

Article

Imipenem/Cilastatin Sodium as Reabsorbable Embolic Agent in Acute Lower Gastrointestinal Bleeding: A Multicentric Prospective Study

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Abstract

Background/Objectives: This study aims to analyze safety and effectiveness of imipenem/cilastatin sodium (IPM/CS) as an off-label embolic agent in acute lower gastrointestinal bleeding (LGIB). **Methods:** This is a multicentric prospective study including patients treated in emergency with endovascular embolization for acute LGIB. IPM/CS particles were prepared using one vial containing 500 mg/500 mg of IPM/CS in powder diluted with 5 mL of pure iodine contrast agent. Inclusion criteria were: acute bleeding managed with IMP/CS embolization, unfeasible/ineffective endoscopic management, availability of a pre-procedural contrast-enhanced Computed Tomography (CT) scan, pre- and post-procedural blood count, pre- and post-procedural hemodynamic balance evaluation, and follow-up to 30 days. Exclusion criteria were: patients treated in elective conditions, LGIB embolization performed without IMP/CS, IMP/CS adoption after other embolics, incomplete clinical-laboratoristic follow-up, and age < 18 years. Technical success was intended as angiographic disappearance of extravasation or significant reduction/stasis of blood flow to the target; clinical success was considered as hemoglobin values increase and/or stop transfusions and/or hemodynamic restoration. **Result:** Twenty-one patients were enrolled; bleeding etiologies included angiodysplasia, diverticular disease, gastrointestinal tumor-related bleeding, and post-surgical hemorrhage. Technical success rate was 100%, and clinical success rate at 30 days was 85.7%. Rebleeding occurred in three patients: two managed with surgery and one with coil re-embolization. Neither major and IPM/CS related complications occurred. **Conclusions:** In this study IPM/CS was a safe and feasible embolic agent in selected patients with acute LGIB; no bowel ischemia occurred during the 30 day follow-up. Future studies with larger samples are required to confirm these findings to include IPM/CS as an off-label alternative embolic agent in LGIB.

Keywords: embolization; transarterial; imipenem/cilastatin sodium; lower gastrointestinal bleeding



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1. Introduction

Imipenem/cilastatin sodium (IPM/CS) is a broad-spectrum intravenous antibacterial agent that belongs to the group of carbapenems and consists of a fixed combination (1:1 ratio) of imipenem (a carbapenem antibiotic which is a derivative of thienamycin) and cilastatin (an inhibitor of dehydropeptidase I, a renal enzyme which metabolizes and inactivates imipenem). Imipenem has activity against a wide variety of bacteria, including Gram-positive aerobic cocci, Gram-positive aerobic bacilli, Gram-negative aerobic bacteria, and anaerobes. In clinical practice, IPM/CS is approved for the treatment of severe and complicated bacterial infections, in particular, four divergent indications (i.e., gynecological infections, septicemia, bone and joint infections, and endocarditis) [1].

The off-label endovascular use of IPM/CS as a temporary embolic agent started in 1999, when two Japanese studies introduced IPM/CS as an embolic agent for chemoembolization in animal models [2]. These studies revealed that IPM/CS powder mixed with an iodine contrast agent produced small microparticles (10–70 µm) suitable for transient embolization (24–48 h); its embolic properties were not related to its antimicrobial activity, but rather to the formation of small suspended particles.

Additionally, IPM/CS has been explored in humans as an off-label embolic agent in several musculoskeletal embolization procedures targeting pathological neovascularization associated with chronic inflammatory and degenerative conditions [3,4].

Concerning IPM/CS applications in gastrointestinal bleeding embolization, only few literature data are available, mainly on patients with tumor-related bleeding and poor candidates for other treatments, including endoscopic or surgical hemostasis [5,6]. This is of interest for interventional radiologists: indeed, even if transcatheter arterial embolization (TAE) is considered a standard treatment for lower gastrointestinal bleeding (LGIB) when endoscopic approaches are technically not feasible or ineffective [7–10], LGIB embolizations still remain a technical challenge because of the complex arterial network.

TAE is highly effective in cases when a single bleeding vessel can be identified and selectively catheterized, while its efficacy decreases in more complex scenarios, such as diffuse bleeding, microvascular hemorrhage, tumor-related bleeding, angiodysplasia or when angiographic extravasation is absent or intermittent [11–14].

Multiple embolic agents, including coils, gelatin sponges, liquids (polymers and cyanoacrylates) and microspheres, have been described to treat LGIB but no clear superiority of a specific agent has been demonstrated, with choice mainly depending on operator preference. One of the major complications of TAE for LGIB is bowel infarction, occurring with higher rates compared to upper gastrointestinal bleeding; this is related to the poorer collateral circulation [15,16]. Indeed, recent meta-analyses reported technical success rates around 91–99% and clinical success rates around 76–78%, but major complications up to 8.6–10%, higher than those reported for upper gastrointestinal bleeding (UGIB) embolization [17]. In this scenario, a temporary and effective embolic agent such as IPM/CS may be particularly attractive, as it could provide distal microvascular embolization while potentially limiting prolonged ischemic injury.

The aim of this study is now to evaluate prospectively the safety and effectiveness of off-label application of IPM/CS as a reabsorbable embolic agent in patients with acute LGIB from different etiologies.

2. Materials and Methods

2.1. Study Design

This is a bicentric prospective study considering patients treated with TAE for acute LGIB from October 2025 to April 2026. Ethical approval from the local committee was obtained (protocol number 11/25 approved on 23 July 2025). The study protocol, proposed

by the leading center, received ethical approval and was accepted by the other participating center before patient enrollment. Written informed consent for the intervention and study participation was acquired from all patients. All institutions adopted the same study protocol, including patient selection, embolization technique, and outcome assessment, in order to minimize inter-operator variability.

Patient characteristics (sex, age, bleeding etiology, hemodynamic balance, hemoglobin values, coagulation status) and procedural details (anatomical district, additional embolics, procedural outcomes, additional embolization or surgery sessions, complications) were analyzed. Workload data (e.g., kV, mA) and the dose index (e.g., fluoroscopy time) were acquired for each procedure.

IPM/CS was selected as embolic agent in all cases where clear focal angiographic blushes were absent and superselective embolization with coils, particles or liquids was technically unfeasible and/or associated with a supposed risk of bowel ischemia.

Inclusion criteria were: acute bleeding managed with IMP/CS embolization, unfeasible/ineffective endoscopic management, availability of a pre-procedural contrast-enhanced CT scan, pre- and post-procedural blood count, pre- and post-procedural hemodynamic balance evaluation, follow-up to 30 days. Exclusion criteria were: patients treated in elective conditions, LGIB embolization performed without IMP/CS, IMP/CS adoption after other embolics, incomplete clinical-laboratoristic follow-up, and age < 18 years. Endovascular treatments were selected according to a multidisciplinary evaluation involving emergency clinicians, gastroenterologists, anesthesiologists, diagnostic and interventional radiologists. Primary endpoints of the study were to assess safety and efficacy of IMP/CS in acute LGIB patients; secondary endpoints were to evaluate rebleeding rate and need for additional embolics.

2.2. Pre-Procedural Evaluation

All patients were treated in acute setting, clinically presenting with melena or hematochezia and hemoglobin drop.

A contrast-enhanced CT scan was acquired in all cases.

CT examinations were performed with 128-slice multidetector CT scanners (GE Revolution GSI, General Electric Company[®]—Chicago—US or SOMATOM Definition Flash, Siemens Healthcare[®]—Erlangen—Germany), with a slice thickness of 1.2 mm, collimation of 2 mm × 128 mm × 0.6 mm and rotation time of 0.28 s. Patients were positioned supine with the arms abducted.

Enteric contrast material was not administered, while intravenous contrast material consisted of 100–120 mL iodinated contrast agent (Iomeron 400; Bracco Diagnostics[®], Milan, Italy) at 400 mg/mL concentration injected at 3–4 mL/s, followed by 40 mL of saline chaser at the same flow rate to obtain optimal vessel depiction.

An automated bolus tracking, with the region of interest placed in the descending thoracic aorta at an attenuation threshold of 100 HU, was used to time the beginning of the arterial phase. The venous phase was performed at 60–70 s delay from the end of the injection. A delayed phase (180 s delay from the end of the injection) was included to evaluate eventual slight bleeding [18].

Three-dimensional multiplanar reconstructions and maximum intensity projection were routinely performed to assess occurrence, site and etiology of the bleeding, as well as to plan the procedure in terms of device selection and embolization strategy (Figure 1).

Laboratory data, including blood count, coagulation status (INR, platelets and antiplatelet/anticoagulation drug uptake) and renal function, were assessed.

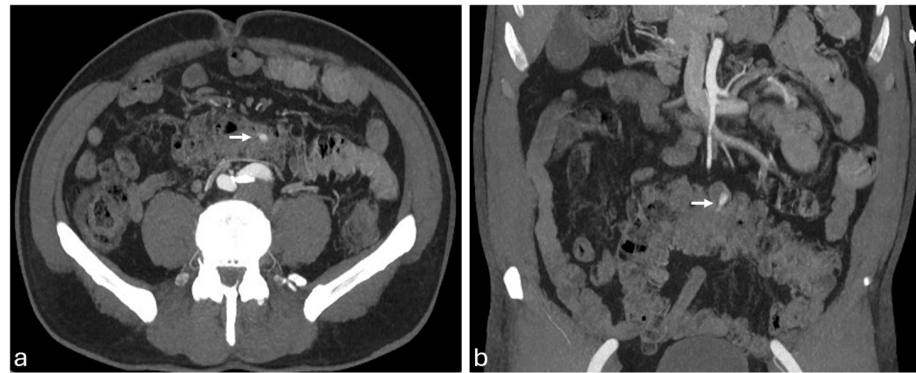


Figure 1. A 69-year-old man, taking anticoagulant and antiplatelet therapy (clopidogrel + aspirin). Axial (a) and coronal (b) CT scan showing contrast extravasation in the arterial phase due to a small bleeding diverticulum (white arrows) of the transverse colon.

2.3. Embolization Intervention

All embolization procedures were performed in interventional radiology cath labs with modern-generation C-arms equipped with ConeBeamCT (CBCT) (Axiom Artis Zee, Siemens®, Erlangen—Germany) or CT (Alphenix, Canon®, Tokyo—Japan) by interventional radiologists with almost 5 years of experience in gastrointestinal bleeding management.

An ultrasound-guided femoral or radial access positioning a femoral 5Fr 11 cm introducer was adopted; a 5Fr diagnostic catheter (Cobra, Sim 1 or Sheperd tips) was advanced up to the superior mesenteric (SMA) or inferior mesenteric (IMA) arteries, depending on the bleeding site, and a digital subtracted arteriography (DSA) with power injector (15 mL at 4–5 mL/s with 900 psi for SMA; 12 mL at 2–3 mL/s with 900 psi for IMA) was acquired to assess vascular anatomy and localize the bleeding; a microcatheter (Progreat 2.4Fr or 2.7Fr—Terumo®, Tokyo—Japan) was then advanced and additional superselective DSA were conducted to evaluate the proper targeting; if no contrast extravasation was identified, provocative maneuvers with papaverin (10–15 mg transcatheter intra-arterial injection) were performed and microcatheter-directed contrast-enhanced CBCT or CT scans were acquired to confirm proper microcatheter positioning compared to diagnostic CT.

IPM/CS was adopted as first embolic agent in all cases; if needed, additional mechanical embolics were used.

A final DSA was acquired to confirm bleeding resolution (Figure 2).

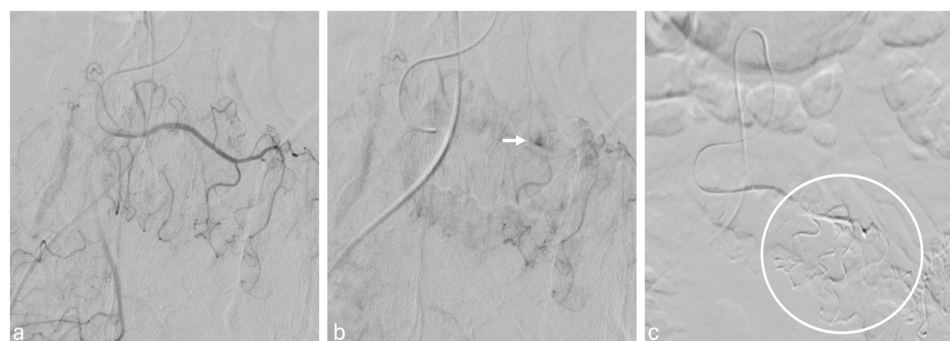


Figure 2. Same patient from Figure 1. Superselective arteriography via a 2.7Fr microcatheter, using an automatic injector with a flow rate of 2 mL/s, 6 cc of contrast volume and a pressure setting of 600 psi, of a feeder branch arising from the middle colic artery; while in early phase (a) no bleeding is evident, in delayed injection phase (b) focal contrast staining (white arrow) is appreciable corresponding to CT findings; (c) via the 2.7Fr microcatheter, embolization with IPM/CS is performed to occlude the extravasation area (white circle) and the feeding artery.

Femoral access was sealed using mechanical closure device (Femoseal or Angioseal 6-VIP, Terumo®, Tokyo—Japan); radial access was compressed with a dedicated air-inflated bracelet.

All procedures were performed with the support of an anesthesiologist, under sedo-analgesia or general anesthesia depending on clinical conditions.

2.4. IPM/CS Mixture Preparation and Injection Technique

Just before embolic injection, IPM/CS was prepared as follows in the cath lab by the interventional radiologist (Figure 3): 5 mL of pure iodinated contrast agent was injected into a vial of 500 mg/500 mg of IPM/CS in powder and manually shaken for 60–100 s.

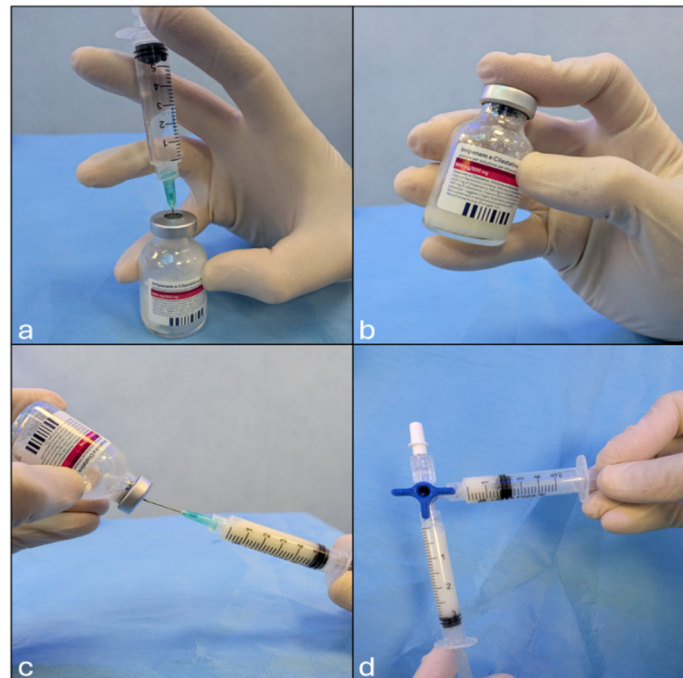


Figure 3. Preparation of the IPM/CS mixture: (a) Injection of 5 mL of iodinated contrast medium into the vial containing powdered IPM/CS using a luer-lock syringe. (b) Manual shaking of the vial to obtain adequate suspension of the particles. (c) Aspiration of 5 mL of the IPM/CS mixture into a syringe. (d) Through a three-way stopcock, the mixture is repeatedly aspirated into a 3 mL syringe before injection through the microcatheter.

The mixture was then aspirated into a 5 mL syringe and repeatedly exchanged through a three-way stopcock with a 3 mL syringe to guarantee adequate particle suspension before and during injection via the microcatheter. The suspension was slowly injected until angiographic stop-flow within the target was achieved, which represented the procedural endpoint. Luerlock syringes were adopted to avoid splashes.

2.5. Outcome Evaluation

Procedural efficacy was measured by technical and clinical success rates. Technical success was intended as angiographic disappearance of the target or, in DSA-negative cases, as angiographic stasis within the targeted vascular territory, according to the pre-procedural CT findings and/or intraprocedural CBCT/CT guidance; clinical success was considered as hemoglobin values increase, transfusion interruption and/or hemodynamic restoration if previously unbalanced. In our study, blood transfusion was indicated for hemoglobin values < 7 g/dL, according to current restrictive transfusion strategies [19,20] and hemoglobin stabilization or an increase of >1 g/dL within the first 24 h after emboliza-

tion was considered indicative of bleeding control. Persistence of melena or hematochezia within the first 24 h after embolization, in the absence of laboratory or clinical evidence of ongoing blood loss, was not considered clinical failure, in accordance with the Cardiovascular and Interventional Radiology Society of Europe (CIRSE) Quality Improvement Guidelines [13].

Procedural safety was evaluated according to complication occurrence related to the use of IPM/CS and graded by the CIRSE complication classification system [21].

Patients were monitored up to 30 days after the intervention.

2.6. Statistical Analysis

Descriptive analysis included continuous variables expressed as absolute values, standard deviations and percentages.

All data analysis was performed in Excel environment (Microsoft®, Redmond, WA, USA).

3. Results

3.1. Sample Features

Between October 2025 and April 2026, 64 patients underwent transarterial embolization for acute LGIB among the participant centers; IPM/CS was adopted as the initial embolic agent in 27 patients (21 were enrolled at Center 1 and 6 at Center 2). Six patients were subsequently excluded because of incomplete follow-up data (two) or embolization procedures performed in elective settings (four); patients not treated with IPM/CS had high-flow arterial bleeding or vascular injuries, such as pseudoaneurysms, demonstrated on angiography, allowing superselective embolization with conventional permanent embolic agents and therefore did not meet the predefined criteria for IPM/CS embolization.

Overall 21 consecutive patients with acute LGIB were treated with TAE using IPM/CS and were included in the present analysis (Figure 4).

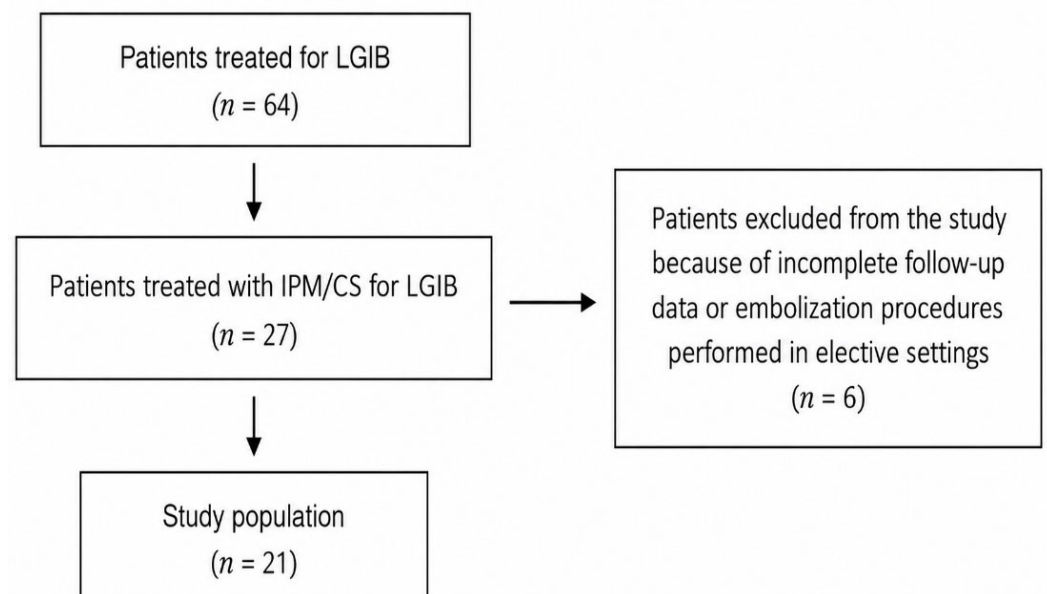


Figure 4. Study flowchart describing enrolled population.

The study sample included 18 men and 3 women, with a mean age of 67.5 ± 11.2 years. The underlying causes of bleeding included: angiodysplasia (Figure 5), diverticular disease, tumor-related bleeding and post-surgical hemorrhage. At hospital admission, 15/21 patients (71.4%) were hemodynamically stable, while hemodynamic instability was observed

in 6/21 patients (28.6%). Mean hemoglobin level at hospital admission was 8.7 ± 1.9 g/dL (Table 1).

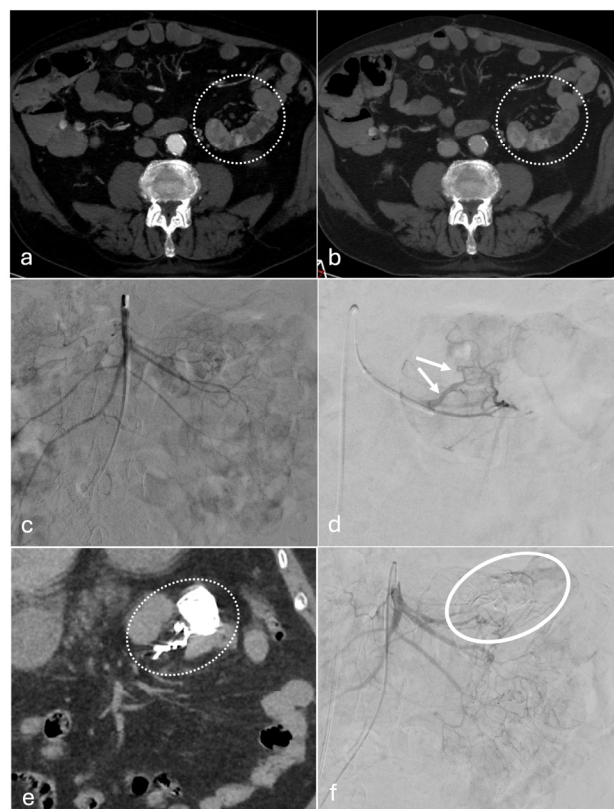


Figure 5. An 88-year-old male taking oral anticoagulant (edoxaban) presenting with melena and hemoglobin drop (7.3 g/dL) in the emergency room. Pre-procedural contrast-enhanced CT in arterial (a) and venous (b) phases showing an extensive angiodysplasia involving a jejunal loop (whited dotted circle). Selective DSA of the SMA (c) does not depict clear bleeding extravasation or vascular anomalies. Based on pre-procedural CT reconstructions, a suspected proximal jejunal artery is catheterized with a 2.4Fr microcatheter and a DSA (d) shows findings compatible with angiodysplasia with a tortuous vascular network and early venous opacification (white arrows). An intraprocedural transmicrocatheter contrast-enhanced CT (e) confirms correct jejunal loop (whited dotted circle) targeting compared to pre-procedural CT. Final DSA after embolization with IPM/CS (f) confirms occlusion of the target area and the feeding artery (white circle). Patient recovers with hemoglobin increase and no re-bleeding events.

Table 1. Baseline data, patients' characteristics.

Parameter	Value
Demographic data	
Sex	Male: 18/21 (85.7%) Female: 3/21 (14.3%)
Age	67.5 ± 11.2 years
Hemodynamic status	Stable: 15/21 (71.4%) Unstable: 6/21 (28.6%)
Mean hemoglobin at admission	8.7 ± 1.9 g/dL
Negative DSA	12/21 (57.1%)
Positive DSA	9/21 (42.9%): 4/9 (44.5%) pseudoaneurysm; 5/9 (55.5%) vascular blush
Anticoagulant/antiplatelet therapy at admission	5/21 (23.8%): 3/5 (60%) clopidogrel + aspirin; 2/5 (40%) apixaban

In 12/21 patients (57.1%) no frank extravasation was visible during angiography despite positive CT findings and provocative test with papaverin, likely due to intermittent bleeding; in these cases, the microcatheter was positioned within the vascular territory corresponding to the CT blush and additional intraprocedural CBCT or CT scan was performed (Figure 5). In nine patients (42.9%) positive angiographic findings included pseudoaneurysms (four, 44.5%) and vascular blushes (five, 55.5%).

3.2. Procedural Outcomes

The embolized vascular territories involved branches of the SMA in 76.2% (five jejunal (23.8%); six ileocecal (28.6%); five middle colic (23.8%)) and of the IMA in 23.8% (four sigmoid (19%), one left colic (4.8%)). In two patients (9.8%), two different branches were embolized in the same session.

IPM/CS was used as the sole embolic agent in 16/21 procedures (76.2%), whereas additional embolic agents (coils) were required in 5/21 patients (23.8%) to achieve technical success. IPM/CS represented the primary embolic agent in all patients; the adoption of additional embolic agents was decided intra-procedurally according to angiographic findings and operator preference, especially in cases characterized by persistent arterial inflow, pseudoaneurysm, or high-flow vascular patterns. Regarding radiation exposure, the mean fluoroscopic time was 21.5 ± 10.0 (10–38) min, whereas the mean overall procedural time was 47.7 ± 13.8 (32–67) min.

Technical success was achieved in all procedures (100%), while clinical success at 30 days was achieved in 18/21 patients (85.7%). Post-procedural monitoring demonstrated hemodynamic stabilization, progressive hemoglobin increase, and reduction or interruption of blood transfusion requirements in 18/21 patients (85.7%). Clinical failure occurred in 3/21 patients (14.3%): 2/21 patients (9.5%) required surgical treatment because of persistent or recurrent bleeding, whereas 1/21 patient (4.8%) underwent re-embolization with coils two days after the initial procedure (Table 2). In the subgroup of patients treated with IPM/CS as the sole embolic agent, clinical failure at 30 days occurred in two cases, both requiring surgical treatment for persistent or recurrent bleeding. No repeat endovascular embolization was required in this subgroup. No significant differences in technical or clinical outcomes were observed between the 5 patients receiving anticoagulant and/or antiplatelet therapy and the remaining 16 patients; this preliminary observation suggests that antithrombotic/antiplatelet therapy did not appear to adversely influence procedural success or early clinical outcomes in our cohort.

No complications directly related to IPM/CS were observed during the follow-up; especially, no clinically evident bowel ischemia was observed during the follow-up; in the absence of clinical signs or symptoms suggestive of bowel ischemia, no additional investigations were performed. According to the modified CIRSE classification system, only minor complications (grade 1b) were recorded. Post-procedural abdominal pain within the first 24 h occurred in 5/21 patients (23.8%) and was managed conservatively with analgesic therapy. Melena within 48 h after embolization was observed in 3/21 patients (14.3%), without hemodynamic instability or need for additional intervention. Access-site minor hematoma at the femoral puncture site developed in 2/21 patients (9.5%) within the first 24 h after the procedure and resolved spontaneously with conservative management.

Table 2. Clinical outcomes and complications.

Parameter	Value
Arterial targets	SMA: 16/21 (76.2%)—5 jejunal (23.8%), 6 ileocecal (28.6%), 5 middle colic (23.8%) IMA: 5/21 (23.8%)—4 sigmoid (19%), 1 (4.8%) left colic
Embolics	IPM/CS alone: 16/21 (76.2%)—additional coils: 5/21 (23.8%)
Technical success	21/21 (100%)
Clinical success	18/21 (85.7%)
Rebleeding requiring additional treatment	2/21 (9.5%) surgery 1/21 (4.8%) re-embolization
Mean fluoroscopic time	21.5 ± 10.0 (10–38) min
Complications	
Major	0/21 (0%)
Minor (CIRSE grade 1b)	5/21 (23.8%) abdominal pain 3/21 (14.3%) melena 2/21 (9.5%) access-site hematoma

4. Discussion

In this study the off-label application of IPM/CS as a temporary particulate embolic agent in acute LGIB was safe and effective, particularly in cases where CT showed active bleeding but DSA did not present clear signs of hemorrhage, without major ischemic complications occurring.

TAE is a well-established treatment for acute gastrointestinal bleeding: conventional embolic agents such as coils, N-butyl-cyanoacrylate (NBCA), gelatin sponge, polyvinyl alcohol (PVA) and microspheres have demonstrated high technical and clinical success rates [22,23]. However, the use of permanent embolic materials in LGIB may be associated with ischemic complications, particularly in non-selective embolization of the small bowel and right colon [24]. In particular, Nykänen et al. reported post-embolization ischemia in 17% of patients despite a superselective approach, with bowel resection in 13% [25]. Unlike conventional permanent embolics, IPM/CS does not appear to induce durable arterial occlusion, but rather a temporary reduction in blood flow within the pathological vascular bed [5,6].

This characteristic may explain the favorable safety profile observed in this series; despite the fact that in more than half of the cases during the procedure a defined contrast extravasation or a pseudoaneurysm was not evident and embolization was conducted nonsuperselectively with an anatomical rationale based on CBCT/CT targeting, no ischemic complications were observed.

A review of the literature on the off-label use of IPM/CS in LGIB reveals a very limited number of studies. Among the most relevant experiences, Woodhams et al. [5] in 2013 first described the use of IPM/CS in seven patients with intestinal tumor-related bleeding, reporting 100% technical success, rebleeding in four patients successfully re-embolized with the same approach and no major ischemic complications despite proximal non-selective embolization. More recently, Hiraki et al. [6] in 2023 confirmed the feasibility and safety of IPM/CS embolization in a monocentric retrospective series of 12 patients with acute LGIB due to diverticulosis, inflammatory, ulcerative and cancerous etiologies without reporting bowel ischemia episodes; despite in their series in 50% of the cases CT showed extravasation while DSA did not, technical success was 100% and clinical success was 83.3% with

2 patients rebleeding within 24 h. Compared with these preliminary experiences, our study provides a broader spectrum of bleeding etiologies and reflects a prospective multicentric real-world experience in acute LGIB management. Despite the complexity of the treated vascular territories and the frequent absence of active angiographic extravasation, IPM/CS embolization achieved excellent technical and clinical outcomes, with no major ischemic complications observed. In our opinion, the favorable safety profile of a temporary embolic agent may justify a potentially acceptable risk of rebleeding, particularly when balanced against the risk of bowel ischemia associated with permanent embolic material.

Moreover, IPM/CS has been adopted with success also in musculoskeletal embolizations [3,26–28]. Although targets are different in terms of anatomical and functional aspects, these studies support the safety of IPM/CS as an embolic agent too.

The concept emerging from the available literature, and further supported by our experience, is that IPM/CS may act as a “functional embolic agent” rather than a purely occlusive embolic material; in our opinion, this represents the most relevant characteristic of this technique and it is especially useful in patients with active bleeding detected on pre-procedural CT but not subsequently evident on angiography, a relatively frequent scenario in intermittent LGIB. In these situations, positioning the microcatheter within the vascular territory corresponding to the CT blush and performing embolization with a temporary and resorbable agent such as IPM/CS may represent a feasible therapeutic option in carefully selected patients, especially considering the absence of clinically ischemic complications observed in our cohort and the favorable clinical improvement reported during the 30-day follow-up period.

Another important aspect emerging from our series is the versatility of IPM/CS. In several patients, IPM/CS was used as the sole embolic agent (16/21, 76.2%), whereas in others it was combined with coils or additional embolic materials (5/21, 23.8%). This combined strategy may be particularly useful in complex hemorrhagic settings, where proximal mechanical control can be associated with distal microvascular embolization. Such an approach potentially combines the advantages of both techniques while reducing the limitations of each individual embolic agent; the combined use of IPM/CS and coils was also safe, without evidence of adverse interactions or increased ischemic complications. Rebleeding remains one of the principal limitations of embolization using temporary embolic materials. Although recurrent bleeding occurred in a minority of patients in our series, safety should be a compelling priority in our treatment so transient embolization with IPM/CS may be one of the viable therapeutic options if repetition is acceptable.

This study presents different limitations: first of all, the sample analyzed is too small to achieve definitive conclusions and further larger studies are required, second although IPM/CS was adopted according to predefined procedural criteria, absence of a clear focal angiographic blush and situations in which superselective embolization with permanent embolic agents was technically unfeasible or considered at increased risk of bowel ischemia, the assessment of these conditions inevitably relied on operator interpretation, therefore a degree of selection bias cannot be excluded. Follow-up was conducted only up to 30 days, so delayed rebleeding and long-term clinical outcomes still have to be investigated. No direct comparison with traditional embolics has been conducted, so no superiority of IPM/CS over mechanical, particulate and liquid embolics can be demonstrated. Finally, it should be considered that IPM/CS use as an embolic agent was an off-label application.

5. Conclusions

In this study embolization of acute LGIB using IPM/CS was a safe and feasible procedure, with high technical and clinical success rates; within the 30-day follow-up of the present study, no major complications, including bowel ischemia, were observed. IPM/CS

off-label application could be considered a valuable alternative temporary embolic agent in LGIB; however, studies including larger samples and longer follow-up are required to further define its role in clinical practice.

Author Contributions: P.R., F.G. and H.S.T. conceived and designed the analysis; P.R., A.M. and F.D. collected the data; F.C., F.D. and H.S.T. contributed to data or analysis tools; F.G., P.R., A.M. and A.D. performed the analysis; P.R., F.G., J.B. and A.M. wrote the paper; F.G., A.D. and R.N. supervised the research. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study adhered to the principles of the Declarations of Helsinki and Istanbul. The study was approved by the ethical review board (the study received approval from the local ethical committee (DEL. 11/25; Date: 23 July 2025; “CET Campania 3”, Ethical Committee Campania 3) considering its prospective design.

Informed Consent Statement: All patients gave written informed consent to participate in the study and data analysis; all written consents are available in the archives of the Vascular and Interventional Radiology Dept of Cardarelli Hospital of Naples.

Data Availability Statement: The data presented in this study are available on request from the corresponding author due to privacy.

Conflicts of Interest: The authors declare no conflicts of interest.

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