Article published online: 2024-02-29

Prophylactic Antibiotic Use Prior to Port Placement and Its Effect on Insertion-Related Infection Rates: A Five-Year Retrospective Review

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Arab J Intervent Radiol 2024;8:31–35.

Abstract

Purpose The aim of this study was to compare insertion-related port infection rates between patients who received intraprocedural prophylactic antibiotics versus those who did not.

Materials and Methods All patients who underwent port insertion by interventional radiology from 7/1/ 2015 through 7/1/2020 at a single U.S.-based Health System were identified using electronic medical records database. During this period, 2,099 patients underwent port placement at three hospitals within the same health system. One-thousand sixty-three patients who underwent port placement at one hospital received periprocedural antibiotics and 1,036 patients at the two other hospitals did not receive antibiotics. Retrospective data were reviewed on each patient including demographics, reason for port insertion, and evidence of port infection. All relevant data up to 30 days postinsertion were reviewed, including blood cultures, unplanned readmissions, emergency room visits, and clinic visits. Qualitative trends were evaluated for various subgroups including presence of bacteremia, time from insertion, and demographics. Patients with an obvious external source of infection were excluded.

Results Insertion-related infection rate was 0.9% for the entire cohort, 1.23% for the antibiotic group, and 0.68% for the nonantibiotic group. The insertion-related infection for adult patients was 0.88% for the antibiotic group and 0.68% for the nonantibiotic group. The pediatric insertion-related infection rate was 7.69%, all of whom received intravenous antibiotics. No other clear qualitative differences were noted for analyzed subgroups.

Conclusion This study demonstrates low insertion-related port infection rate with no clinically significant difference between the groups that did or did not receive antibiotics. Subgroup analysis showed an exceptionally high infection rate in the pediatric population despite receiving preprocedure antibiotics.

Keywords
- antibiotics
- implanted port
- infection
- vascular

article published online
February 29, 2024

DOI https://doi.org/10.1055/s-0044-1779492.
ISSN 2542-7075.

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

Introduction

Implantable central venous access ports are commonly placed by interventional radiologists for patients requiring long-term central venous access, typically for infusion of fluids or chemotherapy.[1] Although insertion-related infection rates are low, the morbidity and costs associated with managing these complications are high with many patients requiring port removal and replacement.[2,3] As such, there has long been an emphasis on measures aimed at prevention of these complications including the use of periprocedural prophylactic antibiotics targeted at skin flora.[4] In the past, prophylactic antibiotics have been routinely used by many physicians despite lack of clear scientific benefit and classification of port placement as a clean procedure as defined by the National Academy of Sciences/National Research Council.[4–6]

The original Society of Interventional Radiology (SIR) practice guidelines regarding prophylactic antibiotics for various interventional radiologic procedures published in 2010 provided no consensus statement on the routine use of prophylactic antibiotics prior to port placement.[7] More recent studies, including meta-analysis and randomized controlled trials, have shown no significant benefit to the use periprocedural antibiotics prompting the SIR to recommend against the routine use of antibiotics in the most recent updated version of these guidelines published in 2018.[8–10]

Patients included in this study were from a single large U.S.-based health system that encompasses both a large academic hospital and multiple other smaller community-based hospitals. Up until July 2020, patients at the large academic hospital were routinely given periprocedural antibiotics prior to port placement, while patients at two other smaller community-based hospitals did not. The aim of this study was to compare insertion-related infection rates between those patients who received periprocedural antibiotics versus those who did not within the same healthcare system.

Materials and Methods

A query of two of the health systems radiologic databases identified all the patients who underwent port placement by interventional radiology at the large academic hospital and the two smaller community-based hospitals from July 1, 2015 through July 1, 2020. During this 5-year period, a total of 2,099 patients underwent port placement by interventional radiology at these three sites. Of these 2,099 patients, 1,063 patients, who underwent port placement at the large academic hospital, received 1 g of cefazolin prior to the procedure, while a total of 1036 patients, who underwent port placement at both of the other two community-based hospitals, did not.

A retrospective review of the electronic medical record was completed for each of these patients to identify those patients who had insertion-related port infections. Insertion-related port infections included both systemic central line-associated bloodstream infections (CLABSI) and local infections (port site). Data collected included demographics (sex, age), date of insertion, reason for port insertion, evidence of an insertion-related port infection, and date of port removal (if applicable). All relevant data regarding evidence of port infection were reviewed within a 30-day period from insertion including blood cultures, unplanned readmissions, emergency room visits, and clinic visits. Evidence of local infections included port site skin induration, erythema, purulent discharge, and dehiscence. Systemic infections were defined by the Center for Disease Control's definition of a CLABSI and required the presence of laboratory confirmed bacteremia taken from the patient with an indwelling port at least 2 calendar days after port placement.[11]

A detailed clinical chart review was completed to ensure that those patients with infections identified within 30 days of insertion were related to placement and not subsequent access. Patients with an obvious external source of infection were excluded from the study. Qualitative trends were analyzed for various subgroups including time of infection from insertion, demographics, reason for insertion, presence of bacteremia versus local infections, and inpatient versus outpatient status. Statistical analyses using the Pearson's chi-squared test were performed to assess differences in the frequency of insertion-related infections between the antibiotic and nonantibiotic groups.

Results

Over 60% of the patient in the study were female with a similar distribution between the antibiotic and nonantibiotic groups. The overall average age was approximately 61 years and was slightly higher in the nonantibiotic group (64 years) versus the antibiotic group (58 years) (►**Table 1**). Of note, the antibiotic group included 39 pediatric patients, while all the patients in

Table 1 Overall demographics

	Antibiotic	No antibiotic	Total
Age	58.08	64.02	61.01
Gender Male, *n* (%) Female, *n* (%)	1,063 392 (36.9%) 671 (63.1%)	1,036 408 (39.4%) 628 (60.6%)	2,099 800 (38.1%) 1,299 (61.9%)
Diagnosis Cancer Noncancer	 994 (93.5%) 69 (6.5%)	 1,021 (98.6%) 15 (1.4%)	 2,015 (96.0%) 84 (4.0%)

Table 2 Comparison of antibiotic versus no antibiotic populations

	Antibiotic	No antibiotic	Total	*p*-Value
n	1,063	1,036	2,099	0.273
Total infections, *n* (%)	12 (1.13%)	7 (0.68%)	19 (0.91%)	
Systemic, *n* (%)	7 (58.3%)	5 (71.4%)	12 (63.2%)	
Local, *n* (%)	5 (41.7%)	2 (28.6%)	7 (36.8%)	
Mean time (days) from insertion to infection	8.8	15.9		

Table 3 Adult demographics and infection rate

	Antibiotic	No antibiotic	*p*-Value
N	1,024	1,036	0.599
Age	60.15	64.02	
Gender	1,024	1,036	
Male, *n* (%)	371 (36.2%)	408 (39.4%)	
Female, *n* (%)	653 (63.8%)	628 (60.6%)	
Diagnosis			
Cancer	989 (96.6%)	1,021 (98.6%)	
Noncancer	35 (3.4%)	15 (1.4%)	
Total Infections, *n* (%)	9 (0.88%)	7 (0.68%)	
Systemic, *n* (%)	5 (55.6%)	5 (71.4%)	
Local, *n* (%)	4 (44.4%)	2 (28.6%)	
Mean time (days) from insertion to infection	8.9	15.9	

the nonantibiotic group were adults. Of the 2,099 patients in both the antibiotic and nonantibiotic groups, 96% of patients had ports placed for infusion of chemotherapy with a similar distribution between the two groups (►**Table 1**). A total of 19 infections were identified (12 systemic and 7 local; ►**Table 2**). The overall infection rate for both groups was 0.91%. There was no statistically significant difference in the infections rates between the antibiotic group (1.13%) and the nonantibiotic group (0.68%; $p = 0.273$; ►**Table 2**). The average time from insertion to infection was 8.8 days in the antibiotic group and 15.9 days in the nonantibiotic group (►**Table 2**).

When the 39 pediatric patients were removed from the antibiotic group, the adult infection rate in the antibiotic group was 0.88% and the mean time to infection was 8.9 days (►**Table 3**). There was no statistically significant difference in the adult infection rates between the two groups (0.88 vs. 0.685; p-value = 0.599; ►**Table 3**). The average age of the pediatric subgroup was 3.89 years with 21 males and 18 females (►**Table 4**). A total of three pediatric infections were identified (2 systemic and 1 local) yielding a 7.69% pediatric infection rate. Mean time from insertion to infection in the pediatric subgroup was 12 days (►**Table 4**).

Table 4 Pediatric demographics and infection rate

n	39
Age	3.89
Gender	
Male, *n* (%)	21 (53.8%)
Female, *n* (%)	18 (46.2%)
Diagnosis	
Cancer	5 (12.8%)
Noncancer	34 (87.2%)
Infections, *n* (%)	3 (7.69%)
Systemic, *n* (%)	2 (66.67%)
Local, *n* (%)	1 (33.33%)
Mean time (days) from insertion to infection	12

Discussion

The majority of all the patients included in this study (>95%) was oncology patients who underwent port placement for infusion of chemotherapy. Nearly half of the nononcologic patients (~40%) were in the subgroup of pediatric patients (within the antibiotic group), most of whom underwent port placement for secure venous access in the perioperative period around organ transplantation. This finding suggests that the vast majority of all the patients included in this study were likely immunosuppressed making an insertion-related infectious event more consequential. Nearly two-thirds (61.9%) of all the patients included in the study were female likely due to the healthcare system's comprehensive breast cancer center operating within these three sites.

The overall insertion-related infection rate for both the entire cohort (0.91%) and the adult patients (0.78%) was low and comparable to prior studies.[12] A 2016 meta-analysis by Johnson et al comparing infections rates for totally implanted venous access devices with and without antibiotic prophylaxis found an overall infection rate of 1.25% with similar rates in the two groups.[8] Interestingly, most of the infections identified in those studies were local infections, while

systemic infections were more common in our patient population no matter the group or subgroup. While this difference was not statistically significant, it suggests that we may be missing some subclinical local infections that were not documented in the electronic medical record.

When comparing insertion-related infection rates between the antibiotic and nonantibiotic groups for the entire cohort, the antibiotic group was unexpectedly found to have slightly more infections than the nonantibiotic group (12 vs. 7); although this difference was not statistically significant. The higher number of infections found in the antibiotic group may be partially accounted for by the fact that patients in the antibiotic groups came from a large tertiary care, academic referral center, while the patients in the nonantibiotic group came from community-based practices without trainees in interventional radiology. Subgroup analysis found that the small number of pediatric patients in the antibiotic group (39/1063) accounted for nearly 16% of all the infections identified and 25% of infections identified in the antibiotic group. When excluding the pediatric subgroup and comparing adults only, the overall infection between the antibiotic and nonantibiotic groups was comparable at 0.88 versus 0.68%. Therefore, as expected, prophylactic antibiotics made no significant difference on the insertion-related infection rates for both the entire cohort ($p = 0.273$) and adults only ($p = 0.599$).

A substantially higher number of insertion-related infections were found in the pediatric population (7.69%) compared to the adult population who also received antibiotics (0.88%). Of note, all three insertion-related infections occurred in patients with multivisceral transplants whose ports were placed in the inpatient setting. While there are no published studies to date which evaluate the insertion-related infection rates for radiologically placed ports in the pediatric population, multiple observational studies looking at complications of radiologically placed pediatric ports have found overall infection rates ranging from 2.56 to 14%.[13–15] The markedly higher infection rate in our pediatric population may be due to the anecdotally higher number of comorbidities in pediatric population specific to that large academic hospital when compared to adults. Future studies are needed to evaluate port insertion-related infectious rates in the pediatric population and whether prophylactic antibiotics are indicated.

The mean time to infection was nearly double in the nonantibiotic group (15.9 days) when compared to the antibiotic group both with (8.8 days) and without (8.9 days) the pediatric subgroup. Differences in practice patterns between the academic (antibiotic) and community (nonantibiotic) settings may account for the earlier detection of infectious events in the antibiotic group. While we acknowledge that an infection identified greater than 14 days after placement may related to subsequent access rather than placement, we extended our search to 30 days post-placement to be conservative and ensure that we were catching all patients with a placement-related infectious event who may have presented later.

Our study was limited in its retrospective nature making it difficult to discern between insertion-related infections and those that were unrelated to placement but occurred within 30-day after insertion. Additionally, documentation of infectious events between the three hospitals was not uniform especially in the earlier years of the study. Future prospective studies with uniform, well-documented short-term follow-up would be instructive. In conclusion, our data supports the most recent SIR guidelines recommending against the routine use of antibiotics prior to port placement.

The authors declare that they had full access to all of the data in this study and the authors take complete responsibility for the integrity of the data and the accuracy of the data analysis. The authors declare no conflict of interest.

Note

Saher S. Sabri is Chief of Interventional Radiology, Medstar Health System and Division Chief of Interventional Radiology at Medstar Georgetown University Hospital

Conflict of Interest

S.S.S. reported consulting fees from Boston Scientific, Medtronic, participation on a Data Safety Monitoring Board or Advisory Board for Alucent Medical, and leadership or fiduciary role in VIVA Foundation Board member.

References

1 Pinelli F, Cecero E, Degl'Innocenti D, et al. Infection of totally implantable venous access devices: a review of the literature. J Vasc Access 2018;19(03):230–242
2 Pegues D, Axelrod P, McClarren C, et al. Comparison of infections in Hickman and implanted port catheters in adult solid tumor patients. J Surg Oncol 1992;49(03):156–162
3 Lebeaux D, Fernández-Hidalgo N, Chauhan A, et al. Management of infections related to totally implantable venous-access ports: challenges and perspectives. Lancet Infect Dis 2014;14(02): 146–159
4 Ryan JM, Ryan BM, Smith TP. Antibiotic prophylaxis in interventional radiology. J Vasc Interv Radiol 2004;15(06):547–556
5 Spies JB, Rosen RJ, Lebowitz AS. Antibiotic prophylaxis in vascular and interventional radiology: a rational approach. Radiology 1988;166(02):381–387
6 Altemeier WA. Manual on Control of Infection in Surgical Patients. Lippincott Williams & Wilkins; 1984
7 Venkatesan AM, Kundu S, Sacks D, et al; Society of Interventional Radiology Standards of Practice Committee. Practice guidelines for adult antibiotic prophylaxis during vascular and interventional radiology procedures. Written by the Standards of Practice Committee for the Society of Interventional Radiology and Endorsed by the Cardiovascular Interventional Radiological Society of Europe and Canadian Interventional Radiology Association [corrected]. [corrected]J Vasc Interv Radiol 2010;21(11): 1611–1630, quiz 1631
8 Johnson E, Babb J, Sridhar D. Routine antibiotic prophylaxis for totally implantable venous access device placement: meta-analysis of 2,154 patients. J Vasc Interv Radiol 2016;27(03):339–343, quiz 344
9 Karanlik H, Kurul S, Saip P, et al. The role of antibiotic prophylaxis in totally implantable venous access device placement: results of a single-center prospective randomized trial. Am J Surg 2011;202 (01):10–15

10 Chehab MA, Thakor AS, Tulin-Silver S, et al. Adult and pediatric antibiotic prophylaxis during vascular and IR procedures: A Society of Interventional Radiology Practice Parameter Update Endorsed by the Cardiovascular and Interventional Radiological Society of Europe and the Canadian Association for Interventional Radiology. J Vasc Interv Radiol 2018;29(11):1483–1501.e2
11 STRIVE Infection Control Training | CDC. Published September 22, 2021. Accessed January 10, 2023 at: https://www.cdc.gov/infectioncontrol/training/strive.html
12 Covey AM, Toro-Pape FW, Thornton RH, et al. Totally implantable venous access device placement by interventional radiologists: are prophylactic antibiotics necessary? J Vasc Interv Radiol 2012; 23(03):358–362
13 Munro FD, Gillett PM, Wratten JC, et al. Totally implantable central venous access devices for paediatric oncology patients. Med Pediatr Oncol 1999;33(04):377–381
14 Lorenz JM, Funaki B, Van Ha T, Leef JA. Radiologic placement of implantable chest ports in pediatric patients. AJR Am J Roentgenol 2001;176(04):991–994
15 Ghmaird AS, Mohammad Alnoaiji MS, Alalawi YS, et al. Port-a-Cath insertion in pediatric patients with malignancy in Tabuk. Cureus 2021;13(08):e17379

