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Challenges of Malignant Small Bowel Obstruction – Results of a State Surgical Mortality Dataset

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Authors' contributions

This work was carried out in collaboration between all authors. Authors SM and APW designed the study. Authors JA and TRC extracted the raw data. Author SM cleaned and categorized the data. Author APW analyzed the data. Authors SM and APW wrote the initial draft. All authors contributed to the final manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Background: Small bowel obstruction is a common acute surgical pathology. Despite the substantial postoperative mortality associated with small bowel obstruction (SBO), there is limited evidence to support clinical decision-making. The purpose of this study was to identify differences in system, patient and operative features in adults who died following operative treatment of malignant versus nonmalignant small bowel obstruction.
Methods: Retrospective analysis of adults with SBO who died in hospital while under the care of a surgeon. Data was collected by the Australian and New Zealand Audit of Surgical Mortality from Queensland hospitals between January 2009 and December 2014.
Results: 523 patients died post-operatively following surgical treatment of small bowel obstruction over the six-year study period. The most common etiologies were adhesive (41%), malignancy

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(25%) and hernia (16%). Compared to those with a nonmalignant etiology, patients with malignant SBO were younger (P < 0.001) but had a longer mean pre-operative inpatient admission (P = 0.007), and were more likely to require an anastomosis at the time of operation (P < 0.001).
Conclusion: Despite being younger, patients with malignant small bowel obstruction are challenging to manage. Further studies are needed to help surgeons manage patients with malignant small bowel obstruction.

Keywords: Small bowel obstruction; mortality; audit; laparotomy.

1. INTRODUCTION

Small bowel obstruction (SBO) is a common surgical emergency, accounting for up to 20% of all acute surgical admissions [1]. Despite recent technical advances, all-cause mortality for SBO ranges from 5% for uncomplicated disease to 30% if ischemia is present [2]. Surgeons caring for patients with SBO continue to face substantial clinical challenges. A diagnosis of SBO encompasses a heterogeneous spectrum of disease in terms of etiology, complication rates and response to medical management. There is a paucity of research that addresses SBO as a clinical syndrome. Rather, most evidence regarding SBO management comes from subgroup analysis of relatively robust populations, for example patients with adhesive SBO [3-4].

In the absence of clinical practice guidelines, SBO management is largely driven by surgeon experience and preference. Currently, patients with simple adhesive obstruction may be offered medical management (e.g. up to 72 hours [3-4]). Early surgical intervention is indicated in patients with signs of complicated disease such as ischemia or perforation, those with simple obstruction that fails to resolve with medical therapy, and when obstruction is due to a luminal lesion [3-4].

Early postoperative mortality for patients with a primary diagnosis of SBO has been reported to range from 3% to 6.5% [5-11]. In 2013, Schraufnagel, et al. noted delaying operative management by four or more days from time of presentation was associated with increased in-hospital mortality but did not impact on the frequency of bowel resection [10]. Otherwise there is little data evaluating mortality following surgical management of SBO.

The present study used the Australian and New Zealand Audit of Surgical Mortality (ANZASM) dataset to compare patient characteristics and surgeon reported peri- and intra-operative factors in patients who died following surgery for SBO depending on whether the etiologly was malignant or not.

2. METHODS

The ANZASM retrospectively collects mortality data from hospitals where patients died while under the care of a surgeon. The functioning, governance and objectives of ANZASM have been previously described [12]. Briefly, participating hospitals independently notify ANZASM when a surgical in-patient dies, regardless of whether the patient was treated medically or operatively. The treating surgeon then provides additional clinical information using a 25 question standard surgical case form.

Surgeon participation in ANZASM is a requirement of the Royal Australasian College of Surgeons for continuing professional development and nearly 100% of Australian surgeons participate. Currently, 99% of public hospitals and 76% of private hospitals with surgical services take part in ANZASM. Not all hospitals participated in ANZASM from the beginning of the study period, however no hospital withdrew. Each Australian State and Territory evaluates patient care in their jurisdiction and in Queensland all 38 public hospitals and all 37 private hospitals participate.

Inclusion criteria for the present study were Queensland patients aged 18 years or older who died following surgical treatment of small bowel obstruction between January 2009 and December 2014. The treating team on the basis of clinical, laboratory, radiological and intra-operative findings, made a primary diagnosis of mechanical SBO. Patients whose planned surgeries were abandoned intra-operatively due to advanced malignancy were also included. Baseline patient population data was not available for patients managed nonoperatively or for patients managed operatively who were discharged from hospital alive.

Data were extracted from the ANZASM dataset and analysed using IBM SPSS Statistics 19 (Armonk, NY: IBM Corporation, 2010) and Microsoft Excel (Redmond, Washington: Microsoft, 2010). Continuous variables are presented as means. Categorical variables are presented as frequencies, with the percentages in brackets. The significance of the difference between two proportions was determined using a Z-test. To compare means, the Mann-Whitney U test was used. Two-tailed P values are presented and statistical significance was determined at $P < 0.05$.

3. RESULTS

523 adults died following operative management of small bowel obstruction in Queensland over the six year study period. The most common etiologies were postoperative adhesions and malignancy as shown in Table 1. Those with a malignant etiology were found to be approximately 6 years younger (73.7 years vs. 78.9 years; $p < 0.001$) than patients with a non-malignant SBO. Comorbidities were less often present in patients with malignant vs. nonmalignant SBO (89.3% vs 97.4% respectively; $p < 0.002$).

While patients with malignant SBO had a slightly lower ASA class compared to patients with a nonmalignant SBO (3.4 vs. 3.5; $P = 0.051$) this difference is not clinically meaningful. Patients with a malignant etiology had a more complicated hospital stay: longer preoperative length of stay (5.3 days vs. 2.7 days; $P = 0.007$), more likely to have an anastomosis (64.4% vs. 29.7%; $P < 0.002$) but equally likely to have postoperative fluid balance issues (10.9% vs. 14.4%; $P = 0.323$). ICU admission for patients with a malignant etiology was less frequent than those with a nonmalignant SBO (62.9% vs. 81.8%; $P < 0.001$). The frequency of reoperation was independent of SBO etiology. The treating surgeon identified delay to diagnosis occurred in 11.5% of cases overall but this did not differ between malignant and nonmalignant SBO.

In 32 patients with a malignant etiology, the type of cancer was not stated. Of the remaining 100 patients, 50% had colorectal adenocarcinoma, 13% carcinoid, 7% transitional cell carcinoma, 6% gynaecological malignancy, 5% small bowel adenocarcinoma and 19% other malignancy (e.g. upper gastrointestinal, pancreatobiliary, lymphoma, sarcoma, lung). In 17 / 100 patients the primary site of the malignancy was the small bowel. In 83 / 100 patients the small bowel obstruction was due to metastatic disease not originating in the small bowel.

Table 2 demonstrates that in retrospect, surgeons would have managed 115 patients (22.0%) differently, although there was no difference between malignant and nonmalignant groups. Treating surgeons suggested in future they would: operate or reoperate earlier (39 / 115; 34%), improve assessment or overall care (36 / 115; 31%), change intraoperative management (19 / 115; (17%) e.g. performing a complete adhesiolysis), not operate or not reoperate (19 / 115 (17%)) or admit earlier to ICU (2 / 115 (2%)).

Fig. 1 suggests for patients with a nonmalignant SBO etiology, most primary operations occurred on Friday and least often on Sunday. However, patients with a malignant SBO etiology tended to have most of their primary operations on Wednesday to Friday but most admissions occurred on Sunday and Monday.

Table 1. Details of patients who died following surgical management of small bowel obstruction

Type of obstruction	Age in years	Female (%)	ASA class	Delay to diagnosis (%)
Malignant N = 132 (25.2%)	73.7	65 (49.2%)	3.5	11 (8.3%)
Adhesive N = 214 (40.9%)	79.8	116 (54.2%)	3.6	22 (10.3%)
Hernia N = 84 (16.1%)	81.1	47 (56.0%)	3.4	14 (16.7%)
Other N = 33 (6.3%)	78.5	18 (54.5%)	3.3	5 (15.2%)
Not stated N = 60 (11.5%)	79.1	38 (63.3%)	3.8	8 (13.3%)
Total N = 523	78.3	284 (54.3%)	3.5	60 (11.5%)
P value*	<.001	0.135	0.051	0.202

*N: Number, * comparison of malignancy vs. rest, ASA: American Society of Anesthesiologists*

Table 2. Perioperative details of patients who died following surgical management of small bowel obstruction

Type of obstruction	Preoperative inpatient days	Anastomosis (%)	Number of reoperations per patient	Fluid balance issues (%)	ICU admission (%)	Different actions in retrospect (%)
Malignant N = 132 (25.2%)	5.3	85 (64.4%)	0.42	14 / 128 (10.9%)**	83 (62.9%)	28 (21.2%)
Nonmalignant N = 331	2.6	78 (23.6%)	0.35	46 / 311 (14.8%)	271 (81.9%)	72 (21.8%)
Not stated N = 60 (11.5%)	3.8	38 (63.3%)	0.40	7 / 57 (11.7%)**	49 (81.7%)	15 (25.0%)
Total N = 523	3.4	201 (38.4%)	0.38	67 / 496 (13.5%)**	403 (77.1%)	115 (22.0%)
P value*	0.007	<0.002	0.576	0.332	<0.001	0.803

*N: Number, * comparison of malignancy vs. rest, **data not available for all patients*

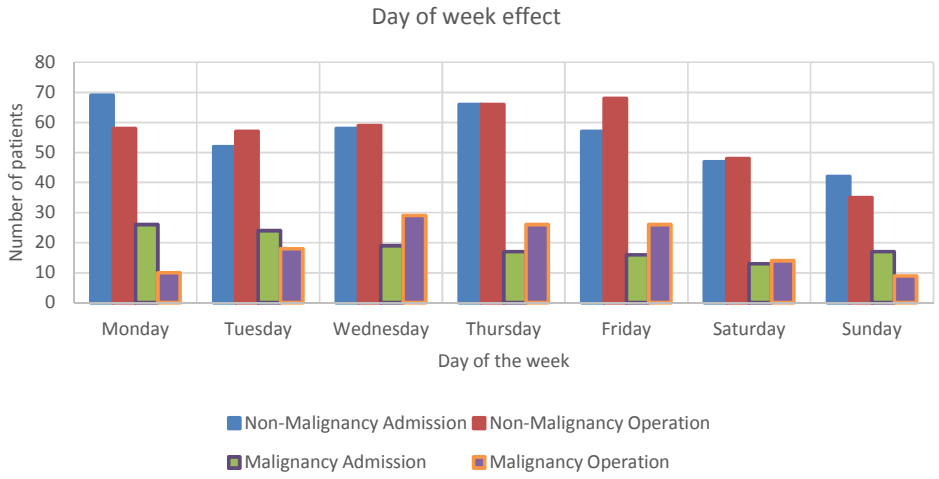

Fig. 1. Admission and surgery day of the week for malignant and nonmalignant SBO

4. DISCUSSION

Over 6 years, this study identified 523 patients in Queensland with SBO who died in the immediate post-operative period. Patients with a malignant etiology had a more complicated hospital stay longer preoperative length of stay and more likely to have an anastomosis compared to patients with a benign etiology. Our results also suggest patients with a malignant etiology were possibly healthier (younger, less likely to have comorbidities and lower ASA class) than those with a non-malignant SBO. In keeping with an expected poorer prognosis, patients with a malignant SBO were less likely to be admitted to ICU and to have postoperative fluid balance issues identified. This is a very heterogenous group of patients - not just demographically. Other differences include types of comorbidities and whether or not chemotherapy or radiotherapy had been previously administered. At least 5 000 patients undergo emergency adhesiolysis annually in Queensland but surgical procedures for SBO other than adhesiolysis are not routinely recorded [13].

Early post-operative mortality for SBO is reported to be between 3% and 6.5% [6,10-11,14] however patients with malignancy are typically excluded. The literature suggests that patients with abdominal malignancy account for only 5% to 13% of all patients who undergo operative

management for SBO [9,15]. In this study the most common SBO etiology was adhesive (40.9%) followed by malignancy (25.2%) and hernia (16.1%). As such, we have identified a possible over-representation of patients with malignant SBO dying in the early post-operative period. Similar results have been previously described by Butler et al. (1991), who found malignant SBO to be predictive of early post-operative mortality. True postoperative mortality in SBO may thus be greater than the rates reported in the literature.

Despite its enormous length, small bowel malignancy accounts for less than 5% of gastrointestinal tumours [16]. Primary small bowel tumours are typically Gastro Intestinal Stromal Tumour in the proximal small bowel, adenocarcinoma distally and lymphoma anywhere [17]. However, the present study highlights that in the majority of patients who died after surgical management of malignant small bowel obstruction, the obstruction was actually a representation of metastatic disease not originating in the small bowel (83%).

Subgroup studies of patients with adhesive SBO have postulated a number of patient and technical factors associated with post-operative mortality. Age over 75 years [5] and ASA class of greater than 3 [11] has been associated with increased post-operative mortality from SBO. Time from presentation to operation was significantly greater for malignant SBO in this study, with an average delay of over 5 days. Schraufnagel et al. (2013) found preoperative stay of four or more days increased in-hospital mortality by 64%. Correspondingly, guidelines for the management of adhesive SBO recommend that surgery be considered for obstructions that fail to resolve within 72 hours [3-4]. In conflict with these findings, a recent study examining outcomes for patients undergoing emergency laparotomy for adhesive SBO, found a stepwise increase in mortality for each pre-operative day [11].

The significant operative delay for patients with malignant SBO identified in this study likely reflects the absence of evidence-based guidelines for management of this condition. While pre-operative diagnosis of malignant SBO may straight forward with cross-sectional imaging, management and especially timing of surgery are challenging. Clinical history and physical exam findings are non-specific, although partial obstruction and obstruction occurring within three years of an indexed cancer are suggestive of malignant etiology [18,19]. However, malignant SBO occurs in less than 30% of patients with a history of malignancy and 50% of patients with dissemination [19]. Plain abdominal x-rays have sensitivity of 69-77% for SBO but cannot differentiate the cause [20-21]. Computerized Tomography (CT) scanning is 90% sensitive in the detection of high grade obstructions, and can identify etiology in 70-95% of cases [20,22-23]. CT is less useful in diagnosing partial obstructions or peritoneal carcinomatosis [19].

Medical management in patients with malignant SBO often results in incomplete resolution of symptoms and frequent re-obstruction [15]. Suitable patient selection is paramount in reducing post-operative morbidity and mortality. Ascities [19,24-25], hypoalbunaemia [24] and peritoneal carcinomatosis [24-25] are associated with poor post-operative outcomes. The most common intra-operative techniques employed for patients with malignant SBO are resection with anastomosis, stoma formation or bypass [15,19]. Our study demonstrates patients with malignant SBO were significantly more likely to require an anastomosis than those with nonmalignant SBO. In suitable patients with disseminated disease resection may be preferable as it improves return to bowel function, lengthens the interval to re-obstruction and confers a survival advantage over both nonoperatively managed patients and patients undergoing stoma formation or bypass [26-27]. When compared to adhesiolysis alone, bowel resection has been found to increase post-operative morbidity but not mortality [28].

To our knowledge, no study has previously investigated how the day of admission affects post-operative outcomes for patients with SBO. Our data suggests patients who died after surgical management of malignant SBO tended to undergo surgery mid week while those with a nonmalignant SBO were more clustered at the start of the week. Previous research has shown that emergency admissions over the weekend are associated with significantly higher short term mortality as compared with patients admitted on a weekday [29,30]. This effect is likely multifactorial and includes lack of availability of senior staff, less access to diagnostic services, workforce shortages and decreased access to operating theatres. The lack of a comparator population of patients who survived surgical management of SBO makes interpretation of our day of the week data difficult.

This retrospective hypothesis generating study has some limitations. The ANZASM database is

unable to generate a control group of patients who were operatively managed and survived. We were not able to verify the clinical details as ANZASM does not have access to patient medical records. As surgeons self-submit data to ANZASM, there is a possibility of self-reporting bias by the treating surgeon although this seems unlikely [31]. This study only includes in hospital deaths potentially missing patients who died after discharge from the primary surgical unit. Reviewer surgeons may demonstrate retrospective hindsight bias when assessing the care delivered to patients who are known to have died. Our study covers only one Australian state and whether the findings are generalizable across the wider surgical population needs further study.

5. CONCLUSION

Patients who died following surgical management of a malignant small bowel obstruction had a more complicated hospital stay: longer preoperative length of stay and more likely to have an anastomosis compared to patients with a benign etiology. As opposed to adhesive small bowel obstruction, there is a lack of clinical guidelines to assist acute care general surgeons managing this complex group of patients.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Ethical approval was not required as ANZASM is a protected quality assurance activity in Australia under Part VC of the Health Insurance Act 1973 (gazetted August 2011). According to policy this work meets criteria for operational improvement activity. Hospital approval was also not required.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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