ORIGINAL ARTICLE

Bleeding Complications in Patients Undergoing Celiac Plexus Block

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Background and Objectives: Celiac plexus blockade has known risks including bleeding and neurologic injury because of the close proximity of vascular and neuraxial structures. The aim of this study was to determine the incidence of bleeding complications in patients undergoing celiac plexus block (CPB), with an emphasis on preprocedural antiplatelet medication use and coagulation status.

Methods: This is a retrospective study from 2005 to 2014 of adult patients undergoing CPB by the pain medicine division at a tertiary care center. The primary outcome was red blood cell (RBC) transfusion within 72 hours of needle placement, with a secondary outcome of bleeding complications requiring emergency medicine, neurology, or neurosurgical evaluation within 31 days.

Results: A total of 402 procedures were performed on 298 unique patients, with 58 patients (14.4%) receiving aspirin or nonsteroidal anti-inflammatory drugs (NSAIDs) preoperatively. Five patients (1.2%) received RBC transfusion within 72 hours, of which one had received preprocedure NSAIDs. A platelet count measured within 30 days was available for 268 patients, with 7 patients (2.6%) having platelet counts of 100×10^9/L or less at the time of needle placement. A total of 187 patients had a valid preoperative international normalized ratio (INR), with 9 (4.8%) having an INR of 1.5 or higher (range, 1.5–2.6). One patient (11.1%) required RBC transfusion compared with an RBC transfusion rate of 2.3% (4 of 178) in those with normal INR ($P = 0.221$). We identified no bleeding complications requiring emergency medicine, neurology, or neurosurgical evaluation.

Conclusions: This study suggests that CPBs may be safely performed in patients receiving aspirin and/or NSAID therapy.

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Celiac plexus blocks (CPBs) are routinely performed for patients with pancreatic and other intra-abdominal cancers and other abdominal visceral pain complaints. Literature exists regarding the safety of these procedures in relation to technique, sedation, and patient selection. Recently, guidelines have been published that suggest consideration for discontinuation of nonsteroidal anti-inflammatory drugs (NSAIDs) and prophylactic aspirin therapy before interventional pain procedures such as CPB that are associated with either a heightened risk of bleeding or an anatomic configuration that could result in dramatic clinical consequences should hematoma development occur.[1] A CPB requires procedural needle placement adjacent to the spine in close proximity to spinal radicular medullary arteries and/or the aorta, celiac truck, superior mesenteric artery, or other deep vessels; recently published international guidelines suggest that CPB procedures have at least intermediate bleeding risk. However, there is only limited published data available about the risk of performing these procedures in patients who are taking aspirin or NSAIDs or who may have suboptimal coagulation status because of baseline coagulation abnormalities or anticoagulant medication use. The issue of coagulation status and antiplatelet medications is especially relevant in patients undergoing CPB, considering that many of these patients have significant comorbid diseases, namely, metastatic visceral cancer, which may be associated with underlying preprocedural coagulation abnormalities or the use of antiplatelet or anticoagulant medications. As such, further study is clearly warranted to better define the safety of antiplatelet medication use and coagulation status in patients undergoing these procedures. This study aims to delineate the risk of performing CPB on patients maintained on aspirin or NSAID therapy and in those with suboptimal coagulation status.

METHODS

This is a retrospective study approved by the Mayo Clinic (Rochester, Minnesota) Institutional Review Board.

Study Population

Inclusion criteria for this study were age greater than or equal to 18 years and completion of a CPB by the division of pain medicine at a single tertiary care medical center between January 1, 2005, and December 31, 2014. All procedures were performed with real-time fluoroscopic guidance rather than computed tomographic imaging. The vast majority of CPB procedures used a retrocrural needle placement at the anterolateral L1 vertebral body, thus targeting the proximal splanchnic nerves. A minority of cases used a transcrural or transaortic technique to place the needle in close proximity to the celiac ganglia proper. Exclusion criteria included performance of the block by another division (ie, endoscopic celiac plexus neurolysis by gastroenterology), procedural cancellation before needle placement, or the absence of research consent.

Outcome Variables

The primary outcome for this investigation was the presence of a periprocedural red blood cell (RBC) transfusion. To qualify, the transfusion was required to occur during the procedural encounter or within the first 72 postprocedural hours. The presence and timing of all periprocedural transfusion episodes were extracted from the electronic health record. Detailed chart review was performed for all patients with qualifying RBC transfusion episodes by 2 independent reviewers (N.S.W., M.A.W.) to assess the cause of the transfusion episode. Secondary outcome

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for this investigation was the presence of a bleeding-related neurological complication requiring emergency medicine, neurology, or neurosurgical evaluation within 31 days. Identified complications were then independently analyzed (N.S.W., M.A.W.) for their potential relationship to procedural bleeding.

Data Sources

Identification of study participants was performed using the Perioperative Data Mart. This institutional resource captures clinical and procedural data for all patients who are admitted to an acute care environment including procedure suites, operating rooms, intensive care units, and progressive care units at the study's participating institution.[2] It also contains information on baseline demographics and clinical characteristics, fluid and transfusion therapies, periprocedural medications and laboratory values, postprocedural outcomes, and lengths of stay. Additional baseline characteristics were extracted from a second validated database, the Mayo Clinic Life Sciences System.[3] Both databases have undergone extensive validation with accuracy superior to manual data collection alone.[4]

Statistical Considerations

Baseline demographics, clinical characteristics, medications, laboratory values, and procedural information were summarized and presented as median with 25% to 75% interquartile range for continuous data elements and frequencies (percentage) for categorical data. An international normalized ratio (INR) of 1.5 or higher was used as a threshold for coagulopathy and a platelet count of 100×10^9/L or less was used as a cutoff for thrombocytopenia. The frequency of outcomes was assessed using point estimates with 95% confidence intervals. Fisher exact test was used to assess differences in RBC transfusion rates between patients with or without preprocedural antiplatelet medication use, coagulopathy, or thrombocytopenia.

RESULTS

A total of 402 procedures were performed on 298 unique patients during the 10-year study period. Baseline demographic, laboratory, and clinical characteristics of the study cohort are shown in Table 1. Of the 402 CPB procedures, 58 (14.4%) were performed in those receiving preoperative aspirin or NSAID therapy (Table 2). Of note, patients on aspirin or NSAID therapy had higher rates of cerebrovascular disease and myocardial infarction.

In total, 5 procedures (1.2%) were associated with RBC transfusion within 72 hours of needle placement. The incidence of RBC transfusion in the setting of aspirin or NSAID use was 1.7% (1 of 58), which was not statistically different from a transfusion rate of 1.2% (4 of 344) in the absence of aspirin or NSAID therapy ($P = 0.544$). Patient and procedural details for the 5 transfused patients are summarized in Table 3. Each transfused patient had a diagnosis of metastatic cancer and preprocedural anemia. The lowest pretransfusion hemoglobin was 6.9 g/dL. Transfusions were administered for fatigue, syncope, and unspecified reasons. No clinical note made mention of transfusion in response to procedural bleeding. Four of the 5 transfused patients experienced a hemodynamically significant postprocedural sympathectomy with hypotension and tachycardia requiring aggressive fluid resuscitation, likely contributing to a further decrease in hemoglobin values secondary to dilution. With regard to immediate procedural fluid therapy, no patient received more than 1.5 L of intravenous crystalloid in the procedural encounter, with a median (interquartile range) of 900 (350–1090) mL on the day of the procedure.

In total, 193 of the 298 unique patients in the cohort (64.8%) had a diagnosis of cancer. In patients with a diagnosis of cancer,

TABLE 1. Baseline Demographic and Clinical Characteristics of Patients Undergoing Celiac Plexus Blockade (N = 402 Procedures)

Variable		
Demographics		
Age, y	56.0	43.0, 64.0
ASA PS		
1	1	0.3
2	31	9.8
3	51	16.1
4	1	0.3
Unknown	318	79.1
Comorbidities		
Myocardial infarction	16	4.0
Congestive heart failure	2	0.5
Peripheral vascular disease	6	1.5
Cerebrovascular disease	35	8.7
Dementia	2	0.5
Chronic pulmonary disease	42	10.4
Connective tissue disease	5	1.2
Ulcer disease	53	13.2
Mild liver disease	10	2.5
Diabetes mellitus	89	22.1
Hemiplegia	0	0
Moderate to severe renal disease	18	4.5
Diabetes with end-organ damage	24	6.0
Tumor	234	58.2
Leukemia	1	2.5
Lymphoma	6	1.5
Moderate to severe liver disease	7	1.7
Metastatic solid tumor	197	49
AIDS	0	0
Perioperative medications		
Aspirin	39	9.7
NSAIDs	21	5.2
Aspirin and/or NSAIDs	58	14.4
Clopidogrel	1	0.2
Coumadin	23	5.7
Heparin	1	0.2
LMWH	3	0.7
Baseline laboratory values		
INR	1.1	1.0, 1.2
Hemoglobin, g/dL	11.8	10.7, 13.2
Platelet count	237	188, 327
APTT, s	30	26, 34
Creatinine, mg/dL	0.8	0.6, 1.0
Albumin, g/dL	3.8	3.3, 4.1

Continuous variables are summarized as median (Q1, Q3). Categorical variables are summarized as n (%).

INR was available for 187 (46.5%) of procedures. Platelet count was available for 269 (66.9%) of procedures. Hemoglobin was available for 269 (66.9%) of procedures. Activated partial thromboplastin time (APTT) was available for 86 (21.4%) of procedures. Creatinine was available for 269 (66.9%) of procedures. Albumin was available for 162 (40.3%) of procedures.

ASA PS indicates American Society of Anesthesiologists Physical Classification score; AIDS, acquired immunodeficiency syndrome; LMWH, low-molecular-weight heparin.

TABLE 2. Baseline Demographic and Clinical Characteristics of Patients Undergoing Celiac Plexus Blockade With Preoperative Aspirin or NSAID Use (n = 58)

Variable		
Demographics		
Age, y	64.0	56.0, 68.0
ASA PS		
1	1	1.7
2	3	5.2
3	11	19.0
Unknown	43	74.1
Comorbidities		
Myocardial infarction	5	8.6
Congestive heart failure	1	1.7
Peripheral vascular disease	0	0
Cerebrovascular disease	8	13.8
Dementia	1	1.7
Chronic pulmonary disease	15	25.9
Connective tissue disease	0	0
Ulcer disease	4	6.9
Mild liver disease	2	3.4
Diabetes mellitus	19	32.8
Hemiplegia	0	0
Moderate to severe renal disease	7	12.1
Diabetes with end-organ damage	8	13.8
Tumor	38	65.5
Leukemia	0	0
Lymphoma	0	0
Moderate to severe liver disease	1	11.1
Metastatic solid tumor	31	53.4
AIDS	0	0
Perioperative medications		
Aspirin	39	67.2
NSAIDs	21	36.2
Aspirin and NSAIDs	2	3.4
Clopidogrel	1	1.7
Coumadin	6	10.3
Heparin	0	0
LMWH	1	1.7
Baseline laboratory values		
INR	1.1	1.0, 1.2
Hemoglobin, g/dL	11.9	10.6, 12.8
Platelet count	215	175, 263
APTT, s	30	26, 34
Creatinine, mg/dL	0.8	0.6, 1.0
Albumin, g/dL	3.9	3.4, 4.0

INR was available for 37 (63.8%) procedures. Hemoglobin was available for 46 (79.3%) procedures. Platelet count was available for 46 (79.3%) procedures. Activated partial thromboplastin time (APTT) was available for 16 (27.6%) procedures. Creatinine was available for 46 (79.3%) procedures. Albumin was available for 31 (53.4%) procedures.

Continuous variables are summarized as median (Q1, Q3). Categorical variables are summarized as n (%).

ASA PS indicates American Society of Anesthesiologists Physical Classification score; AIDS, acquired immunodeficiency syndrome; LMWH, low-molecular-weight heparin.

TABLE 3. Clinical Characteristics of 5 Patients Requiring RBC Transfusion Within 72 Hours of Needle Placement

Patient	Age	Sex	Medical History	Laboratory Results	Preoperative FFP	Antiplatelet Therapy	Postprocedure Hypotension and Fluid Totals	Time to RBC Transfusion, h	RBC Quantity, units	Pretransfusion Hb	Transfusion Indication and Dilutional Anemia
1	31	M	Metastatic cholangiocarcinoma, autoimmune hepatitis, ulcerative colitis	Hb 8.1 PLT 217 INR 1.1	No	Ibuprofen	No; 900 ml IVF on day of procedure; no additional IVF	53	2	7.3 g/dL	Fatigue No significant dilution
2	38	F	Metastatic colon cancer, liver metastasis	Hb 8.0 PLT 98 INR 1.4	Yes, 4 units	None	Yes; 4.6L IVF in first 24 h in response to hypotension	27	2	7.7 g/dL	Fatigue Dilutional anemia
3	49	M	Metastatic renal cell carcinoma	Hb 8.5 PLT 215 INR 1.5	Yes, 2 units	None	Yes; 4.8L IVF in first 24 h in response to hypotension	25	2	7.8 g/dL	Uncertain Dilutional anemia
4	64	M	Metastatic pancreatic carcinoma	Hb 8.4 PLT 468 INR 1.2	No	None	Yes; 3L IVF in 11 h in response to syncope, required ICU admission	11	2	6.9 g/dL	Syncope Dilutional anemia
5	66	F	Metastatic gastric adenocarcinoma	Hb 9.6 PLT 555 INR 1.0	No	None	Yes; 7.6L IVF over postprocedural days 1 to 3 in response to hypotension	43	2	8.1 g/dL	Uncertain Dilutional anemia

Hb indicates hemoglobin; PLT, platelet count ($\times 10^9$/L); IVF, intravenous fluids.

there was an increased risk of perioperative RBC transfusion compared with those without a cancer diagnosis (2.56% vs 0%; $P = 0.043$). A similar relationship was seen when comparing periprocedural RBC transfusion rates between those with known metastatic disease compared with those without cancer (3.05% vs 0%; $P = 0.033$).

A platelet count measured within 30 days was available for 268 procedures (66.7%). Of these, 7 patients (2.6%) had platelet counts of 100×10^9/L or less (range, 36–98 $\times 10^9$/L) at the time of needle placement. Demographic and clinical characteristics for thrombocytopenic patients are displayed in Table 4. Only 1 patient received a prophylactic platelet transfusion in the 24-hour period preceding the procedure, with this patient having received 1 unit of single-donor apheresis platelets for a platelet count of 76×10^9/L. The next measured platelet count (measured 13 hours postprocedurally) was 90×10^9/L. This patient was not on any antiplatelet or anticoagulation medications, had a normal INR, and did not require periprocedural RBC transfusion. The rate of RBC transfusion in thrombocytopenic patients was 14.3% (1 of 7) compared with a rate of 1.5% (4 of 261) in those with higher platelet counts ($P = 0.125$). Of note, the thrombocytopenic patient receiving RBC transfusion (Table 3; patient 2) also received 4 units of fresh-frozen plasma (FFP) in the 24 hours before the procedure for an INR of 1.5, achieving an INR of 1.4 before needle placement.

A preprocedural INR value was available for 187 procedures (46.5%). Of these, 9 patients (4.8%) had an INR of 1.5 or higher (range, 1.5–2.6). Demographic and clinical characteristics for those with preprocedural coagulopathy may be found in Table 5. One patient (11.1%) required RBC transfusion (Table 3; patient 3) compared with an RBC transfusion rate of 2.3% (4 of 178) in those with normal INR ($P = 0.221$). In total, 6 patients received prophylactic FFP transfusion in the 24 hours before their procedure for INR values ranging from 1.1 to 1.6. Two (33%) of these patients received periprocedural RBC transfusion. The first patient had an INR of 1.5 approximately 24 hours before the procedure and was given 4 units of FFP, achieving an INR of 1.4 the morning of the procedure (Table 3; patient 2). The second patient had an INR of 1.5 measured 4 hours preprocedure and was given 2 units of FFP 2 hours before the procedure with no INR recheck (Table 3; patient 3). The remaining 4 patients who received prophylactic FFP but did not require RBC transfusion had INR values of 1.1 to 1.6, and each received 1 to 2 units of FFP. There were no bleeding complications requiring emergency medicine, neurology, or neurosurgical evaluation identified in any patient in the study cohort.

TABLE 4. Baseline Demographic and Clinical Characteristics of Patients Undergoing Celiac Plexus Blockade With Preoperative Platelet Count Less Than 100×10^9/L (n = 7)

Variable		
Demographics		
Age, y	52.0	40.0, 63.0
ASA PS		
3	1	14.3
Unknown	6	85.7
Comorbidities		
Myocardial infarction	1	14.3
Congestive heart failure	0	0
Peripheral vascular disease	0	0
Cerebrovascular disease	2	28.6
Dementia	0	0
Chronic pulmonary disease	1	14.3
Connective tissue disease	0	0
Ulcer disease	0	0
Mild liver disease	3	42.9
Diabetes mellitus	4	57.1
Hemiplegia	0	0
Moderate to severe renal disease	0	0
Diabetes with end-organ damage	24	6.0
Tumor	5	71.4
Leukemia	0	0
Lymphoma	0	0
Moderate to severe liver disease	3	42.9
Metastatic solid tumor	5	71.4
AIDS	0	0
Perioperative medications		
Aspirin	0	0
NSAIDs	0	0
Aspirin and/or NSAIDs	0	0
Clopidogrel	0	0
Coumadin	2	28.6
Heparin	0	0
LMWH	0	0
Baseline laboratory values		
INR	1.1	1.1, 1.4
Hemoglobin, g/dL	9.6	9.0, 11.3
Platelet count	84	46, 92
APTT, s	31	26, 39
Creatinine, mg/dL	0.7	0.7, 0.7
Albumin, g/dL	3.3	2.7, 4.0

Continuous variables are summarized as median (Q1, Q3). Categorical variables are summarized as n (%).

Activated partial thromboplastin time (APTT) was available for 4 (57.1%) of procedures. Albumin was available for 5 (71.4%) of procedures.

ASA PS indicates American Society of Anesthesiologists Physical Classification score; AIDS, acquired immunodeficiency syndrome; LMWH, low-molecular-weight heparin.

DISCUSSION

The recently published consensus guidelines for the periprocedural management of antiplatelet and anticoagulant medications in patients undergoing interventional spine and pain procedures provide an initial framework on which to base management decisions regarding medication therapy before invasive pain procedures.[1] According to these guidelines, CPBs are categorized into the moderate bleeding risk category in which aspirin and NSAIDs do not implicitly require discontinuation. However, the authors also recognize that the anatomic configuration of certain structures such as the celiac plexus to the aorta and other vascular structures may heighten the risk for serious bleeding, and hence, the discontinuation of antiplatelet medications may be considered.[5]

Unfortunately, the ambiguity of bleeding risk stratification leaves many unanswered questions for the pain interventionalist, and the actual incidence of bleeding complications in this population remains unknown. Furthermore, there is very little evidence available to make clinical inference on whether to continue or interrupt antiplatelet therapy before these interventions or to aggressively correct abnormal coagulation

TABLE 5. Baseline Demographic and Clinical Characteristics of Patients Undergoing Celiac Plexus Blockade With Preoperative INR Greater Than or Equal to 1.5 (n = 9)

Variable		
Demographics		
Age, y	52.0	42.0, 64.0
ASA PS		
2	1	11.1
3	1	11.1
Unknown	7	77.8
Comorbidities		
Myocardial infarction	1	11.1
Congestive heart failure	0	0
Peripheral vascular disease	0	0
Cerebrovascular disease	1	11.1
Dementia	0	0
Chronic pulmonary disease	2	22.2
Connective tissue disease	0	0
Ulcer disease	0	0
Mild liver disease	1	11.1
Diabetes mellitus	4	44.4
Hemiplegia	0	0
Moderate to severe renal disease	0	0
Diabetes with end-organ damage	1	11.1
Tumor	8	88.9
Leukemia	0	0
Lymphoma	0	0
Moderate to severe liver disease	1	11.1
Metastatic solid tumor	8	88.9
AIDS	0	0
Perioperative medications		
Aspirin	1	11.1
NSAIDs	0	0
Aspirin and/or NSAIDs	1	11.1
Clopidogrel	0	0
Coumadin	2	22.2
Heparin	0	0
LMWH	0	0
Baseline laboratory values		
INR	1.6	1.5, 1.8
Hemoglobin, g/dL	10.0	9.3, 12.0
Platelet count	258	151, 330
APTT, s	36	31, 38
Creatinine, mg/dL	0.7	0.6, 0.9
Albumin, g/dL	2.4	2.9, 3.6

Continuous variables are summarized as median (Q1, Q3). Categorical variables are summarized as n (%).

Activated partial thromboplastin time (APTT) was available for 3 (33.3%) of procedures. Albumin was available for 8 (88.9%) of procedures.

ASA PS indicates American Society of Anesthesiologists Physical Classification score; AIDS, acquired immunodeficiency syndrome; LMWH, low-molecular-weight heparin.

parameters. The cancer population presents unique challenges as the risk of proceeding with a CPB may be justified given the goal of profound pain relief when coagulation and laboratory values may never normalize.

This investigation aimed to help elucidate the rate of serious bleeding complications after celiac plexus blockade. To that end, we found that bleeding complications after celiac plexus blockade are rare, with a periprocedural RBC transfusion rate of approximately 1 in 100. It is unclear whether these patients would have received RBC transfusions had they not undergone CPB, given that their preprocedural hemoglobin values ranged from 8.0 to 9.6 g/dL. Recognizing that clinically significant bleeding may not manifest with a dramatic drop in hemoglobin requiring RBC transfusion but rather with new or progressive neurological symptoms, we also assessed postprocedural bleeding-related neurological complications. To that end, no bleeding-related neurological complication was identified in this cohort, further supporting the notion that bleeding complications are rare during CPB even in the presence of antiplatelet therapy. The absence of bleeding-related neurological outcomes in this investigation is consistent with earlier studies that have estimated the risk of major neurologic complications after CPB to be less than 0.15%.[6–11]

In addition, the procedural technique used for the majority of our CPB procedures may have further lessened the overall risk of clinically significant bleeding; it is conceivable that targeting the proximal splanchnic innervation with a retrocrural needle placement is much less likely to puncture or otherwise damage the aorta compared with more traditional techniques of CPB that use transcrural placement in closer proximity to great vessels (eg, aorta, superior mesenteric artery, celiac trunk). Conversely, a retrocrural approach anterolateral to the vertebral body may place the needle in close proximity to smaller radicular medullary arteries that form anastomotic connections between the aorta and the anterior spinal artery[12]; such risk may not be reflected in the incidence of clinically significant bleeding but rather potentiate the possibility of neurologic injury. In either case, the routine use of a local anesthetic test dose and digital subtraction angiography by our institution helps minimize the degree of transgression of procedural needles into such blood vessels, thereby reducing the risk of intravascular injection of neurolytic compounds that may otherwise potentiate vascular injury and bleeding risk.

On further review of the 5 patients who received RBC transfusion after CPB, it is noted that none of the procedures were performed via a transaortic approach. The procedures were performed via a retrocrural approach, which has been previously described.[13] Before needle placement, advanced imaging such as a computed tomographic scan of the abdomen is reviewed by the proceduralist to anticipate any unexpected anatomy, as displacement of vascular structures may occur secondary to significant tumor burden.

Most patients undergo CPB for cancer-related pain,[14] although the procedure is performed for other indications including chronic pancreatitis, median arcuate ligament syndrome, and other causes of visceral abdominal pain. The efficacy of CPB for visceral malignancy has been reported previously, with a recent Cochrane review demonstrating superior visual analog score reductions with CPB at 4 and 8 weeks compared with conventional medication management.[10] In this study, the majority of patients carried a diagnosis of cancer. For these patients, there was an increased risk of perioperative RBC transfusion compared with those without an underlying cancer diagnosis. This relationship was even more pronounced when comparing patients with known metastatic disease with those without cancer, as all patients receiving RBC transfusion had known metastases. It is well known that patients with cancer have an increased risk of venous thromboembolism and an increased risk of bleeding because of coagulation abnormalities, thrombocytopenia, and other derangements within the hematologic system.[15] In an effort to

decrease periprocedural bleeding risk, physicians often attempt to optimize INR with prophylactic FFP transfusion. In this series, 6 patients were transfused with FFP before CPB, and 2 ultimately required RBC transfusion after the procedure. Given the low incidence of transfusion episodes, there is no way to ascertain the efficacy of prophylactic FFP transfusion for the prevention of periprocedural bleeding.

A known consequence of CPB is vasodilatation as a result of a functional sympathectomy, often resulting in hypotension that requires further fluid resuscitation after the procedure. Furthermore, this cancer population is often cachectic with poor intravascular volume status, thus predisposing them to orthostatic hypotension, light-headedness, fatigue, and other similar symptoms after CPB. In our practice, nearly all patients receive a preprocedural crystalloid volume load of 250 to 500 mL, followed by additional fluid therapy as needed for blood pressure support. In patients with preprocedural anemia, the need for further fluid resuscitation may result in significant hemodilution and, in some cases, may ultimately lead to RBC transfusion for dilutional anemia. In fact, 4 of the 5 patients requiring RBC transfusion in our study required significant postprocedural fluid resuscitation in response to hypotension, tachycardia, or syncope.

There are several important limitations to this investigation. First, this is a retrospective investigation, and hence, it is not possible to fully elucidate the reasons regarding decision to transfuse in the periprocedural period. In addition, as medication therapies were extracted from corresponding clinical documentation within 7 preprocedural days, it is possible that some patients were receiving NSAID or aspirin therapy that went uncaptured because of the absence of a qualifying preprocedural clinic visit or an incomplete medication record. Finally, the results of this investigation are derived from a single tertiary care medical center and will ultimately require external validation.

In conclusion, CPBs can provide significant pain relief in patients with cancer-related abdominal pain and other abdominal processes. Although not without risk, these procedures are safely performed by trained interventional pain physicians on a routine basis for patients with such disease states. Vigilance must be taken to evaluate patients' risk factors including bleeding risk, anatomical considerations (such as anticipated retrocrural vs transaortic CPB approaches), and risks from aspirin or NSAID discontinuation. This review suggests that CPBs are safely performed in patients while on aspirin and NSAID therapy. Future studies are needed to further address the utility of prophylactic FFP or platelet administration in patients with abnormal INR values or platelet counts.

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