

Risk factors for readmission in patients with acute diverticulitis: a retrospective study at Auckland City Hospital

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ABSTRACT

AIM: Approximately one in five patients with acute diverticulitis (AD) will experience a recurrence. This study aimed to investigate the factors at AD admission that correlate with recurrence and test the proposed risk of recurrence-score according to Sallinen et al.

METHOD: This retrospective study followed patients for five years who were admitted with operatively or computed tomography (CT)-verified AD at Auckland City Hospital from January 2012–June 2013. Demographic, laboratory, radiological and patient-related factors at initial admission were analysed in relation to readmission with recurrent AD and to test a risk score presented by Sallinen et al.

RESULTS: In the adjusted analyses, previous diagnosis of AD (OR, 7.3; 95% CI, 3.1–16.9), Māori ethnicity (OR, 5.7; 95% CI, 1.4–22.7) and complicated AD at index admission (OR, 2.5; 95% CI, 1.0–6.2), were all independent factors associated with readmission with recurrence. High-risk versus low-risk groups, according to the risk score, showed 71.4% and 18.6% recurrence rates, respectively.

CONCLUSION: History of diverticulitis and complicated AD are risk factors for recurrence. The finding of higher recurrence rate in Māori requires further investigation utilising appropriate research methodologies. The risk score presented by Sallinen et al. may be a useful predictor of recurrent AD.

The risk of developing acute diverticulitis (AD) in patients affected by diverticulosis is relatively low, approximately 4–7%.^{1,2} However, the prevalence of AD is rising, along with AD-related hospital admissions, which impacts on wider wellbeing as well as imposing socioeconomic costs.³

Despite complete remission, including regression of clinical symptoms, approximately 20% of all patients will experience recurrence requiring admission.^{4–6} The risk of recurrence appears increased during the first year after the initial AD episode and in complicated disease.^{7,8}

During recent years, the management of AD has undergone paradigm shifts, with a trend towards a more conservative approach.^{5,6,9–11} Elective resection for patients with recurrent AD has been questioned and guidelines no longer recommend elective surgery based on certain number of previous episodes of AD.^{5,6,12} Furthermore, there is no evidence that a high fibre diet or medical agents prevent recurrences.⁶ Research on the factors at AD admission that correlate with recurrent AD requiring admission could help detect patients with higher likelihood of recurrence with complicated disease, possibly selecting those who would benefit from elective surgery.

Several attempts have been made to create a risk of recurrence tool in the decision making regarding aggressive treatment approach and elective resection.^{13,14} Sallinen et al. have presented a simple bedside risk score to predict complicated recurrence that consists of three parameters, including previous diagnosis of AD, abscess at index admission and corticosteroid use.¹³

The aims of this retrospective study were to identify factors correlating with recurrent AD requiring readmission and test the risk score presented by Sallinen's group.

Method

Patient population and data sources

All potential admissions for AD were identified by the discharge International Classification of Diseases (ICD)- 10 code K57 under General Surgery at Auckland City Hospital between January 2012–June 2013. The National Health Index numbers were used to gather clinical data at index admission and AD readmissions for a follow-up period of five years.

Inclusion/exclusion criteria and definitions

Inclusion criteria for the index admission were all patients aged >18 years with computed tomography (CT) or intraoperative evidence of sigmoid AD. Cases with diverticulosis only, elective hospital admissions, diverticular bleeding, patients living outside Auckland District Health Board (ADHB) jurisdiction and those lost to follow-up were excluded. Patients who underwent acute surgical resection on index admission were excluded, as those with a previous resection would not pose the same risk of recurrent disease.

Recurrent AD was defined as a subsequent readmission with AD >30 days after index admission. Readmissions <30 days from the discharge from index AD were classified as treatment failure, and thus incorporated in the index AD cases.

Study variables at initial admission

At the time of the study, management of the patients was guided by the admitting doctor, and not by a formal protocol. Demographic information of each patient was collected, including age, sex and ethnicity. Vital signs were recorded, including temperature, heart rate, blood pressure, respiratory rate and symptoms of peritonitis. Blood tests, including C-reactive protein (CRP), white blood cell count (WCC), neutrophil count, sodium, potassium and creatinine levels, were collected. The following data were extracted from the patient record: hours to CT, modified Hinchey classification based on CT or intraoperative findings, nil by mouth orders, intravenous fluids, intravenous antibiotics, patient-recorded pain score in an emergency department, in-hospital mortality, admission to an intensive care unit, use of CT-guided percutaneous drainage, length of hospital stay, duration of symptoms, smoking status, previous abdominal surgery, medication including corticosteroids, non-steroidal anti-inflammatory drugs (NSAIDs) and immunomodulators, and comorbidities. Patients were classified in either the low- or high-risk group, according to the risk score presented by Sallinen et al., originally designed to identify complicated diverticulitis (see Table 1).¹⁴

Follow-up

Information regarding the five-year mortality and readmission rates for AD were collected. Readmissions in the absence of clinically verified AD, admissions for “elective operative interventions” due to AD and “postoperative complications” after AD surgery were not included.

Ethical approval for this study was obtained from the Auckland Health Research Ethics Committee (reference 000046) and the ADHB.

Statistics

Statistical analyses were performed using IBM SPSS Statistics version 25. The study population was outlined with descriptive statistics. Categorical variables were analysed with the Chi-squared test and Fisher’s exact test. Continuous variables were analysed using the student’s t-test and Mann–Whitney U test. Differences were considered statistically significant at a two-tailed p-value of <0.05. Multivariate analysis was performed for variables that were considered clinically appropriate and had a univariate p-value <0.1. Continuous variables were modified to dichotomous variables and used in a binary logistic regression analysis. As this study is retrospective it was not powered to explore details of subgroups, such as different ethnicities.

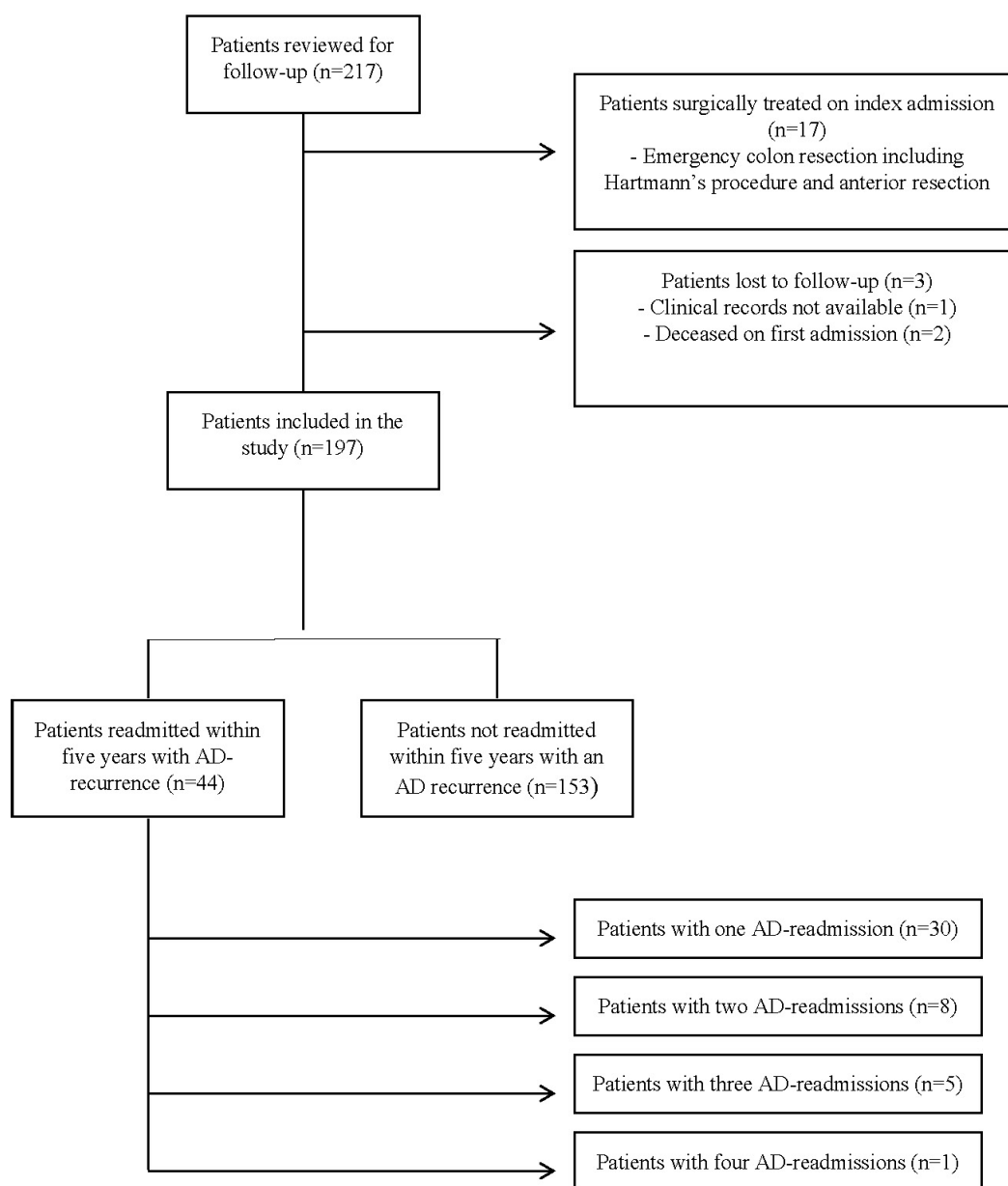
Results

Study cohort

In total, 217 patients affected by AD were reviewed. A total of 197 patients with non-surgically treated AD were included in the final study (Figure 1). All but one patient underwent CT imaging; the remaining patient was diagnosed with uncomplicated AD intra-operatively after suspicion of appendicitis.

Recurrent disease

During the follow-up period, 44 patients (22.3%) with a mean age of 53.5 (49.2–57.9) years had readmissions for recurrent AD. 30 (68.2%) of these patients had one readmission, eight (18.2%) had two readmissions, five (11.4%) had three readmissions and one (2.3%) had four readmissions (Figure 1). In patients with readmissions for recurrent disease, two patients (4.5%) underwent acute surgical resection on their first readmission. Overall, three patients (1.5%) had elective surgery with resection during the study period, of which all had previous readmissions for recurrent disease. Of those with recurrent disease, 10 patients (23%) had complicated AD classified by CT, 29 patients (66%) had uncomplicated AD and five patients (11%) did not have imaging during their recurrence and, therefore, were not classified. Māori patients had a significantly higher percentage of readmissions with recurrent AD compared to non-Māori (9/14 versus 17/183; $p<0.01$).

Figure 1: Study flowchart.

Abbreviation: AD = Acute diverticulitis

Table 1: Risk score for recurrence of complicated diverticulitis as suggested by Sallinen et al.¹⁴

	Points given
Earlier diverticulitis: any	1
CT: abscess	2
Medication: corticosteroids	3

Note: patients are divided into low risk (0–2 points) and high risk (>2 points).

Table 2: Descriptive statistics of patient demographics in the total study cohort and among groups of patients readmitted with recurrent acute diverticulitis (AD) and patients without readmission with recurrent AD.

Characteristics	Total (%)	Patients with AD readmission(s) (%)	Patients without AD readmission (%)	P-values
	n=197	44 (22.3)	153 (77.7)	
Age at index AD (years)	57.8 [55.7–60.0]	53.5 [49.2–57.9]	59.1 [56.6–61.5]	0.03
Age <50 years	68 (34.5)	20 (29.4)	48 (70.6)	0.08
Female sex	100 (50.8)	23 (23.0)	77 (77.0)	0.82
Male sex	97 (49.2)	21 (21.6)	76 (78.4)	0.82
Ethnicity				0.00
Caucasian	158 (80.2)	31 (19.6)	127 (80.4)	0.07
Māori	14 (7.1)	9 (64.3)	5 (35.7)	0.00
Other	25 (12.7)	4 (16.0)	21 (84.0)	0.31

Note: means and ranges were used for normally distributed data and median for non-parametric; % in brackets, if another not indicated. Other ethnicities include Fijian, Indian, Middle Eastern, Niuean, Asian, Samoan, Cook Islander and Tongan.

Table 3: Baseline characteristics at the time of index admission among the total study cohort, and in groups of patients readmitted with recurrent acute diverticulitis (AD) and patients without readmission with recurrent AD.

Characteristics	Total (%)	Patients with AD readmissions (%)	Patients without AD readmission (%)	P-value
	n=197	44 (22.3)	153 (77.7)	
AD in history	68 (34.5)	28 (41.2)	40 (58.8)	0.01
Previous abdominal surgery	73 (37.1)	16 (21.9)	57 (78.1)	0.91
Smoking status				0.06
Non-smoker	119 (60.4)	20 (16.8)	99 (83.2)	0.02
Smoker	26 (13.2)	7 (26.9)	19 (73.1)	0.55
Ex-smoker	52 (26.4)	17 (32.7)	35 (67.3)	0.04
Comorbidities				
No comorbidities	123 (62.4)	27 (22.0)	96 (78.0)	0.87
Diabetes	19 (9.6)	2 (10.5)	17 (89.5)	0.26
Cardiac disease	34 (17.3)	6 (17.6)	28 (82.4)	0.47
Respiratory disease	22 (11.2)	9 (40.9)	13 (59.1)	0.05
Renal disease	13 (6.6)	2 (15.4)	11 (84.6)	0.74
Malignancy	6 (3.0)	1 (16.7)	5 (83.3)	1.00
Inflammatory disease	9 (4.6)	3 (33.3)	6 (66.7)	0.42
Use of medications				
Steroids	4 (2.0)	2 (50.0)	2 (50.0)	0.22
Immunomodulators	3 (1.5)	2 (66.7)	1 (33.3)	0.13
NSAIDs	9 (4.6)	1 (11.1)	8 (88.9)	0.69

Abbreviation: NSAIDs = non-steroidal anti-inflammatory drugs.

Demographics of study population

The study cohort comprised of 100 (50.8%) women and 97 (49.2%) men (Table 2). The mean age for patients with AD readmission was significantly lower, 53.5 (49.2–57.9) years versus 59.1 (56.6–61.5) years ($p=0.03$). In the study population, 158 patients (80.2%) were New Zealand European or European, 14 patients (7.1%) were Māori and 25 patients (12.7%) were categorised as Other.

Medical history

Of the 44 patients with a previous diagnosis of AD, 28 (63.3%) had readmissions with AD, compared to 40 of the 155 patients without previous history of AD (26%) ($p<0.01$) (Table 3). Smoking status failed to be significant for AD recurrence ($p=0.06$), thus non-smoking status appeared protective for recurrence. Among the current smokers, 14 patients (53.8%) had complicated index AD, compared to 24 (20%) of the non-smoking patients and 16 (31%) previous smokers ($p<0.002$). No significant differences in specific comorbidity rates were seen in the AD readmission or non-readmission groups, except for respiratory disease ($p=0.05$). Only a few patients met the criteria for steroid, immunomodulator and NSAID use and there were no significant differences (Table 3).

Clinical data

No significant differences in the vital parameters, duration of symptoms prior to admission, length of stay for index admission or laboratory tests were noted between the AD readmission group and non-readmission group. None of the patients in the study cohort ended up at the ICU on their index admission.

Of the study population, 54 patients (27.4%) were classified as having complicated disease on index admission. Of those with complicated index AD, 18 (33.3%) had readmissions compared to 26 (18.2%) of those with uncomplicated index AD ($p=0.02$). The five-year mortality in the study population was 13 out of 197 (6.6%) with no significant difference between the two groups.

Multivariate analysis

The binary logistic regression analysis identified three factors associated with recurrence: history of AD (multivariate odds ratio (OR) 7.3; 95% confidence interval (CI) 3.1–16.9), Māori ethnicity (multivariate OR 5.7; 95% CI 1.4–22.7) and complicated index AD (multivariate OR 2.5; 95% CI 1.0–6.2).

Sallinen risk score

Fourteen patients (7%) were classified as having high-risk AD on index admission and 183 patients (93%) as having low-risk index AD. Of those with high-risk AD on index admission, 10 patients (71%) had readmissions with recurrent AD versus 34 patients (19%) in the low-risk group. The OR for AD readmission in the high-risk group compared to the low-risk group was 11.0 (95% CI 3.2–37.0).

Discussion

The management of recurrent diverticular disease remains controversial since there are no clear indications for elective surgery. Despite the fact that elective surgery is associated with lower morbidity and mortality compared to emergency surgery, it still poses some risk for patients who may have a very low risk of recurrent AD. The ultimate goal of this study is to help clinicians identify those patients with a very high risk of readmission for recurrent AD where resection may be indicated. Our retrospective study revealed a readmission rate for AD recurrences of 22%. The risk score presented by Sallinen et al identified a subgroup with a much greater risk (71%) of readmission with AD. Adjusted multivariate analysis showed that previous diagnosis of AD and complicated disease were related to recurrence.

This study tested the risk score presented by Sallinen et al., categorising our patients into high-versus low-risk groups.¹⁴ To our knowledge this is the only risk score described for AD. Our findings indicate that this risk stratification model is a useful clinical tool, with an 11 times higher risk of AD recurrence in the high-risk group compared to the low-risk group. However, there are some differences between the present study and that of Sallinen et al. Their study used a different definition for recurrent AD and included those diagnosed and treated as outpatients in their uncomplicated group. They presented their score as a risk stratification model in the prediction of “complicated” recurrent disease, rather than “overall” AD recurrence. In fact, when Sallinen et al. applied this risk stratification model exclusively for uncomplicated recurrence, it turned out not to be a reliable predictor. Sallinen et al. did not report the utility of this risk score for overall recurrence in their study. Our results, however, indicate that this model is a useful tool and could potentially be used as a predictor of “overall” AD readmission, not only for complicated recurrence. Furthermore, Sallinen et al. did not precisely

describe how they defined corticosteroid use, which could potentially impact the utilisation of the risk score. Finally, only 14 patients were classified as high risk, and although the vast majority of these developed recurrent AD, this only made up a quarter of all those with recurrent AD, as 19% of the low-risk group developed recurrent AD. This lack of sensitivity of the score must be considered in the clinical setting, thus the score itself is insufficient for decision making regarding resection.

Previous diagnosis of AD was the strongest factor correlated with AD recurrence. Several studies have suggested that patients with more than three medically treated episodes of AD had a threefold increase in risk of future recurrence, regardless of previously uncomplicated or complicated AD episodes.^{14,15} This study did not investigate the risk of recurrent AD after one or more recurrences, but it did emphasise that a history of AD is a strong risk factor for recurrent disease.

Participants of Māori ethnicity had a significantly higher risk of readmission for AD recurrence and a lower mean age at index admission compared to NZ European participants. This was an unexpected finding, which the study was not designed to identify or explore. The total number of Māori participants was low and although the increased risk of recurrent admission for AD in Māori was statistically significant, its clinical significance is unknown at present. Previous studies have shown inconclusive results regarding ethnicity and recurrent AD. Bose et al. proposed that American Caucasians were less likely to suffer recurrent AD compared to other ethnicities, whereas Rose et al. suggested the opposite, implying that Asians and Pacific Islanders had lower risks of recurrence.^{16,17}

We note the difference between recurrence of AD (disease-related outcome) and recurrence requiring hospital admission (disease severity, access to health services including community services). Our measure of readmission with recurrent AD may reflect health service factors other than those directly related to AD, including inequities in access to community-based management of AD versus secondary/tertiary hospital care. These factors are important for the optimal management of AD and may reduce the need for hospital admissions with recurrence, but sit outside the scope of this study.

The higher comorbidity among Māori people in contrast to the non-Indigenous population is well known and has been related to socio-economic disadvantage and poorer access to healthcare.^{18–20} Additionally, studies have shown that Māori

receive lower quality care, have a lower life expectancy by eight to nine years and the mean age of AD presentation is lower.^{21–23} The finding of higher recurrence rate in Māori requires further investigation utilising appropriate research methodologies.

Complicated AD on index admission was the third factor associated with recurrent disease, which is consistent with earlier studies.^{8,24} Studies on recurrent AD have shown higher likelihoods of complicated AD on the first admission compared to recurrent episodes.²⁵ Due to our study design, which included clinically verified readmissions and not only CT-verified cases, we were unable to investigate the true rate of readmitted uncomplicated vs complicated disease. Several earlier studies have concluded that abscess formation on first admission is correlated with readmission.^{24–26} Abscess size on the CT images was not routinely measured by a radiologist and as a result, we could not investigate the relationship between abscess size and recurrence rate.

This study was limited by several factors; primarily its retrospective study design, relatively small study population, the low number of Māori in the cohort, no formal treatment protocol, abstractors not blinded and follow-up limited to Auckland City Hospital. However, the present inclusion criteria resulted in a well-defined study cohort that was managed and treated in a similar way and allowed a complete five-year follow-up period. The fact that a low number of patients had a bowel resection (7.5%) in the index admission indicates that the recorded recurrence rate is likely to be an accurate estimate of the risk of readmission with recurrence in those patients presenting with AD.

In the future, it would be valuable to include a standardised comorbidity score obtained during the index admission. Prospective studies with follow-up that included contacting the patients and cross-linking to primary care facilities would also be of interest in identifying the burden of recurrent AD in the primary setting. Applying the risk score by Sallinen et al. on a larger study population to more accurately validate the risk score is another desirable objective. Lastly, the association of the Māori ethnicity with a higher risk of readmission with recurrent AD requires further investigation.^{27,28}

In conclusion, the risk score presented by Sallinen et al. appears to be a useful tool to identify a group with a high likelihood of readmission after an episode of AD. Ethnic differences in readmission with recurrent AD need further attention in larger study cohort.

COMPETING INTERESTS

Nil.

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