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Abstract

Purpose: To apply and monitor a single institution’s adherence to internally established guidelines for the preoperative administration of platelets and/or fresh frozen plasma (FFP) before a specified subset of minimally invasive interventional radiology (IR) procedures.

Materials and Methods: Beginning in December 2008, we implemented a set of restrictive guidelines for preoperative platelet and/or FFP administration before IR procedures at a single academic hospital. Basing our program on the methodology of Lean Six Sigma, we compared the number and appropriateness of transfusions between the months of January and October in 2008 (prepolicy), again in 2010 (postpolicy), and finally in 2015 (follow-up). Patients with a platelet count less than or equal to 50,000 or an international normalized ratio greater than or equal to 1.7 met criteria for receiving platelets or FFP, respectively, before their IR procedure. For all three periods, we compared the rates of transfusion, hemorrhagic complications, and proportion of appropriate versus inappropriate blood product administration (BPA) per our guidelines.

Results: There was a significant increase in the number of appropriate BPAs between 2008 and 2010 from 58% to 76% (\(P = .021\)). Between 2010 and 2015, the rate trended up further, from 76% to 88% (\(P = .051\)). Overall, between 2008 and 2015, the improvement from 58% to 88% was significant (\(P < .001\)). The rate of hemorrhagic complications was extremely low in all three groups.

Conclusion: Restrictive guidelines for receiving platelets and FFP administrations before IR procedures can sustainably decrease the rate of overall BPA while increasing the proportion of appropriate BPA without impacting the rate of hemorrhagic complications.

Key Words: Lean Six Sigma, transfusion, guidelines, interventional radiology

INTRODUCTION

Inappropriate administration of blood products in the hospital setting has an obvious impact on the cost of health care delivery as well as on patient safety [1-3]. For instance, Yazdi demonstrated that inappropriate guidelines can lead to wasteful practices that can result in blood banks being unable to meet their needs [4]. Furthermore, blood product administrations (BPAs) carry risk, such as bacterial contamination and antibody development [5-7]. A reduction in the cost of producing, processing, and transporting unnecessary blood products can be achieved by applying restrictive protocols guided by process-improvement methodologies such as Lean Six Sigma [8-10].

Based on our guidelines for platelet and fresh frozen plasma (FFP) administration before interventional radiology (IR) procedures on the Society of Interventional Radiology/Cardiovascular and Interventional Radiological Society of Europe (SIR/CIRSE) Standards of Practice guidelines, our goal was to investigate thresholds for BPA that might reduce the number of preprocedure
were chosen for consistency, speci
neous biopsy, and percutaneous tumor ablation. They
study: chemoembolization, radioembolization, percuta-

start of the procedure.

deciliter, the patient would receive platelets before the
or equal to 1.7, FFP would be given, and (2) if the

remaining 28 procedures, (1) if the INR was greater

administration of blood products preoperatively was at the discretion of

practitioners involved in the screening process. That
time, our faculty developed guidelines for 38 IR pro-
cedures (see Appendix A) that were based on the SIR/
CIRSE Standards of Practice guidelines [5]. Using a
modified Delphi process, we sought to re-examine

those thresholds and possibly establish different
criteria that could lower the administration of blood

products. Ten procedures, such as drain exchanges, do
not require results for INR or platelet count before the

procedure. For patients scheduled to undergo any of
the remaining 28 procedures, (1) if the INR was greater
or equal to 1.7, FFP would be given, and (2) if the
platelet count was less than or equal to 50,000 per
deciliter, the patient would receive platelets before the

start of the procedure.

Of those 28 procedures, four were included in this
study: chemoembolization, radioembolization, percuta-

neous biopsy, and percutaneous tumor ablation. They
were chosen for consistency, specifically because they are
elective and IR staff is responsible for ordering (or not
ordering) blood products before the procedure. In certain
instances for the other 24 procedures covered by the

guidelines, patients’ primary physicians often acted
independently and ordered blood products in response to
their own laboratory tests and according to their own
practices. Additionally, the 24 excluded procedures often
included inpatients with morbidities and acuities that
impact decision making.

From the electronic medical records (Epic, Madison,
Wisconsin, USA), we obtained and tabulated all INR and
platelet counts that were available within 30 days before
the procedures identified. We created three cohorts of
patients, taken from three separate years, each covering
the same 9-month period from January to October. The
first was from 2008 (before the implementation of the
protocol), the second was from 2010 (after implementa-
tion and a period of establishing regular work routines),
and the third was from 2015 (5 years after implementa-

We noted administration of FFP or platelets before
any of the four procedures listed previously. The
administration was linked to a procedure only if it was
given within 30 days before the procedure in response to
the most recent laboratory test values. Patients who
received a BPA to treat their underlying illness(es) by
their primary caregivers were excluded from analysis. For
patients who underwent multiple procedures and received
a preprocedure BPA within 30 days, each administration
was only counted once and linked to the procedure most
proximate in time.

According to their baseline laboratory test values and
whether they received a preprocedure BPA or not, all
patients fell into one of four categories: “appropriate,”
“not appropriate,” “indicated,” or “not indicated” (Fig. 1).
For instance, if the laboratory test values correctly triggered an administration, a BPA was
considered appropriate for that value and blood product
received. It was possible, therefore, to have an
appropriate administration of FFP but an inappropriate
administration of platelets in the same patient. If a
laboratory test value was abnormal, but a BPA was not
given beforehand, the patient fell into the indicated
group, such that they were indicated for a BPA but did
not receive one. Most patients in all three cohorts fell
into the category of not indicated because their
laboratory test values were normal and no preprocedure
blood products were given.

We also searched the database for patients who
received one or more red blood cell (RBC) transfusions
within 30 days after their procedure, as an indicator of a
hemorrhagic complication requiring intervention. These
patients’ records were manually reviewed to determine
whether a hemorrhagic complication might be respon-
sible for the RBC transfusion. Hemorrhagic complica-
tions not requiring a transfusion were excluded. These
data were then correlated to the preprocedure coagula-
tion parameters to determine whether the thresholds
that had been selected had an effect on the number of
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