ERAS® Program in a Portuguese Hospital: Results from Elective Colorectal Surgery after One Year of Implementation

Programa ERAS® num Hospital Português: Resultados na Cirurgia Colorretal Eletiva Um Ano após a Sua Implementação

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ABSTRACT

Introduction: The Enhanced Recovery After Surgery® program comprises the implementation of various perioperative measures that reduce surgical stress and ultimately improve patient recovery and outcome. The purpose of this study is to evaluate the first-year compliance and clinical outcomes after implementation of the Enhanced Recovery After Surgery® program in elective colorectal surgery in our hospital.

Material and Methods: An analysis was performed on the 210 patients who underwent elective colorectal surgery from May 2016 to December 2017. The group of patients that underwent surgery after the protocol implementation (Enhanced Recovery After Surgery® group) was compared to a conventional care control group (pre- Enhanced Recovery After Surgery® group). Differences between the two groups were adjusted using Propensity Score matching. The main outcomes were length of stay, return of bowel function, complications and mortality. The evolution of compliance with Enhanced Recovery After Surgery® principles was also analyzed.

Results: After propensity score matching, 112 patients were included in the present study: 56 patients formed the pre-Enhanced Recovery After Surgery® group and 56 the Enhanced Recovery After Surgery® group. The overall adherence to the protocol increased from 35.7% to 80.8%. There was a decrease in length of stay, time to return of bowel function and medical complications.

Discussion: The Enhanced Recovery After Surgery® program is safe and seems to shorten length of stay and improve patient recovery and clinical outcome.

Conclusion: This study showed that the implementation of the Enhanced Recovery After Surgery® program was possible in Hospital Beatriz Ângelo, with a positive impact in the immediate postoperative recovery of colorectal patients.

Keywords: Colon/surgery; Digestive System Surgical Procedures; Elective Surgical Procedures; Perioperative Care; Portugal; Rectum/surgery

RESUMO

Introdução: O programa de *Enhanced Recovery After Surgery®* consiste na implementação de várias medidas perioperatórias que reduzem o *stress* cirúrgico e, consequentemente melhoram a recuperação dos doentes. O objetivo deste estudo é avaliar a *compliance* com o programa *Enhanced Recovery After Surgery®* bem como os resultados obtidos no final do primeiro ano da sua implementação para a cirurgia colorretal eletiva no nosso hospital.

Material e Métodos: Foi feita uma análise dos 210 doentes submetidos a cirurgia colorretal no período entre maio de 2016 e dezembro de 2017. O grupo de doentes intervencionados após a implementação do protocolo (grupo *Enhanced Recovery After Surgery®*) foi comparado com um grupo que recebeu cuidados convencionais (grupo pré- *Enhanced Recovery After Surgery®*). Diferenças entre os dois grupos foram ajustadas usando o emparelhamento com base na propensão. Os objetivos primários foram o tempo de internamento, o tempo até retorno do trânsito intestinal, a incidência de complicações e a mortalidade. Analisámos também a evolução da *compliance* com as recomendações *Enhanced Recovery After Surgery®*.

Resultados: Após emparelhamento com base na propensão para pertencer ao grupo pré- *Enhanced Recovery After Surgery®* e *Enhanced Recovery After Surgery®*, foram incluídos 112 doentes neste estudo, 56 em cada grupo. A adesão global ao protocolo *Enhanced Recovery After Surgery®* registou um aumento de 35,7% para 80,8%. Houve uma redução no tempo de internamento, tempo até retorno do trânsito intestinal e complicações médicas.

Discussão: O programa E*nhanced Recovery After Surgery®* é seguro e parece reduzir a estadia hospital e melhorar a recuperação dos doentes.

Conclusão: Este estudo mostrou que a implementação do programa *Enhanced Recovery After Surgery®* foi possível no Hospital Beatriz Ângelo e teve um impacto positivo no pós-operatório imediato dos doentes com patologia colorretal.

Palavras-chave: Colon/cirurgia; Cuidados Perioperatórios; Portugal; Procedimentos Cirúrgicos Electivos; Procedimentos Cirúrgicos do Sistema Digestivo; Recto/cirurgia

INTRODUCTION

The Enhanced Recovery After Surgery (ERAS®) program is an evidence-based multidisciplinary care pathway, which entails a change in the perioperative management through the implementation of ever-evolving and audited

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protocols. The goal of the program is to reduce the surgical-induced neuroendocrine stress response, by treating the potential risk factors, in order to shorten length of hospital stay, perioperative morbidity and mortality.

It was developed by a group of European surgeons, who founded the ERAS® Study Group in 2001, which was the basis of the ERAS® Society, created in 2010. This new approach to the surgical patient contrasts with the 'fast track' concept, which emerged for the first time in 1994, since it emphasizes the quality of the care given and not solely fast discharge.[1]

The first ERAS® protocols were drafted in the early 2000s, initially for colon surgery and swiftly followed by rectal surgery. After this, a wide range of surgical areas followed the same path.

The ERAS® Society guidelines for Colorectal Surgery were last updated in 2018. They encompass 24 core elements (Table 1) that include preoperative, intraoperative and postoperative measures to be implemented.[2]

Several studies have shown that the application of these protocols is safe, leads to a better postoperative recovery, a faster return of bowel function, less morbidity and a shorter length of hospital stay after surgery.[2-4]

The implementation of these protocols is a complex process which requires the integration and contribution of all the professional groups involved, including surgeons, anesthesiologists, nurses, nutritionists and physiotherapists, among others.

Constant monitoring is needed to guarantee sustainability and continuous improvement. In the absence of continuous training and auditing there is a decrease in the program's compliance.[5] It has been shown that a compliance greater than 70% is associated with better clinical results,[6-8] including 5-year survival after malignant colorectal surgery.

Hospital Beatriz Ângelo was the first hospital in Portugal to adhere to the ERAS® society program. The ERAS® implementation program (EIP) consists of four seminars and three action periods in between, with a total length of eight to 10 months. It started with the creation of a multidisciplinary team composed of surgeons, anesthesiologists, nurses, an intensive care physician and a member of the management board. During this period, this team had weekly meetings where international guidelines were adapted to the local features, the patient perioperative circuit was organized, patients´ data were introduced in the audit system and staff education was prepared.

One of the important steps was the reorganization of the preoperative period with the creation of new appointments in order to better evaluate and optimize the surgical patient. These included nursing, nutritional and physical rehabilitation consultations, in addition to the preexisting general surgery and anesthesiology ones. They form a one-day bundle to avoid extra visits to the hospital and enable patient education and management of their expectations. It also allows for the formulation, together with the patient, of a postoperative recovery plan including early mobilization, ambulation and oral intake.

Another crucial change in perioperative care was to grant dedicated time to an ERAS® nurse for patient and family support, supervision of the circuit, data collection and audit, and staff coaching.

As said before, maintaining this program is not possible without continuous auditing of the compliance with the different protocol´s elements and the clinical outcomes. This allows the team to identify the success of the implementation or the need of change in strategy. To enable this, the patients' clinical data have to be inserted in EIAS (ERAS® interactive audit system) in real time.

Hospital Beatriz Ângelo (HBA) in Loures, Portugal, started the ERAS® implementation program (EIP) for colorectal

Table 1 – Recommendations for perioperative care in colon and rectal surgery[1]

Preoperative	Intraoperative	Postoperative
Patient education and counselling	Minimal invasive surgical techniques	No nasogastric tubes
Cessation of smoking and excessive intake of alcohol	Avoid long-acting opioids	Early removal of urinary catheter
Medical optimization of chronic disease	Mid-thoracic epidural for open surgery	Avoidance of salt and water overload
Preoperative nutritional assessment and, as needed, nutritional support	Avoidance of salt and water overload	Early intake oral fluids and solids/ nutritional supplements
No prolonged fasting and carbohydrate loading	Maintenance of normothermia	Multimodal non-opioid oral analgesia
No/selective bowel preparation	Prevention of nausea and vomiting	Early mobilization
Antibiotic prophylaxis	No drains	Stimulation of gut mobility
Thromboprophylaxis		Audit of compliance and outcomes
No premedication		

[1] According to the ERAS® Society Guidelines: World J Surg. 2019;43:659-95.[2]

surgery in May 2016, which lasted about 8 months; and since January 2017 all colorectal surgery patients were included in the program. The purpose of this study is to evaluate the first-year compliance and clinical outcomes.

MATERIALS AND METHODS

Patients

A consecutive series of 210 patients undergoing elective colorectal surgery in Hospital Beatriz Ângelo was analyzed. The first 67 patients (pre-ERAS® group) underwent surgery in 2016 and were registered during the implementation program. The remaining 143 are all the patients treated during 2017 – after the full implementation of the ERAS® program (ERAS® group). The data concerning both groups of patients (which include over one hundred variables) were inserted into the ERAS® database (EIAS – ERAS® interactive audit system), either retrospectively (pre-ERAS® group) or prospectively (ERAS® group). The study was approved by the Health Ethics Committee of Hospital Beatriz Ângelo.

Outcomes

Demographics and preoperative data of all patients were extracted from the EIAS database: gender, age, body mass index (BMI), history of tobacco use, diabetes, cardiovascular and respiratory disease, American Society of Anesthesiologists (ASA) physical status, P-POSSUM score mortality risk, use of neoadjuvant treatment, final diagnosis and procedure group (colonic vs rectal). The operative variables analyzed were duration of surgery, intraoperative blood loss, total volume of IV fluids and transfusion rate.

Compliance with the care elements of the perioperative period was recorded and compared between the two groups. The compliance represents the percentage of patients that were treated according to the protocol and it is calculated taking into account only the data available (the data not registered in the clinical records appear as 'missing').

The main outcome measures in the postoperative period were length of stay (number of days between operation and discharge), time to return of bowel function (described as time to first flatus and first bowel movement), complications (divided in medical and surgical and according to their severity – Clavien-Dindo classification) and mortality.

Table 2 – Demographic patient data and preoperative characteristics

	Pre-ERAS® group (n = 56)	ERAS® group (n = 56)	*p*-value
Gender - n (%)			0.321
Female	17 (30.4%)	22 (39.3%)	
Male	39 (69.6%)	34 (60.7%)	
Age, years – median (Q1 - Q3)	72 (61.0 - 77.0)	72.5 (57.5 - 80.5)	0.524
Body Mass Index, kg/m^2 - median (Q1 - Q3)[1]	26 (23.6 - 29.7)	26.7 (24.3 - 28.9)	0.511
Tobacco use – n (%)[2]	3 (5.7%)	3 (5.4%)	0.381
Comorbidities – n (%)			
Cardiovascular disease[3]	1 (1.8%)	1 (1.8%)	0.752
Respiratory disease[4]	3 (5.4%)	1 (1.8%)	0.309
Diabetes	19 (33.9%)	20 (35.7%)	0.843
ASA performance score – n (%)			1.000
I	1 (1.8%)	1 (1.8%)	
II	37 (66.1%)	37 (66.1%)	
III	18 (32.1%)	18 (32.1%)	
IV			
P-POSSUM mortality risk, % - median (Q1 - Q3)	3.3 (1.6 - 7.7)	2.85 (1.9 - 6.8)	0.738
Diagnosis – n (%)			0.586
Malign	47 (84.0%)	46 (82.2%)	
Benign	9 (16.0%)	10 (17.8%)	
Surgical procedure group – n (%)			0.825
Colon	43 (76.8%)	42 (75.0%)	
Rectal	13 (23.2%)	14 (25.0%)	
Neoadjuvant chemotherapy – n (%)	9 (16.1%)	6 (10.7%)	0.405
Neoadjuvant radiotherapy – n (%)	7 (12.5%)	5 (8.9%)	0.541

* Seven missing-values in the pre-ERAS group and one in the ERAS group; **Three missing-values in the pre-ERAS group
Analysis of categorical variables was done using the χ^2 test except for 'Cardiovascular disease' and 'Respiratory disease' which used Fisher's exact test. Analysis of continuous variables was done using the Mann-Whitney U test.

Statistical analysis

Statistical analysis was performed using SPSS software version 23 for Windows (SPSS Inc., Chicago, IL, USA). Descriptive data were reported as mean ± standard deviation (SD), median (interquartile range - IQR) or number of patients (percentage) as appropriate. Categorical variables were compared using the Pearson's chi-square test or Fisher's exact test. For continuous variables, differences between groups were tested using Student's *t* test for normally distributed data or the Mann-Whitney U test for non-normally distributed data (based on Kolmogorov-Smirnov test). A *p*-value < 0.05 was considered statistically significant.

In order to reduce selection bias, pre and ERAS® patients were matched according to propensity scores determined with the near neighbor matching procedure. Diabetes, respiratory disease and ASA score were used as matching covariates. Matching was performed using R package MatchIt.

RESULTS

Demographic

Demographic patient data and preoperative characteristics are shown in Table 2. After propensity score matching, one hundred and twelve patients were included in the present study: 56 patients formed the pre-ERAS® group and 56 the ERAS® group. There was no difference in median age, BMI or in the distribution of gender between the two groups. Also, there was no significant difference regarding history of tobacco use, cardiovascular disease, respiratory disease, diabetes, ASA score and mortality risk prediction P-POSSUM score. Finally, there was no difference regarding the surgical procedure group (colonic vs rectal), the diagnosis (whether it was benign or malignant) nor whether the patient had received neoadjuvant chemotherapy or radiotherapy.

Perioperative variables

Regarding the preoperative period (Table 3), there was a significant increase in patient education and counselling (0% *vs* 100%, *p*-value < 0.001), fluid and carbohydrate loading (63.6% *vs* 96.4%, *p*-value < 0.001) and thromboprophylaxis (92.6% *vs* 100%, *p*-value < 0.001). The use of sedative premedication decreased (55.6% *vs* 5.4%, *p*-value <0.001) as did bowel preparation (50% *vs* 28.6%, *p*-value 0.021).

The intraoperative variables for the ERAS® and pre-ERAS® groups are presented in Table 4. The difference in mean duration of surgery did not achieve statistical significance (216.9 minutes *vs* 190.4 minutes, *p*-value 0.166) but there was a significant reduction in the median amount of fluids administered in the intraoperative period (1316.9 mL *vs* 1796.5 mL, *p*-value 0.039). Despite this reduction in fluid therapy, the need for vasoactive medication was not increased (*p*-value 0.611). There was no statistically significant difference regarding blood loss and transfusion rate. Monitoring of anesthesia depth and maintenance of normothermia increased (*p*-value < 0.001) whereas the use of opioid analgesia (*p*-value < 0.001) and surgical drains decreased (*p*-value 0.033). The use of nerve blocks and local anesthesia also increased (21.7% *vs* 51%, *p*-value 0.004) and there wasn´t a statistically significant difference in the use of mid-thoracic epidural anesthesia in open surgery. Regarding the prevention of nausea and vomiting there was not a significant difference either (98.2% *vs* 100%, *p*-value 0.495).

During the postoperative period there was a significant decrease in the median duration of intravenous fluid therapy in the ERAS® group (four days versus one day, *p*-value < 0.001) as well as an increase in the median volume of oral fluids on the day of surgery (0 mL *vs* 700 mL, *p*-value < 0.001), as shown in Table 5. This group also had a statistically significant increase in stimulation of gut mobility, avoidance of nasogastric tubes as well as earlier removal of urinary catheter (*p*-value < 0.001). About three quarters (73.2%) of the patients in the ERAS® group had early mobilization (out of bed in the day of surgery and walking three times a day starting in the first postoperative day), when compared with 14.8% in the pre-ERAS® group (*p*-value < 0.001). The use of opioids for postoperative analgesia had a major decrease in the ERAS® group (3.6% *vs* 38.9%, *p*-value < 0.001).

Compliance

Overall mean adherence to the ERAS® protocol was 80.8% in the ERAS® group compared with 35.7% in the pre-ERAS® group (*p*-value < 0.001). The compliance in each operative period is described in Table 6.

Table 3 – Preoperative variables[1]

	Pre-ERAS® group (n = 56)	ERAS® group (n = 56)	*p*-value
Patient education and counselling (including nutrition assessment) – n (%)	0 (0.0%)	56 (100.0%)	< 0.001
Fluid and carbohydrate loading – n (%)[2]	35 (63.6%)	54 (96.4%)	< 0.001
Bowel preparation – n (%)[3]	27 (50.0%)	16 (28.6%)	0.021
Antibiotic prophylaxis – n (%)[4]	53 (96.4%)	56 (100.0%)	0.243
Thromboprophylaxis – n (%)[5]	50 (92.6%)	56 (100.0%)	< 0.001
Sedative premedication – n (%)[6]	30 (55.6%)	3 (5.4%)	< 0.001

[1] According to the ERAS® Society Guidelines: World J Surg. 2019;43:659-95.[2]
[2,4] One missing-value in the pre-ERAS group; [3,5,6] Two missing-values in the pre-ERAS group
Analysis of categorical variables was done using the χ^2 test except for 'Antibiotic prophylaxis' which used Fisher's exact test.

Table 4 – Intraoperative variables[1]

	Pre-ERAS® group (n = 56)	ERAS® group (n = 56)	*p*-value
Duration of surgery, minutes – mean ± SD[2]	216.9 ± 109.4	190.4 ± 89.7	0.166
Total fluid volume, mL – mean ± SD[3]	1796.5 ± 1197.4	1316.9 ± 884.3	0.039
Vasoactive medication – n (%)[4]	13 (29.5%)	14 (25.0%)	0.611
Blood loss, mL – median (Q1 - Q3)[5]	100 (50 - 200)	100 (50 - 200)	0.477
Transfusion rate, mL – mean ± SD[6]	116.67 ± 531.9	6.25 ± 35.8	0.171
Monitoring of anesthesia depth – n (%)[7]	13 (52.0%)	55 (8.2%)	< 0.001
No opioid analgesia – n (%)[8]	29 (60.4%)	56 (100.0%)	< 0.001
Mid-thoracic epidural anaesthesia in open surgery – n (%)	9 (64.3%)	8 (47.1%)	0.276
Nerve blocks or local anesthesia – n (%)[9]	12 (21.7%)	28 (51.0%)	0.004
Maintenance of normothermia – n (%)[10]	23 (74.2%)	51 (100.0%)	< 0.001
Prevention of nausea and vomiting – n (%)	54 (98.2%)	56 (100.0%)	0.495
No surgical drains – n (%)	29 (51.8%)	40 (71.4%)	0.033

[1] According to the ERAS® Society Guidelines: World J Surg. 2019;43:659-95.[2]
[2,5,11] One missing-value in the pre-ERAS group; [3] 27 missing-values in the pre-ERAS group; [4] 12 missing-values in the pre-ERAS group; [6] 11 missing-values in the pre-ERAS group; [7] 31 missing-values in the pre-ERAS group; [8] Eight missing-values in the pre-ERAS group; [9] One missing-value in the pre-ERAS group and one in the ERAS group; [10] 25 missing-values in the pre-ERAS group and five in the ERAS group
Analysis of categorical variables was done using the χ^2 test except for 'Monitoring of anaesthesia depth', 'Maintenance of normothermia' and 'Prevention of nausea and vomiting' which used Fisher's exact test. Analysis of continuous variables was done using Student's *t*-test except for 'Blood loss' which used the Mann-Whitney U test.

Table 5 – Postoperative variables[1]

	Pre-ERAS® group (n = 56)	ERAS® group (n = 56)	*p*-value
Oral fluids on day of surgery, mL – median (Q1 - Q3)[2]	0 (0 - 0)	700 (325 - 1000)	< 0.001
IV fluids on day of surgery, mL – median (Q1 - Q3)[3]	2000 (1250 - 2550)	2000 (1587.5 - 2450)	0.386
Duration of IV fluid therapy, days – median (Q1 - Q3)[4]	4 (3 - 6)	1 (1 - 2)	< 0.001
Stimulation of gut mobility* – n (%)	11 (19.6%)	39 (69.6%)	< 0.001
No nasogastric tubes – n (%)	17 (30.9%)	52 (92.9%)	< 0.001
Time to removal of urinary catheter, days – median (Q1 - Q3)[5]	2 (1 - 3)	1 (1 - 1)	< 0.001
Early mobilization – n (%)[6]	8 (14.8%)	41 (73.2%)	< 0.001
Opioid analgesia – n (%)[7]	21 (38.9%)	2 (3.6%)	< 0.001

[1] According to the ERAS® Society Guidelines: World J Surg. 2019;43:659-95.[2]
[2] 25 missing-values in the pre-ERAS group; [3] 19 missing-values in the pre-ERAS group; [4] Four missing-values in the pre-ERAS group and one in the ERAS group; [5] Three missing-values in the pre-ERAS group and four in the ERAS group; [6,7] Two missing-values in the pre-ERAS group
Analysis of categorical variables was done using the χ^2 test. Analysis of continuous variables was done using the Mann-Whitney U test.
* Laxatives, chewing gum or both; IV: intravenous

Table 6 – Compliance with ERAS® Society core recommendations for perioperative care

	Pre-ERAS® group (n = 56)	ERAS® group (n = 56)	*p*-value
Overall compliance, % - mean ± SD	35.7 ± 8.7	80.8 ± 12.9	< 0.001
Preoperative compliance, % - mean ± SD	58.8 ± 18.1	96.3 ± 6.8	< 0.001
Intraoperative compliance, % - mean ± SD	46.3 ± 26.1	86.3 ± 16.4	< 0.001
Postoperative compliance, % - mean ± SD	18.4 ± 9.7	69.1 ± 22.3	< 0.001

Analysis of continuous variables was done using Student's *t*-test

Outcomes

Time to return of bowel function

Overall there was a faster return of bowel function in the ERAS® group compared with the pre-ERAS® group. The median time to first flatus decreased from two to one day (*p*-value 0.004) while the median time to first bowel movement decreased from three to two days (*p*-value 0.001). Patients also started solid oral intake earlier in the postoperative period in the ERAS® group (*p*-value < 0.001).

Complications and Reoperations

There was no difference in the overall number of patients who presented complications (*p*-value 0.154) as summarized in Table 7. In the pre-ERAS® group, 37.5% (22) of the patients developed at least one complication compared with 25% (14) in the ERAS® group. In both groups 28.6% of these were major complications. When analyzing overall medical complications, there was a significant decrease in the ERAS® group (14.3% *vs* 39.3%, *p*-value 0.003). There was no difference regarding surgical complications.

Table 7 – Outcomes

	Pre-ERAS® group (n = 56)	ERAS® group (n = 56)	*p*-value
Length of stay, days			
Overall – median (Q1 - Q3)	6 (4.0 - 10.7)	4 (4.0 - 7.0)	< 0.001
Colon procedures – median (Q1 - Q3)	6 (5.0 - 9.0)	4 (3.0 - 6.0)	< 0.001
Rectal procedures – mean ± SD	12.3 ± 6.9	7.1 ± 3.6	0.028
ICU admission – n (%)	4 (7.1%)	1 (1.8%)	0.182
Time to first flatus, days – median (Q1 - Q3)[1]	2 (1 - 3)	1 (1 - 2)	0.004
Time to first bowel movement, days – median (Q1 - Q3)[2]	3 (2 - 4)	2 (1 - 3)	0.001
Time to solid oral intake, days – median (Q1 - Q3)	4 (3 - 5)	1 (1 - 2)	< 0.001
Patients with complications – n (%)	21 (37.5%)	14 (25%)	0.154
Complication severity grade* – n (%)			0.652
Minor	15 (71.4%)	10 (71.4%)	
Major	6 (28.6%)	4 (28.6%)	
Medical complications – n (%)	22 (39.3%)	8 (14.3%)	0.003
Surgical complications – n (%)	10 (17.9%)	8 (14.3%)	0.607
Reoperations – n (%)	6 (10.7%)	4 (7.1%)	0.508
Readmissions – n (%)	4 (7.1%)	3 (5.4%)	0.500
Deaths – n (%)	0 (0.0%)	0 (0.0%)	-

[1] 22 missing-values in the pre-ERAS group and nine in the ERAS group; [2] One missing-values in the pre-ERAS group and three in the ERAS-group
* Minor complication: Clavien-Dindo I, II and IIIa; Major complication: Clavien-Dindo > IIIa
Analysis of categorical variables was done using the χ^2 test except for 'ICU admission', 'Complication severity grade' and 'Readmissions' which used Fisher's exact test. Analysis of continuous variables was done using the Mann-Whitney U test except for 'Length of stay – Rectal procedures' which used Student's *t*-test.
ICU: intensive care unit

There was no difference in the number of patients receiving unplanned operation after primary surgery nor in the number of readmissions after discharge.

Length of Stay (LOS)

There was a significant decrease in the length of stay from a pre-ERAS® median of six days to an ERAS® median of four days (*p*-value < 0.001) as depicted in Table 7. In the ERAS® groups, patients undergoing colonic surgery spent a median of four days in hospital while those who underwent rectal surgery spent on average 7.1 days. Around 7% (n = 4) of the patients in the pre-ERAS® group versus 1.8% (n = 1) in the ERAS® group required admission to the Intensive Care Unit (*p*-value 0.182).

Mortality

There were no deaths in both groups.

Discussion

In our hospital, the overall adherence to the protocol increased from 35.7% to 80.8%, which is in accordance with various published studies and accomplishes the threshold associated with better clinical outcomes.[6-8]

In contrast to traditional care, 100% of the ERAS® patients attended preoperative education and counseling. There was a statistically significant rise in the percentage of patients receiving the carbohydrate loading supplement on the evening before and morning of the surgery. This practice complies with ASA Practice Guidelines for Preoperative Fasting.[9] According to some authors this also decreases the perioperative catabolic process and insulin resistance[10-12] and, ultimately, increases patient satisfaction.[13]

Although still in debate, the ERAS® Society does not recommend bowel preparation as a routine, since it is linked to adverse effects such as dehydration, prolonged ileus and patient distress without any evidence of advantages.[14-16] This strategy was included in our hospital's protocol and there was a statistically significant decrease in its use (50% *vs* 28.6%, *p*-value 0.021).

Regarding the intraoperative period, restrictive fluid therapy is an established practice that is believed to reduce the incidence of several complications, including anastomosis leak, fluid overload and hypothermia.[17-20] This practice was adopted and there was a decrease in average intraoperative fluid therapy from 1796.5ml to 1316.9ml. This change occurred without an increase in use of vasoactive medication, which may indicate that the patients arrive at the operating room well hydrated.

The ERAS® program emphasizes pain control through the use of a multimodal opioid-sparing analgesic scheme. Our protocol established performing a thoracic epidural block for laparotomic surgery. For laparoscopic surgeries or if contraindications for a thoracic epidural block were present, other regional techniques (including intrathecal opioids) or IV lidocaine perfusion were instituted. In addition to this, postoperative analgesia is switched to oral at postoperative day one. Based on this analgesic scheme, the adherence to an opioid sparing strategy rose from 60.4% to

100%. At the same time, the use of peripheral nerve blocks or local anesthesia increased from 21.7% to 51%.

According to the ERAS® Society peritoneal drainage hasn´t shown any advantage in the available literature[2] and may impair patient postoperative mobilization. The avoidance of surgical drain placement was promoted and there was a decrease in its use from 49.2% to 28.6%.

The routine prophylactic use of nasogastric intubation is being abandoned. An association has been shown between its use and postoperative fever, oropharyngeal and pulmonary complications.[21] There was a significant difference in the use of nasogastric intubation before and after the implementation of the program, with a decrease from 69.1% to 7.1%.

In order to reduce the infectious risk, patient discomfort and facilitate mobilization, an early removal of urinary catheter was promoted with a reduction in the median of time to remove it from two days to one day.[2]

The ERAS® patients' postoperative period is marked by early mobilization and ambulation (73.2% of the patients), which in our case reflects the effort and coordination between the ERAS® nurse and the ward and rehabilitation nurses.

These patients also had a faster onset of oral fluid intake and progression to solid food. There was an increase in the average oral fluid intake in the day of the surgery from 0 to 700 mL and a decrease in the average duration of intravenous fluid therapy from four to one day. All patients were offered a liquid diet and supplements on the day of surgery and progress to solid food at the postoperative day one.

This early advancement of diet and prompt mobilization may have contributed to the quicker return of bowel function observed (median decreased from three to two days), which in turn may have been associated with the shorter length of stay.

The return of gastrointestinal function was assessed using the time to first flatus and time to first bowel movement. In these fields, an improvement was observed with reduction of the median time of at least one day. This may be associated with the use of measures that promote bowel motility, such as administration of domperidone, reduction of the use of opioid analgesics, early mobilization and ambulation.

Similar to other existing studies,[6,7,22-24] there was a statistically significant decrease in the rate of medical but not of surgical complications.

Regarding length of stay, there was a significant decrease in hospitalization time from a median of 6 to 4 days for all elective colorectal patients. This shorter length of stay was not associated with a higher percentage of readmissions, which reflects the safety of this program. This allows not only to lower the cost per patient, increase patient turnover and hospital productivity (a growing concern in the current era of cost-containment in health care),[24-26] but also a faster return to usual patient activity and improvement in patient satisfaction.[26,27]

Limitations

Despite the good results obtained, this study presents some limitations. These include the retrospective nature of the pre-ERAS® group and small sample size (further reduced by the need to perform a propensity score matching due to differences in patient characteristics such as ASA score (III), higher incidence of respiratory disease and diabetes). Another limitation is the lack of registration of several parameters before the implementation of the protocol.

CONCLUSION

This study showed that the implementation of ERAS® program in Hospital Beatriz Ângelo was possible, with a positive impact on outcomes. It´s execution is a complex process that requires a multidisciplinary approach, a structured implementation program and continuous data audit. It requires the commitment of the patient and all the perioperative professionals and represents a change in the institution culture.

As in other studies, it was shown that enhanced recovery programs are safe and bring major benefits to the patients. Its adoption is spreading worldwide, and this evidence based multimodal approach is becoming the cornerstone of high-quality perioperative care.

PROTECTION OF HUMANS AND ANIMALS

The authors declare that the procedures were followed according to the regulations established by the Clinical Research and Ethics Committee and to the Helsinki Declaration of the World Medical Association.

DATA CONFIDENTIALITY

The authors declare having followed the protocols in use at their working center regarding patients' data publication.

PATIENT CONSENT

Obtained.

COMPETING INTERESTS

The authors have declared that no competing interests exist.

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