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Research Article

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An Observational Study of Oncological and Short-term Outcomes in Laparoscopic Colon Surgery

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Abstract

Objective: *The advancement of colorectal surgery through a laparoscopic approach has represented one of the greatest challenges for digestive surgeons in the modern era.*

The lack of understanding of the oncological quality and radical nature of this approach has long been the cause of the delay in its implementation in colonic pathology, especially for malignancies.

Our objective is to share the results and analysis of the oncological quality of the work we have done in the Coloproctology Section of Médica Uruguaya (MUCAM).

Methods: *This was a descriptive, retrospective, observational study of a prospective database of patients over 15 years of age who underwent consecutive laparoscopic colon surgery. The plants were scheduled between December 2008 and December 2022 at the MUCAM. A total of 432 patients underwent surgery (377 cancer patients).*

Demographic population characteristics, hospital stay, suture leakage, reinterventions, 90-day mortality, nodal harvest, overall survival, cancer-related survival, disease-free survival.

Results: *Our series included 53% women and 47% men, with an average age of 62.6 years (15-90 years). The average hospital stay was 4 days. We reported 5.5% suture leakage, 11.3% reintervention and 3.2% mortality at 90 days. The average nodal harvest was 16.*

Overall survival rates were 77.7% and 65.5% at 5 and 10 years, respectively, and cancer-related survival rates were 82.7% and 79.2% at 5 and 10 years, respectively. The median survival was 136.6 months. The 5-year survival rates for patients with stage 0 disease were 96.6%, 91.7% for those with EI, 92.8% for those with IBD, 80.3% for those with stage III, and 35.2% for those with EIV.

Our study has the limitation of being a retrospective case series in a single health institution.

Conclusions: *The above results show that laparoscopic colon surgery is feasible and safe in our environment and is comparable to large prospective, randomized, multicenter studies.*

Keywords: Colon Cancer. Laparoscopic Surgery. Oncological Outcomes

Introduction

Advances in colorectal surgery through laparoscopic approaches have undoubtedly represented one of the greatest challenges for digestive surgeons in the modern era. Despite the obvious advantages of this approach compared to conventional surgery, its implementation should be faster and more effective, but several factors contribute to its slower development compared to laparoscopic cholecystectomy or esophageal hiatus surgery.

Laparoscopic colorectal surgery involves working in multiple quadrants, performing intestinal anastomoses, using sutures, and controlling large-caliber blood vessels [1].

In the early years of its development, laparoscopic colorectal cancer surgery was marred by the description of large numbers of tumor implants in trocar scars, which raised doubts about its possible application in oncological surgery.

It was Moises Jacobs in the United States who first published reports on minimally invasive surgery in the treatment of colorectal pathology [1-4].

A few years later, Lacy, in a randomized study with more than 200 patients, showed similar results and even better survival in patients with stage III disease by laparoscopy. The authors attributed this situation to a likely better immune response with this approach [1].

Since then, multiple studies have shown that there are no differences in terms of survival associated with this approach compared to conventional surgery in patients with colon cancer.

The COST, COLOR, and CLASICC studies were among the first randomized controlled trials that changed the course of laparoscopic colorectal surgery. They demonstrated the safety and effectiveness of this approach in malignant pathology [1-3].

The perioperative and oncological results were similar to those found in open surgery, with all the known postoperative benefits of laparoscopy. These results were confirmed years later in long-term analyses of some of the aforementioned study populations [1, 2].

However, not all patients are candidates for this approach, and technique selection depends on several factors, such as the surgical team's experience, the complexity of the surgery and the patient's condition; therefore, the decision must be individualized and adapted to each patient.

Quality in colorectal surgery can be measured through the use of different indices, such as suture failure, harvest and lymph node index, reinterventions, readmissions and operative mortality, beyond purely oncological indices.

The analysis of these indices allows us to understand our reality and be able to compare our results with those of international centers, daily seeking excellence in care through high-quality procedures and the best results for our patients [1-3].

Currently, there are different strategies available for optimizing the recovery of patients who have undergone colorectal surgery. These are multimodal rehabilitation programs that include a set of perioperative care aimed at reducing the physiological response to surgical stress and improving postoperative recovery through a multidisciplinary team.

From the first Fast Track programs to the current ERAS (enhanced recovery after surgery) programs, there has been a decrease in morbidity and mortality, mainly due to a substantial improvement in anesthetic management.

In the Anglo-Saxon and Asian literature, there is scarcely any evidence generated from developing countries, especially from Latin America, regarding experiences in laparoscopic colon surgery [1-4].

The results generated by our group reveal that working in multidisciplinary teams, with methodology and systematization, can achieve levels of excellence even in developing countries.

Objective

The aim of this study was to share our daily work in the Coloproctology Section of Médica Uruguaya (MUCAM) since the beginning of laparoscopic surgery at our institution as a standard approach for colon pathology.

Furthermore, we report our results for the period from December 2008 to 2022 in terms of demographics, duration of hospital stays, readmission, removal rate and number of lymph nodes, suture leakage, reintervention, disease-free survival, overall survival, cancer-related survival and survival by stage.

Materials and Methods

An observational study was carried out through retrospective analysis of a prospective database in Microsoft Excel for Mac spreadsheet version 16.66 and medical records.

The IRB of Médica Uruguaya endorsed the conduct of this study based on a prospectively and consecutively filled database of all patients who underwent elective colon surgery at our institution. All patients included in the study signed informed consent for surgery and participation.

As inclusion criteria for the study, we utilized all patients aged 16 years and above who underwent elective consecutive colon surgeries at our institution. Patients younger than this age and who underwent emergency surgeries were excluded. We highlight the inclusion of intraperitoneal rectal surgery as colon surgery due to its similarity in technical aspects, as well as its oncological behavior.

A total of 432 consecutive patients over 15 years of age who underwent surgery via a laparoscopic approach for colonic pathology between December 2008 and 2022 at the MUCAM were included. For the oncological analysis, colectomies for adenocarcinoma (360 patients) were considered. Patients who underwent emergency surgery were excluded from this analysis.

We defined term suture failure as encompassing all patients who required surgery or another percutaneous intervention to address a disruption in the continuity of the anastomosis we performed. This includes patients with peritonitis in its various presentations, as well as abscesses and perianastomotic collections.

As of June 2017, all patients in the series followed the standard of care of the ERAS programs. ERAS is a new way of understanding perioperative care that is based on 3 fundamental pillars.

First, a multidisciplinary work team including anesthesiologists, nurses, nutritionists, ostomatherapists and surgeons interacts with all the necessary specialists to guarantee the best quality of care, centering the patient in their work.

A second pillar is a paradigm shift in the care of patients undergoing colon surgery through evidence-based practices: adopting pre, intra- and postoperative measures aimed at reducing the response to surgical stress and modulating physiological factors and thus trying to reduce the most frequent complications of this surgery.

The third pillar is the audit through software provided by the program, which allows us to control our processes and results permanently and in real time. These clinical management protocols go hand in hand with a fundamental premise in any strategic plan to improve the quality of care, which says what we cannot measure we cannot control, what we cannot control we cannot manage, and if we cannot manage, we cannot improve.

Continuous variables are expressed as the mean with standard deviation (SD) or median and range. Categorical variables are expressed as N and/or percentages. A P value <0.05 was considered to indicate statistical significance; survival was analyzed using the Kaplan–Meier test. Statistical analysis was performed using IBM SPSS W statistical software version 26.0.

Results

A total of 377 of the 432 patients who underwent surgery had disease due to oncological pathology, and 55 had nononcological disease. Of the first, 360 corresponded to adenocarcinoma. The distribution by sex was similar, with 53% women and 47% men, and the average age was 62.6 years (15–90 years). (Table 1).

Table 1: Caracteristics of series population.

432 total patients	377 ocnologic patients	55 benign patology
	360 adenoc./17 other malignancy	
200 female (53%)	177 male (47%)	
Min. Age 15 y.o	Max. Age 90 y.o	Avg. Age 62,6 y.o

Compliance with the measures proposed in the ERAS protocol by our team is currently 77%. Currently, our institution is certified as an ERAS Center of Excellence, and the colorectal surgery team is also certified as a trainer of the ERAS implementation program (EIP).

A total of 217 were right colectomies, 45 were left colectomies, 11 were sigmoidectomies, 153 were anterior intra-abdominal rectal resections, and 17 were total abdominal colectomies. All the previously mentioned surgeries were performed interchangeably by two senior surgeons from the colorectal surgery team at our institution throughout the study period.

At the beginning of the experience, few laparoscopic colon surgeries were performed due to the overlap with surgeons performing laparotomy colectomies. Currently, the unit performs more than 100 scheduled laparoscopic colorectal surgeries annually.

The average operative time was 127 minutes, and the median hospital stay was 4 days (2-35 days). There was 5.5% (24 patients) suture leakage, 49 reinterventions (11.3%) and 3.2% (14 patients) mortality at 90 days. Twelve patients (2.8%) were readmitted. (Table 2)

Table 2: Type of surgeries and quality of surgery.

Right colectomy	217 (50,2)
Left Colectomy	34 (7,9)
Sigmoidectomy	11 (2,5)
Intraabdominal rectal resection	153 (35,5)
Total abdominal colectomy	17 (3,9)
Suture Leakage	24 (5,5)
Reinterventions	49 (11,3)
90 days Mortality	14 (3,2)
Readmission	12 (2,8)
AVG LOS	4 days (2-35 says)
AVG Op. Time	127 min. (50-300 min.)

Among the adenocarcinomas, 2 patients had stage 0 disease, 74 had stage I disease, 124 had stage II disease, 111 had stage III disease and 24 had stage IV disease. The average number of harvested lymph nodes harvested was 16 (5-87), with 72% of patients having more than 12 nodes resected.

Lymph nodes were positive in 125 patients (34.7%), and the lymph node ratio was 0.34 when more than 12 nodes were resected and 0.36 when fewer than 12 were resected; these values were not significantly different (p>0.05). Of the 377 oncologic patients, 10 experienced local relapses, and 47 experienced systemic relapses. (Table 4)

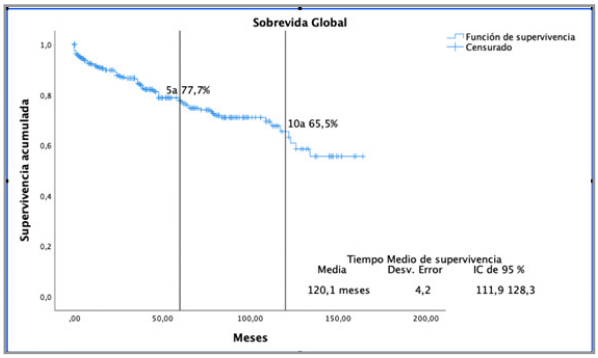
Table 3: Distribution TNM stadification for Adenocarcinomas.

TNM Stadification	# Patients
Stage 0	27
Stage I	74
Stage II	124
Sateg III	111
Stage IV	**24**

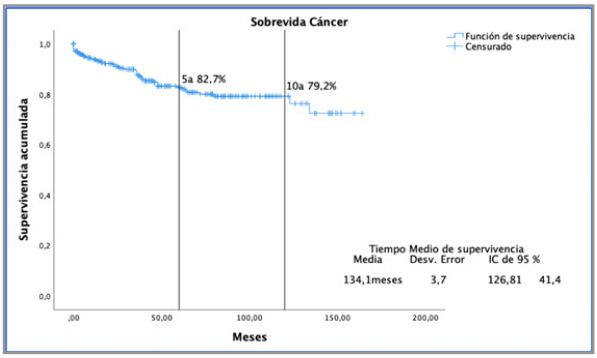
Table 3: Distribution TNM stadification for Adenocarcinomas.

	# Patients (%)
Min. Harvest LN	5
Max. Harvest LN	87
AVG Harvet LN	16
LN+	125 (34,7)
LN-	235 (65,3)
>12LN	LNRatio 0,34
<12LN	LNRario 0,36 (p>0,05)
Local Relapses (LR)	10 (2,8)
Systemic Relapses (SR)	47 (13)

The overall survival rates of the patients in the series were 77.7% and 65.5% at 5 and 10 years, respectively, with a mean survival of 120.15 months (95% CI 111.99 - 128.32). The cancer-related survival rates in our series were 82.7% and 79.2% at 5 and 10 years, respectively, with a median survival of 134.09 months (95% CI 126.78–141.40). (Graph 2).

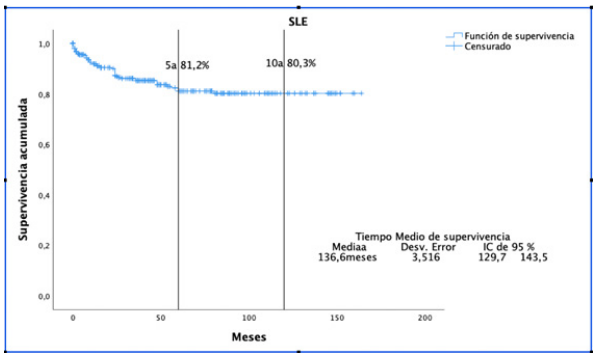


Graph 1: The 5- and 10-years overall survival in our series.

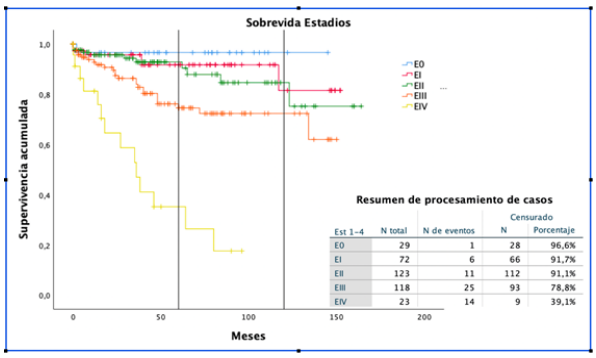


Graph 2: The 5- and 10-years cancer-related survival in our series.

The local and/or systemic disease-free survival time was 136.6 months (95% CI 129.7 - 143.5) (Graph 3). Discriminating by stage, the 5-year survival rate was 96.6% for Stage 0, 91.7% for Stage I, 91.1% for Stage II, 78.8% for Stage III and finally for Stage IV. 39.1% (Graph 4)



Graph 3: The 5- and 10-years disease-free survival



Graph 4: Discriminating by stage, 5-year survival rate.

Discussion

The benefits of laparoscopic colorectal surgery, such as less surgical trauma, less bleeding, less postoperative ileus, less pain and shorter hospital stays, are widely recognized.

Since the COST, COLOR and CLASICC studies, which demonstrated the oncological safety and efficacy of laparoscopic procedures in the treatment of malignant diseases of the colon, there has been an exponential increase in the use of minimally invasive approaches worldwide. In addition, better short-term results have been observed in certain population groups, such as elderly patients, which is a less invasive alternative with less blood loss and shorter hospital stays than conventional surgery [7-9].

Despite all the benefits reported by laparoscopic colon surgery, one of our groups' concerns from the beginning of the experience was to permanently audit our results and evaluate whether they are comparable with experiences published in other media. At fourteen years after onset, with an average follow-up of 52.5 months, and for 71% of patients after more than 2 years, we present our oncological and short-term results.

As there are multiple quality indicators in colon surgery we decided to consider the following to meet our objectives: anastomotic leakage rate, operative mortality, duration of hospital stay, readmission, reinterventions, harvest and lymph node index, oncological follow-up, overall and cancer-related survival, and disease-free survival [1].

Our average incidence of anastomotic leakage was 5.5%: 5% for intracorporeal suturing and 9% for extracorporeal suturing. We have not reported any cases of ileocolic suture failure in the last 28 months, highlighting that we have been performing these exclusively side-to-side isoperistaltic intracorporeal sutures with a 45 mm violet reload stapler for 6 years. Colorectal anastomosis was reported in 4.5% of patients, which is within the range reported in international studies [1, 2].

Murray reviewed 23,568 patients from the American College of Surgeons (ACS-NSQIP) database and observed lower rates of anastomotic leakage with laparoscopic surgery than with conventional surgery (2.8% vs. 4.5%, respectively) [1].

The ANACO reference study, a Spanish prospective multicenter study, showed a median anastomotic leakage of 8.5%, with 25th and 75th percentiles of 6.1% and 12.4%, respectively.

The European Society of Coloproctology collaborating group reported an overall incidence of 8.3% for ileocolic anastomosis [1].

The highest incidence of leakage in ileocolic anastomosis stands out in our series. During the first 8 years of experience, we performed extracorporeal "Barcelona" type sutures, with leakage rates close to 9%, so we began to perform intracorporeal sutures. Colorectal anastomosis was always performed in the same way from the beginning of the experience, with the double stapler technique.

Although intracorporeal anastomosis is technically more demanding, its benefits are recognized, especially in obese patients where traction and tearing of the mesos are avoided, which can occur when the piece is removed to perform extracorporeal anastomosis. On the other hand, it provides the possibility of extracting it through a Pfannenstiel incision, which is less invasive than a median supraumbilical incision, the one we usually use to perform extracorporeal anastomosis.

The median hospital stay was 4 days, with a low readmission rate of 2.8%, 14 patients. There has been a clear downward trend in the length of stay in recent years, with a large number of patients with 2 and 3 days of hospitalization, which correlates with the incorporation of the ERAS protocol since 2015 and the formal accreditation by the ERAS Society since 2017.

The results are comparable to those published by Shah, who reported a median hospitalization of 4 days with a high readmission rate of 12%, although he identified ileostomy as the main factor in the multivariate analysis. Shah included patients who were not considered in our study series since we decided to exclude lower rectal cancer because we considered it a different pathology [2].

The implementation of the ERAS® Program allows us to continuously audit our results through the use of online software, which links our experience to more than 180,000 patients around the world. This working modality allows us not only to control our results but also to compare them with those of worldwide centers, improving them based on scientific evidence [10-15].

References from the ANACO study show a median hospital stay of 10.28 days and a reintervention rate of 12%, which a priori may seem somewhat high [16-23].

A prospective, observational, multicenter, Norwegian analysis revealed a reintervention rate of 8.7%, which was slightly lower than that of our series [2, 24].

When we analyzed the causes of our reinterventions, we identified 49 (11.3%) cases, 8 of which involved nontherapeutic laparoscopies, reducing therapeutic reinterventions to 9.49%. Our strategy to improve results when there are complications is to perform surgery vigorously through early relaparoscopy, in the same way as when there is unexpected clinical evolution or an ascending PCR and procalcitonin curve.

This strategy has allowed us to reduce the need for scheduled reinterventions, morbidity and mortality and, ultimately, healthcare spending.

The operative mortality at 90 days was 3.2% (14 patients), which was slightly greater than that reported by the ANACO study x, which was 2% (0.6-4.7%). The mortality of our series in the last 3 years was 3 patients (2.3%).

Another quality indicator in colon cancer surgery is lymph node extraction, since it constitutes one of the main independent prognostic factors in this pathology, having a great impact on overall and disease-free survival, in addition to determining the indication for adjuvant treatment.

Currently, a minimum of 12 nodes is suggested for classifying surgical colon resection as oncologically sufficient. However, this is an arbitrary, debatable figure that depends on multiple factors. These include the resection quality, the thoroughness of the pathologist's search for the nodes, the tumor stage of the disease and the anatomical and biological factors of each patient.

Our series revealed that 72% of the nodes had a node count greater than 12 (n=260). Regardless of whether the nodal harvest was greater or less than 12, the nodal ratio did not significantly differ (0.34 vs. 0.36), which does not affect oncological radicality. We also did not observe a correlation with a higher incidence of locoregional recurrence.

Following the same line of research, regarding the resection quality, we decided to review photographic documentation of low lymph node count patient tissue, finding no evidence of poor quality in the extent of the surgery performed. This was carried out by a group external auditor, an anatomopathologist with a special dedication to coloproctology.

Sometimes a patient with a low lymph node count is questioned or interpreted as an insufficient surgically treated patient, which could lead to underdiagnosis and sometimes to overtreatment given the possibility of indicating adjuvant treatment in such an eventuality. Hence, it is important to discuss these patients in multidisciplinary groups to help them interact and define possible treatments with oncologists, pathologists, imaging specialists and surgeons.

According to our analysis, the overall survival rates were 77.7% and 65.5% at 5 and 10 years, respectively, with a mean survival of 120.15 months (95% CI 111.99 - 128.32). These figures are higher than those reported in the COST study xiv of 66.8% at 5 years for the laparoscopic group and are similar to those reported in the CLASICC study xvi, where overall survival was 85.1% in both the conventional and laparoscopic groups [25-30].

Conclusion

Our study has some limitations regarding the number of patients analyzed over such a long period of time, but this is an undeniable reality in developing countries with small populations, where establishing high-volume centers is very complex. Additionally, over the years, through the unification and centralization of surgeries, we have managed to perform just over 100 laparoscopic colorectal surgeries per year in our unit.

Another limitation is the difficulty in patient follow-up; however, we managed to achieve this in more than 90% of our patients through telephone interviews or in-person consultations.

Our series included a large number of patients, considering the reality of our country, as well as many others in Latin America and other developing countries. Additionally, this is the largest series with long-term follow-up in Uruguay.

The results presented through the analysis of different quality indicators in our series show that laparoscopic colon surgery is feasible and safe in our environment, with oncological and short-term results comparable to those of large multicenter prospective randomized studies.

As it is a technically demanding surgery with a long learning curve, we recommend performing it in the context of multidisciplinary teams with exclusive dedication, where perioperative procedures and processes are systematized, especially within multimodal rehabilitation programs.

References

1. Balen, E., Suarez, J., Ariceta, I., Oronoz, B., Herrera, J., & Lera, J. M. (2005, January). Laparoscopic surgery in colorectal diseases. In Anales del Sistema Sanitario de Navarra (Vol. 28, pp. 67-80).
2. Wexner, S. D., & Cohen, S. M. (1995). Port site metastases after laparoscopic colorectal surgery for cure of malignancy. Journal of British Surgery, 82(3), 295-298.
3. Reilly, W. T., Nelson, H., Schroeder, G., Wieand, H. S., Bolton, J., & O'Connell, M. J. (1996). Wound recurrence following conventional treatment of colorectal cancer: a rare but perhaps underestimated problem. Diseases of the colon & rectum, 39, 200-207.
4. Whelan, R. L., & Young-Fadok, T. M. (2004). Should carcinoma of the colon be treated laparoscopically?. Surgical Endoscopy And Other Interventional Techniques, 18, 857-862.
5. Jacobs, M., Verdeja, J. C., & Goldstein, H. (1991). Minimally invasive colon resection (laparoscopic colectomy). Surgical Laparoscopy Endoscopy & Percutaneous Techniques, 1(3), 144-150.
6. Lacy, A. M., García-Valdecasas, J. C., Delgado, S., Castells, A., Taurá, P., Piqué, J. M., & Visa, J. (2002). Laparoscopy-assisted colectomy versus open colectomy for treatment of non-metastatic colon cancer: a randomised trial. The Lancet, 359(9325), 2224-2229.
7. Weeks, J. C., Nelson, H., & Geiber, S. (2004). A comparison of laparoscopic assisted and open colectomy for colon cancer: the clinical outcomes of surgical therapy study group. N Engl J Med, 350, 2050-9.
8. Buunen, M. (2009). Colon Cancer Laparoscopic or Open Resection Studfy Group. Survival after laparoscopic surgery versus open surgery for colon cancer: long-term outcomes of a randomised clincal trial. Lancet Oncol., 10, 44-52.
9. Green, B. L., Marshall, H. C., Collinson, F., Quirke, P., Guillou, P., Jayne, D. G., & Brown, J. M. (2013). Long-term follow-up of the Medical Research Council CLASICC trial of conventional versus laparoscopically assisted resection in colorectal cancer. Journal of British Surgery, 100(1), 75-82.
10. Deijen, C. L., Vasmel, J. E., de Lange-de Klerk, E. S. M., Cuesta, M. A., Coene, P. L. O., Lange, J. F., ... & Bonjer, H. J. (2017). COLOR (COlon cancer Laparoscopic or Open Resection) study group. Ten-year outcomes of a randomised trial of laparoscopic versus open surgery for colon cancer. Surg Endosc, 31(6), 2607-15.
11. Bingener, J., Sloan, J. A., Novotny, P. J., Pockaj, B. A., & Nelson, H. (2015). Perioperative patient-reported outcomes predict serious postoperative complications: a secondary analysis of the COST trial. Journal of gastrointestinal surgery, 19(1), 65-71.
12. Liz, A., Castro, A., Soumastre, A., Lavega, Á., Fagúndez, N., & Malet, M. V. (2022). Seguridad y calidad oncológica de la cirugía por cáncer colorrectal en un centro docente universitario. Revista Argentina de Coloproctología, 33(3).
13. Bannura, C. G. (2014). Quality standards in colorectal surgery. Revista Chilena de Cirugía, 66, 86–91.

14. De La Portilla, F. (2018). Analysis of quality indicators in colorectal cancer surgery in units accredited by the Spanish Association of Coloproctology. Cirugía Española, 96(3), 139–146. https://doi.org/10.1016/j.ciresp.2017.06.003
15. Gustafsson, U. O., Scott, M. J., Schwenk, W., Demartines, N., Roulin, D., Francis, N., ... & Ljungqvist, O. (2013). Guidelines for perioperative care in elective colonic surgery: Enhanced Recovery After Surgery (ERAS®) Society recommendations. World journal of surgery, 37, 259-284.
16. Ljungqvist, O., Scott, M., & Fearon, K. C. (2017). Enhanced recovery after surgery: A review. JAMA Surgery, 152(3), 292–298. https://doi.org/10.1001/jamasurg.2016.4952
17. Gustafsson, U. O., Scott, M. J., Hubner, M., Nygren, J., Demartines, N., Francis, N., ... & Ljungqvist, O. (2019). Guidelines for perioperative care in elective colorectal surgery: enhanced recovery after surgery (ERAS®) society recommendations: 2018. World journal of surgery, 43, 659-695.
18. Greer NL, Gunnar WP, Dahm P, Lee AE, MacDonald R (2018) Enhanced Recovery Protocols for Adults Undergoing Colorectal Surgery: A Systematic Review and Meta-analysis. Dis Colon Rectum 61: 1108-1118.
19. Nishikawa, T., Ishihara, S., Hata, K., Murono, K., Yasuda, K., Otani, K., ... & Watanabe, T. (2016). Short-term outcomes of open versus laparoscopic surgery in elderly patients with colorectal cancer. Surgical endoscopy, 30, 5550-5557.
20. Vergara-Fernandez, O., Swallow, C. J., Victor, J. C., O'Connor, B. I., Gryphe, R., MacRae, H. M., ... & McLeod, R. S. (2010). Assessing outcomes following surgery for colorectal cancer using quality of care indicators. Canadian journal of surgery, 53(4), 232.
21. Kube, R., Mroczkowski, P., Steinert, R., Sahm, M., Schmidt, U., Gastinger, I., & Lippert, H. (2009). Anastomotic leakage following bowel resections for colon cancer: multivariate analysis of risk factors. Der Chirurg, 80, 1153-1159.
22. Baker IS, Grossmann I, Henneman D, Havenga K, Wiggers T (2014) Risk factors for anastomotic leakage and leak-related mortalitity after colonic cáncer surgery in a nationwide audit. Br J Surg 20101: 424-432.
23. Murray AC, Chuzan C, Kiran RP (2016) Risk of anastomotic leak after laparoscopic versus open colectomy Surg Endosc 30: 5275-5282.
24. Sancho-Muriel, J., Frasson, M., Hervás, D., Flor-Lorente, B., Rodriguez, J. L. R., Simó, M. R., ... & ANACO Study Group. (2017). Standard outcome indicators after colon cancer resection. Creation of a nomogram for autoevaluation. Cirugía Española (English Edition), 95(1), 30-37.
25. 2015 European Society of Coloproctology Collaborating Group, Glasbey, J. C., Nepogodiev, D., Battersby, N., Bhangu, A., El-Hussuna, A., ... & Karvonen, J. (2018). The impact of stapling technique and surgeon specialism on anastomotic failure after right-sided colorectal resection: an international multicentre, prospective audit. Colorectal disease, 20(11), 1028-1040.
26. Shah, P. M., Johnston, L., Sarosiek, B., Harrigan, A., Friel, C. M., Thiele, R. H., & Hedrick, T. L. (2017). Reducing readmissions while shortening length of stay: the positive impact of an enhanced recovery protocol in colorectal surgery. Diseases of the Colon & Rectum, 60(2), 219-227.
27. Nymo, L. S., Norderval, S., Eriksen, M. T., Wasmuth, H. H., Kørner, H., Bjørnbeth, B. A., ... & Lassen, K. (2019). Short-term outcomes after elective colon cancer surgery: an observational study from the Norwegian registry for gastrointestinal and HPB surgery, NoRGast. Surgical Endoscopy, 33, 2821-2833.
28. Martinez D (2008) Is there a minimum number of lymph nodes that should be analyzed in colorectal cancer surgery? Cir Esp 83: 108-117.
29. NCCN Clinical Practice Guidelines in oncology. Colon Cancer. Version 4.2018- October 19, 2018 www.nccn.org
30. Wong J (1999) Number of nodes examined and staging accuracy in colorrectal carcinoma. Journal of Oncol 17: 2896-2900.