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Systematic Review

New Methods for Controlling Gastrointestinal Bleeding: A Systematic Review

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Abstract

Introduction: Gastrointestinal bleeding is a serious medical issue that demands effective treatments. This systematic review aims to assess new therapeutic approaches for managing gastrointestinal bleeding and compare their effectiveness with traditional methods. The focus is on evaluating the impact of interventions like endoscopic treatments and surgical procedures.

Methods: A systematic search was conducted in scientific databases including MagIran, PubMed, Scopus, and others using keywords such as "patient safety", "surgical process", and "qualitative research". Studies published between 2015 and 2025 were included. This review compares the effectiveness of various gastrointestinal bleeding treatments.

Results: Endoscopic techniques, including OTSC, haemostatic powders, and suturing, have significantly improved the management of gastrointestinal bleeding by enhancing haemostasis and reducing rebleeding rates. Transarterial embolization (TAE) has proven effective for refractory cases, while self-expandable metal stents (SEMS) offer a viable option for managing variceal bleeding. Capsule endoscopy has improved the diagnosis of obscure bleeding sources, leading to more targeted interventions. Personalized treatment strategies, considering patient-specific risk factors, are essential for optimizing outcomes and minimizing complications.

Conclusion: Advancements in GI bleeding management have improved haemostasis and reduced rebleeding rates. Endoscopic techniques, TAE, and SEMS offer effective solutions, though challenges remain. Ongoing research and personalized approaches are key to optimizing outcomes.

Keywords: Gastrointestinal bleeding, bleeding control methods, endoscopic treatments, hemostasis, self-expanding metal stents, Hemospray, hemostatic clips, endoscopic suturing devices, surgical procedures, patient safety

Introduction

Gastrointestinal (GI) bleeding is a major clinical concern, resulting from a variety of causes such as peptic ulcers, esophageal varices, malignancies, and angiodysplasias. If not effectively managed, GI bleeding can lead to serious complications, including haemorrhagic shock and increased mortality rates.[1] Over the years, several approaches have been developed to control bleeding, and recent advances in endoscopic techniques, pharmacological interventions, and interventional radiology have significantly improved patient outcomes. Among the latest strategies for treating non-variceal upper GI bleeding, the use of Over-the-Scope Clips (OTSC) has gained attention due to its superior haemostatic capabilities compared to standard methods.[5] In addition, haemostatic powders such as TC-325 have shown promising results in managing malignancy-related bleeding, though further research is required to establish their long-term effectiveness.[6]

New minimally invasive techniques, including self-assembling peptides, have demonstrated efficacy and safety in controlling colonic diverticular bleeding.[1] Furthermore, transarterial embolization (TAE) has emerged as an effective method for treating active GI bleeding, with evidence suggesting that it reduces early mortality rates and the need for subsequent blood transfusions.[2]

Managing GI bleeding in cirrhotic patients remains particularly challenging. Studies have indicated that endoscopic variceal ligation (EVL) carries a risk of rebleeding, emphasizing the need for a better under standing of associated risk factors to optimize treatment

strategies.[3] For patients suffering from gastric antral vascular ectasia (GAVE), comparative studies suggest that endoscopic band ligation (EBL) may be more effective than argon plasma coagulation (APC), requiring fewer treatment sessions while providing superior outcomes.[4] Self-expandable metal stents (SEMS) have also been proposed as an innovative approach for managing refractory variceal bleeding, demonstrating high success rates in selected cases.[15] Moreover, the application of haemostatic powders to prevent post-procedural bleeding after endoscopic submucosal dissection (ESD) has shown encouraging results.[10] Given the critical role of effective GI bleeding management in improving patient survival and quality of life, this systematic review aims to explore the most recent advancements in treatment techniques, evaluating their benefits, limitations, and potential future applications.

Materials and Methods

This study is a qualitative systematic review based on the PRISMA framework, aiming to evaluate the latest methods for controlling gastrointestinal bleeding. The study focuses on identifying challenges and proposing effective solutions in the management of gastrointestinal bleeding. The study was conducted in six phases. The first phase involved formulating the research questions. During this phase, the main research questions were designed to identify the challenges and solutions in managing gastrointestinal bleeding. The research questions were "What are the challenges in implementing gastrointestinal bleeding control methods?" and "What solutions could be effective in improving the implementation of these methods?" The PICO strategy was used to structure these questions. In this model, the population (P) consisted of patients with gastrointestinal bleeding, the intervention (I) included various bleeding control techniques, and the outcome (O) focused on the challenges and solutions related to these methods. It is important to note that the comparison (C) component was not included, as the study aimed to explore challenges and solutions. * "In the second phase, a structured search strategy was developed using expert opinions and the MeSH (Medical Subject Headings) system. Relevant keywords and search phrases were identified to cover different aspects of gastrointestinal bleeding, including its management, treatment modalities, patient safety, and novel haemostatic techniques. These keywords were systematically applied across multiple databases, particularly PubMed. A stepwise search strategy was implemented, where different terms were combined in sequential rounds to refine and expand the search results. The search included terms related to endoscopic, pharmacological, and surgical interventions, as well as emerging treatment techniques. Additionally, searches were restricted to articles in English and Persian to ensure a relevant and comprehensive dataset.

Search Round	Search Combination (Syntax)
1	("Gastrointestinal bleeding"[Title/Abstract] OR "GI bleeding"[Title/Abstract]) AND ("Treatment"[Title/Abstract] OR "Management"[Title/Abstract])
2	("Endoscopic hemostasis"[Title/Abstract] OR "Endoscopic therapy"[Title/Abstract]) AND ("English"[Language] OR "Persian"[Language])
3	1+2
4	("Pharmacologic treatment"[Title/Abstract] OR "Drug therapy"[Title/Abstract]) AND ("English"[Language] OR "Persian"[Language])
5	3+4
6	("Surgical intervention"[Title/Abstract] OR "Surgery"[Title/Abstract]) AND ("English"[Language] OR "Persian"[Language])
7	5+6
8	("Novel hemostatic techniques"[Title/Abstract] OR "New hemostatic methods"[Title/Abstract]) AND ("English"[Language] OR "Persian"[Language])
9	7+8
10	("Hemostatic agents"[Title/Abstract] OR "Topical hemostatics"[Title/Abstract]) AND ("English"[Language] OR "Persian"[Language])
11	9+10
12	("Patient safety"[Title/Abstract]) AND ("English"[Language] OR "Persian"[Language])
13	("Randomized controlled trial"[Title/Abstract] OR "Clinical study"[Title/Abstract]) AND ("English"[Language] OR "Persian"[Language])
14	11+12
15	13+14

Cochrane Library	PubMed/Medline	Embase	Web of Science	Scopus	ProQuest	Ovid	SID	Google Scholar	Total
10	665	85	115	870	579	387	3	78	2792

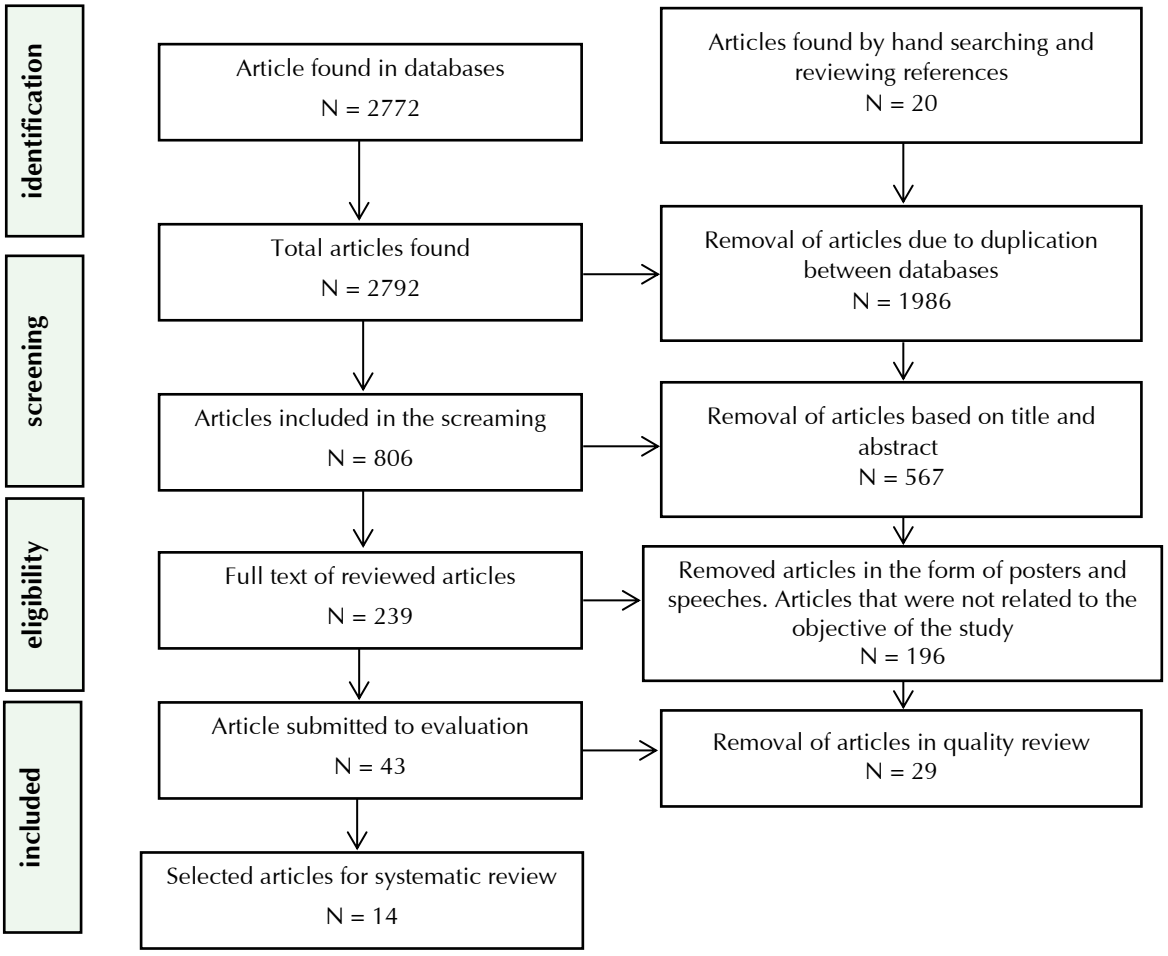

Figure 1. Prisma Flow Diagram.

In the third phase, the inclusion and exclusion criteria were defined by the research team members. The inclusion criteria for the study were: 1. Articles related to the latest methods of gastrointestinal bleeding control, 2. Studies that examine novel treatments, surgical methods, and endoscopic interventions; 3. Articles published within the timeframe from 2015 to February 2025. This time period was selected because most of the recent and innovative methods in this field have emerged during this period. 4. Articles written in English or Persian, 5. Studies that were reported qualitatively. Articles that merely introduced methods or discussed the advantages and disadvantages without focusing on novel gastrointestinal bleeding control techniques, as well as articles presented as posters, speeches, or letters to the editor, were excluded from the study.

The fourth phase focused on conducting a systematic search across electronic databases. In this phase, databases like PubMed, Cochrane Library, Embase, Web of Science, Scopus, and Google Scholar were utilized. The search was carried out independently by two researchers based on predefined keywords and search strategies. The initial search results yielded a total of 380 articles, which, after removing duplicates, were further evaluated, and 14 articles were selected for final inclusion in the review.

The fifth step was the selection of qualified research articles. The summaries of the articles were examined, and the screening of the studies and the extraction of the results, as well as the evaluation of the quality control of the articles, were evaluated. The related articles were separated, and their full text was extracted. A total of 2792 articles were found, and after removing duplicate articles, 806 articles entered the review stage in terms of titles and abstracts. After reviewing the titles and abstracts of the articles, 239 articles entered the next stage, in which the full text of the articles was reviewed, and the articles based on criteria for exit and entry were checked. Finally, 43

Author(s)	Year	Study Location	Data Collection Tools and Study Type	Title	Results
Yamaguchi D et al.	2024	Multi-center	Multicenter Pilot Study	Efficacy and safety of endoscopic hemostasis with a self-assembling peptide solution in patients with colonic diverticular bleeding: a multicenter pilot study (with video)[1]	The study demonstrated the safety and efficacy of PuraStat for treating colonic diverticular bleeding.
Chloé Extrat et al.	2022	France	Retrospective Study	Transarterial Embolization for Active Gastrointestinal Bleeding: Predictors of Early Mortality and Early Rebleeding[2]	Hyperlactatemia and increased blood transfusion needs were identified as predictors of early mortality and early rebleeding.
Drolz A et al.	2021	Various international hospitals	Observational study	Risk factors associated with bleeding after prophylactic endoscopic variceal ligation in cirrhosis[3]	Identified risk factors such as variceal size, clinical condition, and specific medications influencing post-ligation bleeding.
Fábián A et al.	2021	Hungary	Randomized Controlled Trial	Endoscopic treatment of gastric antral vascular ectasia in real-life settings[4]	Both APC and EBL were effective for treating GAVE, but EBL required fewer treatment sessions.
Jensen DM et al.	2021	United States	Randomized Controlled Trial	Over-the-Scope Clip as Initial Treatment of Severe Nonvariceal Upper Gastrointestinal Bleeding[5]	OTSC was superior to standard treatments in controlling severe nonvariceal upper gastrointestinal bleeding.
Hussein M et al.	2021	International	International Registry	Hemostatic powder TC-325 treatment of malignancy-related upper gastrointestinal bleeds[6]	TC-325 was effective in controlling malignancy-related gastrointestinal bleeding.
Baracat FI et al.	2020	Brazil	Randomized Controlled Trial	Hemostatic powder vs. endoscopic clipping for non-variceal upper gastrointestinal bleeding[7]	Hemostatic powder was an effective alternative to endoscopic clipping.
Lee H et al.	2020	South Korea	Prospective Cohort Study	Cognitive impairment in hemodialysis patients: The role of fluid management[8]	Correlation between improper fluid management and cognitive decline in hemodialysis patients.
Agarwal A et al.	2018	International	Case Series Study	Endoscopic suturing for peptic ulcer-related upper gastrointestinal bleeding[9]	Endoscopic suturing may be effective for controlling bleeding resistant to standard treatments.
Hahn KY et al.	2018	South Korea	Randomized Controlled Trial	Efficacy of hemostatic powder in preventing bleeding after gastric endoscopic submucosal dissection[10]	Hemostatic polysaccharide powder reduced bleeding rates in high-risk patients after ESD.
Douglas G. Adler et al.	2018	International	Technology Review	Hemospray for Gastrointestinal Bleeding: Technology Status Update[11]	Hemospray is used as a hemostatic agent for GI bleeding control but may have a risk of rebleeding.
Garcia M, et al.	2018	Spain	Observational study	Renal rehabilitation and its effects on cognitive function in CKD patients[12]	Structured renal rehabilitation programs positively impacted cognitive function and quality of life.
Li L et al.	2016	China	Clinical Study	The role of capsule endoscopy in the diagnosis and treatment of obscure GI bleeding in older individuals[13]	Capsule endoscopy can be an alternative for managing obscure GI bleeding in elderly patients.
Martin Müller et al.	2015	Germany	Retrospective Study	Self-Expandable Metal Stents for Persisting Esophageal Variceal Bleeding[15]	SEMS can be effective in controlling persistent esophageal variceal bleeding after standard treatments.

articles were included in the final analysis.

In the sixth phase, the quality of the selected articles was assessed independently by two researchers using a quality evaluation checklist designed by the Joanna Briggs Institute.[14] This tool consists of 10 questions with responses categorized as "yes", "no," "unclear," or "not applicable". Articles that were rated as low quality were excluded from the final review. As a result, some articles were excluded, and only 15 articles were retained for the final systematic review. The extracted data from these 15 studies were combined and analyzed to provide a comprehensive overview of the challenges and effective methods for controlling gastrointestinal bleeding.

These systematic review steps aimed to provide an accurate depiction of the latest approaches and challenges in gastrointestinal bleeding management, helping to identify the most effective treatment and management strategies.

After extraction, all the information collected from the qualitative studies was transcribed into a Word file, and the main and secondary fields were identified and coded, and the codes were compared and discussed and interpreted. A summary of the reviewed articles in the following table includes the names of the authors, year of publication, location of the study, number of samples, title of the study and findings, and key results of the study.

Results

Endoscopic Approaches

Over-the-Scope Clips (OTSC): OTSCs have demonstrated high efficacy in controlling severe non-variceal upper GI bleeding. In a randomized controlled

trial, OTSCs significantly outperformed conventional methods, including standard clips and thermal coagulation, in achieving immediate haemostasis and reducing rebleeding rates.[5] Their ability to grasp a larger tissue area ensures better mechanical compression, making them particularly useful for large ulcerations or recurrent bleeding sites.

Haemostatic Powders: The use of hemostatic powders, particularly TC-325, has gained widespread recognition for treating malignancy-related GI bleeding. A large international study confirmed its high success rate in achieving initial haemostasis, although concerns persist regarding delayed rebleeding. Furthermore, applying TC-325 following endoscopic submucosal dissection (ESD) has led to a significant reduction in post-procedural bleeding complications.[10]

Endoscopic Suturing: Endoscopic suturing has emerged as a promising technique for peptic ulcer-related bleeding, especially in cases where traditional methods have failed. This approach enables full-thickness closure of mucosal defects, leading to improved haemostasis and a reduced risk of rebleeding.[9] Studies indicate that patients who underwent endoscopic suturing required fewer repeat interventions compared to those treated with standard haemostatic therapies.

Self-Assembling Peptide Solutions: A novel self-assembling peptide solution has shown promise in treating colonic diverticular bleeding. A multicenter study reported rapid haemostasis with minimal adverse effects, positioning this approach as a safe and effective alternative to traditional endoscopic interventions.[1] The biocompatibility and ease of application of these peptides make them particularly valuable in cases where conventional therapies are less effective.

Interventional Radiology

Transarterial Embolization (TAE): TAE has become a crucial intervention for cases of active GI bleeding refractory to endoscopic therapy. Studies show that TAE significantly reduces early mortality and decreases the necessity for repeated blood trans fusions, particularly in haemodynamically unstable patients.[2] However, the risk of early rebleeding remains a concern, especially in patients with extensive vascular abnormalities or underlying coagulation disorders.

Self-Expandable Metal Stents (SEMS): SEMS placement has been investigated as a treatment option for refractory esophageal variceal bleeding. Retrospective analyses indicate that SEMS effectively controls blee ding in patients who have failed standard endoscopic therapies, with high rates of initial haemostasis. However, stent migration has been identified as a potential complication, necessitating further research on optimizing placement techniques.[15]

Risk Factors and Special Considerations

Endoscopic Variceal Ligation (EVL) and Rebleeding Risks: EVL is a widely used strategy for preventing variceal haemorrhage in cirrhotic patients. However, research has identified significant risk factors for post-ligation bleeding, including severe liver dysfunction, large varices, and coagulopathy.[3] Addressing these risk factors through individualized treatment strategies may help improve patient outcomes and reduce complications.

Gastric Antral Vascular Ectasia (GAVE): The treatment of GAVE remains a clinical challenge, with endoscopic band ligation (EBL) showing superior efficacy compared to argon plasma coagulation (APC). Patients treated with EBL required fewer treatment sessions and exhibited lower recurrence rates, making it a preferred option for long-term management.[4]

Capsule Endoscopy for Obscure GI Bleeding: Capsule endoscopy has become an invaluable tool in diagnosing and managing obscure GI bleeding, parti cularly in elderly patients. This minimally invasive technique allows for detailed visualization of the small intestine, facilitating accurate diagnosis and targeted treatment strategies.[13] The increased use of capsule endoscopy has improved the identification of bleeding sources that were previously undetectable through conventional methods.

Discussion

The management of gastrointestinal (GI) bleeding has seen remarkable advancements in recent years, particularly in endoscopic, interventional radiology, and novel therapeutic techniques. These innovations have significantly improved haemostasis, reduced reb leeding rates, and enhanced patient survival. However, selecting the most effective approach depends on a thorough understanding of the underlying causes, patient conditions, and the nature of the bleeding. A comprehensive evaluation of these emerging techniques in comparison to traditional methods is essential for optimizing treatment strategies.

Endoscopic Techniques in GI Bleeding Control

Endoscopic interventions remain the first-line approach for managing non-variceal GI bleeding. One of the most significant innovations in this field is Over-the-Scope Clips (OTSCs), which provide superior mechanical compression compared to standard clips and thermal coagulation. Studies have demonstrated that OTSCs achieve higher rates of immediate haemos tasis and significantly lower rebleeding rates, especially in cases of complex ulcers or lesions with a high risk of recurrent bleeding.[5] Their ability to grasp a larger tissue area makes them particularly effective in challenging cases where conventional methods may fail.

Another promising technique is the use of haemostatic powders, such as TC-325, which have shown high efficacy in managing malignancy-related GI bleeding. These powders offer a non-contact method for haemostasis, making them particularly valuable in situations where direct tissue manipulation is difficult.[6] However, concerns remain regarding delayed rebleeding, as the powder gradually absorbs over time, potentially exposing the underlying lesion. Recent studies suggest that combining haemostatic powders with other modalities, such as endoscopic clips or injection therapy, may enhance long-term outcomes and reduce the risk of recurrent bleeding.[10]

Endoscopic suturing has also emerged as a promising option, particularly in cases of peptic ulcer bleeding where conventional methods fail. This technique enables full-thickness closure of mucosal defects, leading to improved haemostasis and a reduced need for repeat interventions.[9] Patients treated with endoscopic suturing have shown lower rates of rebleeding compared to those managed with standard haemostatic therapies.

Another novel approach involves the use of self-assembling peptide solutions, which have shown promise in the treatment of colonic diverticular bleeding. These peptides rapidly form a protective barrier over the bleeding site, facilitating clot stabilization and tissue healing. A multicenter study demonstrated their high efficacy with minimal adverse effects, suggesting that they could serve as a valuable alternative to conventional endoscopic interventions.[1]

Interventional Radiology in GI Bleeding Management

In cases where endoscopic therapy fails to control severe bleeding, transarterial embolization (TAE) has become an essential intervention. This technique is particularly beneficial for haemodynamically unstable patients, as it effectively reduces early mortality and minimizes the need for repeated blood transfusions.[2] However, early rebleeding remains a concern, particularly in patients with extensive vascular abnormalities or coagulation disorders. Some studies suggest that selective embolization techniques and adjunctive pharmacologic therapies may help mitigate this risk.

For patients with refractory esophageal variceal bleeding, self-expandable metal stents (SEMS) offer a viable treatment option. Retrospective analyses indicate that SEMS can successfully control bleeding in cases where standard endoscopic treatments fail, with high rates of initial haemostasis. However, stent migration has been reported as a significant complication, underscoring the need for further research into optimal placement strategies and improved stent designs.[15]

Risk Factors and Special Considerations in GI Bleeding

Patients with cirrhosis undergoing endoscopic variceal ligation (EVL) face an increased risk of post-ligation bleeding, particularly those with severe liver dysfunction, large varices, and coagulation abnormalities. Identifying these risk factors and implementing individualized management strategies, such as adjunctive pharmacologic therapy, may help reduce complications and improve overall outcomes.[3]

The management of gastric antral vascular ectasia (GAVE) remains challenging, with endoscopic band ligation (EBL) showing superior efficacy compared to argon plasma coagulation (APC). Studies indicate that patients treated with EBL require fewer treatment sessions and have lower recurrence rates, making it the preferred long-term management strategy.[4]

The advent of capsule endoscopy has revolutionized the diagnosis and management of obscure GI bleeding, particularly in elderly patients. This minimally invasive technology allows for detailed visualization of the small intestine, significantly improving diagnostic accuracy and guiding more targeted treatment strategies.[13] The widespread adoption of capsule endoscopy has reduced reliance on invasive procedures, leading to earlier detection and intervention.

Future Perspectives in GI Bleeding Management

Despite recent advancements, several challenges remain in optimizing the management of GI bleeding. Enhancing the durability of haemostatic agents, refining combination therapies, and developing biocompatible materials for improved tissue healing are areas of active research. Additionally, the integration of artificial intelligence in endoscopic imaging and decision-making could further improve early detection and treatment precision, paving the way for more personalized patient care.

Conclusion

The management of gastrointestinal (GI) bleeding has significantly evolved with the introduction of inno vative endoscopic techniques, interventional radiology procedures, and novel haemostatic agents. Advances such as over-the-scope clips (OTSC), haemostatic powders, and endoscopic suturing have improved immediate haemostasis and reduced rebleeding rates in non-variceal bleeding cases. Meanwhile, transarterial embolization (TAE) and self-expandable metal stents (SEMS) have become essential tools for managing refractory bleeding, particularly in patients who fail endoscopic treatment. Despite these advancements, challenges remain, including the risk of delayed rebleeding, complications related to stent migration, and the need for more durable haemostatic solutions.

A key aspect of optimizing GI bleeding management lies in personalized treatment approaches, where patient-specific factors such as underlying comorbidities, coagulopathies, and haemodynamic stability guide therapeutic decisions. Future research should focus on refining existing techniques, exploring new biomaterials for haemostasis, and integrating artificial intelligence to enhance diagnostic accuracy and procedural precision. As technology continues to advance, a multidisciplinary approach combining endoscopic, interventional, and pharmacological therapies will be essential in further improving patient outcomes and reducing mortality associated with GI bleeding.

Conflict of Interest

The authors declare no conflicts of interest.

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