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Case Report

Colon Cancer Surgery in Jehovah's Witnesses Patients: Case Series and Literature Review

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Abstract

Background and objectives: The refusal of blood transfusions and blood derivatives compels surgeons to face clinical and ethical challenges. We reviewed our perioperative and long-term outcomes of Jehovah's Witnesses undergoing colon cancer surgery to evaluate the feasibility of bloodless procedures.

Methods: We retrospectively analyzed data from patients with colon cancer and Jehovah's Witnesses who underwent surgery between January 2014 and December 2023. A protocol was systematically followed to optimize hemoglobin levels and other parameters according to the Enhanced Recovery After Surgery guidelines.

Results: Sixteen patients underwent colon surgery, with a median age of 69 years and an equal gender distribution. Thirty-seven and a half percent had preoperative anemia and were managed by a hematologist. All procedures were performed in accordance with oncological standards. Postoperative treatment included low molecular weight heparin, and hemoglobin levels temporarily decreased postoperatively. No blood transfusions were needed during hospitalization. Two patients required surgical intervention due to postoperative hemorrhage. Complications included anastomotic dehiscence and perforation, with an overall morbidity rate of 25% and no 90-day mortality.

Conclusions: This study highlights the challenges in managing patients who reject blood products during colon cancer surgeries; however, the outcomes show results comparable to those of the general population with appropriate protocols. Preoperative optimization is crucial to reduce blood loss. Treatment of postoperative hemorrhage requires a lower threshold for intervention due to limited alternatives to blood products. Despite the limitations of the study, the findings advocate for careful monitoring and intervention. Larger studies are needed to validate these findings and improve care for this group of patients.

Introduction

Colorectal cancer (CRC) is one of the most common cancers affecting both sexes. In the United States, colorectal cancer remains the third most common cancer and the third leading cause of cancer-related death.[1]

It has been shown that the incidence of colon cancer per 100,000 people decreased from 60 in 1976 to 46 in 2005 and, more recently, to 38 in 2016.[1,2] Generally, 90% of CRC patients are diagnosed at 50 years of age or older, with decreasing incidence and mortality rates in this age group since 1947 in women and since 1980 in men. However, both have been increasing for those under 50 years old.[1,2]

A report from the Surveillance, Epidemiology, and End Results for CRC, after conducting a retrospective cohort study, is consistent with the information that the incidence of CRC in those under 50 years of age has increased.[3] The authors inferred an increase

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in incidence for colon and rectal tumors of 90.0% and 124.2%, respectively, for patients aged 20 to 34 years in the year 2030.[4]

The treatment of colon cancer patients is defined according to the stage of onset, emphasizing the importance of a comprehensive strategy for diagnosis, evaluation, and treatment. In the American cohort of the international CONCORD-2 study, the five-year net survival was 90%, 70%, and 14% among those with localized, regional, or distant distribution of their colon cancer, respectively.[5] Surgery is the fundamental treatment for most colon cancer patients, except for those requiring chemotherapy in an adjuvant context.

The goal of surgery is to completely remove the tumor, the main vascular pedicle, and the corresponding lymphatic drainage area.[6]

The restoration of intestinal continuity through primary anastomosis can be achieved in most patients undergoing uncomplicated colectomy.[6] Complications associated with the surgical procedure itself include surgical site infection, ureteral injury, anastomotic leak, intra-abdominal abscess, enteric fistula, bleeding, and postoperative intestinal obstruction, among others.[7]

The safety of colorectal surgery has dramatically improved over the past 50 years due to improvements in preoperative preparation, antibiotic prophylaxis, surgical technique, and postoperative management.[7]

In addition to other factors, perioperative morbidity and mortality after surgery largely depend on the patient's associated comorbidities and baseline status at the time of surgery.[7]

Enhanced Recovery After Surgery (ERAS) protocols, which have been universally implemented for colon cancer surgery, have contributed to this improvement. In the case of our country, Spain, a clinical pathway called RICA (Intensified Recovery in Adult Surgery) has also been established, providing perioperative recommendations for surgical patients, including information on desirable preoperative hemoglobin levels as one of its guidelines. Since there is a correlation between preoperative anemia and postoperative mortality, morbidity, and increased transfusion risk, it is recommended that preoperative hemoglobin concentration before surgical intervention be above 13 g/dL, regardless of gender/sex.[8]

There is no definite agreement on what the definitive hemoglobin transfusion threshold level is, but the diverse literature and available studies seem to demonstrate that mortality increases in patients with hemoglobin concentrations below 5 g/dL. For healthy individuals, the threshold may be even lower, but comorbid conditions such as oncological pathology requiring surgery, trauma, sepsis, and cardiovascular diseases may influence this figure.[9]

The role of anemia in the healing of anastomoses, one of the most feared complications in colon surgery, remains controversial.[10] Some authors have shown that in anemic patients, there is an increased incidence of colonic anastomosis dehiscence. Zaharie *et al*. have shown that low levels of serum hemoglobin (<9.9 mg/dL) are an independent factor for anastomotic fistula.[11] Other authors found no effect of preoperative anemia on the incidence of fistulas.[12] It seems possible that other factors associated with anemia in surgical patients are responsible for precipitating this complication, such as malnutrition, type of surgery, or hypovolemia causing tissue hypoxia.

On the other hand, recent studies have suggested a negative role of blood transfusions in the outcome of cancer patients, as they can depress the immune system and thus increase the risk of postoperative infectious complications and/or the incidence of anastomotic fistulas, as published by Tadros *et al*.[13] A multivariable analysis of factors associated with intestinal anastomotic fistulas showed that the incidence of digestive fistulas is significantly higher in transfused patients compared to non-transfused patients, regardless of blood loss, hypotension, or preoperative hemoglobin.[12] Boccola *et al*. also found that postoperative blood transfusion is an independent predictive factor for anastomotic leakage.[14]

Regardless of this controversial information about the benefits of blood transfusions in surgical patients, there are patients who do not accept receiving blood products under any circumstances. These are Jehovah's Witnesses (JW), a group of people who engaged in biblical analysis of traditional Christian doctrine under the leadership of Charles Taze Russell in the late 19th century in Pittsburgh, Pennsylvania, United States.[15] Regarding the medical field, JW reject blood transfusions for religious reasons, as they affirm that both the Old and New Testaments decree it, because for God, blood represents life, and refraining from receiving it is to respect God, who gave them life (Genesis 9:4; Leviticus 17:10–14; Deuteronomy 12:23; Acts 15:28, 29).[9] Currently, there are around eight million worldwide and more than 122,000 in Spain (one in every 400 Spaniards).

A study with JW showed that lower hemoglobin levels are associated with a higher risk of mortality in these patients. In a study with 300 patients who refused a blood transfusion, the odds of death increased by a factor of 2.5 for every 1 g/dL decrease in hemoglobin (Hb) at Hb of less than 8 g/dL.[15] A more recent update from a single center receiving JW (n = 293) who refused blood transfusion reported an overall mortality rate of 8.2%, with twice the risk of death for each decrease of 1 g/dL in Hb value.[16]

However, they do accept receiving oral or intravenous iron therapy and administration of recombinant human erythropoietin, treatments that have been demonstrated to be effective in the perioperative management of patients with colon cancer and within the aforementioned RICA clinical pathway.[8]

In these challenging circumstances, healthcare professionals struggle between ensuring the highest quality of care and respecting patients' religious/cultural beliefs.[17] This requires a well-established communication with patients and their families so that decision-making is shared.

Several studies have been conducted on the medical and legal difficulties faced by physicians treating JW when involving the four fundamental principles of medical ethics (beneficence, non-maleficence, autonomy, and justice).[18] Overseeing these situations can be frustrating or seem irrational to doctors. Sometimes, blood refusal can lead to the patient's death and contravene the principle of non-maleficence, but the principle of autonomy guided by informed consent must be respected.

These patients present unique challenges, particularly in the context of anemia or sepsis, both of which can be complications of the surgical procedures necessary for the treatment of colon cancer. Previous studies focused on cardiac surgery suggest that bloodless patients have comparable outcomes to those receiving standard care.[19] The scientific literature on these patients has traditionally been limited to the exposure of specific clinical cases or studies with limited retrospective data and no established guidelines to inform their management. During the bibliographic search, no source of information was found that combines this population group and their management and outcomes in colon cancer. This article is presented in a novel way with our series of JW patients with colon cancer, their management, and outcomes.

Materials and methods

We retrospectively analyzed data from patients with colon cancer and JW treated with surgery between January 2014 and December

2023 at the University Hospital of Torrejón (Madrid, Spain).

The inclusion criteria were: 1) patients over 18 years of age; 2) JW patients; 3) patients diagnosed with localized colon cancer; and 4) patients who were candidates for surgical treatment. The exclusion criteria were absolute contraindication to surgery or rectal cancer.

The surgical techniques used included: right hemicolectomy, right extended hemicolectomy, sigmoidectomy, left hemicolectomy, subtotal colectomy, and appendectomy. Laparoscopic procedures were performed in all cases except for one sigmoidectomy due to tumor size.

A multidisciplinary team comprising anesthesiologists, hematologists, oncologists, intensivists, and surgeons collaborated to develop preoperative optimization strategies. It is noteworthy that the perioperative protocol utilized for JW patients mirrored the institutional protocol routinely employed for transfusion-consenting patients. Our preoperative optimization protocol is based on the ERAS guidelines for colonic surgery.[20,21]

Preoperatively, comprehensive patient histories were obtained to identify potential medical conditions or medications warranting intervention. For instance, anticoagulant medications were discontinued to mitigate blood loss, with high-risk patients receiving bridging therapy involving therapeutic doses of low-molecular-weight heparin.

Clinical data and blood tests facilitated the detection and classification of concurrent medical conditions, including coagulation defects and preoperative anemia. Anemia was defined based on Hb levels, adhering to World Health Organization criteria (Hb < 13 g/dL for men and Hb < 12 g/dL for women).[22]

The multidisciplinary team evaluated patients requiring preoperative optimization to ensure optimal physical condition before surgery. During the intraoperative period, controlled hypotension was maintained to minimize bleeding. Blood salvage techniques, such as cell saver, were not available, and alternative blood-sparing measures, such as acute normovolemic hemodilution, were not employed. Intravenous hemostatic agents were used as needed, emphasizing rigorous hemostasis techniques and the utilization of surgical hemostatic tools and non-blood-derived topical hemostatics.

Postoperatively, most patients were monitored for 6 h, while those with high-risk comorbidities were monitored for 24 h in the Intensive Care Unit before transitioning to the ward. Antithrombotic prophylaxis commenced on postoperative day one with low-molecular-weight heparin if bleeding risks were absent.

Anemia and postoperative inflammatory disorders were monitored through blood tests. Intravenous iron was administered for Hb > 11 g/dL, while subcutaneous erythropoietin was administered for Hb < 11 g/dL.

Routine postoperative imaging was not performed unless selectively indicated in cases with deviations from the normal physical examination or abnormal clinical findings.

Resumption of oral feeding with a fractioned diet occurred on the first postoperative day, and protein and vitamin supplements were introduced after the first six postoperative hours.

All postoperative complications were recorded and classified according to the Clavien-Dindo scale.

The study was conducted in compliance with the ethical standards of our affiliated institutions and the principles outlined in the Declaration of Helsinki. The protocol was approved by the institutional review board of our institution. Individual consent for this retrospective analysis was waived.

The software IBM SPSS Statistics version 26 was used for statistical analyses. Continuous variables were reported as median and range, while categorical or dichotomous data were presented as percentages.

Table 1. Preoperative clinicopathological patient data

Variable	Number of patients (%)
Age, years, median (range)	69 (45–93)
Female	8 (50)
Diabetes Mellitus	4 (25)
Hypertension	10 (62)
Smoking habit	2 (12.5)
Chronic respiratory disease	3 (19)
Chronic renal disease	1 (6.25)
Preoperative Creatinine, median (range)	0.98 (0.6–3.12)
Preoperative erythropoietin	2 (12.5)
ASA	
1:	0
2:	11
3:	5
Histological diagnosis:	
Right colon adenocarcinoma:	6
Transverse adenocarcinoma:	2
Sigma adenocarcinoma:	3
Left adenocarcinoma:	2
Carcinoid ileocecal tumor:	1
Appendicular mucocele:	1
Follicular lymphoma:	1

ASA, American Society of Anesthesiologists.

Results

Clinicopathological characteristics of the patients

Sixteen patients underwent scheduled colon surgery at our institution. Results obtained from our patients were compared with the current scientific literature. The clinicopathological characteristics are detailed in Table 1. The median age was 69 years (range, 45–93), with a gender distribution of 50% female.

Patient treatments

All patients consented to treatment with erythropoiesis-stimulating agents (ESAs) to promote hematopoiesis. Preoperatively, anemia was detected in six cases (37.5%), prompting consultation with hematologists. Two patients (12.5%) required ESAs for optimization, and all six patients (37.5%) received intravenous iron treatment.

Surgical procedures included right hemicolectomy in nine patients (56%), one of which was an extended hemicolectomy; sigmoidectomy in three patients (18.7%); left hemicolectomy in two patients (12.5%); sigmoid colectomy in one patient (6.7%); and ileocecal resection in one patient (6.7%). The median operative

Table 2. Details of operative data

Variable	Number of patients (%)
Colon surgeries:	
Right hemicolectomy	9
Extended hemicolectomy	1
Sigmoidectomy	3
Left hemicolectomy	2
Subtotal colectomy	1
Ileocecal resection	1
Operating time, min, median (range)	135 (45–210)
Lymph node harvested, n, median (range)	15 (3–31)

time was 135 m (range, 45–210), with a median lymph node yield of 15 (range, 3–45) for all malignant neoplasms. Detailed operative data are presented in Table 2.

Low-molecular-weight heparin was initiated on postoperative day (POD) 1 for all patients except one with suspected hemorrhage. Resumption of antiplatelet or anticoagulant therapy was determined based on clinical assessment.

Median preoperative and postoperative day 1 hemoglobin levels were 13 g/dL (range, 8.9–16) and 11.4 g/dL (range, 9–12.9), respectively. Median hemoglobin at discharge was 10.9 g/dL (range, 8.2–12.8). Postoperatively, there was a transient decrease in median hemoglobin levels, likely attributable to intraoperative blood loss and subsequent inflammatory response. We hypothesize that stabilization of median hemoglobin levels near discharge reflects the resolution of inflammation and successful postoperative care, including erythropoiesis-stimulating drugs and dietary optimization (Fig. 1).

Post-operative complications

No patients received blood transfusions during hospitalization. There was one patient with Hb levels under 8 g/dL (7.7) who had no indication of blood transfusion. Two patients experienced postoperative hemorrhage requiring surgical reintervention.

Complications according to the Clavien-Dindo classification included: grade I–II in one patient (6.25%) due to conservatively managed anastomotic dehiscence; grade III in two patients (12.5%) with postoperative hemorrhage (epiploic bleeding in both cases, treated with electrocoagulation) requiring reintervention; and grade IV in one patient (6.25%) with postoperative perforation requiring reintervention and intensive care unit admission. The overall morbidity was 25% (four patients), while the 90-day mortality was 0% (Table 3).

Follow up

According to our long-term data, after 10 years of performing colon cancer surgery in patients with blood transfusion refusal, six patients (37.5%) have completed oncological follow-up, and nine patients (56.25%) are currently under medical follow-up. None of them has presented recurrence. Only one patient was lost to follow-up due to death from COVID-19 pneumonia (Table 4).

Discussion

A prerequisite for performing major surgical interventions in JW is consensus within the treatment team about the possibilities and

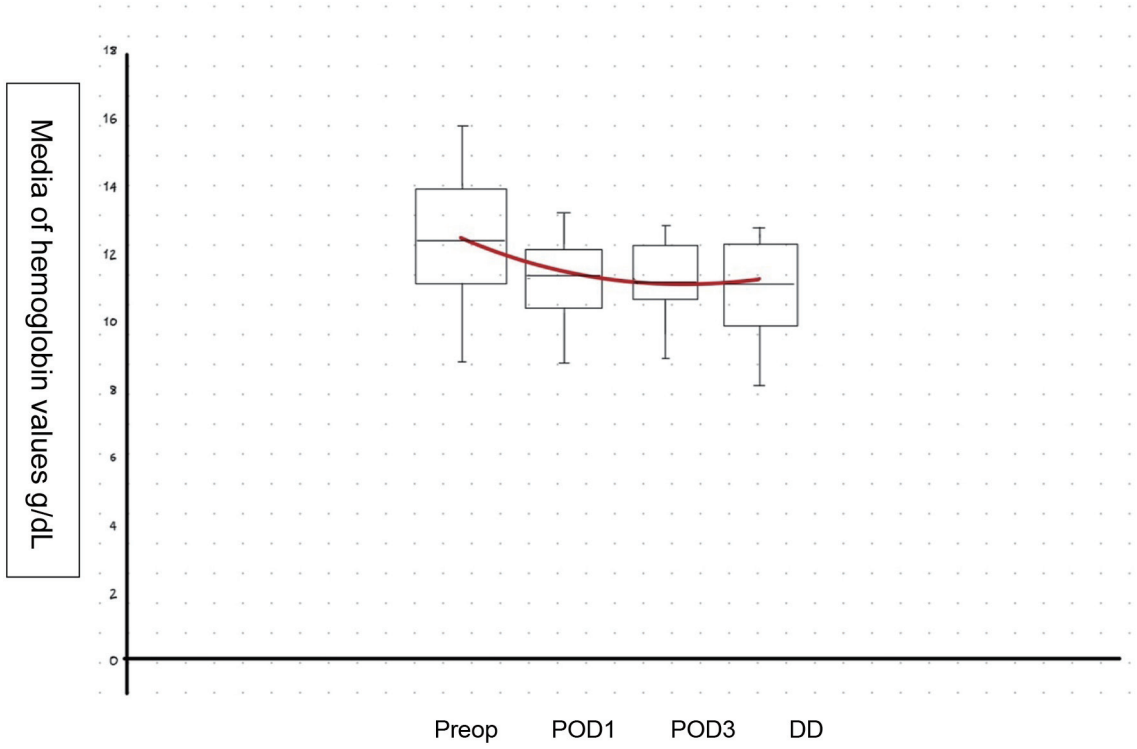

Fig. 1. Perioperative hemoglobin values. DD, Day of discharge; POD1, postooperative day 1; POD3, postooperative day 3; Preop, preoperative.

Table 3. Postoperative outcome

Variable	Number of patients (%)
90-day mortality 0	0
Morbidity 4	4
Blood transfusion:	0
Postoperative hemorrhage	2
Clavien-Dindo grade II	
Paralytic ileus*	1 (6.25)
Clavien-Dindo grade III	
Hemorrhage and reintervention	2 (12.5)
Clavien-Dindo grade Iva	
Perforation, reintervention and ICU	1 (6.25)
Hospital stays, days, median (range)	9 (2–35)

*The complication was assumed to be due to anastomotic dehiscence and was managed conservatively. ICU, intensive care unit.

limitations of the procedure, as well as the management of the patients in the perioperative phase. This consensus should be based on thorough discussions with the patient and a precise plan to optimize conditions to minimize blood loss. The purpose of this study is to demonstrate that this is feasible in JW patients who require oncological surgical interventions.[9]

The study sample consists of 16 patients. While this is a small sample size, the larger series of colon cancer in JW patients was not found in the literature.

The fact that 37.5% of patients in our series had anemia prior to surgery highlights the importance of preoperative evaluation and optimization in patients undergoing colorectal surgery. It also underscores the need for multidisciplinary management, including a preoperative assessment by the hematology department.

Antithrombotic prophylaxis was initiated on the first postoperative day, following the protocol applied in our center, which does not differ between JW and non-JW patients. There was no increased risk of bleeding or hemorrhagic complications. Postoperative hemoglobin levels were maintained within a range where the need for blood transfusion was not considered, and postoperative anemia was managed with the administration of ESAs, as with other patients in our unit. Transfusion requirements are often overestimated, and morbidity and mortality are rarely increased in patients with hemoglobin concentrations > 7 g/dL.[23] According to current guidelines, postoperative hemoglobin concentrations in this patient group should be maintained above 8 g/dL.[24] In our series, no patient had hemoglobin levels below this threshold.

Regarding postoperative complications, two patients required urgent reintervention due to active intra-abdominal bleeding. This complication in non-JW patients would also have required an invasive procedure and could not have been resolved with blood transfusion alone. In such cases, an endoscopic approach or embolization might have been attempted prior to surgery. Therefore, despite their belief regarding transfusions, JW patients do not have a higher morbidity or mortality rate after surgery, as there are many treatment modalities available to assist in their care.[24]

Complications after surgery

Between 10% and 30% of patients suffer some type of complica-

Table 4. Patological stage, adjuvant chemotherapy and follow-up

N° Patient	Year of inclusion	Presurgical Hb	TNM	N° Lymph Nodes	Stage	AChT	Type of ChT	Follow-up in our center (months)	Follow-up state.
1	2014	12	pT1 pN0 M0, G2.	23	I	No	No	60	Finish Follow Up
2	2014	13	pT3	0	IIA	No	No	60	Finish Follow Up
3	2014	14	pTis pN0 M0	15	0	No	No	60	Finish Follow Up
4	2014	14.8	pT3 pN1 M0	15	IIIB	No	No	60	Finish Follow Up
5	2019	14.2	pTis pN0 M0	6	0	No	No	60	Finish Follow Up
6	2019	12.2	pT2 pN0 M0	11	I	No	No	48	Finish Follow Up in other center
7	2020	11.5	pTis pN0 M0	3	0	No	No	12	Finish Follow Up in other center
8	2020	16	pT4 pN2 , G4	18	IIIC	No	No	4	Finish Follow Up in other center
9	2020	10.9	pT3 pN0	14	IIA	No	No	36	Finish Follow Up in other center
10	2021	11.5	pT4 pN2A	25	IIIC	Yes	Capecitabine	12	Finish Follow Up in other center
11	2021	13.6	Non Hodgkin's lymphoma	9	IE	Yes	Lymphoma ChT	0	Finish Follow Up in other center
12	2021	15.9	pT2 pN1a	11	IIIA	No	No	24	Currently under follow-up
13	2021	11.2	pT2 pN0 M0	12	I	No	No	25	Currently under follow-up
14	2021	12	pT3 pN0	12	IIA	Yes	Capecitabine	25	Currently under follow-up
15	2023	11.9	pT4a pN0	22	IIC	No	No	11	Currently under follow-up
16	2023	12.4	pT3 pN0	31	IIA	No	No	6	Currently under follow-up

AchT, adjuvant chemotherapy; Hb, Hemoglobin.

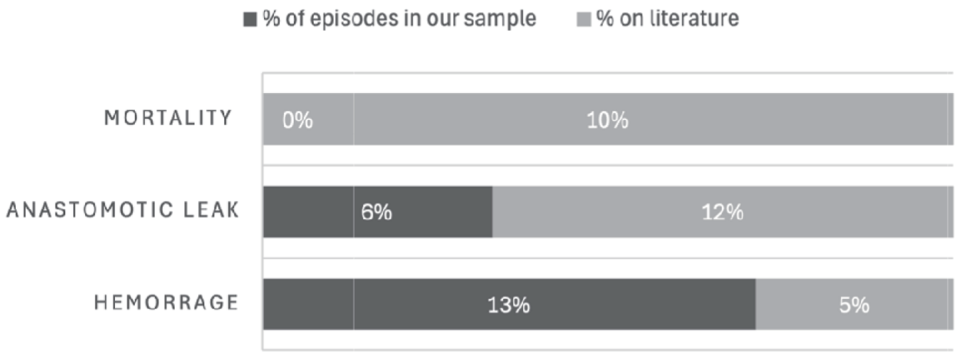

Fig. 2. Percentage of complications between our sample and literature.

tion after colorectal surgery, according to the literature, so it is important to prevent possible adverse consequences that may occur as a result of it.

As we have already seen, a good preoperative assessment and preparation, an adequate selection of the surgical technique, and proper postoperative management are essential to minimize these complications.[25] Our data on JW patients fall within this range (25%), suggesting that we are within the quality standards.

Hemorrhage

After surgery, one of the quickest complications to detect is bleeding. Hypotension, tachycardia, the presence of blood in the drainage, and a decrease in hemoglobin levels are the most indicative signs of hemorrhage.

An attempt is always made to prioritize the location of the bleeding point through endoscopy and/or angiography, if the patient's situation allows it. If not, a surgical approach would be indicated to stop the bleeding.[25]

It could be considered that 5% of patients may present postoperative hemorrhage.[26] In our center, the incidence has been 12.5%, which is higher than the average reported in other studies. This may be justified by the small sample size. Furthermore, one of the patients who required reintervention due to bleeding had a pathological stage T4 N2, indicating a larger tumor with a more complex surgery, which may explain this complication.

Anastomotic dehiscence or leak

Anastomotic leak is the most serious complication with the greatest consequences in colorectal surgery, with an estimated incidence between 2% and 5%. It is the opening of the lumen of the colon to the abdominal cavity, which can lead to the formation of abscesses if localized, or peritonitis if the opening is to a free cavity, with the risk of sepsis. Sepsis due to intraperitoneal abscesses (50%), fecal peritonitis (25%), wall abscesses, and surgical wound infections are complications caused by dehiscence.[25]

In other studies, the incidence of anastomotic leak varies from 2% to 4% in proximal anastomoses and from 6% to 12% in extraperitoneal anastomoses. These leaks are associated with mortality rates of approximately 10%.[27]

In our center, the dehiscence rate was 6.25%, which is within the average quality standards but slightly above what other centers report. The mortality rate was 0%, which may also be explained by the small sample size (Fig. 2).

The ERAS protocols are multimodal perioperative optimization strategies that accelerate recovery by minimizing the stress of surgical procedures. The benefits they provide to patients undergoing colorectal surgery include a reduction in hospital stay, a decrease in complications without increasing the readmission rate, and a reduction in the stress produced by surgery.

During the pre-surgical period, the patient must be informed of all steps to be taken before surgery, such as good nutrition, proper hydration, adequate carbohydrate intake, physical prehabilitation with toning exercises, and respiratory stimulation. Intravenous antibiotics are administered within 60 m prior to the surgical incision, as along with antithrombotic prophylaxis 12 h before surgery.

In the intraoperative period, the goal is to reduce the surgical stress response using neuro/regional analgesic techniques. Perioperative fluid management is essential to maintain tissue oxygenation, gastric motility, lung function, and wound healing. Optimal maintenance of body temperature throughout the intervention is also crucial. Additionally, preventing postoperative nausea and vomiting is a priority.

During the post-surgical period, early mobilization within 6 h and intake of sugary liquids within 6 h are very important.

The implementation of these protocols in recent years has helped to reduce postoperative morbidity and mortality in all types of patients and surgeries globally.[28–31]

In our population, there are no significant socioeconomic differences, variations in healthcare infrastructure, or disparities in regional resources between JW and the general population that accepts blood transfusions.

Limitations

This study is limited by its descriptive nature and small sample size, given the infrequency of patients who are JW and have colon cancer. As a result, the literature on this topic is quite limited, making it difficult to find scientific articles describing similar patient series for comparison. During the bibliographic search, no source of information was found that combines this population group with their management and outcomes in colon cancer.

Conclusions

Our study underscores the clinical management nuances inherent in patients who reject blood products, particularly in the context of surgical interventions for colon cancer. Notably, despite these challenges, this cohort demonstrates morbidity and mortality rates comparable to the general population when adhering to prescribed protocols.

Preoperative optimization, in accordance with established guidelines, proves essential to minimize transfusion requirements both intra- and post-operatively.

This underlines the safety and feasibility of such interventions within this patient demographic, aligning with current international guidelines.

Furthermore, adherence to fundamental oncologic principles, including lymphadenectomy standards, does not introduce undue risk, affirming the compatibility of standard protocols with optimal outcomes in this cohort.

Our findings advocate for a nuanced approach to the management of postoperative hemorrhage, with a lower threshold for intervention due to the limited options for managing anemia without blood products. This emphasizes the importance of vigilant surveillance and prompt intervention to mitigate potential complications.

Recognizing the inherent limitations of our study, particularly its descriptive nature and modest sample size, our observations serve as a springboard for further research. Larger-scale investigations are necessary to validate and extrapolate our findings, fostering a deeper understanding of optimal care paradigms for this unique patient demographic.

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Conflict of interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Author contributions

Conceptualization, methodology (DDP), original draft preparation (DDP, AGH), review (L Colao-García, NCT), writing (JZS), literature review (AGH), supervision (DDP, AGH, JCP, PGJ, L Cabezón-Gutierrez), and editing (L Cabezón-Gutierrez).

Ethical statement

The study was conducted in compliance with the ethical standards of our affiliated institutions and the principles outlined in the Declaration of Helsinki. The protocol was approved by the institutional review board of our institution. Individual consent for this retrospective analysis was waived.

References

[1] Siegel RL, Miller KD, Goding Sauer A, Fedewa SA, Butterly LF, Anderson JC, *et al*. Colorectal cancer statistics, 2020. CA Cancer J Clin 2020;70(3):145–164. doi:10.3322/caac.21601, PMID:32133645.

[2] Cheng L, Eng C, Nieman LZ, Kapadia AS, Du XL. Trends in colorectal cancer incidence by anatomic site and disease stage in the United States from 1976 to 2005. Am J Clin Oncol 2011;34(6):573–580. doi:10.1097/COC.0b013e3181fe41ed, PMID:21217399.

[3] Bailey CE, Hu CY, You YN, Bednarski BK, Rodriguez-Bigas MA, Skibber JM, *et al*. Increasing disparities in the age-related incidences of colon and rectal cancers in the United States, 1975-2010. JAMA Surg 2015;150(1):17–22. doi:10.1001/jamasurg.2014.1756, PMID:25372703.

[4] Weinberg BA, Marshall JL, Salem ME. The Growing Challenge of Young Adults With Colorectal Cancer. Oncology (Williston Park) 2017;31(5):381–389. PMID:28516436.

[5] White A, Joseph D, Rim SH, Johnson CJ, Coleman MP, Allemani C. Colon cancer survival in the United States by race and stage (2001-2009): Findings from the CONCORD-2 study. Cancer 2017;123(Suppl 24):5014–5036. doi:10.1002/cncr.31076, PMID:29205304.

[6] Vogel JD, Felder SI, Bhama AR, Hawkins AT, Langenfeld SJ, Shaffer VO, *et al*. The American Society of Colon and Rectal Surgeons Clinical Practice Guidelines for the Management of Colon Cancer. Dis Colon Rectum 2022;65(2):148–177. doi:10.1097/DCR.0000000000002323, PMID:34775402.

[7] Bartels SA, Gardenbroek TJ, Ubbink DT, Buskens CJ, Tanis PJ, Bemelman WA. Systematic review and meta-analysis of laparoscopic versus open colectomy with end ileostomy for non-toxic colitis. Br J Surg 2013;100(6):726–733. doi:10.1002/bjs.9061, PMID:23355043.

[8] Muñoz M, Acheson AG, Bisbe E, Butcher A, Gómez-Ramírez S, Khalafallah AA, *et al*. An international consensus statement on the management of postoperative anaemia after major surgical procedures. Anaesthesia 2018;73(11):1418–1431. doi:10.1111/anae.14358, PMID:30062700.

[9] Hughes DB, Ullery BW, Barie PS. The contemporary approach to the care of Jehovah's witnesses. J Trauma 2008;65(1):237–247. doi:10.1097/TA.0b013e318176cc66, PMID:18580506.

[10] Iancu C, Mocan LC, Todea-Iancu D, Mocan T, Acalovschi I, Ionescu D, *et al*. Host-related predictive factors for anastomotic leakage following large bowel resections for colorectal cancer. J Gastrointestin Liver Dis 2008;17(3):299–303. PMID:18836623.

[11] Zaharie F, Mocan L, Tomuş C, Mocan T, Zaharie R, Bartoş D, *et al*. Risk factors for anastomotic leakage following colorectal resection for cancer (in Romanian). Chirurgia (Bucur) 2012;107(1):27–32. PMID:22480112.

[12] Golub R, Golub RW, Cantu R Jr, Stein HD. A multivariate analysis of factors contributing to leakage of intestinal anastomoses. J Am Coll Surg 1997;184(4):364–372. PMID:9100681.

[13] Tadros T, Wobbes T, Hendriks T. Blood transfusion impairs the healing of experimental intestinal anastomoses. Ann Surg 1992;215(3):276–281. doi:10.1097/00000658-199203000-00013, PMID:1543401.

[14] Boccola MA, Buettner PG, Rozen WM, Siu SK, Stevenson AR, Stitz R, *et al*. Risk factors and outcomes for anastomotic leakage in colorectal surgery: a single-institution analysis of 1576 patients. World J Surg 2011;35(1):186–195. doi:10.1007/s00268-010-0831-7, PMID:20972678.

[15] Carson JL, Noveck H, Berlin JA, Gould SA. Mortality and morbidity in patients with very low postoperative Hb levels who decline blood transfusion. Transfusion 2002;42(7):812–818. doi:10.1046/j.1537-2995.2002.00123.x, PMID:12375651.

[16] Shander A, Javidroozi M, Naqvi S, Aregbeyen O, Caylan M, Demir S, *et al*. An update on mortality and morbidity in patients with very low postoperative hemoglobin levels who decline blood transfusion (CME). Transfusion 2014;54(10 Pt 2):2688–2695. doi:10.1111/trf.12565, PMID:24527739.

[17] Nishant, Kumari R. Surgical management in treatment of Jehovah's witness in trauma surgery in Indian subcontinent. J Emerg Trauma Shock 2014;7(3):215–221. doi:10.4103/0974-2700.136868, PMID:25114433.

[18] Macklin R. Applying the four principles. J Med Ethics 2003;29(5):275–280. doi:10.1136/jme.29.5.275, PMID:14519836.

[19] Jassar AS, Ford PA, Haber HL, Isidro A, Swain JD, Bavaria JE, *et al*. Cardiac surgery in Jehovah's Witness patients: ten-year experience. Ann Thorac Surg 2012;93(1):19–25. doi:10.1016/j.athoracsur.2011.06.029, PMID:21978873.

[20] Zheng V, Wee IJY, Abdullah HR, Tan S, Tan EKW, Seow-En I. Same-day discharge (SDD) vs standard enhanced recovery after surgery (ERAS) protocols for major colorectal surgery: a systematic review. Int J Colorectal Dis 2023;38(1):110. doi:10.1007/s00384-023-04408-7, PMID:37121985.

[21] Lewis CA, de Jersey S, Seymour M, Hopkins G, Hickman I, Osland E. Iron, Vitamin B(12), Folate and Copper Deficiency After Bariatric Sur-

gery and the Impact on Anaemia: a Systematic Review. Obes Surg 2020;30(11):4542–4591. doi:10.1007/s11695-020-04872-y, PMID: 32785814.
[22] Høiseth LØ, Giercksky KE, Larsen SG, Kongsgaard U. Major surgery on Jehovah's Witnesses (in Norwegian). Tidsskr Nor Laegeforen 2006;126(20):2658–2661. PMID:17057765.
[23] Habler O, Thörner M, Schmidt C, Hofmann P, Döbert U, Höhler M, *et al*. Mortality after high-risk surgery in Jehovah's Witness patients. Anaesthesist 2019;68(7):444–455. doi:10.1007/s00101-019-0617-8, PMID:31236704.
[24] Ruiz-Tovar J, Morales-Castiñeirasc V, Lobo-Martínez E. Postoperative complications of colon surgery (in Spanish). Cir Cir 2010;78(3):281–288. PMID:20642915.
[25] Molina Meneses SP, Palacios Fuenmayor LJ, Castaño LLano R de J, Mejia Gallego JI, Sánchez Patiño LA. Determinación de los factores predictivos para complicaciones en cirugía electiva de pacientes con cáncer colorrectal. Experiencia del Instituto de Cancerología Las Américas Auna (Colombia, 2016-2019). Rev Colomb Cir 2021;36:637–646.
[26] Tevis SE, Carchman EH, Foley EF, Harms BA, Heise CP, Kennedy GD. Postoperative Ileus—More than Just Prolonged Length of Stay? J Gastrointest Surg 2015;19(9):1684–1690. doi:10.1007/s11605-015-2877-1, PMID:26105552.
[27] Robella M, Tonello M, Berchialla P, Sciannameo V, Ilari Civit AM, Sommariva A, *et al*. Enhanced Recovery after Surgery (ERAS) Program for Patients with Peritoneal Surface Malignancies Undergoing Cytoreductive Surgery with or without HIPEC: A Systematic Review and a Meta-Analysis. Cancers (Basel) 2023;15(3):570. doi:10.3390/cancers15030570, PMID:36765534.
[28] Ho JCE, Goel AR, Fung AH, Shaikh I, Iqbal MR. Robotic ambulatory colorectal resections: a systematic review. J Robot Surg 2024;18(1):202. doi:10.1007/s11701-024-01961-3, PMID:38713324.
[29] Köhnenkampf R, Maldonado F. Enhanced Recovery after Surgery (ERAS) protocols: is there a place in our clinical practice? Rev Chil Anest 2019;48(1):10–27. doi:10.25237/revchilanestv48n01.05.
[30] Siragusa L, Pellino G, Sensi B, Panis Y, Bellato V, Khan J, *et al*. Ambulatory laparoscopic colectomies: a systematic review. Colorectal Dis 2023;25(6):1102–1115. doi:10.1111/codi.16511, PMID:36790358.
[31] Slim N, Teng WH, Shakweh E, Sylvester HC, Awad M, Schembri R, *et al*. Enhanced recovery programme after colorectal surgery in high-income and low-middle income countries: a systematic review and meta-analysis. Int J Surg 2023;109(11):3609–3616. doi:10.1097/JS9.0000000000000644, PMID:37598350.