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Endovascular Interventions for Controlling Gastrointestinal Bleeding: A Targeted Approach to Patient Outcomes

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Abstract:

Background: Non-variceal GI bleeding is a potentially fatal condition affecting regions in the upper or lower GI tract, such as peptic ulcers, vascular malformations, malignancies, and diverticulosis. Trans-arterial embolization (TAE) has emerged as a very effective means of achieving haemorrhage control and has the advantage of being minimally invasive. This study aims to assess the effectiveness and safety of TAE as a treatment option for non-variceal GI bleeding, focusing on the clinical outcomes, rebleeding rates, and incidence of complications. **Methods:** The current investigation was undertaken on 30 patients with non-variceal GI bleeding. There were 53.33% upper and 46.67% lower GI bleedings reported, whose peptic ulcers accounted for 50% of the upper gastrointestinal bleeding and vascular malformation for 42.86% of the lower gastrointestinal bleeding. **Results:** A higher level of severe bleeding had a statistically significant positive correlation with both hypertension (p-value .022) and renal impairment (p-value .009). TAE bears an extremely high clinical success rate, with 86.67% of patients achieving hemostasis without rebleeding. So far, 86.67% have not rebleed, but 6.67% had to undergo repeat embolization, while another 6.67% of patients underwent additional surgery. The rate of complications was low, with 3.33% of patients showing mild vascular complication in the form of self-limited hematoma. **Conclusions:** TAE represents a safe and effective therapeutic option for patients suffering from non-variceal GI bleeding. It is effective, with higher success rates than complication risks. Meanwhile, hypertension and renal impairment was significant predictor of the bleeding severity.

Keywords: trans-arterial embolization; peptic ulcers; vascular malformations; hypertension; clinical outcomes.

Introduction

Gastrointestinal (GI) bleeding is a major medical issue in which patients experience blood loss from any part of the GI tract, including the oesophagus to the rectum. It is usually classified as upper GI bleeding (UGIB), which originates from the oesophagus, stomach or duodenum, and lower GI bleeding (LGIB), which arises from the jejunum, ileum, colon and rectum. The condition spans the entire spectrum of severity, from occult bleeding detected in laboratory tests to life-threatening hemorrhage. GI bleeding continues to be a major contributor to morbidity and mortality in the world, particularly in the adult. Epidemiological studies show that for UGIB, the incident rate is approximately 50 to 150 cases for every 100,000 individuals in a year, and LGIB is slightly less frequent, ranging from 20-30 cases for every 100,000 individuals in a year [(1)]. Age is an essential variable as GI bleeding is higher in the population over 50 because of higher consumption of nonsteroidal anti-inflammatory drugs (NSAIDs), antifragmentation medication and other associated ill health like peptic ulcers and diverticulosis.

Endovascular therapy has become a critical modality for managing gastrointestinal bleeding that is unresponsive to endoscopic treatment. Techniques such as transcatheter arterial embolization (TAE) are helpful in targeting the offending bleeding vessels, which provides an alternative to surgical intervention. This is especially important in patients with challenging anatomy or those who are likely to have complications from surgery. Reports suggest that TAE has a more than 90% technical success rate in achieving hemostasis and clinical success in 70 to 80% of cases [(2)]. Also, developments in Computed Tomography Angiography (CTA) have greatly improved the localization of bleeding sites, leading to better procedural outcomes. Although these interventions improve the chances of survival and reduce the duration of hospital stay, they are usually performed in specialized centers with qualified interventional radiologists, which is a major limiting factor.

Endovascular management, however, has its challenges despite its successes. A fundamental issue is the absence of any approach for selecting patients and performing the procedure, which contributes to differing outcomes. Besides, some complications may occur within endovascular procedures, such as ischemia from non-selective embolism and vessel injury with or without rebleeding, especially in patients with some form of coagulopathy [(3)]. Post-surgical interventions collect longitudinal data for assessing the effectiveness and provide a historical perspective on bleeding conditions and their recurrence rate, especially after non-variceal GI bleeding, which are other aspects that need more investigation when compared to variceal bleeding.

This study aims to evaluate the effectiveness and safety of endovascular management for non-variceal gastrointestinal bleeding. By focusing on procedural outcomes, complication rates, and bleeding recurrence, this research seeks to address existing gaps in the literature and provide evidence to guide clinical decision-making. Understanding the nuances of endovascular therapy in this context will contribute to optimizing care for patients with GI bleeding, particularly in high-risk populations or settings where traditional interventions have proven insufficient.

Objectives

- To assess the efficacy of the endovascular approach in stopping nonvariceal gastrointestinal bleeding.
- To determine safety standards in endovascular procedures through examination of complication incidences such as ischemic complications, rebleeding episodes, and vascular damages.

Patients and methods

***Study Design*:** The research design chosen for this study is prospective intervention quasi-experimental design to analyze the contribution of super-selective trans–arterial embolization (TAE) in the treatment of non-variceal gastrointestinal bleeding in adult patients. The investigation concentrated on cases of both upper and lower gastrointestinal bleeding. The study was conducted at two institutions, Alexandria University Hospital and Benha University Hospital, both of which are equipped with modern interventional radiology departments, which made these places appropriate for this study.

***Study Population*:** This research included 30 adult patients with upper and lower non-variceal gastrointestinal bleeding that might include bleeding from ulcers in the oesophagus, stomach, and small or large intestines. These patients were sent to the interventional radiology departments in both hospitals after the presentation of uncontrolled bleeding or severe bleeding that had persistent characteristics. The sample was chosen within the limits to ensure the provision of diversity in non-variceal gastrointestinal bleeding conditions that would need endovascular intervention. The study was done between May 2022 and November 2024 at Alexandria University Hospital and Benha University Hospital. Such a long duration of the study allowed us to recruit a sufficient number of patients and conduct follow-up observations to measure the efficiency and safety of the interventions.

***Process and Methodology*:** The methodology followed in this case was systematic and sequential, with an emphasis on thorough patient evaluation and consideration. First, there was a clinical examination, which included taking a detailed history of when and where the bleeding started and its course, as well as the patient's medical, surgical and occupational history. Physical examination was also done in a general and local manner with a special focus on the general condition of the patient.

Laboratory complete blood counts (CBC), INR, and renal parameters were checked for all patients. These tests served as critical exclusionary criteria for the initial processes and were helpful in obtaining correct reference measures. Imaging has proved entirely significant in determining the precise abdominal location of the bleed. All patients participated in MD-CT enterocolonography of the abdomen and pelvis. During the procedure, three sets of images were captured at different phases: before contrast, during arterial, and portal venous. To facilitate the interventional radiologist during the operation, techniques like Maximum Intensity Projection (MIP) and Volume Rendering (VR) were performed, creating 3D vascular maps.

- ***Consent and Patient Preparation***

Informed consent was obtained from each participant, including the patients and their families, after all the potential risks, benefits, and alternatives to the procedure were discussed. All pre-procedural preparations comprise supportive therapy and any anticoagulant or antiplatelet therapy that may need attention. In almost all instances, a urinary bladder catheter was placed to aid the patient's comfort during the intervention as well as to supervise their urine output.

- ***Ethical considerations***

This research was adhered to ethical principles that ensure the protection of patients, respect for their privacy, and the confidentiality of their health information. Patient confidentiality was strictly maintained, with data collected in a coded or non-identifiable format. Ethical approval was obtained from the Institutional Review Board (IRB) or ethics committee of each participating hospital. Patients were closely monitored for adverse events, and any complications.

- ***Endovascular Management***

The procedures followed strict aseptic techniques. Throughout the intervention,

patients' vitals were observed in the form of blood pressure, heart rate, oxygen saturation levels, and ECG, and these were gathered on a continuous basis. Anaesthetic or intensive care personnel were present to assist the unstable patients. The access site was the deep femoral artery, out of which the site was injected with a local anaesthetic to the groin region. A 5-Fr sheath was employed, with primary unpaired visceral branches of the abdominal aorta catheterized in a selective manner with 4 or 5-F catheter. These branches included the celiac and the superior and inferior mesenteric arteries. After the bleeding source was detected, microcatheter was advanced coaxially to the super-selective site for embolization. The selection of the embolic substance available in the forms of coils, liquid embolic, gel foam, and other forms was best suited to the individual's condition and clinical needs.

- ***Post-procedure Follow-up***

The patients were subsequently observed post-treatment for any rebleeding or related issues with intense vigilance. Clinical evaluations encompassed all vital signs, stability, and hemoglobin concentration at regular intervals. In case of suspected renewed bleeding, MD-CT enterocolonography was done again to find the cause. When renewed bleeding was revealed, a second TAE was conducted as required. Complication-free patients with good clinical conditions were appropriately managed and followed up to check for long-term outcomes. This strategy has been used because of the multifaceted nature of the available literature concerning non-variceal gastrointestinal bleeding. Still, it is also focused on safeguarding the patient and effective treatment while promoting individualization.

Approval code: MD 6-11-2021

Statistical Analysis

Categorical variables were tested using the chi-square test, while group comparisons of means will be performed using the t-test or its non-parametric equivalent where applicable. The data analysis was done using the Statistical Package for the Social Sciences (SPSS) (SPSS Inc., Chicago, Illinois, USA) version 27. A p-value of less than 0.05 indicated statistical significance.

Results

The study comprised 30 patients who suffered from nonvariceal gastrointestinal bleeding, and as such, there was considerable variation in socio-demographics. Most of those included were middle-aged or older, with the highest group (30%) ranging between 51 and 60 years old, while those aged over 60 years accounted for 26.67% of the patients. Persons aged 41 to 50 and between 30 to 40 made up 23.33% and 20% of the sample, respectively. These findings suggest that the condition is more common in elderly populations, probably due to age-related factors such as increased comorbidity and medications that may provoke bleeding (Table 1).

The study also uncovered a male predominance. The male-to-female ratio was 60 to 40. This supports previous studies with gender disparity in the prevalence of males suffering from gastrointestinal bleeding being higher than that of women. This might be related to greater lifestyle risk factors such as smoking. Smoking history was significant, as 33.33% of the patients were active smokers and 26.67% were former smokers, while only 40% of the study patients were not smokers. Smoking is one of the known precipitants of some gastrointestinal diseases, especially peptic ulcers, which ultimately increase the risk of bleeding. There was an underlying presence of comorbidities with the majority of the individuals suffering from Hypertension accounting for 50% of the patients. Diabetes was reported at 33.33%, with Cardiovascular Disease and Renal impairment at 20% and 13.33%, respectively. These findings also suggest that the sociodemographic and clinical

characteristics of this population point toward a complex etiology of non-variceal gastrointestinal bleeding (Table 1).

Table (1) Sociodemographic Characteristics of Patients with Non-Variceal Gastrointestinal Bleeding.

Sociodemographic Variable	Category	Number of Patients (n = 30)	Percentage (%)
Age	30 - 40 years	6	20%
	41 - 50 years	7	23.33%
	51 - 60 years	9	30%
	> 60 years	8	26.67%
Sex	Male	18	60%
	Female	12	40%
Comorbidities	Hypertension	15	50%
	Diabetes	10	33.33%
	Cardiovascular Disease	6	20%
	Renal impairment	4	13.33%
Smoking History	Current smoker	10	33.33%
	Ex-smoker	8	26.67%
	Non-smoker	12	40%

Table (2) Clinical Features of Patients Suffering from Non-Variceal Gastro Intestinal Tract Bleeding

Clinical Variable	Category	Number of Patients (n = 30)	Percentage (%)
Type of Bleeding	Upper GI Bleeding	16	53.33%
	Lower GI Bleeding	14	46.6%
Bleeding Severity	Mild	5	16.67%
	Moderate	10	33.33%
	Severe	15	50%
Duration of Bleeding	Acute (< 24 hours)	12	40%
	Subacute (1-7 days)	8	26.67%
	Chronic (> 7 days)	10	33.33%
Initial Hemoglobin Levels	Markedly low (< 7 g/dL)	6	20%
	Low (7-13 g/dL)	22	73.33%
	Normal (> 13 g/dL)	2	6.67%

The medical records of the 30 patients included in the study provide important information about non-variceal gastrointestinal bleeding. There was a slight difference between the frequencies of upper gastrointestinal (GI) bleeding, which was seen in 53.33% of patients, versus lower GI bleeding, which affected 46.67% of patients. This near-equal distribution reveals the presence of a wide range of cases, which must be included in a thorough analysis. The bleeding was of different intensities, with 50% of patients suffering from severe bleeding, which shows the urgency in many cases. Moderate bleeding was noted in 33.33% of patients, while in 16.67% of cases where mild bleeding occurred, the majority of these cases were of acute or intensive management nature (Figure 1). In terms of classification according to the duration of bleeding, 40% of patients demonstrated acute bleeding (within 24 hours), whereas 26.67% showed subacute bleeding (1-7 days), with the remaining 33.33% group having chronic bleeding for more than 7

days. These patterns suggest that the study encompassed immediate to long-term cases of bleeding (Table 2).

The measured initial haemoglobin levels reflected the degree of blood loss among patients. Most of them (73.33%) had low haemoglobin levels (7–13 g/dL), demonstrating moderate anaemia producing no clinical impact, although concerning. Markedly low haemoglobin (<7 g/dL) was noted in 20% of patients marked with severe anaemia and the need for intervention. Only 6.67% of patients had normal hemoglobin levels which could be attributed to the early presentation or transfusion. These findings point out the heterogeneity in clinical presentation and severity of non-variceal GI bleeding, which calls for a prompt response and tailored investment (Figure 1).

Table (3) Causes of bleeding among participants.

Type of Bleeding	Cause of Bleeding	Number of Cases	Percentage of Total Cases
Upper GI Bleeding (16 cases)	Chronic Pancreatitis	2 cases	12.5%
	Peptic Ulcer	٨ cases	50.0%
	Duodenal Malignancy	3 cases	18.75%
	Gastric Malignancy	3 cases	18.75%
Lower GI Bleeding (14 cases)	Vascular Malformations	6 cases	42.86%
	Malignancy	4 cases	28.57%
	Diverticulosis	4 cases	28.57%

Table (4) Post-Procedure Outcomes and Follow-Up in Non-Variceal Gastrointestinal Bleeding Treatment

Post-Procedure Variable	Category	Number of Patients (n = 30)	Percentage (%)
Rebleeding Rate	Yes	4	13.33%
	No	26	86.67%
Need for Additional Interventions	Repeat Embolization	2	6.67%
	Surgical Intervention	2	6.67%
Length of Hospital Stay	Average Number of Days (mean±SD)	5 d±1.2	
ICU Admission after procedure	Yes	20	66.7%
	No	10	33.3%

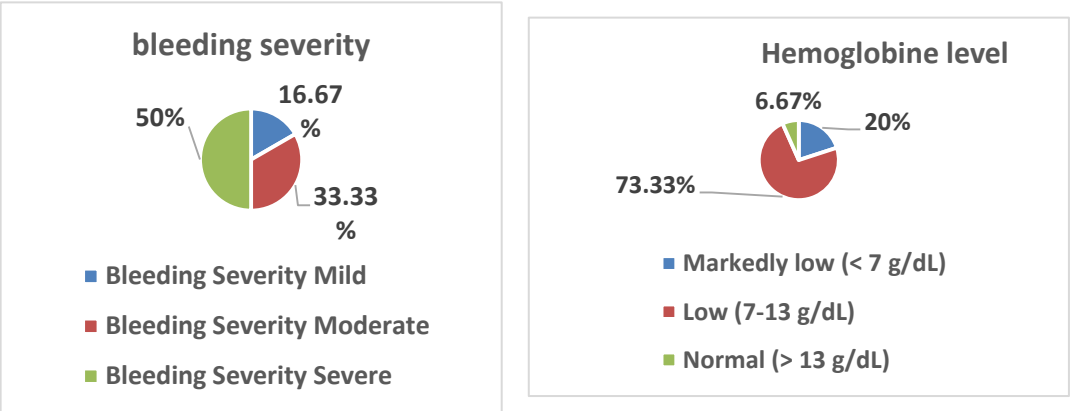

Figure (1) Bleeding severity and haemoglobin level among the participants

The results following the procedure shed light on the utility and safety of TAE in non-variceal gastrointestinal bleeding. The recurrence rate of four patients (13.33%) suggests that it was indeed quite low, with the rest (86.67%) successfully controlling the bleeding. Out of those who required further treatment, two patients (6.67%) underwent repeat embolization, and another two (6.67%) had to resort to surgery as well, which garners support for TAE working solo in the majority of patients. The mean hospital stay was five days (±1.2), demonstrating the balance between intervention effectiveness and complication incidence, combine those metrics with the fact that 66.7% of patients had to go to the ICU after obtaining further evidence to the possible grievous nature of treatment required before TAE or even the close scrutiny obligatory with some extreme cases. The rest, 33.3%, did not need the ICU, symbolizing distinct recovery targets with respect to each patient. All in all, TAE appears to have a high success rate and acceptable complication frequency as a technique in non-variceal gastrointestinal bleeding (Table 4).

The outcome variables validate the considerable efficacy and safety of trans-arterial embolization (TAE) in the treatment of non-variceal gastrointestinal bleeding. Control of bleeding was achieved in 86.67% of patients, where complete hemostasis was achieved after initial embolization. Only four patients (13.33%) required further measures, such as repeat embolization (6.67%) or surgery (6.67%), which strengthens the evidence of TAE being a primary treatment strategy for this condition. Post-procedural complications were minimal, with only one patient (3.33%) reporting a self-limiting hematoma. Equally important, no bowel ischemia or renal impairments have been reported, which demonstrates the procedure's safety. For functional recovery, only 16.67% of patients did not return to full normal activities after the intervention, they needed at least two to three weeks for full recovery. These outcomes are indicative of the overall success of TAE; satisfactory bleeding controls, patient safety, and recovery with minimal adverse effects (Table 5).

The association of age group with degree of bleeding had interesting trends but it was not statistically significant with a p-value of .248. Patients within the age bracket of 30-40 primarily suffered from moderate (6.67%) and severe bleeding (10%), and there no cases with mild bleeding reported. For the older 41-60 age bracket, bleeding cases were a bit more normalized, with mild at 10%, moderate at 20% and severe at 20%. For patients above the age of 60 years, the severe bleeding cases remained fairly high at around 20%, but the mild and moderate cases were lower (6.67% each). This indicates that the older age group is more vulnerable to severe bleeding, although this association was not statistically significant in this study (Table 6).

The relationship between coexisting illnesses and the degree of bleeding is greater with all comorbid conditions. Statistically significant outcomes were noted for hypertension (p =.022), diabetes (p =.03) and renal impairment (p =.009). Severe hypertension was the strongest correlate of bleeding, where the percentage of cases with severe bleeding was 33.33 % compared to 10% and 6.67% in moderate and mild cases, respectively. Diabetes was associated with 16.67% of severe bleeding, while moderate and mild bleeding represented in 10% and 6.67% of diabetic patients respectively. Renal impairment as a single comorbidity factor was identified in 13.33% of moderate bleeding cases only, signifying an important risk factor. In comparison, cardiovascular disease is less strongly correlated with lower p-values of .56. The co-existence of these diseases is common and represented here as two hypertensive patients had diabetes mellitus, and two diabetic patients had cardiovascular disease, while one patient

with cardiovascular disease had renal impairment. The explanation where these p values are mentioned specifically emphasizes hypertension, diabetes and renal impairment are having serious outcomes hence stressing the need to control such patients (Table 6).

Table (5) Outcome Analysis of Non-Variceal Gastrointestinal Bleeding Treatment.

Outcome Variable	Category	Number of Patients (n = 30)	Percentage (%)
Success	Technical success	26	86.67%
	Clinical success	28	93.3%
Post-procedural Complications	Self-limited hematoma	1	3.33%
	Bowel ischemia	0	0%
	Renal complications	0	0%
Functional Recovery	Return to full normal activities	25	83.33%

Table (6) Analysis of Bleeding Severity by Age Group and Comorbid Conditions Have Correlation

Age Group	Mild Bleeding	Moderate	Severe Bleeding	p-value
30-40 years	0 (0%)	2 (6.67%)	3 (10%)	
41-60 years	3 (10%)	6 (20%)	6 (20%)	**.248**
> 60 years	2 (6.67%)	2 (6.67%)	6 (20%)	
	Comorbid Condition			
Hypertension	2 (6.67%)	3 (10%)	10 (33.33%)	**.022**
Diabetes	2 (6.67%)	3 (10%)	5 (16.67%)	**.03**
Cardiovascular Disease	3 (10%)	1 (3.33%)	2(6.67%)	**.56**
Renal impairment	0 (0%)	4 (13.3%)	0 (0%)	**.009**

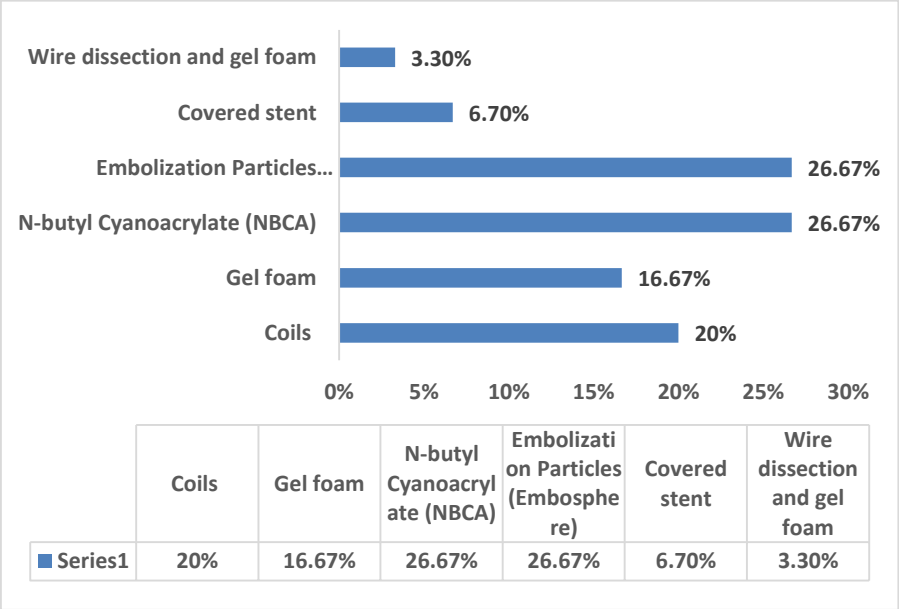

Figure (2) Types of embolic materials during super-selective trans-arterial embolization (TAE)

This bar chart describes the proportional use of various types of embolic materials during super-selective trans-arterial embolization (TAE) for the treatment of non-variceal gastrointestinal bleeding in this study. The most frequent embolic materials used were particles and NBCA, which were applied in 26.67% of the cases for each one, N-butyl Cyanoacrylate (NBCA) was used primarily for rapid vessel occlusion bleeding during difficult treatments which required permanent embolization. Similarly, embolization particles, (Embosphere) were used to achieve controlled and effective occlusion. Coils were the third most common material in this category, making up 20% of cases. Gel foam was used in 16.67% of patients, probably used for less evident occasions when a temporary embolization was required. Covered stents were used in 6.7% of patients, probably for those with complex anatomy that needed to preserve the vessel. Wire dissection combined with gel foam was the least popular, at 3.3%, suggesting that this technique was used for a certain special case where primary embolization is risky. This technique profile stresses the specific clinical circumstances and characteristics of the bleeding and the systematic approach towards embolic materials (Figure 2).

Analysis of Bleeding Duration and Rebleeding Rate

The evaluation of bleeding time and its subsequent patterns of rebleeding shows meaningful patterns, although these were not statistically significant (p =.065). In the groups suffering from acute bleeding (less than 24 hours), 33.33% showed no report rebleeding episodes while 6.67% had. These indicate that acute bleeding has a propensity to have a slightly increased chance of rebleeding relative to the other durations. For patients with subacute bleeding (one to seven days), 20% did not have rebleeding episodes, and 6.67% had, which indicates a similar rate of rebleeding as in acute situations.

On the contradictory perspective, patients suffering from chronic bleeding (>7 days) showed zero rebleeding episodes, with 33.33% being stable without recurrence. In spite of the specified differences reaching statistical significance, outcomes demonstrate the nuanced relationship between bleeding duration in predicting rebleeding risk and follow-up action.

The relation between the risk factors and the severity of bleeding

The assessment of the risk factors show their relationship with severe bleeding. Hypertension, which affected nearly half of the patients (50%) showed a significant association with severe bleeding in 33.33% of the cases (p=.022), emerged as the most significant of the risk factors. This is a strong indicator of hypertension being a significant risk factor for severe bleeding, which, as noted above, is probably due to the underlying causes of vascular fragility, plus the fact that many hypertensive patients are on anti-platelet therapy.

When examining the age factor, over 60 years, patients with severe bleeding constituted 26.67% of the sample population, and 20% had severe bleeding. This relationship was insignificant (p =.248); thus, it indicates that age is not a robust factor alone for severe bleeding.

Discussion

Nonvariceal gastrointestinal (GI) tract bleeding is a highly advanced medical condition which can prove to be a dangerous condition if mishandled. This is linked with the upper and lower gastrointestinal tract. They originate from a number of things, such as ulcers, tumours, and overgrown tissues, and if left untreated, they can lead to dire outcomes and even prove to be fatal. They have primarily been dealt with using therapy and endoscopic procedures. However, some cases are much more severe and

complicated. For these types of issues, TAE is used to treat cases that are severe or rather tough to treat using medication therapy or endoscopy. This technique is a lot more modern than the traditional approach of surgery and is deemed to have a much higher success rate as a result [4,5]. Despite its merits, there are some hurdles, such as the expertise of the operator, and not all patients are the same, therefore making it harder to standardize the procedure.

In this current study, TAE is used to test the safety and efficiency of the method and ensure that the standard is higher than what is currently accepted for people who do not respond to modern therapy procedures**.**

The study consisted of 30 patients who suffered from non-variceal GI bleeding. They were mostly in middle or old age, with the highest incidence of 30% among those between 41 and 50 years, followed by 26.67% of those over 60 years. These findings correlate with the basic understanding that the burden of GI bleeding is higher in the elderly population, which is plausibly attributable to increased comorbidities and medication use. There was a marked male predominance (60%), corroborating prior studies that show a greater prevalence of GI bleeding among men, which may be attributable to associated high-risk lifestyle factors, for instance, smoking. The history of smoking was relevant, where 33.33% of the study population were current smokers, and 26.67% were ex-smokers, which endorses the role of smoking in the causation of hemorrhagic conditions, for instance, peptic ulcers. Comorbidities had a significant contribution. Hypertension affected 50%, diabetes 33.33%, cardiovascular disease 20% and renal impairment 13.33%. These findings propose a multi-factorial origin of non-variceal GI bleeding in relation to age, sex, lifestyle factors, and other comorbidities. The study demonstrates the need for a more specific approach, especially concerning high-susceptible populations and reveals TAE as an innovative method to improve results where there is an unmet need after conventional treatment.

The significant socio-demographic patterns were uncovered in a study conducted by Elghuel et al.[6] in Libya at the Tripoli Medical Center**,** which was centered around 928 cases of UGIB. A clear male predominance (60.3%) was observable alongside an average age of men (49.6 years), which was comparatively younger than women (53.9 years, p= .001). The most prevalent cause was peptic ulcer disease, especially duodenal ulcers, which constituted 30.7% of cases, with a total of 37.1%. Although there was significant variceal bleeding within females (35.1%), smoking and the use of NSAIDs were major contributors. Lifestyle factors such as the use of medication and smoking showcased a major impact in the context of this research in relation to UGIB's prevalence and etiology.

Many studies as Raj et al.[7] and Theocharis et al.[8] report that GI Bleeding is significantly affected sociodemographic and clinically by being male, older, having other illnesses such as hypertension and renal impairment, and by lifestyle practices such as smoking and NSAID use. In our study, hypertension had a strong association with severe bleeding at a p-value of .022 which is significant. However, the current study was different from other studies in that we found no significant relationship between age and severe bleeding (p= .248), which showed that age is not a good indicator of the severity of bleeding.

Wilkins et al.[9] reemphasized the role of modifiable risk factors, such as prior GI bleeding, use of NSAIDs, and H. pylori infection, including pertinent facts that these are key components of UGIB. Their emphasis on managing H. pylori infections and avoiding high doses of NSAIDs confirms our view on the importance of treating these risks.

The ongoing research serves to enhance these findings by investigating the incidence, intensity and causes of GI bleeding. It has been found that while the percentage of those suffering from upper GI bleeding stands at 53.33%, individuals afflicted with lower GI bleeding account for 46.67%, marking a relatively reasonable split of proportions. Moderate severity (33.33%) seemed to be the key suspect, with the need for an acute endovascular intervention taking the topmost position. Acute haemorrhage, accounting for the largest type at 40%, came out with the worst outcomes by far, while chronic bleeding (33.33%) faired on the better end of the scale. Significant blood loss levels were also highlighted by haemoglobin concentrations, with 73.33% coming out as low (7-13g/dL), with 20% suffering from severe anaemia (<7g/dL), marked the claim for a response. These findings align with existing research. Prominence of upper GI bleeding (60-70%) and the increasing magnitude of lower GI bleeding caused by development in diagnosis.[10,11]

The underlying reasons responsible for causing gastrointestinal (GI) bleeding have been assessed in detail in our study. In upper GI bleeding, peptic ulcers remained the most common cause, comprising more than 50% of cases. This is consistent with the existing literature, which noted H. Pylori infections and NSAID use as the significant factors.[9] The gastric and duodenal malignancies also comprised a notable portion where each of the malignancies accounted for 18.75% of cases. This fact also indicates the need for early cancer screening of patients with complicated GI symptoms. Chronic pancreatitis, though less frequent (12.5%), was also noted as an important factor. In terms of lower GI bleeding, the most common cause was found to be vascular malformations, with 42.86%, which collaborated with the results of Marion et al.[12] and Sengupta et al.[13]. Furthermore, malignancies and diverticulosis were also found to be equally responsible for 28.57% of lower GI bleeding cases. However, the lessened frequency of diverticulosis, as compared to other studies, might be due to some differences in dietary habits or referral patterns between the regions.

Acute bleeding was the most common type, occurring in approximately 40% of the sample population. Its time classification was associated with the most severe outcomes, as indicated by the calculated P value of .005. However, it did not exhibit any substantial association with the severity of the condition, probably because of better hemodynamic compensation and control measures in place over time.[14]

Our findings correlate with investigations done by Loffroy et al.[11] and Wilkins et al.[9], which correlate peptic ulcers and vascular malformations with GI bleeding. However, the higher incidence of malignancies in cases of both upper and lower GI bleeding indicates the possibility of geographic and or population differences, which require additional examination.

Strategies employed in the management of gastrointestinal bleeding concentrate on the degree, origin, and site of bleeding. Achieving hemodynamic stability using fluid resuscitation, blood transfusion, and coagulopathy correction is imperative. Proton pump inhibitors are crucial components in the medical treatment of upper GI bleeding, as they limit acid production and facilitate clot retention. Stepwise management usually incorporates endoscopic procedures and trans-arterial embolization, which are done more often now. Trans-arterial embolization has been remarkably effective in complex cases, exhibiting positive results and limited complications.[15] This research and literature have already enhanced existing knowledge on the significance of collaborative efforts and coordination in managing GI bleeding.

TAE tends to have a beneficial success rate of 90% and incidentally generates

fewer complications than surgical methods.[11] TAE surpassed expectations in a sub-study of approximately 100 patients by stopping bleeding in 86.67% of patients without rest bleeding. Nonetheless, 13.33% of subjects had an occurrence of rebleeding and required either repeat embolization or surgical intervention. This is consistent with Loffroy et al.[11] study, where the rebleeding rate is 10% to 20%. The mean length of stay in the hospital was five days, with this recovery period considered short. Of importance, 66% of patients were monitored in the ICU afterwards, which is strongly indicated in critical instances.

The primary treatment for upper bleeding of the GI tract involving peptic ulcers, or variceal haemorrhage, is endoscopic therapy. When such therapy fails to provide satisfactory results, TAE comes in as a second alternative treatment, which is not only effective but also minimally invasive. This technique is particularly useful because it can employ various embolic materials such as coils, gel foam, and cyanoacrylate. TAE's flexibility with materials allows clinicians to optimize treatment for the needs of specific patients. In the case of lower GI tract bleeding caused by diverticulosis, vascular malformation, or even tumours, endoscopic therapy is prioritized. However, if the sources cannot be identified, TAE is a viable alternative. Unlike TAE, surgical interventions are rarely required because of the modernized endoscopic and endovascular techniques, but they can be resorted to when devices fail to treat non-variceal GI bleeding.[8]

According to an article published by Loffroy et al.[11] and confirmed by our own study, TAE is a safe intervention that is reliable for treating non-variceal GI bleeding. These findings augment the need to adopt a multi-disciplinary approach which encompasses surgical, endoscopic, and interventional radiology methods to improve patient outcomes and solve the multifaceted issues of non-variceal gastrointestinal bleeding.

Our research underlines the effectiveness of trans-arterial embolization (TAE) in treating non-variceal gastrointestinal (GI) bleeding with a success rate of 86.67%, claiming most patients did not have any rebleeding episodes. These results align with those of Wang et al.[16], who indicated that clinical success rates were above 85%. This bolsters the argument in favour of TAE as the top choice for the treatment of unmanageable GI bleeding. However, a portion of patients (13.33%) did experience rebleeding episodes requiring additional interventions, such as repeat embolization (6.67%) or surgical management (6.67%). These studies correlate with those outlined previously, validating the claim that TAE, despite being highly effective for the majority, is not always a cure-all, and supplementary management may be needed.

A stay of around five days in the hospital was seen in our group. This seems to match with the studies done by Minici et al.[17], where a recovery period of four to six days was noticed in patients after undergoing TAE procedures. On the other hand, ICU admission rate observed by Ini,C et al.[18] was 66.7%, which was much higher than what they published, where rates were only between 50%-60 %. This could be due to the fact that there are some differences in the selection criteria of the patients because our studies could have more unwell patients who needed close monitoring after the procedure. Even so, our study's low complication rate of 3.33% is still very much in line with what Bauer and Ray.[19] found, which affirms that TAE is a relatively safe procedure to perform by trained interventional radiologists. Both this and other studies show how the incidence of significant complications is very low, such as, but not limited to, ischemia and other vascular injuries, which are usually lower than 5%.

In our study, patients who were treated by medical therapy had higher rates of repeat

embolization (6.67%) and surgical intervention (3.33%) than procedures without further interventions, such as endoscopic therapy. This is also what Hiraki et al.[20] noted, where they highlighted the advantage of beginning endoscopic therapy as early as possible in order to lessen the clinical consequences of secondary treatment. It is also worth noting that while our rebleeding rate is 13.33%, which corresponds to Hiraki et al.[20] estimate of 10-15%, this illustrates the necessity for appropriate intervention and material selection in achieving stronger outcomes.

At long last, although Matsumoto et al.[21] posit that the longer the duration of the bleed, the more adverse the outcomes, our study shows that there is no significant association between the duration of the bleed and rebleeding. This difference may be due to the number of subjects and patient divergences, which points to the need for more focused intervention measures. All these findings, both ours and those in the broader literature, encourage a blend of endoscopic and interventional radiology techniques in dealing with nonvariceal GI bleeding in order to reduce the consequences.

In summary, this paper confirms the significant effectiveness and safety of trans-arterial embolization (TAE) as a first-line approach of care intervention for non-variceal gastrointestinal bleeding. Our data corroborates and enhances existing literature on the subject, assuring that TAE yields high clinical success, low complication rates, and modest rebleeding episodes. In addition, the study describes hypertension and renal impairment as critical determinants of bleeding severity while also considering the timeliness of the intervention and allowances on the type of intervention in improving patient outcomes. However, variations in rebleeding rates, admission to ICU, and how the duration of bleeding relates to outcomes draw attention to the necessity of providing individualized treatment to patients as well as further studies to improve the therapeutic approaches. With the emerging trends in interventional radiology, endoscopic techniques and multidisciplinary approaches, the management and prognosis of non-variceal gastrointestinal bleeding will be significantly improved, thus elevating patient care and recovery.

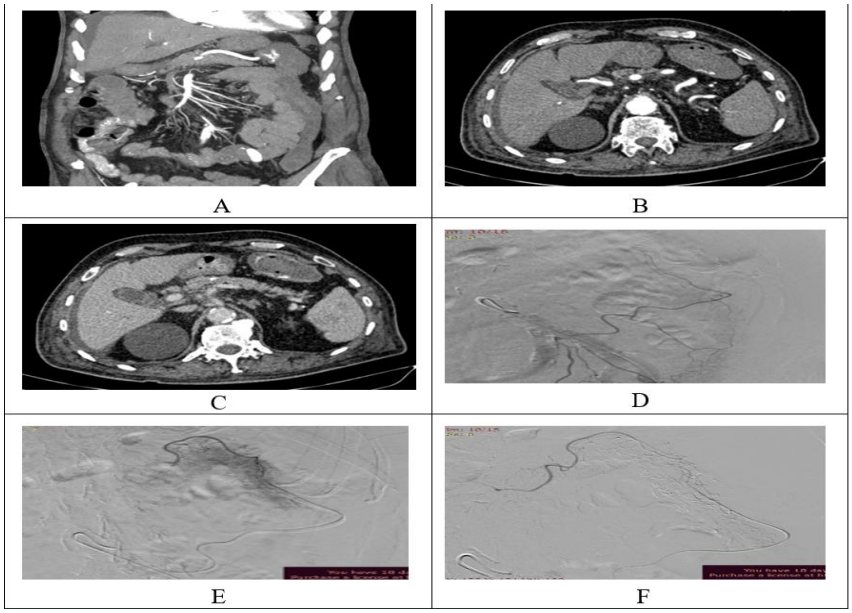

Figure 3: Angiodysplasia of splenic flexure.(A-G) CT angiography (CTA) and digital subtraction angiography (DSA) of an 80-year-old male patient presented with hematochezia (A-C) CTA

demonstrates active endoluminal bleeding from splenic flexrture of the colon angiodysplasia (D-E) DSA obtained with catheterization of the left colic artery (LCA) confirms CTA findings (F) DSA obtained with catheterization of the LCA after PVA embolization. No evidence of active bleeding.

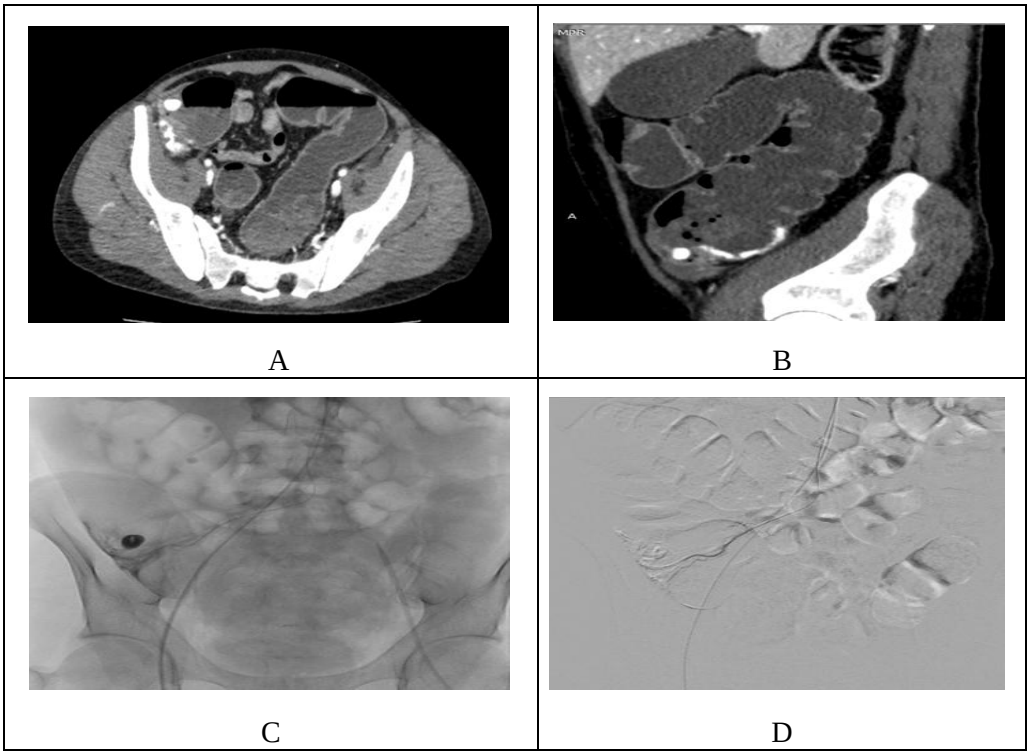

Figure 4: Colonic pseudoaneurysm. (A-D) CT angiography (CTA) and digital subtraction angiography (DSA) of an 32-year-old male patient with acute lower gastrointestinal tract bleeding (A-B) CTA identified active arterial bleeding in the region of the asending colon. (C) DSA showed pseudoaneurysm originating from the ileocolic artery (D) The final mesenteric angiogram confirms that the entire remaining bowel is still adequately perfused while the pseudoaneurysm was obliterated.

Conclusion

This study analyzes the efficacy and safety of trans-arterial embolization (TAE) as a treatment option for non-variceal gastrointestinal (GI) bleeding. Its 86.67% rate of clinical success and low 3.33% complication rate confirm TAE as a dependable treatment for hemostasis. There was a 13.33% TAE rebleeding rate, which matches our literature's findings but further emphasizes the need for additional research on optimal embolic materials and techniques. Some of the most impactful findings of this study were that the presence of hypertension and renal impairment was related to worse bleeding outcomes. Age, on the other hand, was not significantly related to bleeding severity. Although some of the other studies might have covered this, our research emphasizes the need for early intervention and the aggressive treatment of comorbid conditions to prevent severe outcomes and address the acute bleeding issues.

Recommendations

From the findings of this study, recommendations for clinical practice and further studies emerge. First, it is necessary that the healthcare system adopt endovascular management as a first line of approach to the treatment of patients who experience GI bleeding. Also, there is a need to train and educate interventional radiologists further on current endovascular developments to improve their skills and patient care. Subsequent studies should investigate the long-term impact of endovascular treatments on patients in comparison to the traditional methods, alongside the possibility of using both endovascular and surgical treatment

for patients suffering more severe cases of GI bleeds.

Limitations

As previously stated, this research has certain limitations that need to be considered. To begin with, the small sample size—only 30 patients — constrains the scope of applicability of the results. Larger multicentric studies are needed to support these findings.

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