Journal of Radiology Nursing xxx (2017) 1–8

Contents lists available at ScienceDirect

Journal of Radiology Nursing

journal homepage: www.radiologynursing.org

Prophylactic Antibiotic Administration in Vascular Interventional Radiology

Melanie Camp, DNP, MA, BS, RN [a,*], Jennan Phillips, PhD, RN, FAAOHN [b], Cynthia Selleck, PhD, RN, FAAN [b]

[a] Heat and Vascular Center, University of Alabama Hospital, Birmingham, AL
[b] UAB School of Nursing, University of Alabama at Birmingham, Birmingham, AL

Keywords:
Antibiotics
Prophylaxis
Interventional radiology
Surgery

A B S T R A C T

Vascular interventional radiology (VIR) laboratories perform a myriad of procedures. Although antibiotic prophylaxis is not beneficial in all procedures performed in the VIR laboratory, in cases where antibiotic prophylaxis is recommended, evidence-based processes should be implemented to ensure guidelines established by the Society of Interventional Radiology are followed. This project evaluated if the addition of an evidence-based algorithm to the current prophylactic antibiotic process would improve compliance with administration within 1 hr of the procedure start time. Algorithms were developed and used for five common procedures in the VIR laboratory to ensure that prophylactic antibiotics were administered according to guidelines. Use of the algorithms was initiated in December 2016. The prophylactic antibiotic compliance rate using the algorithms for 3 months was compared with customary practice prophylactic antibiotic compliance rates for the same period 1 year earlier. The customary practice compliance rates averaged between 39% and 55% during the preintervention 3 months studied. After implementation of the algorithms, prophylactic antibiotic compliance rates ranged from 92% to 97%, thus indicating that the use of algorithms to help support usage of prophylactic antibiotics can positively impact quality improvement.

Introduction

According to Drake (2011), surgical site infections account for 38% of the total number of infections acquired within the hospital setting. The Centers for Medicare and Medicaid Services and the Centers for Disease Control spearheaded a program in 2002 to focus on the use of prophylactic antibiotics to help address the problem (Drake, 2011). Antibiotic prophylaxis in the surgical environment is targeted at preventing the surgical wound from becoming contaminated or infected by body fluids or organisms contained on the patient's skin (Venkatesan et al., 2010).

With advances in interventional devices and imaging technology, interventional radiology (IR) has grown into a practice that allows physicians to use minimally invasive techniques to treat disease processes. As the IR specialty evolved, organizations such as the Society for Interventional Radiology (SIR) adopted many infection-reducing protocols from the surgical specialty (Moon, Tam, Kikano, & Karuppasamy, 2010; Ryan, Ryan, & Smith, 2004; Sutcliffe et al., 2015; Venkatesan et al., 2010). In IR procedures, surgical wounds are tiny; however, infection can arise from the interaction that takes place between the catheter, space being manipulated, and bloodstream (Venkatesan et al., 2010).

Vascular interventional radiology (VIR) laboratories perform a myriad of procedures ranging from simple tunneled peripherally inserted central catheter lines to complex transjugular intrahepatic portosystemic shunt placements. Infections are a common complication in the VIR environment; thus, the practice of administering prophylactic antibiotics (Pr-Abx) was adopted by SIR over 25 years ago (Sutcliffe et al., 2015).

Smith, Lankster, and McInnis (2007) acknowledge that infections remain a common complication of IR procedures and stress the importance of appropriate timing of the prophylactic antibiotic to ensure effectiveness of the medication. The VIR at a large academic medical center in the southeastern United States established a goal to administer Pr-Abx within 1 hr of the procedure start time; however, compliance rates consistently fell below 60%.

The purpose of this project was to evaluate if the addition of an evidence-based algorithm to the current Pr-Abx process would

The authors declare no conflicts of interest.

* Corresponding author: Melanie Camp, RN Quality Improvement, 619 19th Street S. NP6361, Birmingham, AL 35294.
E-mail address: mecamp@uab.edu (M. Camp).

https://doi.org/10.1016/j.jradnu.2017.10.010
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improve compliance with Pr-Abx administration within 1 hr of the procedure start time.

Materials and methods

The population served by the VIR at the academic medical center where this project took place is predominately adults. There are 14 procedure laboratories and 48 beds in the center. The procedure laboratory skill mix consists of 23 registered nurses (RNs) and 27 radiology technologists with a nurse:patient ratio of 1:1. The preprocedure unit (PRU) and postprocedure area (stretcher bay) consist of 22 and 26 beds, respectively. The staff skill mix in the preprocedure/postprocedure areas consist of 16 RNs, 2 unit secretaries, and 7 patient care technicians with a nurse:patient ratio of 1:4 to 6 in the PRU and 1:2 in the stretcher bay. Most staff works 10-hr shifts that vary between the hours of 0530 and 2100 with on-call coverage for nights and weekends.

The VIR medical team consists of seven full-time interventional radiologists, three full-time physician assistants, five full-time IR fellows, and rotating radiology residents. Imaging devices and techniques such as fluoroscopy, ultrasound, and computed tomography are used to provide treatments for such things as malignant tumors, peripheral arterial, venous, urologic, and hepatobiliary disease (UAB School of Medicine, 2015).

Prophylactic Antibiotic Administration Areas for Improvement

The administration of Pr-Abx within 1 hr of the procedure start time was one of the three goals outlined by the VIR for the calendar year beginning January 2016. Unit staff members were educated on the goal, and small process improvement measures were taken to improve the flow and ensure that antibiotics were not given outside the 1-hr time frame. The VIR unit hired a quality improvement (QI) RN who began working on the unit in February 2016. One of the first tasks the QI RN was charged with was reviewing Pr-Abx compliance rates on the unit to determine if patients were receiving their prophylactic antibiotic within an hour of the procedure start time. The data for cases performed in March 2016 and April 2016 showed a compliance rate of 59% and 53%, respectively. These figures identified an area for improvement.

A failure mode effect analysis (FMEA) was completed, and the process steps and failure modes identified in the analysis are summarized herewith:

1. Order for Pr-Abx entered when procedure scheduled: The Pr-Abx can either be entered or not entered at the time procedure is scheduled.
2. Pr-Abx: The Pr-Abx can either be given as ordered, not given as ordered, or given and not documented in the patient electronic medical record (EMR).
3. Appropriate Pr-Abx given: The appropriate Pr-Abx for the specific procedure scheduled can either be given or not given.

The information gathered from the microsystem, initial compliance rates, and the FMEA was used to identify the components of the evidence-based Population/Patients, Intervention, Comparison, Outcome, and Time (PICOT) question and frame the project. The PICOT components are outlined in Table 1. The initial PICOT question identified was as follows: In patients admitted for IR procedures requiring prophylactic antibiotics, how does a standardized prophylactic antibiotic protocol compare with a nonstandardized protocol in ensuring the appropriate antibiotic is given within 1 hr before the procedure start time?

Table 1
Components of the PICOT

P	Population/Patients: Patients admitted to VIR for interventional procedure
I	Intervention: Evidence-based addition to customary Pr-Abx process
C	Comparison: Customary Pr-Abx process
O	Outcome: Pr-Abx given within 1 hr before the procedure start time
T	Time frame: December 2015–February 2016, December 2016–February 2017

VIR = Vascular interventional radiology; Pr-Abx = prophylactic antibiotics.

Literature Search and Synthesis

Several key terms were identified to search for the highest level of evidence, including antibiotics, prophylaxis, Interventional Radiology, and surgery. The search strategies involved searching the key terms alone and in combination using the PubMed and CINAHL databases. Numerous articles matched the search criteria. The abstracts for each article were reviewed to determine if the article was research based and if it addressed the initial PICOT question. The articles providing the best match were then critically appraised to assess both the level and the quality of evidence.

Venkatesan et al. (2010) provided a systematic review of the literature with the aim of developing recommendations to guide Pr-Abx in VIR. The wealth of existing evidence revolves around peer-reviewed literature, and despite the lack of randomized controlled trials (RCTs) to support Pr-Abx, the practice has evolved into the gold standard for care. According to Venkatesan et al. (2010), the limitations resulting from the lack of RCT are compensated by the potential to improve patient safety and procedure effectiveness.

The timing of Pr-Abx administration was adopted from the surgical setting, and evidence from the literature was presented that showed the potential for postprocedure infections increased the longer the time frame between medication administration and procedure start time (Venkatesan et al., 2010). The article described a randomized double-blind study from the gastrointestinal surgical setting that showed patients not receiving Pr-Abx had a 16% infection rate compared with a 15% infection rate when the Pr-Abx was provided after the procedure and a 6% infection rate when the medication was provided 1 hr before the procedure. The recommendation was therefore made that Pr-Abx be administered just before the procedure begins (Venkatesan et al., 2010).

Moon et al. (2010) used a systematic review of the literature to shape recommendations for Pr-Abx administration for 17 common IR procedures. Emphasis was placed on potential complications for each procedure and the patient populations at risk for the complications. Timing of the Pr-Abx is important with shorter-infusing intravenous antibiotics having greater efficacy than their longer-infusing counterparts when administered 30 min before the procedure start time (Moon et al., 2010).

Sutcliffe et al. (2015) pointed out that during 25 years ago, surgical and medical literature was used to shape the Pr-Abx guidelines in IR and has developed into the standard of care although evidence from RCT is lacking. Technological advances have increased both the volume and the type of procedures performed in the IR laboratories. According to Sutcliffe et al. (2015), the major complications associated with most IR procedures are infections, and these authors provide updated recommendations on the timing and duration of Pr-Abx. The article presented evidence dating back to the late 1950s that showed Pr-Abx were most effective when given before starting the procedure and added the results of a recent prospective study involving 29 hospitals and more than 4,000 randomly selected patients undergoing various surgical procedures to further support the evidence. The study showed an infection rate of 5.3% when the Pr-Abx was given after the procedure compared with 2.4% when the Pr-Abx was given 31