



## Medical audit

# Small bowel obstruction due to postoperative adhesions: treatment patterns and associated costs in 110 hospital admissions

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The workload and costs of the emergency admissions and treatment of adhesive small bowel obstruction (ASBO) are unclear. This review details and costs the admission workload of ASBO.

All admissions over a 2-year period for ASBO at two district general hospitals were identified through ICD10 diagnostic codes. Diagnostic investigations, treatment patterns, ward stay and outcome information for admissions were detailed from clinical records to develop mean cost estimates and assess the associated workload.

Of the 298 admissions identified, 188 were not due to ASBO and were excluded from analysis. Of the 110 admissions detailed, 41 (37%) were treated surgically and 69 (63%) conservatively. Most admissions occurred through general practitioner referral (86.4%) to accident and emergency (90.0%). Mean (SD) length of stay was 16.3 days (11.0 days) for surgical treatment and 7.0 days (4.6 days) for conservative treatment. In-patient mortality was 9.8% for the surgical group and 7.2% for the conservative group. Costs were based on the mean values from both centres for surgical and conservative admissions and detailed according to the cost of referral and follow-up (£100.98 surgical versus £102.61 conservative), hospital ward and ICU stay (£3,327.48 versus £1,267.92), theatre time (£832.32 surgical only), investigations (£282.73 versus £207.33) and drug costs (£133.90 versus £28.29). Total treatment cost per admission for ASBO was £4,677.41 for surgically treated admissions and £1,606.15 for conservatively treated admissions.

The impact of admissions for ASBO is considerable in terms of both costs and workload. Bed stay for these admissions represents the equivalent of almost one surgical bed per year

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**and at least 2 days theatre time, impacting on surgical capacity and waiting lists. Adhesion prevention strategies may reduce the workload associated with ASBO. The review provides useful information for planning resource allocation.**

*Key words:* Adhesions – Abdominal surgery – Small bowel obstruction – Costs

The most common cause of small bowel obstruction is postoperative adhesions,<sup>1</sup> yet the workload and economic burden associated with emergency admissions and treatment of small bowel obstruction remains unclear. Studies in the US,<sup>2</sup> Europe<sup>3</sup> and the UK<sup>4</sup> have attempted to address this problem, but a detailed analysis of hospital treatment patterns and associated costs has not been undertaken. We have initiated a retrospective review of all hospital admissions for adhesion-related small bowel obstruction to examine: referral patterns, diagnostic measurements, ward stay, surgical treatment, drug treatment and follow-up at two district general hospitals in southern England.

This information has been used to provide a detailed estimate of the workload and associated costs of both surgical and conservative hospital treatment of small bowel obstruction due to postoperative adhesions. Such data are important when considering the implementation of adhesion prevention strategies such as the use of bioresorbable membranes.

## Patients and Methods

The study was conducted at Colchester General Hospital, Colchester and Joyce Green Hospital, Dartford, two similar-sized district general hospitals (66 and 44 surgical beds, respectively). The same surgical research nurse conducted the analysis at both centres to minimise inter-centre variation, and a quality-monitoring service was provided by Strategen Disease and Therapy Management to verify the data entry records of the first 10 records at each centre and then to randomly verify 20% of the remaining admissions documented. Admissions were identified by assessment of the following ICD10 diagnostic codes from the admissions register of each hospital between 1996 and 1997: (i) K56.5 – intestinal adhesions (bands) with obstruction; and (ii) K56.6 – other and unspecified intestinal obstruction. We selected the K56.5 code as the principal code for admission selection, but also included K56.6 based on experience from an earlier study.<sup>4</sup>

The hospital records of all identified admissions were reviewed. Admissions with obstruction due to causes other than adhesions, duplicated admissions, notes with insufficient documentation for analysis and patients without a previous history of laparotomy were

excluded. All remaining admissions were reviewed according to the following criteria: (i) pain on admission; (ii) nausea and vomiting; (iii) abdominal distension; (iv) absence of bowel movements; and (v) abdominal X-ray evidence of small bowel obstruction.

Admissions that failed to meet all these criteria were reviewed by the principal surgical investigator at both hospitals. For surgically treated patients without an OPCS surgical procedure code documenting surgical adhesions, this involved an assessment of the operation notes for evidence of surgical adhesions. For conservatively treated patients, this included a detailed review of the hospital notes and X-rays.

The number of admissions requiring surgical or conservative treatment were documented and details of hospital referral, investigations, ward stay, operations, drug treatment, fluids and follow-up were recorded. Mean unit costs were derived from the financial department of each hospital. These figures, together with the percentage occurrence, time and incidence values obtained from the analysis, were then used to derive the mean costs for surgical and conservative treatment. Drug and i.v. fluid treatment costs were calculated using the mean of the average unit charge by the pharmacy at each hospital and by using the drug records including median dose, mean number of administrations per day, total days of treatment and proportion of patients treated.

## Results

Selection of the small bowel obstruction admission population is shown in Figure 1. A total of 412 K56.5 and K56.6 coded hospital admissions were identified from the admission registers (206 from each hospital). Only those recorded as primary diagnosis were analysed. Of the 298 admission records analysed, 188 were excluded.

A total of 110 admissions were analysed in detail, of which three patients had admissions recorded on two occasions and one on three occasions. All other admissions related to individual patients. There was a ratio of approximately 1:2 for surgical versus conservatively treated admissions. The demography and admission history of all analysed admissions are summarised in Table 1.

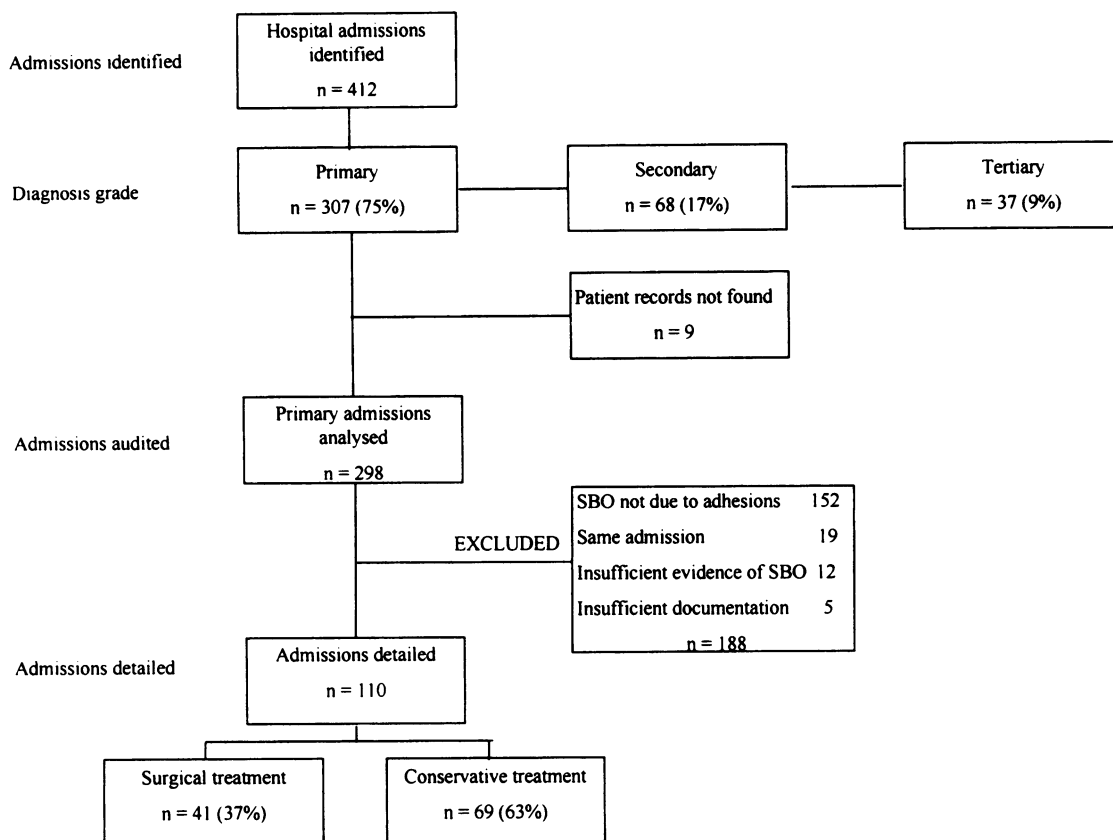


Figure 1 Small bowel obstruction due to postoperative surgery – admission selection

All admissions were in-patients who had undergone previous laparotomies. Patients had two or more previous laparotomies in 56% of the surgically treated group and 68% of the conservative group.

Two patients in the surgical group were elective admissions for small bowel obstruction with previous histories of multiple admissions for adhesions and have been excluded from the analysis of emergency admissions.

Details of admission referral, hospital stay and follow-up are shown in Table 2. Most admissions occurred through the accident and emergency unit, having been referred by their general practitioner. Theatre time for treatment of small bowel obstruction was classified as emergency and costed accordingly. Theatre costs included pre-operative time and post-operative recovery, and theatre time was derived from

Table 1 Demography and admission history

Demography / admission history	All admissions		Surgical admissions		Conservative admissions	
	n	(%)	n	(%)	n	(%)
Number of admissions	110		41		69	
Age	Mean (SD)	61.8 yr (19.4 yr)	58.0 yr (20.5 yr)		64.1 yr (18.4 yr)	
	Range	15–94 yr	15–90 yr		15–94 yr	
Sex	M/F	49/61	22/19		27/42	
Obstruction on X-ray		88 (80.0%)	31 (75.6%)		57 (82.6%)	
Abdominal pain and nausea and/or vomiting		106 (98.1%)*	38 (97.4%)*		68 (98.6%)*	
Abdominal distension		73 (67.6%)*	26 (66.6%)*		47 (68.1%)*	
Absence of bowel movements		48 (44.4%)*	20 (51.3%)*		28 (40.6%)*	

\*Emergency admissions only

Table 2 Pattern of admission referral, duration of hospital stay, number of out-patient follow-ups and corresponding unit costs

Referral, hospital stay and follow-up		Number of events (%) or days (SD)		
		Surgical n = 41	Conservative n = 69	Unit costs
Referral	A & E	34 (82.9%)	65 (94.2%)	£59.75 per visit
	GP referrals	33 (80.5%)	62 (89.9%)	£23.00 per visit
	Out-patient	2 (4.9%)	1 (1.4%)	£59.50 per visit
Theatre time	Emergency	96 min	NA	£8.67 per min
ICU ward stay	Mean (SD)	0.29 days (0.8 days)	0.01 days (0.1 days)	£1,332.00 per day
Surgical ward stay	Mean (SD)	16.34 days (11.0 days)	6.97 days (4.6 days)	£180.00 per day
Follow-up	Out-patient visits	23 (56.1%)	32 (46.4%)	£53.50 per visit

the mean of the average times for OPCS 4 procedure code T41.0 classified laparotomies for each hospital. The mean length of stay on ICU related to 5 admissions in the surgical group and one in the conservatively treated group. The mean length of stay on surgical wards was 16.3 days (range, 2–45 days) for operative admissions and 7.0 days (range, 1–23 days) for conservative admissions.

Nine patients died and assessment of the pre-operative state was undertaken. Four patients died (9.8%) during the hospital admission stay in the surgically treated group – assessed as American Society of Anesthesiologists' (ASA) pre-operative physical status<sup>5</sup> grade 4 (2 patients) and grade 5 (2 patients) – and 5 patients (7.2%) in the conservative group – all assessed as ASA pre-operative physical status grade 4.

The mean frequency of diagnostic tests are shown in Table 3 and were greater in the surgical group than the conservative group.

Drug and i.v. fluid use was similar in each group with the following exceptions: antibiotics (cefuroxime and

metronidazole) were administered to 61% of the surgical admissions and 13% of the conservative admissions; over 75% of the surgical and 60% of the conservative patients received pethidine, but the surgical group required analgesics for twice as long, and more than a third of the surgical patients received morphine; TPN usage (i.v. feed) was higher in the surgical group. Blood was administered to 6 patients in the surgical group, one of whom was given 12 units per day for 2 days, and to 2 patients in the conservative group.

#### Cost of treatment

Using the mean incidence values for surgical and conservative treatment and the corresponding unit costs, the mean admission costs for small bowel obstruction due to postoperative adhesions were calculated and are presented in Table 4.

The data show that the cost of surgical treatment of admissions is nearly three times that of conservative

Table 3 Frequency of admission diagnostic tests and corresponding unit costs

Admission diagnostics (No. of tests)	Mean number tests per admission		Unit cost per test
	Surgical	Conservative	
Laboratory investigations			
Haematology (full blood count)	7.4	3.3	£3.04
Blood cross match	0.9	0.5	£2.70
Biochemistry (urea and electrolytes)	8.0	3.2	£2.95
Microbiology (urine and sputum culture)	2.8	1.0	£6.82
X-rays			
Abdominal	1.5	1.4	£13.28
Chest	1.3	0.8	£13.28
CT	0.1	0	£135.75
Contrast meal and follow-through	0.2	0.2	£135.90
Contrast enema	0.1	0.1	£74.02
Other			
Ultrasonography	0.3	0.2	£31.02
Sigmoidoscopy	0.2	0.2	£511.00
ECG	0.7	0.3	£25.00

Table 4 Mean costs of hospital admission for small bowel obstruction treatment – treated surgically and conservatively

Cost component		Mean cost of component per admission	
		Surgical	Conservative
Referral	A&E	£49.53	£56.28
	GP	£18.52	£20.68
	Out-patient	£2.92	£0.83
Ward stay	ICU	£386.28	£13.32
	Surgical ward	£2,941.20	£1,254.60
Theatre		£832.32	–
Diagnostics	Laboratory tests	£67.63	£27.64
	X-rays	£85.34	£63.79
	Other diagnostics	£129.76	£115.90
Drugs (not ICU)	Antibiotics	£7.51	£2.70
	Analgesics	£4.45	£1.22
	Anti-emetics	£0.04	£0.04
	i.v. fluids	£81.64	£21.77
	Blood	£40.26	£2.56
Follow-up		£30.01	£24.82
<b>Total</b>		<b>£4,677.41</b>	<b>£1,606.15</b>

treatment, with the greatest proportion of costs being associated with ward bed stay (63% surgical and 78% conservative). Surgery accounted for only 18% of the total costs in the surgically treated group.

Drug and i.v. fluid costs were nearly 4 times as high in the surgical group compared with the conservative group due primarily to a greater use of antibiotics, i.v. fluids and blood. There was little difference between the two groups with respect to costs of diagnosis and follow-up.

## Discussion

### *Hospital diagnosis and management of small bowel obstruction due to postoperative adhesions*

This study showed that over a third of all hospital admissions for adhesive small bowel obstruction are treated surgically. This figure is less than that observed in some studies,<sup>4,6</sup> but similar to other reports.<sup>7,8</sup>

The 41 operations identified and analysed represent approximately 3% of the total laparotomy case load in the two hospitals. This compares with the workload seen in other studies. A survey by Treutner and colleagues demonstrated that 2.6% of laparotomies in 750 German hospitals were for adhesive small bowel obstruction<sup>9</sup> and a retrospective study by Menzies and Ellis indicated that, over a 25 year period, 3.3% of all laparotomies were for adhesional obstruction.<sup>10</sup>

This requirement for emergency surgery places an important extra burden on hospital bed space, an important factor to consider when endeavouring to improve throughput of patients in order to reduce surgical waiting lists. Our study showed that the average ward stay for the surgical treatment of adhesion-related small bowel obstruction was 16 days, more than double that for an elective laparotomy, (7 days; Colchester General Hospital, 1997). These admissions will inevitably impact on elective surgery and increase waiting lists.

We found that the ICD10 diagnostic code K56.5 was the most appropriate code to identify these patients (55 of 80 identified). However, use of this code alone may seriously underestimate the local burden of this problem, since half of our study population came from the less specific K56.6 code (55 of 227 identified). Given the high level of miscoding, it is likely that other admission codes contain admissions due to postoperative adhesions and that our data may be underestimating the true impact of adhesion-related small bowel obstruction. Better training of hospital staff involved in discharge summary production and in coding could help improve the process of coding, to the appropriate diagnostic ICD code and operative OPCS codes and provide a more accurate local assessment of the incidence of these types of admissions. It is well recognised that coding errors occur and a 20% discrepancy between surgical records and hospital activity data has been reported in England.<sup>11</sup> However, the full scale of the problem of coded data is not currently known. The National Health Service in Scotland may prove a useful model as the Quality Assessment and Accreditation Unit (QAA) of their Information and Statistics Division (ISD) has gone far in ensuring the quality of all hospital coding and its subsequent national recording through intensive training, audit and feedback.<sup>12,13</sup>

This study found that the presenting features of adhesive small bowel obstruction were variable. The classical cluster of colicky pain, distention, vomiting and absolute constipation was not a regular feature. This has been highlighted in other studies.<sup>14,15</sup> Plain abdominal X-rays only confirmed obstruction in 80% of the cases in this study, a fact emphasised by Shrake and colleagues,<sup>16</sup> who observed an absence of plain X-ray evidence of small bowel obstruction in 22% of patients. This absence of plain X-ray evidence of small bowel obstruction has often been reported.<sup>17,18</sup>

The study showed that, apart from abdomen and chest X-rays, diagnostic tests are comparatively few. Although recent studies showing that ultrasound, small bowel contrast studies and CT scans can improve the accuracy and sensitivity of diagnosis,<sup>6,8,16,19</sup> their current use in NHS practice does not appear to be widespread.

Providing guidance on diagnosis and management appears to be essential if the subsequent long lengths of stay, variable drug management, particularly with respect to antibiotic use, and high mortality rates are to be reduced.

Although mortality was nearly 10% in the surgical group, analysis of the pre-operative state of deceased patients suggests that there are likely to be other causes contributing to the high mortality observed. These should not detract, however, from the fact that there is significant mortality associated with surgical intervention to relieve small bowel obstruction due to surgical adhesions.

#### *The costs of small bowel obstruction due to surgical adhesions*

The mean costs of both operative (£4,677.41) and non-operative (£1,606.15) treatment estimated in this study are considerably higher than those calculated by Wilson and colleagues who studied a population in Manchester (£1,964.83 and £814.86, respectively), even allowing for location and inflation.<sup>4</sup> These differences can be explained by longer ward stays, higher theatre costs and the inclusion of referral, diagnostic, admission and follow-up costs in our study. Our figures provide a more detailed estimate of the total costs for a hospital admission for small bowel obstruction due to postoperative adhesions. Extrapolation of the surgical ward stay and operation figures suggest that small bowel obstruction due to postoperative adhesions accounts for over 287 ward days and at least 10 extra emergency laparotomies per annum for an average district general hospital. Bed stay for these cases represents approximately 2% of the total bed occupancy per year (equivalent to almost one surgical bed being occupied by these patients all year) and at least 2 days of theatre time.

The cost to society and to the individuals has not been estimated, but is likely to be substantial.

#### Conclusions

The study shows that the impact of admissions for adhesion related small bowel obstruction is considerable. By the nature of the study design and methodology, the data are still likely to be a substantial underestimate of the actual burden. Once adhesions have developed, progression to obstruction is inevitable in a significant proportion. Improved diagnosis and identification of complications at an early stage may reduce in-patient stay, morbidity and mortality.

We are convinced that a greater reduction in burden will be achieved by adhesion prevention. Recent work with site specific barriers<sup>21</sup> and a liquid barrier<sup>22</sup> would suggest that strategies may be available that not only reduce adhesions but in turn reduce the consequences of adhesions in the form of small bowel obstruction. Without clear guidelines on adhesion-prevention strategies and the use of technological advances, this cost burden will remain unchecked as will its drain on hospital resources and NHS ability to meet demand. The important morbidity for patients will also remain unchecked.

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#### References

1. Ellis H. The magnitude of adhesion-related problems. *Ann Chir Gynaecol* 1998; **87**: 9–11.
2. Fox Ray N, Denton WG, Tharner M, Henderson SC, Perry S. Abdominal adhesiolysis: inpatient care and expenditure in the United States in 1994. *J Am Coll Surg* 1998; **186**: 1–9.
3. Jeckel H. Cost implications of adhesions as highlighted in a European Study. *Eur J Surg* 1997; **Suppl S79**: 43–5.
4. Wilson MS, Hawkswell JA, McCloy RF. The natural history of adhesional small bowel obstruction: counting the cost. *Br J Surg* 1998; **85**: 1294–8.
5. American Society of Anesthesiologists. *Relative Value Guide*. USA: 520 North West Highway, Park Ridge, Illinois 60068, 1998; vii.
6. Ogata M, Mateer JR, Condon RE. Prospective evaluation of abdominal sonography for the diagnosis of bowel obstruction. *Ann Surg* 1996; **223**: 237–41.
7. Seror D, Feigin E, Szold A, Allweiss TM, Carmon M, Nissan S *et al*. How conservatively can post operative small bowel obstruction be treated? *Am J Surg* 1993; **165**: 121–5.
8. Ko YT, Lim JH, Lee DH, Lee HW, Lim JW. Small bowel obstruction: sonographic evaluation. *Radiology* 1993; **187**: 649–53.
9. Treutner KH, Bertram P, Loser S, Winkeltau G, Schumpelick V. Prevention and therapy of intra-abdominal adhesions. A survey of 1200 clinics in Germany. *Chirurg* 1995; **66**: 398–403.
10. Menzies D, Ellis H. Intestinal obstruction from adhesions – how big is the problem? *Ann R Coll Surg Engl* 1990; **72**: 60–3.
11. Gaugh MH, Kettlewell MGW, Marks CG, Holmes SJK, Holderness J. Audit: an annual assessment of the work and

- performance of a surgical firm in a regional teaching hospital. *BMJ* 1980; **281**: 913–8.
12. Harley K, Jones C. Quality of Scottish Morbidity Record. *Health Bull* 1996; **54**: 410–7.
  13. Kendrick S, Clarke J. The Scottish Record Linkage System. *Health Bull* 1993; **51**: 72–9.
  14. Pain JA, Collier DS, Hanka R. Small bowel obstruction: computer assisted prediction of early strangulation at presentation. *Br J Surg* 1987; **74**: 981–3.
  15. Eskelinen M, Ikonen J, Lipponen P. Contribution to history taking, physical examination, computer assistance to diagnosis of acute small bowel obstruction. Prospective study of 1333 patients with acute abdominal pain. *Scand Gastroenterol* 1994; **29**: 715–21.
  16. Shrake PD, Rex DK, Lappas JC, Maglinte DD. Radiographic evaluation of suspected small bowel obstruction. *Am J Gastroenterol* 1991; **86**: 175–8.
  17. Gough IR. Strangulating adhesive small bowel obstruction with normal radiographs. *Br J Surg* 1978; **65**: 431–4.
  18. Kingsnorth AN. Fluid filled intestinal obstruction. *Br J Surg* 1976; **63**: 289–91.
  19. Maglinte DD, Reyes BL, Harmon BH, Kelvin FM, Turner Jr WW, Hage JE *et al*. Reliability and role of plain film radiography and CT in the diagnosis of small bowel obstruction. *AJR* 1996; **176**: 1451–5.
  20. Diamond MP on behalf of The Seprafilm Adhesion Study Group. Reduction of adhesions after uterine myomectomy by Seprafilm® membrane (HAL-F): a blinded, prospective, randomized, multicenter clinical study. *Fertil Steril* 1996; **66**: 904–10.
  21. Becker JM, Dayton MT, Fazio VW, Beck DE, Stryker SJ, Wexner SD *et al*. Prevention of postoperative abdominal adhesions by a sodium hyaluronate-based bioresorbable membrane: a prospective, randomized, double-blind multicenter study. *J Am Coll Surg* 1996; **183**: 297–306.
  22. Verco SJS, di Zerega GS, CLASSIC study group. Tolerability and effectiveness of 4% icodextrin solution in the reduction of post-surgical adhesions following laparoscopic surgery; multicentre, pilot, clinical study. *J Reprod Fertil* 2000; **25**: 62