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Original article

Selective intestinal preparation in a multimodal rehabilitation program. Influence on preoperative comfort and the results after colorectal surgery[☆]

José Vicente Roig,^{*} Alfonso García-Fadrique, Antonio Salvador, Francisco L. Villalba, Bárbara Tormos, Miguel Ángel Lorenzo-Liñán, Juan García-Armengol

Unidad de Coloproctología, Servicio de Cirugía General y del Aparato Digestivo, Consorcio Hospital General Universitario de Valencia, Valencia, Spain

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A B S T R A C T

Introduction: Despite there being no evidence of the advantages of its use, mechanical bowel preparation (MBP) continues to be routine in colorectal surgery. Our objective is to analyse the impact of its selective use, as regards patient comfort and results, comparing a perioperative multimodal rehabilitation program (MMRH) with conventional care (CC).

Material and methods: A prospective study of 108 patients proposed for elective surgery, assigned consecutively 2:1 to an MMRH protocol which only included MBP in rectal surgery with low anastomosis, or to CC in whom MBP was used except in right colon surgery. We also studied two Groups (A and B) with and without the use of MBP. Their tolerance, results and postoperative recovery variables were analysed.

Results: Thirty-nine patients were included in Group A, and 69 in Group B. A MMRH protocol was used in another 69 patients. The Group A patients had more abdominal pain, anal discomfort, nausea and thirst, but there were no differences as regards, death, overall or local complications, whilst there was less complications, suture failures and death in the MMRH when compared with CC Group ($P < .05$). There were no advantages observed in the use of MBP as regards the start of bowel movements, tolerance to diet or hospital stay, but these parameters were favourable to the MMRH when compared with CC Group.

Conclusions: The restriction of MBP is safe, and associated with an MMRH program, contributes to a faster and more comfortable recovery, without increasing complications.

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^{*}Corresponding author.

E-mail address: roig_jvi@gva.es (J.V. Roig).

Preparación intestinal selectiva en un programa de rehabilitación multimodal. Influencia en el confort preoperatorio y resultados tras cirugía colorrectal

R E S U M E N

Palabras clave:

Preparación mecánica intestinal
Rehabilitación multimodal
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Cirugía colorrectal

Introducción: Pese a no haberse evidenciado ventajas de su empleo, la preparación mecánica anterógrada (PMA) sigue siendo usual en cirugía colorrectal. Nuestro objetivo es analizar el impacto de su empleo selectivo respecto a confort y resultados en pacientes de un programa de rehabilitación multimodal perioperatoria (RHMM) o con cuidados convencionales (CC).

Material y métodos: Estudio prospectivo de 108 pacientes propuestos para cirugía electiva, asignados consecutivamente 2:1 a un protocolo de RHMM que incluyó emplear solamente PMA en cirugía rectal con anastomosis baja o a CC en los que se empleó PMA, salvo en cirugía del colon derecho. Además se estudiaron dos grupos (A y B) en función de si se usó o no PMA. Se analizaron su tolerabilidad, sus resultados y las variables de recuperación postoperatoria.

Resultados: Se incluyó a 39 pacientes en el grupo A y a 69 en el B; 69 siguieron el protocolo de RHMM. Los pacientes del grupo A presentaron más dolor abdominal, malestar anal, náuseas y sed, pero no hubo diferencias en lo que respecta a la tasa de muertes, complicaciones globales o su tipo, mientras que sí tuvieron menos complicaciones, fallos de sutura y muertes los pacientes del grupo RHMM ($p < 0,05$). Tampoco hubo ventajas del empleo de PMA respecto al inicio del tránsito intestinal, tolerancia a la dieta o estancias, pero estos parámetros fueron favorables al grupo de RHMM.

Conclusiones: La restricción de la PMA a casos seleccionados es segura, y asociada a un programa de RHMM contribuye a una recuperación más rápida y cómoda sin incrementar las complicaciones..

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Introduction

Mechanical bowel preparation (MBP) is still quite a common practice in colon surgery, in the belief that reduced faecal bacterial flora is associated with less risk of infection and anastomotic complications.¹ Despite the lack of proven advantages, 99% of US surgeons used it in 2003,² and a recent survey showed that 98% of Spanish colorectal surgeons continue using it.³ However, there is significant evidence against its routine use, as several randomised studies have shown that as many or more infectious and anastomotic complications are found when it is used, i.e. the opposite of its aim.⁴⁻⁶ In addition, some electrolyte disorders are associated with its use, especially in combination with surgical aggression.⁷ Furthermore, the fear of it is the worst perioperative experience for some patients, including preparation for endoscopy, surgery and even other tests (enema, CT coronagraph); therefore, we must use it rationally and selectively.

Omitting MBP is one of the pillars of multimodal perioperative rehabilitation (MMRH) or fast-track, which aims to reduce morbidity, mortality and promote faster recovery by reducing the impact of surgical stress factors, based on scientific evidence.⁸ This enhanced recovery programme has proven effective,⁹ and is slowly changing the views of surgeons and attracting support for what will be the standard of care in the coming years.¹⁰

The primary objective of our study was to analyse the impact of a selective use of MBP on perioperative comfort and

postoperative outcomes in patients on a MMRH programme and with conventional perioperative care after colorectal surgery. As a secondary objective, we analysed the MMRH results.

Material and methods

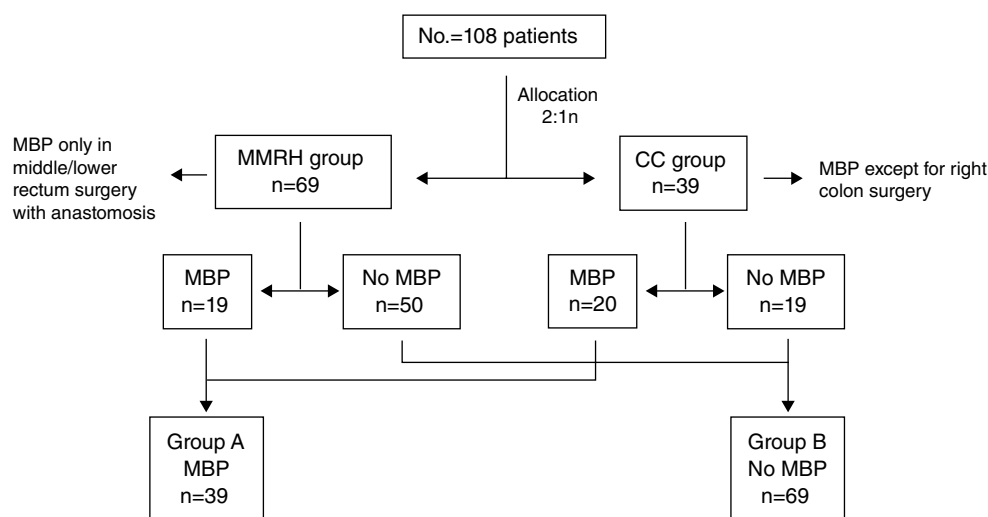
A prospective cohort study was performed of 108 patients: 63 males and 45 females with a mean age of 67.7 ± 10 (34-86). Inclusion criterion was an indication for elective colorectal surgery. Exclusion criteria included simple closure of stomas, partial bowel subocclusion and need for postoperative parenteral nutrition. The patients were consecutively assigned to one of the two groups on a 2:1 basis, upon inclusion on the waiting list. These groups were MMRH without MBP, except for middle or lower third rectal surgery with anastomosis, and conventional care (CC) with MBP, except for right colon surgery. A 2:1 ratio was used because the MMRH group included two subgroups (with and without oral preoperative carbohydrate overload) for analysis in another study. The basic protocols for action (intention to treat analysis) are described in Table 1. The MBP consisted of a solution of monosodium and disodium phosphate (Fosfosoda®, Laboratorios Casen-Fleet) in two 45 ml twice-daily doses (morning and evening) before surgery, and liquid diet 24 hours before surgery. The other patients had no dietary restrictions.

The subjects were divided into two groups (A and B), depending on whether they had received preoperative MBP

Table 1 – Characteristics of study groups

	Multimodal rehabilitation	Conventional care (CC)
MBP	Only in rectal surgery	Left colon and rectal surgery
Warm water enema	Left colon surgery	No
Preoperative carbohydrate ^a	Yes	No
Preoperative fasting	3 h for liquids	6-8 h
Epidural catheter	Yes (except laparoscopy)	No
NGT	No	No
Drainage	Only rectal surgery	Only rectal surgery
Bladder catheter removal	Day 1 (2 if epidural catheter)	Day 1
Postoperative fluid therapy	1500 ml/24 h	2500 ml/24 h
Analgesia	NSAID-paracetamol	Paracetamol-metamizol/tramadol
Start oral intake	6 h after surgery	Day 3
Protein drinks	Yes (at 6 h)	No
Lactulose	Yes (at 24 h)	No
Mobility	6 h after surgery	Day 1
Withdrawal of fluid therapy	At 24 h if tolerated	At day 4 if tolerated

MBP indicates mechanical bowel preparation; NGT, nasogastric tube.
^aUsed in half the patients in the MMRH group, forming the cohort of another study.

**Figure 1 – Flow chart for study group allocation. CC indicates conventional care; MBP, mechanical bowel preparation; MMRH, multimodal rehabilitation programme.**

or not (Figure 1). All completed a survey regarding the preparation conducted, and were analysed for surgical risk according to the American Society of Anesthesiologists (ASA) classification,¹¹ POSSUM score (Physiological and Operative Severity Score),¹² postoperative complications, tolerance to oral intake, time to the first evacuation, mobilisation, non-dominant hand strength, measured in kilograms using a dynamometer (day 1), and hospital stay. These parameters were also evaluated by considering whether a fast-track programme (MMRH and CC groups) was used or not, irrespective of receiving MBP or not.

The study was approved by the hospital research and ethical committees. The data were processed using SPSS (version 15) for Windows (SPSS Inc, Chicago, Illinois, USA). It was calculated that 38 patients per branch were required to obtain a 40%-10% reduction in preoperative alterations at a

5% statistical significance with a statistical power of 80%. The chi-square test and Fisher's exact test were used to compare categorical variables. For the mean of independent variables, the Student's t test was used after checking for a normal distribution with the Kolmogorov-Smirnov test. A statistical significance of $P < .05$ was used.

Results

The MMRH protocol was followed by 69 patients, while 39 were in the control group (CC). The mean age was 66.6 ± 9 and 69.8 ± 10 years respectively ($P = .101$).

A total of 39 patients (36%) received MBP (Group A): 19 (27%) from the MMRH group and 20 (51%) from the CC group ($P = .014$). Naturally, there were significant differences between the

Table 2 – Diagnosis, surgery type and approach

	Group A	Group B	MMRH	CC
Patients	39	69	69	39
Colon cancer	11 (28)	48 (70)	37 (54)	22 (56)
Rectal cancer	24 (61)	10 (14)	21 (30)	13 (33)
Colon polyps	3 (8)	3 (4)	5 (7)	1 (3)
Diverticular disease	0	4 (6)	3 (4)	1 (3)
Ulcerative colitis	0	2 (3)	1 (1)	1 (3)
Familial adenomatous polyposis	0	1	1 (1)	0
Crohn's disease	1 (3)	0	0	1 (3)
Hartmann's reconstruction	0	1 (1)	1 (1)	0
Laparoscopic approach	12 (31)	20 (29)	23 (33)	9 (23)
Right colon surgery ^a	1 (3)	24 (35)	16 (23)	9 (23)
Left colon surgery ^b	7 (18)	26 (67)	23 (33)	10 (26)
Total colectomy/proctocolectomy ^c	1 (3)	4 (6)	3 (4)	2 (5)
Anterior resection of rectum (ST) ^d	6 (15)	11 (16)	10 (15)	7 (18)
Anterior resection of rectum (TME)+ileostomy ^e	21 (54)	2 (3)	13 (19)	10 (26)
Abdominoperineal amputation ^f	3 (8)	2 (3)	4 (6)	1 (3)

CC indicates conventional care; MMRH, multimodal rehabilitation; ST, subtotal; TME, total mesorectal excision.

Diagnosis: Group A vs Group B, $P<.001$; MMRH vs CC, $P=.853$. Laparoscopic approach: Group A vs Group B, $P<.456$; MMRH vs CC, $P=.261$.

Type of resection: Group A vs Group B, $P<.001$; MMRH vs CC, $P=.878$.

Data expressed as no. (%).

^aMBP in 1 patient in Group CC with splenic neoplasia (extended right hemicolectomy was performed).

^bThree patients in Group CC received no MBP (because of doubts over performing an extended right hemicolectomy).

^c1 patient was prepared for the same reason.

^dMBP was not performed in 1 patient due to protocol failure.

^eTwo patients were not given MBP, due to ultra-low anastomosis being performed after proposal for amputation.

^fIn 2 patients, MBP was carried out to try and preserve the sphincter.

diagnostic and surgical techniques included in groups A and B, as the selection criteria were different, but there were none according to MMRH or CC classification (Table 2), or the type of surgery: open or laparoscopic. There were no differences in ASA surgical risk classification between groups A and B

($P=.332$), but there was regarding the use of fast-track protocol or not, which was more frequent in Group B ($P=.014$). There were also no differences in the physiological POSSUM score (Group A vs B, 16.9 ± 8 vs 14.7 ± 9 , $P=.303$; MMRH vs CC, 14.7 ± 8 vs 17 ± 10 , $P=.315$). However, the surgical POSSUM score was

Table 3 – Preoperative symptoms survey

	Group A	Group B	P	MMRH	CC	P
Patients	39	69		69	39	
Comfortable preoperative period	8 (21)	31 (23)	0.814	21 (30)	3 (8)	.007
Abdominal pain	8 (21)	2 (3)	0.004	7 (10)	3 (8)	1
Anal discomfort	25 (64)	8 (12)	<0.001	16 (23)	17 (44)	.032
Dizziness	4 (10)	0	0.015	2 (3)	2 (5)	.619
Cramping	3 (8)	1 (1)	0.133	3 (4,3)	1 (3)	1
Nausea	14 (36)	1 (1)	<0.001	8 (12)	7 (18)	.394
Vomiting	1 (3)	0	0.361	1 (1)	0	1
Thirst	24 (61)	24 (35)	0.004	27 (39)	21 (54)	.161
Would you repeat this preparation?	1 (3)	13 (19)	0.017	10 (14)	4 (10)	.766
Last stool characteristics			<0.001			.131
Solid	0	18 (26)		16 (23)	2 (5)	
Soft	2 (5)	21 (30)		16 (23)	7 (18)	
Very soft	8 (21)	9 (13)		8 (12)	9 (23)	
Liquid with remains	10 (26)	7 (10)		9 (13)	8 (21)	
Liquid	19 (49)	3 (4)		14 (20)	8 (21)	
Lost	0	11 (16)		6 (9)	5 (13)	
Hours since the last stool			<0.001			.586
<2	15 (39)	4 (28)		12 (17)	7 (18)	
2-6	21 (54)	15 (22)		21 (30)	15 (54)	
>6	3 (8)	39 (57)		30 (44)	12 (31)	
Lost	0	11 (16)		6 (41)	5 (20)	

CC, conventional care; lost, missing values; MMRH, multimodal rehabilitation.

Data expressed as no. (%).

Table 4 – Postoperative complications

	Group A	Group B	P	RHMM	CC	P
Patients	39	69		69	39	
Overall complications	16 (41)	31 (45)	.694	25 (36)	22 (56)	.042
NGT placement	4 (10)	12 (17)	.404	9 (13)	7 (18)	.576
Replacement bladder catheter	9 (23)	9 (13)	0.191	7 (10)	11 (28)	.029
Perioperative transfusion	6 (15)	9 (13)	.776	7 (10)	8 (20)	.155
Prolonged ileus	8 (21)	16 (23)	.814	14 (20)	10 (26)	.631
Anastomotic dehiscence	4 (11)	7 (10)	1	4 (6)	7 (18)	.043
Surgical wound infection	5 (13)	13 (19)	.592	9 (13)	9 (23)	.191
Intra-abdominal abscess	4 (10)	6 (9)	1	7 (10)	3 (8)	1
Diffuse peritonitis	2 (5)	3 (4)	1	1 (1)	4 (10)	.056
Evisceration	0	3 (4)	.552	3 (4)	0	.562
Respiratory complications	2 (5)	5 (7)	1	3 (4)	4 (10)	.25
Heart failure	0	2 (3)	0.534	1 (1)	1 (3)	1
Urinary tract infection	3 (8)	3 (4)	.665	2 (3)	4 (10)	.186
Re-operations	6 (15)	12 (17)	1	9 (13)	9 (23)	.191
Death	4 (10)	5 (7)	.72	2 (3)	7 (18)	.01

CC indicates conventional care; lost, missing values; MMRH, multimodal rehabilitation programme.
Data expressed as no. (%).

higher in Group A patients than in B (12.8 ± 6 vs 9.4 ± 6 , $P=.029$), although there were no differences when comparing MMRH patients with the CC controls (11.3 ± 6 vs 10.2 ± 7 , $P=.501$).

Patients in Group A had more abdominal pain, anal discomfort, dizziness, cramps, nausea and thirst than those in Group B (Table 3), with 36 patients (92%) completing the preparation. Moreover, 36 patients (92%) with MBP defecated in the last 6h of the preoperative period against 34 (49%) of those unprepared ($P<.001$), with significantly more liquid stools. However, there was no difference in the rate of postoperative complications, ileus, anastomotic leaks or wound infections among them, whereas, when comparing patients in the MMRH group with the CC, the former had significantly fewer complications (36 vs 56%, $P=.042$) and anastomotic dehiscence (6% vs 18%, $P=.043$), see Table 4.

The non-MBP group had no disadvantages regarding food tolerance in relation to the postoperative day, the resumption of intestinal transit or the ability to walk (Figure 2). There were also no differences regarding the average day for the first two events to occur or postoperative stays, with differences in favour of Group B only being seen in functional capacity (standing, walking) and spontaneous voiding. On the other hand, patients who completed a MMRH protocol showed significantly faster postoperative recovery in almost all parameters evaluated (Table 5).

Discussion

Mechanical bowel preparation is a practice which has been undertaken since the beginning of the twentieth century, when abdominal surgery was associated with a high rate of infections. In the antibiotic era, antimicrobial agents were associated with this preparation and infections were reduced. This reinforced the use of mechanical preparation, which has been implemented with various laxatives, enemas and irrigation with large volumes of physiological serum through a nasogastric tube.^{1,13,14}

Given the evidence for dispensing with MBP^{1,4-6} and the many years experience without its systematic use by some of the authors (JVR, JGA), a working hypothesis was to demonstrate that selective use of MBP was not a worse choice, despite a national and international reluctance to change policy.^{2,3} We compared two groups of patients with and without preoperative MBP, from a cohort of 108 subjects undergoing colorectal surgery consecutively assigned to a MMRH or CC protocol. MBP was still used in rectal surgery with complete mesorectal excision and low anastomosis, as there is currently no sufficient statistical power to demonstrate any benefits for not preparing the colon in this case.⁵ In addition, a derivative ileostomy was systematically carried out, which might conflict with the omission of the MBP. It also was employed in those patients requiring intraoperative colonoscopy and in some candidates for laparoscopic surgery, at the surgeon's judgment, due to (not proved) improved handling of colon preparation.

According to a recent survey of Spanish colorectal surgeons, MBP was used for 59% of right colon surgery, 90% of left colon surgery and 98% of rectal surgery.³ These figures are much higher than the equivalent figures from the Association of Coloproctology of Great Britain and Ireland,¹⁵ which were 9.5%, 42.1% and 72.2%, respectively.

Patients who underwent MBP had related symptoms such as thirst and anal discomfort in more than 60% of cases, plus increased nausea in 36% and abdominal pain in 20%, as well as more liquid stools in the hours preceding the operation, as referred to by other authors.¹⁶ Moreover, the use of sodium phosphate is specifically contraindicated in patients with renal, liver or heart failure, and dehydration can lead to hypotension during anaesthesia induction.¹ Although we did not analyse analytical changes after MBP, Holte et al¹⁷ found a loss of 1.2 kg in weight and a significant decrease in exercise capacity of 9% in healthy volunteers and, despite a high intake of fluids, increased concentrations of urea and phosphate and reduced potassium and calcium. It is difficult for elderly

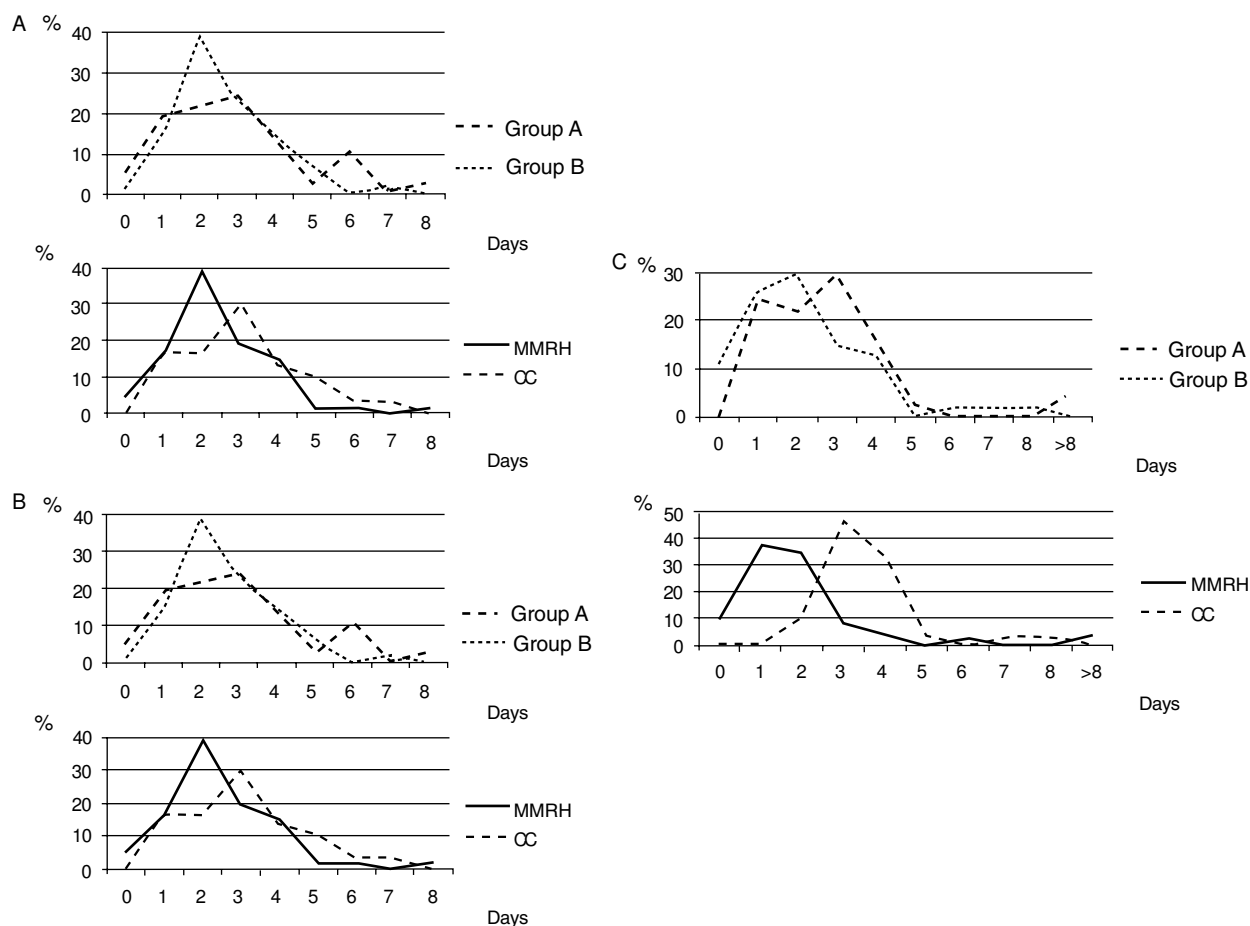


Figure 2 – Percentage of patients meeting certain criteria according to days after surgery. A: soft diet toleration; Group A vs B, $P=.272$; MMRH vs CC, $P<.001$. B: first stool; Group A vs B, $P=.171$; MMRH vs CC, $P=.067$. C: walking; Group A vs B, $P=.192$; MMRH vs CC, $P<.001$. CC indicates conventional care; MMRH, multimodal rehabilitation programme.

patients or those with comorbidity to be in good condition to undergo surgery, as the main physiological effect of MBP is dehydration.^{18,19} This, enhanced by unjustified prolonged preoperative fasting,²⁰ requires optimised intraoperative fluid management.²¹ When analysing patients following a MMRH programme, they reported a more comfortable preoperative period.

In addition, the increased discomfort associated with MBP is not offset by any postoperative benefit of lesser complications. However, when comparing the patients on the MMRH programme against those who were not on it, we observed improvements in complications, anastomotic leaks and death. Thus, in our series, omitting MBP did not result in disadvantages regarding tolerance, preoperative discomfort and complications prevention. Furthermore, we have not performed any bowel preparation of any kind for several years, or had any special diet for right and transverse colon surgery. Even in our CC group, this may be an attitude that could be considered advanced, since a recent survey carried out by member surgeons of the *Sección de Coloproctología de la Asociación Española de Cirujanos* (Coloproctology Section of the Spanish Association of Surgeons) and the *Asociación Española de Coloproctología* (Spanish Association of Coloproctology) showed a fairly traditional approach in perioperative

management.²² This was similar to another study that assessed several European countries and the USA.²³ In left colon or high rectum surgery, we use a single enema which may be applied by the patients themselves or their relatives, without any prior dietary restriction, similar to that used by 42.1% of British surgeons.¹⁵ This is basically to make anastomosis easier, and usually mechanical. In addition, it is more comfortable and is not associated with the inflammatory process induced by the irritants in a MBP.^{24,25} The intention of performing a particular surgical technique after one or another type of preparation was not fulfilled in all patients, as some decisions to change the type of surgery or planned approach were made during surgery. This may lead to bias in the study; however, we wanted to offer a more realistic approach to everyday practice. Another possible cause of bias, as discussed previously, is that Group B (without MBP) was made up of significantly more patients on the MMRH programme than Group A. This could not influence the preoperative findings regarding MBP, as the other MMRH measures had not yet been implemented, although they could have influenced in postoperative findings.

Lastly, the restoration of oral intake, the restart of intestinal transit and functional ability to move were analysed, with no differences being found between groups A and B, except

Table 5 – Postoperative course

	Group A	Group B	P	MMRH	CC	P
Patients, no.	39	69		69	39	
Number times vomited p.o.	0.9 (1.3)	.9 (1.3)	.093	0.8 (1.2)	1.1 (1.3)	.325
Soft diet toleration	4.4 (3.5)	3.6 (2.9)	.285	3.1 (2.7)	5.5 (3.5)	.001
Normal diet toleration	5.8 (3.8)	5.1 (3)	.37	4.6 (2.9)	7 (3.8)	.001
Start of flatulence	1.8 (1.2)	1.7 (0.9)	.631	1.6 (1)	1.9 (1)	.226
First stool	2.9 (1.8)	2.6 (1.3)	.367	2.4 (1.4)	3.3 (1.7)	.016
Sitting	1.9 (1.6)	1.2 (1.2)	.019	1 (1.4)	2.5 (1)	<.001
Walking	3 (2.7)	2.2 (1.7)	.094	2 (2.3)	3.6 (1.3)	<.001
Hand strength, ^a kg	7.4 (6.3)	15.4 (9.1)	.044	12.3 (8.9)	9.6 (8.3)	.505
Urination without catheter	3 (2.9)	1.3 (0.9)	.002	1.6 (1.9)	2.8 (2.3)	.017
I.v. fluid withdrawal	4 (3.5)	3.7 (5.6)	.764	3.2 (5.3)	5 (3.5)	.046
Postoperative admission (days)	9.1 (6.2)	9.2 (8.7)	.943	7.9 (7.4)	11.5 (8)	.025

CC indicates conventional care; lost, missing values; MMRH, multimodal rehabilitation.

Values expressed as means (SD) from postoperative day that each event occurred, except for the number of times vomited.

^aHand strength on the first day after surgery in a cohort of 10 patients per group.

in regard to functional capacity and spontaneous voiding, although these data should be interpreted with caution due to the predominance of patients with MMRH in Group B. Surgery with low rectal anastomosis, which combines two surgical procedures (anastomosis + derivative stoma), was included in Group A and had both higher surgical POSSUM scores and an increased risk of voiding disorders; however it was at least demonstrated that performing MBP did not lead to better results in the majority of colorectal surgeries. Other authors have shown in randomised trials that MBP does not reduce hospital stay or facilitate the resumption of intestinal transit²⁶⁻²⁹ and, once again we would like to emphasise that patients following a MMRH protocol in our series recovered earlier than controls, regarding tolerance to intake, intestinal transit recovery, functional capacity and length of stay.

Our group is committed to an individualised bowel preparation adapted to the type of surgery. Evidence from the literature refers to complete bowel preparation, as many surgeons interpret “not preparing the colon” in many ways, and dietary restrictions, laxatives, saline or phosphate enemas may be used or not depending on the surgical approach, etc. We believe it appropriate to adopt a reasonably flexible policy, avoiding scientific dogmas, as there are points still to be resolved in the literature, such as whether it is necessary or not to perform MBP in rectal surgery associated with derivative stoma, the potential benefits of using it in laparoscopic surgery or the severity of a dehiscence according to its use.

This study supports the multiple meta-analysis in which MBP has not shown any benefit^{4-6,30} and supports the idea of a selective indication. Moreover, with the advent of fast-track care, one must take into account its restricted use, contributing to a more comfortable and faster perioperative period and its impact on cost reduction.^{9,31,32} It is difficult to overcome tradition,³³ and adopt changes in attitude, mainly those related to MBP, early feeding, preoperative carbohydrate intake and fluid optimisation. Fortunately, surgeons with more dedication, experience and certification in colorectal surgery already behave in line with scientific evidence in this area.^{21,34}

In conclusion, using MBP in selected cases is safe and, combined with a perioperative MMRH programme, contributes to a quicker and easier recovery without increasing surgical complications.

Conflict of interest

The authors declare that they have no conflict of interest.

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