EGYPTIAN JOURNAL OF ANAESTHESIA
2023, VOL. 39, NO. 1, 313–321
https://doi.org/10.1080/11101849.2023.2196113

Enhanced recovery after spinal surgery protocol versus conventional care in non- insulin diabetic patients: A prospective randomized trial

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ABSTRACT

Background: Enhanced Recovery After Surgery (ERAS) approach was proven in many surgical specialties. This prospective, randomized, single-blinded trial was designed to assess the effectiveness of ERAS on quality of recovery (QOR) after surgery in non-insulin-dependent diabetic patients.

Patients and methods: 72 patients undergoing elective lumbar decompressive surgery were randomly allocated to one of two equal groups receiving either ERAS protocol in group E or conventional care in group C. QOR after surgery using QOR-40 score, pain score, perioperative opioid consumption, time to early ambulation, serum markers of stress response, length of stay and possible perioperative complications were recorded.

Results: QOR-40 scores were significantly greater in group E at PACU, first postoperative day and second postoperative day ($P = 0.015$, 0.041 and 0.048, respectively). VAS was significantly lower in group E in the first eight hours postoperative. Time to first postoperative analgesic requirement was significantly longer in group E ($P = 0.0001$). Intraoperative fentanyl and post-operative nalbuphine requirements were significantly less in group E ($P = 0.001$, and 0.0001, respectively). Time to early ambulation was significantly less in group E ($P = 0.006$). Both CRP and interleukin-6 were significantly less at the second postoperative day in group E ($P = 0.001$, and 0.017, respectively). There was insignificant difference among groups in length of hospital stay and intraoperative insulin requirements ($P = 0.251$, and 0.347, respectively).

Conclusion: In non-insulin diabetic patients, enhanced recovery after spinal surgery improved quality of recovery, lowered pain scores, reduced perioperative opioid consumption, allowed early ambulation and decreased stress response but not length of hospital stay.

ARTICLE HISTORY
Received 15 March 2023
Accepted 22 March 2023

KEYWORDS
Enhanced; recovery; spinal; surgery; non- insulin diabetic

1. Introduction

Enhanced recovery after surgery (ERAS) is established perioperative care to improve quality of recovery and pain control while minimizing opioid use, the advantages of ERAS have been verified across multiple surgical fields, it improves patient satisfaction, lower morbidity, decreased length of hospital stay and costs [1,2]. The main of ERAS elements include perioperative feeding, minimally invasive surgical technique, regional analgesia, and improvement of insulin sensitivity with subsequent improvement of postoperative outcomes [2,3]. However, few studies investigating the application of ERAS program in spinal surgery to improve patient outcomes [4–7]. After spinal surgery, moderate to severe postoperative pain is usually accompanied with increased opiate consumption, late mobilization with subsequent extended length of hospital stay (LOS) and higher possibility of chronic pain [8]. Therefore, strategies to improve recovery following spinal surgery are required. The global prevalence of diabetes is 7.2–11.4%, with a predicted increase in the future [9]. Diabetic patients undergoing surgery face numerous hazards, including extended stay in the hospital, increased costs, and increased morbidity and mortality [10]. However, there are conflicting data regarding the usage of pre-operative carbohydrate load in ERAS pathways for diabetic patients due to the potential risk of delayed emptying of gastric content and compromised control of blood sugar which make their inclusion in ERAS guidelines to be a contentious practice [11–13]. Consequently, studies to investigate this conflict is needed. The objectives of this study were to assess the effectiveness of (ERAS) protocol in patients with non-insulin dependent diabetes mellitus scheduled for lumbar decompression surgery. The primary outcome was quality of recovery after surgery. The secondary outcomes involved postoperative pain score, perioperative opioid consumption, time to early ambulation, serum markers of inflammation, length of hospital stay and perioperative complications.

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2. Patients and methods

After gaining the approval of the Institutional Review Board (No. 00012098), registration at the ClinicalTrials.gov (NCT05033899) and informed written consent from each patient, we studied 72 controlled non-insulin-dependent diabetic patients, of both sex, aged between 20 and 60 yrs, with ASA physical status II - III, who were planned for 1–3 levels elective lumbar decompression surgeries under general anesthesia. This prospective, randomized, controlled clinical study was conducted at Main University Hospital, Faculty of Medicine, Alexandria University, Egypt, between May 2021 and September 2022. Patients with a history of cervical and thoracic surgery, > 3 levels lumbar spine surgery, revision surgery, cognitive impairment, infection, trauma, neoplasm, patients with renal or cardiac and liver failure, BMI>35 kg/m^2, patients with retinopathy or reduction of visual acuity, patients with known hypersensitivity or contraindication to medications, coagulopathy or uncontrolled DM, Arrhythmias, patients receiving any analgesics within one day pre-operatively or antiplatelet drugs within the previous 14 days, patients who had symptoms of nausea and vomiting or received an antiemetic within 24 h of surgery, random blood glucose more than 250 mg/dl just before shifting the patient from the ward to the operating room were excluded. During preoperative visit, all patients were informed about the ERAS protocol and the procedure of US guided erector spinae plane block. They were trained during preoperative visit on a visual analogue scale (VAS). 40 mg subcutaneous Enoxaparin was started 12 hours preoperatively and oral hypoglycemic drugs were discontinued after the last meal. Ceftriaxone 2 g intravenously was given one hour for every patient before surgical incision. After informed consent, the allocated patients were randomly assigned using a sealed, opaque, envelope method by investigator not involved in the study to one of two equal groups: Group (E): ERAS group (n = 36) Group (C): Conventional group (n = 36). In group E, patients received solid foods until 6 hours and clear liquids until 4 hours before surgery. A 400 ml of clear carbohydrate-rich drink (12.5 g/100 ml) was provided prior to the day of surgery, to be taken 4 hours before the planned time of surgery. In the holding area, pre-emptive analgesia was provided orally including 1 g acetaminophen and 300 mg gabapentin while in group C, patients fasted for 8 hours and no pre-emptive analgesia was given. After entrance in the operating theatre, patients were monitored by electrocardiogram, non-invasive blood pressure, nasopharyngeal core temperature, Entropy, capnography, pulse oximetry, Neuromuscular transmission (TOF) and non-invasive cardiac output monitoring device (ICON, Osypka Medical, Berlin, Germany). Anesthesia was induced with propofol 1-2 mg/kg, fentanyl 2 µg/kg and atracurium 0.5 mg/kg intravenously. Anesthesia was maintained using oxygen 1.5 L/min mixed with air 1.5 L/min and isoflurane 1.2–1.5 MAC to keep entropy between 40–60 and stable hemodynamics. Lung ventilation was performed to keep the end-tidal carbon dioxide tension ranged between 35 and 40 mmHg and an oxygen saturation of ≥ 98% with 50% oxygen in air. No positive end expiratory pressure (PEEP) was applied. Incremental doses of atracurium were given according to train of four. In both groups, if signs of inadequate analgesia occurred during anesthesia such as tachycardia and increased arterial pressure more than 20% of the preoperative baseline or somatic response (e.g., sweating, lacrimation, or movements), extra doses of intravenous fentanyl 0.5 mcg/kg were injected as required. Methods to keep normothermia were done via warmed i.v fluids, and forced air-warming blankets. In group E, dual antiemetic prophylactic therapy (10 mg metoclopramide and 8 mg dexamethasone) were given intravenously immediately after induction. Also, intravenous infusion of tranexamic acid 10 mg/kg [14] was given in this group, after turning the patient into prone position, bilateral US guided erector spinae plane block (ESPB) was given, a total volume of 20 mL of 0.25% bupivacaine was injected on each side [15]. In group E: we used stroke volume variation to achieve goal-directed fluid administration [16] while in group C, all patients received a strict fluid replacement consistent with guidelines of the standard intraoperative fluid therapy. 3 ml/kg/hour infusion of balanced lactated ringer was administered. In both groups, lost blood was replaced with lactated ringer on a 1.5:1.0 volume basis until a blood transfusion threshold was met. Dextrose-containing solutions were avoided due to the adverse effects of hyperglycemia. During surgery, hypotension (decline in systolic blood pressure 20% less than preoperative base line measure) was managed with (5 mg ephedrine) rather than intravenous fluids to keep perioperatively neutral fluid balance. In both groups: Intraoperative blood glucose level range was kept intraoperatively between 140 and 180 mg/dl. Rate of insulin infusion was 2 U/hour and it was adjusted to gain the glycemic aim by testing the blood glucose level hourly. Intraoperative fentanyl requirements and amount of blood loss was recorded. All the surgical procedures were implemented by the same three neurosurgeons, altogether using the same surgical technique with a clinical practice of more than six years. Patients developed intraoperative arrhythmias were omitted from the study. At the end of the surgery, patient was turned to supine position then anesthesia was discontinued and oxygen 100% was applied then

the oral secretions were suctioned. Slow intravenous neostigmine 40 ug/kg and atropine 20 ug/kg were given to reverse any residual neuromuscular relaxation. Awake extubation was performed after the resuming of protective airway reflexes. Serum levels of C reactive protein and Interleukin 6 were measured preoperatively, immediately after recovery and at the second postoperative day (POD2). Blood sugar level was measured 8 hours before surgery, before shifting patient from ward to OR and on admission to post-anesthesia care unit (PACU). The total quantity of the used intraoperative insulin units and the number of patients who required insulin intraoperatively were recorded in both groups. Upon admission to (PACU), all patients was observed continuously for at least 30 min. Quality of recovery 40 score (QoR40) [17] using 40-item questionnaire that evaluates five dimensions of recovery after surgery and anesthesia including (comfort, emotions, physical independence, patient support, and pain) with mean time to completion of 5 minutes was measured in the PACU and at postoperative day 1 (POD1) and day 2 (POD2). The time at which the patients reached modified Aldrete score≥9 [18] and time to early ambulation in PACU were recorded. Data collectors and those assessed the postoperative outcomes in PACU and the ward were all blinded to the patient group assignment and to the design of the study. In group E, immediate postoperative management involved stoppage of intravenous fluid, oral intake, and early mobilization within 2 hours after PACU arrival, target postoperative glycemic range was between 140 and 180 mg/dl. The insulin infusion was continued postoperatively until oral intake was established, and the first dose of the oral hypoglycemic drugs was given 30–60 min before disconnecting the infusion. In both groups, postoperative pain was assessed using Visual Analogue Score (VAS) every 2 hours postoperatively for 8 hours. Rescue analgesia with intravenous paracetamol 1 g/6 hours and intravenous ketorolac loading 30 mg then 15 mg/8 hours regularly were given to treat pain postoperatively whenever VAS was≥4. As paracetamol and ketorolac are the standard postoperative analgesics for patients undergoing lumbar decompression procedure in our hospital. The second rescue analgesic was Nalbuphine 0.15 mg/kg IV if VAS score was≥4 in spite of IV paracetamol and ketorolac and was repeated if required to maximum dose of 100 mg/24 hours. Time to first postoperative analgesic request (the time passed between end of surgery and first administration of pain killer) and postoperative nalbuphine requirements were recorded. The incidence of postoperative nausea and vomiting (PONV) was evaluated by a nurse for the first 24 hrs and only 2 possible answers will be accepted (yes or no). Rescue anti-emetic ondansetron 8 mg was administered intravenously if the patient complained of more than a single incidence of vomiting or persistent nausea and number of patients needed rescue anti-emetic postoperatively was documented. The volume status was assessed by the heart rate, blood pressure, urine output and mental status. Discharge from hospital required an alert, oriented patient, stable vital signs, controlled pain on non-opioid analgesics, adequate mobility, and absence of postoperative complications. Postoperative hospital stay from admission to discharge was recorded. The incidence of readmissions and perioperative complications including block-related complications, nausea and vomiting, urinary tract infection, wound infection, deep vein thrombosis and hematoma were noted among the whole duration of patient stay in hospital and were managed accordingly.

2.1. Statistical analysis

A sample size of 36 participants in each study group was calculated using G power sample size calculator, considering the confidence level 95.0%, the power 80.0% and the effect size was estimated to be 0.59. The measured primary outcome was quality of recovery 40 score (estimated in intervention group to be 179.0 ± 14.0 vs. 170.0 ± 16.0 in the control group) [7]. Statistical analysis was performed using version 24.0, IBM SPSS software package. Qualitative data were described as number and percentages. Quantitative data were described as means ±SD for normally distributed data. For normally quantitative variables, we used Student's t-test to compare between two studied groups and paired t-test to compare between two periods in the same group. Categorical data were statistically analyzed using Chi-square ($\chi 2$) test or Fisher's exact test as applicable. Significance of the achieved results was considered at the 5% level.

3. Results

Eighty five patients included on list of surgery were recognized as possible participants. Of these, 72 patients achieved all criteria, consented and were enrolled in two equal groups (n = 36 per group), to share in the study with no participant dropouts (Figure 1) There were no significant differences among the two groups regarding age, sex, body mass index, ASA status, number of operated lumber spine levels, duration of surgery and Comorbidities ($p > 0.05$) (Table 1). The mean QOR 40 total score was significantly higher in group E compared to group C, the mean QOR 40 total score in group E was 176.78 ± 4.16, 180.39 ± 3.92, 183.83 ± 4.17 in PACU, POD1 and POD2

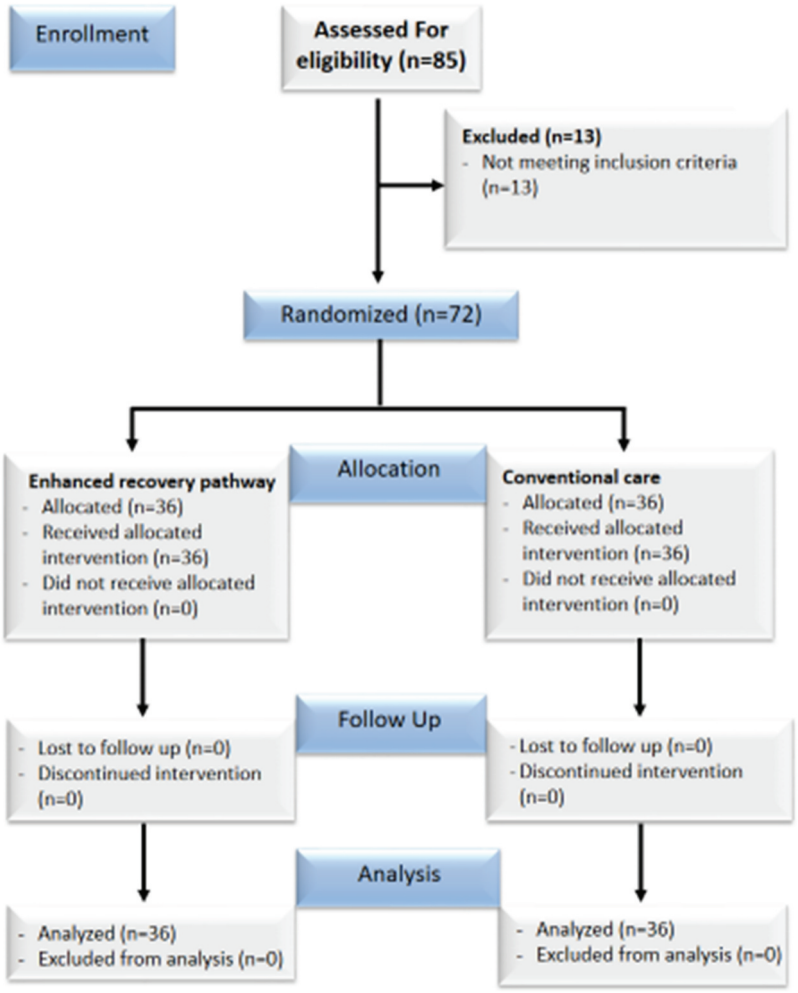

Figure 1. Consort flow chart.

Table 1. Demographic characteristics.

	Group E	Group C	*p*- value
Number (n)	36	36	
Age (year)	53.36 ± 8.12	53.03 ± 7.96	0.349
Sex M/F	17/19	19/17	0.321
BMI (kg/m2)	29.36±3.09	28.24±2.88	0.066
ASA physical status I/II	35/1	35/1	1.000
Number of levels 2/3	20/16	21/15	0.818
Duration of surgery (min)	143.33 ± 24.96	145.83 ± 23.95	0.611
Comorbidities			
Hypertension	11 (30.6)	9 (25.0)	0.321
Bronchial asthma	1 (2.8)	2 (5.6)	0.511
Hypothyroidism	4 (11.1)	1 (2.8)	0.177
IHD	4 (11.1)	1 (2.8)	0.177
NIDDM	36 (100)	36 (100)	1.000

Values are presented as mean ± SD or number (percentage), BMI = body mass index, IHD = ischemic heart disease. NIDDM= Non-insulin dependent diabetes mellitus.; ASA: American Society of Anesthesiologists (physical status).

respectively while in group C, it was 170.92 ± 2.93, 177.78 ± 3.62, 182.17 ± 3.14 in PACU, POD1 and POD2 respectively ($P = 0.015$, 0.041, and 0.048, respectively) (Figure 2). The mean intraoperative fentanyl requirement was significantly less in group E in comparison to group C, ($P = 0.001$) (Table 2). The mean time to first postoperative analgesic requirement was significantly longer in group E in comparison to group C ($P = 0.001$) (Table 2). The mean postoperative nalbuphine requirement was significantly less in group E compared to group C ($P = 0.001$) (Table 2). The mean time at which the patients attained modified Aldrete score≥9 was significantly shorter in group E compared to group C ($P = 0.001$) (Table 2). The number of patients required rescue antiemetic postoperatively was significantly less in group E compared to group C, 5 (13.9%) versus 11 (30.6) respectively ($P = 0.013$) (Table 2). Incidence of nausea and vomiting was significantly lower in group E than in group C 13.9% versus 30.6% respectively ($P = 0.016$) (Table 2). The mean time to early ambulation was

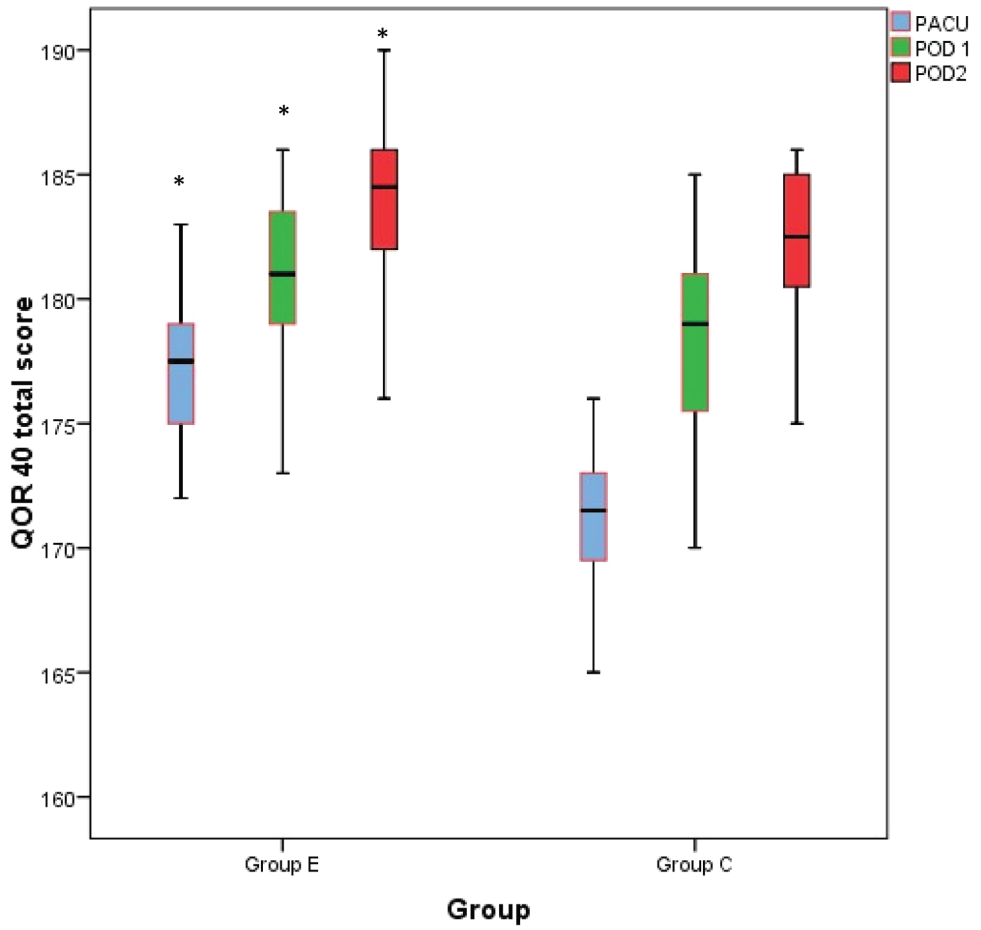

Figure 2. Comparison of QOR 40 total score between the two studied groups. Values are presented as mean ±SD. *significant differences between groups $P < 0.05$.

Table 2. Perioperative data.

	Group E	Group C	*p*- value
Intraoperative fentanyl consumption (ug)	150.56 ± 19.12	236.11 ± 35.07	0.001*
Time to first analgesic (min)	362.78±115.65	33.19 ± 9.27	0.001*
Postoperative nalbuphine consumption (mg)	9.61 ± 2.56	19.69 ± 5.10	0.001*
Time to modified Aldrete score ≥ 9	17.39 ± 3.16	21.97 ± 4.96	0.001*
Intraoperative insulin requirements (units)	3.33 ± 1.03	3.60 ± 1.14	0.347
Number of patients required intraoperative insulin	6 (16.7)	5 (13.9)	0.328
Total blood loss	859.17 ± 350.18	913.89 ± 380.90	0.449
Number of patients required rescue antiemetic	5 (13.9)	11 (30.6)	0.013*
Postoperative nausea &vomiting n (%)	5 (13.9)	11 (30.6)	0.016*
Time to early ambulation (hrs)	10.03 ± 1.59	12.50 ± 2.26	0.006*
Hospital stay(days)	3.83 ± 0.38	3.89 ± 0.32	0.251

Values are presented as mean±SD or number (percentage). *Significant differences between groups $P < 0.05$.

significantly shorter in group E compared to group C ($P = 0.006$) (Table 2). There was statistically insignificant difference among the groups for the mean intraoperative insulin requirement and the number of patients needed insulin intraoperatively ($P = 0.347$, and 0.328 respectively) (Table 2). There was insignificant difference among the groups for total blood loss and time to early ambulation ($P = 0.449$, and 0.251, respectively) (Table 2). There was insignificant difference among the groups for the mean random blood sugar measurements 8 hours before surgery, before shifting patient from ward to OR, on admission to PACU ($P = 0.304$, 0.096, and 0.064 respectively) (Figure 3) The VAS pain scores were significantly lower in group E when compared with group C postoperatively at PACU, 2 h, 4 h, 6 h, 8 h ($P = 0.011$, 0.035, 0.042, 0.022, and 0.005) respectively (Figure 4) The mean CRP was significantly less in group E when compared with group C in POD2 ($P = 0.001$, 95% CI = 0.11–0.82), with insignificant difference among the groups preoperatively and immediately after recovery ($P = 0.174$, 0.305, 95% CI = 0.13–2.60, 0.36–1.85)(Table 3). The mean IL6 was significantly less in group E when compared with those in groups C in POD2 ($P = 0.017$, 95% CI = 0.11–0.91), with insignificant difference among the groups preoperatively and immediately after recovery ($P = 0.097$, 0.062, 95% CI = 0.25–

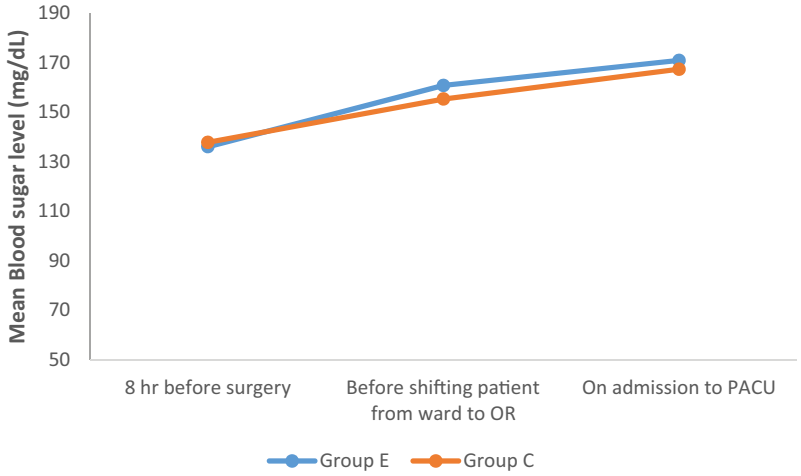

Figure 3. Comparison of random blood sugar (mg/dL) between the two studied groups. Values are presented as mean ±SD. *significant differences between groups $P < 0.05$.

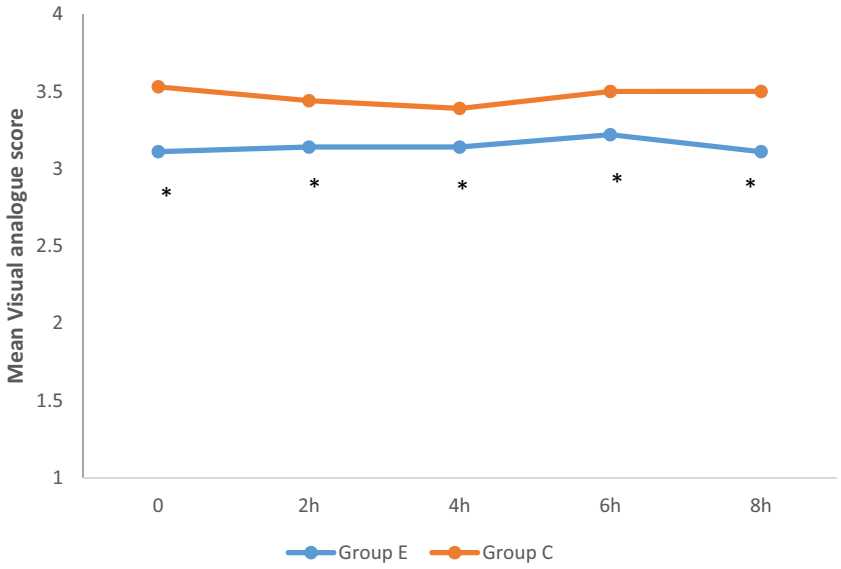

Figure 4. Comparison of visual analogue score (VAS) between the two studied groups. Values are presented as mean ±SD. *significant differences between groups $P < 0.05$.

Table 3. Comparison of C-reactive protein (mg-dl-1) and interleukin-6 (pg.Ml-1) between the two studied groups.

Biomarkers	Group E	Group C	*p*- value	95.0% C.I
C- Reactive protein				
Preoperative	1.78 ±0.66	1.93±0.68	0.174	0.13–2.60
Immediately after recovery	4.87±5.16	4.73±4.83	0.305	0.36–1.85
POD2	43.57±13.07	88.95±31.49	0.001*	0.11–0.82
Interleukin 6 (pg.ml−1)				
Preoperative	1.05±0.11	1.08±0.17	0.097	0.12–2.15
Immediately after recovery	1.15±0.12	1.15±0.18	0.062	0.25–1.98
POD2	1.06±0.13	1.21±0.19	0.017*	0.11–0.91

Values are presented as mean ±SD. *Significant differences between groups $P < 0.05$.

1.98, 0.11–0.91) (Table 3). Wound infection was reported in one patient in group C (2.8%), while no reported cases in group E ($P = 0.811$). Hematoma was reported in one patient in group C (2.8%), while no reported cases in group E ($P = 0.811$). No recorded cases of urinary tract infection or deep vein thrombosis in either groups.

POD2 = postoperative day 2

4. Discussion

In this randomized, prospective, controlled trial, we found that the implementation of ERAS protocol in patients with non-insulin dependent diabetes undergoing lumbar decompression surgical procedures improved the quality of recovery, decreased the VAS

score, reduced perioperative opioid consumption, allowed early ambulation, and decreased the serum markers of stress response. However, there was no difference in blood sugar level, intraoperative insulin requirements and postoperative hospital stay. In agreement with the present study, Soffin and colleagues in their investigation on implementation of ERAS in patients randomized for lumbar spine fusion, reported higher QOR40 scores three days after surgery, decreased narcotic consumption, lower pain scores, and C-reactive protein with no clinically significant reductions in length of stay [7]. We chose the QoR40 scores which are a valid and reliable multi-dimensional measures of functional recovery after surgery and anesthesia [17]. It has been verified in various surgical procedures pathway-effectiveness studies [19,20]. In our study, the use of pre-emptive analgesia and US guided erector spinae plane block may be a contributing factors for improvement of the quality of recovery scores in ERAS group so apparent benefits might be in the pain domain, opioid sparing which might enhance the emotional state, early ambulation and subsequently the physical independence domain [21]. Most of the studies investigating the advantages of implementing ERAS in spine surgery are retrospective. These studies concluded that ERAS reduces length of hospital stay, opioid use, morbidity and readmission after spine surgery [21–26]. Smith *et al*. [27] showed that, ERAS pathway decreased the consumption of long-acting opioid with insignificant reductions in length of stay, but differently, they reported insignificant differences regarding postoperative pain scores, or consumption of short-term opioid. Maheshwari *et al*. [28] found no significant merits of standardized multimodal analgesia composed of oral acetaminophen and gabapentin combined with intravenous infusions of ketamine and lignocaine on quality of recovery, pain scores, or opioid consumption after lumbar fusion. Our trial was not quite identical with prior trials because of the variations in characteristics of patient population, study design; multimodal analgesic regimens and lastly type of surgical procedures. Multimodal analgesic regimens are an essential element of ERAS protocols that includes non-opioids (acetaminophen, gabapentin), regional anaesthetic techniques to minimize the consumption of perioperative opioids, and consequently their adverse effects aiming to improve the quality of recovery after surgery. In the present study, the implemtation of US guided erector spinae plane block (ESPB) in ERAS protocol reduced the pain score and opiate requirements. A systematic review investigated the analgesic effectiveness of ESPB in adult patients scheduled for lumbar spine surgery revealed that ESPB significantly decreased the pain scores either at rest or during movement at different times in the first 48 hours after surgery, reduced the opioid consumption for 24 h postoperatively, a lower incidence of PONV, shorter length of hospital stay and consequently better patient satisfaction when compared with the control [15]. Another recent a systematic review reported that ESPB significantly decreased the postoperative pain scores and lower narcotic requirements during the first 24 postoperative hours [29]. Garg *et al* [30] retrospectively compared the implementation of ERAS in patients scheduled for lumbar spine fusion with conventional care, and reported significantly lower pain score in ERAS group up to 4 weeks after surgery with significantly shorter LOS. In our trial, there was statistically insignificant difference in hospital stay between the two studied groups which may be attributed to nature of surgical procedure and poor compliance of protocol adherence. However, LOS is influenced by a variety of variables including preoperative comorbidities and postoperative complications such as hemorrhage, surgical drains, and late mobilization [31]. Similarly, Smith *et al*. [20] concluded that ERAS implementation for one-two level lumbar fusion had little effect in diminishing LOS. The pathway enhanced both early enteral nutrition and mobilization, however it is unclear which elements contributed to the favorable outcomes. Within an enhanced recovery paradigm, these two domains have been recognized as some of the most significant drivers of favorable outcomes following colorectal surgical procedures [32]. A study by Zakaria *et al*. [33] reported that early ambulation is accompanied with reduced incidence of morbidity following lumbar spine surgery which might be useful in shortening LOS with significant cost savings. Immune response modulation may achieve better outcomes and enhance the postoperative quality of recovery. Thus, the selection of anesthetic technique may compromise clinical outcomes through disturbing the balance between pro- and anti-inflammatory responses. Previous investigation by Aono *et al*. [34]. reported that 48% of the patients who underwent posterior lumbar interbody fusion resumed normal level of CRP after 14 days. In our trial, there was statistically significant decrease in CRP and IL6 in POD 3. This may be attributed to that ERAS implementation improves recovery and facilitate healing process. Soffin *et al*. [7] concluded that ERAS group had significantly lower CRP level at POD3 compared to control group with insignificant difference in IL6 levels among groups at any time measured. This may be attributed to that the amplitude of stress response for one or two-level lumbar fusion surgery may have been inadequate to reveal effects on the investigated markers. Another investigation by Mari *et al* [35]

concluded that IL-6 levels and CRP level were significantly less in the ERAS group on first, third, and fifth days postoperatively in comparison to standard group, IL-6 levels reverted to preoperative baseline level three days postoperatively. ERAS reduces postoperative complications and length of stay in non-diabetic patients. The unanswered question is whether diabetic patients participating in ERAS would experience postoperative outcomes that were comparable to those described in clinical trials of non- diabetic patients, or if those improvements would be countered by the possible hazards of the carbohydrate load [13]. In the present study, preoperative oral carbohydrate drinking did not increase the incidence of hyperglycemia which may be attributed to reduction in insulin resistance. Consistent with those results, systematic review by Li-Na Ge and colleagues [12] reported that preoperative carbohydrate consumption in diabetic patients improve insulin resistance and prevent postoperative hyperglycemia. Prolonged fasting leads to increased glucagon and glucocorticoids due to increased stress and surgical trauma, it reduces insulin sensitivity eventually leading to increased insulin resistance with possible postoperative hyperglycemia. Preoperative carbohydrates shortens the duration of fasting, reduce thirst, hunger, anxiety, surgical trauma, perioperative hypoglycemia, insulin resistance, nausea, vomiting and stress, and consequently shorten the recovery time [36,37].

Limitations of the study

Firstly, complete blindness was not possible for all personnel sharing in the study due to the need for active patient participation. Secondly, short follow-up period. Finally, a relatively small sample size so that larger sample sized randomized controlled trials are required to support the implantation of ERAS pathways for diabetic patients.

In conclusion the implementation of ERAS protocol in non-insulindependent diabetic patients undergoing lumbar decompression surgical procedures improved the quality of recovery, lowered pain scores, reduced consumption of perioperative opiate, allowed early ambulation, and decreased the serum markers of stress response with no clinically significant effect on postoperative hospital stay. However, there was insignificant difference in blood sugar level and intraoperative insulin consumption indicating the safety and feasibility of preoperative oral carbohydrates in ERAS protocol for diabetic patients.

Acknowledgments

The authors gratefully acknowledge Miss Habiba Ashraf Abdelhalim for her assistance in the editing of the manuscript, student at faculty of clinical pharmacy, Alexandria University, Egypt and all nursing staff members of the operating room & PACU for their help in data collection.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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