Is patient outcome affected by the administration of intravenous fluid during bowel preparation for colonic surgery?

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ABSTRACT

INTRODUCTION We have previously shown that Picolax® bowel preparation causes a significant dehydrating effect, which can be minimised by administering a calculated volume of intravenous fluid. The aim of this prospective study was to assess whether peri-operative outcome is affected by administering a calculated volume of intravenous fluid during bowel preparation.

PATIENTS AND METHODS Patients having bowel preparation (Picolax®: Ferring Pharmaceuticals Ltd, Middlesex, UK) prior to colonic surgery were prospectively randomised to receive no intravenous fluid (group 1) or calculated intravenous crystalloid based on their body weight (group 2), during preparation. In both groups, transfusion was protocol-driven. Outcome variables measured included intra-operative and postoperative intravenous fluid requirement, hourly recorded urine output for 24 h, number of patients transfused, number of units of blood transfused, time to the passage of flatus, time to having their bowels open, time until tolerating a full diet, complications and length of stay in hospital.

RESULTS Thirty-three patients were recruited – group 1 ($n = 18$) and group 2 ($n = 15$). There were 24 men and 9 women, median age 69 years (range, 29–86 years). There was no significant difference between the groups with respect to age, sex, weight, ASA grade, pre-operative haemoglobin concentration, duration or type of operation. The total number of patients receiving a transfusion ($P = 0.026$) and the number of units of blood transfused ($P = 0.017$) was significantly greater in group 1. The number of units of blood transfused intra-operatively was significantly greater in group 1 ($P = 0.029$). Significantly fewer patients had a urine output < 30 ml/h in the first 24-h after operation ($P = 0.046$) in group 2. There was no difference between groups in other outcomes measures.

CONCLUSIONS This study indicates that a calculated volume of intravenous fluid administered during bowel preparation improves patient outcomes with respect to blood transfusion and postoperative oliguria. We advocate calculated intravenous fluid administration in all patients undergoing bowel preparation prior to colonic surgery.

KEYWORDS

Picolax® – Colorectal surgery – Fluid therapy – Transfusion

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Two sachets of Picolax® (Ferring Pharmaceuticals Ltd, Middlesex, UK) are administered to patients for bowel preparation prior to colonic surgery in our unit. We have previously shown that Picolax bowel preparation causes a significant dehydrating effect that can be minimised by administering a calculated volume of intravenous fluid;¹ however, that study was only designed to analyse data up until the time of surgery.

The aim of this prospective study was to assess whether peri-operative outcome is affected by administering a calculated volume of intravenous fluid during bowel preparation.

Patients and Methods

Eligibility, inclusion and intervention

The study received approval from the Plymouth local

research ethics committee and patients were required to give informed consent for their inclusion. Eligibility and intervention were as for the original study.¹ Only patients who received bowel preparation and proceeded to surgery were included in this study (Fig. 1). Patients were randomised to receive no intravenous fluid (group 1) or a calculated volume of intravenous normal saline (i.v. infusion rate per hour was 4 ml/kg for the first 10 kilograms + 2 ml/kg for the second 10 kilograms + 1 ml/kg for each subsequent kilogram)² during bowel preparation (group 2), which commenced at the same time as taking Picolax®.

Baseline variables measured prior to Picolax® administration included weight, ASA grade and haemoglobin concentration. Both groups received two sachets of Picolax® 6 h apart starting 18 h prior to surgery. Patients were allowed to drink unlimited clear fluids until 6 h prior to their surgery.

All patients received a standard general anaesthetic and epidural catheter for peri-operative analgesia. The patients were monitored during the operation using standard equipment. Minimum monitoring included continuous ECG, pulse rate, oxygen saturations. Radial artery catheters and central venous lines were used at the discretion of the anaesthetist. Although blood transfusion was protocol-driven (Table 1), intra-operatively this was left to the anaesthetist's discretion.

Outcome measures

Outcome variables included intra-operative and 24-h post-operative intravenous fluid requirements, hourly recorded urine output, number of patients transfused, number of units of blood transfused, haemoglobin concentration 48-h post-operation, time to the passage of flatus, time to having their bowels open, time until tolerating a full diet, complications and length of hospital stay. The change in haemoglobin concentration between admission and 48-h postoperation was calculated after adjusting for any blood transfusion by subtracting 1 g/dl per unit transfused from the latter measurement.⁵ Oliguria was defined as a urine output of less than 30 ml/h.

Statistics

Patients were randomised by sealed envelope prior to administration of Picolax®. Both anaesthetist and surgeon were blinded during the study period. Data were analysed

Table 1 Transfusion protocol

Haemoglobin > 10 g/dl	No transfusion
Haemoglobin 8–10 g/dl	Transfuse if:
	Abnormal ECG
	Ischaemic heart disease
	Obstructive lung disease
	Consultant's discretion
	Unable to absorb oral iron
Haemoglobin < 8 g/dl	Transfuse

using Mann-Whitney for ordinal data and Chi-squared or Fisher's exact for categorical data and expressed as median and range taking $P < 0.05$ as being significant.

Results

Thirty-three patients were recruited – group 1 ($n = 18$) and group 2 ($n = 15$). There were 24 men and 9 women, median age 69 years (range, 29–86 years). There was no significant difference between the groups with respect to age, sex, weight, ASA grade, pre-operative haemoglobin concentration, duration or type of operation.

There was a significant difference in the total number of patients who received a blood transfusion with nine out of 18 (50%) patients in group 1 and two out of 15 (13%) in group 2 receiving blood ($P = 0.026$; Table 2). A significant difference was also recorded in the total number of units of blood transfused – 32 units (group 1) and 5 units (group 2; $P = 0.017$). A similar difference was seen intra-operatively with 5 patients from group 1 being transfused ($P = 0.049$) a total of 12 units of blood ($P = 0.029$) but no patients from group 2 requiring transfusion.

A significant difference was also seen between the two groups in the number of patients with a urine output < 30 ml/h in the first 24-h postoperation – group 1, 14/16 (86%) and group 2, 7/14 (50%; $P = 0.046$). The total number of hours the urine output was < 30 ml/h in the first 24 h in each group was not significantly different ($P = 0.052$), nor was any significant difference recorded in the median 24-h urinary output – group 1, 1090 ml (range, 460–4000 ml); group 2, 1660 ml (range, 560–3000 ml; $P = 0.112$). There was no significant difference in the total intra-operative and 24-h postoperative crystalloid and colloid administration.

The median fall in haemoglobin concentration between admission and 48-h postoperation was significantly different between the two groups – group 1, 3.75 g/dl (range, 2.1–7.4 g/dl) and group 2, 2.8 g/dl (range, 1.6–3.9 g/dl; $P = 0.021$). There was no significant difference between groups in the other outcome measures.

Table 2 Outcome variables

Variable measured		Group 1 (n = 18)	Group 2 (n = 15)	P-value
Total numbers transfused	Patients	9	2	0.026***
	Units	32 (0–5) ^a	5 (0–3) ^a	0.017*
Total intra-operative transfusion	Patients	5	0	0.049**
	Units	12 (0–4) ^a	0	0.029*
Total postoperative transfusion	Patients	6	2	0.242**
	Units	20 (0–5) ^a	5 (0–3) ^a	0.156*
Urine output < 30 ml/h	Patients	14	7	0.046**
	Hours	4 (0–17)	0.5 (0–15)	0.052*
Intra-operative fluids (l)	Crystalloid	3 (1–9)	2.5 (1–7)	0.42*
	Colloid	0.75 (0–2)	0.5 (0–2)	0.20*
24-h postoperative fluid (l)	Crystalloid	3.5 (2–6.3)	3.6 (2.3–6)	0.92*
	Colloid	0 (0–2)	0 (0–2.5)	0.62*

Significant *P*-values in bold.

^aRange per patient; *Mann-Whitney test; **Fisher's exact test; ***Chi-squared test.

Discussion

We have previously shown that administering intravenous fluid during bowel preparation minimises the dehydrating effect of Picolax® bowel preparation.¹ The effect on patient outcome has not been previously studied prospectively.

This study indicates that supplementary intravenous fluid during bowel preparation improves outcome with respect to peri-operative transfusion, most obvious in the intra-operative period. We hypothesise that this can be explained by improved intra-operative haemodynamic stability, as a hypovolaemic, anaesthetised patient demonstrates greater on-table instability lowering the threshold for intra-operative transfusion. The incidence of postoperative oliguria was decreased in group 2 patients and this was thought to be important as an episode of oliguria typically results in a ward intervention, which may result in inappropriate fluid challenges or diuretic administration. There was no difference between the two groups with respect to peri-operative crystalloid or colloid administration despite the fact that group 2 patients had received significantly less blood transfusions, supporting the fact that intravenous fluids at the time of bowel preparation has a beneficial effect.

The median change in haemoglobin concentration between admission and 48-h postoperatively (when fluid shifts have equilibrated) demonstrates that more haemoglobin was lost in patients not receiving pre-operative intravenous fluids. A possible hypothesis for this observation is the haemoconcentrating effect of the Picolax®, as previously described,^{4,5} and subsequent loss of blood of a higher haematocrit.

Although this study did not demonstrate any significant differences in speed of recovery, complication rates or length of stay in hospital, there was a trend in favour of patients who received supplementary intravenous fluids; 3 versus 4.5 days to flatus, 5 versus 6 days to bowels open, 6 versus 7 days to full diet and 9 versus 10.5 days in hospital.

Conclusions

We advocate the use of supplementary intravenous fluids in all patients undergoing bowel preparation to reduce peri-operative blood transfusion and postoperative oliguria in patients undergoing colonic surgery.

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