

Original Research

Modified Cervical Cerclage Balloon Fixation With Cervical Clamping: A Retrospective Analysis Across Two Hospitals

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Academic Editor: Valerio Gaetano Vellone

Submitted: 3 May 2025 Revised: 27 July 2025 Accepted: 6 August 2025 Published: 13 October 2025

Abstract

Background: Balloon tamponade is an effective intervention for managing postpartum hemorrhage, particularly in resource-limited settings. However, cervical relaxation during balloon insertion may cause balloon slippage, resulting in placement failure. This complication is associated with increased blood loss, a higher risk of hysterectomy, and unnecessary use of resources. **Methods:** We conducted a retrospective analysis of 10 patients who underwent modified cervical cerclage balloon fixation combined with cervical clamping for postpartum hemorrhage complicated by balloon slippage. These patients were treated between January 1, 2021, and January 1, 2024, at two hospitals in Cheng Du and Xizang, China. The primary outcome was successful hemostasis following intervention. Secondary outcomes included perioperative blood loss and drainage volume. Data analysis was performed using descriptive statistics and the Shapiro-Wilk test. **Results:** The modified method was applied in 10 patients. Hemostasis was successfully achieved in 9 of 10 cases (90%). In 1 patient, additional uterine artery embolization was required due to an arteriovenous fistula. **Conclusions:** Modified cervical cerclage balloon fixation combined with cervical clamping is an effective and low-cost approach for preventing balloon slippage in appropriate clinical settings.

Keywords: modified cervical cerclage; balloon fixation; cervical clamp

1. Introduction

Postpartum hemorrhage remains the leading cause of maternal deaths and complications globally [1,2]. Despite strong recommendations from the World Health Organization (WHO) for its prevention and management, postpartum hemorrhage continues to account for approximately 27% of maternal deaths worldwide [3]. A systematic review by Yunas *et al.* [4] identified the five most frequently reported causes of postpartum hemorrhage: uterine atony, genital tract trauma, retained placenta, placenta accreta spectrum, and coagulopathy. Uterine balloon tamponade is a recommended treatment for postpartum hemorrhage, followed by surgical intervention and blood transfusion when standard first-line treatments fail [3]. Although high-quality randomized trials remain limited, particularly in low-resource settings, previous systematic reviews have reported high success rates in treating severe postpartum hemorrhage using uterine balloon tamponade [5,6]. As no single treatment fits all cases of postpartum hemorrhage, strengthening first-line treatment programs and improving adjunctive measures remains essential.

In resource-limited areas, balloon tamponade may be particularly valuable. However, balloon spillage due to cervical relaxation during application is a common application, potentially leading to placement failure. This is of particular concern in settings with limited resources, as it can in-

crease the risk of hysterectomy, exacerbate blood loss, and waste critical medical supplies. To address this problem, we propose a method using modified cervical cerclage balloon fixation combined with cervical clamping, based on our case reports, to effectively manage postoperative hemorrhage in appropriate clinical scenarios. Herein, we detail the modified surgical procedure.

2. Materials and Methods

This study involved a retrospective analysis of 10 patients who required uterine balloon tamponade for postpartum hemorrhage after vaginal delivery, treated between January 1, 2021, and January 1, 2024, at West China Second University Hospital, Sichuan University, and Women and Children's Hospital of Xizang Autonomous Region in Chengdu and Xizang, China (Fig. 1). Inclusion criteria included patients with postpartum hemorrhage and a fully dilated cervix requiring balloon tamponade (≥ 26 weeks), who provided consent for the procedure. Exclusion criteria were as follows: (1) presence of intrauterine infections contraindicating balloon placement or surgical intervention; and (2) patients who declined the procedure. The study was approved by the Ethics Committee of the West China Second University Hospital, Sichuan University (approval no. 2017-033, 2022-006).



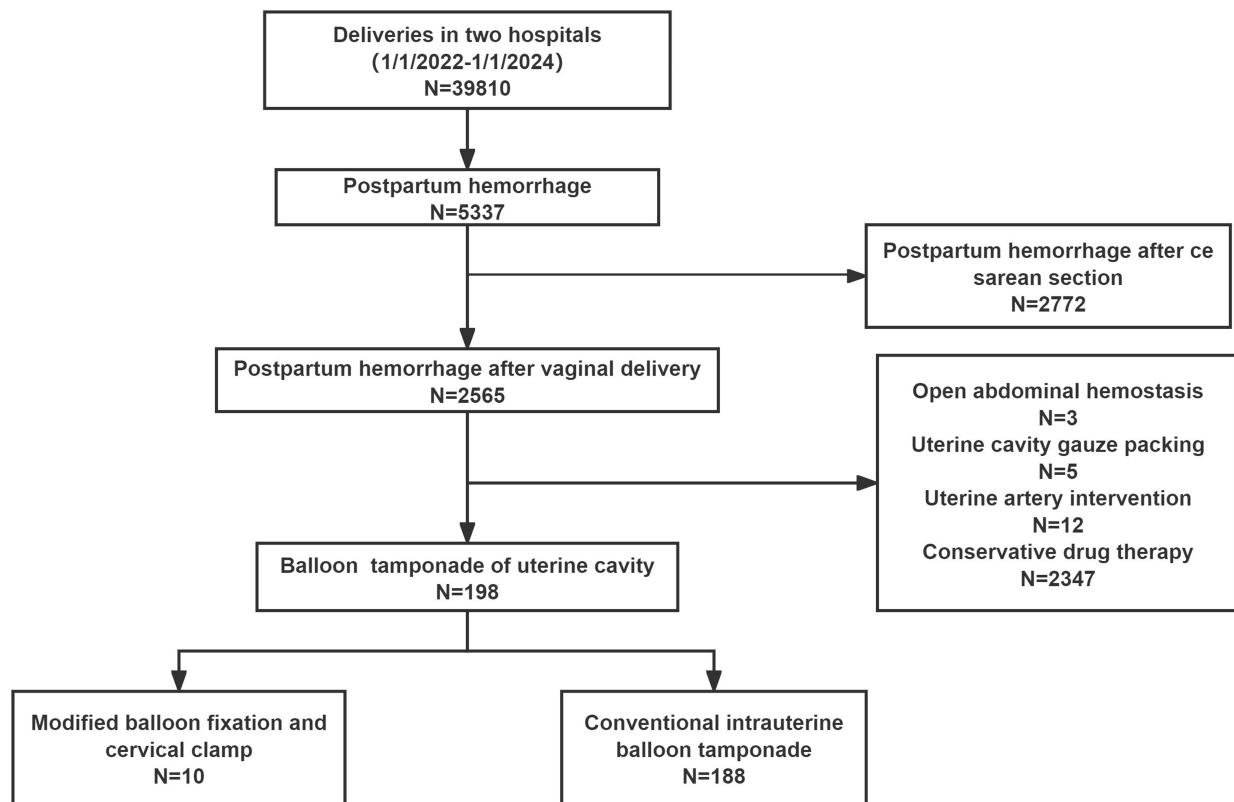


Fig. 1. The flowchart of the patients included. N, number of samples.

Cervical forceps were used to clamp the descending branches of the uterine artery before performing cervical cerclage to reduce bleeding. The Bakri balloon was then rapidly secured using a modified cervical cerclage. The procedural steps are described below (Fig. 2).

2.1 Step 1: Clamping the Descending Branches of the Uterine Arteries

A vaginal retractor was used to expose the cervix after delivery. Two oval forceps were applied to the left and right sides of the cervix at the 3 and 9 o'clock positions (Fig. 2A), at a depth of 0.5 cm below the bladder reflex. These forceps clamped the descending branches of both uterine arteries, necessitating caution to avoid damaging the bladder or rectum. This technique helped achieve temporary hemostasis.

2.2 Step 2: Modified Cervical Cerclage Suturing

We placed 1-0 absorbable sutures adjacent to the oval forceps, taking care to avoid blood vessels. At each location, two stitches were placed: one inserted at the 4 o'clock position and exiting at 2 o'clock position, avoiding the 3 o'clock vascular area on the cervical side; the other inserted at the 10 o'clock position and exiting at the 8 o'clock, avoiding the 9 o'clock area on the cervical side. The suture lines are marked in yellow to represent the exit and entrance points of the needle (Fig. 2B). The modified cerclage technique is faster and simpler than conventional cervical cerclage, requiring only sutures at 3 and 9 o'clock positions,

avoiding those at 12 and 6 o'clock or up to the internal cervical os. This allows rapid completion without delaying balloon placement.

2.3 Step 3: Balloon Placement

The balloon was placed carefully into the uterine cavity and advanced to the fundus. Normal saline was infused into the balloon until adequate compression was achieved and visible bleeding ceased (Fig. 2C). Balloon placement was guided by ultrasonography, which was also used to confirm proper balloon positioning, assess intrauterine bleeding, and detect large blood clots.

2.4 Step 4: Balloon Fixation

The sutures were securely tied behind the cervix at the posterior fornix of the vagina. Oval forceps were gently released to tighten the knot, narrowing the cervical opening and effectively preventing balloon displacement (Fig. 2D). The Bakri balloon's drainage channel was connected to continuous suction to monitor for residual bleeding in the uterine cavity.

2.5 Step 5: Balloon Removal

Balloon removal followed standard uterine tamponade protocols, typically between 8 and 12 h, based on ongoing bleeding and drainage volume, not exceeding 24 h. First-generation cephalosporins were administered for 24 h as prophylaxis for infection. All medications, including

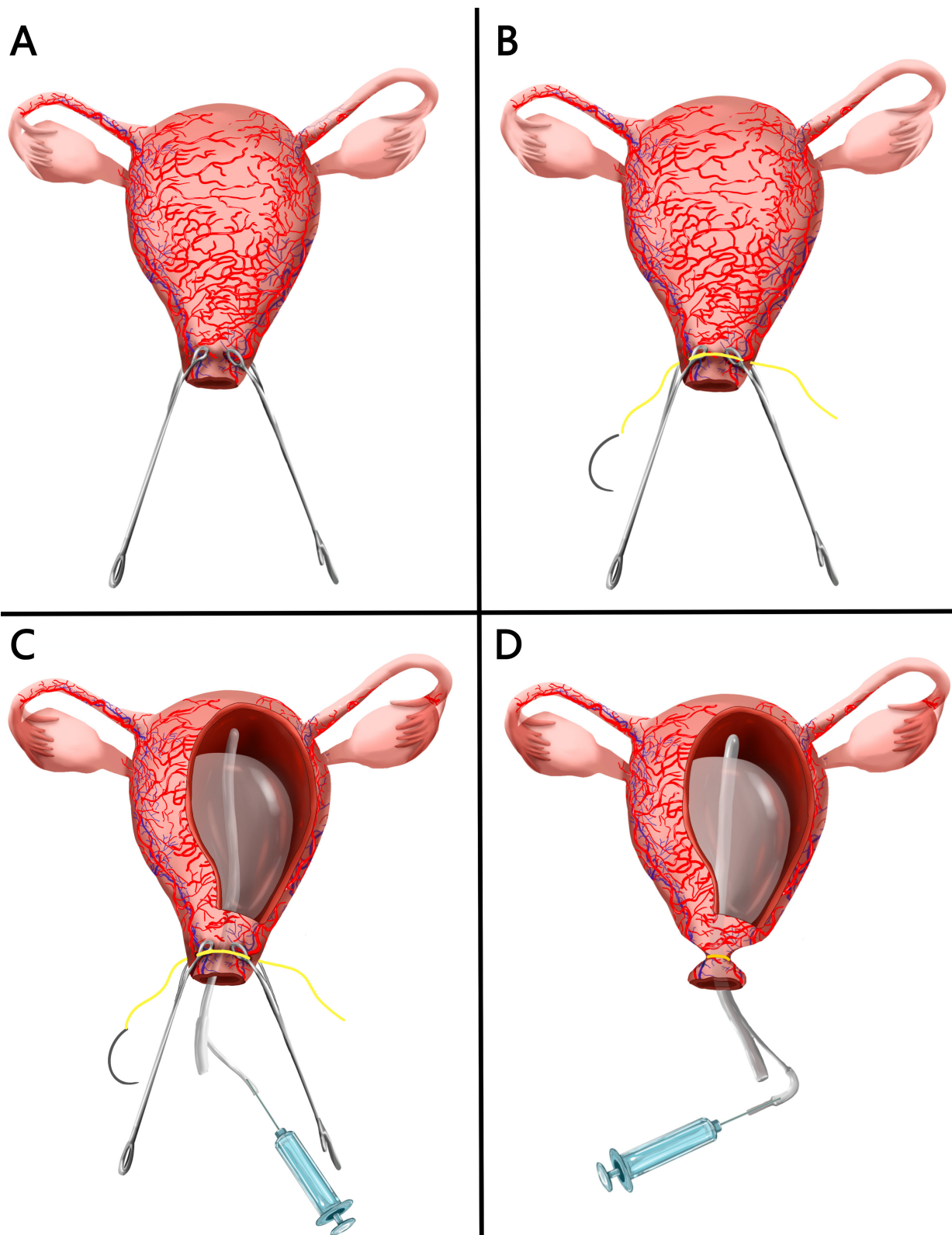


Fig. 2. The procedural steps. (A) Two oval forceps are then used to clamp the left and right sides of the cervix at the three and nine o'clock positions. (B) Quickly performed the modified cervical cerclage. (C) Balloon placement. (D) The suture is securely tied behind the cervix to help balloon fixation.

oxytocin and tranexamic acid, were administered according to standard postpartum hemorrhage guidelines, with no de-

viations due to surgical procedure. Cerclage sutures were removed simultaneously with balloon deflation.

Patient baseline characteristics included age, body mass index (BMI), gestational age, parity, gravidity, and maternal complications during pregnancy and delivery. Perioperative data included blood loss prior to balloon placement, postoperative bleeding, drainage volume, use of modified method, combination with other methods, and outcomes.

The primary objective of this study was to determine the success rate of the modified technique, defined by prevention of balloon slippage and effective hemorrhage control. Secondary objectives included perioperative outcomes associated with the application of the modified technique. All patients underwent six-week postpartum cervical assessments to evaluate recovery.

2.6 Statistical Analysis

Normality was tested for all continuous variables using the Shapiro-Wilk test due to the small sample size ($n = 10$). Variables with a normal distribution are expressed as mean $\pm$ standard deviation, and non-normally distributed variables are presented as median (interquartile range).

3. Results

This modified technique was applied in 10 patients with balloon detachment (Table 1). The mean maternal age was 34 ± 3.4 years, and the median BMI was 26.7 ± 2.9 kg/m². Gestational age at delivery ranged from 26 + 1 to 41 weeks. As shown in Table 2, the mean blood loss prior to balloon placement was 1366 ± 432 mL; the median postoperative vaginal bleeding was 44.5 (38.5, 58) mL; and the mean drainage volume was 73 ± 28 mL.

Balloon slippage was successfully prevented in all 10 patients. Hemostasis was achieved in nine patients using the modified technique. In one patient, although bleeding was reduced, it remained uncontrolled and required uterine artery embolization. An arteriovenous fistula was later identified as the underlying cause of balloon compression failure during intervention.

4. Discussion

Postpartum hemorrhage remains a significant cause of maternal morbidity and mortality [7,8]. Intrauterine balloon tamponade has demonstrated efficacy, with reported success rates of 78.0% to 88.9% after vaginal delivery [9,10], and a notable reduction in postpartum hysterectomy rates from 7.8 to 2.3 per 10,000 deliveries [11]. Moreover, the administration of intrauterine balloon tamponade is associated with a decreased need for invasive interventions such as vessel ligation, arterial embolization, and hysterectomy among women undergoing vaginal delivery [12].

Systematic reviews indicate an 85% success rate for balloon tamponade, with 10%–15% of failures attributable to balloon displacement [6,13,14]. After vaginal delivery, cervical dilation and uterine relaxation increase the likelihood of balloon expulsion, resulting in continued bleeding,

contamination of equipment, and resource wastage. Existing methods for preventing balloon slippage—such as vaginal packing, abdominal wall fixation, cervical stabilization with ring forceps left in place for 12 to 24 h, suspension of the balloon using bilateral cervical sutures, or placement of a McDonald cerclage prior to balloon inflation [13].

Vaginal packing is cost-effective but can cause vaginal mucosal injury and does not effectively stabilize or reduce the cervical os, making it difficult to ensure proper balloon placement within the uterine cavity. Moreover, obstructed vaginal blood flow compromises accurate assessment of hemorrhage and increases the risk of infection. Abdominal wall fixation, although useful, is limited to cesarean deliveries [15]. Although technically simple, the ring forceps method poses a risk of ischemic complications if clamped for prolonged periods of (12–24 h) [16].

Alternative techniques include suspending the balloon with bilateral cervical sutures or performing McDonald cerclage. In contrast, our modified cerclage is faster and simpler than conventional cervical cerclages. It requires suturing only at the 3 and 9 o'clock positions, eliminating the need for sutures at the 12 and 6 o'clock positions or extension to the internal cervical os. A full encirclement of the cervix is sufficient, enabling rapid placement without delaying balloon insertion.

Before suturing, oval forceps were applied bilaterally to the cervix to reduce bleeding, stabilize cervical tissue, and prevent balloon slippage during knot-tying. Early recognition and timely management are essential in cases of postpartum hemorrhage, as delays can result in complications or death [17]. To address balloon slippage, we developed a technique combining cervical clamps and a modified cervical cerclage for rapid and effective control. Cervical forceps were used to clamp the uterine artery prior to balloon fixation to reduce ongoing bleeding [18]. Special care was taken to avoid accidental ureteral clamping during this step. In the cerclage procedure, sutures were inserted near the outer edge of the cervical clamp, intentionally avoiding the blood vessels at the 3 and 9 o'clock positions. With clear landmarks and ease of execution, the balloon could be quickly secured in place by knotting the sutures.

Our modified approach for managing balloon slipping in postpartum hemorrhage demonstrated a 90% success rate. Although Statistical comparison was not performed due to the small sample size, but the numerical trend suggests a potential advantage. The only cause of failure was attributed to an arteriovenous fistula. Nevertheless, the technique rapidly reduced bleeding and provided sufficient time for further intervention, ultimately preserving the uterus. The method is effective, easily applicable, and promptly resolves balloon tamponade-related complications.

Table 1. The basic characteristics of enrolled patients on modified protocols.

Case	Age (year) (Mean $\pm$ SD)	BMI (kg/m ²) (Mean $\pm$ SD)	Gestational week	Gravida and parity	Previous history of surgery	High risk factor	Causes of postpartum hemorrhage
1	34	26.3	41	G2P1	no	Placental adhesion, fetal macrosomia	Placental adhesion and Uterine atony
2	30	28.8	39 + 1	G2P1	no	-	Uterine atony
3	31	22.2	39 + 5	G3P2	cholecystectomy	Precipitate labor	Uterine atony
4	32	31.2	37	G2P1	no	Scarred uterus, uterine arteriovenous fistula	Arteriovenous fistula
5	33	30.5	26 + 1	G1P0	no	Placental adhesion, twin pregnancy	Placental adhesion and Uterine atony
6	32	28.2	40 + 5	G3P2	no	-	Uterine atony
7	35	24.2	39 + 4	G3P2	no	-	Uterine atony
8	36	25.3	40	G5P2	no	-	Uterine atony
9	35	25.4	38 + 3	G3P2	no	Marginal placenta previa	Marginal placenta previa
10	42	25.3	38	G2P1	no	Advanced maternal age, fetal macrosomia	Uterine atony
	34 $\pm$ 3.4	26.7 $\pm$ 2.9					

Gravida (G): The total number of pregnancies a woman has had, regardless of outcome (including live births, stillbirths, miscarriages, ectopic pregnancies, or elective terminations). Parity (P): The number of pregnancies reaching viable gestational age (typically ≥ 28 weeks).

BMI, body mass index; SD, standard deviation.

Table 2. The perioperative characteristics of the included patients.

Case	The amount of bleeding before balloon placement (mL) (Mean $\pm$ SD)	The amount of postoperative vaginal bleeding (mL) (Median, IQR)	The amount of drainage (mL) (Mean $\pm$ SD)	Preoperative hemoglobin (g/L) (Mean $\pm$ SD)	Postoperative hemoglobin (g/L) (Mean $\pm$ SD)	Placental residue	Modified method	Combined with other method
1	1500	52	110	138	107	no	yes	no
2	1418	38	70	131	84	no	yes	no
3	964	40	89	130	104	no	yes	no
4	2008	400	55	115	58	no	yes	Uterine artery embolization
5	1815	20	80	117	65	no	yes	no
6	890	49	30	126	91	no	yes	no
7	900	30	50	128	98	no	yes	no
8	1900	60	120	116	62	no	yes	no
9	1280	40	80	92	62	no	yes	no
10	980	70	50	102	82	no	yes	no
	1366 $\pm$ 432	44.5 (38.5, 58)	73 $\pm$ 28	119.50 $\pm$ 14.14	81.30 $\pm$ 18.59			

IQR, interquartile range.

Strengths and Limitations

Our findings support the effectiveness of modified cervical cerclage balloon fixation combined with cervical clamping in addressing balloon slippage during postpartum hemorrhage. However, the retrospective study design introduces potential biases, and the limited sample size restricts the generalizability of results. This preliminary report reflects a small case series of patients treated with uterine balloon tamponade for postpartum hemorrhage across two institutions. To overcome this limitation, we intend to expand our case cohort in future research and conduct a controlled comparative study. Ongoing enrolment and long-term follow-up are planned to validate these initial findings. Although no adverse events occurred in this series, it remains possible that the additional surgical procedure may lead to complications such as bleeding, laceration, or infection [13].

5. Conclusions

The adoption of modified cervical cerclage balloon fixation combined with cervical clamping effectively addresses the problem of balloon slippage during postpartum hemorrhage. This technique represents a low-cost, simple, and easily implementable intervention that has demonstrated efficacy. Its success in reducing bleeding and preserving the uterus highlights its value as a clinically relevant solution. Overall, this method offers a promising approach for the management of postpartum hemorrhage, particularly in resource-limited settings where rapid and reliable interventions are essential.

Availability of Data and Materials

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Author Contributions

LH and BL were responsible for the conception of the study and manuscript drafting. LH and BL were responsible for data collection, methodology. AZ was responsible for the interpretation of data. LH and AZ contributed to the revision and final approval of the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

The study was carried out in accordance with the guidelines of the Declaration of Helsinki. The study was approved by the Ethics Committee of the West China Second University Hospital (approval no. 2017-033, 2022-006) and informed consent was taken from all the patients.

Acknowledgment

Not applicable.

Funding

This research received no external funding.

Conflict of Interest

The authors declare no conflict of interest.

Declaration of AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work the authors used ChatGpt-3.5 in order to check spell and grammar. After using this tool, the authors reviewed and edited the content as needed and takes full responsibility for the content of the publication.

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