BMC Surgery

STUDY PROTOCOL

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Laparoscopic versus open distal gastrectomy with d2 lymphadenectomy in treatment of locally T4A gastric cancer: the protocol of a randomized controlled trial

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Abstract

Background Gastric cancer (GC) remains one of the leading causes of cancer-related mortality worldwide. While laparoscopic gastrectomy (LG) has been widely adopted for early and locally advanced gastric cancer (AGC), its safety and oncological efficacy in T4a GC remain unclear. To date, no randomized controlled trials have specifically examined the role of LG in the treatment of T4a GC. This study aims to provide robust evidence comparing the short- and long-term outcomes of laparoscopic distal gastrectomy (LDG) versus open distal gastrectomy (ODG) in resectable T4a GC.

Methods This is a phase III, randomized controlled, non-inferiority trial. Patients with clinical T4a GC (cT4aN0-3M0) suitable for distal gastrectomy with D2 dissection will be randomly assigned in a 1:1 ratio to undergo either LDG or ODG. A total 240 patients (120 each group) are required to statistically show non-inferiority of the LDG with respect to the primary end-point, 3-years disease-free survival (DFS). Secondary endpoints include morbiity, mortality, postoperative recovery, and quality of life.

Discussion This study is the first prospective randomized trial specifically designed to compare laparoscopic and open approaches for T4a GC. By standardizing surgical techniques and ensuring experienced surgeons perform the procedures, this trial aims to establish whether LDG can provide equivalent oncological outcomes while reducing perioperative morbidity and enhancing postoperative recovery. The findings will provide high-quality evidence to inform future guidelines and clinical decision-making in the management of T4a gastric cancer.

Trial registration This study is registered at ClinicalTrials.gov (NCT04384757), version 6. Registration Date: 08/05/2020.

Keywords Gastric Cancer, Laparoscopic Distal Gastrectomy, Open Distal Gastrectomy, T4a

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Introduction

Gastric cancer (GC) is one of the most common malignancies worldwide1, accounting for significant morbidity and mortality. Despite advancements in adjuvant therapies2, surgery remains the main curative treatment for gastric cancer. In recent years, laparoscopic gastrectomy (LG) has been increasingly adopted as a minimally invasive alternative to open gastrectomy (OG) for advanced gastric cancer (AGC). Large-scale randomized controlled trials (RCT) such as CLASS-01 [3] and KLASS-02 [4] have established the non-inferiority of LG in terms of oncological outcomes compared to OG, with additional benefits such as reduced blood loss, shorter hospital stays, and faster postoperative recovery. These findings have led to the recommendation of LG as an alternative approach in treatment guidelines for locally AGC2, 5, 6, 7.

However, these studies have notable limitations, including a high proportion of stage I patients and a focus on T2–T3 tumors, resulting in limited representation of T4a cases. T4a tumors, characterized by serosal invasion, represent a particularly aggressive and challenging subset of gastric cancers. These tumors are often associated with large tumor sizes, extensive nodal metastases, and peritumoral inflammatory reactions, posing significant challenges to surgical management. Achieving an adequate D2 lymph node dissection laparoscopically in T4a cases is technically demanding, increasing the risk of intraoperative, postoperative complications and inadequate lymphadenectomy. Furthermore, T4a tumors carry a higher risk of recurrence, particularly peritoneal dissemination, and are associated with poorer prognoses. These risks may be exacerbated in laparoscopic procedures due to factors such as pneumoperitoneum and tumor manipulation, which could facilitate peritoneal seeding and trocar site metastasis8, 9.

Several retrospective studies had demonstrated the benefits of LG for T4a GC, including better surgical outcomes, such as operation time, blood loss, lower complication rates, shorter postoperative recovery, and comparable survival outcomes to OG10, 11, 12, 13, 14, 15. However, the majority of these studies suffer from significant limitations, such as patient selection bias, which cannot be completely mitigated even with propensity score-matched method, small sample sizes, missing tumor's characteristics, variation in surgical techniques and an inadequate long-term follow-up data. The lack of high-quality evidence has limited the generalizability of these findings, and is insufficient to establish robust evidence on long-term oncological outcomes. Subgroup analysis of JLSSG0901 trial in patients with T4a disease suggested worse 5-year recurrence-free survival (RFS) in those underwent laparoscopic distal gastrectomy compared to open distal gastrectomy16. Although these findings highlight potential concerns, the trial was not specifically designed to evaluate outcomes in T4a cases, and definitive conclusions cannot be drawn. Currently, no RCTs have been conducted to directly compare LG and OG specifically for T4a gastric cancer. Thus, the efficacy of LG for T4a gastric cancer remains controversial, particularly regarding long-term survival outcomes. Given these gaps in the evidence, there is an urgent need for high-quality research to clarify the role of LG in the management of this high-risk GC subgroup. The rationale is to determine whether laparoscopic surgery provides equivalent oncological outcomes while reducing complications and enhancing recovery for patients with T4a GC. This RCT is conducted to compare laparoscopic and open distal gastrectomy with D2 lymphadenectomy in term of early outcomes and long-term survival for patients with resectable T4a GC.

Patient and method

Objectives

This study aims to compare laparoscopic distal gastrectomy (LDG) with D2 lymphadenectomy to conventional open distal gastrectomy (ODG) in patients clinically diagnosed with locally T4a gastric cancer regarding surgical safety and long-term outcomes.

Study design

This study is a phase III, open-label, randomized controlled trial (RCT) with a parallel-group, non-inferiority design from a tertiary medical center.

Participants are randomized 1:1 to receive LDG or ODG.

The primary outcome was 3-year disease free survival (DFS).

This RCT is monitored by an independent data and safety monitoring committee (DSMC) organized by the Department of Scientific Research and Training of Ho Chi Minh City University Medical Center.

Patients

The trial enrolls patients with locally clinical T4a GC suitable for curative resection by distal gastrectomy.

Inclusion criteria

- Age 18–80 years.
- ECOG performance status of 0 or 1.
- ASA score of I–III.
- Clinical diagnosis with T4aN0-3M0 gastric adenocarcinoma suitable for curative resection by distal gastrectomy with D2 lymphadenectomy based on preoperative imaging.
- Willingness to participate the study and written informed consent.

Exclusion criteria

- Bulky LNs on preoperative findings.
- Previous gastric surgery.
- Severe tumor-related complications such as bleeding or perforation.
- Prior chemotherapy or radiotherapy.
- Diagnosis of other malignancies within the past 5 years.
- Severe comorbidities or vulnerable conditions (e.g., cognitive impairment, ongoing or planned pregnancy) contraindicating laparoscopy.
- Participation in another clinical trial.

Study protocol

Patients will be recruited from the outpatient clinics and surgical departments of participating hospital. All patients undergo gastroscopy with histological confirmation prior to enrollment to ensure the diagnosis of gastric adenocarcinoma. Patients with gastric adenocarcinoma accessing the Gastro-Intestinal Surgery Department will be performed image staging with chest-abdomen Computed Tomography (CT), and Positron Emission Tomography if necessary. Perioperative assessment will be performed by a multidisciplinary team. An Independent Tumor Board (ITB) will be conducted to identify clinical staging and a decisive treatment plan.

Patients who are determined as T4aGC to undergo distal gastrectomy with curative intention are potential subjects for this trial.

For the protocol of abdominal CT-scan, all patients received 500 mL water as an oral contrast agent approximately 15 min before the examination. The clinical T4a tumors are diagnosed based on one or more the following criterias on CT-Scan: (1) nodular or an irregular outer layer of the gastric wall, (2) haziness/ stranding of the perigastric fat, and (3) a hyperattenuating serosa sign.17.

The diagnosis of cT4a stage based on CT scan findings will be determined by a team of consultant radiologists specialized in abdominal imaging (at least two experienced radiologists). All CT scans are interpreted independently and prospectively in the radiology department, with radiologists blinded to prior knowledge of treatment plans, to ensure objectivity and standardization. Then, a multidisciplinary team meeting will be conducted to determine the final clinical staging and treatment plan.

Following consent, patients will be randomized into either the LDG or ODG group. Patients will undergo surgery within 30 days of randomization. Perioperative care and follow-up adhere to standard guidelines for GC management.

Laparoscopic distal gastrectomy procedure

Prophylactic antibiotics are used routinely.

Step 1: Trocar placement and comprehensive assessment

During abdominal cavity assessment, cases with peritoneal metastasis, tumors invading surrounding organs, or requiring total gastrectomy are excluded from this RCT. For resectable distal gastrectomy cases, peritoneal lavage is conducted at the subdiaphragmatic and Douglas areas using 250–300 mL of normal saline, collecting at least 200 mL for cytology.

Step 2: Dissection of the greater omentum and lymph node stations 4sb and 4d

Total omentectomy was performed by dividing the greater omentum along the transverse mesocolon. The LGEA and LGEV are ligated at their origins from the splenic artery and vein, and adipose tissue containing station 4sb lymph nodes is dissected. The short gastric arteries are preserved during this process. Dissection continues along the greater curvature of the stomach to remove station 4d lymph nodes.

Step 3: Dissection of station 6

A plane between the omentum and transverse colon is dissected to expose the duodenum and pancreatic head. The RGEV is identified at its confluence with Henle's trunk, serving as the inferior boundary for station 6v. The RGEV is ligated, and adipose tissue containing station 6 nodes is carefully dissected off the pancreatic head, preserving the pancreatic capsule to avoid damage to the parenchyma. The RGEA is divided at its origin from the gastroduodenal artery, and infrapyloric vessels are ligated to complete the en bloc removal of station 6 lymph nodes. (Fig. 1)

Step 4: Dissection of stations 5 and 12a

The lesser omentum is divided along the left lobe of the liver to the cardia. The peritoneum above the duodenum is incised, and the lymphatic tissue of station 12a is dissected along the left side of common bile duct and down to the left side of the portal vein. The right gastric artery is ligated at its origin from the proper hepatic artery to retrieve stations 5 and 12a lymph nodes. The duodenum is transected 2 cm distal to the pylorus using a linear stapler. The duodenal stump is routinely reinforced in all cases by inverting the stapler line using hand-sewn seromuscular sutures.

Step 5: Suprapancreatic lymph node dissection (stations 7, 8a, 9, and 11p)

Suprapancreatic lymph node dissection involves the removal of nodes in stations 7, 8a, 9, and 11p, located around major vessels such as the common hepatic artery, splenic artery, and celiac trunk. Using the "outermost layer-oriented medial approach" method 18, 19, 20, a surgical approach including (1) medial dissection of the left

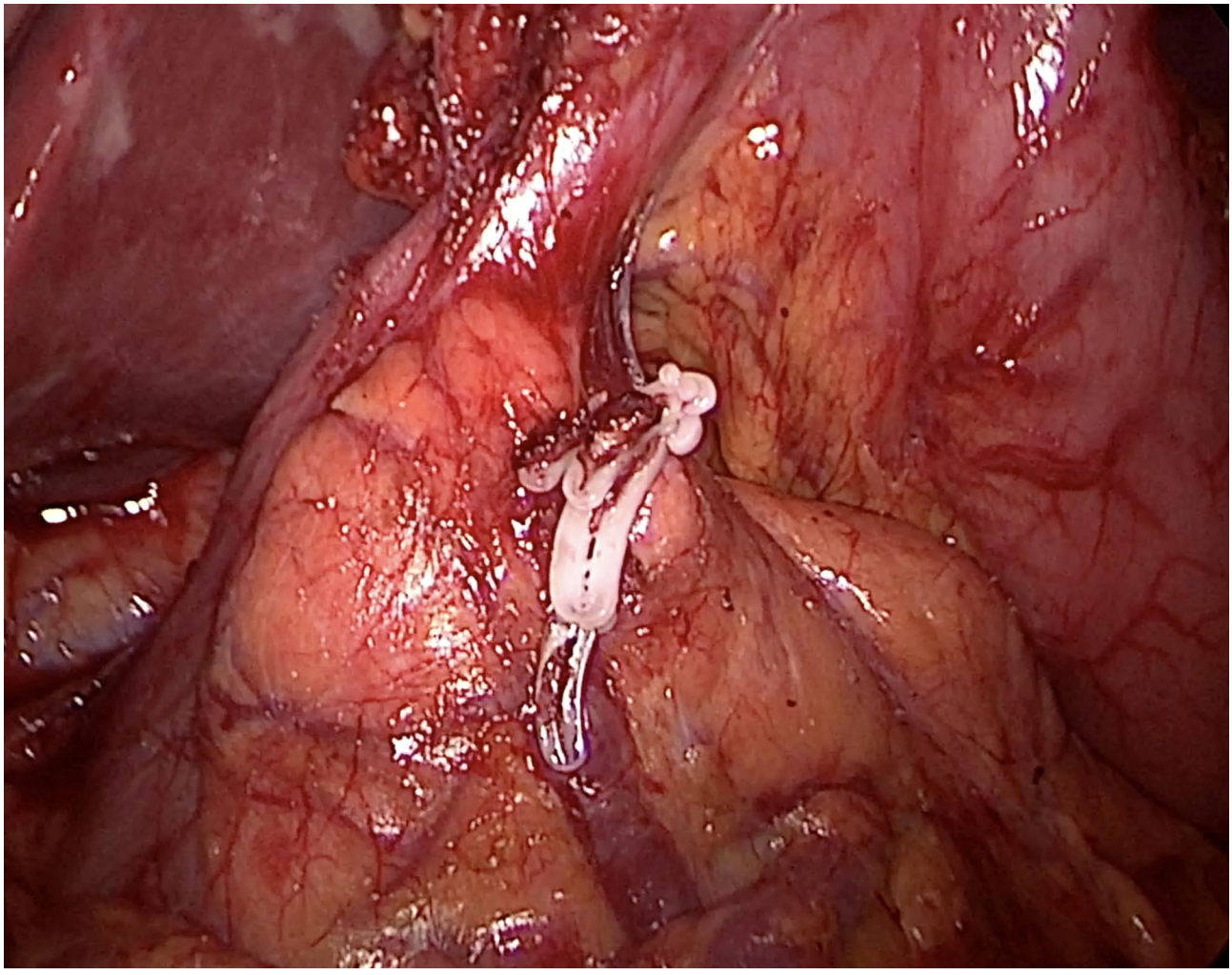

Fig. 1 After lymphadenectomy group 6

gastric artery; (2) right suprapancreatic dissection; (3) left suprapancreatic dissection was performed. The outermost layer between the autonomic nerve sheaths and the lymphatic tissue is dissected. The avascular space of the left gastric artery (LGA) is dissected bilaterally and ligated the left gastric artery at its root for station 7. The adipose tissue containing station 8a is dissected along outermost layer of the common hepatic artery, dissection along the splenic artery for station 11p, and en bloc removal of tissue around the celiac trunk for station 9. (Fig. 2)

We expose this area using a compressionless technique, including: (1) the assistant 's left hand uses laparoscopic forceps to grasp the fatty tissue at the inferior border of the pancreas, pulling it downward and posteriorly (Fig. 3), (2) grasping and pulling the connective tissue surrounding the major blood vessels (outermost layer) (Fig. 4) to expose and dissect along the superior border of the pancreas.

Step 6: Lymph node dissection along the lesser curvature (Stations 1 and 3)

Dissection proceeds along the lesser curvature of the stomach to retrieve stations 1 and 3 lymph nodes.

Step 7: Gastric transection and reconstruction

The stomach is transected at least 5 cm proximal to the tumor using a linear stapler. Specimens are extracted through a small abdominal incision, and examination of proximal margin is performed, including frozen resection if necessary. A post-gastrectomy cytology is performed in the surgical area routinely. Gastrointestinal reconstruction is performed using either Billroth II or Roux-en-Y methods. All Billroth II anastomoses are completed entirely intracorporeally. For Roux-en-Y reconstruction, the gastrojejunostomy are performed intracorporeally, while the jejunojejunostomy (Y-limb anastomosis) is constructed extracorporeally through the umbilical incision. A drainage tube is placed routinely.

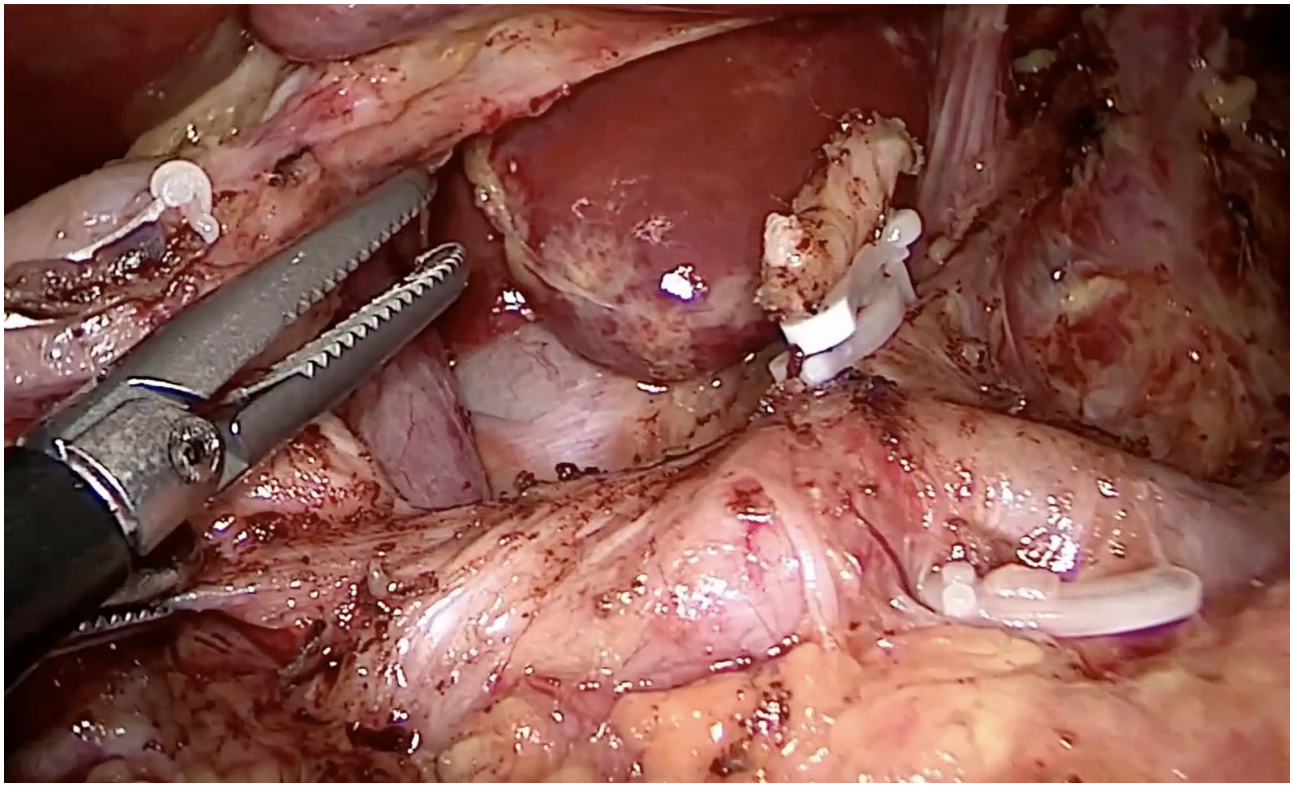

Fig. 2 After lymphadenectomy the superior pancreatic border

If a laparotomy is performed before finishing D2 lymphadenectomy for any reason, it will be recorded as "conversion to open".

Conventional open distal gastrectomy procedure

The ODG procedure is similar to that of LDG in accordance with the instructions of the 6th Japanese Gastric Cancer Treatment Guidelines2.

All procedures included in this study are strictly performed by five senior consultant surgeons from our upper gastrointestinal surgical team. Each surgeon has personally conducted more than 100 standard open and laparoscopic gastrectomies with D2 lymphadenectomy for gastric cancer prior to the initiation of this study.

Postoperative treatment and follow up

After surgery, all patients will be followed regularly using the same protocol, and relevant data, including recurrence and mortality, were recorded. Follow-up visits are scheduled every 3 months for the first 2 years postoperatively and every 6 months for the subsequent 3 years, ensuring a minimum follow-up period of 36 months for all patients. The follow-up protocol adheres to the 6th Edition of the Japanese Gastric Cancer Treatment Guidelines. (Table 1)

After full recovery from surgeries, all participants who undergo radical resection are recommended to receive adjuvant chemotherapy, about 4–6 weeks postoperatively. The regimens include one-year S-1 or Capecitabin alone for pathological stage II diseases, or 8 courses of S-1-based or Capecitabin-based combinations (CS, DS, SOX, CapeOX) for pStage III GC. If a patient experiences severe side effects and is unable to tolerate the chemotherapy, the drug dosage should be reduced, or chemotherapy may be discontinued entirely. In this case, the patient is recorded as incomplete adjuvant chemotherapy.

Outcome measurements

The primary outcomes of this RCT are 3-year disease-free survival (DFS) and 3-year overall survival (OS). To assess the 3-year DFS rate, clear criteria for recurrence are defined. For patients without specific symptoms, recurrences are detected during regular follow-up investigations, such as abdominopelvic computed tomography (CT). If any suspicious findings are noted, further diagnostic procedures, including whole-body positron emission tomography-CT (PET-CT), magnetic resonance imaging (MRI) of the liver, or laparoscopic exploration, will be performed to confirm recurrence. In these cases, follow-up intervals are shortened, and patients are monitored more frequently than the standard schedule. For patients presenting with suspected symptoms of recurrence, evaluation for recurrence will be conducted immediately, irrespective of the planned follow-up schedule.

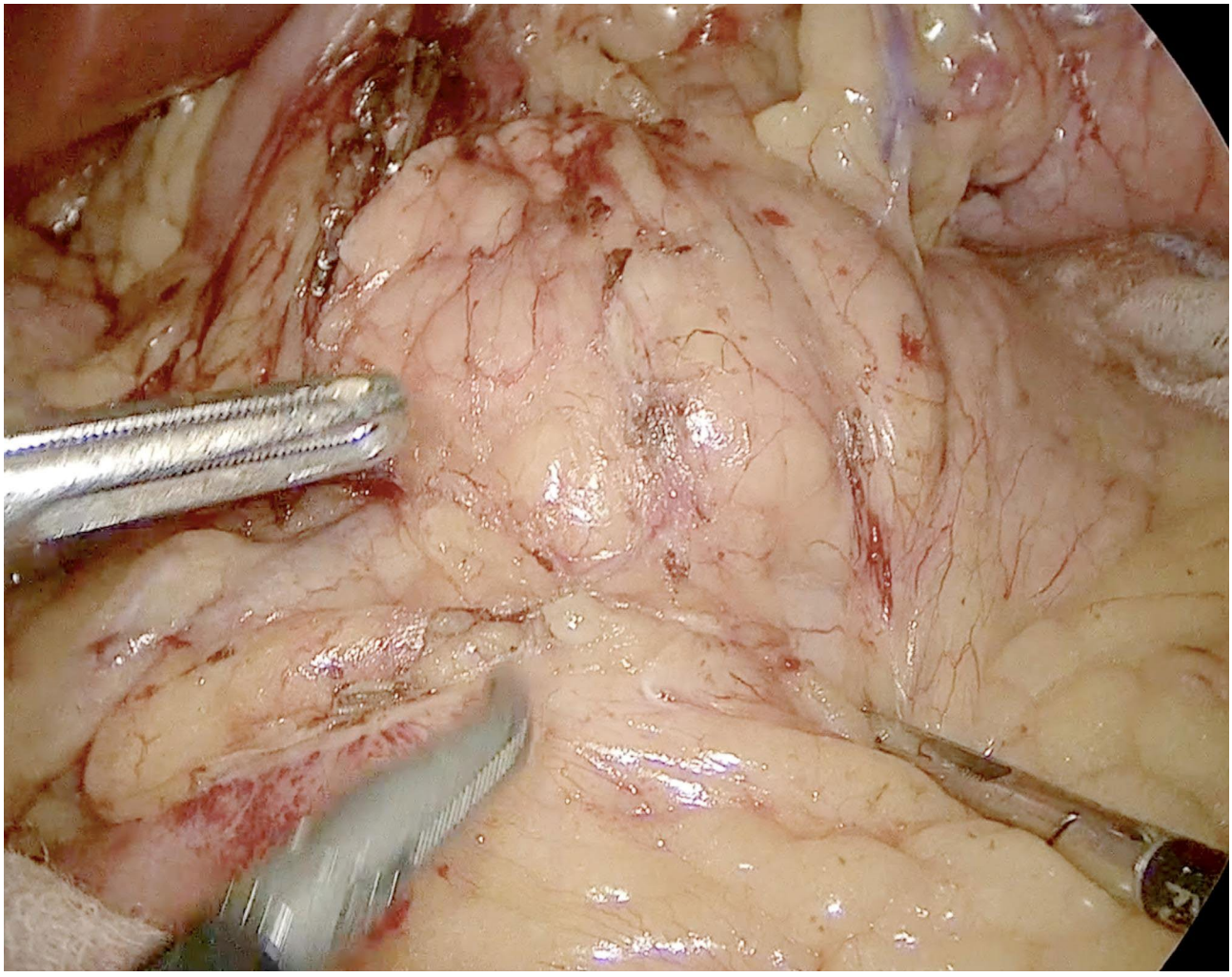

Fig. 3 Pancreas-Compressionless

Overall survival is defined as the time from randomization to death from any cause.

Secondary outcomes include intraoperative outcomes, early and late complications, postoperative recovery and quality of life assessed by the EORTC QLQ-C30 questionnaire. Intraoperative outcomes are operative time, blood loss, rate of conversion to open surgery due to bleeding or organ injuries. Early postoperative complications, occurring within 28 days after surgery, will be classified using the Clavien-Dindo classification system21, and include wound infections, intra-abdominal or intraluminal bleeding, fluid collection or abscess, anastmosis or duodenal stump leakage, anastomotic stenosis, pancreatic fistula, postoperative ileus, cardio-pulmonary complications. Late complications, defined as those occurring after 28 days, include intestinal obstruction related to adhesion, abdominal incision hernia, chronic wound infection. Postoperative recovery are evaluated by time to first flatus, length of hospital stay, time to solid foood and time to adjuvant chemotherapy.

Sample size

To estimate the sample size for a non-inferiority RCT with 3-year DFS primary enpoint, the calculation is performed using the log-rank test for survival analysis in non-inferiority trials, with the use of a web-based tool developed by Kengo Nagashima, Keio University, Japan22, 23. In a subgroup analysis for T4a GC, the estimation of 3-year DFS rates were 57% for the LDG group and 55% for the ODG group15, 24. Therefore, a hazard ratio (HR) of 1.45 was used for the non-inferiority margin (Δ_0). The null hypothesis was assigned as HR ≥ HR0, and the alternative hypothesis as HR < HR0. Type I error was set at 0.05 (one-sided) with 80% power, with a 1:1 allocation ratio. The estimated total sample size required is 240 patients (120 patients in each group), with 116 target events as recurrence. This ensures that at least 206 patients (103 per group) will be analyzed in the intention-to-treat (ITT) population after considering for the 14% dropout rate. (Fig. 5).

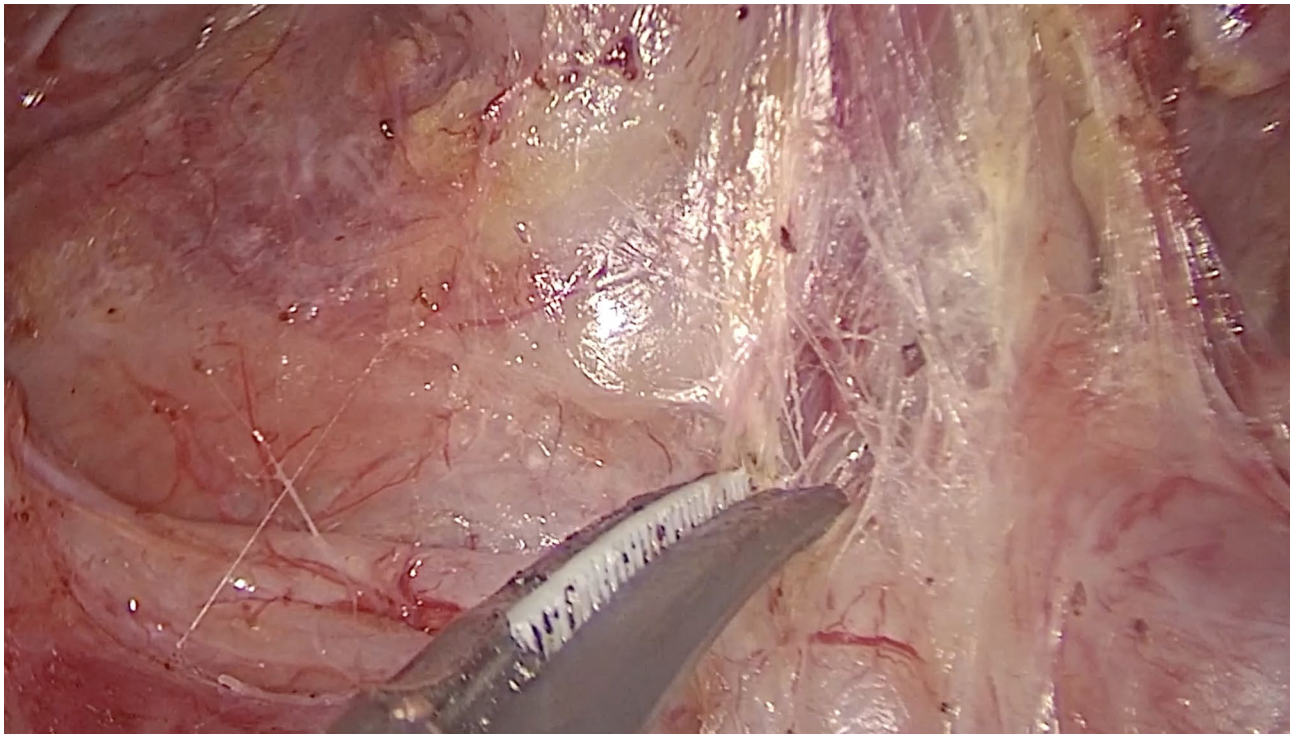

Fig. 4 Outermost layer technique

Table 1 The schedule of enrolment, interventions, and assessments

	Study period								
	Enrollment	**Allocation**	**Post allocation**						**Close-out**
Timepoint	-t1	Surgery	30d	3 m	6 m	12 m	18 m	24 m	36 m
Enrollment									
Eligibility screen	x								
Informed consent	x								
Allocation		x							
Intervention									
LDG		x							
ODG		x							
Assessment									
Intraoperative outcomes		x			x	x			
Early complications			x						
Late complications				x	x	x			
Recovery after surgery			x						
Quality of life						x		x	x
Survival outcomes				x	x	x	x	x	x

The estimated patient recruitment period for this study is approximately 60 months, assuming a steady accrual rate, to complete the trial enrollment.

Randomization and masking

Patients are randomly assigned in a 1:1 ratio to the LDG or ODG group using block randomization with random block sizes of 2, 4, or 6, generated by Stata software (version 16). Allocation concealment is ensured through sealed envelopes. Due to the nature of surgical interventions, blinding of surgeons and patients is not possible. However, outcome assessors and data analysts remain blinded to group assignments.

Surgical standardization

All patients enrolled in this trial are performed only by members of upperGI surgical team. Prior to the initiation of this study, all participating surgeons had standardized their techniques for both open and laparoscopic gastrectomy with D2 lymphadenectomy for advanced gastric

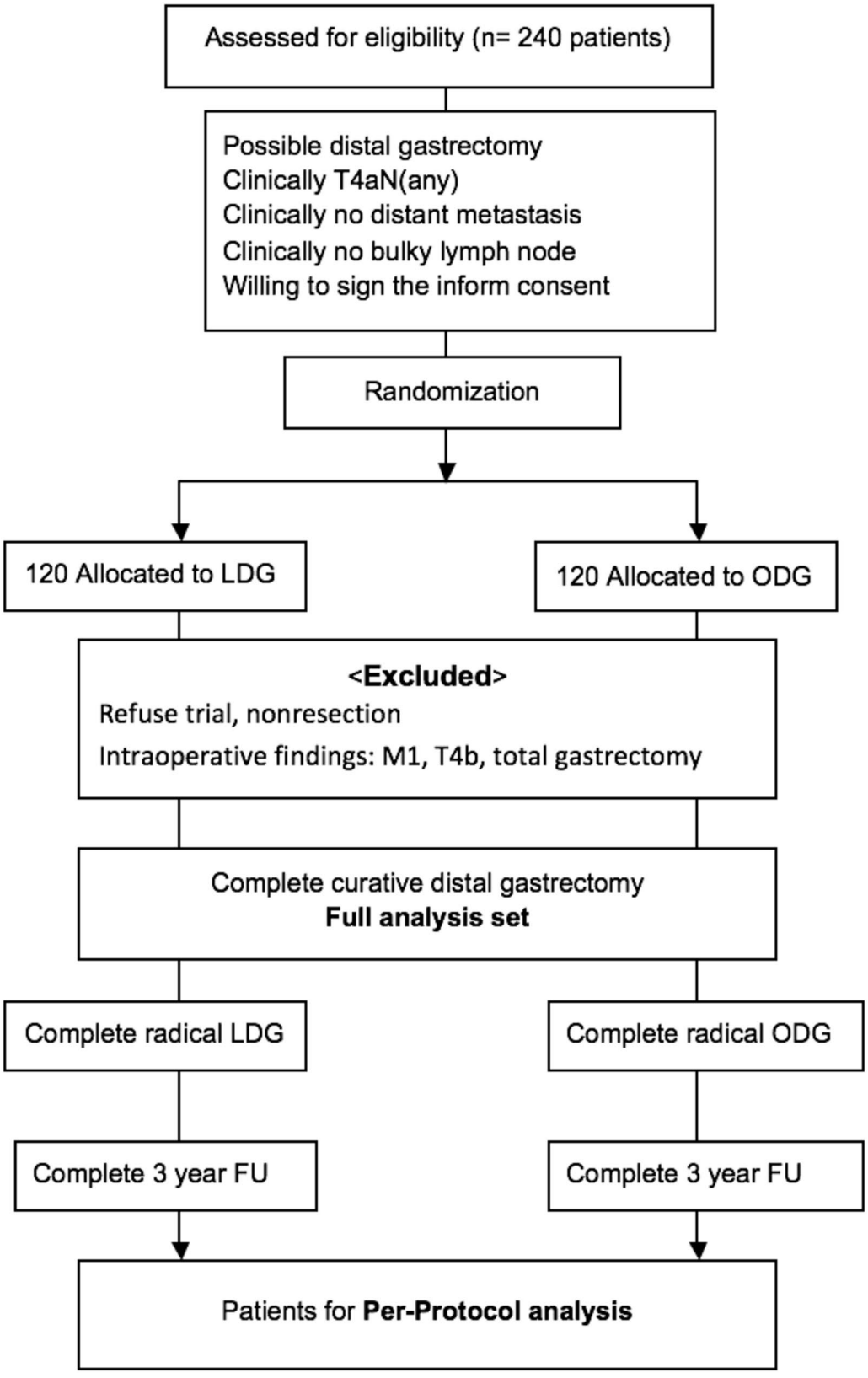

Fig. 5 Flowchart of patient selection. T: tumor; N: Node; LDG: laparoscopic distal gastrectomy; ODG: open distal gastrectomy; M: metastasis; FU: flow-up

cancer. Each surgeon had independently performed at least 100 laparoscopic and 100 open gastrectomy procedures. A checkpoint list of surgical steps was used to validate the procedure.

Statistical analysis

Outcomes will be analyzed using intention-to-treat (ITT), per-protocol (PP), and full analysis set (FAS) populations. Patients who crossover treatments preoperatively will be analyzed in the as-treated group (based on the actual procedure performed), while those converting from laparoscopic to open surgery intraoperatively remain in the laparoscopic group.

Summary statistics are mean ± standard deviation or median (interquartile range) for continuous variables and frequency and percentage for categorical variables. Continuous variables are compared using t-tests or Mann–Whitney U tests. Categorical variables ared analyzed using chi-squared or Fisher's exact tests. Kaplan–Meier method is used to estimate OS and DFS, with comparisons between groups using the log-rank test. Hazard ratios with 95% is calculated using Cox proportional hazards models.

All analyses will be conducted using Stata (version 17).

Data management

Data management will be handled through a centralized electronic data capture (EDC) system. Trained personnel will perform data entry, ensuring accuracy through double-checking. Data will be securely stored with restricted access, and regular audits will maintain data quality.

An independent Data Safety Monitoring Committee (DSMC) will be assembled with 3 members from the Department of Scientific Research and Training of Ho Chi Minh City University Medical Center. An interim analysis will be performed after the enrolment of the first 120 participants. The DSMC will assess the following content:

- the number of participants and planned time for completion;
- drop rate of participants and compliance with procedures in each group;
- preliminary analysis of efficacy, including rate of complications and recurrence.
- incidence and classification of adverse events.

The interim analysis will be conducted using a two-sided significant test with the Haybittle–Peto spending function and a Type I error rate of 5% with stopping criteria of $P < 0.001$ (Z alpha = 3.29).

Independent study monitoring will be performed monthly by the Department of Scientific Research and Training of Ho Chi Minh City University Medical Center to ensure adherence to the protocol, International Conference on Harmonisation-Good Clinical Practice, standard operating procedures and applicable regulatory requirements, maintenance of trial-related source records, completeness, and accuracy and verifiability of case report form entries compared with source data.

Ethical approval

The study is conducted according to the guidelines of the Declaration of Helsinki and approved by Institutional Review Board, University Medical Center Ho Chi Minh city. Approval to perform research on human subjects in this study was provided by the Institutional Review Board, University Medical Center Ho Chi Minh city (registration number: 26/HDDD-DHYD) in June, 11th, 2020. Informed consent will be obtained in writing from all patients prior to their enrollment in the study.

This trial was registered at ClinicalTrials.gov (NCT04384757). The study was first registered on May 08, 2020.

The findings of this trial will be published in peer-reviewed journals and presented at international conferences. Additionally, data will be shared on ClinicalTrials.gov to meet transparency requirements. De-identified participant data will be accessible upon reasonable request following the trial's publication, in accordance with institutional and ethical guidelines.

Discussion

The treatment strategy for T4a gastric cancer varies across regions. In East Asia, particularly Japan and Korea, the standard approach remains upfront surgical resection with D2 lymphadenectomy followed by adjuvant chemotherapy, as supported by national guidelines2, 5 and trials such as ACTS-GC25 and JACCRO GC-07 [26]. In contrast, Western guidelines like NCCN and ESMO emphasize perioperative chemotherapy (e.g., FLOT regimen) as the preferred strategy for resectable locally advanced tumors, including T4a disease6, 7. These divergent approaches reflect differences in clinical practice patterns and tumor biology, and underline the need for high-quality, region-specific evidence. Our trial follows the Asian surgery-first paradigm, aiming to evaluate whether laparoscopic distal gastrectomy can achieve comparable oncological outcomes to open surgery in patients with serosa-invasive gastric cancer.

The role of laparoscopic surgery in the management of T4a gastric cancer remains a critical area of investigation. While minimally invasive approaches such as laparoscopic distal gastrectomy (LDG) with D2 lymphadenectomy have shown clear results in T2, T3 AGC, their application in more advanced stage cancers, including T4a, is still under exploration due to technical challenges and potential oncological risks. This RCT seeks to

address this gap by directly comparing the surgical and oncological outcomes of LDG and ODG for patients with resectable T4a GC.

Several high-quality studies had investigated the efficacy of laparoscopic approaches for AGC. The CLASS-01, KLASS-02 and JLSSG0901 trials demonstrated the non-inferiority of laparoscopic surgery compared to open surgery for locally AGC in terms of overall survival (OS) and disease-free survival (DFS), with additional benefits such as reduced blood loss and faster recovery. However, these studies primarily included about 30% patients with stage I and more than 50% patients with T2–T3 diseases, leaving T4a cases underrepresented. The JLSSG0901 trial, although not focused exclusively on T4a tumors, reported worse survival outcomes in cases underwent LDG compared to ODG. Although few studies and a meta-analysis suggested that LD for T4a tumors may achieve comparable survival outcomes with reduced complications, there are inevitable limitations due to the relying on retrospective data and absence of randomization.

Moreover, our study's criteria includes some exclusions of previous studies. For example, KLASS-02 included only patients with no LN metastasis or limited perigastric LNs and excluded patients with complete gastric outlet obstruction, limiting its generalizability to more complex T4a cases. In contrast, our study specifically targets T4a GC, including higher rate of LNs metastasis (up to N3b), greater surgical complexity, and a higher incidence of preoperative gastric outlet obstruction (about 22,5% according to Yao27). While this increases the heterogeneity of our study population, it reflects real-world clinical scenarios more accurately. Moreover, our protocol includes detailed preoperative diagnostic criteria of clinical T4a tumors. These imaging criteria enhance the accuracy of patient selection, addressing limitations in preoperative staging reported in earlier trials. Furthermore, our study excludes cases with bulky LN or suspected distant metastases which are not suitable for upfront surgery2, and total gastrectomy to balance surgical feasibility with oncological rigor.

Consistent to other high quality study about surgery, our RCT emphasize the critical role of surgical expertise and procedural standardization in ensuring patient safety and the quality of outcomes. Due to the risks of laparoscopic aprroach for this subgroup of GC, we introduces a surgical protocol based on the previous evidences. These include "outermost layer-oriented medial approach" 19 and "Pancreas-Compressionless"28 methods. Compression of the pancreas to expose the surgical field during laparoscopic suprapancreatic LN dissection has been shown to increase the rate of postoperative pancreatic fistula29. Regarding surgical quality control, our protocol requires all surgeons to have completed a minimum of 100 laparoscopic gastrectomies with D2 lymphadenectomy and adhere to a standardized surgical checklist.

Despite its strengths, this study has limitations. First, the 3-year follow-up period may underestimate long-term oncological outcomes such as 5-year OS and DFS. Second, the study is conducted in a single center, which may limit the generalizability of the results to other populations. Third, the inability to blind surgeons and patients introduces potential performance and detection biases. Finally, the surgeons involved to this RCT are not validated officially due to the absence of international experts as a review commitee.

In conclusion, this protocol is designed to address the unmet need for high-quality evidence on laparoscopic management of T4a gastric cancer. By focusing exclusively on T4a tumors and ensuring surgical standardization, our study aims to provide critical evidence on the safety and efficacy of LDG with D2 lymphadenectomy in this high-risk population.

Abbreviations

RCT	Randomized clinical trial
GC	Gastric cancer
AGC	Advanced gastric cancer
LG	Distal gastrectomy
LDG	Laparoscopic distal gastrectomy
ODG	Open distal gastrectomy
CT	Computed tomography
IIT	Intension to treatment
FAS	Full analysis set
PP	Per protocol
DFS	Disease-free survival
OS	Overall survival

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12893-025-02933-6.

Supplementary Material 1

Supplementary Material 2

Author contributions

Tran Quang Dat, Vo Duy Long wrote the manuscript and the primary author of it. Dang Quang Thong provided statistical counseling in clinical trial design, and performed the primary statistical analysis. Nguyen Viet Hai, Doan Thuy Nguyen and Nguyen Hoang Bac designed the study and participated in the design of this protocol. Nguyen Lam Vuong supervised the manuscript construction. All authors have read and approved the final manuscript for publication.

Funding

This study was supported by a grant from the University Medical Center, University of Medicine and Pharmacy at Ho Chi Minh City.

Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

The study is conducted according to the guidelines of the Declaration of Helsinki and approved by Institutional Review Board, University Medical

Center Ho Chi Minh city. Approval to perform research on human subjects in this study was provided by the Institutional Review Board, University Medical Center Ho Chi Minh city (registration number: 26/HDDD-DHYD) in June, 11th, 2020. Informed consent will be obtained in writing from all patients prior to their enrollment in the study.

Consent for publication
Not Applicable. This manuscript does not contain any individual person's data requiring consent.

Competing interests
The authors declare no competing interests.

Adherence to SPIRIT guidelines
This manuscript has been prepared in compliance with the SPIRIT (Standard Protocol Items: Recommendations for Interventional Trials) guidelines for clinical study protocols. A completed SPIRIT checklist has been provided as an additional file.

Adherence to CONSORT guidelines
This study adheres to the CONSORT guidelines for randomized controlled trials. A completed CONSORT checklist is provided as an additional file in the submission.

Received: 26 February 2025 / Accepted: 23 April 2025
Published online: 02 May 2025

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