Management of Home Parenteral Support Catheter Occlusion

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A fully functioning central venous catheter is essential for the administration of home parenteral support (HPS). Early and urgent intervention for catheter occlusion is necessary to preserve long-term vascular access. Management should be undertaken by an experienced, fully trained, multidisciplinary team (MDT), a nutrition support team (NST) within a HPS or intestinal failure (IF) centre, or a vascular access team. An intravenous catheter should have the minimum number of lumens required to meet the vascular access needs of the patient, and catheter manipulations must be kept to a minimum. All procedures involving the catheter must follow evidence-based guidelines and an aseptic non-touch technique (ANTT). An occlusion can be total where nothing can be instilled or aspirated, partial where there is resistance on flushing, or where flushing is possible, but aspiration is not (persistent withdrawal occlusion [PWO]). An occlusion may be due to a fibrin sheath covering the end of the catheter, thrombus, lipid, particulate debris (e.g. protein or drug deposits) or kinking of the catheter (including pinch-off syndrome). In clearing an occlusion there is a risk of fracture and/or infection. It is important for carers/patients to promptly escalate any concerns about catheter occlusion.

Key points

1. **Assessment:** Assessment should include exploring the events leading up to the occlusion, including sudden or gradual onset, recent resistance to flushing, changes in ambulatory pump infusion pressures or occlusion alarms. It should be noted if the catheter is used for any purpose other than HPS (e.g. blood sampling or administering medication) and if there have been delays in taking down the infusion.
2. **Fibrin sheath (flushes but cannot aspirate):** A fibrin sheath at the tip of the catheter may cause an occlusion in which the catheter may still flush, but aspiration is difficult or impossible.
3. **Thrombotic occlusion:** An occlusion may be caused by a backflow of blood into the catheter lumen.
4. **Non-thrombotic occlusion:** An occlusion may be due to lipid or particulate debris (e.g. protein or drug deposits) forming within the lumen.
5. **Mechanical troubleshooting:** Look for any compression of the catheter, any bends, or a closed/partially closed clamp. Kinking may be visible on the catheter reinforcement sheath. Massaging any kinks may be sufficient to relieve an occlusion. Patient repositioning (e.g. raising arms, coughing) may also relieve an obstruction.
6. **Inspection of the catheter hub:** Inspect the hub for visible debris; remove the needle free connector to assess and, if necessary, remove any noticeable obstruction.
7. **Saline manipulation techniques:** Before pharmaceutical intervention, perform pulsatile flushing or the percussive pop technique.
8. **Thrombolytic agents (urokinase or similar):** If fibrin is suspected, urokinase or a similar agent may be instilled under clinical guidance.
9. **Radiological imaging:** A chest radiograph will clarify the catheter tip position. If a partial catheter occlusion remains unresolved, a lineogram may help define the problem.

Explanations

1. Questions to ask in assessing a patient with a total or partial catheter occlusion are:
   a. Was the onset sudden or gradual and has there been a change in flushing behaviour? How long has the catheter been in situ?
   b. Did it occur after a dressing change? If so, is the catheter twisted (can occur if a tunnelled Hickman™ type catheter has been coiled under the dressing)? For patients with a peripherally inserted central catheter (PICC), has the catheter been pinched when securing it in a catheter securement device, for example Statlock™ or SecurAcath™.
   c. Did it occur following changing the needle-free connector? Changing the connector may resolve the occlusion.
   d. Did it occur following a Huber™ needle (a non-coring needle used for accessing an implanted port) change? This can occur if the Huber™ needle was bent when inserted. Has the right length of needle been used? The needle needs to be long enough to reach the back of the port.
   e. Has blood been taken through the catheter? This is not recommended as it can cause a thrombus, especially if the catheter was not adequately flushed post sampling.
   f. Are any intravenous therapies being administered through the catheter? This includes post-infusion catheter locks.

Generally, a catheter used for parenteral support should not be used for any other medication. Occlusion can occur if multiple medications are given without adequately flushing the catheter with 0.9% sodium chloride between each drug administered.

g. Does the patient receive lipid containing HPS and how often? Lipid containing HPS may contribute to intraluminal deposits.
h. Has there been a delay in flushing the catheter post infusion? The infusion rate to 'keep a vein open (KVO)' should be 15-20 ml/hour and ideally not exceed 2 hours. This can result in blood backflow into the catheter and/or the development of particulate matter within the catheter.
i. Have there been any changes in the practitioners/carer's/patient's ability to administer a flush using a push/pause technique with positive pressure (includes dexterity issues)?
j. Have they had a fever after starting a feed? Catheter-related bloodstream infection (CRBSI) may be associated with catheter occlusion.
k. Has there been a history of infusion deficits? If there are pump pressure readings, does the event log on the infusion pump show frequent interruptions of the infusion? Has the pressure indicator on the infusion pump changed gradually over a period of time? There needs to have been clear explanations about how to identify increasing pressures on the pump and what action to take.

Catheter care protocols should emphasise the need to maintain patency by using a push-pause flushing technique and positive pressure clamping.

2. A fibrin sheath is a layer of fibrin and platelets that can form around a central venous catheter. It develops from the point where the catheter enters the body and gradually extends towards the catheter tip. Once it fully encases the catheter tip, it can function like a one way valve.
3. A thrombus can extend from the catheter to the central vein or vice versa. A central vein thrombosis should be considered if the patient develops ipsilateral swelling of the arm, neck, head or face, a raised non pulsatile jugular venous pressure, or distended collateral veins across the chest wall (typically in chronic cases). Other symptoms may include jaw or shoulder pain, headaches, or a sensation of head fullness. Once suspected there should be a low threshold for investigating.

   Blood backflow into the catheter can be reduced by using a brisk push-pause flushing technique and positive pressure clamping (open-ended catheters only). If a patient has a valved catheter, positive pressure can be achieved by keeping the thumb on the syringe plunger when removing the syringe. Using a zero-reflux syringe will also reduce the risk of blood backflow. Most commercially available prefilled syringes with 0.9% sodium chloride for injection are zero-reflux.
4. A catheter may also become obstructed by non-thrombotic material, such as lipid residue, protein buildup, or drug precipitate. These substances can accumulate and restrict flow. Non-thrombotic occlusions may develop gradually and can be linked to inadequate flushing or incompatible drug combinations.
5. Understanding the mechanical causes of catheter obstruction helps guide safe management and prevents recurrence. Mechanical obstruction is usually external to the catheter and can occur due to repeated stress, stretching, incorrect clamping or external compression or internal obstruction due to debris in the hub. Positional changes may temporarily relieve obstruction by altering catheter alignment. Pinch-off syndrome where the catheter becomes caught between the clavicle and first rib is a rare cause of occlusion of a catheter entering the subclavian vein. It can be identified by its resolution when the patient rolls their shoulder on the side of insertion forward. The catheter will need to be removed and resited.
6. Inspect the catheter hub and the opening between the hub and the catheter to check for debris or a foreign body causing obstruction. Any visible debris, in a non-valved catheter only, can be removed aseptically by using a green (21G) safety needle.
7. Saline manipulation can help dissolve intraluminal debris. A 10 ml Luer lock syringe should be attached directly to the hub, using gentle back and forth motion without forcing the plunger. A smaller syringe is not recommended as they generate higher pressures that could burst the catheter and/or cause vessel trauma. The percussive pop technique may also be used. The percussive pop technique aims to remove an obstruction by sending shock waves through the catheter thereby allowing the debris to fall back into the syringe, as opposed to being flushed through the catheter. It is achieved by placing a 10 ml Luer lock syringe with 5 ml 0.9% sodium chloride for injection directly onto the catheter hub. The syringe is then inverted with the plunger uppermost. The syringe plunger is then pulled up and released, continuing this until debris from within the catheter is drawn back into the syringe. These methods provide information about the degree of occlusion and may restore patency without medication.
8. If mechanical and saline methods fail, a thrombolytic agent (e.g. urokinase) may be used according to local policy. If catheter functionality is not restored after the first dose, then a second dose of thrombolytic agent may be used. Clinicians must monitor for catheter ballooning or leakage and have atraumatic clamps available. If an agent is used, after a specified dwell time, the solution should be withdrawn, and patency reassessed. Patients should be monitored for signs of systemic infection following restoration of flow. Previous methods of prevention and clearing of lipid deposits or particulate debris included alcohol (70%), hydrochloric acid and sodium hydroxide but these solutions are no longer (widely) available and therefore no recommendations/guidance can be made as to their use. Instruction for use should include dwell time and initial aspiration attempted after this. The volume to be instilled should match the fill volume of the catheter; this will vary according to the size (Fr) and type of catheter (e.g. PICC, tunnelled Hickman™ type or totally implanted port). The solution may be flushed through if a PWO persists.
9. A chest X-ray can confirm catheter tip position, identify any kinking or looping, and detect some mechanical issues contributing to occlusion. Imaging findings can guide decisions about repositioning, pharmacological intervention, or catheter replacement. A lineogram is useful for identifying a fibrin sheath and any associated central vein thrombosis. ANTT must be followed whenever accessing the catheter to administer contrast.

Suggested reading

- Cawley C, Lal S, Nightingale J, Small M (2018). Standardised parenteral support catheter guidelines. April 2018 (reviewed April 2024). Accessed online: www.bapen.org.uk/pdfs/bifa/standardised-parenteral-support-catheter-guidelines.pdf
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- Rothkopf M, Pant M, Brown R, *et al.* (2022). Impact of a multidisciplinary nutritional support team on quality improvement for patients receiving home parenteral nutrition. BMJ Nutr Prev Health.; 5(2): 286-296.
- Royon L, Merckx J, Herbaut R, *et al.* (2020). Experimental study of the POP technique: focus on the physical basis of the process. J Vasc Access.; 21(6): 953-958.