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Analysis of the Management of Adhesive Small Bowel Obstruction Using Oral Contrast Medium - A Prospective, Observational, Analytical Study

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Abstract

Background: Postoperative adhesions account for the majority of episodes of mechanical small bowel obstruction in adults.

Water-soluble contrast medium is used both to predict the need for operation and, possibly, to hasten resolution of partial obstruction, but the optimal duration of a conservative trial before its administration remains undefined.

Aim: To assess the therapeutic effect of oral Gastrografin in adhesive small bowel obstruction, and to analyse the intra operative findings in patients in whom non-operative management failed.

Materials and Methods: A prospective, observational, analytical study was conducted in the Departments of General Surgery and Surgical Gastroenterology of a tertiary care hospital in South India from October 2016 to March 2018.

Forty-three consecutive patients with suspected adhesive small bowel obstruction were managed with intravenous fluids, nasogastric decompression and nil per oral for the first 24 hours.

Patients who did not settle received 90 mL of oral Gastrografin diluted in 110 mL of water through the nasogastric tube or orally, with erect abdominal radiographs at 6 and 24 hours.

Appearance of contrast in the colon defined a successful non-operative course; failure of the contrast to reach the colon at 24 hours was an indication for operation. Data were analysed in SPSS version 22.0 using the unpaired t test, Yates-corrected chi-square and Fisher exact tests, with $p < 0.05$ taken as significant.

Results: The mean age was 50.9 ± 17.7 years and 22 patients (51.2%) were women. Obstruction settled with the initial 24-hour conservative regimen in 3 patients (7.0%). Of the 40 patients who then received Gastrografin, contrast reached the colon in 31 (77.5%) — in 8 (20.0%) by 6 hours and in a further 23 (57.5%) by 24 hours — and all were managed without operation. The remaining 9 patients (22.5%) underwent laparotomy, giving an overall operative rate of 20.9%. Operative findings were ileal stricture, obstructing band and dense inter loop or parietal adhesions. Hospital stay was significantly longer after operation than after successful non-operative treatment (18.78 ± 9.86 versus 8.68 ± 7.25 days; $p = 0.001$).

Conclusion: Oral Gastrografin resolved obstruction in more than three-quarters of patients who had failed an initial 24-hour conservative trial and reliably identified the small group requiring surgery, shortening hospital stay.

Keywords: Adhesive Small Bowel Obstruction, Gastrografin, Water-Soluble Contrast Medium, Conservative Management, Adhesiolysis; Laparotomy, Length of Hospital Stay.

Abbreviations: ASBO – adhesive small bowel obstruction; SBO – small bowel obstruction; NG – nasogastric; WSCM – water-soluble contrast medium; SD – standard deviation.

Introduction

Adhesions that follow abdominal and pelvic operations are the single commonest cause of mechanical small bowel obstruction in adults, and are demonstrable in the great majority of patients who undergo repeat laparotomy[1]. In a post-mortem series of 752 subjects, Weibel and Majno found intra-abdominal adhesions in 67% of those with a history of abdominal surgery, compared with 28% of those without [2].

The Surgical and Clinical Adhesions Research (SCAR) study, which followed 52,192 patients undergoing laparotomy in Scotland, reported that approximately one in three were readmitted over the subsequent ten years with a problem attributable to adhesions [3,4].

The risk is not uniform across procedures. Operations in the lower abdomen and pelvis, and those that denude a large area of peritoneum, carry the greatest risk. The reported incidence of subsequent small bowel obstruction is 7.1% after open cholecystectomy compared with 0.2% after the laparoscopic operation, and 15.6% after open total abdominal hysterectomy compared with 1% after the laparoscopic approach, whereas no difference is seen after open and laparoscopic appen dicectomy (1.3% versus 1.4%) [5–7]. Pathologically, adhesion formation reflects fibrin deposition on injured serosal surfaces with impaired peritoneal Fibrinolysis, allowing fibroblast in growth and organisation of the Fibrinous bridge into a permanent fibrous band [8,9]. In the absence of strangulation or peritonitis, most episodes of adhesive small bowel obstruction (ASBO) settle without operation.

Traditional conservative management consists of intravenous fluid and electrolyte replacement, nasogastric decompression and nil by mouth, and is

successful in 73–90% of episodes [10–14]. The duration for which such a trial may safely be continued remains unsettled: the risk of missed strangulation rises appreciably when operation is deferred beyond 48 hours[12,15], yet premature laparotomy exposes patients to the morbidity of repeat adhesiolysis and to further adhesion formation.

Against this background, oral water-soluble contrast medium has become central to the non-operative management of ASBO [16,17]. Gastrografin (Bayer AG, Berlin, Germany) is a hyperosmolar (approximately 1900 mOsm/L) mixture of sodium amidotrizoate 100 mg/mL and meglumine amidotrizoate 660 mg/mL containing the wetting agent polysorbate 80.

Its osmotic activity draws fluid into the bowel lumen, increases the pressure gradient across the obstructed segment, dilutes and lubricates the luminal content, reduces bowel wall oedema and enhances peristalsis; less than 3% of the amidotrizoic acid is absorbed after oral administration [13,18]. It therefore has a dual role: the appearance of contrast in the colon on a plain film predicts resolution and selects patients for continued non-operative treatment, while its physicochemical properties may themselves hasten that resolution[19–21]. Current guidelines endorse its use in patients without signs of strangulation[22].

Published experience nonetheless varies in the timing of administration, the dose used and the interval to the follow-up radiograph, and few Indian series have examined contrast given specifically after a failed 24-hour conservative trial.

The present study was therefore undertaken with the primary objective of assessing the therapeutic effect of oral Gastrografin in adhesive small bowel obstruction, and the secondary objective of analysing the intra operative findings in patients in whom conservative management failed, so as to characterise the cohort that ultimately requires operation.

Materials and Methods

Study design and setting

This was a prospective, observational, analytical study carried out in the Departments of General Surgery and Surgical Gastroenterology, Meenakshi Mission Hospital and Research Centre, Madurai, Tamil Nadu, India, between October 2016 and March 2018. The protocol was approved by the Institutional Ethics Committee and written informed consent was obtained from every participant.

Sample size

The sample size was calculated using an expected proportion of successful non-operative resolution of 88%, taken from an earlier study of Gastrografin in ASBO [23], an absolute precision of 5%, a design effect of 1, a source population of 50 and a confidence level of 95%, using the formula $n = [DEFF \times N \times p\,(1 - p)] / [(d^2 / Z^2_{1-\alpha/2}) \times (N - 1) + p(1 - p)]$. The required sample size was 39; 43 consecutive eligible patients were enrolled during the study period and all were analysed.

Eligibility criteria

All patients admitted with a clinical and radiological diagnosis of suspected adhesive small bowel obstruction, with a history of previous abdominal or pelvic surgery, were eligible. Patients with small bowel obstruction accompanied by peritonitis, those with large bowel obstruction, and those with clinically obvious strangulation or documented intra - abdominal malignancy at the time of admission were excluded.

A previous operation performed for a malignant condition was not itself a criterion for exclusion,

provided there was no documented recurrent or residual intra-abdominal disease.

Management protocol

On admission, patients were resuscitated with intravenous fluids and electrolytes and acid–base disturbances were corrected. A nasogastric tube was passed, oral intake was withheld and a urinary catheter was placed where indicated.

Complete blood count with haematocrit and total leucocyte count, renal function tests and serum electrolytes were obtained, and an erect abdominal radiograph was taken at admission.

Patients were monitored in the intensive care unit for the first 24 hours with serial recording of vital signs, abdominal girth and tenderness, nasogastric aspirate volume and passage of flatus or faeces, and a repeat erect abdominal radiograph was obtained at 24 hours.

Patients whose symptoms did not settle within 24 hours received 90 mL of Gastrografin diluted in 110 mL of water, administered orally or through the nasogastric tube, with the tube clamped for two hours thereafter. Erect abdominal radiographs were obtained 6 hours and 24 hours after administration.

Passage of contrast into the colon was taken to indicate a partial obstruction likely to resolve, and non-operative management was continued. Failure of contrast to reach the colon on the 24-hour film was taken to indicate complete obstruction, and laparotomy was performed. Non-operative treatment was abandoned and operation undertaken at any point if the patient developed increasing pain, tachycardia, fever, localised tenderness or other signs of clinical deterioration.

Outcome measures

The primary outcome was resolution of obstruction without operation after Gastrografin administration. Resolution was defined clinically as relief of pain, reduction in abdominal distension, passage of flatus and/or stool, return of normal bowel sounds, stool on per rectal examination and a fall in nasogastric aspirate, together with radiological passage of contrast into the colon. Secondary outcomes were the timing of contrast appearance in the colon (6 versus 24 hours), the need for operation, the operative findings and the total length of hospital stay.

Statistical analysis

Data were recorded on a structured proforma for each patient, compiled in a master chart in Microsoft Excel and analysed with SPSS version 22.0 (IBM Corp., Armonk, NY, USA). Frequencies and percentages were computed for qualitative variables, and range, mean and standard deviation for quantitative variables.

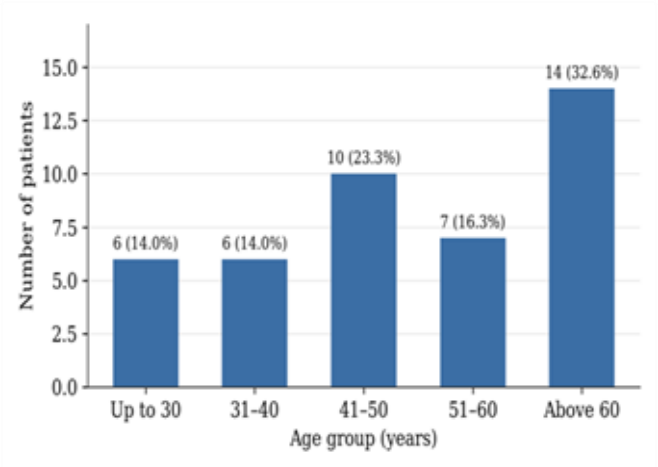
The unpaired t test was used to compare quantitative variables between groups, and the Yates-corrected chi-square and Fisher exact tests for qualitative variables. A p value of less than 0.05 was considered statistically significant.

Results

Demographic profile

Forty-three patients with adhesive small bowel obstruction were studied. Their ages ranged from 15 to 83 years, with a mean of 50.9 ± 17.7 years; the largest single group (14 patients, 32.6%) was aged above 60 years (Figure 1). Twenty-two patients (51.2%) were women and 21 (48.8%) were men, a male-to-female ratio of 1:1.05.

Figure 1: Age distribution of the study population (n = 43)



Range 15–83 years; mean 50.9 years; standard deviation 17.7 years.

Co morbidity and clinical presentation

Twenty-seven patients (62.8%) had no recorded co morbidity; some of the remainder had more than one comorbid condition (Table 1).

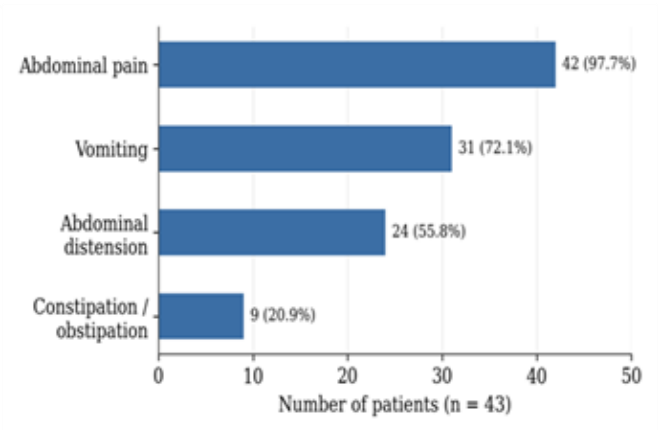
Abdominal pain was almost universal, reported by 42 patients (97.7%), followed by vomiting in 31 (72.1%), abdominal distension in 24 (55.8%) and constipation or obstipation in 9 (20.9%). Most patients presented with more than one complaint (Figure 2).

Table 1: Co morbidity profile of the study population (n = 43)

Co morbidity	Number	Percentage
None	27	62.8
Diabetes mellitus	9	20.9
Hypertension	9	20.9
Coronary artery disease	2	4.7
Hypothyroidism	1	2.3

Categories are not mutually exclusive; individual patients could have more than one co morbidity. Percentages are of the total 43 patients.

Figure 2: Presenting complaints at admission (n = 43)



Categories are not mutually exclusive; most patients had more than one complaint.

Index operation and interval to obstruction

Every patient had undergone at least one previous abdominal or pelvic operation. The index operation had been performed for a benign condition in 28 patients (65.1%), most often small bowel disease requiring resection and anastomosis, and for a malignant condition, predominantly colorectal cancer, in 15 patients (34.9%).

The interval between the index operation and the present admission ranged from 15 days to 17 years, with a mean of 4.37 ± 4.78 years; 16 patients (37.2%) presented within one year of their operation (Table 2).

Table 2: Indication for the index operation and interval to the present episode (n = 43)

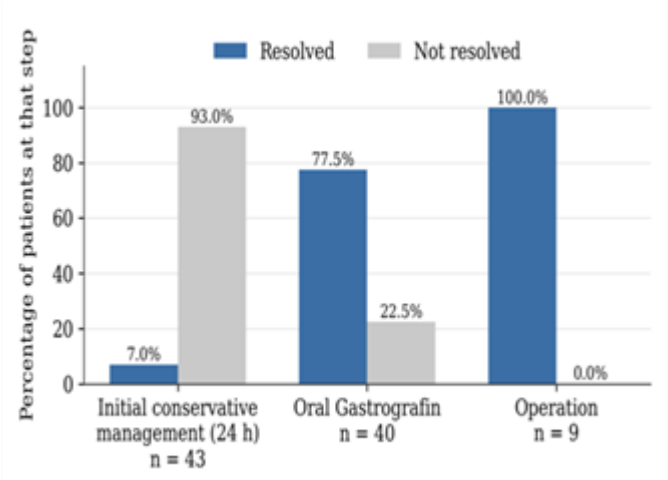
Variable	Category	Number	Percentage
Indication for index surgery	Benign	28	65.1
	Malignant	15	34.9
Interval since index surgery	Up to 1 year	16	37.2
	1–5 years	14	32.6
	6–10 years	6	14.0
	Above 10 years	7	16.3
Total		43	100.0

Interval: range 15 days to 17 years; mean 4.37 years; standard deviation 4.78 years.

Outcome of treatment

Obstruction settled with the initial 24-hour regimen of intravenous fluids, nasogastric decompression and nil per oral in only 3 of the 43 patients (7.0%). The remaining 40 patients received oral Gastrografin. Contrast reached the colon in 31 of these 40 patients (77.5%), all of whom were managed successfully without operation. In the 9 patients (22.5%) in whom contrast failed to reach the colon by 24 hours, laparotomy was undertaken and was therapeutic in every case. The overall non-operative success rate was thus 34 of 43 (79.1%) and the operative rate 9 of 43 (20.9%) (Figure 3).

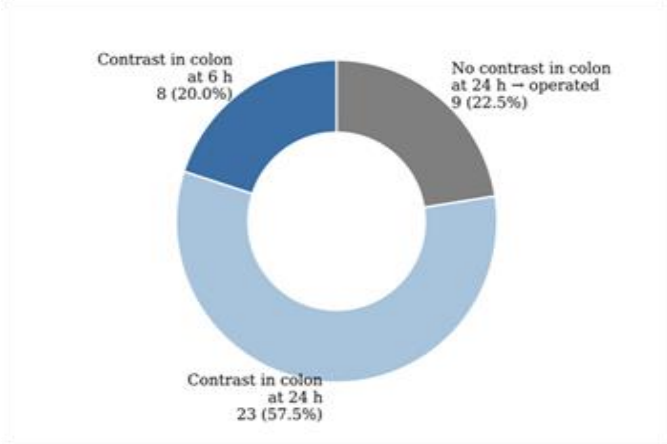
Figure 3: Outcome of each successive step of the treatment protocol



Percentages are calculated within the group of patients entering each step. Resolution denotes clinical and radiological relief of obstruction without progression to the next step.

Among the 40 patients given Gastrografin, contrast was demonstrated in the colon at 6 hours in 8 patients (20.0%) and at 24 hours in a further 23 patients (57.5%), a cumulative resolution rate of 77.5% (Figure 4).

Figure 4: Timing of appearance of contrast in the colon after oral Gastrografin (n = 40)



Association of baseline characteristics with outcome

Resolution within the first 24 hours of conservative treatment was equally uncommon whether the index operation had been performed for benign disease (2 of 28, 7.1%) or for malignant disease (1 of 15, 6.7%); the

difference was not statistically significant (p = 0.495) (Table 3).

Table 3: Indication for index surgery and outcome of conservative management in the first 24 hours.

Indication for index surgery	Patients	Relieved (n)	Relieved (%)	Not relieved (n)	Not relieved (%)
Benign	28	2	7.1	26	92.9
Malignant	15	1	6.7	14	93.3
Total	43	3	7.0	40	93.0

Chi-square test, p = 0.495 (not significant).

Patients who ultimately required operation were, on average, older than those managed without operation (54.4 ± 22.2 versus 50.0 ± 16.5 years), and 5 of the 9 operations were performed in patients aged above 60 years; this difference did not reach statistical significance (p = 0.506) (Table 4).

Table 4: Age group and final outcome of treatment

Age group (years)	Patients	Non-operative (n)	Non-operative (%)	Operative (n)	Operative (%)
Up to 30	6	4	66.7	2	33.3
31–40	6	6	100.0	0	0.0
41–50	10	8	80.0	2	20.0
51–60	7	7	100.0	0	0.0
Above 60	14	9	64.3	5	35.7
Total	43	34	79.1	9	20.9

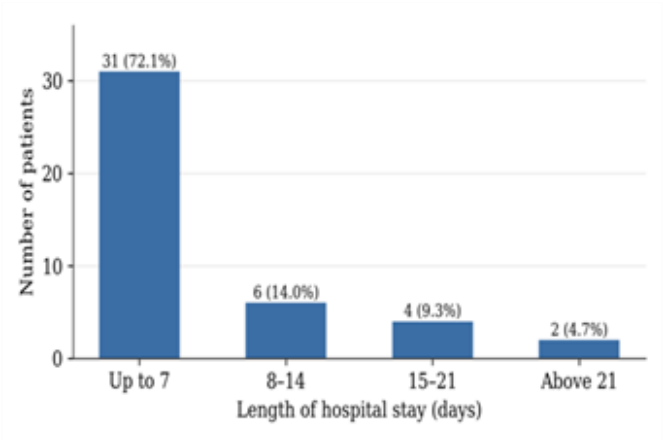
Mean age of the non-operative group 50.0 ± 16.5 years (range 15–83); mean age of the operative group 54.4 ± 22.2 years (range 17–79). Unpaired t test, p = 0.506 (not significant).

Length of hospital stay

The total hospital stay ranged from 3 to 35 days, with a mean of 8.47 ± 7.03 days, and 31 patients (72.1%) were discharged within 7 days (Figure 5).

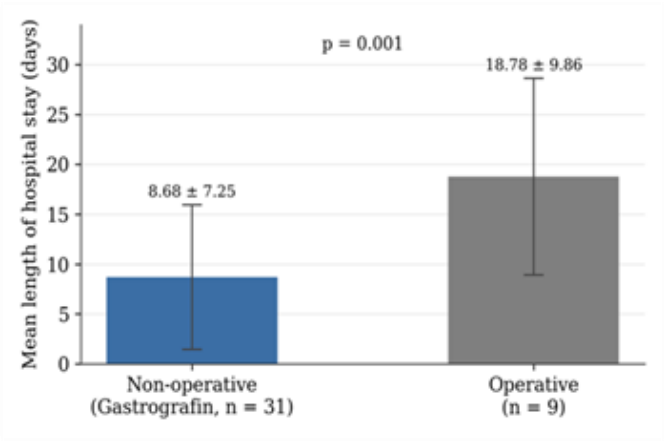
Stay was significantly longer in patients who required operation (18.78 ± 9.86 days) than in those whose obstruction resolved after Gastrografin (8.68 ± 7.25 days), the difference being statistically significant (p = 0.001) (Figure 6).

Figure 5: Distribution of the length of hospital stay (n = 43)



Range 3–35 days; mean 8.47 days; standard deviation 7.03 days.

Figure 6: Mean length of hospital stay according to treatment modality



Error bars represent one standard deviation. Unpaired t test, p = 0.001. The three patients whose obstruction settled during the initial 24-hour conservative period are not shown separately; their recorded mean stay should be re-verified against the master chart before publication.

Operative findings

At laparotomy the nine patients in whom contrast failed to reach the colon were found to have an ileal stricture, for which resection and anastomosis was performed; an obstructing fibrous band, treated by band release; or dense adhesions between small bowel loops and to the anterior abdominal wall, treated by adhesiolysis. No patient in this series required resection for established gangrene, and there was no in-hospital mortality. [Author note: the exact number of patients in each operative category should be inserted here from the master chart.]

Discussion

In this prospective series of 43 patients with adhesive small bowel obstruction, an initial 24-hour trial of conventional conservative treatment resolved obstruction in only 7.0% of patients, whereas oral Gastrografin given to the remaining 40 patients led to resolution in 77.5%. The overall operative rate of 20.9% compares favourably with the 27–42% reported in earlier series of adhesive obstruction managed without contrast [11,24], and is consistent with the view that water-soluble contrast both selects patients for continued non-operative treatment and contributes therapeutically to resolution.

Duration of the conservative trial

There is no consensus on how long non-operative treatment may safely be continued. Hofstetter argued for operation if obstruction had not resolved within 12 hours [25], whereas Cox et al. found that 88% of episodes that ultimately settled did so within 48 hours [10] and Brolin and colleagues recommended prompt laparotomy, usually within 24 hours, once conservative treatment had failed [26]. Sosa and Gardner considered 24–48 hours adequate [12], Bizer et al. 48–72 hours [27], and Seror et al. reported that a trial of up to five days was safe in the majority [11]. Clinical indicators used to judge progress — nasogastric output, passage of flatus, abdominal distension and the character of the pain — are notoriously inconsistent [28,29], which has prompted the development of multivariate prediction models [30]. The protocol used here, in which a fixed 24-hour conservative period is followed by contrast administration and a further 24-hour observation, resolves this uncertainty pragmatically: the decision to operate is taken at 48 hours from admission on an objective radiological criterion, before the interval at which the risk of unrecognised strangulation is known to rise [15].

Predictive value of water-soluble contrast

The predictive performance of contrast passage in this study reproduces earlier work. Chen et al. showed that all patients with contrast in the right colon within 24 hours were treated successfully without operation,

whereas laparotomy became necessary in 96% of those without [31]. Onoue et al., administering Gastrografin on admission, reported that 98% of patients settled if contrast reached the colon within 24 hours, and that 80% failed conservative treatment if it did not [32]. Perea García et al. and Al Wadani et al. similarly found that contrast administration reliably assigned patients to a non-operative course [33,34]. In the present series the criterion was absolute: every patient with contrast in the colon avoided operation and every patient without it had an operative cause of obstruction confirmed at laparotomy.

This objective end point is a considerable advance on plain radiography alone. Abdominal radiographs have a reported sensitivity and specificity of about 83% for acute small bowel obstruction [35], and although air–fluid levels of differing heights or an air–fluid level width of 2.5 cm or more suggest high-grade obstruction [36], normal films do not exclude the diagnosis. Clinical assessment, though highly specific, is likewise imperfect [37]. Water-soluble contrast studies have been shown to be safe in this setting [38], and in this series no case of aspiration, contrast-related pneumonitis, anaphylaxis or renal impairment was encountered.

The rapeutic effect of Gastrografin

Whether Gastrografin does more than predict outcome remains debated. In a randomised trial, Assalia et al. found that Gastrografin shortened the time to resolution and hospital stay and reduced the need for operation [13]. The meta-analysis of Abbas et al. concluded that water-soluble contrast is effective in reducing the need for operation and shortens hospital stay in patients whose obstruction settles[16]. Randomised data from Di Saverio et al. and Farid et al. support a therapeutic role [39,40], whereas Fevang et al. and others found no reduction in operative rate [41]. Choi et al. demonstrated a therapeutic benefit specifically in patients in whom initial conservative treatment had already failed [17] — the population studied here. Our finding that 31 of 40 patients settled after contrast, having failed 24 hours of standard treatment, is consistent with a genuine therapeutic effect, although in an observational design without a control arm the possibility that these obstructions would have resolved with continued conservative treatment alone cannot be excluded.

Patient characteristics

All patients had at least one previous laparotomy, and in most a single previous operation had been sufficient to produce obstructing adhesions, a finding reported in other series [33,34]. Small bowel resection and colorectal cancer surgery accounted for most index operations, in keeping with the known association between lower abdominal and pelvic procedures and subsequent adhesive obstruction. The mean interval of 4.37 years from index surgery, with more than a third of patients presenting within the first year, mirrors the wide temporal distribution described in long-term cohort studies [4,43]. Neither the benign or malignant nature of the index operation nor patient age predicted the need for surgery in this study, although the operative group was on average four years older and five of nine operations were performed in patients over 60 years; the study was not powered to detect differences of this magnitude.

Hospital stay and clinical implications

Length of stay was approximately twice as long in operated patients as in those managed non-operatively ($p = 0.001$). Since mortality from small bowel obstruction has fallen from about 50% to under 3% over the past century, largely through improvements in non-operative care [42], the incremental gains now available lie in avoiding unnecessary laparotomy in patients who will

settle, while identifying without delay the minority who will not. Avoiding operation also avoids the further adhesion formation and the recognised risk of recurrent obstruction that follow adhesiolysis [43], and reduces the substantial cumulative cost of adhesion-related readmission[44].

A protocol based on oral contrast achieves both aims with a single inexpensive investigation and no additional imaging burden.

Limitations

This was a single-centre observational study without randomisation or a concurrent control group, and the sample size, although exceeding that calculated, was modest. Because contrast was given only after 24 hours of conservative treatment, the study cannot determine whether earlier administration would have shortened stay further. Patients with clinically obvious strangulation were excluded by design, so the findings do not apply to that group, in whom preoperative recognition remains difficult and early operation mandatory [45]. Finally, follow-up was limited to the index admission, so recurrence rates after Gastrografin-assisted resolution were not assessed.

Conclusion

In patients with adhesive small bowel obstruction who fail an initial 24-hour trial of conventional conservative treatment, oral Gastrografin resolved the obstruction in more than three-quarters of cases and correctly identified every patient who required operation. Passage of contrast into the colon within 24 hours is a simple, inexpensive and reliable predictor of successful non-operative management, and its absence is a clear indication for laparotomy. Used in this way, oral contrast radiography shortens hospital stay and avoids the morbidity associated with both unnecessary and unduly delayed operation, and merits routine inclusion in the management algorithm for adhesive small bowel obstruction in patients without signs of strangulation or peritonitis.

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