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Effect of intraoperative intravenous infusion of dexmedetomidine on postoperative ileus in parturients undergoing cesarean section with combined spinal-epidural anesthesia: a single center, prospective, double blind, randomized controlled trial

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Abstract

Objective To evaluate the effect of intraoperative intravenous dexmedetomidine on postoperative ileus in parturients with a previous cesarean scar undergoing elective cesarean delivery under combined spinal–epidural anesthesia.

Methods In this prospective, double-blind trial, 78 parturients (ASA physical status II, aged 18–45 years) scheduled for elective cesarean section with a history of lower-segment cesarean section were randomly assigned to receive either dexmedetomidine ($n=39$) or normal saline ($n=39$). Following umbilical cord clamping, the dexmedetomidine group received a loading dose of 1 μg·kg^{-1} over 10 min, followed by a maintenance infusion of 0.5 μg·kg^{-1}·h^{-1} until the end of surgery. The control group received an equivalent volume of saline at the same infusion rate. The primary outcome was time to first flatus. Secondary outcomes included time to first defecation, incidence of abdominal distension, postoperative nausea and vomiting (PONV), the requirement for rescue analgesia within 24 h, and length of hospital stay.

Results Baseline characteristics were comparable between groups (all $P>0.05$). Compared with the control group, the dexmedetomidine group demonstrated significantly shorter times to first flatus (23.5 ± 6.8 h vs. 32.1 ± 8.7 h; $P<0.001$) and first defecation (41.5 ± 8.3 h vs. 57.5 ± 16.8 h; $P<0.001$), as well as a lower incidence of abdominal distension (10.3% vs. 32.4%; $P<0.05$). In addition, the dexmedetomidine group had lower incidence of PONV at 24 h (7.7% vs. 32.4%; $P=0.007$) and required less rescue analgesia within 24 h (10.3% vs. 29.7%; $P=0.033$). The requirement

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for intraoperative atropine for bradycardia was significantly higher in the dexmedetomidine group (28.2% vs. 8.1%; $P=0.024$).

Conclusion Intraoperative intravenous dexmedetomidine significantly accelerates postoperative gastrointestinal recovery, reduces the incidence of postoperative ileus and related adverse events, and shortens hospital stay in parturients undergoing cesarean delivery under combined spinal–epidural anesthesia.

Trial registration The trial was prospectively registered in the Chinese Clinical Trial Registry (ChiCTR) prior to patient enrollment (registration number: ChiCTR2300068136, date of registration: February 8, 2023; URL: https://www.chictr.org.cn/showproj.html?proj=185474).

Keywords Dexmedetomidine, Anesthesia, epidural, Anesthesia, spinal, Cesarean section, Gastrointestinal motility, Postoperative ileus

Introduction

Cesarean delivery is one of the most frequently performed surgical procedures in obstetrics. In China, the rate of cesarean delivery increased from 28.8% in 2008 to 36.7% in 2018 [1]. A recognized complication of this surgery is transient impairment of gastrointestinal motility, known as postoperative ileus. The reported incidence of postoperative ileus following cesarean delivery ranges from 0.9% to 21.5% [2]. Postoperative ileus can restrict maternal mobility and increase the risk of thrombosis [3] and pulmonary complications such as pneumonia, pulmonary embolism, and atelectasis [4]. It may also prolong hospital stay, increase healthcare costs [5], and negatively affect breastfeeding duration and early mother-infant bonding [6].

Dexmedetomidine, a highly selective α_2-adrenoceptor agonist, exhibits sedative, analgesic, sympatholytic, and anxiolytic properties [7]. It has been demonstrated to attenuate intraoperative stress [8] and reduce postoperative pain, and decrease the incidence of postoperative nausea and vomiting (PONV) [9]. Increased evidence supports its use as an adjunctive analgesic agent in cesarean delivery [10], with reported benefits for maternal emotional well-being and lactation, without adverse neonatal effects [11, 12]. Notably, recent clinical studies suggest that intraoperative dexmedetomidine may facilitate recovery of gastrointestinal function [13, 14]. These pharmacological characteristics could potentially lower the incidence of postoperative ileus and improve perioperative comfort. However, findings from two preclinical studies [15, 16] and one study in healthy volunteers [17] indicate that dexmedetomidine can inhibit gastric emptying and gastrointestinal transit, leaving its net effect on postoperative gastrointestinal recovery uncertain.

Given these conflicting data, the effect of dexmedetomidine on postoperative gastrointestinal function—particularly in women undergoing repeat lower-segment cesarean section (LSCS), in whom surgical adhesiolysis and peritoneal manipulation are more pronounced—warrants further investigation. Therefore, we conducted a prospective, randomized controlled trial to evaluate the effect of intraoperative intravenous dexmedetomidine on gastrointestinal recovery in parturients with previous LSCS undergoing elective repeat LSCS under combined spinal-epidural anesthesia. We hypothesized that dexmedetomidine administered immediately after umbilical cord clamping would not accelerate maternal postoperative gastrointestinal recovery compared with standard care.

Methods

Ethical approval and trial registration

The study was approved by the Ethics Committee of the Third Affiliated Hospital of Wenzhou Medical University (Approval No. YJ2023001) and conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrollment. The trial was prospectively registered with the Chinese Clinical Trial Registry (ChiCTR) before patient enrollment (registration number: ChiCTR2300068136; date of registration: February 8, 2023; URL: https://www.chictr.org.cn/showproj.html?proj=185474). The study was designed, conducted and reported in accordance with the CONSORT 2025 guidelines for randomized controlled trials [18].

Subjects

Between February 2023 and June 2024, parturients scheduled for elective cesarean delivery with previous LSCS were screened for eligibility at our institution. Inclusion criteria were: American Society of Anesthesiologists (ASA) physical status II (as normal pregnancy is classified as ASA II [19]), age 18–45 years, singleton pregnancy, prior LSCS, and surgery performed by a consistent obstetric team. Exclusion criteria included: primiparity, hypertensive disorders of pregnancy, placenta previa or abruption, pre-existing gastrointestinal dysfunction, known allergy to anesthetics, significant cardiopulmonary, hepatic, or renal impairment, psychiatric or communication barriers, and anticipated operative time exceeding 120 min.

Randomization and blinding

Eligible parturients were randomly assigned in a 1:1 ratio to the dexmedetomidine group or the saline control group using a computer-generated random sequence. An independent statistician prepared the allocation list, and group assignments were concealed in sequentially numbered, opaque envelopes. A study nurse not involved in perioperative care opened the envelopes and prepared the study solutions (dexmedetomidine or 0.9% saline), which were dispensed in identical 50-mL syringes labeled only with the participant's study code. Parturients, anesthesiologists, surgeons, postoperative evaluators, and data analysts remained blinded to group allocation throughout the study. Blinding was maintained until all data collection and statistical analyses were completed.

Anesthesia protocol

All participants were fasted preoperatively for a minimum of 8 h for solids and 2 h for clear fluids, in accordance with standard preoperative guidelines. Upon arrival in the operating room, heart rate (HR), noninvasive blood pressure (BP), and peripheral oxygen saturation (SpO_2) were monitored, and oxygen was administered by a facemask. An 18-gauge intravenous catheter was inserted, and 500 mL lactated Ringer's solution was infused to reduce the risk of hypotension. With the patient positioned in the left lateral decubitus position, combined spinal-epidural anesthesia was performed at the L2-L3 interspace by experienced attending anesthesiologists, with successful placement achieved on the first attempt in all cases. After confirming correct subarachnoid needle placement, 2–3 mL of 0.5% isobaric ropivacaine (batch LCLD; AstraZeneca AB) was injected at a constant rate, and an epidural catheter was advanced 4–5 cm cephalad. Patients were then returned to the supine position, and the sensory block level was verified and maintained at T4-T6 before surgical draping.

Following fetal delivery and umbilical cord clamping, the dexmedetomidine group received a continuous intravenous infusion of dexmedetomidine (batch N22090721; Chenxin Pharmaceutical Co., Ltd.) consisting of a loading dose of 1 $\mu g \cdot kg^{-1}$ over 10 min, followed by a maintenance infusion of 0.5 $\mu g \cdot kg^{-1} \cdot h^{-1}$ until skin closure. The control group received an equivalent volume and infusion rate of 0.9% saline. Drug dosages were calculated based on each patient's standard body weight according to World Health Organization recommendations [19]: (height in cm − 70) × 0.6.

Intraoperative bradycardia (HR < 50 beats/min) was managed with intravenous atropine 0.5 mg, while hypotension (defined as a decrease in BP > 20% from baseline or systolic BP < 80 mmHg) was treated with intravenous ephedrine (6 mg) or norepinephrine (0.1 mg). After delivery, 2 mg morphine (batch 220201; Shenyang First Pharmaceutical Co., Ltd.) diluted in 5 mL saline was administered as a slow bolus via the epidural catheter. Before morphine administration, sensory block regression was assessed, and hemodynamic stability confirmed. For PONV prophylaxis, 8 mg ondansetron was administered intravenously before skin closure. Following surgery, patients were monitored in the postanesthesia care unit for at least 30 min and transferred to the ward upon achieving stable vital signs.

Postoperative pain was evaluated using the Numerical Rating Scale (NRS, 0–10, with 0 representing no pain and 10 the worst pain imaginable). Pain scores were documented whenever patients reported pain during the initial 24 postoperative hours. Rescue analgesia, consisting of either acetaminophen or non-steroidal anti-inflammatory drugs(NSAIDs), was provided if the NRS score exceeded 3.

Surgical technique

All repeat cesarean deliveries were performed through a Pfannenstiel incision at the previous scar site. Adhesiolysis was conducted using blunt and sharp dissection to release adhesions involving the bladder, rectus muscles, and uterine surface. The peritoneum was carefully incised, and the bladder was mobilized inferiorly to adequately expose the lower uterine segment.

A low transverse uterine incision was made above the previous scar site to avoid areas of thinned or fibrotic tissue. Following delivery of the fetus and placenta, the uterine incision was closed in two layers using a continuous locking technique with absorbable sutures to ensure sufficient tissue thickness and promote healing. The abdominal wall was subsequently closed in a standardized layered manner. This systematic approach prioritized meticulous adhesiolysis and reinforced uterine closure, thereby reducing risks associated with repeat cesarean section while maintaining procedural consistency across all cases.

Data collection

Patient demographic and clinical characteristics were documented for both groups, including age, height, weight, gestational age, hemoglobin, hematocrit, potassium, and sodium levels. The main observational index was time to first flatus; secondary indices included time to first defecation, incidence of nausea and vomiting at 24 and 48 h, requirement for rescue analgesia within 24 h, incidence of abdominal distension, and length of hospital stay. Intraoperative data collection included operation time, total fluid administration and the use of vasoactive medications and atropine. PONV was assessed at 24 and 48 h through direct patient inquiry during routine postoperative rounds; any episode of nausea or vomiting reported by the patient was recorded as a PONV event.

Abdominal distension was defined as a subjective sensation of fullness, trapped gas, or abdominal pressure in the absence of overt visible distension [20].

Sample size calculation

A pilot study was conducted prior to the main trial, enrolling 9 participants per group (18 total) who satisfied the same inclusion and exclusion criteria as the main study. The intervention protocol and outcome assessments were identical to those used in the definitive trial. Based on the pilot results, the mean time to first flatus was 35.42 ± 9.92 h in the dexmedetomidine group and 42.16 ± 5.10 h in the control group. Using these data, sample size calculation indicated that 31 participants per group would be required to detect a significant difference with a two-sided α of 0.05 and 90% power (1-β = 0.90), assuming a 1:1 allocation ratio. Accounting for a 20% dropout rate, 39 patients were enrolled in each group, yielding a total sample size of 78 participants.

Statistical analysis

Statistical analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY). The normality of continuous variables was evaluated using the Shapiro-Wilk test. Normally distributed data are presented as mean ± standard deviation (SD) and were analyzed using independent samples t-tests. Non-normally distributed data are expressed as median with interquartile range (IQR) and were compared using the Mann-Whitney U test. Categorical variables are summarized as frequencies with percentages and were analyzed using either the Chi-square test or Fisher's exact test, as appropriate. A two-sided P value < 0.05 was considered statistically significant.

Results

Among 98 parturients assessed for eligibility, 18 were excluded for not meeting the inclusion criteria and 2 declined participation. The remaining 78 parturients were randomized to either the dexmedetomidine group (n = 39) or the control group (n = 39). Two participants in the control group were subsequently excluded—one due to conversion to general anesthesia following failure of combined spinal-epidural anesthesia, and one due to uterine atony with significant hemorrhage requiring blood transfusion. Consequently, 39 patients in the dexmedetomidine group and 37 in the control group completed the study and were included in the final analysis (Fig. 1).

Baseline characteristics, including age, height, standard body weight, gestational age, hemoglobin, hematocrit, potassium, and sodium levels, were comparable between the two groups (all P >0.05; Table 1). Postoperative gastrointestinal recovery was significantly faster in the dexmedetomidine group. The time to first flatus was shorter in the dexmedetomidine group compared with the control group (23.5 ± 6.8 h vs. 32.1 ± 8.7 h; P < 0.001), corresponding to a mean reduction of 8.6 h. Similarly, time to first defecation was also shorter (41.5 ± 8.3 h vs. 57.5 ± 16.8 h; P < 0.001), representing a mean reduction of approximately 16 h. The incidence of abdominal distension was also lower in the dexmedetomidine group (10.3% vs. 32.4%; P = 0.018). Additionally, the dexmedetomidine group demonstrated a lower incidence of PONV at 24 postoperative hours (7.7% vs. 32.4%; P = 0.007) and required less rescue analgesia during the first 24 postoperative hours (10.3% vs. 29.7%; P = 0.033). However, the incidence of PONV at 48 h did not differ significantly between groups (P = 0.957; Table 2). Postoperative hospital stay was shorter in the dexmedetomidine group (5 [5–6] days vs. 6 [5–7] days; P = 0.001).

No significant differences were observed between groups in surgical duration, intraoperative fluid volume, or use of vasoactive agents (all P > 0.05). However, the dexmedetomidine group required intraoperative atropine more frequently than the control group (28.2% vs. 8.1%; P = 0.024; Table 3).

Discussion

In this prospective randomized controlled trial, intravenous dexmedetomidine administered after umbilical cord clamping significantly accelerated gastrointestinal function recovery and reduced the incidence of postoperative ileus in parturients undergoing elective repeat LSCS. Compared with the saline control group, patients receiving dexmedetomidine experienced shorter times to first flatus and first defecation, a lower incidence of postoperative abdominal distension, and reduced requirements for rescue analgesia within the first 24 h postoperatively.

Postoperative ileus represents a common surgical complication with a complex pathophysiology involving multiple factors, including neurogenic reflex inhibition from surgical trauma, intestinal inflammation and dysbiosis, medication effects, and intraperitoneal accumulation of blood or amniotic fluid [21, 22]. Repeat LSCS may further exacerbate ileus risk due to extensive adhesiolysis, increased intestinal manipulation, prolonged operative time, and other surgical factors [23]. Whereas the absence of bowel sounds was historically employed for clinical diagnosis, the subjective nature of abdominal auscultation limits its reliability [24]. Therefore, this study utilized objective measures—time to first flatus and defecation—as primary endpoints.

Our findings indicate that dexmedetomidine significantly shortened both the time to first flatus and defecation compared to controls (P < 0.001), while also reducing the incidence of abdominal distension (P < 0.05). These results suggest that intravenous dexmedetomidine effectively promotes gastrointestinal function

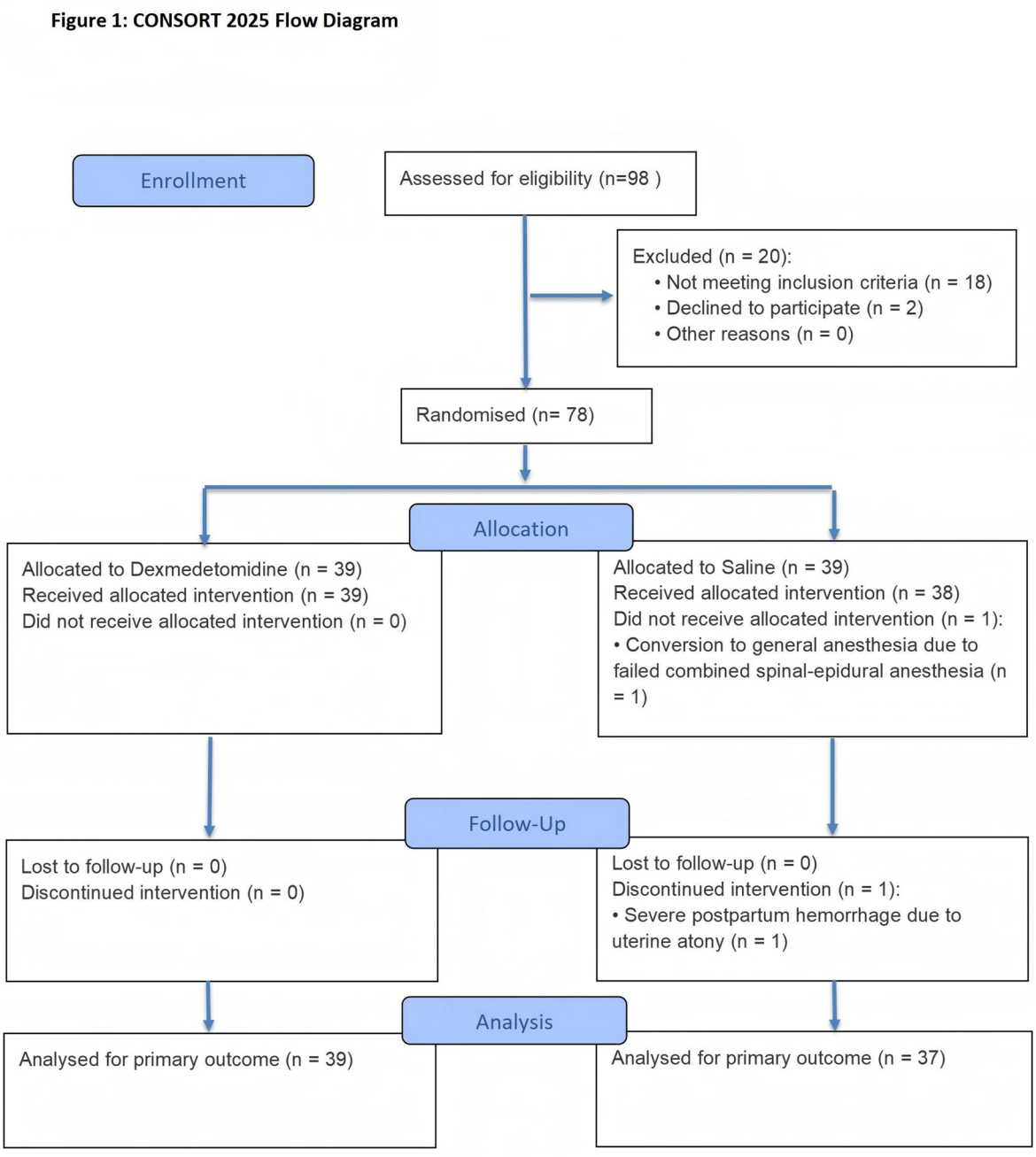

Fig. 1 Participant flowchart for the study of intraoperative dexmedetomidine in cesarean section under combined spinal-epidural anesthesia

recovery and reduces postoperative ileus in parturients with a previous cesarean scar. The underlying mechanism may involve dexmedetomidine's activation of central and peripheral α_2-adrenergic receptors, which inhibits sympathetic excitability [25] and downregulates the release of pro-inflammatory cytokines such as IL-6 and TNF-α [26], thereby attenuating intestinal inflammatory injury and improving microcirculation and motility.

Our results are consistent with the findings of Sun et al. [27], though several important distinctions exist. Our study specifically focused on a high-risk population with previous LSCS, utilized standard body weight for dexmedetomidine dosing, and implemented standardized postoperative analgesic management. Consequently, our investigation examines dexmedetomidine's effects in a population at elevated risk for postoperative ileus, providing novel and clinically relevant insights that complement rather than duplicate existing literature. Furthermore, our observations align with broader surgical evidence. Lu et al. [13] reported that intraoperative

Table 1 Baseline demographic, obstetric, and preoperative examination characteristics of parturients undergoing Cesarean section in the two groups

Variable	Dexmedetomidine Group (*n* = 39)	Control Group (*n* = 37)	t-value	*P*-value
Age (years)	32.7 ± 4.4	32.7 ± 4.1	-0.069	0.945
Height (cm)	159.2 ± 4.7	158.1 ± 3.3	-1.220	0.226
Standard body weight (kg)	53.5 ± 2.8	52.8 ± 2.0	-1.233	0.222
Gestational age (weeks)	38.6 ± 0.7	38.4 ± 0.4	-1.737	0.087
Hemoglobin (g/L)	111.68 ± 9.71	114.41 ± 8.75	0.671	0.504
Hematocrit (%)	34.20 ± 2.80	34.62 ± 2.63	1.274	0.207
Potassium(mmol/L)	3.84 ± 0.22	3.89 ± 0.19	0.796	0.429
Sodium (mmol/L)	137.65 ± 1.24	137.74 ± 1.38	0.299	0.766

dexmedetomidine enhanced gastrointestinal recovery following abdominal surgery in elderly patients, while Behera et al. [14] documented similar beneficial effects in adults undergoing general anesthesia.

The prokinetic properties of α_2-adrenoceptor agonists appear to be both context-dependent and agent-specific. Although our results and those of others [13, 14, 27] support a facilitatory role for dexmedetomidine, preclinical investigations of clonidine—an earlier α_2-agonist—have yielded conflicting outcomes. Asai et al. [15, 16] demonstrated that both clonidine and dexmedetomidine inhibited gastric emptying and gastrointestinal transit in rats, particularly during co-administration with morphine. This inhibitory effect was confirmed in human volunteers by Iirola et al. [17], where dexmedetomidine directly delayed gastric emptying and orocecal transit. The apparent discrepancy between these inhibitory findings and our clinical observations may be explained by interspecies variations, differences in dosing regimens, and the presence of surgical stimulation.

Additionally, the dexmedetomidine group demonstrated lower incidence of PONV within 24 h and reduced requirement for rescue analgesia compared to controls ($P < 0.05$). These beneficial effects highlight dexmedetomidine's utility as an effective multimodal adjunct. Our findings are supported by Akhondzadeh et al. [9], who reported superior postoperative analgesia with dexmedetomidine compared to fentanyl as an epidural adjunct. The analgesic-sparing and antiemetic properties may stem from synergistic sedative-analgesic effects mediated by α_2-receptors in the locus coeruleus, combined with attenuation of the surgical stress response and reduced catecholamine release [28].

Table 3 Comparison of intraoperative parameters between the two groups

Variable	Dexmedetomidine Group (*n* = 39)	Control Group (*n* = 37)	$t/\chi^2/Z$ value	*P*-value
Duration of surgery (min)	81.4 ± 6.7	77.8 ± 10.0	-1.830	0.071
Total intraoperative fluid volume (mL)	700[500, 1000]	800[500, 1000]	-1.634	0.102
Use of vasoactive agents (%)	56.0	48.6	0.815	0.367
Use of atropine (%)	28.2	8.1	5.103	0.024

It should be noted that the dexmedetomidine group required intraoperative atropine more frequently ($P < 0.05$), indicating an increased risk of bradycardia. However, the overall use of vasoactive agents did not differ significantly between groups ($P > 0.05$), suggesting that dexmedetomidine did not compromise hemodynamic stability in parturients, which aligns with previous safety studies [11, 13].

Our study has several limitations

First, the intervention was limited to intraoperative intravenous dexmedetomidine administration, precluding assessment of extended postoperative infusions or alternative routes of administration. Second, we did not evaluate psychosocial factors such as anxiety or sleep quality, nor did we measure serum inflammatory markers or gastrointestinal hormones, limiting our understanding of potential confounders and underlying mechanisms. Third, the standardized analgesic regimen—including

Table 2 Comparison of postoperative recovery indicators between the two groups

Variable	Dexmedetomidine Group (*n* = 39)	Control Group (*n* = 37)	t/χ^2 value	*P*-value
Primary Outcome				
Time to first flatus (h)	23.5 ± 6.8	32.1 ± 8.7	4.827	< 0.001
Secondary Outcome				
Time to first defecation (h)	41.5 ± 8.3	57.5 ± 16.8	5.227	< 0.001
Incidence of abdominal distension (%)	10.3	32.4	5.618	0.018
Incidence of nausea and vomiting at 24 h (%)	7.7	32.4	7.336	0.007
Incidence of nausea and vomiting at 48 h (%)	5.1	5.4	0.003	0.957
Rescue analgesia within 24 h postoperatively (%)	10.3	29.7	4.545	0.033
Length of hospital stay (days)	5[5, 6]	6[5, 7]	3.529	0.001

routine epidural morphine and patient-triggered rescue analgesia with acetaminophen or NSAIDs—may have influenced gastrointestinal motility and introduced heterogeneity in pain management. Nevertheless, the significantly reduced demand for rescue analgesia in the dexmedetomidine group supports a genuine analgesic-sparing effect. Fourth, we did not conduct formal correlation analyses among postoperative outcomes such as gastrointestinal recovery, PONV, and length of stay; thus, any inferred relationships should be considered exploratory, and future studies should include prespecified correlation analyses to better elucidate these interactions. Finally, the time interval from surgical incision to umbilical cord clamping was not recorded. Since the study drug was infused only between cord clamping and skin closure, the actual duration of exposure varied among participants and could not be precisely quantified. However, given that infusion initiation points and rates were standardized across groups and total operative times were comparable, any variation in exposure would most likely bias effect estimates toward the null hypothesis rather than produce spurious positive findings.

Conclusions

In summary, this randomized controlled trial demonstrates that intraoperative intravenous dexmedetomidine administered after umbilical cord clamping accelerates postoperative gastrointestinal recovery and reduces postoperative ileus in parturients undergoing repeat LSCS under combined spinal-epidural anesthesia. Although associated with increased bradycardia, this effect was manageable and did not compromise hemodynamic stability. With appropriate monitoring and prompt intervention for bradycardia, dexmedetomidine may serve as a useful adjunct to enhance perioperative recovery in women undergoing repeat LSCS.

Authors' contributions

S.Z. and S.B. contributed equally to this work and are co-first authors. They were responsible for the conceptualization, methodology, formal analysis and drafting of the original manuscript. M.L., S.H., and X.Z. contributed to data collection, data curation and participated in reviewing and editing the manuscript. B.L. supervised the study, contributed to methodology and project administration, and participated in manuscript review and editing. All authors read and approved the final manuscript.

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Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Third Affiliated Hospital of Wenzhou Medical University (Approval No. YJ2023001). All participants gave written informed consent before data collection began.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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