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Implementation of enhanced recovery after surgery in gynecological operations: a randomized controlled trial

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Abstract

Background: To investigate the effects of enhanced recovery after surgery (ERAS) in patients undergoing gynecologic surgery on length of hospital stay, pain management, and complication rate.

Results: The length of hospital stay was reduced in ERAS groups when compared with the control groups (3.46 days vs 2.28 days; $P < 0.0001$; CI − 1.5767 to − 0.7833 for laparotomy groups and 2.18 vs 1.76 days; $P = 0.0115$; CI − 0.7439 to − 0.0961 for laparoscopy groups respectively). Intraoperative fluid use was reduced in both ERAS groups compared to the two control groups (934 ± 245 ml and 832 ± 197 ml vs 1747 ± 257 ml and 1459 ± 304 respectively; $P < 0.0001$) and postoperative fluid use was also less in the ERAS groups compared to the control groups (1606 ± 607 ml and 1210 ± 324 ml vs 2682 ± 396 ml and 1469 ± 315 ml respectively; $P < 0.0001$). Pain score using visual analog scale (VAS) on postoperative day 0 was 4.8 ± 1.4 and 4.1 ± 1.2 ($P = 0.0066$) for both laparotomy control and ERAS groups respectively, while in the laparoscopy groups, VAS was 3.8 ± 1.1 and 3.2 ± 0.9 ($P = 0.0024$) in control and ERAS groups respectively.

Conclusion: Implementation of ERAS protocols in gynecologic surgery was associated with significant reduction in length of hospital stay, associated with decrease intravenous fluids used and comparable pain control without increase in complication rates.

Keywords: Enhanced recovery after surgery, Length of hospital stay and gynecological operations

Background

Implementation of an enhanced recovery after surgery (ERAS) protocol is associated with decreased length of hospital stay, a decrease in rates of postoperative complication, decreased morbidity, and cost savings while preserving patient satisfaction and quality of life3 (El and Van Le 2015; de Groot et al. 2016).

ERAS programs include preoperative, intraoperative, and postoperative strategies; preadmission counseling, use of opioid-sparing multimodal perioperative analgesia (including regional analgesia), intraoperative goal-directed fluid therapy (GDT), and use of minimally invasive surgical techniques with avoidance of routine use of nasogastric tube, drains, and/or catheters. Postoperatively, patients are encouraged for early feeding, early mobilization, early removal of tubes, and drains once patients can walk. Successful implementation of an ERAS program requires a multidisciplinary team effort of all hospital staff and active participation of the patient (Greco et al. 2014).

A recent meta-analysis included 2376 colorectal patients from 16 randomized controlled trials. All studies compared ERAS pathways to conventional postoperative care. ERAS pathways were associated with a significant decrease in overall morbidity (RR = 0.60, 95% CI 0.46–0.76), medical complications (RR = 0.40 95% CI 0.27–0.61), and a decreased length of hospital stay of 2.28 days (95% CI 1.47–3.09 days) with no differences in readmissions (Lassen et al. 2005).

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Due to its successful implementation in other surgical specialties, e.g., colorectal surgery, there has been a need of investigating the benefits of ERAS in gynecological surgical management.

The aim of the present study was to investigate the effects of enhanced recovery after surgery in patients undergoing gynecologic surgery on length of hospital stay, pain management, patient satisfaction, and complication rate.

Primary outcome

Postoperative length of hospital stay.

Secondary outcomes

Postoperative morbidities, for example, acute confusion, nausea and vomiting, postoperative fever, secondary hemorrhage, atelectasis, pneumonia, wound infection, embolism and deep vein thrombosis, acute urinary retention, and paralytic ileus. Re-admission rate due to bowel dysfunction or wound dehiscence or infection was also reported.

Methods

Study design

The current study was a prospective randomized controlled clinical study on women who underwent major pelvic surgery for benign non-cancerous lesions. The study was conducted during the period between January 2013 and December 2016.

Ethical approval

The study protocol was approved by the scientific ethical committee of the Department of Obstetrics and Gynaecology, Faculty of Medicine in August 2012. Approval was ascertained from the Institutional Review Board of the Faculty of Medicine, in our university in September 2012. All procedures performed in the study were in accordance with the ethical standards of our university.

Informed consent

The study procedure was explained to all eligible participants. Informed written consent was obtained from all patients included in the study.

Data obtained was confidential and used only for the purpose of the study.

Patients

Eligible subjects were American Society of Anesthesiologists (ASA) physical status I and II females undergoing gynecologic non-cancerous operations.

All patients admitted for gynecologic non-cancerous operations in the period of the study were included aged 18–60 years, also BMI more than 40 were excluded as morbid obesity patients need special care.

Patients with a history of coagulopathy, recent infection as renal, gynecological, or chest infection that occurred during the last month before surgery (< 1 month) as they may need special management that increase their hospital stay and confuse our results, current use of an opioid analgesic or corticosteroid, allergies to drugs included in the study protocol, gross neurologic impairment, or suspected difficult airway were excluded. Reasons for exclusion after randomization were protocol violations or patient request.

Subjects were randomized using a computer-generated table of random numbers. Group assignments were sealed in sequentially numbered opaque envelopes that were opened after patient inclusion in the study.

Sample size calculation and statistical analysis

Sample size calculation

Before the study, the number of patients required in each group was determined after a power calculation according to data obtained from pilot study. Pilot study on 26 patients reported a mean duration of hospital stay of 3 days with standard deviation (SD) of 1.03 day with TAH via laparotomy and reported a mean duration of hospital stay of 2 days with standard deviation (SD) of 1.54 day with total laparoscopic hysterectomy. A sample size of 50 patients in each group was determined to provide 99% power for two-tail '*t*' test at the level of 5% significance (sample size calculated using medcalc version 12.

Patients were classified into four groups two groups were control and other two were active groups; first group included patients undergoing total abdominal hysterectomy (TAH) via laparotomy (n = 55) were managed with conventional perioperative protocol (control 1); second group included patients undergoing TAH via laparotomy also managed with enhanced recovery perioperative protocol (ERAS 1) (n = 52); third group undergoing total laparoscopic hysterectomy (TLH) managed with conventional perioperative protocol (control 2) (n = 55); and fourth group included patients undergoing TLH were managed with enhanced recovery perioperative protocol (ERAS 2) (n = 54).

Methods

Patients in control groups were instructed to fast overnight. Patients were hospitalized for 1–2 days for laparoscopic and 2–5 days for open procedures. Prophylactic antibiotics (2 g 3rd generation cephalosporins (ceftriaxone) after performing sensitivity test) were administered half an hour before skin incision. Another dose of IV antibiotic was administered 12 h postoperatively. All patients of control groups received general anesthesia, where induction of anesthesia was performed using 2 to 3 mcg/kg of IV fentanyl, 1.5 to 2.0 mg/kg of propofol, and 0.5 mg/kg of atracurium. Anesthetic maintenance

was achieved with isoflurane at 1 minimum alveolar concentration (MAC), fentanyl 1 mcg/kg titrated to avoid arterial blood pressure values above 20% of baseline, and additional doses of atracurium to keep 2 twitches using a train-of-4 monitor. At skin closure, neuromuscular blockade was antagonized with 0.01 mg/kg of atropine and 0.05 mg/kg of neostigmine. Intraoperative fluid administration was managed by anesthesiologist according to the situation of each case. Postoperative fluids were continued until the intestinal motility was regained.

ERAS protocol

Establishment of a multi-disciplinary team to implement the protocol of ERAS. The team consisted of gynecologist, anesthetist, nurse specialist, ward nurse managers, and clinical dieticians. The aim of the ERAS protocol is to ensure that patient is in the best possible physical state for surgery to minimize length of hospital stay without increase rate of complication or the rate of readmission.

Components of the protocol

Patient counseling and education

The patient is an active part in the program. Preoperative patient education to meet patient expectations is a main principle of ERAS. The patient was counseled with the surgeon, nurse, and anesthetist. Education and counseling specifically addressed details about the surgical and anesthetic steps as well as pre- and postoperative procedures.

Patient preparation for surgery

Medical optimization of chronic disease (cardiac function, pulmonary function, blood pressure, and diabetes) was achieved. Serum albumin level was maintained greater than 3.5 g/dl. Preoperative prophylaxis against thrombosis, infection and nausea and vomiting was established. All patients in all groups received low molecular weight heparin (LMWH) prophylactic dose 12 h before surgery and 2 g 1st generation cephalosporins 30 min. before skin incision also all patients received metoclopramide as prophylaxis against nausea and vomiting. Patients in control groups received LMWH as prophylactic doses but received anti-emetic drugs according to guidelines for example, patients who had previous history of post-operative nausea and vomiting (PONV).

Perioperative diet

Fasting of no more than 6 h preoperatively for solid foods and 2 h for clear liquids was advised.

Preoperative carbohydrate loading drinks were used to minimize effect of fasting. These drinks are composed of concentrated complex carbohydrates suspended in a clear fluid.

Postoperatively patients were encouraged to use chewing gums, laxatives and drink clear liquids upon awakening from anesthesia and to eat a general diet when started walking. Intake of protein and energy-rich nutritional supplements was advised. Prevention of postoperative nausea and vomiting were ensured with the use of multimodal approach to control of nausea and vomiting by 2 or more anti-emetics in combination. Dexamethasone is also an important prophylactic agent in prevention of nausea and vomiting. Patients in ERAS groups received metoclopramide 10 mg i.v plus dexamethasone 8 mg i.v. Additional non-pharmacologic approaches such as avoiding inhalational anesthetics and an increased use of propofol are important as well.

Mechanical bowel preparation

Rectal enemas and mechanical bowel preparations were avoided for patients in ERAS groups while patients in control groups had rectal enemas as routine recommendations.

Anesthesia

Patients of the ERAS groups received combined general anesthesia with lumbar epidural analgesia.

Pre-anesthetic medications

All subjects were pre-medicated with 0.04 mg/kg IV midazolam except patients > 60 years receives no sedative premedication. After arrival in the operating room, standard ASA monitors were applied. In addition, depth of anesthesia was monitored by using bispectral index to avoid deep levels of anesthesia especially in patients > 60 years.

Patients received lumbar epidural (L2-3/L3-4) in sitting position under all aseptic precautions using 15 ml bupivacaine 0.125% plus 100 μg fentanyl was administered via the epidural catheters then all patients in these groups received general anesthesia as done in the other conventional groups without fentanyl during induction, then bupivacaine 0.125% infusion through the epidural catheter was started at a rate of 4 ml/h. Any incidence of hypotension and bradycardia was noted. Hypotension defined as SBP < 90 mmHG or > 20% reduction in preoperative SBP and bradycardia defined as pulse rate (PR) < 50/min. Hypotension treated by incremental doses of ephedrine while bradycardia treated by incremental doses of atropine.

Fluid balance and management

Perioperative fluid management aimed to maintain perioperative euvolemia or a zero-sum fluid balance.

All patients were recommended to have liberal fluid intake policy before surgery.

Intraoperatively patients received 2–4 ml/kg/h of crystalloids (Ringer acetate). If there was hypotension (less than 25% of baseline) 500 ml hydroxyethyl starch 130/0.4

or vasopressor in the form of noradrenaline was administered.

Postoperative patients have IV fluids decreased to 40 ml/h on POD 0; fluids stopped at 8:00 AM on POD 1.

Pain management

Our protocol included the use of opioid-sparing pain control as combining regional anesthetics techniques with multimodal pharmacologic pain management instead of the use of opioids. Multimodal pain management consisted of the use of two pain killers with different modes of action as NSAIDs, paracetamol, or acetaminophen.

All patients in all groups received nothing preoperatively.

Intraoperative

Patients in the control groups received 100 μg fentanyl + 30 mg ketorolac, while patients in the ERAS groups received lumber epidural analgesia as shown before + 30 mg ketorolac.

Postoperative

One gram acetaminophen i.v. + 30 mg ketorolac every 6 h as a basic analgesia for all patients in all groups. Patients in ERAS groups received bupivacaine 0.125% 10 ml + 50 μg fentanyl in the epidural catheter while patients in the control groups received nalbuphine 5 mg as a supplemental analgesia if VAS ≥ 4 also this is allowed for ERAS patients if their VAS ≥ 4.

Drains and catheters

The study protocol eliminated the use of drains, tubes, and catheters. Urinary catheters were removed as soon as possible, usually when the patients had left the bed. It is worth mentioning that nasogastric tubes were not used for patients in the ERAS groups.

Early mobilization

All patients were encouraged to start early mobilization and to leave their beds as early as possible. Patients got out of bed a minimum of 2 h on the day of surgery and then 6 h per day until discharge.

Parameters assessed

Length of hospital stay (LOS) in days was assessed as 1ry outcome.

Patients characteristics were assessed including age, BMI and components of the protocol applied as shown in Table 1.

Fluids administered also measured in (ml) either intra- or postoperative.

Consumption of analgesia was measured as total consumption of nalbuphine in milligram. Also, VAS was assessed postoperatively. Postoperative complications were noticed and recorded included surgical site infection, urinary tract infection, pneumonia, and sepsis.

Monitoring of HR, SBP, DBP, SpO2, and Et CO2 was done every 5 min intraoperatively and at specific stages (pre-operative, after premeditation, after induction, after Trendelenburg position, after insufflation, after desufflation, reversal) and every 15 min in postoperative period up to 2 h postoperative and then every 1 h till 24 h later.

Statistical analysis

The collected data were coded, tabulated, and statistically analyzed using SPSS program (Statistical Package for Social Sciences) software version 20.

Descriptive statistics were done for numerical data by mean, standard deviation, and minimum and maximum of the range, while they were done for categorical data by number and percentage.

Analyses were done for quantitative variables using independent sample t test for parametric data between each two groups and Mann-Whitney test for non-parametric data between each two groups.

Chi-square test was used for qualitative data between groups when the cell contains more than 5 and Fisher exact test when the cell contains less than 5.

ANOVA test was used for comparison between the groups for parametric data.

The level of significance was taken at (P value ≤ 0.05)

Results

A total of 216 patients were included in the current study; 107 patients were planned to undergo open laparotomy for benign gynecological lesions, and they were randomly distributed into two groups: group 1 (control 1, n = 55) included patients managed with conventional protocol and group 2 (ERAS 1, n = 52) included patients managed with ERAS. One hundred nine patients underwent laparoscopy for different lesions. They were also classified randomly into control group (control 2, n = 55) who were managed with conventional protocol and active groups (ERAS 2, n = 54) (Fig. 1).

The mean age for control 1 group was 49.6 years (range 32–67 years) compared with mean age of 50.1 years for ERAS group 1 (range 30–63 years) (P value = 0.3840). The mean age for control 2 group was 38.5 years (range 23–49 years) and 39.2 for ERAS group 2 (range 20–50 years) (P value = 0.1501). The mean body mass index (BMI) (calculated as weight (kg)/[height (m)]^2) for patients of control 1 group was 37.3 and for patients of ERAS 1 group was 38.5 (P value = 0.4248). The mean BMI for patients of control 2 group was 36.3 and for patients of ERAS 2 group was 38.7 (P value = 0.0705).

There was a statistically significant difference in the length of hospital stay which was reduced with ERAS

Table 1 Shows component of the protocol applied to different groups

	Control 1 *n* = 55	ERAS 1 *n* = 52	*P* (1) value	Control 2 *n* = 55	ERAS 2 *n* = 54	*P* (2) value
Preoperative bowel preparation: *n*	26	0	–	23	0	–
Admission preoperative (days) (mean ± SD)	3.96 ± 0.8	1.02 ± 0.8	0.011	3.37 ± 1.23	1.4 ± 0.81	0.012
Overnight enema (*n* of patients)	55	0	–	36	0	–
Fasting (h) (mean ± SD)	11.6 ± 1.9	6.3 ± 0.89	0.002	11.1 ± 1.97	6.05 ± 0.85	0.0012
Preoperative carbohydrate drink (*n* of patients)	0	52	–	0	54	–
Preoperative antiemetic (*n*)	6	52	–	12	54	–
Fluid: (mean ± SD)						
• Intraoperative fluid balance (ml)	1747 ± 257	934 ± 245	< 0.0001	1459 ± 304	832 ± 197	< 0.001
• Postoperative fluid balance (ml)	2682 ± 396	1606 ± 607	< 0.0001	1469 ± 315	1210 ± 324	< 0.001
Analgesia						
• Epidural (*n*=)	0	52		0	54	
• Total nalbuphine (mg) (mean ± SD) (range)	11.2 ± 3.4 (7–20)	2.1 ± 0.8 (0–10)	< 0.001	9.6 ± 2.4 (6–14)	1.4 ± 0.7 (0–10)	< 0.001
Ambulation: (*n*=)						
• Day of surgery	16	49		46	54	
• More than 4 times on POD 1[a]	27	52		53	54	
Start oral feeding						
• Fluid	18	48		37	51	
• Oral soft food in operative day	7	44		12	46	
• Oral soft food in OPD 1 day	48	50		51	54	

[a]*POD 1* postoperative day one

groups when compared with the control groups (3.46 days compared with 2.28 days; $P < 0.0001$; CI – 1.5767 to – 0.7833 for laparotomy groups and 2.18 compared with 1.76 days; $P = 0.0115$; CI – 0.7439 to – 0.0961 for laparoscopy groups, respectively).

Visual analog score (VAS) was less in patients managed with ERAS protocols rather than patients managed with conventional protocols in both laparotomy and laparoscopy patients; 4.47 ± 0.49 vs 2.81 ± 0.57 ($P < 0.001$) in both laparotomy control and active groups respectively, while in the laparoscopy groups, VAS was 3.22 ± 0.66 and 1.62 ± 0.58 ($P < 0.001$) in control and active groups respectively after ERAS (Table 2).

Similar reductions were seen in total nalbuphine dose 11.2 ± 3.4 compared with 2.1 ± 0.8 mg ($P < 0.001$) in laparotomy groups, also significant reductions in this dose in ERAS 2 as compared to control 2 (9.6 ± 2.4 vs 1.4 ± 0.7 $P < 0.001$ respectively).

Intraoperative fluids used (1747 ± 257 ml compared with 934 ± 245 ml; $P < 0.0001$; CI – 909.3574 to – 716.6426 for laparotomy groups and 1459 ± 304 ml compared with 832 ± 197 ml; $P < 0.001$; CI – 724.4638 to – 529.5362 for laparoscopy groups) and postoperative fluid used (2682 ± 396 ml compared with 1606 ± 607 ml; $P < 0.0001$; CI – 1271.4120 to – 880.5880 for laparotomy groups and 1469 ± 315 ml compared with 1210 ± 324 ml; $P < 0.0001$; CI – 380.3331 to – 137.6669 for laparoscopy groups)

There was a statistically significant reduction in the rate of complication in the laparotomy groups (OR = 0.3116, CI = 0.1033 to 0.9394 and $P = 0.0384$) after ERAS protocol implementation. The rate of complication was reduced in the laparoscopy group but not reaching the level of statistical significance (OR = 0.3846, CI = 0.0713 to 2.0744 and $P = 0.2664$).

Discussion

As with any clinical or behavioral model changes, there are multiple resistances in how to implement ERAS; the most important point was to exploit a devoted resident and nurse to supervise the procedure. Applicability of ERAS is complex and hard, not only due to requirement of high level of harmony of healthcare provider teams, but also because many of these procedures work against the present clinical practice.

As such, reevaluation, auditing, and supervising ERAS implementation is decisive to reach success. Parameters evaluation should include protocol application and deviation, detect clinical outcomes of ERAS, and improve the patient's quality of life and satisfaction. Implementation of ERAS protocol is associated with improved postoperative outcomes suggesting a dose-response relationship.

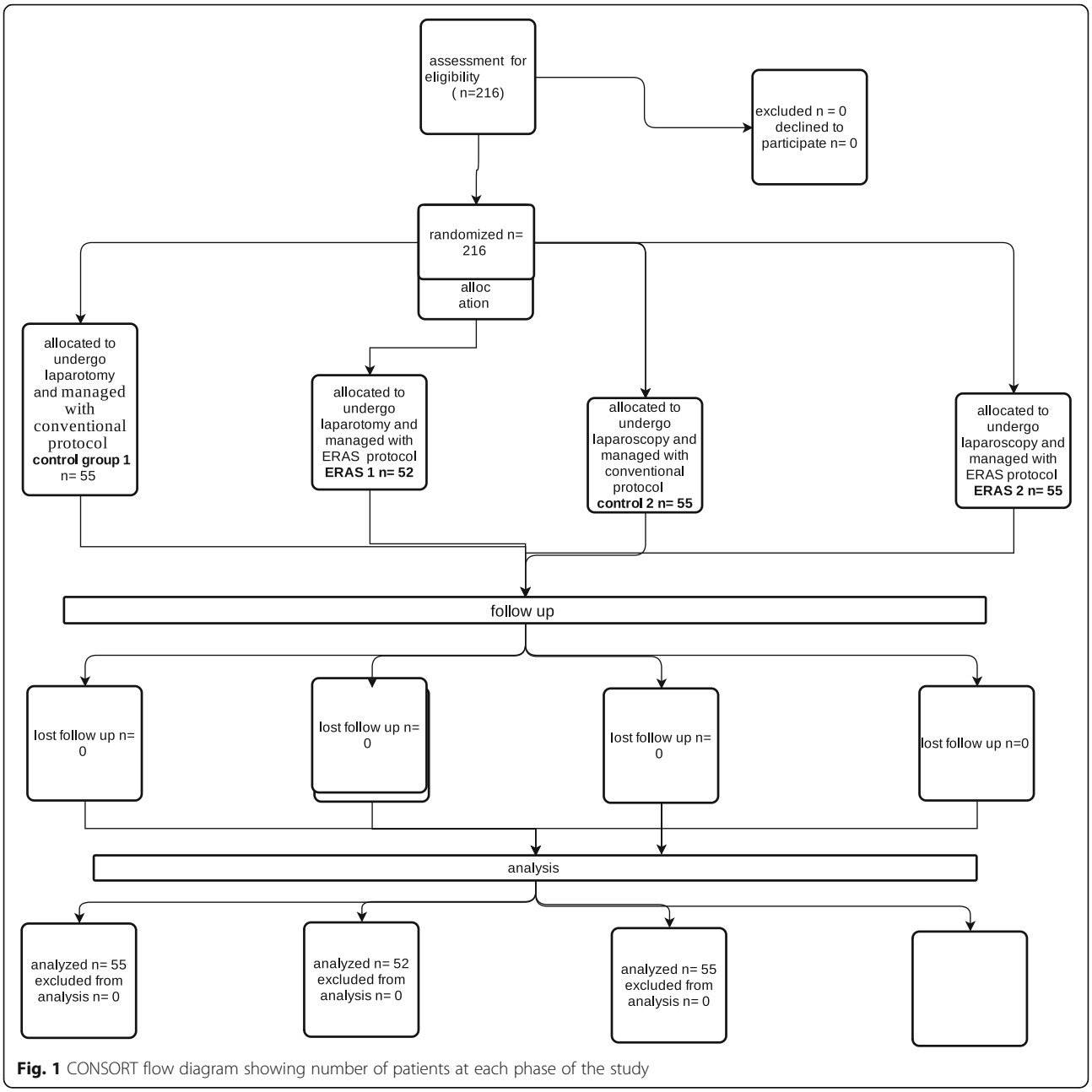

Fig. 1 CONSORT flow diagram showing number of patients at each phase of the study

Guidelines indicate that clear evidence may take a long time up to 15 years to result in clinical practice changes (5Group EC 2015). The medical and surgical community should be encouraged to implement new and better care rapidly. Annually, about 310 million major operations are performed. Available data suggest that ERAS implementation can improve complication rates by 20% or more (Lassen et al. 2005; Goodman et al. 2007).

Our results highlight the merits of ERAS as shortened hospital stay, enhanced bowel motility, more patient satisfaction, comparable pain management without excess opioids use, and with reduced complication and readmission rates resulting in decreased costs and bed occupations.

The ERAS protocols include the following: preoperative nutritional support for the patient who is malnourished, carbohydrate loading before surgery to minimize postoperative insulin resistance, epidural or spinal analgesia to reduce the endocrine stress response, anti-inflammatory drugs to reduce the inflammatory response, early feeding after surgery to secure energy intake, and optimal pain control to avoid stress and insulin resistance. ERAS processes also aim to minimize fluid shifts. Too little fluid can cause a reduction in perfusion and organ

Table 2 Operative and postoperative outcome

	Control 1 *n* = 55	ERAS 1 *n* = 52	*P* value [1]	Control 2 (*n* = 55)	ERAS 2 (*n* = 54)	*P* value [2]
LOS (days)[a] (mean ± SD)	3.46 ± 1.11	2.28 ± 0.948	< 0.0001	2.18 ± 0.941	1.76 ± 0.7528	0.0115
VAS (mean ± SD)	4.47 ± 0.49	2.81 ± 0.57	< 0.001	3.22 ± 0.66	1.62 ± 0.58	< 0.001
Infections (*n*=):						
• Surgical site infection	4	2		1	0	
• Urinary tract infection	4	1		1	0	
• Pneumonia	2	1		2	1	
• Sepsis or septic shock	2	0		0	0	
• Total rate of complications	12	4	0.0384	4	1	0.2664
Unplanned return to OR (*n*=)	2	1		1	1	
Readmission (*n*=)	5	3		1	1	

[a]*LOS* length of hospital stay

dysfunction, whereas intravenous salt and fluid overload is recognized as a major cause of postoperative ileus and its complications (Bragg et al. 2015; Kehlet 1997)

Ideally, patients managed with ERAS protocol should be drinking, eating, mobilizing, and sleeping on the same day of operation. The ERAS program also avoids the routine use of nasogastric tubes, prolonged urinary catheterization, and prolonged or inappropriate use of abdominal drains.

Skin incisions lead to pain, inflammation, and catabolism (Colling et al. 2015). Minimally invasive surgery offers benefits over laparotomy for benign hysterectomies and is associated with decreased complications, decreased surgical site infections, decreased risk of venous thromboembolism, and shorter hospital stay with improving quality of life (Kurz et al. 1996).

Preventing hypothermia is critical to minimize postoperative morbidity. Hypothermic patients have higher rates of surgical site infections, susceptible more for cardiac morbidity, coagulopathy, and bleeding. The compensatory shivering accompanying hypothermia increases oxygen consumption and contributes to increased catabolic state (Brady et al. 2003).

"NPO after midnight" has been a longstanding inherent dogma in preoperative preparation to prevent aspiration of gastric contents and gastric acid. A Cochrane review of 22 RCTs found no evidence that a shortened period of fasting was associated with an increased risk of aspiration, regurgitation, or related morbidity (Abola and Gan 2017). The American Society of Anesthesiology recommends a fast of 6 h preoperatively for solid foods and that clear liquids be consumed for up to 2 h prior to surgery (Chon et al. 2017).

Minimizing the preoperative fasting period increases patient quality of life and satisfaction as prolonged preoperative fasting is annoying for patients and may increase patient anxiety (Charoenkwan and Matovinovic 2014).

In ERAS program, patients were promoted to start clear fluid upon awakening from anesthesia and to start eating small snack once patient started walking.

In gynecology and gynecologic oncology (Arnold et al. 2015), early enteral intake was associated with a faster regain of bowel motility and a decreased length of stay without increase in postoperative complications.

We advised our patients against use of mechanical bowel preparations. Recent studies have supported these advices as bowel preparation is associated dehydration, electrolyte abnormalities, and a prolonged period of fasting (Ryan et al. 2015). For gynecologic surgery, a recent meta-analysis of 5 RCTs found that there was no benefit of bowel preparation in regard to visualization of the surgical field or decreases in operative time. However, patients undergoing bowel preparation did experience increased patient discomfort (Siedhoff et al. 2014; Maund et al. 2011). Arnold et al. (Ryan et al. 2015) conclude that rectal enemas and mechanical bowel preparations can safely be discarded in gynecologic surgery.

Our policy in postoperative pain control is the use of regional anesthetics techniques with multimodal pharmacologic pain management with decrease use of opioids because use of opioids resulted in impaired gastrointestinal motility and nausea and vomiting. Opioids can deteriorate the patient's equilibrium affecting patients' mobilization and depressing the respiratory vitality

A systematic literature review of 60 RCTs found that use of anti-inflammatory adjuncts in addition to morphine PCA decreased the amount of morphine used by patients in a 24-h period by 6.34 mg when Tylenol was used, 10.2 mg when NSAIDs were prescribed, and 10.9 mg when COX-2 inhibitors were used (Nelson et al. 2014).

Our recommendations were against the use of peritoneal drains and nasogastric tubes and removing urinary catheters as early the patient's feet reach the ground. Gynecologists have inserted peritoneal drains to decrease

intraperitoneal fluid collections, decrease rates of infections, and as a mirror to diagnose intra-abdominal bleeding and anastomotic leaks. However, studies have concluded that insertion of these drains is not correlated with decreased rates of infection or postoperative fluid collections. In contrast, use of drains may result in increased rates of infections of the abdominal cavity by tracking infection from the skin, and can cause bleeding and pain (Zaouter et al. 2009). Peritoneal drains also disturb mobilization, which is mainstay for the success of ERAS. Prolonged catheter use is linked to an increased rate of urinary tract infection. In an RCT which examined early removal (1 day) compared to standard removal (approximately 4 days) the prevalence of urinary tract infection was increased to 12% for those in the in standard group and was only 2% in the early removal group (p = 0.004) (Vlug et al. 2012).

Early mobilization is a lineament of ERAS. Traditional teaching and improvisation concluded that early mobilization decreases pulmonary complications, prevents loss of muscle mass, decreases insulin resistance, and improve bowel function. Also, late mobilization is associated with increased risk of thromboembolism and decreased oxygen delivery to tissues. However, there are no current RCTs that show that early mobilization results in improved postoperative outcomes. Analysis of ERAS shows that a failure to mobilize is associated with increased length of stay suggesting that early mobilization is a key to achieve the advantageous results of ERAS protocols (Nygren et al. 2013). Many ERAS protocols recommend that patients start walking after a minimum of 2 h on the day of surgery and then 6 h per day until discharge (Varadhan et al. 2010).

The current study showed that there was a statistically significant difference in the length of hospital stay which was reduced with ERAS groups when compared with the control groups, this in agreement with meta-analyses and randomized controlled trials of ERAS pathways that have shown benefit (Sibbern et al. 2017). These meta-analyses found improved outcomes when ERAS were implemented compared with routine postoperative care. Also, they found a reduction in length of hospital stay for patients in the ERAS groups, with no difference in readmission rates.

In the present study, there was a statistically significant reduction in the rate of complication in the laparotomy groups, in laparoscopy groups rate of complication was reduced but not reaching the level of statistical significance. These findings were in line with previous data that found a significant reduction in postoperative morbidity in patients undergoing ERAS and a trend towards decreased mortality. A recent meta-analysis included 2376 colorectal patients from 16 randomized controlled trials that compared ERAS pathways to conventional postoperative care. ERAS pathways were resulted in a significant reduction in overall morbidity (RR = 0.60, 95% CI 0.46–0.76), medical complications (RR = 0.40 95% CI 0.27–0.61) (Lassen et al. 2005). Another meta-analysis included patients from 38 RCTs with 5099 patients in all surgical disciplines, including colorectal, orthopedics, urology, and upper gastrointestinal tract surgery. ERAS patients had a decreased risk of all 30-day complications (RR = 0.71, 95% CI 0.60–0.86), but no reduction in mortality (Wong and Aly 2016).

Pain management was evaluated using visual analog score. ERAS is associated with improvements in pain scores due to the use of multimodal pain management strategies. This was supported with findings of different studies (de Groot et al. 2016). A study of gynecologic oncology patients found refinement in "autonomy," "physical complaints," and "postoperative pain" using a validated quality of life tool (Spanjersberg et al. 2011). Patient satisfaction is not studied well but the available data suggests better satisfaction among ERAS patients (Kalogera et al. 2013).

Conclusions

Implementation of ERAS resulted in significant reduction in hospital stay, proper pain management and reduced rate of complications without an increase in re-admissions. ERAS has resulted in a significantly increased understanding of perioperative physiology. This has led to the concept among gynecologist that the role perioperative care may be important and warrants recognition as a separate subspecialty since it does not exclusively fall into the domain of any of the existing specialties.

Abbreviations

ERAS: Enhanced Recovery After Surgery; VAS: Visual analog scale; GDT: Goal-directed fluid therapy; ASA: American Society of Anesthesiologists; TAH: Total abdominal hysterectomy; TLH: Total laparoscopic hysterectomy; IV: Intravenous; MAC: Minimum alveolar concentration; L: Lumbar; SBP: Systolic blood pressure; PR: Pulse rate; HR: Heart rate; SPo2: Oxygen saturation; DBP: Diastolic blood pressure; Et CO2: End-tidal carbon dioxide; NSAIDs: Non-steroidal anti-inflammatory drugs; BMI: Body mass index; POD: Post-operative day; LOS: Length of hospital stays; OR: Operative room; NPO: Nothing per os; RCTs: Randomized controlled trials; PCA: Patient-controlled analgesia; COX2: Cyclo-oxygenate

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Authors' contributions

Both authors participated in the operative procedures either abdominal or laparoscopic hysterectomies. ANA supervised the anesthetic team that contributed in the study. ASS designed the study protocol, prepared the manuscript, and performed the statistical analysis. Both authors conceived of the study and participated in its design and coordination and helped to draft the manuscript. The authors read and approved the final manuscript.

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Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request. Data obtained was confidential and used only for the purpose of the study.

Ethics approval and consent to participate
The protocol for the research project has been approved by Ethics Committee of the Faculty of Medicine, Minia University within which the work was undertaken.
The study protocol was approved by the scientific ethical committee of the Department of Obstetrics and Gynecology, Faculty of Medicine, Minia University, in August 2012. Approval was ascertained from the Institutional Review Board of the Faculty of Medicine, Minia University in September 2012. All procedures performed in the study were in accordance with the ethical standards of Minia University.
The study procedure was explained to all eligible participants. Informed written consent was obtained from all patients included in the study.

Consent for publication
Not applicable

Competing interests
There is no possible conflict of interest. The authors declare that they have no competing interests.

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