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ORIGINAL RESEARCH

# Preliminary Results of Extraperitoneal Rectus Abdominis Anterior Sigmoid Colostomy (ERASC) for Prevention of Parastomal Hernia Following Abdominoperineal Resection

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**Introduction:** Among patients with rectal cancer undergoing abdominoperineal resection (APR), parastomal hernia (PSH) is the most common long-term complication. Although extraperitoneal colostomy (EPC) has been proposed as an effective surgical method to prevent PSH, its efficacy remains controversial. To effectively reduce the incidence of PSH after APR, we report a new surgical technique—extraperitoneal rectus abdominis anterior sigmoid colostomy (ERASC).

**Objective:** To preliminarily explore the feasibility of extraperitoneal rectus abdominis anterior sigmoid colostomy (ERASC) and its effectiveness in preventing parastomal hernia after abdominoperineal resection (APR).

**Methods:** A retrospective analysis was conducted on the clinical data of patients diagnosed with rectal cancer at the First Affiliated Hospital of Chongqing Medical University from 2022 to 2025, who underwent APR and ERASC. Operative duration, stoma-related complications, re-hospitalizations, and re-operations were recorded and preliminarily analyzed.

**Results:** A total of eight patients met the criteria (six males and two females). Two patients developed incomplete intestinal obstruction during the postoperative hospital stay, both of whom improved after conservative treatment. During a median follow-up of 501 days (IQR 338–618), no stoma-related complications (including but not limited to postoperative stoma obstruction, prolapse, or necrosis) were observed, and none of the eight patients developed a parastomal hernia.

**Conclusion:** Extraperitoneal rectus abdominis anterior sigmoid colostomy (ERASC) has preliminarily demonstrated technical feasibility and long-term effectiveness in preventing PSH in this study.

**Keywords:** parastomal hernia, extraperitoneal colostomy, abdominoperineal resection, colorectal cancer

## Background

Colorectal cancer (CRC) represents the second most prevalent malignancy and fourth leading cause of cancer-related deaths in China (2022 data).[1] Approximately 10–20% of patients with distal rectal cancer ultimately require abdominoperineal resection (Miles surgery) with permanent sigmoidostomy.[2] Colostomy-related complications occur in 62.6% (range 2.0–100%) of patients undergoing abdominoperineal resection, with parastomal hernia (PSH) being the most prevalent long-term sequela [59.3% (41.5–88.2%)].[3] The 2017 European Hernia Society (EHS) guidelines report PSH incidence rates of >30% at 1 year, >40% at 2 years, and ≥50% with extended follow-up.[4]

Notably, 50% of PSH cases ultimately require surgical repair, though outcomes remain suboptimal: Suture-only repair carries 69.4% recurrence risk; mesh reinforcement reduces recurrence to 6.9–17.8%, but risks bowel adhesion/erosion, hematoma, and infection.[5] Therefore, it is preferable to implement preventive measures during the initial APR surgery.

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Current methods for preventing parastomal hernia prioritize prophylactic mesh placement and extraperitoneal colostomy (EPC). While 2017 EHS/2018 ACPGBI guidelines endorse prophylactic mesh for PSH prevention,[4,6] 2022 ASCRS CPG withdrew this recommendation due to lack of sustained efficacy in two RCTs.[7] In the meantime, a meta-analysis of 8 RCTs (n=537) further confirmed no long-term preventive benefit from mesh.[8]

First described by Goligher (1958), EPC reduces both PSH and small bowel obstruction rates.[9] 2017/2022 ASCRS CPG recommend EPC based on moderate-quality evidence of lower PSH incidence versus transperitoneal approaches,[10] supported by a meta-analysis of 5 RCTs (n=417).[11] However, 2017 EHS/2018 ACPGBI guidelines caution that evidence remains insufficient for definitive superiority claims.[4,6] Recent modified EPC techniques preserving rectal posterior sheath integrity require validation through prospective RCTs.[12]

The reasons for these discrepancies among guidelines remain unclear and may be related to the timing of guideline publication and the fundamental methods used. However, this also reflects the current lack of a reliable and effective approach to reduce the incidence of parastomal hernia following permanent sigmoid colostomy. Therefore, to address this issue, we report ERASC, an anatomical reinforcement modification of conventional EPC, and provide a preliminary analysis and discussion regarding its feasibility and its impact on postoperative stoma complications, particularly parastomal hernia.

# Methods

A retrospective analysis was conducted on the clinical data of patients diagnosed with rectal cancer at the First Affiliated Hospital of Chongqing Medical University from 2022 to 2025, who underwent APR and extraperitoneal rectus abdominis anterior sigmoid colostomy (ERASC). Operative duration, stoma-related complications (particularly parastomal hernia), re-hospitalizations, and re-operations were recorded and preliminarily analyzed. All surgeries were performed by the same surgical team, and patients were regularly followed up postoperatively.

The PSH was defined by Physical examination (standing position) or CT confirmation with Valsalva maneuver (supine position). The follow-up period was calculated from surgery date to either last CT scan or last outpatient visit. During the follow-up period, all patients underwent ≥1 postoperative CT scan. This study was approved by the Ethics Committee of the First Affiliated Hospital of Chongqing Medical University.

## Specific Surgical Procedure of ERASC

### Stoma Site Selection

Preoperative marking was performed by surgeons and stoma therapists according to international guidelines. The stoma site should ideally be located within the rectus abdominis muscle and be at the inner one-third of the line connecting the left anterior superior iliac spine and the umbilicus.

### Surgical Procedure

#### Laparoscopic TME with Miles Resection

(1) Total mesorectal excision (TME) was performed laparoscopically following standard protocol.[13] (2) Mobilization: The sigmoid colon and rectum were dissected along Toldt's fascia, followed by complete lymph node dissection at the root of the inferior mesenteric vessels. (3) Transection: The distal sigmoid colon was divided using a linear stapler after mesenteric mobilization. (4) Specimen extraction: The anal canal was excised via transperineal approach, and the specimen was removed en bloc. (See Supplementary Video S1).

#### Stoma Tunnel Preparation

(1) Peritoneal dissection: The left parietal peritoneum and retroperitoneal fat were incised at the proposed stoma site, exposing the transversus abdominis muscle (2) Tunnel marking: A gauze-packed was placed subperitoneally under laparoscopic guidance.

#### Stoma Tunnel Construction

(1) Incision: A 3-cm linear skin incision was made at the premarked site, followed by subcutaneous fat excision down to the


**Figure 1** Expose the anterior sheath of the rectus abdominis.

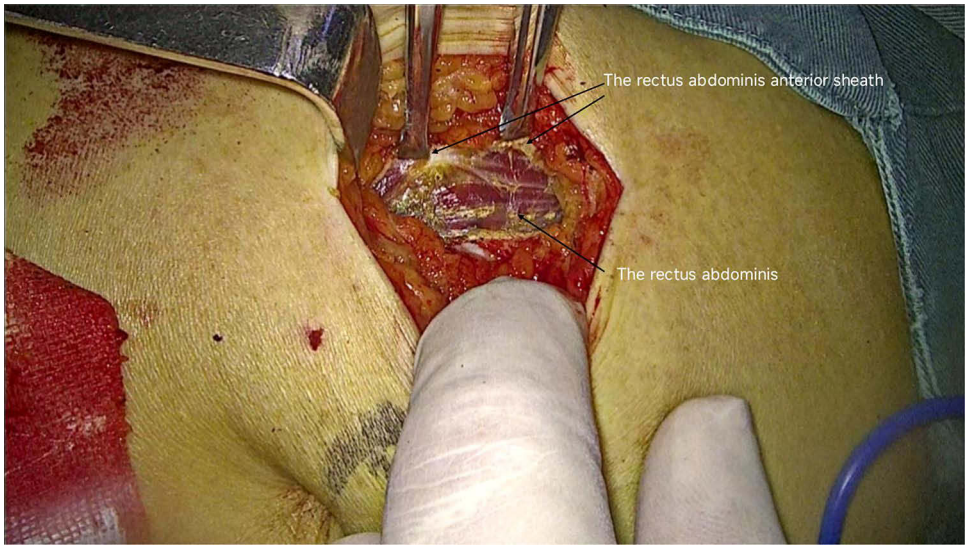


**Figure 2** Expose the rectus abdominis muscle fibers.

rectus abdominis anterior sheath. (Figure 1) (2) Sheath opening: The anterior sheath was incised vertically (3 cm) to expose the rectus muscle fibers. (Figure 2) (3) Muscle dissecting: Sharp electrocautery dissection is performed along the superficial surface of the rectus muscle until reaching the conjoined aponeurosis of the rectus abdominis, internal/external oblique muscles, and transversus abdominis. (Figure 3) (4) Tunnel creation: The conjoined tendon was incised to enter the transversus abdominis-peritoneal plane, and a tunnel was bluntly dissected to connect with the intra-abdominal gauze marker.

## Stoma Formation

(1) Bowel exteriorization: The sigmoid stump was pulled through the tunnel without torsion or tension, with laparoscopic confirmation of adequate vascular perfusion. (Figure 4) (2) Maturation: The colonic lumen was opened, everted, and secured to the skin with interrupted 3–0 absorbable sutures (Figure 5).


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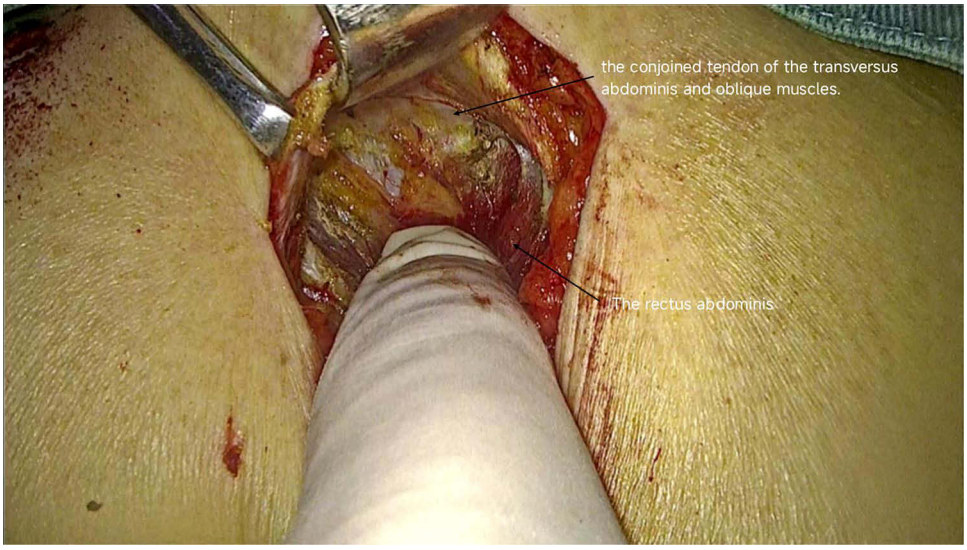


**Figure 3** Expose the conjoined aponeurosis of the rectus abdominis, internal/external oblique muscles, and transversus abdominis.

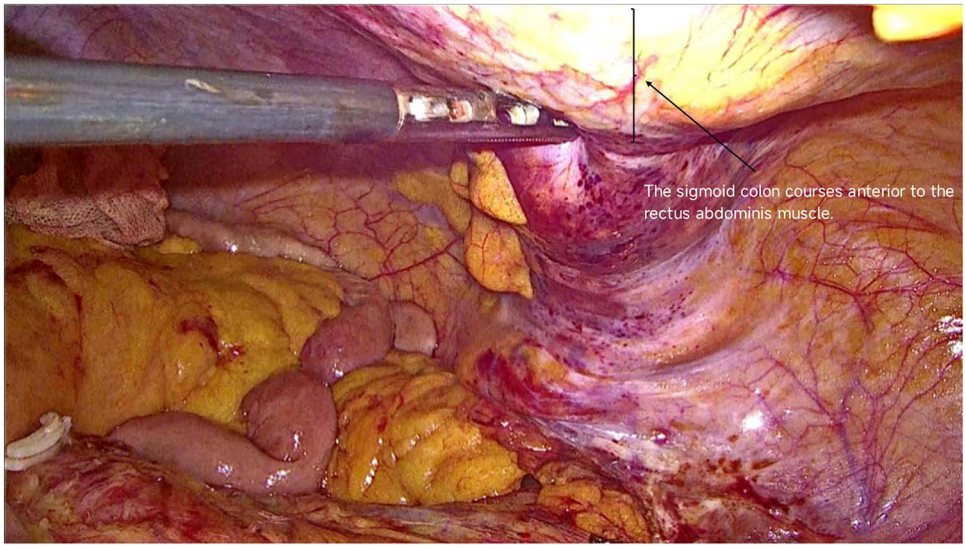


**Figure 4** Pull the sigmoid colon out of the tunnel.

## Results

From June 2022 to February 2025, all procedures were performed by a same surgical team (Xiangshu Li and Zhengqiang Wei), with 8 consecutive low rectal cancer patients (6 males, 2 females) undergoing this technique. The baseline data of the eight patients and details of long-term stoma complications postoperatively are provided in Table 1 and Table 2, respectively.

The baseline characteristics, including male/female ratio, age, postoperative TNM staging, operation time and follow-up period. The median age was 73 years (range 45–77), the mean BMI was 23.4±4.9 kg/m$^2$ (range 17.2–29.3), and the mean operative time was 259.3±51.0 minutes (range 197–330) (Detailed demographics in Table 1).

During the follow-up period, parastomal hernia incidence was 0% during median 501-day follow-up (IQR 338–618). Two cases of postoperative ileus occurred on postoperative day 6, both resolved with conservative management (no surgical intervention required). No other long-term stoma-related complications, such as stoma prolapse, necrosis, or

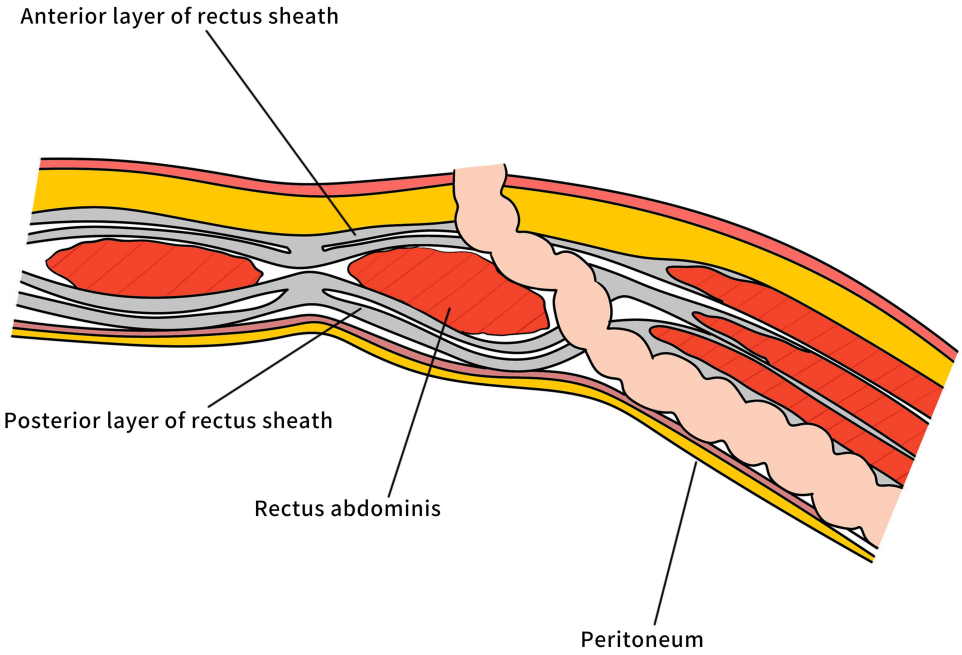


**Figure 5** The cross-section diagram of abdominal wall structure during ERASC.

obstruction, were observed. Furthermore, none of the eight patients required rehospitalization or reoperation due to stoma-related issues (Detailed demographics in Table 2).

**Table 1** Baseline Characteristics

| Baseline Characteristics | Results |
|---|---|
| Male/female | 6/2 |
| Age, y | 73 (45–77) |
| BMI, kg/m$^2$ | 23.4±4.9 (17.2–29.3) |
| History of abdominal surgery | 0 |
| Diabetes | 3 |
| COPD | 0 |
| Postoperative tumor TNM staging | |
| I | 4 |
| II | 1 |
| III | 3 |
| Total operation time, min | 259.3±51.0 (197–330) |
| Follow-up period (d) | 501 (IQR 338–618). |

**Table 2** Long-Term Stoma Complications

| Long-Term Stoma Complications | Results |
|---|---|
| Retraction | 0 |
| Prolapse | 0 |
| Parastomal hernia | 0 |
| Stoma necrosis | 0 |
| Obstruction | 0 |
| Rehospitalization | 0 |
| Reoperation | 0 |


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## Discussion

In this study, we introduce a modified extraperitoneal approach for stoma formation, in which the sigmoid colon is exteriorized through a pathway anterior to the rectus abdominis muscle—specifically between the muscle and its anterior sheath. This method is safe, technically feasible, and effective for the long-term prevention of PSH.

The surgical management of parastomal hernia can generally be categorized into three approaches: traditional suture repair, stoma relocation, and mesh repair. The first two have recurrence rates as high as 50% and are often only employed in emergency situations involving incarceration or necrosis.[14] Mesh repair is currently the mainstream surgical method for PSH. Based on the placement position of the mesh, mesh repair can be further divided into: onlay (anterior to the rectus muscle), sublay (posterior to the rectus muscle), and intraperitoneal onlay mesh (IPOM). Several studies comparing laparoscopic versus open mesh repair have shown that the laparoscopic approach is associated with lower recurrence rates and fewer postoperative complications.[15,16] Over the past decade, laparoscopic mesh repair has become one of the preferred methods for surgical correction of PSH. The most commonly used laparoscopic repair techniques are the keyhole (KH) technique,[17] the Sugarbaker (SB) technique,[18,19] and the sandwich technique.[20,21] Some studies have reported that the KH technique is associated with a postoperative parastomal hernia recurrence rate as high as 20.8%.[22] A recent non-randomized prospective case-control study indicated that after SB repair, the postoperative complication rate was 11.5%, the parastomal hernia recurrence rate was 10%, and the rate of late mesh-related morbidity was 10%.[21] In the report by Barranquero et al, the sandwich technique resulted in a parastomal hernia recurrence rate of 7.9%, with a median time to recurrence of 12 months and a median follow-up period of 39 months.[23] Furthermore, mesh repair for parastomal hernia carries risks such as mesh infection, mesh erosion into the bowel, adhesions, fistula formation, as well as recurrence due to mesh shrinkage and displacement.

Given the high recurrence rates associated with surgical repair of parastomal hernia, implementing effective preventive measures during the initial APR surgery is of paramount importance.

From an anatomical perspective, approximately 4–5 cm below the umbilical plane, demarcated by the arcuate line, the upper two-thirds of the rectus abdominis muscle is enveloped by both an anterior and a posterior sheath. The anterior sheath is formed by the aponeurosis of the external oblique muscle and the anterior layer of the aponeurosis of the internal oblique muscle; the posterior sheath is formed by the posterior layer of the aponeurosis of the internal oblique muscle and the aponeurosis of the transversus abdominis muscle. In contrast, for the lower one-third of the rectus abdominis, the aponeuroses of all three flat muscles pass anterior to the muscle to form the anterior layer of the sheath, while the posterior layer is absent.

In our surgical procedure, above the arcuate line, the skin, subcutaneous tissue, and superficial and deep fascia are incised down to the anterior rectus sheath using electrocautery. The aponeurosis of the external oblique muscle and the anterior aponeurotic layer of the internal oblique muscle are incised sequentially (even though they are often difficult to distinguish in practice), thereby exposing the rectus abdominis muscle under direct vision. Subsequently, the anterior rectus sheath is sharply dissected off the surface of the rectus muscle using electrocautery, proceeding downward until reaching the conjoined aponeurosis formed by the three flat muscles. A small opening is made in this conjoined fascia with electrocautery to enter the retroperitoneal space. After entering the retroperitoneal space, we initially recommend using a finger for blunt dilation of the tunnel's external orifice, as it is gentler and more flexible. A curved bowel spatula is then used to enlarge the tunnel toward the peritoneal cavity. The curvature of the spatula can be adjusted according to the varying abdominal wall curvature of different patients, and its blunt tip helps protect tissues from injury during tunnel dilation. Following the surface of the spatula, a duckbill forceps is passed through the tunnel to the pre-marked internal orifice within the abdominal cavity. The distal end of the sigmoid colon is then exteriorized through this channel to complete the stoma formation.

The reason for not choosing a site below the arcuate line for stoma creation is that attempting to enter the retroperitoneal space below this line using this method carries a high risk of peritoneal injury and lacks the protective barrier of the posterior rectus sheath.

A point of contention lies in the selection of the colostomy site. Stoma site selection is complex and requires collaboration between stoma therapists and surgeons. It also necessitates consideration of multiple factors, such as

assessing the patient's abdominal contour in various positions, abdominal protrusions, skin folds and creases, wrinkles, uneven scars, and the boundaries of the rectus abdominis muscle.[24] Similar to PSH prevention, the choice of stoma site, particularly whether lateral to or through the rectus muscle, is also inconsistently recommended by different guidelines.[4,24] Various studies have reported on different colostomy sites, while some research indicates that patients with a transrectus stoma may have better fecal continence.[12,25] According to our method, the stoma is located anterior to the rectus muscle, and the exteriorized bowel does not pass through the muscle but follows a novel pathway. However, we did not observe any reports of fecal incontinence during our follow-up period, although this result may be attributable to the small number of cases in our study.

The extraperitoneal rectus abdominis anterior sigmoid colostomy (ERASC) enhances traditional EPC by preserving rectus abdominis integrity (augmented "autologous mesh") and incorporating rectus sheath into abdominal wall reinforcement. This multilayered anatomical reconstruction theoretically minimizes stomal weakness.

Preliminary results (8 cases, 501-day median follow-up) show 0% PSH incidence, though 2 cases of transient postoperative ileus occurred (resolved conservatively).

We have demonstrated the feasibility and surgical effectiveness of this approach. In our study, the shortest follow-up period was approximately 10 months. While this timeframe may theoretically seem brief, parastomal hernias could have already developed during this interval. Moreover, the majority of such hernias tend to occur within the first few postoperative years, particularly during the initial year.[26] Therefore, we consider the follow-up duration presented in this study to be valid for assessment.

In recent years, artificial intelligence (AI)[27] has achieved significant progress in the medical field, demonstrating potential for clinical application. In histopathology, deep learning-based algorithms hold the potential to assist in diagnosis, predict clinically relevant molecular phenotypes and microsatellite instability (MSI), identify histological features associated with prognosis and metastasis, and evaluate specific components of the tumor microenvironment. This substantially improves diagnostic efficiency and enables better stratified treatment. Meanwhile, recent studies have indicated that a low preoperative serum cholinesterase (CHE) level is an independent risk factor for postoperative complications in elderly patients undergoing major emergency gastrointestinal surgery.[28] In the future, we anticipate the possibility of integrating AI with serum CHE levels and other indicators to construct predictive models for various complications following sigmoid colostomy, including but not limited to postoperative ileus, surgical site infection (SSI), parastomal hernia, and stoma prolapse. This would guide clinicians to implement interventions proactively, thereby achieving the goal of "prevention outweighing treatment."

This study still has limitations. The occurrence of parastomal hernia (PH) is associated with multiple factors, including but not limited to: age, sex, waist circumference, stoma type, stoma construction technique, laparoscopic approach, stoma aperture >3 cm, stoma not traversing the mid-rectus abdominis, body mass index (BMI) >25 kg/m$^2$, altered collagen metabolism, and diabetes mellitus.[29] This article exclusively examines the impact of stoma construction technique on PH development and did not incorporate other relevant factors into the analysis, thereby introducing confounding bias. BMI >25 kg/m$^2$ has been established as one of the primary risk factors for PH occurrence, with the underlying mechanism being that obesity leads to increased intra-abdominal pressure, consequently reducing abdominal cavity capacity.[29] In the preliminary analysis of this study, none of the four patients with BMI >25 kg/m$^2$ (maximum: 29.2 kg/m$^2$) developed PH. These preliminary findings suggest that this stoma construction technique may be feasible in patients with elevated BMI; however, further evaluation involving a larger cohort of high-BMI patients is warranted to assess its applicability in populations with higher BMI.

## Conclusion

ERASC demonstrates feasibility for PSH prevention in this pilot study. Prospective randomized trials comparing ERASC versus standard EPC are warranted to establish long-term efficacy and safety profiles.

## Data Sharing Statement

Correspondence and requests for materials should be addressed to Xiangshu Li and Zhengqiang Wei.

## Ethical Approval

This study was reviewed and approved by the Ethics Committee of First Affiliated Hospital of Chongqing Medical University (Approval No. 2024-460-01 Date: 2024-11-288). All participants provided written informed consent prior to enrollment. The research conforms to the ethical principles of the Declaration of Helsinki (2013 revision) and was conducted in compliance with ICMJE guidelines.

## Disclosure

The authors declare no competing interests in this work.

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