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Time to Catheter Angiography for Gastrointestinal Bleeding after Prior Positive Investigation Does Not Affect Bleed Identification

Akshaar Brahmbhatt[1], Pranay Rao[1], Andrew Cantos[2], Devang Butani[2]

Departments of [1]Radiology and [2]Imaging Sciences, University of Rochester Medical Center, Rochester, New York, United States.

***Corresponding author:**
Akshaar Brahmbhatt,
Department of Radiology,
University of Rochester Medical Center, 603 Elmwood Avenue,
Rochester, New York 14642,
United States.

akshaar@gmail.com

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ABSTRACT

Objective: To determine, time to angiography for patients with positive gastrointestinal bleeding (GIB) on prior investigation (endoscopy [ES], nuclear medicine [NM] Tc99m red blood cells (RBC) scan, or computed tomography angiography), affects angiographic bleed identification.

Materials and Methods: Visceral Angiograms performed from January 2012 to August 2017 were evaluated. Initial angiograms performed for GIB were included in the study. Exclusion criteria included recent abdominal surgery or procedure (30 days), empiric embolization (embolization without visualized active bleeding), and use of vasodilators, or subsequent angiogram. Timing and results of ES, NM Tc99m RBC scan, or computed tomography angiogram and catheter angiogram were recorded. In addition, age, gender, angiogram time, anti-platelet therapy, anti-coagulation therapy, bleed location, international normalized ratio, and units of packed RBCs received in the 24 h before catheter angiography were included in the study.

Results: One hundred and seventy angiograms were included in the final analysis. Forty-three angiograms resulted in the identification of an active bleed (68.9 years, and 67.4% male). All of these patients were embolized successfully. One hundred and twenty-seven angiograms failed to identify an active bleed (70.4 years, and 49.6% male). No significance was found across the two groups with respect to time from prior positive investigation. Receiver operating characteristic analysis demonstrated that units of packed RBCs received in the preceding 24 h were correlated with positive bleed identification on catheter angiography.

Conclusion: Time to angiography from prior positive investigation, including ES, NM Tc99m RBC scan, or computed tomography angiogram does not correlate with positive angiographic outcomes. Increasing units of packed RBCs administered in the 24 h before angiogram do correlate with positive angiographic findings.

Keywords: Gastrointestinal bleeding, Embolization, Interventional radiology, Visceral angiography

INTRODUCTION

Gastrointestinal bleeding (GIB) is a complex multifactorial problem. GIB can occur due to a variety of pathologies, including neoplasm, varices, arteriovenous malformations, and diverticulosis, among others. Given the multitude of causes and a variety of diagnostic and therapeutic modalities involved in addressing GIB, treating GIB requires a multidisciplinary team. This team often consists of gastroenterologists, interventional radiologists (IRs), and surgeons, among others.

The role of IR in the setting of GIB has evolved over time. Since the 1960s, transcatheter arteriography/intervention (TAI) has been used in cases of lower GIB (LGIB). Initially, TAI

served a purely diagnostic function but grew into a treatment modality through the use of vasoconstrictors. Now the modern practicing IR can employ microcatheters, coils, gel foam, and glue in identification and treatment of GIB.[1,2] The modern IR is serves an important diagnostic and therapeutic role and ultimately decides which patients would benefit from TAI.

The ACR appropriateness criteria recommend TAI in cases where patients have received 5 or more units of blood and colonoscopy in stable patients. This is congruent with several studies demonstrating decreased utility of colonoscopy in actively bleeding unstable patients, where angiography is more likely to be positive. In addition, many studies have evaluated factors that may affect angiographic outcomes have demonstrated factors which increase the utility of TAI, such as transfused units in the prior 24 h, patient comorbidities, and location. Overall, these studies have found that patients with more severe bleeds are more likely to have positive bleeding seen on catheter angiography.[1,3-6] The purpose of this study is to determine if time to angiography from prior positive investigation affects, TAI findings, and outcomes. Other factors were also included to corroborate prior studies and to control for important variables.

This review included both upper and LGIB. Although GIB has been classically divided into two types based on its location relative to the ligament of Trietz, this distinction is less clinically evident in practice and many times unclear the time of IR consultation. Further subgroup analysis was performed on the upper GIB seen on endoscopy (ES) and LGIB seen on and nuclear medicine (NM) Tc99m red blood cells (RBC) scan (NM). The primary aim was to see if there is a reason to urgently perform TAI on a patient with active bleeding noted on another diagnostic modality or ES. Other variables were also included both to control for potential confounders and to see if there were other factors that could aid an IR in deciding whether a patient would benefit from angiogram at the time of initial consultation.

MATERIALS AND METHODS

The RRSB approved this retrospective cohort study.

Visceral Angiograms performed at Strong Memorial Hospital Rochester, NY, USA, and Highland Hospital, Rochester, NY, USA from January 2012 to August 2017 were evaluated. Patients over the age of 18 years who underwent visceral angiogram for suspected GIB were identified. All angiograms were performed by a radiology resident or fellow under the direct supervision of an IR attending. In patients with serial angiograms, only the first was included in the study. Cases were excluded due to recent abdominal surgery or procedure within the past 30 days, or provocative angiogram. Patients who underwent empiric embolization were excluded. Empiric embolization was defined as embolization without an a visualized bleed. Additionally, bleeds that stopped spontaneously due to suspected dissection or vasospasm were also excluded. A total of 170 studies were included in the final analysis. The timing and result of angiography, ES (including Esophagogastroduodenoscopy, colonoscopy, and/or sigmoidoscopy), computerized tomographic angiography (CTA), and NM were evaluated in the prior 72 h, in cases of multiple prior investigations the one closest to the time of angiography was recorded. In addition, age, gender, angiogram time, anti-platelet use (ticagrelor clopidogrel, and/or aspirin), anticoagulant use (Enoxaparin, heparin, warfarin, or novel oral anti-coagulant) bleed location, international normalized ratio, and units of pRBC received in the 24 h prior to TAI were included in the study. The data were divided into two groups. The positive group had a bleed identified and treated during digital subtraction angiography. In the negative group, no bleed was identified. Several factors were compared across the two groups. TTA prior investigations ES, NM, and CTA were included if performed in the prior 72 h and mention of an active or highly suspected bleed was stated the final impression or procedure note.

Statistical analysis

The two groups were compared using independent, unpaired *t*-tests for continuous variables and Fischer's exact test for gender. Receiver operating characteristic (ROC) analysis was performed on age, units of pRBC, and TTA from a prior positive investigation, a direct visualization on endoscopy, positive RBC scan, or positive CTA. In addition, logistic regression analysis was performed on these factors. Time from CTA was excluded, given a small sample size in the negative group. Subgroup comparisons were made between TTA from positive suspected LGIB from prior tagged RBC scan and suspected upper GIBs visualized on prior upper endoscopic evaluation.

RESULTS

Initially, 269 studies performed for intra-abdominal embolization were identified. After filtering for exclusion criteria, 170 cases remained. In this, final set 127 patients had negative angiograms and 43 were positive with successful bleed identification and embolization. The baseline data between the two groups are presented in Table 1. There was no difference across the two groups with respect to age, gender, or anticoagulation use at time of presentation. Differences between the groups for units of pRBC transfused in the 24 h prior to TAI and use of antiplatelet therapy at time of bleed presentation were significant [Table 2].

TTA from prior investigations ES, NM, and CTA were not statistically different across the two groups. Table 3 ROC

Table 1: Baseline characteristics.

Measure	Positive (*n*=43)		Negative (*n*=127)		*P* value
Age (years)	68.9±15.7		70.4±13.4		0.55
Gender (% male)	*n*=29	67.4% (51.5–80.9%)	*n*=63	49.6% (40.6–58.6%)	0.052
Anti-coagulation	*n*=11	25.6% (13.5–41%)	*n*=38	29.9% (22.1–38.6%)	0.698
Anti-platelet therapy	*n*=10	23.3% (11.8–38.6%)	*n* =59	46.5% (37.6–55.5%)	**0.0075**
Units or pRBC administered in the prior 24 h	4.98±4.82		3.43±3.44		**0.023**

Values are mean±standard deviation for continuous variables, and % male (95% CI) (bionomial clopper/pearson) for gender, anticoagulation at time of initial presentation, and antiplatelet therapy at time of initial presentation. *P* values are results of independent, unpaired *t*-tests for continuous variables, and Fisher's exact test for gender. CI: Confidence interval

Table 2: Positive angiographic locations.

Embolized location	*n*
GDA	11
Gastric branch	4
Ileocolic branch	6
Colonic branch	9
Rectal	9
Other	7

Locations of bleeds seen on catheter angiography. GDA: Gastroduodenal artery

analysis also demonstrated that units in the prior 24 h were significant. Table 4 logistic regression did not identify any factors that were significant; this likely due to the limited number of patients in several groups.

Additional subgroup analysis on TTA between positive and negative angiographic outcomes was performed for upper GI bleeds seen on prior ES evaluation and LGIBs seen on NM. These two groups were evaluated since ES has a high efficacy for localizing upper, and NM has a high efficacy for identifying LGIB, respectively. These comparisons demonstrated no difference between the two groups, Table 1. Although several recent studies have showed the utility of CTA for LGIB, the small sample size in our review precluded meaningful statistical analysis.[7-10]

DISCUSSION

In our study, there was no difference between negative and positive groups with respect to time from prior study. This finding is likely multifactorial, but mainly due to the intermittent and variable nature of GIB. In addition, patients often go through varying sequences of diagnostic and therapeutic tests, which create heterogeneity in the sample. In addition, our evaluation was limited to the initial angiogram. Many of patients with GIB undergo repeat angiograms, especially those with severe blood loss. Evaluating these patients may have elucidated a difference in time from suspected bleed. However, this was outside the scope of our aim. Empiric embolization, defined as embolization without a visualized bleed, was excluded from the study. These cases were excluded, as it was unclear if the decision to perform angiography on these patients was based on other factors. It is likely that the timing of these procedures may not have been as dependent on prior studies.

When evaluating the prior investigative modalities, a binary system was used to evaluate the results of prior investigative modalities, and the amount of hemorrhage seen on prior ES examination or the time to positive NM scan was not included in the study. Several studies have shown that more severe bleeds correlate to positive bleeding on TAI.[11]

This study did demonstrate a positive relationship between units of pRBCs in the prior 24 h with successful angiography, Table 3. This finding corroborates several prior studies, which have shown that as bleeding severity increases, demonstrated by a drop in hemoglobin and increasing transfusions, the probability of finding a bleed also increases.[5,12,13] Comparison between the two groups also demonstrated that a higher percentage of patients with negative angiograms was on some form of antiplatelet therapy at time of initial presentation. Overall, this difference was not felt to be clinically useful as a significant percentage of patients in both groups was on antiplatelet therapy and that these medications are largely held in the acute setting.

Aside from blood loss, several studies have correlated hemodynamic instability with an increased likelihood of visualizing an active bleed on TAI and an increased risk of rebleeding.[5,12] However, more recent work has questioned this notion as there is large variability, especially given the variations in transfusion and resuscitation. These factors may be useful in patients with recurrent bleeds or serve a marker for worsening bleeding, suggesting the need to intervene.[6] Timing of angiography outside of work hours has also been shown to correlate with better technical success; this is likely due to unaccounted for variables and degree of hemorrhage.[4] Several studies have looked at similar factors have been inconclusive.[3] Finally, several studies have also demonstrated factors which decrease angiographic success. For example, patients with the left ventricular assist devices

Table 3: Time to angiography from prior investigation.

Investigation	Positive (*n*=43)		Negative (*n*=127)		*P* value
Endoscopy (e.g. endoscopy, colonocoscopy, sigmoidoscopy, etc)	Positive: 15 Total: 17	TTA from positive visualization 18.6±19.7 h	Positive: 40 Total: 57	TTA from positive visualization 23.2±33.0 h	0.41
NM	Positive: 12 Total: 15	TTA from positive NM 10.3±10.8 h	Positive: 65 Total: 69	TTA from positive NM 14.7±26.9 h	0.58
CTA	Positive: 10 Total: 12	TTA from positive CTA 16.4±18.5 h	Positive: 2 Total: 3	TTA from positive CTA 3.24±0.60 h	0.36
Subgroup: Upper GIB seen on endoscopy	*n*=11	19.9 (±21.3) h	*n*=19	17.0 (±15.8) h	0.68
Subgroup: Lower GIB seen on NM	*n*=11	8.78 (±9.4) h	*n*=53	11.4 (±10.4) h	0.45

For prior investigations, the total number performed and total positive is shown. The TTA is the average for those with positive results, with a standard deviation. *P* values are shown for unpaired *t*-tests. TTA from suspected upper GIB seen on endoscopy is shown in hours and standard deviation, *P* values are shown for independent unpaired two-tailed *t*-tests. TTA: Time to angiography, GIB: Gastrointestinal bleeding, NM: Nuclear medicine, CTA: Computerized tomographic angiography

Table 4. ROC analysis.

Measure	Area under curve (95% CI)	*P* value
Age (years)	0.46 (0.36–0.57)	0.48
Units	0.64 (0.54–0.73)	**0.008**
TTA from SC (h)	0.45 (0.28–0.62)	0.56
TTA from NM (h)	0.45 (0.27–0.62)	0.58
TTA from CTA (h)	0.88 (0.64–1.00)	0.11

Receiver operating characteristics of factors contributing to successful bleed identification. ROC: Receiver operating characteristic, CI: Confidence interval, TTA: Time to angiography, CTA: Computerized tomographic angiography, NM: Nuclear medicine

are less likely to have a bleed identified on arteriography, despite their anticoagulation. It is proposed that these experience bleeding due to small vascular malformations that are less amenable to angiographic treatment.[14]

In contrast to patient-based predictive factors, the usefulness of prior imaging tests has been more definitive. For example, NM scintigraphy has been shown to increase the yield of arteriography.[15] A study by Kennedy *et al*. demonstrated that 86% of patient with bleeding seen on CTA had bleeds confirmed on angiography. In the same study, 92% of patients without bleeding seen on CTA required no further treatment.[16] There studies evaluating the usefulness of CTA before TAI have shown sensitivities ranging from 50% to 86%.[17] In contrast, CTAs have been shown to provide increased information before colonoscopy in only 15% of cases.[18] In our series, the location of bleeds seen on TAI corresponded to the areas seen on prior investigative modalities, most of the time, 93% for SC, 92% for NM, and 80% for CTA. These findings support the utility of diagnostic studies before TAI.

There are several important limitations to this study. Given the retrospective nature of this study, an underlying selection bias among patients who ultimately underwent TAI maybe have skewed results. In addition, our analysis was limited to an academic tertiary care center and large academic hospital. As a result, the underlying patient population and the etiology of bleeding are likely different from those in different regions and settings. The retrospective nature of analysis did limit evaluation as some records were incomplete. In addition, when reviewing results, there was some interpretation of procedural studies and reports, which could have been standardized in a prospective project. However, overall our results were similar to prior studies and are likely relevant in similar care centers.

CONCLUSION

Time to angiogram from bleed seen on other examinations and modalities does not correlate with angiographic success. This finding may be due to the intermittent nature of many GIBs and in part, to the limitations of our study. This retrospective review did corroborate prior work that demonstrates units of transfused pRBCs in the preceding 24 h are positively correlated with angiographic outcomes. Given these findings, we suggest that the decision to perform angiography should be based on multiple factors. In cases, where a positive bleed is seen on a recent investigative modality, a patient does not always need to be rushed to TAI. Additional factors, including clinical history, hemodynamic status, and amount of blood loss, should also be considered before performing TAI.

Declaration of patient consent

Patient's consent not required as the patient's identity is not disclosed or compromised.

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Conflicts of interest

There are no conflicts of interest.

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