Improved outcomes following implementation of an acute gastrointestinal bleeding multidisciplinary protocol

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BACKGROUND: Effective multidisciplinary management of gastrointestinal bleeding (GIB) requires effective communication. We instituted a protocol to standardize communication practices with the hypothesis that outcomes would improve following protocol initiation.

METHODS: We performed a retrospective cohort analysis of 442 patients who required procedural management of acute GIB at our institution during a 50-month period spanning 25 months before and 25 months after implementation of a multidisciplinary communication protocol. The protocol stipulates that when a patient with severe GIB is identified, a conference call is coordinated among the gastroenterology, interventional radiology, and acute care surgery teams. A consensus plan is generated and then reassessed following procedural interventions and changes in patients' status. Patients' characteristics, management strategies, and outcomes were compared before and after protocol initiation.

RESULTS: Patient populations before and after protocol initiation were similar in age, comorbidities, outpatient use of antiplatelet/anticoagulant medications, admission vital signs, and admission laboratory values. The median interval between admission and the first procedure was significantly shorter in the protocol group (40 vs 47 hours, $p = 0.046$). The proportion of patients who received packed red blood cell transfusions decreased following protocol initiation (41% vs 50%, $p = 0.018$). Median hospital length of stay was significantly shorter in the protocol group (5.0 vs 6.0 days, $p = 0.014$). Readmissions with GIB were decreased after protocol implementation (8% vs. 15%, $p = 0.023$).

CONCLUSION: Implementation of a multidisciplinary protocol for management of acute GIB was associated with earlier intervention, fewer packed red blood cell transfusions, shorter hospital length of stay, and fewer readmissions with GIB. Future research should seek to establish causal relationships between communication practices and outcomes. (*J Trauma Acute Care Surg.* 2017;83: 41–46. Copyright © 2016 Wolters Kluwer Health, Inc. All rights reserved.)

LEVEL OF EVIDENCE: Therapeutic study, level III.
KEY WORDS: Gastrointestinal bleeding; multidisciplinary; communication; diagnosis; management.

Gastrointestinal bleeding (GIB) is a common condition associated with significant morbidity and mortality. Upper GIB has an annual incidence of 60 to 160 per 100,000 people in the United States and is associated with 4% to 10% mortality.[1–4] Lower intestinal bleeding has an annual incidence of approximately 36 of 100,000 people and is associated with 2% to 9% mortality.[1,4–6] Upper and lower GIB disproportionately affect patients with advanced age and multiple comorbidities, complicating the management of these conditions.[4,6,7] Apart from the initial objective of ruling out upper gastrointestinal hemorrhage as the source of blood in the lower gastrointestinal tract, there is no clear consensus regarding management of patients who present with GIB.[5,8–12] In some cases, there are multiple teams of doctors interacting with the patient, ordering tests, and performing procedures without communicating with one another. In a variety of hospital settings, poor communication among physicians has been associated with preventable morbidity and mortality; effective communication has been associated with improved outcomes.[13–17]

For patients requiring multiple procedures for acute GIB at our institution, it was noted that there was no clear ownership of the patient, no consensus on appropriate diagnostic and treatment approach, and poor communication among teams of physicians. Therefore, a multidisciplinary GIB management protocol was created to standardize patient ownership and communication practices. The purpose of this study was to assess the efficacy of the protocol by comparing outcomes before and after implementation. We hypothesized that outcomes would improve following protocol initiation.

METHODS

We performed a retrospective cohort analysis of 442 consecutive patients with acute GIB admitted to our institution between July 2011 and September 2015, spanning 25 months before and 25 months after institution of a multidisciplinary GIB management protocol. The protocol (Table 1) was developed by a multidisciplinary committee chaired by one of the authors (S.J.H.) and including representatives from gastroenterology, interventional radiology, diagnostic radiology, critical care medicine, and internal medicine. The purpose of the protocol was to standardize care and promote effective communication among physicians, patients, and families. The protocol stipulates that when a patient with severe GIB is identified, a conference call is coordinated among the gastroenterology, interventional radiology, and acute care surgery teams. A consensus plan is generated and then reassessed following procedural interventions and changes in patient status. Severe GIB was defined as large-volume bleeding, hemodynamic instability, four or more units of PRBCs over 24 hours, or eight or more units of PRBCs total. Other triggers for multidisciplinary management are listed in Table 1.

Adult patients (age ≥18 years) were identified by the combination of *International Classification of Diseases, Ninth Revision* codes for upper and lower GIB as well as hospital encounter codes for the gastroenterology endoscopy laboratory, interventional radiology procedure room, and operating room. Patients who never required an invasive procedure were excluded by these search parameters. To ensure that records were as complete and accurate as possible, patients managed for more than 12 hours at an outside facility were excluded. Data regarding patients' characteristics, management, and outcomes were obtained from our institutional research database and supplemented by review of the electronic medical record. Baseline hemoglobin and creatinine values represented the most recently obtained value before admission. Baseline hemoglobin values were available for 353 patients (80% of the study population), and baseline creatinine values were available for 345 patients (78% of the study population). Readmissions with GIB were assessed by reviewing all discharge summary notes within 180 days of the index admission.

SPSS (version 23, IBM, Armonk, NY) was used to perform one-way analysis of variance for normally distributed continuous variables (reported as mean ± standard deviation), the Kruskal-Wallis test for non-normally distributed continuous

TABLE 1. Gastrointestinal Bleeding Management Protocol

- GI team is consulted first when a patient presents with GIB
- GI team initiates multidisciplinary communication if any of these criteria are met:
  - Large-volume bleeding
  - Hemodynamic instability
  - ≥4 units PRBC over 24 hours
  - ≥8 units PRBC total
  - No clear source of bleeding is identified on initial endoscopy
  - Rebleed after initial endoscopy
  - Patient's history of recurrent GIB
  - Patient is a Jehovah's witness and refuses blood transfusion
  - At the discretion of the GI attending physician
- GI attending/fellow communicates directly with IR and ACS attending/fellow/chief resident
  - The hospital operator coordinates a conference call
  - An approach to diagnosis and treatment is reached by consensus
  - GI attending physician/fellow produces a templated summary note of the plan
- GI, IR, and ACS discuss the management strategy within their teams
- GI, IR, and ACS teams present a unified plan to the patient/family
- IR and ACS attending physicians have an additional conversation before instituting therapy
- If surgical subspecialty involvement is warranted, then the ACS team contacts the surgical subspecialty team directly

ACS, acute care surgery; GI, gastroenterology; IR, interventional radiology.

variables (reported as median [interquartile range]), and the Fisher exact test for discrete variables (reported as n (%)). To ensure that patients managed before and after protocol implementation had similar overall baseline demographics, a two-sample Kolmogorov-Smirnov test was performed with the null hypothesis that the two samples were drawn from similar distributions. Figures were generated in GraphPad Prism (version 6.05, GraphPad Software, La Jolla, CA). Significance was set at $\alpha = 0.05$.

TABLE 2. Patients' Characteristics

	Before Protocol (n = 219)	After Protocol (n = 223)	*p*
Age	62 ± 14	60 ± 15	0.291
Male	109 (50%)	128 (57%)	0.127
Upper intestinal bleed	115 (53%)	130 (58%)	0.251
Lower intestinal bleed	70 (32%)	67 (30%)	0.682
Unknown etiology GIB	34 (16%)	26 (12%)	0.267
On admission			
Heart rate	90 ± 20	90 ± 19	0.932
Systolic blood pressure, mm Hg	124 ± 25	128 ± 25	0.093
pH	7.37 ± 0.09	7.39 ± 0.09	0.368
Lactate, mmol/L	2.2 ± 1.4	2.3 ± 2.7	0.731
International normalized ratio	1.6 ± 1.2	1.5 ± 1.1	0.215
Charlson comorbidity index	3.5 ± 2.2	3.2 ± 2.2	0.075
Dialysis patients	12 (6%)	9 (4%)	0.510
Outpatient medications			
Aspirin, 81 mg daily	70 (32%)	72 (32%)	>0.999
Aspirin, 325 mg daily	19 (9%)	9 (4%)	0.052
Any antiplatelet therapy	91 (42%)	86 (39%)	0.561
Dual antiplatelet therapy	30 (14%)	18 (8%)	0.067
Anticoagulant therapy	43 (20%)	34 (15%)	0.179

Data are presented as mean ± standard deviation or n (%).

RESULTS

There were no significant differences between any of the patients' characteristics before and after protocol initiation (Table 2), and the significance of the Kolmogorov-Smirnov test for each individual variable was greater than 0.201, indicating that the distribution of these parameters was similar before and after implementation of the GIB protocol. However, the significance of the Kolmogorov-Smirnov test for all variables in Table 2 pooled together by generating the predicted probability of being assigned to the preprotocol or postprotocol group was 0.033, suggesting that the two study populations were not drawn from similar distributions. This may be attributable to higher Charlson comorbidity index and more frequent use of full-dose aspirin and dual antiplatelet therapy before protocol initiation. For the entire study population, the mean patients' age was 61 years, mean Charlson comorbidity index was 3.3, 40% received outpatient antiplatelet therapy, and 17% received anticoagulant therapy.

Following protocol initiation, the median interval between admission and the first procedural intervention was decreased by 7 hours (Fig. 1). Almost one of four patients required multiple procedures (Table 3). Among these patients, there was a nonsignificant trend toward shorter intervals between procedures after the protocol was implemented (47 vs 65 hours). There were no significant differences in the number or type of procedures performed per patient. A greater percentage of patients received PRBC transfusions before the protocol, and the number of PRBC transfusions per patient was higher in this cohort. Hemoglobin and creatinine trends were similar before and after protocol initiation (Fig. 2).

Median hospital length of stay was significantly shorter in the protocol group (5 days vs 6 days, $p = 0.014$). Patients were also more likely to be discharged somewhere other than home

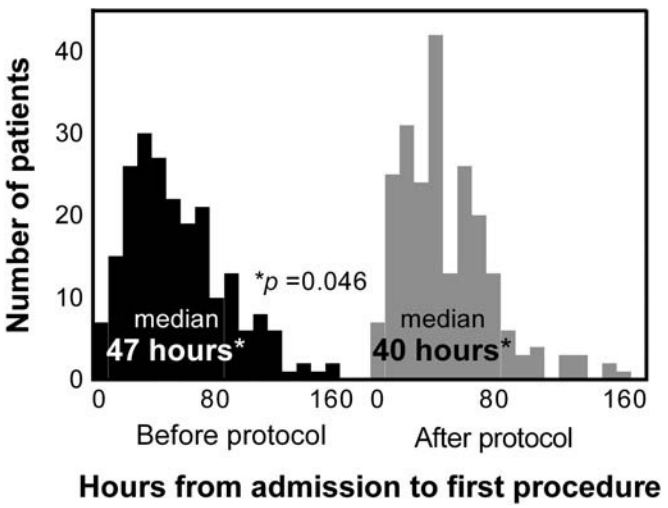

Figure 1. The interval between admission and performance of the first procedure was shorter following initiation of a gastrointestinal bleeding management protocol (*$p = 0.046$).

TABLE 3. Management

	Before Protocol (n = 219)	After Protocol (n = 223)	*p*
Procedures for GIB			
Endoscopy	214 (98%)	215 (96%)	0.575
Interventional radiology	18 (8%)	19 (9%)	>0.999
Surgery	7 (3%)	9 (4%)	0.800
Procedures by two or more disciplines	16 (7%)	19 (9%)	0.726
Hours from admission to first procedure	47 [26–72]	40 [21–64]	*0.046
Patients who had multiple procedures	52 (24%)	51 (23%)	0.910
Hours between procedures	65 [36–94]	47 [24–75]	0.064
PRBC transfusions per patient	1.0 [0.0–3.0]	0.0 [0.0–2.0]	*0.006
Patients who received a PRBC transfusion	111 (51%)	88 (40%)	*0.018

Data are presented as n (%) or median [interquartile range].

TABLE 4. Outcomes

	Before Protocol (n = 219)	After Protocol (n = 223)	*p*
Hospital length of stay	6.0 [3.0–9.0]	5.0 [3.0–8.0]	0.014
Nonhome disposition	65 (30%)	40 (18%)	0.005
Inpatient mortality	12 (6%)	6 (3%)	0.155
Subacute rehabilitation	28 (13%)	25 (11%)	0.662
Long-term acute care	8 (4%)	1 (0.4%)	0.019
Another hospital	7 (3%)	5 (2%)	0.573
Hospice	10 (5%)	3 (1%)	0.052
Readmission* with GIB	32 (15%)	17 (8%)	0.023
Days to readmission	5.0 [3.0–8.0]	4.0 [3.0–6.0]	0.340

*Within 180 days of discharge.
Data are presented as median [interquartile range] or n (%).

before protocol initiation (30% vs 18%, $p = 0.005$). This was primarily due to differences in discharge to long-term acute care and hospice (Table 4). The rate of readmission with GIB was lower after protocol implementation (8% vs 15%, $p = 0.023$).

DISCUSSION

Our data suggest that a multidisciplinary protocol for the management of acute GIB may expedite care and improve outcomes. After the protocol was initiated, the procedures were performed earlier, PRBC transfusion became less frequent, hospital length of stay decreased, discharge disposition improved, and readmissions with GIB decreased. These results must be interpreted in the context that although there were no differences among individual baseline patients' characteristics before and after protocol implementation, a pooled assessment of all patients' characteristics found that the two samples had significantly different distributions. This may indicate that analyses of individual patients' characteristics were underpowered to detect true differences between groups or that the cumulative effects of several nonsignificant differences were indeed significant.

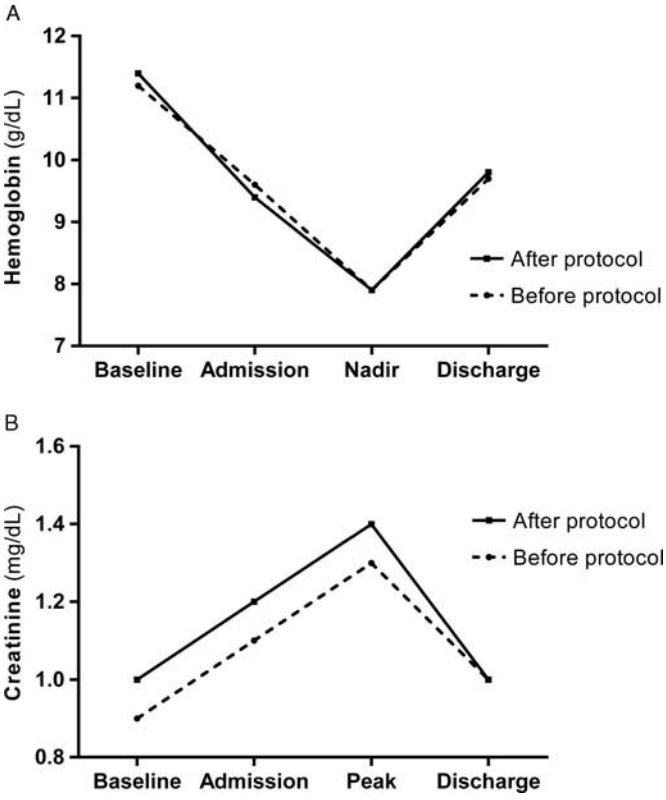

Figure 2. Hemoglobin (A) and creatinine (B) trends were similar before and after initiation of a gastrointestinal bleeding management protocol.

A review of 39,771 patients hospitalized for upper and lower GIB in Canada found that 2.2% of all patients were readmitted with GIB within 1 year, although this population included patients who did not require procedural interventions.[18] A review of patients admitted with upper GIB during a 10-year period in Scotland found that 60,643 patients accounted for 73,834 admissions for a readmission rate of 21.8%.[19] In the same study, average hospital length of stay ranged from 8 to 11 days.[19] Unfortunately, differences in study populations and practice settings make it difficult to compare our results to these database reviews. Advances in science and technology may have affected practices during the study period, and this study was not designed to establish causality. However, previous reports of similar interventions also support the notion that effective communication may improve outcomes.[16,17]

Collaborative medical decision making depends on adequate exchange of information and awareness of the abilities and limits of other team members.[20] A review of medical errors at a tertiary care teaching hospital found that factors negatively influencing effective communication included hesitancy to engage superiors, conflicting or ambiguous roles, and interpersonal conflict.[21] To address these issues, protocols delineating team roles and collaborative workflow have been used in complex transcatheter aortic valve replacement programs[22] as well as labor and delivery team responses to complications.[23] Aviation-based teamwork training has been proposed as a mechanism for improving communication and teamwork among health care professionals and has been shown to improve attitudes toward these principals in a multidisciplinary study.[24] A review of 20 Veterans

Affairs surgical services found that services with higher-than-expected morbidity and mortality had weak collaborative and communication practices, whereas services with favorable outcomes had better supervision and peer interaction practices.[15] Effective communication and collaboration have been noted among intensive care units with lower-than-average risk-adjusted survival[16] and have been associated with decreased postoperative pain and length of stay following joint surgery.[17] In our study, clarifying team roles may have contributed to the observed decrease in time from admission to procedural intervention, which consisted of endoscopy in most cases. Although practice patterns for threshold to perform endoscopy and performance of bedside endoscopy were relatively constant for the duration of the study period, the clear establishment of gastroenterology as the first team to be approached in consultation likely expedited the performance of endoscopic procedures.

The major limitations of this study are its retrospective design, inability to assess protocol compliance, and lack of control for the impact of scientific and technological advances occurring during the study period. Selection bias inherent to retrospective analysis was minimized as much as possible by including all consecutive cases meeting broad inclusion criteria and narrow exclusion criteria. Protocol adherence could not be accurately reported because telephone records were not available and the summary note of the plan could not consistently be differentiated from routine history and physical examination, consultation, and daily progress notes. There were minor changes in endoscopic equipment used during the study period, but no major changes in technologic capabilities or preferences for hemostatic methods among endoscopists. The parameter most likely to have been affected by changes in practice patterns over time was blood transfusion. Restrictive PRBC transfusion practices have been increasingly reported in the literature[25–28] and may have affected management strategies at our institution during the study period. However, nadir and discharge hemoglobin levels were nearly identical before and after protocol implementation, suggesting that the evolution of restrictive transfusion practices may not have significantly affected our results.

CONCLUSIONS

Implementation of a multidisciplinary protocol for the management of acute GIB was associated with earlier intervention, fewer PRBC transfusions, shorter hospital length of stay, improved discharge disposition, and fewer readmissions with GIB. Further research should seek to establish causal relationships among improved communication, management, and outcomes.

AUTHORSHIP

T.J.L., K.L.G., and J.R.J. contributed to literature review and study design. T.J.L. and K.L.G. contributed to data collection and analysis. S.J.H., C.A.C., R.S.S., P.A.E., F.A.M., S.C.B., A.M.M., and J.R.J. contributed to data interpretation and provided critical revisions.

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DISCLOSURE

The authors declare no conflicts of interest.

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