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Reversal of Hartmann's procedure: timelines, preoperative investigations and early outcomes. A single Australian institution's ten-year experience

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Abstract

Background: Real-world data on outcomes following Hartmann's reversal is necessary to help optimize the patient experience. We have explored the timing between the index operation and its reversal; what investigations were carried out prior to this, and the associated short-term outcomes.

Methods: A retrospective study of all patients who underwent Hartmann's reversal from 2010 to 2020 within a tertiary referral centre in Melbourne, Australia. One hundred from a total of 406 (25%) who underwent an emergency Hartmann's procedure had a subsequent reversal. Complete patient data was available for 83 of these patients.

Results: The average patient age was 60 years, and the median time for reversal was 14.0 (IQR 10–23) months. Seventy-nine of 83 (95%) reversals had a preoperative endoscopic evaluation of both their rectal stump and a complete colonoscopy. Stoma stenosis ($n = 2$), patient refusal ($n = 1$) and emergency reversal ($n = 1$) were cited reasons for not undergoing preoperative endoscopic evaluation. A third ($n = 28$, 34%) had a computed tomography prior to reversal; the majority was due to their underlying cancer surveillance ($n = 21$, 75%). Reversal was associated with a morbidity rate of 47% ($n = 39$). Surgical site infections (SSIs) ($n = 21$, 25%) were the most common type of complications encountered, with the majority being superficial ($n = 15$, 71%). SSIs were associated with steroid use (5/21 versus 4/62, $p = 0.03$) and greater hospital length of stay (6 versus 10 days, $p = 0.03$).

Conclusion: Only a quarter of emergency Hartmann's procedures within our institution were reversed. A significant proportion developed postoperative complications. Surgical site infection was the most common morbidity.

Introduction

Hartmann's procedure is a common emergency operation. The reversal of a Hartmann's procedure is a complex, elective surgical procedure which requires planning and optimisation, including endoscopic and CT evaluation. Reversal rates within the literature range between 19% and 71%.[1–4] Reversal is associated with significant morbidity (mean 16.3%, range 3.6%–50%) and mortality (mean 1%, range 0%–7.1%).[4] Complications can be largely classified into those relating to surgical site infections (SSIs) (range 5%–30%), anastomotic leak (range 0%–16%), and cardiopulmonary complications (range 1%–14.6%), which will have a significant impact on the length of stay, health costs and patient quality of life.[4] The availability of real-world data is useful to inform patients and clinicians when considering this complex operation. Unfortunately, relatively little Australian data is available within the literature.

Therefore, this study was performed to identify the proportion of Hartmann's operations that had a reversal, the timelines to reversal, the investigations performed prior to this and the short-term outcomes in a single large tertiary referral centre in Melbourne, Australia.

Method

A retrospective study evaluating all patients who underwent emergency Hartmann's reversal at a tertiary referral metropolitan

hospital in Melbourne, Australia, between January 2010 and January 2020 was carried out. We excluded patients with incomplete data—Figure 1.

Patient characteristics included age, sex, body mass index (BMI), ASA class, comorbidities, medication use, alcohol and smoking status. The initial indication for the emergency Hartmann's procedure is shown in Table 1. Preoperative investigations included colonoscopy and CT. Time to reversal was also captured. Perioperative outcomes included the type of surgery (laparoscopic, open, need for defunctioning stoma), duration of surgery, and length of postoperative hospital stay. Postoperative complications included surgical site infections (superficial, deep, organ/space), anastomotic leak, bleeding, ileus, respiratory, cardiac, renal, and neurological disorders. We used the United States Centre for Disease Control and Prevention (CDC)'s definition of surgical site infection (SSI).[5] Complications were classified using the Clavien-Dindo classification, and mortality was defined as death within 30 days after reversal.

This study was approved by a local ethics committee (Western Health Office for Research) and is consistent with the NHMRC Ethical Considerations in Quality Assurance and Evaluation Activities (2014) guideline. QA Project Number: QA2021.28 ERM ID Reference Number: 75510.

Statistical analysis

All statistical analyses were performed using the Jamovi project (Version 1.6, 2021). Per Shapiro–Wilk criteria, normally distributed data are reported as mean ± standard deviation. Nonparametric data are reported as median (interquartile range). Student's *t*-tests, with equal variances assumed, are used to compare the difference of normally distributed. Mann–Whitney *U* tests are used to compare nonparametric variables. Categorical variables were analysed using the χ^2 or Fisher's exact test and presented as patients' numbers and percentages. A value of $P < 0.05$ was considered statistically significant.

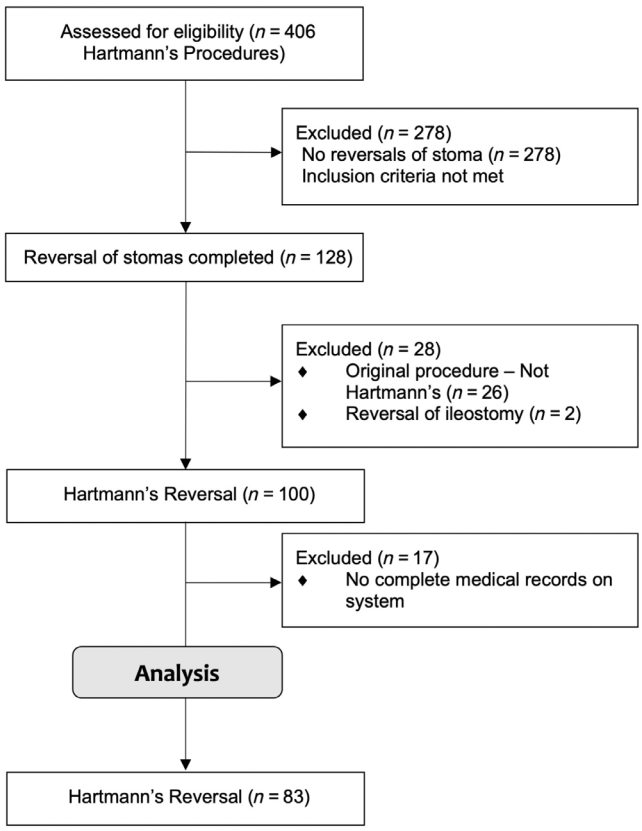

Fig. 1. Inclusion criteria flow diagram.

Results

A total of 406 patients had emergency Hartmann's procedures performed between 2010 and 2020. However, only 100 of these 406 Hartmann's were reversed (24.6%). Complete medical records for 83 of these 100 patients were available (Fig. 1); of these 48 (58%) were male, and 35 (42%) were female patients (average age of 60.1 years, SD 13.0). The median time to reversal was 14.0 months (IQR 10–23). The most common indication for the index Hartmann's procedure was due to acute diverticular disease ($n = 45$, 54%). Of this group, the severity (Hinchey classification) of the diverticular disease episodes were as follows: I ($n = 1$), IIb ($n = 15$), III ($n = 26$) and IV ($n = 3$).[6] The second most common cause was due to large bowel obstruction ($n = 31$, 37%); there were 26 malignant and 5 diverticular strictures. The remainder were due to iatrogenic causes ($n = 7$, 8%); colonoscopic sigmoid perforation ($n = 5$), left colon ischemia in the setting of abdominal aorta aneurysm repair ($n = 1$) and sigmoid injury during laparoscopy for chronic pelvic inflammatory disease ($n = 1$).

In total, 79 (95%) underwent combined preoperative endoscopic evaluation of both of their colon and rectal stump. Reasons for omitting preoperative endoscopic evaluation include the presence of a stoma stenosis ($n = 2$), patient refusal given a history of bowel perforation due to colonoscopy ($n = 1$) and emergency reversal in the setting of incarcerated peristomal hernia and small bowel obstruction ($n = 1$). Almost a third ($n = 28$, 33.7%) had a computed tomography (CT) prior to their reversal. However, most of these CTs (21 out of 28) were performed as a part of their colorectal cancer surveillance. The remainder of patients who had CT scans before the reversal, for the main reason of perioperative planning, including the assessment of the proximity of staple lines to ureters or the severity of incisional hernias. Patients generally had an ASA score of I–II ($n = 56$, 67%), with the remainder being ASA III–IV ($n = 27$, 33%) (Table 2). Frequencies of comorbidities can be found on Table 1.

Most Hartmann's reversals were performed as an open procedure ($n = 74$, 89%), with only a small number performed laparoscopically ($n = 9$, 11%) (Table 2). Only those who had their initial Hartmann's performed laparoscopically underwent a subsequent laparoscopic reversal. Those who underwent laparoscopic reversal were statistically 10.7 years younger than those who had open reversals (50.6 ± 8.8 versus 61.3 ± 13.0, $t_{81} = 2.41$, $P = 0.02$). The median operative time for the reversal surgery was 224 min (IQR 175–267), with a median hospital length of stay of 6 days (IQR 5–11) (Table 2). Eight patients (9.6%) received a defunctioning loop ileostomy at reversal.

Table 1 Patient characteristics of those who underwent Hartmann's reversal

$N = 83$	n (%)		
Age (years)	60.1 (SD 13.0)	Medications	
Gender		Steroid use	9 (10.8)
Female	35 (42.2)	PPI use	20 (24.1)
Male	48 (57.8)	Alcohol use	15 (18.1)
Smoking status		BMI	28 (IQR 24–32)
Non-smoker	35 (42.2)	Initial Indication for HP	
Current smoker	20 (24.1)	Large bowel obstruction	32 (38.6)
Ex-smoker	28 (33.7)	Malignancy	30
Diabetes	17 (20.5)	Diverticular stricture	2
Ischaemic heart disease	7 (8.4)	Perforated diverticular disease	46 (53.0)
Any respiratory disease	15 (18.1)	Iatrogenic	7 (8.4)
Any renal disease	6 (7.2)	Colonoscopic perforation	5
Previous malignancy	4 (4.8)	Colonic Ischemia	1
		Bowel injury	1

There were no 30-day postoperative mortalities identified in our cohort. However, 47% patients developed postoperative complications ($n = 39$, Table 3). The most common postoperative complication seen in our cohort was due to surgical site infections (SSIs), affecting 21 out of 83 (25.3%) patients. The incidence of SSIs was more significant in those with steroid use (5/21 versus 4/62) ($\chi^2_1 = 4.9$, $P = 0.027$) (Table 4). The relative risk of developing SSIs with steroid use is 1.22 (95% CI 0.96–1.57) relative to no use. Those who developed SSIs with steroids use were on low doses of 5 mg prednisolone for chronic conditions such as allergic bronchopulmonary aspergillosis, myasthenia gravis and resistant prurigo ($n = 3$). Others were often on structured prednisolone weaning regimens for exacerbations of respiratory illnesses; doses from prednisolone 30 mg to 5 mg ($n = 2$). We found that those with SSIs had a longer length of stay, 10 days (IQR 5–16) versus 6 days (IQR 4–9) ($U = 411$, $P = 0.03$) (Table 4). We found no overall association with smoking status ($P = 0.47$) or BMI (28 versus 29 kg/m^2, $P = 0.47$) (Table 4).

The 21 patients with surgical site infections were further categorized into having either superficial, deep, organ space infections or a combination of the three. Superficial SSIs occurred in 15 cases (71%), for 8 of whom was their only SSI. Deep surgical site infections occurred in 7 (33%) patients. All 7 of these deep infections were associated with superficial infections resulting in small abdominal wall abscesses/collections.

Finally, organ space infections (OSI) occurred in 8 of 21 (38%) patients. Interestingly all patients with organ space SSIs had their initial Hartmann's performed due to complicated diverticulitis with associated peritonitis. Three of eight patients with OSI had infection present at the time of surgery (PATOS). Three patients developed an anastomotic leak, of which two required a return to theatre for take-down of their anastomosis and the formation of an end colostomy stoma. The other patient with an anastomotic leak was managed conservatively with intravenous antibiotics. All these three cases with anastomotic leaks were current smokers and had raised BMI (24.7, 30.2 and 58.2). Two of these cases were on low-dose prednisolone of 5 mg and could not be reduced due to their chronic medical management.

Finally, nine patients developed prolonged postoperative ileus, which required total parenteral nutrition. One patient developed a venous thromboembolic complication requiring anticoagulation. Five patients developed an acute kidney injury, one complicated by urosepsis secondary to nephrolithiasis.

Table 2 Perioperative/intraoperative Hartmann's reversal outcomes

Type of surgery	n (%)
Open	74 (89.2)
Laparoscopic	9 (10.8)
ASA score at reversal	
1	4 (4.8)
2	52 (62.7)
3	25 (30.1)
4	2 (2.4)
Duration of surgery (mins)	224 (IQR 175–267)
Length of stay (days)	6 (IQR 5–11)
Time to reversal (months)	14.0 (IQR 10–23)

Table 3 Postoperative Hartmann's reversal outcomes

Morbidity	N (%)
Clavien–Dindo score	
Not applicable	44 (53)
1	24 (28.9)
2	4 (4.8)
3a	2 (2.4)
3b	7 (8.4)
4	2 (2.4)
Intraoperative complications	2 (2.4)
Ureteric injury	1
Small bowel enterotomy	1
Need for defunctioning loop ileostomy	9 (10.8)
Postoperative bleeding	4 (4.8)
Postoperative ileus—clinically significant, requiring TPN	9 (10.8)
Anastomotic leak	3 (3.6)
Surgical site infections	21 (25.3)
Superficial	15
Deep	7
Organ/space	8
Venous thromboembolism	1 (1.2)
Renal complications	5 (6.0)
AKI	5
Nephrolithiasis	1
Small bowel obstruction	5 (6.0)

Table 4 Patient characteristics, preoperative, intraoperative and postoperative factors group by surgical site infection

	No surgical site infections *n* (%)	Surgical site infections *n* (%)	*P*
N	62 (75)	21 (25)	
Age	60.0 ± 12.2	60.1 ± 15.3	0.85
Gender			
Female	24 (69)	11 (31)	0.27
Male	38 (79)	10 (21)	
Smoking status			
Non-smoker	28 (80)	7 (20)	0.47
Current smoker	13 (65)	7 (35)	
Ex-smoker	21 (75)	7 (25)	
Diabetes	13 (76)	4 (24)	1.00
Ischaemic heart disease	5 (71)	2(29)	1.00
Any respiratory disease	11 (73)	4 (27)	1.00
Any renal disease	4 (67)	2/6 (33)	0.64
Previous malignancy	3 (75)	1 (25)	1.00
Medications			
Steroid use	4 (44)	5 (56)	0.04*
PPI use	12 (60)	8 (40)	0.08
Alcohol use	9 (60)	6 (40)	0.15
BMI	28 (IQR 24–32.5)	29 (IQR 25–30.5)	0.47
ASA score at reversal			
1	4 (100)	0 (0)	
2	39 (75)	13 (25)	0.55
3	18 (72)	7 (28)	
4	1 (50)	1 (50)	
Type of surgery			
Open	57 (77)	17 (23)	0.69
Laparoscopic	6 (67)	3 (33)	
Initial Indication			
Large bowel obstruction	28 (88)	4 (12)	0.07
Perforated diverticulitis	29 (66)	15 (34)	
Iatrogenic	5 (71)	2 (26)	
Duration of surgery	220 min (IQR 174–270)	228 min (IQR 199–255)	0.66
Length of stay	6 days (IQR 4.3–9)	10 days (IQR 5–16)	0.03*

*Denotes statistical significance $p < 0.05$

Discussion

Hartmann's procedure is a common emergency operation for left-sided colonic perforation or obstruction. Due to surgical sub-specialization within our institution, Hartmann's procedures for consideration for reversal are solely referred to the colorectal unit. There is little real-world data on single centre experience in reversing Hartmann's procedures within the Australian literature. We therefore present a large case series of our tertiary referral centre experience. Our reversal rate of 25% is lower than reported averages (44%, range 19%–71%).[4] This may be influenced by patient demographics and co-morbidities that vary significantly across hospital institutions. The average age of our patients who underwent a reversal was 60 years and were predominantly ASA I/II (67%). The most common cause of their initial emergency Hartmann's procedure was due to complicated diverticular disease, followed by malignant large bowel obstruction and finally, iatrogenic injury. The average age, ASA class and initial indication are similar to several studies within the literature.[1–4] We identified that our median time to reversal was 14.0 months. There are several factors which influenced this, including hospital waiting times for investigations, in particular endoscopic evaluation and the fact that Hartmann's reversal category priority is defined as being non-urgent within our Australian public hospital system.

We found that those who underwent laparoscopic reversals were younger and had a prior laparoscopic Hartmann procedure; but there were no other differences in outcomes, including length of stay or morbidity between laparoscopic and open approaches. We do however acknowledge that our laparoscopic reversal numbers were small. This is contrary to other studies, which found shorter hospital length of stay and lower incidence of morbidity.[7]

Ninety-three percent of our patients underwent endoscopic investigations to assess the upstream colon and their rectal stump before surgery. Reasons for those not having an endoscopic evaluation before surgery included patient choice, the presence of a stenosed upstream colon and finally emergency reversal; although we acknowledge that emergency reversals are very uncommon. A third (34%) of our patients had CT imaging prior to their reversal, but most of these were requested as part of their colorectal cancer surveillance. The remainder of these CT scans were performed to aid surgical planning; in particular cases where there was a significant incisional hernia.

Our cohort had a complication rate of 47%, but there were no deaths. It is difficult to compare the incidence of these with those within the literature, due to the accuracy of capturing postoperative complications in retrospective studies. Twenty-five percent (21/83) of our patients developed surgical site infections which significantly prolonged their hospital inpatient stay by 4 days (10 days versus 6 days; $P = 0.03$). The majority were due to superficial infections 71% (15/21), either alone (8/15) or with another type of SSI (7/15); similar to the range cited within the literature, although superficial site infections are often underreported, underestimating the

incidence of SSIs.[4] There are several surgical preventative strategies have been advocated to minimize SSIs, including the use of wound protection devices.[8] Our institution implemented a sepsis reduction bundle in 2018, which included the use of oral preoperative antibiotics, wound protection, disposable surgical gowns to reduce strike through of fluids, the necessity of a change in gloves and the use of clean surgical instruments for closure.[9,10] Surgical site infections are among the most common healthcare-acquired infections associated with prolonged hospitalization and results in a significant economic burden.[11] Organ space infections contributed to 38% of all of our SSIs. All of these patients had their initial Hartmann's procedure due to complicated diverticular disease with significant pelvic contamination. We suspect a reason for the increased risk of organ space infections in these cases are due to the complexity of the subsequent reversal due to the original pathology. There was also an anastomotic leak rate of 3.6%, which was associated with a patient history of smoking and in the presence of obesity and steroid usage.

Within the limited literature in this area of study our findings of steroid use contributing to overall morbidity has been shared among other studies.[12] Although BMI and smoking status were not independently associated with morbidity, we find that a combination of these risk factors increase the anastomotic leak rate. Weight reduction, smoking cessation and weaning of steroids if appropriate, should be considered part of the real-world preoperative optimisation prior to elective Hartman's reversal.

Within the literature, greater age, frailty, previous postoperative complications and ASA class are potential reasons to abstain from offering a patient a reversal of their Hartmann's.[4] Although we did not examine our cohort of patients who were not offered a reversal, we suspect that these reasons would be similar.

Our study has reviewed the timelines, pre-reversal investigations and outcomes in patients undergoing reversal of their emergency Hartmann's over a 10-year period. Patients were identified from our hospital systems databases, and case records were manually checked for information. Limitations with our study included the retrospective nature of the study as well as changes in practice over the years; in particular with the introduction of sepsis reduction bundles. Time to reversal was subject to numerous hospital system factors. For example, these procedures were generally categorized as lower urgency cases, and there was an impact in 2019–2020 where SARS-CoV-2 reduced our hospital's capacity to carry out these procedures. We unfortunately did not ascertain the reasons for non-reversal in the remaining 75% of patients.

Careful patient selection is crucial when considering Hartmann's reversal, as it is associated with a significant incidence of morbidity, in particular relating to surgical site infections. Adequate optimisation of patients may help reduce the incidence of these complications.

Author contributions

Reshi Suthakaran: Data curation; formal analysis; investigation; methodology; project administration; resources; writing – original draft; writing – review and editing. **Ian Faragher:** Conceptualization; resources; supervision; writing – review and editing. **Justin Yeung:** Conceptualization; project administration; resources; supervision; visualization; writing – review and editing.

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Conflict of interest

None declared.

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