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Implementation of Enhanced Recovery Programme for Colorectal Surgery from the Economical Perspective

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Abstract

Aim: To confirm the applicability of fast-track program in patients undergoing laparoscopic colorectal surgery and to analyze the economic impact.

Methods: Laparoscopic surgery and the implementation of the "fast track" program have radically changed patient management during the last 20 years. In a time of limited financial resources and health expenditure control, the importance of a cost-effectiveness evaluation cannot be ignored when considering new protocols. A comparative, non-blinded prospective evaluation of two cohorts of patients undergoing elective colorectal surgery has been carried out at the General Surgery Department of "Carlo Urbani" Hospital in Jesi, running over 12 months. 118 patients were analyzed and divided in two groups, 67 cases managed with fast track protocol and 51 with traditional treatment. The data were processed with the Chi-Squared test, Student's t test and Mann-Whitney test. Hospitalization costs were classified according to the full costing technique and activity based costing.

Results: In the 118 patients enrolled, 55 were males (46.6%) and 63 were females (53.4%); 90 (76%) patients had comorbidities. Interestingly, no differences in overall morbidity and mortality rates were found between the two groups. In particular, patients subjected to fast track treatment did not experience a higher rate of surgical complications while the patients managed with traditional protocol showed a higher number of medical complications. Moreover, the mean length of hospital stay of the fast-track group was 2.37 days shorter than the one of the control group and there was no difference in the 30-day readmission rate. Remarkably, the total cost per patient was significantly lower in the fast track group with respect to the control group (fast-track: 7027 ± 1275 euros vs. control: 7855 ± 1165 euros; p-value < 0.001) and the decrease in hospitalization unit costs was the main factor contributing to the cost reduction. On the contrary, the cost of the operating room and the type of surgical excision did not affect the cost difference between the two groups of patients.

Conclusion: The fast track program is applicable and safe in a district hospital. Shorter hospitalization duration is associated with a significant reduction of the hospitalization cost.

Keywords: Colorectal surgery; Fast-track; Cost analysis; Enhanced recovery; District hospital

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Introduction

Colorectal cancer represents the most common tumor in the world and its diffusion is bound to increase, due to the still increasing life expectation. Surgical resection is usually the first and best approach to treat that illness and the further development of screening programs will increase the number of patients in need for those treatments.

The factors that affect the duration of hospital stay of any patients after regular colorectal surgery are persistent pain with the need for continuous administration of analgesics, intravenous fluid therapy, because of prolonged fasting and lack of self-care by the patient that lost its mobilization capabilities. These factors very often lead to a delayed recovery of regular physiologic capabilities by the body with consequent long-term hospitalization. Of course, this period may be further extended in case post-operative complications occur. In the latest 20 years abdominal surgery experienced two important advances: on one hand the introduction of the laparoscopic surgery technique and, on the other hand, the implementation of an advanced recovery program after surgery, that is known even as "fast track" [1,2]. Such a program [2] envisages perioperative support, which includes detailed preoperative consulting, cancellation of the bowel preparation, absence of preanaesthetic medication, load of carbohydrates and liquids until 2 hours prior to surgery, multimodal management of pain by means of short term anesthetics, adequate perioperative management of fluids, small incisions,

avoiding the routinely use of drains and nasogastric tube. Indeed, recent clinical studies demonstrated that preoperative administration of a carbohydrate-based drink reduces postoperative catabolism syndrome and improves insulin resistance [3]. The postoperative treatment asks for early mobilization and recovery of oral feeding and removal of the bladder catheter as soon as possible.

The fast-track protocol, also called enhanced recovery program (ERP), is a medical protocol based on scientific evidences, whose purpose is reducing the surgical stress of patients undergoing colorectal surgery while keeping the physiologic capabilities alive and optimizing postoperative recovery, as a result [4].

Education of patients about pre, peri and post-operative phases concerning the treatment play a critical role in the modification of personal reactions to the surgical experience. In literature, some works showed that informed patients asks for lower administration of analgesia, besides reporting that they felt less painful than non informed patients [5].

However, despite the enthusiastic reaction of some surgeons, the majority of them are still skeptical about the new treatment proposals and several questions were posed about its feasibility, utility and costs due to that.

Anyway, it is worth remembering that discharging criteria of patients remain the same both for those ones that are managed in the standard way and those ones that are treated according to the fast-track, even though the latter meets the criteria more quickly.

In order to pursue quick discharging, an adequate social and health support is necessary: help from families and setting up facilities that can welcome patients in the post-operative phase are critical factors towards a correct management of patients that move from the hospital back to their home.

Traditionally, any patients undergoing colorectal surgery were kept under observation inside the hospital and treated in case of anesthesiologist and/or surgical complications that could occur. Hence, patients were gradually brought to a high level of self-sufficiency, until they could be discharged. But recent advances in the anesthesiologist field and pre-operative care, as well as the development of new surgical techniques, such as mini-invasive surgery, limited the number of requirements for managing post-operative hospital stay, hence leading to a quick discharging.

Much attention is presently devoted to the standardization of surgical treatments, to the evaluation of new therapies to be used in the post-operative phase to limit the occurrence of complications, to shorten hospital staying, hence reducing the consumption of resources. The surgical technique adopted plays a role to support the recovery phase after surgery. The use of smaller and smaller incision guarantees an improvement of patients' cosmetics, fast re-alimentation, quick abdominal canalization and reduction in post-operative pain along with a quicker recovery of daily routine [6]. In addition, the safety of these procedures was shown from the oncologic point of view, with the same number of dissected lynph nodes and the same surgical outcomes offered by regular techniques [7]. In this period characterized by limited budget available and close control of healthcare resources, the importance of cost-benefit assessment cannot be neglected any time new protocols are proposed [8]. Economic assessment of any procedure is important because resources are limited when compared to demand and this requires making choices that will have side effects on healthcare treatments [9]. The reduction of the duration of hospital stay and, in most cases, even of post-operative complications should determine a reduction of hospitalization costs. In literature, few studies that evaluated the impact of the multimodal rehabilitation program on hospitalization costs in colorectal surgery are present.

The purpose of this work is to confirm the applicability and safety of the program of enhanced recovery after surgery for patients undergoing colorectal surgery with laparoscopic technique and to assess the social and economic impact of that treatment as compared to the standard treatment.

Materials and Methods

Design of the study

This study consists in a non-blinded prospective comparative evaluation of two consecutive cohorts of patients undergoing colorectal surgery in regime of election.

Population object of this study

During a time window as long as 12 months, from January 2015 until December 2015, on the overall 118 patients were enrolled, who underwent colorectal surgery in regime of election for benign and malign pathologies at the General Surgery Division of the "Carlo Urbani" Hospital in Jesi (AN), Italy. The patients were split into two groups: one hand the group managed by means of the fast-track approach, including 67 individuals, and on the other hand another group that included 51 people managed according to the standard treatment. Those patients who had undergone a surgical intervention in emergency and those ones younger than 18 were not included in this study. All the others that had undergone colorectal surgery were included. The fast-track protocol was made up of a set of pre-, post- and intra-operative phases, as suggested by the guidelines edited by ERAS (Enhanced Recovery after Surgery) society [10] and detailed in the following.

Protocol applied to the patients of the "fast track" group

Three macro-phases can be discerned: the pre-operative, the intra-operative and the post-operative.

The pre-operative phase included the following items:

- Pre-admission information, education and counselling: during the pre-admission medical check, the patients of the fast track group were provided with written information about the surgery, besides a detailed oral presentation by the surgeon and anaesthetist about potential intra- and post-operative complications, drugs to be administered the same day when the surgery takes place and drugs to be suspended and diet to be followed in post-operative days. No alcohol and smoking was allowed since four weeks prior to surgery and, whenever possible, some physical activity such as jogging for 30 min every day was suggested.

- **Bowel preparation:** the patients object of the study were invited to reduce the amount of fibres present in their diet during the week prior to the surgery, so that no mechanical bowel preparation was needed, except in case of likely stoma or possible intraoperative colonoscopy.

- Pre-operative fasting was avoided, instead allowing the assumption of clear liquids until 2 hours prior the surgery and assumption of a solid diet until 6 hours prior the surgery [11].

- Thromboembolic prophylaxis: the fast-track patients were administered a dose of Dalteparin Sodium, since 12 hours prior the surgical intervention, then continued over all the hospital stay and the convalescence at home until four weeks after surgery. In addition, every patient wore compression stockings when entering the surgery room that were removed in the post-operative period once mobilization was triggered and successfully completed.

- Antibiotic preventive care, by means of routine prophylaxis with intravenous antibiotics that was given 30-60 min before initiating colorectal surgery. The use of antibiotics in the post-operative period was needed just in few particular cases, such as for immunodeficiency patients and those ones that were contaminated during surgery. The correct choice of the timing for administering antibiotic doses is very important in our case, even considering the drug's half life (i.e. Cefazolina and Metronidazolo), so that the endovenous infusion was carried out 30 min prior the start of skin incision. In most cases one dose of antibiotic drug was administered, reserving the second those only for the long lasting surgical interventions (i.e. longer than 3 hours).

The intra-operative phase included the following items:

- Skin preparation, that was performed in all cases by means of alcoholic mixtures based on Clorexidina.

- Anesthesiologist protocol for pain management, which in this study was varied according to the type of surgical intervention, patients' comorbidities and effects of the agents used on the organic function in the intra- and post-operative phases. Epidural anesthesia was carried out in few patients under study, by means of infusion of short-duration anesthetics; in the remaining cases analgesic drugs were administered by intravenous injection by means of infusion controlled pumps plus paracetamol 1 g, whenever required, avoiding the use of opioids.

- **Surgical approach:** in our work all the patients under study underwent laparoscopic surgery with mini-incision, to extract the surgical specimen, in left groin region in case of left hemicolectomy or anterior resection of the rectum and middle navel incision in case of right hemicolectomy.

- **Intraoperative normothermia:** All the patients included in the study were preserved from intra-operative hypothermia by means of forced-air warming blankets and infusion of warmed intravenous fluids.

- **Fluid therapy:** The amount of injected fluids was minimized. Laparoscopic surgery is simplifying the administration of a reasonable amount of fluids.

- **Nasogastric tube:** In our study the nasogastric tube was sometimes intra-operatively arranged in patients who belong to the fast-track group, but was then removed soon after the end of the surgical intervention.

- The peritoneal drainage were seldom positioned in patients of the fast-track group and only if large dissection occurred.

- For our patients the bladder drainage was removed on the first or, at the latest, the second post-operative day.

The post-operative phase included the following items:

- In order to prevent the post-operative ileum, prokinetic agents were administered, avoiding the use of opioids along with a moderate injection of fluids during the intra-operative and post-operative phases.

- Pain control in our patients was pursued by means of the multimodal analgesia that is made up of the combination between several agents or techniques. In this study, the use of epidural analgesia was preferred, over the use of intravenous drugs, such as opioids. However, in our records, the concept of analgesia "opioids-free" or "opioids-reduced" should be reconsidered.

- **Perioperative nutritional care:** In case of nausea, vomit and post-operative ileum, pharmacological treatments were used and feeding was not interrupted. Our patients were fed through liquid diet starting from the first post-operative day and solid diet starting from the second day;

- Mobilization was recovered since the first post-operative day, trying to motivate patients to move and, whenever not possible, bringing patients to seat. In a few cases respiratory physiotherapy was practiced.

Protocol applied to the patients of the "control" group

All the patients managed according to the standard protocol (i.e. those ones who belonged to the control group) did not follow a pre-determined list of phases. The most important differences between the two groups consisted in the pre-operative phase, when just oral information was provided by the surgeon and anesthetist on the occasion of the pre-admission medical check about the type of surgery that would be applied and the possible intra- and post-operative complications. In addition, these patients were encouraged to carry out bowel preparation using Macrogol 4000 4 doses melted in 4 liters of water, to be administered the day before surgery, while avoiding fibres in the week before surgery and respecting fasting since midnight of the day preceding the surgery. During the intra-operative phase there was no pre-determined control on liquid administration, but they were dosed following the anesthetist's requests, which were quantified on average as about the double the dose administered to the fast track group. Furthermore, in the surgery room skin preparation was carried out by means of povidone iodine and abdominal drains were always placed, and then removed after the patient's canalization, and the SNG was often placed, and kept in the post-operative phase until the restart of the peristalsis with gas emission.

Only after the removal of such devices mobilization was solicited, also providing for the removal of bladder drainage. Pain management was carried out by means of elastomeric pumps with opioids. In the post-operative phase, realimentation was associated with patient's canalization.

Discharging of both groups was determined by their capability of tolerating solid diet, of having a good pain control through oral analgesics and of being capable of self-ambulating.

Variables

Clinical and demographic variables of the patients included in both groups were compared. Medical and surgical complications that occurred within 30 days after surgery in both groups were collected. The average duration of hospital stay was included in this evaluation, as well as readmission rates.

Lenience towards re-alimentation and early mobilization were evaluated as functional parameters connected to hospital stay. The daily discharging rate was computed for both groups. In addition, the purpose of this study was to perform a cost analysis for all the patients

of both groups, considering hospital stay, surgery suite, laboratory and drugs.

Cost analysis

Our analysis system provides data referred to every single patient. It is based on the full costing approach and, in order to allocate every single cost in the right activity, it is referred to the activity-based costing [12]. The cost of the full treatment of patients is the sum of direct costs and a share of the indirect costs. Information about costs thus organized allows decomposing overall costs into the elementary costs, such as hospital stay, laboratory, radiology, surgery suite.

Statistical analysis

Descriptive statistics and statistical analyses were used to analyze and compare variables, considering that tests are successful if the p-value is lower than 5%. Qualitative variables were stated either as absolute values or as proportions and quantitative variables was stated either as median and range or as mean and standard deviation. Several tests of hypothesis have been used: the Chi-square test as used for qualitative variables (e.g. comparing proportions), Student's t-test in case of continuous variables if applicability criteria were met and the Mann-Whitney test in the remaining cases. The software tool "Gretl 2016™" was used to perform some calculations and the statistics toolbox provided by Matlab 7 (Mathworks™) to perform the remaining some other calculations.

Results

Descriptive statistics

During this 12 month long survey, 118 patients were involved and were split into two groups. On one hand 67 patients (56.8%) that joined to the fast track group and, on the other hand, 51 patients (43.2%) that were included in the group managed according to the standard protocol. The average age of the two samples was 65.06 years old, made up of 55 males (46.6%) and 63 females (53.4%). All the patients were classified according to ASA (*American Society of Anaesthesiology*) classification system, which is made up of six levels: ASA I (to which 51 patients belonged, equals to 43.2% of the two samples), ASA II (41 patients, equal to 34.7%), ASA III (26 patients, equal to 22.1%) and ASA IV (no patient), ASA V (no patient), ASA VI (no patient).

Out of the 118 people enrolled, 16 patients (13.6%) underwent laparoscopic right hemicolectomy with intracorporeal anastomosis, 31 patients (26.3%) underwent laparoscopic right hemicolectomy with extracorporeal anastomosis, 32 patients (27.1%) underwent laparoscopic left hemicolectomy, 19 patients (16.1%) underwent laparoscopic anterior resection of the rectum and 20 patients (16.9%) were treated by means of other atypical interventions, such as abdominoperineal rectal resection with permanent sigmoid stoma (Miles operation), Hartmann's procedure and transverse colon resection. Finally, 21 patients (17.8%) suffered benign pathologies whereas 97 patients (82.2%) suffered malign pathologies. 90 patients (76%) were characterized by comorbidities, such as kidney transplant, anxiety and depressive disorders, vascular disease, chronic atrial fibrillation, chronic hepatitis, Alzheimer's disease, obesity, respiratory diseases, essential hypertension, coronary artery disease, rheumatoid arthritis, chronic renal failure, diabetes mellitus, liver cirrhosis, hypothyroidism, gastroesophageal reflux disease or abdominal surgical interventions, including those ones due to neoplasia. The average BMI (*Body Mass Index*) of the fast track group was equal to 23.47, whereas that one of the control group was equal to 25.32. The average duration of surgical interventions executed on patients belonging to the fast track group was 172.5 min as opposed to the 180.7 min long surgical interventions of the patients belonging to the control group. In both groups, the median of the amount of estimated blood loss during the intraoperative period was 50 ml and the mean was 101.7 ml. The average duration with deviation of the hospital stay was 9.27 + 4.98 days, as opposed to 11.64 + 4.70 days in the case of the control group.

All the patients of the fast track group had no nasogastric tube or, in the worst case, they had it placed during the surgery under anaesthesia, and removed soon after the end of the surgical intervention. On the contrary, the control group had the nasogastric tube removed in a time window in between the first and fifth post-operative day. All the patients of the control group were provided with abdominal drainage, kept in place until stool canalization. Instead, just 18 patients of the control group were treated with abdominal drains, which were all removed in the third post-operative day. Gas canalization in the fast track group, that was allowed to start the liquid diet on the first post-operative day and solid diet on the second post-operative day, occurred in a time window included between the first and fourth post-operative day. Stool canalization occurred between the first and the seventh post-operative day. Gas canalization in the control group took place, on average, after 3.35 days, and it always preceded the re-start of liquid and solid diet. Stool canalization occurred after 4.41 days on average. Autonomic mobilization in the fast track group was triggered on the first post-operative day, whereas in the control group it fell on day the 2.82th post-operative day, on average. In 25 patients (49%) of the control group post-operative complications were recorded, represented by prolonged postoperative ileus with canalization delay (6 records), nausea and vomiting, that required the re-placement of the nasogastric tube (3 cases), pulmonary embolism (1 case), deep vein thrombosis (1 case), acute heart failure (2 cases), acute urinary retention (1 case) with need for replacement of the bladder catheter, blooding anastomotic suture with need for blood transfusions (2 cases), pneumonia with fever (5 cases), infection of the surgical incision (2 cases), further surgery due to acute intestinal obstruction (3 cases). No patient of the control group was re-admitted after the first discharging, while two re-admissions were operated in the case of the fast track group. In 23 patients (34%) of the fast track group, medical and surgical post-operative complications were recorded, such as knee osteoarthritis (1 case), ureterolithiasis (2 cases), paroxysmal atrial fibrillation (2 cases), essential hypertension (1 case), prolonged postoperative ileus (1 case), nausea and vomiting that required the re-placement of the nasogastric tube (1 case), pulmonary embolism (1 case), postoperative delirium (1 case), heart failure (1 case), acute urinary retention (1 case) that required the re-placement of the bladder catheter, blooding anastomotic suture that required blood transfusions (3 cases), pneumonia with high body temperature (1 case), infection of the surgical incision (5 cases), haematoma of the surgical incision (1 case), further surgery due to acute intestinal obstruction (1 case). No patient needed medical inspections at home, once they were discharged. All the patients of the control group were pre-treated by means of a bowel preparation made with Macrogol 4 l, while among the patients of the fast track group only those ones who expected to undergo temporary ileostomy had been previously prepared by means of bowel preparation. As far as thromboembolic prophylaxis is concerned, all the patients were subjected to prophylaxis made with anti-thrombosis compression stockings and provision of Dalteparin Sodium (2500 UI/die or 5000 UI/die according to risk score), whose first dose was administered 12

Table 1: Demographic and clinical characteristics of the fast track and control groups (F^1= Student's t-test, F^2 = Chi-Squared test).

	Fast track (n = 67)	Control (n = 51)	
Sex, no. (F/M)	35 / 32	28 / 23	F^1
Age, mean St. Dev.	69.52 ± 13.05[a]	75.86 ± 10.13	F^1
ASA, no. 1/2/3/4/5/6	37/17/13/0/0/0[b]	14/24/13/0/0/0	F^2
Type of surgical intervention, no. int.1/int.2/int.3/int.4/int.5	14/13/18/16/6[c]	2/18/14/3/14	F^2
Laparoscopic right hemicolectomy with intracorporeal anastomosis, no. (%)	14 (21%)[c]	2 (3%)	F^2
Laparoscopic right hemicolectomy with extracorporeal anastomosis, no. (%)	13 (19%)	18 (27%)	F^2
Laparoscopic right hemicolectomy, no. (%)	18 (27%)	14 (21%)	F^2
Laparoscopic anterior resection of the rectum, no. (%)	16 (24%)[b]	3 (4%)	F^2
Others (Hartmann's procedure, Miles operation), no. (%)	6 (9%)[b]	14 (21%)	F^2

[a] P < 0.002 vs. control group; [b] P < 0.008 vs. control group; [c] P < 0.0001 vs. control group

Table 2: Morbidity and mortality rates computed in the two fast track and control groups (F^2 = Chi-Squared test).

	Fast track (n = 67)	Control (n = 51)	
Morbidity, no. medical/surgical/none	16 / 7 / 44	21 / 4 / 26	F^2
Medical complications, no. (%)	16 (24%)[a]	21 (41%)	F^2
Surgical complications, no. (%)	7 (10%)	4 (8%)	F^2
Mortality, no. (%)	1 (1%)	4 (8%)	F^2

[a] P < 0.05 vs. control group

Table 3: Average duration of the hospital stay and readmission for the fast track and control groups (F^1= Student's t-test, F^2= Chi-Squared test).

	Fast track (n = 67)	Control (n = 51)	
Hospital staying, mean and st. dev. (days)	9.27 ± 4.98[a]	11.64 + 4.70	F^1
Readmission, no. (%)	2 (3%)	0 (0%)	F^2
Intensive care unit, no. (%)	24 (36%)[b]	40 (78%)	F^2

[a] P < 0.005 vs. control group; [b] P < 0.0001 vs control group

hours prior to surgery. Administration of antibiotic in the fast track group was performed through prophylaxis 30 min prior to surgery and continued until 24 hours after surgery, whereas in the control group it was administered for 5 days.

Comparison between the two groups

Table 1 concerns demographic and clinical characteristics of the patient's object of the survey. It shows that no statistically significant difference was recorded as for the parameter sex of the patients, which is, for this reason, not related with the adoption of the fast track program. A different situation was noticed in case of the parameters age, ASA score and type of interventions. More specifically, according to the results of the statistical tests, the ERAS protocol was adopted more often to those patients whose age and ASA score are lower. In addition, the same protocol was adopted more frequently with those patients undergoing laparoscopic right hemicolectomy with intracorporeal anastomosis and laparoscopic anterior rectum resection. On the contrary, there was no statistically significant difference in the cases relative to: laparoscopic left hemicolectomy and laparoscopic right hemicolectomy with extracorporeal anastomosis. The same set of outcomes clearly states that those patients undergoing atypical surgical interventions, such as the Hartmann's procedure, were usually managed according to the standard protocol.

The overall morbidity of both groups, which includes even re-admitted patients, are listed in Table 2, where it is shown that there are no statistically significant differences between the two samples. So it can be inferred that the patients joining the fast protocol group did not experience a higher number of surgical complications. Furthermore, the patients that belong to the control group experienced a higher number of medical complications, such as pneumonia with fever, angina pectoris, pulmonary embolism, deep vein thrombosis, prolonged postoperative ileus and heart failure. The infections of the surgical incision were analyzed separately and even in this case no differences were recorded. Finally, the mortality rate of the two samples was always included between 1% and 8%, and that differences turned out to be no statistically significant. In Table 3, a statistically significant decrease in the average duration of hospital stay is shown, that means that duration for the patients that belong to the fast track group was, on average, 2.37 days shorter than the same duration for the patients that belong to the control group. However, there was no statistically significant increase in the ratio of re-admitted patients monitored in the groups, which were null of almost null. Still statistically significant was the percentage difference in those patients who underwent a period in the intensive care unit, in the case of the fast track group (36%) with respect to the control group (78%). On Figure 1 the plots useful to assess the capability of adaptation to the new fast track protocol are depicted. The plots highlight that on the fifth postoperative day 100% of the patients in the fast track group are ready to be discharged, because they have pursued autonomic mobilization, solid diet and canalization, but only 4.47% is, in fact, actually discharged. Similar plots are depicted on Figure 2, which concerns the data of the control group, where the hospital stay is even longer. Table 4 shows the detail of hospitalization costs per patient and per group. Data analyses showed that on average costs per patient afforded by the fast track group was 828 euro lower than costs per patient afforded by the control group. Such a difference is still statistically significant when the low level items are analyzed, in terms of average cost of the hospital stay, that was computed as the product

Figure 1: Analysis of adaptation to the fast track protocol regarding the parameters solid realimentation, gas canalization, autonomic mobilization and discharging.

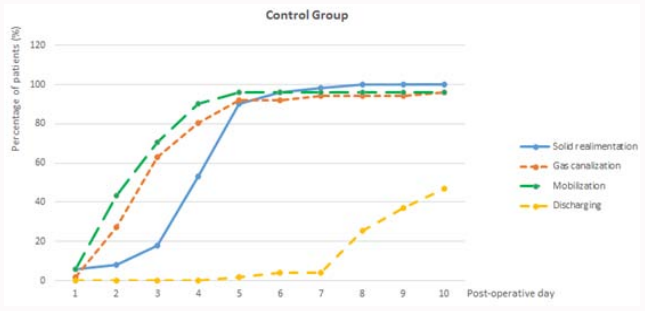

Figure 2: Analysis of adaptation to the standard protocol regarding the parameters solid realimentation, gas canalization, autonomic mobilization and discharging.

Table 4: Costs per patient by the fast track and control groups (F^3= Mann-Whitney U test).

	Fast track (n = 67)	Control (n = 51)	
Total, mean and st. dev.	7027 ± 1275[a]	7855 ± 1165	F^3
Hospital staying, mean and st. dev.	1391 ± 748[a]	1704 ± 697	F^3
Laboratory, mean and st. dev.	61 ± 33[a]	78 ± 48	F^3
Surgery room, mean and st. dev.	1985 ± 518	2080 ± 616	F^3
Surgery room and surgery, mean and st. dev.	5158 ± 590	5186 ± 699	F^3
Consumables, mean and st. dev.	57 ± 28[a]	99 ± 30	F^3
Intensive care units, mean and st. dev.	360 ± 485[a]	788 ± 417	F^3

[a] $P < 0.0001$ vs control group

between daily cost and duration of the stay, cost of the laboratory tests, cost of the patient's intensive care unit, that was computed as the product between the daily hospital stay cost in that ward and the duration, and cost of the consumables, such as abdominal drains, nasogastric tubes, bladder catheter, anti-thrombosis compression stockings, antibiotic and Dalteparin Sodium, proton pump inhibitors, prokinetic agents, stimulant agents and fluid-therapy intravenous. This significant reduction in costs could be due mainly to the variable "duration of the hospital stay" and to the period spent in intensive care unit. Only the cost of the operating room, that was computed as the product between the operating room cost per minute and the duration of the patients' presence in the room, and type of surgical intervention were not statistically significant, hence they did not affect the cost difference between the two samples.

Discussion

First of all, this survey confirmed the applicability and effectiveness of the fast track protocol in a district hospital's General Surgery division. Indeed, in this paper we showed that the new protocol is safe and does not increase the morbidity and mortality of patients, while, additionally, decreasing the duration of the hospital stay as compared with the control group. These outcomes are supported by a number of studies and reviews currently available in literature [13-19]. Secondly, in this survey we showed that the shorter the hospital stay of patients is, the cheaper hospitalization is. Although this evidence may sound obvious, in current literature few journal papers attempted to quantify the related costs, so far. We have found no statistically significant differences in overall morbidity and mortality rates between the two samples, even in the more specific case of surgical complications, so the outcomes from our study are similar to what described in the literature concerning the fast track protocol [20,21]. However, medical complications relative to the patients undergoing the fast track were lower than medical complications relative to the patients subjected to the standard protocol, and the difference was statistically significant. In a complete review by Wind "et al." [13] a morbidity rate included between 8% and 75% was estimated. But the difference between the two samples managed to be statistically significant in one survey only [15]. Another vast and interesting review by Cochrane [19] showed that the overall complications were reduced, but the most serious ones did not show the same trend. The lack of differentiation in morbidity, that in our study is limited to surgical complications, could be due to several reasons. Firstly, there is no globally accepted definition about complications, or a globally valid classification, hence any survey adopted a different criterion. Secondly, the need for implementing the fast track protocol led to minimize these same complications [16].

The fast track program allowed us to gain a meaningful decrease in the duration of the hospital stay, while slightly decreasing the number of complications. But the main issue about this program was the following one: how to set up the new program, as this implied changing the standard program by integrating new perioperative approaches.

Anyway, this issue was successfully faced in a previous study, whose focus was the assessment of the applicability of the new protocol even in a district hospital, and which drew the conclusion that, although the acceptance of the new protocol is hindered at the beginning, it increases more and more while doctors obtain evidences about the positive outcomes [22]. Delaney "et al." [23] noticed that the duration of hospital stay was shorter in case the program was managed by skilled surgeons. The difficulty connected with the implementation of the ERAS protocol in context other than clinical trials was recently surveyed by Ahmed "et al." [24]. These authors found out that the compliance within everyday clinical activity was more limited than within clinical trials. In addition, it is very important to notice that clinical outcomes improved, despite

the limited compliance. This suggests that raising the capability of conforming to the new protocol would cause a better post-operative course and a lower morbidity, too. In addition, in this survey a two days reduction of the hospital stay, on average, was reached, and with no statistically significant increase of the readmission rate. Instead, it was shown by Basse "et al." [25]. That a not appropriate decrease of the hospital stay, consisting in just early discharge, very often leads towards an increase in readmission rates. In the mentioned paper, when the average duration of the hospital stay was decreased of three days, the readmission rate was increased by 20%. Another issue worth considering is the difficulty or even impossibility of discharging patients early, even though they comply with all discharging criteria. This was a limiting factor, with respect to the main objective of this survey. For example, in this work hardly 5% of the patients were discharged within the 5th post-operative day, despite almost all of them complied with all discharging criteria. The reason for why it happened is likely to be le lack of adequate social support in the post-operative phase, before coming back home, where mainly impaired and aged patients could be subjected to a rehabilitation physiotherapy. Finally, fear and uncertainty of spending the post-operative days at home by patients themselves could be another reason. Mismatching between the patients that complied with discharging criteria emerged even in the survey conducted by Meassen "et al." [18]. As a result, the authors recommended improving the quality post-operative care at home. Our opinion is that the analyses of the level of satisfaction of patients undergoing fast track could help face many obstacles. After assessing and confirming that the fast track protocol can be successfully adopted in a district hospital, we focused on hospitalization costs and analyzed how the new protocol affected them. This analysis was justified by the growing need for better economic efficiency in perioperative care with no decrease in care quality [26]. We estimated an 800 euro per patient reduction thanks to the adoption of the fast track protocol as compared to the standard one. The main factor contributing to the decrease of costs is the cost reduction of the hospitalization phase, that depends on the duration of the overall care period, and that turned out to be statistically significant. In our records an average two days reduction of the hospital stay for those patients undergoing fast track than the standard protocol was estimated. A decrease in the same variable was reported even by Kariv "et al." [27]. In Cleveland, as a result of the post-operative care regarding some patients which underwent proctectomy with ileal pouch-anal anastomosis. In that survey the costs and complications affecting patients throughout a 30 day long period after surgery were analyzed. The patients, previously managed according to the fast track protocol, were compared to some other patients who had undergone standard treatment by another surgery team. The complication rates, as referred to both groups, were similar, and so were readmission rates. The patients of the fast track group were characterized by a shorter hospital stay and the median of the direct costs per patient throughout the 30 day period was 1000 euro lower than the one of the patients who belonged to the control group. This result was made possible mainly by a decrease of the costs relative to anesthesia, nursery, laboratory exams and other services such as the respiratory physiotherapy, the education in stoma management and nutrition education centers. In our survey the cost decrease was related to not only the duration of the hospital stay, but also a reduction of laboratory tests, drugs and periods spent in intensive care unit, which occurred more often within the patients of the control group.

In addition, this protocol, while reducing the duration of the patients' presence in a hospital, would determine even an increase in the availability of beds in the interested divisions. As already stated by Adamina "et al." [28], the fast track protocol optimizes resource usage by shortening the patients' stay in hospitals and speeding up the discharge. It may be worth reminding that the LAFA3 analysis [29] included results that pushed towards this direction. This study was the first randomized, prospective trial carried out among nine centers in Norway, which showed how the combination between laparoscopic surgery and patient management based on the fast track protocol could lead to a shorter hospital stay than in other situations. The afore mentioned analysis showed that this new protocol can reduce costs mainly by means of a reduction of hospitalization costs, although the data were no statistically significant.

Conclusion

Given the evidence of validity of those programs, they should be routinely used in the management of patients undergoing colorectal surgery, in particular during periods with limited economic resources.

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