

1. Introduction

Haemodialysis central venous catheters (HD CVC) are used frequently for access to the circulation and to enable adequate blood flow for haemodialysis. Malfunctioning of the catheter is a common problem and is often due to intraluminal thrombus or formation of fibrin. Catheter malfunction leads to poor dialysis due to inadequate blood flow and disruption of dialysis scheduling.

Catheter malfunction may be defined as any of the following:-

- Occluded or partially occluded HDVC (permcaths) indicated by inability or difficulty with aspiration or instillation of fluid through either lumen.
- Elevated venous pressure i.e. higher than 200mmHg.
- Progressive reduction in achieved blood pump flow rates on haemodialysis
- Blood pump flow rate below 200ml/min

Catheter dysfunction can be treated initially by the use of thrombolytic agents (urokinase, alteplase but may require catheter replacement or other interventions (see below).

In order to achieve success in restoring catheter patency, it is critical that treatment is initiated as soon as possible after catheter dysfunction is identified. Thrombolysis should be used pre-emptively where there is a progressive decline in blood flow rate rather than at an absolute value.

2. Scope

This guideline is for nursing and medical staff caring for patients receiving haemodialysis through a tunneled HD catheter which is malfunctioning. The aim is to provide an algorithm to ensure patients have adequate blood flow for haemodialysis.

Clinical guidelines are 'guidelines' only. The interpretation and application of clinical guidelines will remain the responsibility of the individual practitioner. If in doubt consult a senior colleague or expert.

3. Recommendations, Standards and Procedural Statements

The aims of this guideline are:-

- To provide algorithm for catheter dysfunction
- To provide guidance for use of thrombolytic agents
- To describe procedure for administration of thrombolytic agents

Procedure for catheter malfunction	
No.	Action
3.1	Definition of catheter malfunction

Procedure for catheter malfunction	
	<p>The causes of catheter malfunction often differ according to whether it is 'early ' or 'late'. Proposed definitions of these are:-</p> <ul style="list-style-type: none"> • Early malfunction - Initial malfunction of HDVC catheters (within 5 days of insertion) is due usually to malposition, kinking of the line or to intra-catheter / catheter tip thrombosis. Many malfunctioning catheters exhibit positional occlusion during dialysis. • Late malfunction (more than 5 days) - In addition to the above, formation of a fibrin sleeve or a mural thrombosis may be the cause of late HD CVC malfunction. These fibrin sleeves can obstruct the ports at the distal end of the catheter and generally saline can be infused but aspiration is difficult (Daugirdas et al 2001, Nissenson & Fine 2002).
3.2	<p>Criteria to identify patients who require intervention.</p> <ul style="list-style-type: none"> • Difficulty with aspiration or instillation of fluid through either lumen. • Elevated venous (post-dialyser) pressure i.e. higher than 200mmHg. • Inadequate blood flow rates on haemodialysis i.e. below 200ml/min (Levy 2002).
3.3	<p>Measures to overcome catheter dysfunction (see also algorithm for HDVC malfunction in appendix 1)</p> <p>Check for simple reversible factors e.g. kinking of line, effect of clamp on line, line position, and volume depletion</p>
3.4	<p>Attempt thrombolysis of catheter lumen with either urokinase or alteplase lock (see appendix 2 and 3)</p> <p>Consider 'Urokinase Pushlock' (appendix 4)</p>
3.5	<p>If lock fails, use urokinase infusion – initial dose 25000units per lumen (see appendix 5)</p> <p>Consider intra-dialytic urokinase infusion if this is more convenient and fits with dialysis schedule</p>
3.6	<p>If unsuccessful, consider catheter exchange by surgical team</p>
3.7	<p>Alternatives to catheter exchange are described in the literature including fibrin sheath stripping, use of endoluminal brushes and railroading catheter over guidewire. These are not widely available in the network. Where there is concern about SVC occlusion or other central venous problem, a 'permcatheterogram' in conjunction with arm venography may help plan catheter exchange.</p>
3.8	<p>Use of urokinase and alteplase</p> <p>Urokinase and alteplase are fibrinolytic agents, which act on plasmin. Plasmin degrades fibrin and so breaks down thrombin (1).Urokinase has been in general use for catheter thrombolysis for many years although the evidence base for optimal dosage and method of administration is weak. Alteplase is licensed for restoration of HD catheter patency (Actilyse Cathflo).Side effects include haemorrhage if given systemically or rise in temperature(1).</p> <p>Urokinase may be administered by either a lock or infusion by authorised professionals i.e. all registered nurses, who have achieved competency in haemodialysis and intravenous drug administration, or under direct supervision of a haemodialysis competent nurse.</p>
3.9	<p>Contra-indications for use of thrombolytic agents</p> <p>Most of these are relative rather than absolute as the systemic anticoagulant effect is low</p> <ul style="list-style-type: none"> • Active bleeding. • Surgery within 72 hours • Allergy to urokinase or streptokinase (use alteplase)

Procedure for catheter malfunction

3.10 Anticoagulation with warfarin to maintain catheter patency

There are no conclusive studies that show that warfarin can maintain patency of HD catheters. HD patients are at increased risk of bleeding on warfarin. The decision to use warfarin is an individual one by the nephrologist in charge in discussion with the patient but may be used for patients with recurrent catheter dysfunction and limited other access options.

The risk: benefit needs to be carefully assessed, discussed with patient and recorded in the medical records. INR needs to be carefully monitored and maintained around 2.0-2.5

4. Education and Training

This guideline is intended to be used in the UHL haemodialysis units, ward 10 day case, and renal wards at the LGH. It is for use by competent registered nurses and medical staff. Registered nurses should have successfully completed the competencies identified in unit 3 of the UHL Renal Nurse Development Programme, or equivalent.

5. Monitoring and Audit Criteria

Key Performance Indicator	Method of Assessment	Frequency	Lead
Use of urokinase/alteplase locks	Pharmacy records	annual	tbc
Number of urokinase infusions	Clinical records	annual	tbc
Success of urokinase infusions	Clinical records	annual	tbc

6. Legal Liability Guideline Statement

Guidelines or Procedures issued and approved by the Trust are considered to represent best practice. Staff may only exceptionally depart from any relevant Trust guidelines or Procedures and always only providing that such departure is confined to the specific needs of individual circumstances. In healthcare delivery such departure shall only be undertaken where, in the judgement of the responsible healthcare professional' it is fully appropriate and justifiable - such decision to be fully recorded in the patient's notes

7. Supporting Documents and Key References

Syner-KINASE® SmPC (SynerMed November 2006)

Daugirdas, J.T. & Ing, T.S. (2001), Handbook of Dialysis 3rd ed. New York: Little, Brown and Company.

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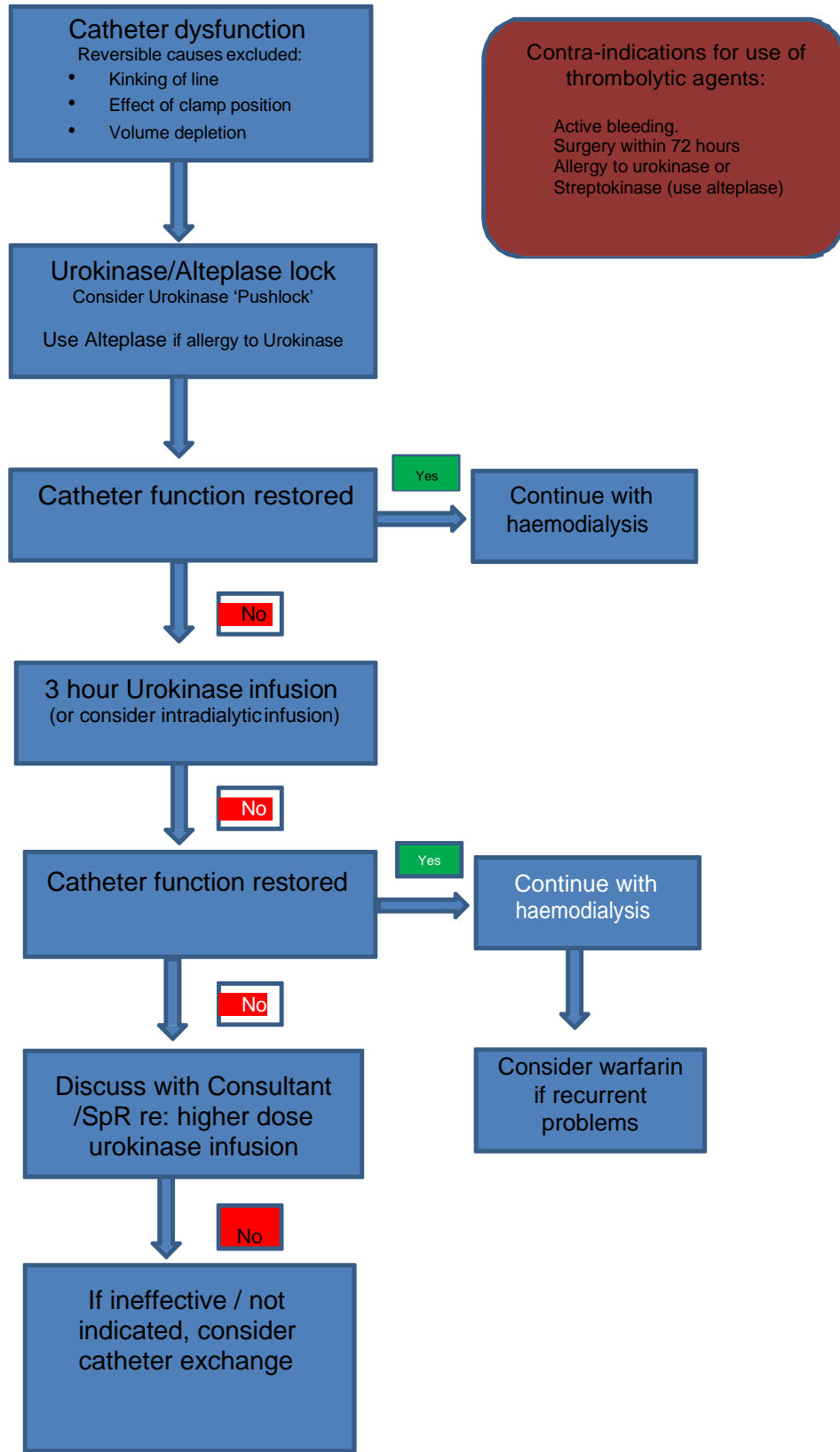
8. Key Words

Haemodialysis, Urokinase, Alteplase, Thrombolysis, Vascular Access, Central venous catheters, Pushlock

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Appendix 1 –Algorithm for Haemodialysis Central Venous Catheter Malfunction



APPENDIX 2: Procedure for UROKINASE LOCK

Dose 12,500 units per lumen (no adjustment necessary for renal/hepatic

impairment) A2.1 Equipment required

- Prescription for Urokinase
- 1 x vial of Urokinase 25,000 units
- 2 x 10ml vial of Sodium Chloride 0.9%

- 2 x green needles
- 2 x chlorhexidine wipes
- 2 x 2ml syringes with luer lock
- 2 x 10ml syringes with luer lock

A2.2 Procedure

- Collect equipment.
- Wash hands or decontaminate with alcohol gel.
- Apply the plastic disposable apron and visor.
- Clean surface with chlorhexidine wipe, when ready to proceed with procedure. Allowing 60 seconds for surface to dry.
- Open dressing pack onto clean surface. Using corners of sterile paper open the sterile field.
- Gently empty on the sterile equipment without contaminating the sterile field:
 - Syringes X 4
 - Needles X 2
 - Transparent dressing if required
 - 2% Chlorhexidine swab if replacing dressing
- Decontaminate hands with alcohol gel.
- Attach needles and draw up 2 X 10ml of 0.9% sodium chloride from ampoules, place on sterile field, dispose of needles into sharps box, place empty ampoules in tray
- Decontaminate hands with alcohol gel.
- Place sterile dressing towel underneath lumens of catheter, using minimal contact holding only corners of dressing towel
- Scrub lumens and removable bungs with 2% chlorhexidine. Allow 60 seconds to dry (if catheter specifies no alcohol use betadine solution).
- Wash hands or decontaminate with alcohol gel.
- Apply sterile gloves.
- Using a non-touch technique, remove bung from one lumen and withdraw 10mls into empty syringe, clamp lumen. Repeat for second lumen.
- Using a non-touch technique, flush each lumen with 10mls 0.9% sodium chloride, clamp lumen.
- Swab the vial of urokinase and dilute with 2 mls of sodium chloride 0.9%.
- Draw up 12,500 units (1ml) into each 2ml syringe and further dilute to volume of lumen with 0.9% sodium chloride. Draw up volume of catheter lumen (to minimise any risk of systemic infusion).
- Using aseptic technique, slowly inject solution into each lumen and clamp. (If the patient is to remain temporarily immobile the syringes may be left in situ, alternatively replace with sterile bungs.) Injection must be slow to prevent the risk of dislodging a clot.
- Leave in situ for no more than 30 mins (2, 3.)
- Attempt aspiration
- Aspirate at least 5 mls from each lumen.
- Successful Aspiration: (both lumens patent)
- Continue with dialysis or flush with 0.9% Sodium Chloride and insert catheter lock as prescribed.
- If one lumen can be easily aspirated and second lumen flushes easily, catheter can be used for dialysis.
- If neither lumen can be aspirated follow APPENDIX 5

APPENDIX 3: Procedure for ALTEPLASE LOCK

A3.1 Alteplase can be used as a thrombolytic treatment of occluded central venous access devices including those used for haemodialysis. A dose of up to 2 mg alteplase to each lumen can be administered up to two times for any one episode of occlusion to restore the function of the lumens.

A3.2 First and second presentation of catheter dysfunction

In patients with a body weight of 30 kg and more, a dose of 2 mg alteplase in 2 ml of reconstituted solution should be infused into each lumen and locked into the affected central venous access device (CVC).

A3.3 The line lock is left for a period of 30 minutes initially before aspirating and attempting dialysis. If it is not possible to aspirate then the lock can be left for a total of 2 hours. If dialysis is attempted and the same problem recurs then the line can be locked again in the same way, with the dwell time as 2 hours.

A3.4 Administration of alteplase

A3.4.1 Reconstitute the alteplase using water for injection to a final concentration of 1 mg alteplase per ml. For a catheter with a lumen volume greater than 2 ml, the reconstituted solution can be further diluted with sterile sodium chloride 0.9% solution for injection to the desired volume, i.e. for a catheter with internal volume of 2.5 ml the total dose of Actilyse Cathflo (alteplase) would be 2mg in a volume of 2.5 ml.

A3.4.2. Inject the appropriate dose of alteplase into the dysfunctional central venous access device.

A3.4.3. After 30 minutes of dwell time, assess catheter function by attempting to aspirate blood. If the catheter is functional, go to Step A3.4.6. If the catheter is not functional, go to Step A3.4.4.

A3.4.4. After 120 minutes of dwell time, assess catheter function by attempting to aspirate blood and catheter contents. If the catheter is functional, go to Step A3.4.6. If the catheter is not functional, go to Step A3.4.5.

A3.4.5. If catheter function is not restored after the first dose and 120minutes dwell time then a second dose of alteplase may be given.

A3.4.6. If catheter function has been restored, aspirate 4-5 ml of blood to remove Actilyse Cathflo and residual clot, and gently irrigate the catheter with sterile sodium chloride 0.9%.

APPENDIX 4: Procedure for UROKINASE 'Pushlock'

Background

Standard 30 minute lock can be ineffective and might be due to insufficient urokinase coming into contact with the clot at the end of the catheter. Half-life of urokinase is 20 minutes.

A4 Procedure

A4.1 Equipment required

- Prescription for Urokinase
- 1 x vial of Urokinase 25,000 units)
- 2 x blue needles
- 2 x alcohol wipes
- 1 x vial of Sodium Chloride 0.9%
- 2 x 2ml syringes with luer lock

A4.2 Procedure

12,500 units of urokinase per lumen dissolved in 1 ml sodium chloride 0.9% provided. The solution can be further diluted with sodium chloride 0.9% for injection dependent on the length of the lumen of the HDVC. The fill volume of the various HDVCs are printed on the side of each limb of the catheter.

- Swab the vial of urokinase and dilute with 2ml of sodium chloride 0.9%.
- Draw up 12,500 units (1ml) into each 2ml syringe and further dilute to volume of lumen plus 0.7mls. The final volume of sodium chloride 0.9% used will depend upon the length of each catheter lumen.
- Using aseptic technique, slowly inject a volume equal to the lumen of the catheter + 0.1ml into each lumen of the HDVC and clamp, leaving the syringes left in situ (containing 0.6mls solution). Injection must be slow to prevent the risk of dislodging a clot.
- After 10 minutes inject a further 0.3mls
- After a further 10 minutes inject the remaining 0.3mls
- After a further 10 minutes attempt aspiration
- Successful Aspiration: (both lumens patent)
- Aspirate at least 5ml from each lumen.
- Continue with dialysis or flush with 0.9% Sodium Chloride and commence haemodialysis or insert Taurolock/heparin lock as per protocol/prescribed.
- Unsuccessful Aspiration. (poor in/out flow from either lumen)
- If still unsuccessful inform medical staff.

For audit purposes record the name of each patient, date and time of administration, dose given and signature of the nurse administering the drug.

Side effects.

Haemorrhage if given systematically

Rise in temperature may occur

APPENDIX 5: Procedure for UROKINASE INFUSION

Larger doses of urokinase may be given as an infusion over 3 hours to try to restore catheter function. Initial dose 25,000 units per lumen
Higher dose up to 100,000units per lumen may be used

2.1. Equipment required

- 7 x 10mls ampoules of 0.9% Sodium Chloride
- Syringe driver x2
- 50ml luer lock syringe x2
- Urokinase asprescribed
- 4 x green needle
- Dressing pack
- 2% Chlorhexidine wipes
- 4 x 10ml luer lock syringes

2.2 Procedure foradministration

- Collect equipment.
- Wash hands or decontaminate with alcohol gel.
- Apply the plastic disposable apron and visor.
- Clean surface with alcowipe, when ready to proceed with procedure. Allowing 60 seconds for surface to dry.
- Open dressing pack onto clean surface. Using corners of sterile paper open the sterile field.
- Gently empty on the sterile equipment without contaminating the sterile field:
Syringes X 4
Needles X 2
Transparent dressing if required 50ml luer lock syringe x2
2% Chlorhexidine swab
- Decontaminate hands with alcohol gel.
- Attach needles and draw up 2 X 10ml of 0.9% sodium chloride from ampoules, place on sterile field, dispose of needles into sharps box, place empty ampoules in tray
- Decontaminate hands with alcohol gel.
- Apply non-sterile gloves.
- Remove existing dressing if required (transparent dressing can be left in place up to 7 days unless otherwise indicated), note the condition of the exit site and surrounding tissue –discard the soiled dressing into yellow clinical waste bag
- Dispose of gloves, decontaminate hands with alcohol gel.
- Place sterile dressing towel underneath lumens of catheter, using minimal contact holding only corners of dressing towel
- Swab exit site, scrub lumen and removable bungs with 2% chlorhexidine. Allow 60 seconds to dry (if catheter specifies no alcohol use betadinesolution).
- Wash hands or decontaminate with alcohol gel.
- Apply sterile gloves.
- Replace dressing if required. If using sterile gauze dressing due to patients' allergy to transparent dressing please change each dialysis session.
- Using a non-touch technique, remove bung from one lumen and withdraw 5mls into empty syringe, clamp lumen. Repeat for second lumen.
- Using a non-touch technique, flush each lumen with 10mls 0.9% sodium chloride, clamp lumen.
- Reconstitute urokinase powder with 2mls of sodium chloride 0.9%
- Dilute the resulting solution with sodium chloride 0.9% to 30mls in a 50ml luer lock syringe
- Repeat for 2nd syringe
- Attach line from pump to arterial lumen repeat for venous lumen, using a non-touch technique.
- Infuse both pumps over 3 hours (10ml/hour)

At end of infusion Equipment needed:

Dressing pack

2x 10mls luer lock syringes
Bungs x2 Chlorhexidine 2%
2x 2.5ml luer lock syringes 4x green needles
2x 10mls ampoules 0.9% sodium chloride

- Collect equipment.
- Wash hands or decontaminate with alcohol gel.
- Apply the plastic disposable apron and visor.
- Clean surface with chlorhexidine wipe, when ready to proceed with procedure. Allowing 60 seconds for surface to dry.
- Open dressing pack onto clean surface. Using corners of sterile paper open the sterile field.
- Gently empty on the sterile equipment without contaminating the sterile field:
Syringes X 4
Needles X 4 Bungs x2
Lock as prescribed
2% Chlorhexidine wipe
- Decontaminate hands with alcohol gel.
- Attach needles to syringes and draw up 2 X 10ml of 0.9% sodium chloride from ampoules, draw up lock as prescribed into 2.5ml syringes, place on sterile field, dispose of needles into sharps box, place empty ampoules in tray
- Decontaminate hands with alcohol gel.
- Place sterile dressing towel underneath lumens of catheter, using minimal contact holding only corners of dressing towel
- Scrub lumen with 2% chlorhexidine. Allow 60 seconds to dry (if catheter specifies no alcohol use betadine solution).
- Wash hands or decontaminate with alcohol gel.
- Apply sterile gloves.
- Using a non-touch technique, remove line from one lumen and attempt to aspirate 5mls into empty syringe, clamp lumen. Repeat for second lumen.
- Successful Aspiration (both lumens patent)
- Continue with dialysis or flush with 0.9% Sodium Chloride and insert catheter lock as prescribed
- Using no touch technique place bungs on lumens, if not using immediately for dialysis.
- If one lumen can be easily aspirated and second lumen flushes easily, catheter can be used for dialysis.
- If neither lumen can be aspirated follow algorithm in consultation with SpR/consultant medical staff
- Dispose of sharps as per sharps disposal policy in infection control guide

APPENDIX 6: Procedure for UROKINASE intra-dialytic infusion

Larger doses of urokinase may be given as an infusion over 3 hours during dialysis to try to improve the catheter flow to attempt to improve catheter function. This can only work if there is an initial blood flow of around 150-200 mls/min. Initial dose 25,000 – 50,000 units infused into venous line during haemodialysis.

Higher dose up to 100,000units per lumen may be used but should be approved by senior decision maker.

A6.1 Equipment required

- 3 x 10mls ampoules of 0.9% Sodium Chloride
- Syringe driver
- 50ml luer lock syringe
- Urokinase asprescribed
- Green needle
- Dressing pack
- 2% Chlorhexidine wipe

A6.2 Procedure for administration once haemodialysis session is established

- Collect equipment.
- Decontaminate hands with alcohol gel.
- Apply the plastic disposable apron and visor.
- Clean surface with alcowipe, when ready to proceed with procedure.
Allowing 60 seconds for surface to dry.
- Open dressing pack onto clean surface. Using corners of sterile paper open the sterile field.
- Gently empty on the sterile equipment without contaminating the sterile field:
Needle
50ml luer lock syringe
2% Chlorhexidine swab
- Decontaminate hands with alcohol gel and apply sterile gloves
- Reconstitute urokinase powder with 2mls of sodium chloride 0.9%
- Dilute the resulting solution with sodium chloride 0.9% to 30mls in a 50ml luer lock syringe
- Attach line from pump to venous port of bubble trap.
- Infuse pump over 3 hours (10ml/hour)
Attempt to increase pump speed during session to assess effectiveness of infusion.