NEONATAL

Life of a Neonatal Longline Catheter

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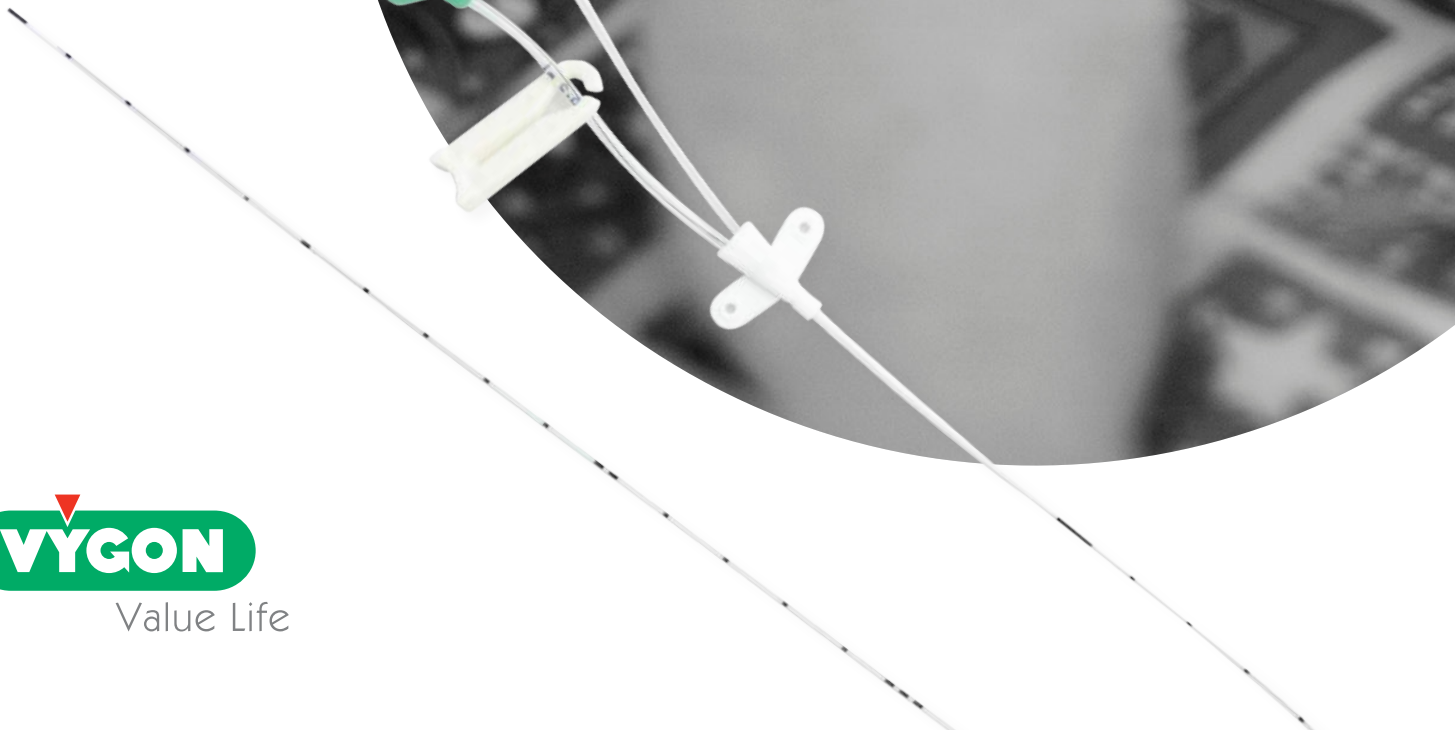

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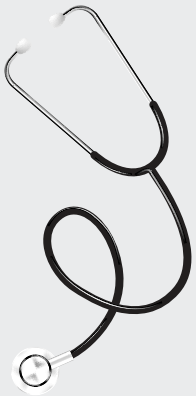

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Article One:

LONGLINE CATHETER INSERTION USING THE MODIFIED SELDINGER TECHNIQUE: CLINICAL AND ECONOMICAL ADVANTAGES

Longline catheters are commonplace in neonatal and paediatric care, providing reliable access for delivering parenteral nutrition, medications, and fluids over extended periods. Traditionally, these catheters are inserted using direct introducer or peelable cannula techniques. However, while widely adopted, these methods present challenges, including multiple venipuncture attempts, increased risk of vein trauma, and higher complication rates such as infection or malposition.

The Modified Seldinger Technique (MST) offers a refined approach that addresses some of these limitations. By combining a micro-puncture entry with guidewire-assisted placement, MST improves both clinical outcomes and procedural efficiency. This article explores how MST works, its advantages over conventional methods, and why it is increasingly recommended in neonatal practice.

MST Applied to Longline Catheters

The classic Seldinger technique revolutionised vascular access by introducing guidewire-assisted catheter placement. MST adapts this principle for fragile neonatal and paediatric vessels.

The process typically involves:

1. Micro-puncture needle insertion into the vein.
2. Guidewire advancement through the needle.
3. Dilator and peelable sheath placement over the guidewire.
4. Catheter insertion through the sheath, followed by sheath removal.

Compared to direct introducer methods, MST uses a smaller gauge needle to reduce vessel trauma, and a controlled, stepwise approach. This minimises vessel trauma and reduces the risk of complications.

Key differences from traditional methods:

- Smaller gauge needle reduces vessel trauma.
- Guidewire ensures controlled access and positioning.
- Peelable sheath dilator allows smooth catheter introduction without excessive force.

Clinical Benefits of MST

The Modified Seldinger Technique offers clear advantages over traditional longline insertion methods, particularly in fragile neonatal and paediatric patients. By using a micro-puncture approach and guidewire-assisted placement, MST reduces procedural trauma and improves overall success. These benefits are supported by strong clinical evidence and international best-practice recommendations.

- **Higher success rates:** Studies show MST improves first-pass and overall success compared to traditional methods (e.g., 72% vs 40% overall success; 53% vs 26% first-pass success).[1]
- **Reduced complications:** Lower risk of vein trauma, inadvertent arterial puncture, and nerve injury.[2]
- **Reduced vein trauma – Fewer venepunctures:** MST requires fewer attempts per successful insertion (average 2.5 vs 5.6 skin breaks).[1]
- **Lower infection risk:** Significant reduction in CLABSI rates (1.06 vs 3.45 per 1,000 catheter days) compared to conventional techniques.[4]
- **Improved patient comfort:** Less pain and stress due to fewer attempts and smaller introducer size.

Cost-Benefit Analysis

While MST may appear more expensive upfront, its true value lies in reducing complications and improving efficiency. When fewer reattempts, reduced need for additional consumables, lower complication rates (infections, vein damage), and shorter procedure times as well as less clinician time spent on repeated attempts are factored in, MST consistently demonstrates cost-effectiveness compared to traditional methods.

Evidence from UK neonatal units shows that the cost per successful insertion of neonatal PICCs is comparable between MST (£156.41) and standard techniques (£152.51); however, MST consistently delivers better clinical outcomes with fewer complications, reduced reattempts and consumable use, and shorter procedure times requiring less clinician time.[5]

Economic models suggest MST becomes cost-effective when factoring in reduced Central Line-Associated Bloodstream Infection (CLABSI) and reintervention rates.[5]

Evidence Summary

The advantages of MST are supported by a growing body of research and international guidelines. Studies confirm higher success rates, improved safety, and reduced infection risk, making MST the recommended approach for neonatal and paediatric longline insertion.

MST is supported by multiple retrospective studies and position statements:

- Success rates up to 90–95% when combined with ultrasound guidance.[6,7]
- Lower infection rates and improved safety profile in neonates and paediatrics.[4]
- International guidelines (e.g., NANN) recommend MST for PICC and longline insertion in neonates.[8]

Practical Considerations

Implementing the Modified Seldinger Technique successfully requires structured training and adherence to protocols. Clinicians need to be competent in using micro-insertion kits that include guidewires, dilators, and peelable sheaths, and should incorporate ultrasound guidance to optimise success and safety. Institutions adopting MST must ensure the availability of appropriate equipment and provide ongoing competency validation to maintain high standards of care.

Conclusion

The Modified Seldinger Technique offers clear clinical benefits for neonatal longline catheter insertion, including higher success rates, fewer complications, and improved patient comfort. These advantages extend beyond clinical outcomes to deliver meaningful cost savings through reduced reattempts, lower infection rates, and shorter procedure times. To realise these benefits fully, adoption should be supported by structured training, competency validation, and institutional protocols that ensure consistent practice and equipment availability. MST represents a proven, evidence-based approach that enhances both safety and efficiency in neonatal vascular access.

Article Two:

BEST PRACTICE FOR CARING FOR A LONGLINE CATHETER: MAINTAINING SAFETY AND REDUCING COMPLICATIONS

In our previous article on Longline Catheter Insertion Using the Modified Seldinger Technique (MST): Clinical and Economical Advantages, we explored how the use of MST optimises placement and reduces procedural complications. Now that the longline catheter is successfully in situ, the focus shifts to the next critical phase, ongoing care and maintenance.

Proper management of longline catheters in neonatal and paediatric care is essential to safeguard the tiniest of patients. Neglecting best practice can lead to serious complications, including catheter-related bloodstream infections, occlusion, and accidental dislodgement, each carrying significant clinical and economic consequences.

This article examines evidence-based strategies for longline care, drawing on the recommendations from both the British Association of Perinatal Medicine (BAPM) Framework for Practice[8] and National Association of Neonatal Nurses (NANN) Guidelines.[7] By prioritising meticulous maintenance, we can ensure that the benefits achieved during insertion are sustained throughout the catheter's use.

Daily Care Essentials

Site inspection

Inspect the insertion site at least once per shift for signs of redness, swelling or leakage. Early detection of these changes is vital to prevent infection and other complications, as recommended by BAPM.[8]

Dressing changes

Use transparent dressings to allow continuous visual inspection of the site. Dressings should be changed every seven days, or sooner, if:

- The dressing becomes loose or is lifting,
- The longline insertion site or the longline hub is exposed,
- The longline position may be compromised,
- The skin is visibly dirty or oozing fluids which affect dressing integrity, or
- There are signs of infection.[3]

Line flushing

Flush the line using strict aseptic technique and the correct syringe size and flush volumes to maintain patency and reduce the risk of occlusion. Follow NANN guidelines for recommended solutions and procedures.[7]

Securement

Ensure the catheter is well secured without tension on the line. Proper securement reduces the risk of accidental dislodgement and is a key element of NICU catheter care.

Infection Prevention

Every interaction with a longline catheter must begin with thorough hand hygiene and the use of aseptic technique. This is a fundamental requirement supported by both BAPM and NANN best practice standards.[8,7] Sterile caps and connectors should be used consistently, and chlorhexidine-based skin antisepsis is recommended to minimise microbial contamination at the insertion site.[3] Evidence shows that implementing standardised care bundles can reduce the incidence of central line-associated bloodstream infections (CLABSI) by up to 70%, highlighting the importance of a structured approach to catheter care.[4]

Monitoring and Troubleshooting

Continuous monitoring of longline catheters is essential to identify complications early and prevent harm. Common complications include occlusion, extravasation and infection, all of which can compromise therapy and patient safety. Clinical signs may include resistance during flushing, swelling or leakage at the insertion site, and systemic indicators such as fever or irritability[7]. When any of these signs are detected, immediate action is required. The Thames Valley & Wessex Neonatal Operational Delivery Network (ODN) recommends stopping infusions, assessing catheter position and escalating promptly to the medical team. Following these protocols ensures timely intervention and reduces the risk of serious outcomes.[3]

Documentation and Protocol Compliance

Accurate documentation is a vital part of longline catheter care. Every intervention, observation and maintenance activity should be recorded promptly and clearly in the patient's notes. This ensures continuity of care and provides an auditable record for clinical governance. Compliance with national guidelines, such as those from BAPM[8] and NANN[7], is essential to maintain safety and standardise practice across neonatal units. Adhering to these protocols not only reduces the risk of complications but also supports quality improvement initiatives and benchmarking within the NHS.[8,7]

Education and Training

Competent handling of longline catheters requires continuous education and validation of staff skills. Regular competency assessments ensure that nurses and clinicians follow best practice for insertion, maintenance and troubleshooting, as recommended by NANN guidelines.[7] In addition to staff training, parent and carer education is essential when longlines are managed at home. The BAPM framework emphasises clear communication and practical instruction for families, covering topics such as line protection, signs of complications and when to seek urgent help.[8] Providing structured education for both professionals and caregivers supports safety and reduces the risk of adverse events.

Conclusion

Consistent, evidence-based care of longline catheters is essential for improving outcomes and reducing complications in neonatal and paediatric patients. By following structured protocols for insertion, maintenance and monitoring, clinicians can significantly lower the risk of infection, occlusion and dislodgement. These practices are supported by international best practice guidelines, including those from the British Association of Perinatal Medicine and the National Association of Neonatal Nurses, which emphasise the importance of standardisation and vigilance. Adhering to these recommendations ensures safer care, optimises catheter performance and ultimately enhances patient well-being.

Article Three:

SAFE REMOVAL OF A LONGLINE CATHETER IN NEONATES: BEST PRACTICE AND EVIDENCE-BASED GUIDANCE

Safe removal of a longline catheter is a critical step in neonatal care. Improper technique can lead to serious complications, including air embolism, bleeding, infection and, in rare cases, catheter embolus. Neonates are particularly vulnerable due to their small blood volume and fragile physiology, making strict adherence to protocols essential. This guidance is supported by the British Association of Perinatal Medicine (BAPM) Framework for Practice[16], National Association of Neonatal Nurses[15], and UK neonatal network recommendations[11], which emphasise preparation, aseptic technique and vigilance throughout the process.

Indications for Removal

Longlines should be removed when therapy is complete or alternative vascular access has been established. Other indications for removal include signs of infection, catheter-related complications, malfunction or physical damage to the line. UK guidance, including the NICE guidelines[12] and Thames Valley & Wessex Neonatal ODN protocols, provides clear criteria for removal to ensure patient safety.[13]

Preparation

Before removal, confirm the clinical indication for removal and obtain parental consent in line with BAPM recommendations.[16] Gather sterile equipment and maintain aseptic non-touch technique (ANTT) principles. Position the infant supine or in a slight Trendelenburg position to reduce the risk of air embolism.[14]

Removal Procedure

Perform hand hygiene and wear appropriate PPE, according to your local guidelines. Remove the dressing and any securement using aseptic technique, ensuring the infant remains warm and stable throughout. Withdraw the catheter slowly and steadily, never pulling against resistance to avoid catheter fracture. Apply firm pressure to the site until haemostasis is achieved, then cover with an air-occlusive dressing for at least 24 hours. Inspect the catheter tip for completeness and send for culture if infection is suspected.[15]

Infection Prevention

Strict aseptic technique during removal is essential. Although evidence shows there is a risk of post-removal bloodstream infection, routine prophylactic antibiotics are not recommended. Instead, monitor the site closely for 24-48 hours and document any signs of infection promptly.[16]

Troubleshooting

If resistance is encountered during withdrawal, stop immediately and seek senior review to prevent catheter embolus. For damaged or fractured catheters, escalate according to local safety alerts, including BAPM recommendations.[16]

Documentation

Record the date and time of removal, reason for removal, catheter length, tip integrity and site condition. Compliance should be audited in line with the National Neonatal Audit Programme to support quality improvement.[17]

Conclusion

Safe removal of longlines requires thorough preparation, meticulous aseptic technique and continuous vigilance. Following UK and European best practice guidelines reduces complications and improves neonatal outcomes, ensuring that this final stage of catheter management is as safe as insertion and maintenance.

Article Four:

SUSTAINABILITY IN NEONATAL VASCULAR ACCESS: CAN LONGLINE CATHETERS SUPPORT GREENER HEALTHCARE?

Sustainability is becoming a critical priority in healthcare, driven by ambitious targets such as the NHS commitment to achieve Net Zero by 2040 and the EU Green Deal objectives. Medical devices contribute significantly to the healthcare sector's carbon footprint, with single-use plastics being a major concern. Within neonatal care, vascular access is an area where sustainability considerations are gaining attention. Longline catheters may offer an opportunity to reduce environmental impact while maintaining clinical effectiveness. This aligns with NHS Greener Healthcare initiatives[18] and the Design for Life[19] roadmap.

Current Practice

Neonatal vascular access typically involves three main options:

- **Umbilical catheters:** These are used for short-term access but often require frequent replacement, generating high levels of waste.
- **Peripheral IV cannulas:** These have a short lifespan and involve multiple disposables, leading to repeated material use.
- **Longline catheters:** These are designed for prolonged therapy and require fewer replacements.

Using longlines reduces the need for multiple peripheral cannulas, helping to cut overall material use and minimise waste.[20]

Environmental Impact of Catheters

Single-use devices generate significant plastic waste, and materials such as PVC and additives such as DEHP[21] raise both health and environmental concerns[22]. Life Cycle Assessment studies indicate that reusable or hybrid kits can cut carbon footprints by up to 90 per cent compared to single-use alternatives[22].

How Longlines Support Sustainability

Longline catheters offer several sustainability advantages:

- **Fewer device changes:** A single longline can remain in place for 7 to 14 days, reducing the need for multiple peripheral cannula insertions and associated consumables.
- **Lower packaging waste:** Compared to repeated short-term devices, longlines generate less packaging waste.

Conclusion

Longline catheters can play a meaningful role in reducing waste and supporting sustainability goals by minimising device turnover. However, further innovation and policy alignment are essential to maximise their environmental benefits without compromising patient safety. Life-cycle costing should become a standard part of procurement decisions, and collaboration between clinicians, manufacturers and sustainability teams will be key to achieving Net Zero targets.

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