alarm parameters and the blood pump will continue.
- c. Any safety equipment must be checked and correctly used.
- d. Blood leak detector equipment can be used with venous access and CVC access.
- e. Any safety equipment use and testing should form part of the in-centre training and the patient should be aware of how to correctly use and test the safety equipment.
- f. Safety equipment must be tested prior to each use as per the manufacturer's instructions.
- g. An enuresis alarm pad and sensor can be used as a secondary backup to the primary blood leak.
- h. Venous alarm parameters can be reduced to increase the sensitivity of venous pressure changes.

5:2 Securing the needles and lines for NHHd.

- a. All arteriovenous fistulas/grafts needles must be secured as per local guidance .
 - b. Entry points of the cannulation sites can also be covered with a sterile dressing to keep the wound clean and free from debris.
 - c. Blood lines should not be taut but looped and taped to the skin at the wrist or shoulder to minimise tension on the needles and connection points. A line clip can be used if the patient wears a pyjama or top.
 - d. A tubular dressing can secure the lines in place, covering both needles but not so tight as to constrict the flow through the vascular access.
 - e. The limb with the vascular access should be rested in a comfortable position, ideally supported by a pillow, to help reduce movement. If the vascular access is on the leg then a bed cradle can be used to reduce the weight of bedding.
 - f. Some blood lines provide a clip to secure the venous blood line to the venous needle, and its use is recommended to help prevent the luer-lock unintentionally coming loose. Alternatively a piece of tape can be placed over the bloodline luer-lock adhering it to the needle to reduce the chance of unintentional disconnection.
- (See appendix 1 for example of securing the needles.)

5:3 Blood leak sensors and safety equipment

- a. As blood loss can occur from anywhere it is advised every patient who undertakes nocturnal haemodialysis has fluid leak detection equipment, including an enuresis mat on the haemodialysis machine. These are readily available from medical companies.

5:4 Access complications, including life threatening haemorrhaging (LTH).

- a. The British Renal Society Vascular Access SIG & VASBI have produced guidelines on how to prevent and manage Life Threatening Haemorrhage (LTH) available at <https://britishrenal.org/quality-improvement-clinical-practice/brs-guidelines/>
- b. All patients should be trained how to deal with LTH as per local protocol; and know who to contact
- c. Access related complications, are often preventable with good assessment of the fistula/graft and with good needling technique.

5:5 Air embolism

- a. A rare but serious adverse event that can potentially cause death. Events resulting in an air embolism include
 - Unintentional disconnection
 - A CVC not clamped when a cap is removed
 - Mis-management of an air alarm
 - Incorrect or failed priming of the bloodlines
 - Poorly secured connectors
 - Defective air detection alarm
- b. The patient should stop the blood pump immediately, clamp all lines and get help.

- c. **The patient must telephone 999 requesting paramedic attendance immediately if an air embolus is suspected**, stating they are a dialysis patient on dialysis and they have accidentally given themselves air.

The patient must take position in the Trendelenburg position (patient is laid supine, or flat on the back on a 15-30 degree incline with the feet elevated above the head), or left lateral position (lying on left side in order to prevent a venous air embolism from lodging in the lungs).

- d. Signs and symptoms of an air embolism in the cerebral venous system include;

- Confusion
- Distorted vision disturbances
- Coma

- e. Signs and symptoms of a pulmonary air embolism include;

- Chest pain,
- Dyspnoea,
- Coughing,
- Cyanosis
- Cardiac arrest.

5:6 Blood pressure control and Intradialytic hypotension

- a. The patient must be assessed as competent in assessing the target weight and agree to contact the appropriate healthcare professional for a target weight and/or medication review at the earliest opportunity. Vital signs are to be recorded pre dialysis, within 15 minutes of commencing dialysis and post dialysis as a minimum.
- b. The patient should adhere to a maximum hourly ultrafiltration rate for dialysing nocturnally that has been assessed as safe by the renal team. Evidence suggests that fluid exceeding 10ml/kg/hr increases the risk of morbidity and mortality (Flythe et al 2001) and concerns achieving this will need to be discussed.
- c. These measures do not prevent excessive ultrafiltration volumes particularly over 6-8 hour treatments, the patients understanding of target weight and the potential causes of low blood pressure should be regularly assessed.
- d. The Renal consultant should review regular medications prior to transferring home, with particular consideration to anti-hypertensive medications.
- e. The patient should understand the potential causes of hypotension, the signs and symptoms and the management of low blood pressure. Regular fluid status reviews and competencies assessed.
- f. The patient or carer if present, should be assessed as competent in how to deliver an emergency bolus of saline or emergency wash back, if it is necessary.
- g. Patients and their dialysis partners should be aware and able to contact emergency services at any time during treatment should this be necessary. In addition, the individual organisation should provide relevant points of contact within the service with accessible times.

6. On-going support

All patients at home should be offered regular contact from a member of the home team which can be a home visit, attending a nurse led clinic, or telephone/Skype call/NHSone, and email support. With some dialysis machines there is the possibility of using IT systems that collect machine data which is transmitted directly to health care teams enabling remote monitoring of patients dialysing at home.

- a. The renal technicians may provide technical support for care and maintenance of the dialysis machine and other equipment supplied, depending on choice of home machine.
- b. Following conversion to NHHD a home visit should be scheduled within the first week, and then monthly. A risk assessment rating tool could be used to determine if the patient requires extra support be it in the form of a phone consultation or additional visits. (See appendix 3 for example of risk assessment)
- c. Frequency of continuing contact and support will depend on the patient and local policy. A minimum of monthly check-ups are common in most Home HD Units. Consultant clinics are usually attended quarterly.
- d. If possible there should be the option to offer respite for patients and carers if the need arises. This can be by offering dialysis at the training centre or the local dialysis unit.

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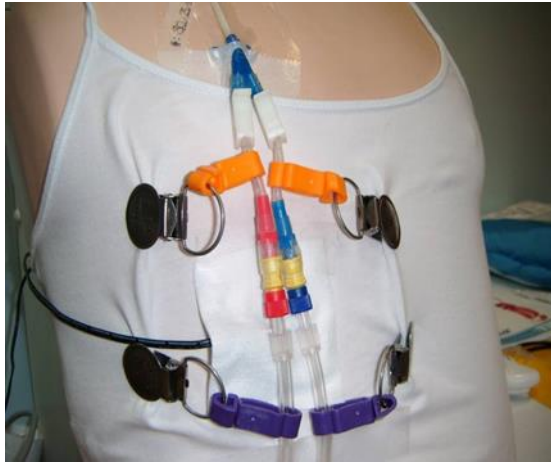
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APPENDIX 1: Securing the needles/CVC Access





APPENDIX 2: Anticoagulation Chart

Agent	Advantages	Disadvantages	loading Dose	maintenance Dose	Monitoring	HD Prescription	Important Issue
Heparin Free/ Saline Bolus	Reduced risk of bleeding	Dialyser Clotting	Rinsing Dialyser and lines with 1L 0.9% saline	Flush dialyser and blood lines with 100-250ml saline every 15-30 mins	Visualisation of haemofilter	Short frequent Dialysis Conventional Standard HD	Indicated: acute bleeding disorder, high risk of bleeding, recent head injury, alternative in HIT
Unfractionated Heparin	safety, short half-life, low cost, Antidote (protamine sulphate)	requiring continuous infusion and/or repeated boluses heparin induced thrombocytopenia, Allergic reactions	1000-1500IU	1000 IU/hr.	aPTTr 2.0-2.5	Conventional standard HD >5-6 hours treatment. Long nocturnal dialysis	Anticoagulant of choice in USA. Usual options: bolus and continuous heparin or an initial bolus followed by subsequent intermittent boluses
Low Molecular weight Heparin (LMWH)	Single dose, at the start of dialysis. No need for routine monitoring	Cost Long Half Life No antidote Heparin-induced thrombocytopenia Allergic reactions	Enoxaparin 0.8mg/kg Bemiparin 2500-3500IU Tinzaparin 2500-4500 IU	None	Anti-Xa 0.4-0.6IU/ml	short frequent Dialysis Conventional Standard HD with <5hours treatments. Enoxaparin for long nocturnal HD	Anticoagulation of choice In Europe Administrate in venous injection port of the circuit to prevent loss of effects
Argatroban	Hepatic metabolism, rapid effect, short <u>half life</u> (40-60min) low cross-reactivity with heparin	Cost Avoid In liver disease Requires monitoring (prolongs INR)	250ug/kg or <20mg	2ug/kg/min 6-15mg/h	aPTTr 2.0-2.5	short frequent dialysis conventional standard HD with <5 hours treatment	Alternative in HIT
Fondaparinux	New drug Better to use with patients who need constant anticoagulation	Long half-life Renal metabolism Can accumulate	2.5mg	None	Pre-HD anti-Xa <0.20IU/l	Long nocturnal dialysis >5-6 hours treatment	Alternative in HIT Not approved for HD in USA
Danaparoid	low cross-reactivity with Heparin	Long half-life No antidote	3750IU (2500 IU if <55kg)	None	Pre-HD anti-Xa <0.20IU/l	Long nocturnal dialysis >5-6 hours treatment	Alternative in HIT Not approved for HD in USA



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