Ulster Med J 2007; **76 (3)** 127-130

Review

The use of mechanical bowel preparation in elective colorectal surgery

Alison S McCoubrey

Accepted 8 March 2007

ABSTRACT

Background: Mechanical bowel preparation (MBP) prior to elective colorectal surgery has been in use for many years. It is considered important in preventing post-operative infectious complications after colorectal surgery. The evidence to support these claims is lacking within the medical literature and yet this still remains standard practice in many hospitals. A literature search was undertaken to ascertain the evidence available regarding the use of MBP in elective colorectal surgery.

Methods: The search included the databases PubMed, Medline and Embase using the keywords "mechanical bowel preparation", "bowel cleansing" and "elective colorectal surgery", a search of recent issues of relevant journals including Diseases of the Colon and Rectum and British Journal of Surgery and backward chaining from articles obtained.

Results and Conclusion: Most authors recommend that colorectal surgery is safe without pre-operative MBP but that there may some situations in which it may be beneficial (e.g. if there is a small tumour or the possible need for intra-operative colonoscopy). The implication for clinical practice in this situation is that there is not enough strength of evidence at present to recommend a change in practice. There is a need for further higher powered trials to try to answer this question definitively.

Keywords: mechanical bowel preparation, colorectal surgery

BACKGROUND

Mechanical bowel preparation (MBP) prior to elective colorectal surgery has been in use for many years. Early observational studies and long-standing clinical experience have shown that removal of faecal matter from the bowel lumen prior to surgery has been associated with decreased patient morbidity and mortality[1]. It is still commonly used in routine practice today[2]. In fact, in a recent survey of members of the American Society of Colon & Rectum Surgeons, 99% of respondents routinely use MBP although 10% question its use[3]. This is in keeping with common belief that clinical practice often is not evidence based but is based on tradition, previous teaching and anecdote.

MBP is considered important in preventing post-operative infectious complications after colorectal surgery[2,4-10]. Important infectious complications include wound infection, intra-abdominal abscess formation and anastomotic leakage. There are a number of ways in which MBP is thought to act. It may decrease intraoperative contamination with faecal material thereby reducing the incidence of post-operative wound infection and residual intra-abdominal infection[6,7,9,10]. It may prevent mechanical disruption of the anastomosis by the passage of hard faeces[9] and improves the handling of the bowel intra-operatively[2,7]. It may reduce the bacterial count within the colon[7,10]. Conversely, it may also be associated with bacterial translocation through the bowel wall hence possibly contributing to post-operative infectious complications[5,11]. The evidence to support these claims is lacking within the medical literature and yet this still remains standard practice in many hospitals[4,12].

Primary colonic anastomosis is considered unsafe in unprepared bowel but there is little data to suggest that infectious complications are decreased by MBP[10]. Bowel preparation is unpleasant for patients and can be associated with complications such as dehydration, nausea, vomiting, mucosal lesions, hypokalaemia and other electrolyte disturbances[1,9,11]. The omission of this practice from pre-operative preparation would be welcomed by nursing staff and patients alike.

METHODS

A literature search was undertaken to ascertain the evidence available regarding the use of MBP in elective colorectal surgery. This included a search of PubMed, Medline and Embase using the keywords "mechanical bowel preparation", "bowel cleansing" and "elective colorectal surgery", a search of recent relevant journals including *Diseases of the Colon and Rectum* and *British Journal of Surgery* and backward chaining from articles obtained. The search was restricted to English language articles and a timescale of 10 years was chosen to give a balanced view of this topic.

In this review, mechanical bowel preparation will be defined as an oral preparation given prior to surgery to clear faecal material from the bowel lumen. There are a number of different preparations available including polyethylene glycol,

Department of Surgery, Antrim Area Hospital, Antrim, BT41 2RL, United Kingdom.

E: amccoubrey@doctors.org.uk

mannitol and sodium picosulphate. Rectal enemas may also be administered before low anterior resections to ensure that the rectum is empty.

Elective colorectal surgery is defined as any surgery undertaken on a planned basis for any condition of the colon or rectum requiring bowel resection and primary anastomosis. This will include colorectal carcinoma and inflammatory bowel disease.

There are a number of recent randomised controlled trials (RCTs) to evaluate the use of MBP prior to elective colorectal surgery,[10,11,13,14] and specifically for left-sided resections[5]. Many of these studies are underpowered therefore introducing the possibility of a Type II error and limiting the use of these results in clinical decision-making (Table I).

This lack of power in studies is somewhat overcome by the use of meta-analyses and systematic reviews of the literature but the reader must be aware that these methods also have their limitations. A number of meta-analyses and systematic reviews were used in this review[1,2,7-9,15].

DISCUSSION

Six systematic reviews were identified in the literature assessing the role of MBP in preventing infectious complications following colorectal surgery[1,2,7-9,15].

The meta-analysis carried out by Platell & Hall[7] found a statistically significant increase in the incidence of wound infection in those patients receiving MBP when considering the three included RCTs. This may have been influenced by the rate of wound infection seen in one trial that used a five day regime of MBP. The anastomotic leakage rate was also higher in the MBP group but not significantly so. Each RCT used a different type of MBP and this lack of standardisation affects the validity of the results. The included studies were also underpowered thereby introducing a high possibility that they failed to detect a significant difference in the results (type II error). Evidence from the prospective and retrospective studies was in favour of no MBP in pre-operative period.

A subsequent review of the literature by Zmora *et al*[9] appraised four RCTs. One of the studies found an increased risk of anastomotic leakage and intra-abdominal infection but no increased risk of wound infection in the group of patients receiving MBP. The remaining RCTs found no significant difference in intra-abdominal infection rate but a slight increase in wound infection rate in the MBP group.

TABLE I:

RCTs examining MBP

	Zmora 2003	Fa-Si-Oen 2005	Ram 2005	Bucher 2005	Miettinen 2000
No. of patients included	415	250	329	153	267
No. of patients excluded	35	0	Not given	0	12
No. of pt (MBP/no MBP)	187/193	125/125	164/165	78/75	138/129
Mean age (MBP/no MBP)	68/68	68/70 (median)	68/68	63/63	61/64
Cancer % (MBP/no MBP)	78/78	90/92	75/88	32/28	46/55
L colon surgery % (MBP/ no MBP)	68/72	48/58	89/85	100/100	45/47
Type of prep	Polyethylene glycol	Polyethylene glycol	Sodium phosphate	Polyethylene glycol	Polyethylene glycol
Antibiotic	Yes	Yes	Yes	Yes	Yes
Same length of prophylaxis	No	Yes	Yes	No	Yes
Rectal enema	Yes	No	No	Yes	No
Anastomosis % (stapled / handsewn)	Not given	7/93 (MBP) 8/92 (no MBP)	94/6 (MBP) 98/2 (no MBP)	Not given	60/30 (MBP) 62/28 (no MBP)
Surgeon/trainee %	Not given	42/59 (MBP) 50/50 (no MBP)	37/63 (MBP) 32/68 (no MBP)	Not given	Not given
Anastomotic leak % (MBP / no MBP)	3.7/2.1 (NS)	5.6/4.8 (NS)	0.6/1.2 (NS)	6/1 (NS)	4/2 (NS)
Wound infection % (MBP / no MBP)	6.4/5.7 (NS)	7.2/5.6 (NS)	9.8/6.1 (NS)	13/4 (NS)	4/2 (NS)
Intra-abdominal abscess % (MBP / no MBP)	1.1/1 (NS)	Not given	0.6/0.6 (NS)	1/3 (NS)	2/3 (NS)

NS = not significant

There were conflicting results in the non-randomised studies with some showing an increased rate of infection and others reporting no difference in infection rates between the groups.

The remaining four meta-analyses only included RCTs[1,2,8,15]. All authors agreed that MBP was of no benefit in preparation for colorectal surgery and it may be detrimental to the patients' outcome[1,2,8]. Wille –Jorgensen *et al*[15] found that although initial analysis showed a significantly higher rate of anastomotic leakage in the MBP group, this significance disappears when sensitivity analyses are applied thereby weakening the conclusion that MBP leads to an increased rate of anastomotic leakage.

Slim *et al*[8] found there was significantly more anastomotic leakage in the group of patients receiving MBP and a tendency to a higher rate of wound infection but this was not statistically significant. This group repeated the analysis excluding the poor quality trials and the results still favoured a no MBP regime although this was not statistically significant.

Only two meta-analyses looked at MBP in rectal surgery specifically[1,15]. Willie-Jorgensen *et al*[15] found that when results were stratified for colonic and rectal surgery there was no trend in either direction. Guenaga *et al*[1] found that the results of stratification favoured no MBP but this was not statistically significant. This is of more clinical importance as it may be difficult to perform a low anterior resection and anastomosis with a loaded rectum[15]. Both authors suggest that further trials evaluating the use of rectal preparation with enemas may be useful. Guenaga *et al*[1] also mention that the use of pre-operative radiotherapy would be an important consideration in assessment of bowel preparation for rectal surgery as many patients with rectal cancer undergo pre-operative radiotherapy.

All but one of the five RCTs examining MBP[5,10,11,13,14] found no significant difference in the rate of anastomotic leakage and wound infection between patients receiving MBP or not[10,11,13,14]. The largest trial was undertaken by Zmora *et al*[10] with 415 patients recruited. There are several flaws in the methodology of this trial introducing bias and compromising the validity of the results.

There was no difference found in the rate of post-operative infectious complications between the two groups. The rate of diarrhoea post-operatively was significantly more common in the group receiving MBP but this is of little clinical significance, as many patients will experience an increased stool frequency once the bowels become active. The authors acknowledge that separating the role of MBP in post-operative infection rate is difficult and ideally all other measures should be constant. They also note that the study is underpowered to detect a 5% difference in infection rate.

The RCT conducted by Bucher *et al*[5] comparing MBP with no MBP in patients undergoing elective left-sided colorectal surgery found an increase in the total incidence of infectious abdominal complications in the group receiving MBP (22% v 8%; p=0.028). This led the authors to conclude that there was good evidence to suggest that the practice of MBP should be re-evaluated. They gave an enema pre-operatively to all patients undergoing an anterior resection regardless of whether they had been randomised to MBP or not, decreasing the internal validity of the results. If anastomotic leak rate (a more clinically important outcome than wound infection) were to be used as the primary end-point then the study would need 514 patients in each group.

The trial conducted by Ram *et al*[14] was not properly randomised, introducing methodological bias and limiting the value of the results of this study. There was no definition of sample size and patients with low rectal anastomosis were excluded. Again, the assessor of outcome was not blinded to the intervention, introducing another source of bias. No statistically significant difference in the frequency of infectious complications was observed between the groups yet the authors concluded that "mechanical bowel preparation is unnecessary for safe elective colonic and colorectal surgery". But they recommend MBP in selected cases including the resection of small tumours when palpation of the colon may be necessary or when intra-operative colonoscopy may be performed.

Fa-Si-Oen *et al*[13] conducted a well-designed multi-centre RCT, reported in 2005. Approximately half the resections carried out in this study were left-sided. This is important as it is now generally accepted that right-sided anastomosis is safe without MBP. This study excluded patients undergoing rectal surgery. There was no significant difference in wound infection or anastomotic leak rate but the bacterial swab results used to define wound infection in this study were only correctly obtained in 185 out of 250 patients therefore this may not be an accurate reflection of the true rate of wound infections. This study could not demonstrate an additional protective effect for MBP but it was an interim analysis and was underpowered. As a result, conclusions for clinical practice cannot be drawn from these results.

Miettinen *et al*[11] reported the results of a prospective, randomised study including patients undergoing rectal surgery. There was no significant difference in infectious complications found between the two groups but it is difficult to conclude on the influence on anastomotic leakage from these results as the study included patients who did not undergo an anastomosis.

A number of these reported trials are underpowered thereby limiting their ability to detect a clinically significant difference in outcome between the two study groups[10,11,13]. One way of overcoming the problem of small sample sizes is to carry out a multi-centre trial where a larger number of patients are easier to recruit. A limitation is that they introduce heterogeneity in operative and peri-operative techniques. This is important, as surgical technique may be the single most important factor in influencing the surgical outcome[9]. All these studies agree that elective colorectal surgery may be safely performed without MBP and that there is no evidence to continue this invasive practice with potentially negative side effects.

Memon *et al*[16] carried out a retrospective non-randomised trial based on operating surgeon preferences using a questionnaire. The validity of this questionnaire is unclear as no pilot study was carried out prior to the collection of definitive data. Follow-up of the patients was obtained using the hospital records therefore relying on accurate clinical notes, which are not always available.

One hundred and thirty six patients who underwent elective left-sided colorectal procedures for non-obstructive large bowel pathologies were identified using the hospital computer system. Coding errors may mean that some eligible patients were excluded from the analysis. This, along with the lack of randomisation, would introduce significant bias.

No statistical difference was found between the two groups for all infectious complications and mortality. The authors recognise the limitations of their results and do not recommend any changes in practice but do suggest that a prospective randomised trial should be performed to demonstrate the impact of MBP on morbidity and mortality in patients undergoing elective colorectal surgery.

A prospective, observational trial performed by van Geldere *et al*[17] assessed the outcome of 250 consecutive patients who underwent resection and primary anastomosis of the colon and upper rectum under the care of a single surgeon. None of these patients received MBP pre-operatively. Both emergency and elective procedures were included in analysis. Results were favourable with an overall wound infection rate of 3.3% and an anastomotic failure rate for left-sided resections of 1.2%. The authors recommend that more powerful randomised trials are needed but in the hands of a single surgeon, primary anastomosis of unprepared bowel is safe with relatively few complications.

A small observational study conducted by Ahmad *et al*[4] found an anastomotic leak rate of 4.2% and a wound infection rate of 8.5%. The average age of the sample was lower than that of the typical population undergoing colorectal surgery. This fact, plus the small sample size, compromises the external validity or the extent to which the results can be generalised to other samples or situations.

CONCLUSION

There are a number of meta-analyses, systematic reviews and RCTs looking at the efficacy of MBP in preventing post-operative infectious complications following elective colorectal surgery. Unfortunately many of these trials are underpowered and have a high chance of a type II error[10,11,13]. Most authors recommend that colorectal surgery is safe without pre-operative MBP but that there may some situations in which it may be beneficial (e.g. if there is a small tumour or the possible need for intra-operative colonoscopy)[14].

The implication for clinical practice in this situation is that there is not enough strength of evidence at present to recommend a change in practice. There is a need for further higher powered trials to try to answer this question definitively. The only way that this may be achieved is by multi-centre trials where it is easier to recruit a large number of patients but it must be taken into consideration that this will introduce heterogeneity in the operative and peri-operative techniques which may have an influence on overall outcome[9]. There is a need for larger clinical trials in this area to address whether MBP, with its potential side effects, is truly necessary prior to elective colorectal surgery.

Further studies are required to assess the use of rectal preparation alone prior to rectal surgery[1,15] and also to include patients who have undergone pre-operative radiotherapy[1] as this is a common occurrence in patients who have rectal carcinoma and these patients may subsequently undergo resection with primary anastomosis. It is clear that further research is needed to clarify the role of MBP in elective colorectal surgery to ensure that the patients are receiving the most appropriate treatment with the least adverse effects.

The author has no conflict of interest

REFERENCES

1. Guenaga K, Atallah AN, Castro AA, Matos DD, Wille-Jorgensen P. Mechanical bowel preparation for elective colorectal surgery. *Cochrane Database Syst Rev* 2005;**1** (CD001544.pub2).
2. Bucher P, Mermillod B, Gervaz P, Morel P. Mechanical bowel preparation for elective colorectal surgery. *Arch Surg* 2004;**139**(12):1359-64.
3. Zmora O, Wexner SD, Hajjar L, Park T, Efron JE, Nogueras JJ *et al*. Trends in preparation for colorectal surgery: survey of members of the American Society of Colon and Rectal Surgeons. *Am Surg* 2003;**69**(2):150-4.
4. Ahmad M, Abbas S, Asghar MI. Is mechanical bowel preparation really necessary in colorectal surgery? *J Coll Physicians Surg Pak* 2003;**13**(11):637-9.
5. Bucher P, Gervaz P, Soravia C, Mermillod B, Erne M, Morel P. Randomised clinical trial of mechanical bowel preparation versus no preparation before elective left-sided colorectal surgery. *Brit J Surg* 2005;**92**(4):409-14.
6. Nichols RL, Smith JW, Garcia RY, Waterman RS, Holmes JW. Current practices of preoperative preparation among North American colorectal surgeons. *Clin Inf Dis* 1997;**24**(4):609-19.
7. Platell C, Hall J. What is the role of mechanical bowel preparation in patients undergoing colorectal surgery? *Dis Colon Rectum* 1998;**41**(7):875-3.
8. Slim K, Vicaut E, Panis Y, Chipponi J. Meta-analysis of randomized clinical trials of colorectal surgery with or without mechanical bowel preparation. *Br J Surg* 2004;**91**(9):1125-30.
9. Zmora O, Pikarsky AJ, Wexner SD. Bowel preparation for colorectal surgery. *Dis Colon Rectum* 2001;**44**(10):1537-49.
10. Zmora O, Mahajna A, Bar-Zakai B, Rosin D, Hershko D, Shabtai M *et al*. Colon and rectal surgery without mechanical bowel preparation. A randomised prospective trial. *Ann Surg* 2003;**237**(3):363-7.
11. Miettinen R, Laitinen ST, Makela JT, Paakkonen ME. Bowel preparation with oral polyethylene glycol electrolyte solution vs. no preparation in elective open colorectal surgery. *Dis Colon Rectum* 2000;**43**(5):669-75.
12. Jansen JO, O'Kelly TJ, Krukowski ZH, Keenan RA. Right hemicolectomy: mechanical bowel preparation is not required. *J R Coll Surg Edinb* 2002;**47**(3):557-60.
13. Fa-Si-Oen P, Roumen R, Buitenweg J, van de Velde C, van Geldere D, Putter H *et al*. Mechanical bowel preparation or not? Outcome of a multicenter, randomized trial in elective open colon surgery. *Dis Colon Rectum* 2005;**48**(8):1509-16.
14. Ram E, Sherman Y, Weil R, Vishne T, Kravarusic D, Dreznik Z. Is mechanical bowel preparation mandatory for elective colon surgery? A prospective randomised study. *Arch Surg* 2005;**140**(3):285-8.
15. Wille-Jorgensen P, Guenaga KF, Castro AA, Matos D. Clinical value of preoperative bowel cleansing in elective colorectal surgery: a systematic review. *Dis Colon Rectum* 2003;**46(8)**:1013-20.
16. Memon MA, Devine J, Freeny J, From SG. Is mechanical bowel preparation really necessary for elective left sided colon and rectal surgery? *Int J Color Dis* 1997;**12(5)**:298-302.
17. van Geldere D, Fa-Si-Oen P, Noach LA, Rietra PJ, Peterse JL, Boom RP. Complications after colorectal surgery without mechanical bowel preparation. *J Am Coll Surg* 2002;**194**(1):40-7.

