ID 133867

Unlocking Potential

Vascular Access Adverse Events: A Comprehensive Literature Review and Comparative Analysis

Bouguerra Houda, MS; Waltl Franziska, BS; Koenraad Dierick, MSc, MBA

Terumo Blood and Cell Technologies

INTRODUCTION

Vascular access devices (VADs) play a crucial role in healthcare by providing access to the circulatory system for various medical treatments and procedures.[1] These devices come in several types, including central venous catheters and peripheral catheters.[2]

By significantly enhancing patient care, vascular access devices allow for the efficient delivery of treatments, such as chemotherapy, while minimizing the need for repeated needle sticks and patient discomfort. However, it's essential to note the fact that these devices can also present potential risks and complications. [3,4]

This literature review aims to identify and analyze the rates of adverse events associated with venous access, with a particular emphasis on peripheral vascular access and other commonly used access devices.

METHODOLOGY

A search was conducted through the PubMed database to identify relevant studies reporting on the rates of complications associated with vascular access devices, with a focus on peripheral catheters (PVCs), peripherally inserted central catheters (PICCs), midline catheters (MCs), and central venous catheters (CVCs).

Studies that provided data on the rates of complications were included.

Additional studies were retrieved by examining the reference lists of relevant publications.

The selected studies were analyzed, and data regarding the rates of specific adverse events were extracted and compared across the different catheter types.

	Inclusion	Exclusion
Population	Adult patients requiring vascular access	▪ Non-human ▪ Pediatric patients
Intervention	PIVC, MC, PICC, CVC	Other VADs
Comparator	PIVC, MC, PICC, CVC	Other VADs
Outcomes	Safety outcomes	Non-relevant outcomes
Study Design	Any primary	▪ Non-clinical studies ▪ Literature reviews, meta-analyses ▪ Commentaries, editorials, letters
Timeframe	Up to 2023	None
Language	English language	Any other language

Figure 1. PICOS Selection Criteria

RESULTS

The literature search yielded 29 studies reporting on the rates of adverse events associated with the different types of catheters.

Data on various complications, such as deep vein thrombosis (DVT), bloodstream infections, pneumothorax, phlebitis, cellulitis, dislodgment, infiltration, occlusion, pain/discomfort, leaking, hematoma, bleeding, and pulmonary embolism, were extracted and analyzed.

RESULTS (continued)

	Peripheral Intravenous Catheter (PIVC)	Peripherally Inserted Central Catheter (PICC)	Midline Catheter (MC)	Central Venous Catheter (CVC)
Deep Venous Thrombosis (DVT)	2.3%[5,6]	2.8%[5,18,19,20,21,22,23,24,25]	2.5%[18,20,25,30,31]	10.9%[31,32]
Bloodstream Infection (BSI)	0.2%[5,7,8,9,10]	8.0%[5,20,21,24,25,26,27,28]	11.1%[20,25,30]	11.8%[27,33]
Pneumothorax	-	-	-	17.0%[32]
Phlebitis	11.9%[8,9,11,12,13,14,15,16]	17.0%[29]	-	-
Occlusion	8.8%[7,9,11,12,16,17]	3.4%[20,22]	1.8%[20]	-
Pulmonary Embolism (PE)	-	0.2%[20,27]	0.1%[20]	1.4%[27]

Figure 2. VADs Safety Profile

The results revealed varying rates of complications across the different catheter types. The rates of DVT were 2.36% (range 1.80%-3.40%) for PVC, 2.87% (range 0.37%-19.4%) for PICC, 2.50% (range 1.05%-7.04%) for MC, and 10.91% (range 7.55%-15%) for CVC.

Bloodstream infections showed rates of 0.21% (range 0%-1.00%) for PVC, 8.02% (range 0%-32%) for PICC, 11.17% (range 0.3%-27%) for MC, and 11.82% (range 2.27%-19%) for CVC. Phlebitis rates were 11.96% (range 0.9%-28.8%) for PVC and 17.00% for PICC. Pneumothorax had a rate of 17.00% for CVC, while other complications displayed varied rates across different catheter types.

CONCLUSIONS

This literature review highlights the varying rates of adverse events associated with peripheral vascular access and other access devices. It emphasizes the importance of considering the specific catheter type when assessing the risks and complications associated with vascular access procedures.

The findings can guide healthcare providers in selecting the most appropriate catheter type based on the desired outcomes and potential risks.

Further research as well as a standardized reporting of adverse events will contribute to a better understanding of these complications and help in the development of effective prevention and management strategies.

REFERENCES

1. Cheung E, Baerlocher MO, Asch M, Myers A. Venous access: a practical review for 2009. Can Fam Physician. 2009;55(5):494-496.; **2.**Ponsoye M, Espinasse F, Coutte L, Lepeule R, Gnamien S, Hanslik T. Utilisation des cathéters veineux : lesquels choisir, comment prévenir leurs complications ? [The use of venous catheter : Which ones to choose, how to prevent their complications?]. Rev Med Interne. 2021;42(6):411-420. doi:10.1016/j.revmed.2020.10.385. ; **3.**Carr PJ, Higgins NS, Cooke ML, Mihala G, Rickard CM. Vascular access specialist teams for device insertion and prevention of failure. Cochrane Database Syst Rev. 2018;3(3):CD011429. Published 2018 Mar 20. doi:10.1002/14651858.CD011429.pub2; **4.** Akhtar N, Lee L. Utilization and Complications of Central Venous Access Devices in Oncology Patients. Curr Oncol. 2021;28(1):367-377. Published 2021 Jan 10. doi:10.3390/curroncol28010039; **5.** Periard D, Monney P, Waeber G, et al. Randomized controlled trial of peripherally inserted central catheters vs. peripheral catheters for middle duration in-hospital intravenous therapy. J Thromb Haemost. 2008;6(8):1281-1288. doi:10.1111/j.1538-7836.2008.03053.x; **6.** Leung A, Heal C, Banks J, Abraham B, Capati G, Pretorius C. The Incidence of Peripheral Catheter-Related Thrombosis in Surgical Patients. Thrombosis. 2016;2016:6043427. doi:10.1155/2016/6043427; **7.** Idemoto BK, Rowbottom JR, Reynolds JD, Hickman RL, Jr. The AccuCath Intravenous Catheter System With Retractable Coiled Tip Guidewire and Conventional Peripheral Intravenous Catheters: A Prospective, Randomized, Controlled Comparison. Journal of the Association for Vascular Access. 2014;19(2):94-102. ; **8.** Anderson NR. Influencing Patient Satisfaction Scores: Prospective One-Arm Study of a Novel Intravenous Catheter System With Retractable Coiled-Tip Guidewire Compared With Published Literature for Conventional Peripheral Intravenous Catheters. J Infus Nurs. 2016;39(4):201-209. doi:10.1097/NAN.0000000000000173 ; **9.** Rickard CM, Marsh NM, Larsen EN, et al. Effect of infusion set replacement intervals on catheter-related bloodstream infections (RSVP): a randomised, controlled, equivalence (central venous access device)-non-inferiority (peripheral arterial catheter) trial. Lancet. 2021;397(10283):1447-1458. doi:10.1016/S0140-6736(21)00351-2 ; **10.** Drugeon B, Guenezan J, Pichon M, et al. Incidence, complications, and costs of peripheral venous catheter-related bacteraemia: a retrospective, single-centre study. J Hosp Infect. 2023;135:67-73. doi:10.1016/j.jhin.2023.02.012; **11.** Galang H, Hubbard-Wright C, Hahn DS, et al. A Randomized Trial Comparing Outcomes of 3 Types of Peripheral Intravenous Catheters. J Nurs Care Qual. 2020;35(1):6-12. doi:10.1097/NCQ.0000000000000421 ; **12.** Miliani K, Taravella R, Thillard D, et al. Peripheral Venous Catheter-Related Adverse Events: Evaluation from a Multicentre Epidemiological Study in France (the CATHEVAL Project). PLoS One. 2017;12(1):e0168637. Published 2017 Jan 3. doi:10.1371/journal.pone.0168637; **13.** Larsen EN, Marsh N, O'Brien C, Monteagle E, Friese C, Rickard CM. Inherent and modifiable risk factors for peripheral venous catheter failure during cancer treatment: a prospective cohort study. Support Care Cancer. 2021;29(3):1487-1496. doi:10.1007/s00520-020-05643-2 ; **14.** Villa G, Giua R, Amass T, et al. In-line filtration reduced phlebitis associated with peripheral venous cannulation: Focus on cost-effectiveness and patients' perspectives. J Vasc Access. 2020;21(2):154-160. doi:10.1177/1129729819861187 ; **15.** Marsh N, Larsen EN, Takashima M, et al. Peripheral intravenous catheter failure: A secondary analysis of risks from 11,830 catheters. Int J Nurs Stud. 2021;124:104095. doi:10.1016/j.ijnurstu.2021.104095 ; **16.** Liu C, Chen L, Kong D, Lyu F, Luan L, Yang L. Incidence, risk factors and medical cost of peripheral intravenous catheter-related complications in hospitalised adult patients. J Vasc Access. 2022;23(1):57-66. doi:10.1177/1129729820978124 ; **17**. Carr PJ, Rippey JCR, Cooke ML, et al. From insertion to removal: A multicenter survival analysis of an admitted cohort with peripheral intravenous catheters inserted in the emergency department. Infect Control Hosp Epidemiol. 2018;39(10):1216-1221. doi:10.1017/ice.2018.190 ; **18.** 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;25:1076029619839150. doi:10.1177/1076029619839150; **19.** Wilson TJ, Brown DL, Meurer WJ, Stetler WR Jr, Wilkinson DA, Fletcher JJ. Risk factors associated with peripherally inserted central venous catheter-related large vein thrombosis in neurological intensive care patients. Intensive Care Med. 2012;38(2):272-278. doi:10.1007/s00134-011-2418-7; **20.** Swaminathan L, Flanders S, Horowitz J, Zhang Q, O'Malley M, Chopra V. Safety and Outcomes of Midline Catheters vs Peripherally Inserted Central Catheters for Patients With Short-term Indications: A Multicenter Study. JAMA Intern Med. 2022;182(1):50-58. doi:10.1001/jamainternmed.2021.6844 ; **21.** Capozzi VA, Monfardini L, Sozzi G, et al. Peripherally Inserted Central Venous Catheters (PICC) versus totally implantable venous access device (PORT) for chemotherapy administration: a meta-analysis on gynecological cancer patients. Acta Biomed. 2021;92(5):e2021257. Published 2021 Nov 3. doi:10.23750/abm.v92i5.11844; **22.** Yu B, Hong J. Safety and Efficacy of Peripherally Inserted Central Catheter Placement by Surgical Intensivist-Led Vascular Access Team. Vasc Specialist Int. 2022;38:41. Published 2022 Dec 30. doi:10.5758/vsi.220054; **23.** Rydell H, Huge Y, Eriksson V, et al. Central Venous Access and the Risk for Thromboembolic Events in Patients Undergoing Neoadjuvant Chemotherapy and Radical Cystectomy for Muscle-Invasive Bladder Cancer. Life (Basel). 2022;12(8):1198. Published 2022 Aug 6. doi:10.3390/life12081198; **24.** Comas M, Domingo L, Jansana A, et al. Cost-effectiveness Analysis of Peripherally Inserted Central Catheters Versus Central Venous Catheters for in-Hospital Parenteral Nutrition. J Patient Saf. 2022;18(7):e1109-e1115. doi:10.1097/PTS.0000000000001028 ; **25.** Bing S, Smotherman C, Rodriguez RG, Skarupa DJ, Ra JH, Crandall ML. PICC versus midlines: Comparison of peripherally inserted central catheters and midline catheters with respect to incidence of thromboembolic and infectious complications. Am J Surg. 2022;223(5):983-987. doi:10.1016/j.amjsurg.2021.09.029 ; **26.** Al Raiy B, Fakih MG, Bryan-Nomides N, et al. Peripherally inserted central venous catheters in the acute care setting: A safe alternative to high-risk short-term central venous catheters. Am J Infect Control. 2010;38(2):149-153. doi:10.1016/j.ajic.2009.06.008 ; **27.** Moss JG, Wu O, Bodenham AR, et al. Central venous access devices for the delivery of systemic anticancer therapy (CAVA): a randomised controlled trial. Lancet. 2021;398(10298):403-415. doi:10.1016/S0140-6736(21)00766-2 ; **28.** Mariggiò E, Iori AP, Micozzi A, et al. Peripherally inserted central catheters in allogeneic hematopoietic stem cell transplant recipients. Support Care Cancer. 2020;28(9):4193-4199. doi:10.1007/s00520-019-05269-z ; **29.** Griffiths VR, Philpot P. Peripherally inserted central catheters (PICCs): do they have a role in the care of the critically ill patient?. Intensive Crit Care Nurs. 2002;18(1):37-47. doi:10.1054/iccn.2002.1615 ; **30.** Jeon MH, Kim CS, Han KD, Kim MJ. Efficacy and Safety of Midline Catheters with Integrated Wire Accelerated Seldinger Technique. Vasc Specialist Int. 2022;38:2. Published 2022 Mar 21. doi:10.5758/vsi.210062 ; **31.** Sebolt J, Buchinger J, Govindan S, Zhang Q, O'Malley M, Chopra V. Patterns of vascular access device use and thrombosis outcomes in patients with COVID-19: a pilot multi-site study of Michigan hospitals. J Thromb Thrombolysis. 2022;53(2):257-263. doi:10.1007/s11239-021-02559-4 ; **32.** Lindgren S, Gustafson P, Hammarskjöld F. Analysis of central venous access injuries from claims to the Swedish Patient Insurance Company 2009-2017. Acta Anaesthesiol Scand. 2019;63(10):1378-1383. doi:10.1111/aas.13430 ; **33.** Zingg W, Sandoz L, Inan C, et al. Hospital-wide survey of the use of central venous catheters. J Hosp Infect. 2011;77(4):304-308. doi:10.1016/j.jhin.2010.11.011