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ADULT GUIDELINE FOR ADMINISTRATION OF ANTIBIOTICS VIA MIDLINE CATHETER

Purpose

The purpose of this guideline is to provide recommendations for antibiotics that can be infused via a midline catheter, specifically for those agents commonly started during inpatient admission and intended for outpatient antibiotic therapy (OPAT). This is NOT a comprehensive policy for medication administration via midline during inpatient admission.

Background

Historically, peripherally inserted central catheters (PICC) have been widely used in patients who require long-term central venous access, particularly for those needing courses of outpatient antibiotics.[1,4] In recent years, renewed interest has emerged in the use of midline catheters, which, as long peripheral catheters, present reduced risk of infection and venous stenosis when compared to PICCs.[2,3,4] Additionally, midlines may result in reduced overall costs for IV therapy.[2,25] Typically, midlines are inserted in patients who require intravenous medications of between 6 to 14 days of duration, but some devices may be used for longer periods.[4] Midlines are not without drawbacks; compared to other options for IV access, they may have increased rates of mechanical complications and studies differ as to whether rates of associated thrombosis are lower or higher compared to PICCs.[1,4] However, a recent review of 987 articles of midline use demonstrated midlines compare favorably against other types of catheters in terms of failure and infection rates.[26]

Because the tip of a midline does not reside in central circulation, midline catheters cannot be used for continuous vesicant therapy, parenteral nutrition, or infusates with an osmolality greater than 900 mOsm/L.[15] Beyond these current recommendations from the Infusion Nurses Society (INS), however, there is debate about which medications are appropriate for use via midline. Midlines reside less superficially than a peripheral intravenous catheter (PIV), and therefore extravasation injuries may be masked in comparison to a PIV.[12] Prior to 2016, INS considered medications to be inappropriate for peripheral administration if they have a pH outside of the 5-9 range. This standard of practice was removed in 2016 after concern for lack of evidence strongly linking pH to phlebitis risk in literature.[14,15]

While INS recommends that each facility should develop guidelines for midline use[4], until recently, literature explicitly referencing use of individual antibiotics infused via midline catheter has been lacking. Michigan Medicine's historical reference for use of antibiotics via midline has been the pre-2016 INS criteria, as well as a reference sheet provided by Bard, our midline manufacturer. In 2019, several new articles became available with more specific reference to particular antibiotics being safely infused through midlines in an outpatient setting[6,7,8]. Based on this literature, this guideline provides recommendations for use of specific antibiotics planned to be administered as outpatient therapy via midline catheter.

Key Practice Recommendations

- Antibiotics acceptable for use via midline catheters* (see Exhibit B for evidence-based recommendations):
    - Ertapenem
    - Cefepime
    - Ceftriaxone
    - Daptomycin
    - Meropenem
    - Cefazolin
    - Ceftazidime

Requests to add additional antimicrobials to the included list should be sent to medusepolicy@med.umich.edu for consideration.

Exclusions

- Absolute exclusion criteria:
  - Known hypersensitivity/allergy to approved antibiotics
  - Prior phlebitis or vein injury to planned antibiotic via peripheral administration
  - Known contraindication to midline such as recent thrombosis within 30 days in same limb as planned midline placement, no available vein or decreased venous flow per assessment by VAST, or a vein preservation strategy.
  - Antibiotics requiring continuous infusion – contraindicated due to potential complications from traction on midline catheter[6]
- Relative exclusion criteria:
  - Recent infection or occlusion of midline
  - Age <18 years. Clinicians should reference pediatric literature. This guideline did not examine pediatric midline use.
  - History of thrombosis and hypercoagulability
  - Consideration should be made in terms of patient's anticoagulation status, clot history/timeline/location, and if previously provoked by line placement.
  - Duration of therapy exceeding 14 days

***Providers can further reference the Improve PICC Guidelines for vascular access queries;* https://www.improvepicc.com/

Administration & Monitoring

- Per Michigan Medicine Nursing Assessment and Care of Venous Access Devices policy Venous Access Devices: Assessment and Care (Venous Access Grid)
- Per Post-Acute Care Services Midline Catheter Care, Policy Stat ID: 6687848 (pending)

Restrictions

VAST approval and placement of midline catheter

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Exhibits:

Nursing Assessment and Care of Venous Access Devices
Venous Access Grid
Infection Prevention for Intravenous Peripheral Short Catheters Policy
Nursing Midline Catheter Removal
https://www.improvepicc.com/key-guidelines.html

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Exhibit B

Antibiotic	Evidence & Recommendations	pH	Osmolarity
Ertapenem	• Used via midline by Dickson et al., no reports of extravasation, necrosis etc. • Likely used via midline in Underwood et al. 2019 without apparent serious injury despite 13 extravasation events, cumulative number of OPAT days >200 • Used via midline in Seo et al 2019, no major complications reported (small number of infiltrations, no extravasations).	7.5[17]	---
Cefepime	• Used via midline by Dickson et al., no reports of extravasation, necrosis etc. <u>Negative</u>: • pH <5	4-6[18]	307
Ceftriaxone	• Used via midline by Dickson et al., no reports of extravasation, necrosis etc. • Used via midline in Seo et al 2019, no major complications reported (small number of infiltrations, no extravasations). • Low risk per Clark et al 2013.	6.6-6.7[20]	270-423
Daptomycin	• Used via midline by Dickson et al., no reports of extravasation, necrosis etc. • Likely used via midline in Underwood et al. 2019 without apparent serious injury despite 13 extravasation events, cumulative number of OPAT days >200. Daptomycin was the 4th most commonly used antibiotic. • Used via midline in Seo et al 2019, but only 2 patients, no major complications reported (small number of infiltrations, no extravasations). • No reports of vein injury, phlebitis, extravasation per internal MM safety reports (from 1/1/20-10/19/20) <u>Negative</u>: • pH <5 • Keller et al., daptomycin was associated with an increased rate of catheter complications, 4.45 [95% CI: 1.02–19.41] • However, use of midlines was low 3% (n=10), as was daptomycin 2.4% (n=8). So don't actually know if any of the daptomycin-catheter associated complications were in patients who were receiving via midline vs PICC or tunneled CVC.	4.7-6.8[21,22]	~323-364[22]
Meropenem	• Used via midline by Dickson et al., no reports of extravasation, necrosis etc. • Likely used via midline in Underwood et al. 2019 without apparent serious injury despite 13 extravasation events, cumulative number of OPAT days >200. • Low risk per Clark et al 2013.	7.3-8.3[23]	300
Cefazolin	• Used via midline by Dickson et al., no reports of extravasation, necrosis etc. • Low risk per Clark et al 2013. <u>Negative</u>: • pH <5	4.5-719	270-351
Ceftazidime	• Likely used via midline in Underwood et al. 2019 without apparent serious injury despite 13 extravasation events, cumulative number of OPAT days >200. • Low risk per Clark et al 2013. • No cases of midline catheter phlebitis per Harwood et al 1992[16], however did not report specifically on ceftazidime, though per the article "95% of patients received IV therapy consisting of tobramycin and ceftazidime"	5-8[24]	---

References

1. Bahl A, Karabon P, Chu D. Comparison of Venous Thrombosis Complications in Midlines Versus Peripherally Inserted Central Catheters: Are Midlines the Safer Option? Clin Appl Thromb Hemost. 2019 Jan-Dec;25:1076029619839150.
2. Chopra V et al. The Michigan Appropriateness Guide for Intravenous Catheters (MAGIC): Results From a Multispecialty Panel Using the RAND/UCLA Appropriateness Method. Ann Intern Med. 2015 Sep 15;163(6 Suppl):S1-40.
3. Adams DZ et al. The Midline Catheter: A Clinical Review. J Emerg Med. 2016 Sep;51(3):252-8.
4. Cawcutt KA et al. Optimizing vascular-access device decision-making in the era of midline catheters. Infect Control Hosp Epidemiol. 2019 Jun;40(6):674-680.
5. Le A and Patel S. Extravasation of Noncytotoxic Drugs: A Review of the Literature. Ann Pharmacother. 2014 Jul;48(7):870-886. Epub 2014 Apr 8.
6. Dickson et al. A Cluster of Failures of Midline Catheters in a Hospital in the Home Program: A Retrospective Analysis. J Infus Nurs. 2019 Jul/Aug;42(4):203-208.
7. Underwood J et al. Intravenous catheter-related adverse events exceed drug-related adverse events in outpatient parenteral antimicrobial therapy. J Antimicrob Chemother. 2019 Mar 1;74(3):787-790.
8. Seo et al. The Safety of Midline Catheters for Intravenous Therapy at a Large Academic Medical Center. Ann Pharmacother. 2020 Mar;54(3):232-238.
9. Reynolds et al. Management of extravasation injuries: a focused evaluation of noncytotoxic medications. Pharmacotherapy. 2014 Jun;34(6):617-32.
10. Vesely T et al. The diverse and conflicting standards and practices in infusion therapy. Journal of Vascular Access Devices (2002) 7 (3): 9–25.
11. Clark E et al. Reducing risk of harm from extravasation: a 3-tiered evidence-based list of pediatric peripheral intravenous infusates. J Infus Nurs. 2013 Jan-Feb;36(1):37-45.
12. Ryder M et al. Investigation of the role of infusate properties related to midline catheter failure in an ovine model. Am J Health Syst Pharm. 2020 Aug 7;77(16):1336-1346.
13. David V et al. Extravasation of Noncytotoxic Drugs. Ann Pharmacother. 2020 Aug;54(8):804-814.
14. Gorski L, Hagle M, and Bierman S. Intermittently delivered IV medication and pH: reevaluating the evidence. J Infus Nurs. Jan-Feb 2015;38(1):27-46.
15. Infusion Nurses Society. (2021) "Vascular Access Device (VAD) Planning" in Gorski L et al Infusion Therapy Standards of Practice. WolterKluwer. pp 59.
16. Harwood I, Greene L, Kozakowski-Koch J, et al. New peripherally inserted midline catheter: A better alternative for intravenous antibiotic therapy in patients with cystic fibrosis. Pediatric Pulmonology 1992 April 12; 4: 233-239.
17. Ertapenem. Package insert. Merck & Co; 2012
18. Cefepime. Package insert. Hospira; 2012
19. Cefazolin. Package insert. GSK; 2004
20. Ceftriaxone. Package insert. Sandoz; 2013
21. Daptomycin. Package insert. Cubist Pharmaceuticals; 2011
22. Frankenfeld et al. Daptomycin: a comparison of two intravenous formulations. Drug Des Devel Therapy 2018; 12: 1953–1958.
23. Meropenem. Package insert. AstraZeneca; 2016
24. Ceftazidime. Package insert. Teligent Pharma; 2017.
25. Nielsen E, Antonsen L, Mensel C, et al. The efficacy of midline catheters-a prospective, randomized, active-controlled study. Int J Infect Dis. 2021 Jan; 102:220-225.
26. Tripathi S, Kumar S, Kaushik S. The Practice and Complications of Midline Catheters: A Systemic Review. Crit Care Med 2021 Feb 1;49(2): e140-e150

Antimicrobial Subcommittee Approval: 02/2021	Originated: 06/2021
P&T Approval: 03/2021	Last Revised: 06/2021
CLABSI Steering Committee (reviewed/approved): 3/22/21 Revision History:	