

Purpose/Design

Peripheral and central IV catheters are vital in acute care, with needleless connectors (NCs) playing a key role in safe access. NC types vary in function and fluid displacement, influencing catheter patency. This review highlights the different designs, terms and proper clamping techniques and how usage may reduce blood reflux and occlusion, improving vascular access outcomes.

Methods

This systematic review, conducted in August 2023, followed PRISMA guidelines to evaluate literature from 1999–2023 on needleless connectors (NCs) and catheter occlusion. Searches included multiple databases and terms related to NC function and occlusion. Needleless connectors (NCs) vary in design and impact catheter performance.

Results

This 2023 systematic review screened over 26,000 records, selecting 61 studies focused on needleless connectors (NCs) and occlusion. Anti-reflux NCs consistently showed reduced occlusion rates. Economic benefits included fewer nursing visits, reduced thrombolytic use, and cost savings. Despite high bias risk, evidence supports NC design as a key factor in catheter patency and fluid displacement outcomes.

Published In Vivo Study Results

| Published In Vivo Study Results for Occlusion With Type of Needleless Connector (NC) | Split-Septum Negative | Negative NC | Positive NC | Neutral NC | Anti-Reflux NC |
|--|-----------------------|-------------|-------------|------------|----------------|
| Berger, ³³ 2000 | Red | Green | Green | Green | Green |
| Bowers, ³⁴ 2008 | Green | Green | Green | Green | Green |
| Buchini et al., ³⁵ 2014 | Green | Green | Green | Green | Green |
| Buehrle, ³⁶ 2004 | Green | Red | Green | Green | Green |
| Buzas et al., ³⁷ 2022 | Green | Green | Green | Red | Green |
| Hitchcock, ³⁸ 2016 | Green | Green | Green | Red | Green |
| Holt & Lawrence, ³⁹ 2015 | Green | Green | Green | Red | Green |
| Jacobs et al., ⁴⁰ 2004 | Red | Green | Green | Green | Green |
| Jasinsky & Wurster, ⁴¹ 2009 | Green | Green | Green | Green | Green |
| Khalidi et al., ⁴² 2009 | Green | Green | Red | Green | Green |
| Logan, ⁴³ 2013 | Green | Green | Red | Green | Green |
| Marsh et al., ⁴⁴ 2023 | Green | Green | Green | Red | Green |
| Patel et al., ⁴⁵ 2017 | Green | Green | Green | Green | Green |
| Rummel et al., ⁴⁶ 2001 | Red | Green | Green | Green | Green |
| Sansalone et al., ⁴⁷ 2021 | Red | Green | Green | Green | Green |
| Schilling et al., ⁴⁸ 2006 | Green | Green | Yellow | Yellow | Green |
| Schora et al., ⁴⁹ 2023 | Green | Green | Green | Green | Green |
| Steere et al., ⁵⁰ 2018 | Green | Green | Green | Green | Green |
| Steere et al., ⁵¹ 2019 | Green | Red | Green | Green | Green |
| Steere, ⁵² 2022 | Green | Red | Green | Green | Green |
| Williams, ⁵³ 2018 | Green | Red | Green | Green | Green |

Legend: Green: positive outcomes Yellow: neutral outcomes Red: negative outcomes

Disclosures/IRB

The study followed ethical guidelines from the American Association for Public Opinion Research and was exempt from IRB review under DHHS regulations, as it involved publications. Ethical standards were followed, and no human participants were involved. NM is an employee of PICC Excellence receiving research funding from Nexus Medical Corporation.

Limitations

This systematic review identified variability, bias, and methodological inconsistencies in needleless connector (NC) publications. Manufacturer sponsorship and clamping confusion further limited findings, highlighting the need for higher-quality, independent research on NC performance.

Clinical Implications

Needleless connectors (NCs) vary in design and impact catheter performance. Negative NCs require a clamping sequence to prevent significant reflux. Positive NCs allow bidirectional flow and release more fluid, increasing occlusion risk. Anti-reflux NCs use pressure-activated valves to minimize reflux and maintain catheter patency. They offer the lowest displacement and simplify fluid control without requiring clamping.

Conclusion

This systematic review indicates that pressure-activated anti-reflux needleless connectors (NCs) are associated with a lower incidence of thrombotic catheter occlusion compared to negative and positive displacement NCs. Evidence from both in vitro and in vivo studies suggests these designs reduce blood reflux and buildup. While promising, additional high-quality research is needed to confirm their effectiveness in preventing IV catheter complications.