A Quality Approach to Reducing the Occurrence of Occluded Leukocyte Reduction Filters During Platelet Transfusion

NCPD 1.5 Contact Hours

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ABSTRACT

Background: In 2019, an increase in clotted platelet filter occurrences was noted with the implementation of new leukocyte reduction filters through a volumetric pump.

Local Problem: Occluded platelet filters contribute to delays in platelet transfusions, additional nursing workflows, and potential wastage of platelets, leading to staff and patient dissatisfaction.

Methods: Direct observation of nursing practice with priming platelet filters identified opportunities for improvement. Education was designed incorporating manufacturer recommendations with results of the observations. Nursing education was disseminated through small group sessions, one-to-one teaching, tip sheets, and an e-learning video.

Results: Nursing education interventions resulted in a 170% reduction in the reported monthly filter occlusion rate.

Conclusion: Engagement of nurses in quality improvement processes and collaboration across departments led to a sustained decrease in the clotted platelet filters.

Keywords: leukocyte reduction filter, occluded platelet filters, platelet administration, quality improvement, volumetric pump

PROBLEM DESCRIPTION

Blood and blood component transfusions are one of the most common procedures performed during hospitalizations, with an average of 17 221 000 products transfused in the United States annually.[1] At a National Cancer Institute–Designated Comprehensive Cancer Center, 161 821 transfusions were administered in FY2020. To put this in perspective, the institution transfused approximately 1% of all blood products used in the United States.[2] The organization developed a Hemovigilance Unit (HVU) to provide real-time surveillance, early identification, and prompt interventions for patients suspected of having a transfusion reaction. This specialized HVU was designed on the basis of the electronic intensive care unit (eICU) model[3] and comprised registered nurses (RNs) and advanced practice providers who collaborate to provide continuous monitoring of blood product administration. In addition to identifying potential transfusion reactions, continuous, real-time surveillance allows the opportunity to monitor and intervene in other areas of blood transfusion such as compliance, safety, education, etc.

In 2019, the nursing team in the HVU noticed an abrupt increase in the frequency of "paused" platelet occurrences in the electronic health record (EHR) during transfusions that were unrelated to a transfusion reaction. The pauses were attributed to occluded PXL8C filters, which are high-efficiency leukocyte reduction filters for platelet transfusions created by Haemonetics. A review of the facility's internal Safety Intelligence event reporting system also showed an increase

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in the number of occluded PXL8C filters. This disruption of transfusion occurred across all patient care areas and with all 3 PXL8C lot numbers available in the institution.

Filter occlusions can impair patient safety, cause delays in care, lead to a decline in patient and nurse satisfaction, and lead to increased labor in the blood bank. Because of the large volume of products administered, it was essential to evaluate the occurrences to determine the cause and propose a solution. The objective of this quality improvement (QI) project was to evaluate and reduce the occurrence of platelet transfusion interruptions associated with occluded PXL8C filters.

AVAILABLE KNOWLEDGE

In a literature search, using the terms "platelet filter" and "leukocyte reduction filter," no previous studies were found regarding platelet filter occlusions, nursing technique for priming platelets with leukocyte reduction filters, or administering platelets with leukocyte reduction filters via volumetric pump.[4] In addition, there were no available alternatives for replacing the PXL8C, as they are the only FDA-approved large-volume platelet filters on the market.[5] The literature review did not provide insight into whether platelets can be administered via volumetric pump, and it also did not yield content pertaining to platelet filter occlusions at other organizations.

RATIONALE

Utilizing the Donabedian's[6] model of quality process by analyzing structure, process, and outcome as well as the Ishikawa diagram analysis,[7] HVU transfusion specialists came to the conclusion that the filter occlusions likely originated from user error, equipment factors (volumetric pumps, new tubing, intravenous [IV] pole setup), and the sensitivity of the new filter. On the basis of observations and end-user interviews, a knowledge deficit related to priming and administering of platelets with the new filters was identified as one of the major issues contributing to filter occlusion. Other possible contributing factors included the recent implementation of a new variation in tubing clamps (roller clamps vs slide clamps), and the change from administering platelets via gravity drip to administering platelets via volumetric pump (Alaris pump). Prior to this change of practice, no issues were reported with the Alaris pump or the infusion tubing sets while administering packed red blood cells via volumetric pump, which is the current standard of practice within the institution.

SPECIFIC AIMS

The aim of this QI project was to decrease the occurrence of leukocyte filter occlusions during platelet transfusion by 50%, from 59 reported occlusions to less than 29.5 occlusions, over a 6-month period. Reaching this goal would decrease delays in platelet administration, improve nursing workflow with platelet transfusion, and reduce cost of replacing platelet leukocyte reduction filters. The project focus was aimed at educating the end users, who were identified as the bedside clinicians.

METHODS

Context

The project was submitted as a formal QI project and approved by the institutional Quality Improvement Advisory Board. Executive nursing leadership support was obtained, and an interprofessional collaboration between nursing, laboratory medicine, and the product manufacturers (of platelet leukocyte reduction filters, volumetric pumps, and blood administration tubing) was formed. Baseline data collection included the number of reported occluded platelet filters and the calculated platelet filter occlusion rate per month. Safety reports were entered by administering clinicians into the patient Safety Intelligence event system. The platelet filter occlusion rate was calculated as the numerator (number of monthly reported platelet filter occlusions) and the denominator (total number of monthly platelet transfusions). The team utilized Donabedian's[6] model of quality as a guide to orchestrate the examination of the structure, processes, and, ultimately, the outcomes.

Interventions

Interventions included education on the effective priming and administration of platelets according to the manufacture guidelines[8] and transfusion specialists directly observing the practice of bedside clinician priming and administration practices. A team of key players and vested stakeholders was assembled that included the end users (clinical nurses), a laboratory medicine manager, HVU nurses, HVU supervisor, Nursing and Transfusion Medicine department chairs,

Nursing Education, and a transfusion medicine quality expert. The team engaged a data analyst from the information technology team. This team met regularly for all stages of the project to provide input and discuss progress. Process mapping and Ishikawa diagramming[7] were used to analyze the various causes of platelet filter occlusion (see Supplemental Digital Content, Figure, available at: http://links.lww.com/JNCQ/A861).

Using the Ishikawa diagram,[7] causes of failure were streamlined into the categories of user error, equipment factors, and filter function. User error factors included errors in the practice of priming and setup of the platelet administration tubing and filter, errors in the setup of the administration pumps, and overall variations in practice. These factors allowed for backflow of air or saline into filtration compartment, which led to malfunction of the filter. Equipment factors were attributed to the volumetric pumps, administration tubing, and IV pole setup. Change in practice dictated that all platelet transfusions be administered via volumetric pump to regulate the rate of transfusion. There is no recommended rate or duration for platelet administration via volumetric pump available as a reference.[4] The volumetric pumps were frequently alarming "high-pressure alarm pump occlusions" during transfusion. It was difficult to identify whether the alarms were related to pump or filter malfunction. Sounding of the alarm led to a pause in transfusion, with troubleshooting procedures completed by the nursing staff, and numerous delays were reported. A manufacturer supply shortage in the administration tubing resulted in substitution of tubing that had slide clamps versus roller clamps. Unfamiliarity in using the new tubing resulted in increased backflow of air during priming and administration. Variation of IV pole setup allowed for differences in filter positioning that resulted in backflow of air bubbles, causing platelet filter malfunction. A variety of available hooks, clamps, and other supportive equipment for the IV poles were found throughout the institution, which led to a lack of consistency in equipment setup.

Interventions began with a consultation between the HVU staff and the platelet leukocyte reduction filter vendor to discuss the concerns encountered by nurses. The vendor disclosed that air or saline infiltration can lead to PXL8C filter occlusion.[5] This infiltration can occur at 2 stages of platelet transfusion—priming and transfusing. Proper, consistent practice for priming, setup, and administration is key to successful transfusion. The vendor team led training sessions that were coordinated through the Nursing Education department. The focus of the sessions was to develop practice experts among the end users. Vendor representatives also focused on sharing "user tips" such as angle of tubing drip chamber, location of drip chamber in relation to pump, and placement of saline flush bag. Because of the continuation of the tubing shortage, demonstrations were provided on how to utilize the slide clamps as well as the roller claps to familiarize end users to this technique. A total of 75 nurses attended these sessions. The scope of participants included charge nurses, clinical nurse leaders, HVU nurses, and clinical nurses from the inpatient and ambulatory care units.

The next intervention was direct observation of nursing practice for platelet transfusion administration. The HVU nursing team conducted 23 direct observations across a total of 8 inpatient and outpatient patient care units over a 2-week period. During the 2-week observation period, clinical nurses were asked to contact the HVU to report filter occlusion. After receiving the call, HVU RN was deployed to observe the practice and assist with administration at bedside. The observing HVU RN completed an audit survey regarding priming techniques and filter position for each platelet transfusion observed (Table). The goal of these real-time observations was to assist in the identification of potential causes for filter occlusion. The HVU auditors addressed discrepancies in real time and provided education to the bedside clinician when warranted. Data collected was compared with the manufacturer's recommendations.

A tip sheet was tailored to the clinicians' needs that were identified through both the training sessions and the direct observations. The handout was a 1-page, 2-sided flyer that demonstrated the proper practice of platelet administration set priming through pictures and written instruction. It was presented at the Clinical Nurse Leader Best Practice Meeting, disseminated through a nursing communication format, and made available to nursing leaders to provide to staff. The annual blood component administration computer-based training for nurses was updated to reflect the manufacturer's recommendations. As a final quality intervention, occluded platelet leukocyte reduction filters

Table. Observation Survey Questions
Platelet Administration Using Filter Observation Questions:
1. Did the RN prime the tubing with saline prior to spiking the platelets?
2. Did the RN close all the clamps on the tubing prior to spiking the platelets?
3. Were all the vertical or horizontal clamps below and above the platelet filter clamped prior to the RN spiking the platelets?
4. Did the RN shake the bag enough to cause bubbles to form in the unit?
5. Did the RN keep the platelet filter vertical throughout priming and start of the transfusion?
6. Did the RN squeeze the saline chamber after the platelets were spiked?
7. Were all the clamps closed if the RN moved the product/transfusion?
8. Was the saline flush bag placed below the platelet bag once the transfusion was started?
9. Did the RN prime the platelets to at least 2 inches before the end of the tubing set?

Abbreviation: RN, registered nurse.

were collected by the blood bank and returned to the manufacturer for evaluation.

Measures

Outcome measures for evaluating the effectiveness of the interventions described in this project focused on the reporting of clogged platelet filters. Occluded filter incidence was measured by the number of safety events for platelet filter occlusions reported and the number of occurrences documented in the EHR. A reduction in the incidence of occluded platelet filters was anticipated to confirm effective intervention.

The first outcome monitored was the number of occluded platelet filters reported using the institutional Safety Intelligence reporting system. This metric is user dependent, and there is a risk for underreporting; however, it provides a baseline account of the event occurrence. The second outcome measure was added to confirm safety report findings. This measure captured the number of platelet transfusions that were either paused or stopped in the EHR due to issues with filter occlusion. The cause of the transfusion pause or stop was verified by reviewing the documented "reason" in the EHR. Both outcome measures were calculated by appropriately identifying a numerator and a denominator. Outcome 1 was calculated as the number of clotted filters reported for the month divided by the total number of platelet transfusion for the month. Outcome measure 2 was calculated as the number of stopped or paused transfusion related to clotted filters documented for the month divided by the total number of platelet transfusion for the month.

RESULTS

Analysis of both outcome measures showed a reduction in the number of reported occluded platelet filter occurrences. The baseline data demonstrated a 1.96% rate of occluded filters from Safety Intelligence event reports and a 0.99% rate documented in the EHR. Postintervention Safety Intelligence reported rate of occluded filters was 0.26% (6 of 2308 transfusions) and the EHR documented rate was 0.51% (12 of 2308 transfusions). The original goal set by the project charter was to achieve a 50% decrease in platelet filter occlusions reported in the Safety Intelligence system. The goal was surpassed, reflected by the results showing a 170% reduction in reported occlusions in the Safety Intelligence system (Figure). This improvement was confirmed by a 48% reduction in documented occurrences in the EHR. No defects were found in the occluded filters collected by blood bank and returned to the manufacturer for analysis.

DISCUSSION

Summary

Comparison of the pre- and postintervention data indicated that the number of clotted filters decreased. This demonstrates the positive impact of the interventions on decreasing clotted filter events. Utilization of QI tools and the development of an interprofessional team influence positive outcomes in the patient care setting. The interventions implemented resulted in measurable improvements that translate into enhanced patient safety and higher quality of care.

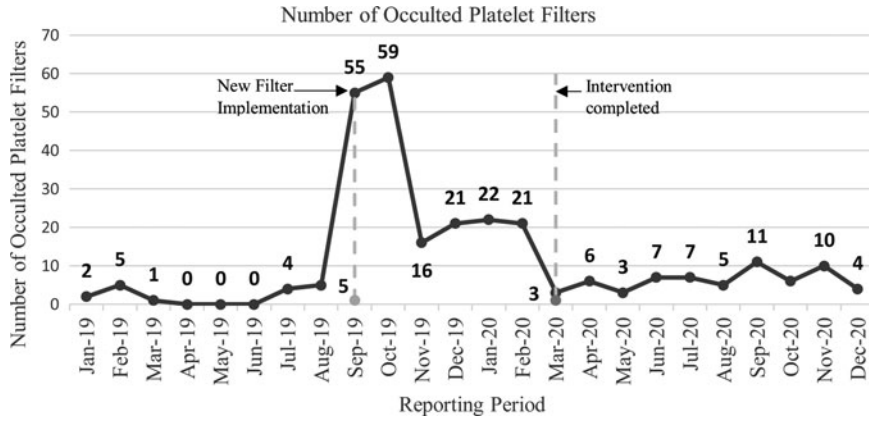

Figure. Number of platelet filter occlusion reported in the Safety Intelligence system. IV indicates intravenous. Copyright 2021 The University of Texas M.D. Anderson Cancer Center. Reprinted with permission from The University of Texas MD Anderson Cancer Center.

Limitations

The project was conducted at one institution with only oncology patients, limiting generalizability to other organizations and patient populations. Different volumetric pumps or blood administration tubing may be utilized elsewhere, and platelets may be administered via gravity versus volumetric pumps. There is no available benchmarking for the rate of platelet leukocyte reduction filter occlusions. Discrepancies were also identified between the number of clotted filters reported in patient safety events and the number of clotted filters documented in the EHR. The sample size (n = 23) of direct observations by Hemovigilance nursing team is disproportionately small compared with the total number (2801) of platelet doses transfused during the month of observation.

CONCLUSION

Nurses often have a unique perspective to evaluate the quality of health care being delivered. Support from institutions encouraging nursing exposure to QI processes and tools can better assist nurses in identifying problems and developing solutions. Utilization of these QI processes and tools among an interprofessional collaboration allowed the project team to discover the factors contributing to the problem of occluded platelet filters. The team collaborated with the manufacturer to incorporate best practice guidelines and provide education and feedback through direct observation of nurses, resulting in decreased rates of platelet filter occlusions.

Decreasing the number of occluded platelet filter occurrences led to a reduction in delays in patient care and resulted in better utilization of resources in the blood bank and clinical areas. Incorporating information regarding proper practice into resources such as the tip sheet, new nurse orientation, and annual blood competencies ensures that the information will be continually reinforced.

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