Validation of a grading system for complicated diverticulitis in the prediction of need for operative or percutaneous intervention

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ABSTRACT

INTRODUCTION The current surgical management of acute complicated diverticulitis has seen a major paradigm shift from routine operative intervention to a more conservative approach. This has been made possible by the widespread availability of computed tomography (CT) to enable stratification of the disease severity of acute complicated diverticulitis. The aim of this study was to retrospectively validate a CT grading system for acute complicated diverticulitis in the prediction of the need for operative or percutaneous intervention.

METHODS Hospital and radiology records were reviewed to identify patients with acute complicated diverticulitis confirmed by CT. A consultant gastrointestinal radiologist, blinded to the clinical outcomes of patients, assigned a score according to the CT grading system.

RESULTS Three hundred and sixty-seven patients (34.6%) had CT performed for acute diverticulitis during the study period. Forty-four patients (12.0%) had acute complicated diverticulitis (abscess and/or free intraperitoneal air) confirmed on CT. There were 22 women (50%) and the overall median age was 59 years (range: 19–92 years). According to the CT findings, there was one case with grade 1, eighteen patients with grade 2, four with grade 3 and twenty-one with grade 4 diverticulitis. Three patients with grade 2, three patients with grade 3 and ten patients with grade 4 disease underwent acute radiological or surgical intervention.

CONCLUSIONS The use of a CT grading system for acute complicated diverticulitis did not predict the need for acute radiological or operative intervention in this small study. Decision making guided by the patient's clinical condition still retains a primary role in the management of acute complicated diverticulitis.

The prevalence of diverticular disease is increasing, affecting a third of patients above 45 years of age.[1] Symptomatic diverticulitis occurs in 10–25% of patients[1] and diverticular perforation has a population incidence of 4 cases per 100,000.[2] Additionally, diverticular perforation that requires operative intervention is associated with mortality rates of between 12% and 36%.[3–6]

The current surgical management of complicated acute diverticulitis has seen a major paradigm shift from routine operative intervention to a more conservative approach.[7–9] This change in practice reflects our increasing understanding of the morbidity and mortality associated with emergency surgery for complicated diverticular disease as well as subsequent interventions attempting to deal with the consequences of the emergency surgery such as stoma complications, incisional hernias and stoma reversal. Historically,

surgical intervention was indicated for sepsis source control, which often required laparotomy and resection of the perforated segment of colon and end colostomy formation (Hartmann's procedure). This operation is known to be associated with a significant mortality rate and complication profile, and up to 65% of end colostomies were not reversed.[10–14]

Traditionally, the Hinchey classification for diverticulitis (developed in 1978) was used with several subsequent modifications[15] to assist surgeons in decision making during the management of complicated diverticular disease but these classifications are based largely on the intraoperative findings. Consequently, even though these classification systems helped to guide treatment, they did not reduce the rate of operative interventions and their serious consequences.

The increasing adoption of a more conservative approach in complicated diverticular disease has only been possible

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because of the advances in antibiotic therapy, nutritional support, critical care and interventional radiology.[16] However, it was mainly the widespread availability and accessibility of computed tomography (CT) in the assessment of the acute surgical abdomen that played a major role in the current trends in the management of acute diverticulitis. CT has enabled accurate diagnosis of complicated diverticular disease as well as stratifying disease severity and could therefore help to identify patients who may benefit from non-operative therapy.[17,18] Furthermore, the use of radiologically guided percutaneous drainage of diverticular abscesses might avoid the need for acute operative intervention.

Increasingly, surgical intervention is reserved for patients who have failed conservative treatment, have generalised peritonitis or are haemodynamically unstable. Laparoscopy and lavage may represent a feasible alternative to open surgery in the management of acute diverticulitis, with the avoidance of colonic resection (and probably colostomy) during the acute illness.[19–21]

As a result, the role of CT has become crucial in decision making for patients with acute diverticulitis, and CT grading systems were developed to stratify disease severity and guide management.[16,22] Nevertheless, most of the published literature uses CT grading in combination with strict management protocol and patients are often offered surgical intervention based on the outcome of the CT grading rather than on clinical assessment.[16] In theory, this could lead to some patients having 'premature' surgical intervention and some of them could possibly have responded to aggressive medical treatment.

The aim of this study was to retrospectively validate a CT grading system[16] for acute complicated diverticulitis to determine its ability to predict the need for operative or percutaneous intervention in a group of patients who had their management and the decision for surgical or radiological intervention based on clinical assessment.

Methods

Patients with a diagnosis of diverticulosis were identified retrospectively by review of computerised hospital records using the International Statistical Classification of Diseases code for 'diverticular disease of intestine' (K57). The radiology database was then searched to identify patients who had acute complicated diverticulitis confirmed by CT. Complicated diverticulitis in this study was defined as abscess and/or free intraperitoneal gas on admission CT. The hospital record search was limited to the period January 2010 to August 2011 inclusive.

A consultant gastrointestinal radiologist, blinded to the outcome of the clinical management, reviewed the CT and assigned a score according to the CT grading system (Table 1).[16] This was correlated with the patient's clinical outcome to determine the grading system's predictive value. There were no exclusion criteria and the main inclusion criterion was the availability of CT for review.

Patient demographic data and the outcomes of failed non-operative management were entered into Excel® (Microsoft, Redmond, WA, US) for analysis.

Table 1 Perforated diverticulitis computed tomography grading system[16]

Grade	Definition
1	Localised free air (pericolonic) without abscess
2	Small (<2cm) collections of distant free air OR small (<4cm) abscess
3	Large (>2cm) collections of distant free air OR large (>4cm) abscess
4	Free air with non-loculated free fluid in the peritoneal cavity

Results

A total of 1,060 patients with a discharge diagnosis of diverticulosis were identified after review of the hospital records. Of these, 365 patients (34.6%) had CT performed for acute diverticulitis during the study period. Forty-four patients (12.0%) had acute complicated diverticulitis (abscess and/or free intraperitoneal gas) confirmed on CT. There were 22 women (50%) and the overall median age was 59 years (range: 19–92 years).
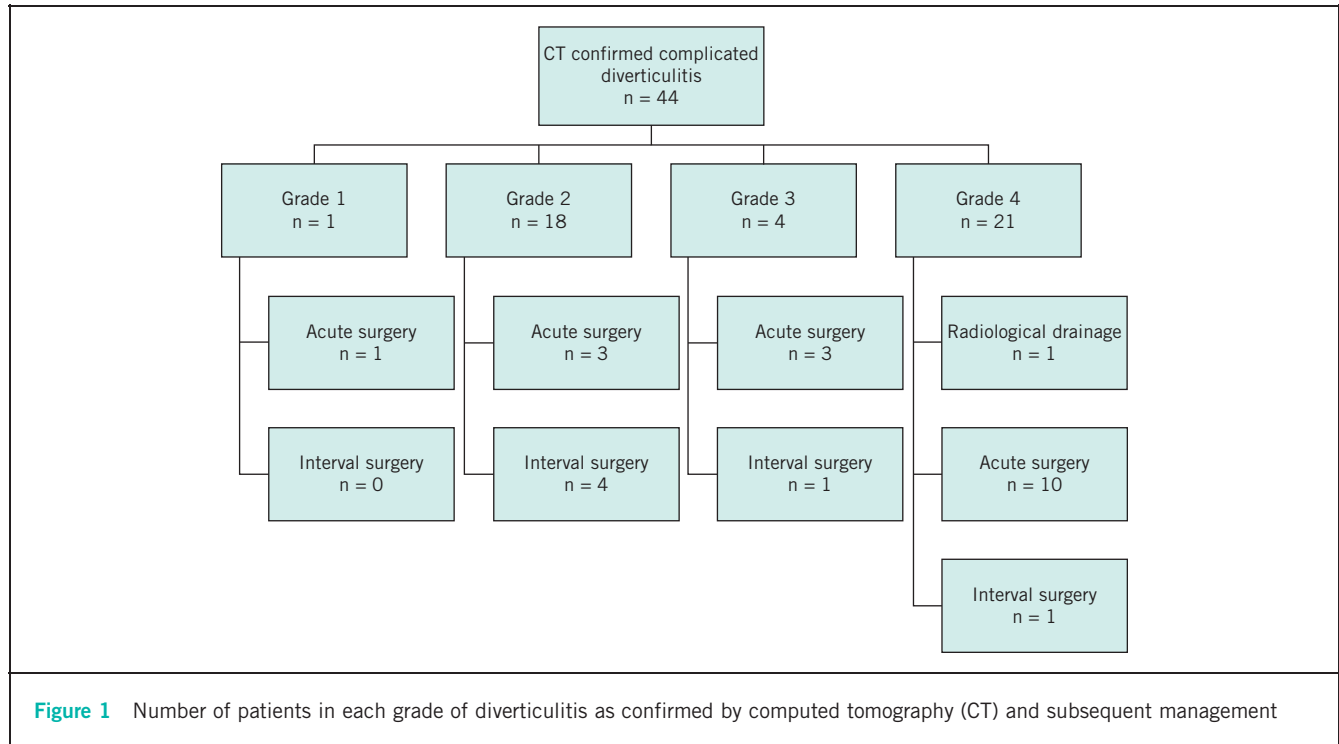
CT grading

According to the CT findings, there was one patient with grade 1, eighteen with grade 2, four with grade 3 and twenty-one with grade 4 diverticulitis. Three patients with grade 2, three patients with grade 3 and ten patients with grade 4 disease underwent acute radiological or surgical intervention (Fig 1). The indications for acute surgical intervention were failure of conservative management and anatomical factors that precluded safe radiological drainage. The median duration from admission until acute intervention was 1 day (range: 0–7 days). The median length of hospital stay was 4 (grade 2), 12 (grade 3) and 9 (grade 4) days.

Acute interventions

The cases that required acute intervention are summarised in Table 2. The one patient with grade 1 diverticulitis according to CT underwent an open sigmoid colectomy for ongoing symptoms of pain during non-operative treatment. Interestingly, this patient had had a previous diverticular resection with colostomy and subsequent restoration of the gastrointestinal tract. Intraoperatively, there was minimal intraperitoneal contamination and conditions were appropriate for a primary anastomosis. Three patients with CT findings of grade 2 disease underwent an emergency Hartmann's procedure.

Among those patients identified by CT as having grade 3 diverticulitis, one patient had laparoscopic washout and drainage of collections that were not amenable to radiological drainage. One elderly patient underwent open surgical drainage of a left paracolic diverticular colocutaneous abscess via a left flank incision under general anaesthesia as the abscess was pointing and easily accessible for open

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Figure 1 Number of patients in each grade of diverticulitis as confirmed by computed tomography (CT) and subsequent management

drainage. This patient was not offered elective diverticular resection in view of his significant cardiac co-morbidities.

Among those patients who had grade 4 diverticulitis according to CT, one patient had successful radiological drainage of the diverticular abscess. This patient proceeded to have an elective open left hemicolectomy one month after the acute admission. Histology of the resected specimen showed chronic diverticulitis. All ten of the patients who underwent acute surgical intervention required a Hartmann's procedure. The clinical indications for surgery were generalised peritonitis (*n*=7), worsening sepsis after trial of non-operative management (*n*=2) and small bowel obstruction secondary to severe diverticular sepsis (*n*=1).

Postoperative complications included two patients who returned to theatre; one patient required refashioning of an ischaemic colostomy and the other had resuturing of a full-thickness wound dehiscence. Additionally, one patient had a superficial surgical site infection managed with intravenous antibiotics and two patients had multiorgan failure, of which one did not survive.

The resection specimen of a 55-year-old woman whose CT results suggested she had grade 4 diverticulitis revealed a perforated adenocarcinoma with associated incidental diverticular disease. The final pathological staging was of pT4 N0 Dukes' B moderately differentiated adenocarcinoma. The tumour was excised completely and the patient referred to the oncologists for adjuvant treatment.

Follow-up

Six patients had elective colonic resections after recovery from acute complicated diverticulitis. A left-sided colectomy was performed in four patients with CT confirmed grade 2

diverticulitis, one patient with grade 3 and one patient with grade 4. Three patients had an open procedure, two had a laparoscopic resection and one had a laparoscopic sigmoid colectomy that was converted to an open procedure. The latter patient developed an anastomotic leak, which required a return to theatre, takedown of the colorectal anastomosis and a Hartmann's procedure. Two patients had reversal of the Hartmann's procedure at follow-up. It is worth noting that no malignancy was detected in the resection specimens (Table 3).

Mortality

There were three deaths in this series of patients. There was a perioperative death in an 85-year-old woman who had grade 4 diverticulitis as identified by CT. She underwent a Hartmann's procedure after four days of failed non-operative management. She developed pulmonary oedema that was refractory to maximal medical therapy and died 14 days after surgery.

One elderly female patient whose CT results suggested grade 4 diverticulitis was managed conservatively and an informed decision was made not to escalate her treatment to include operative intervention. She died eight days into her hospital admission.

One elderly patient with CT confirmed grade 3 diverticulitis that was managed conservatively owing to her co-morbidities died four months later from an unrelated illness (intracerebral haemorrhage).

Discussion

The role of emergency surgery in acute complicated diverticulitis has diminished even in the presence of diverticular

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Table 2 Demographics and outcomes of acute surgical management

Age / sex	CT grade of diverticulitis	Indication for acute surgical intervention	Intervention	Length of stay	Complications	Pathology
62 M	1	Ongoing pain with non-operative treatment	Open sigmoid colectomy	11 days	Superficial surgical site infection	Diverticulosis
43 M	2	Failed non-operative management	Hartmann's procedure	36 days	Postoperative chest sepsis and intensive care unit admission	Diverticular abscess
52 F	2	Failed non-operative management	Open subtotal colectomy (due to unhealthy looking caecum at laparotomy)	20 days	Adhesive small bowel obstruction 11 months after index operations, requiring operative intervention	Diverticular abscess
76 F	2	Failed non-operative management	Hartmann's procedure	19 days	Postoperative myocardial infarct; admission to coronary care unit and angiography	Perforated diverticulitis
57 M	3	Unsuitable for radiological drainage	Laparoscopic washout and drain insertion	7 days	Nil	N/A
69 F	3	Large bowel obstruction	Hartmann's procedure	10 days	Nil	Perforated diverticulitis
88 M	3	Significant co-morbidities precluding major surgery	Open left paracolic drainage	14 days	Nil	N/A
50 F	4	Generalised peritonitis following head and neck surgery	Hartmann's procedure	37 days	Nil	Diverticulitis
51 M	4	Small bowel obstruction	Hartmann's procedure	29 days	Full-thickness wound dehiscence requiring return to theatre	Diverticular abscess
53 M	4	Generalised peritonitis	Hartmann's procedure	17 days	Nil	Diverticular abscess
55 F	4	Generalised peritonitis	Hartmann's procedure	9 days	Superficial surgical site infection	pT4 N0 Dukes' B moderately differentiated adenocarcinoma, completely excised
63 M	4	Generalised peritonitis	Hartmann's procedure	18 days	Nil	Diverticulitis
63 M	4	Generalised peritonitis	Open subtotal colectomy (owing to involvement of the caecum in the inflammatory mass)	16 days	Nil	Diverticular abscess
63 M	4	Generalised peritonitis	Hartmann's procedure	20 days	Nil	Perforated diverticulitis
65 F	4	Failed non-operative management	Hartmann's procedure	22 days	Ischaemic colostomy and return to theatre on day 1 postoperatively for stoma refashion	Diverticulitis
71 F	4	Generalised peritonitis 8 days following cardiac surgery	Hartmann's procedure	96 days	Postoperative multiorgan failure	Diverticular abscess
85 F	4	Failed non-operative management	Hartmann's procedure	14 days	Death on postoperative day 14 from multiorgan failure	Perforated diverticulitis

CT = computed tomography; N/A = not applicable

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Table 3 Demographics and outcomes of elective diverticular resections

Age / sex	CT grade of diverticulitis	Large bowel investigations	Intervention	Length of stay for acute admission	Complications	Pathology
46 F	2	Flexible sigmoidoscopy and CT colonography	Open anterior resection	10 days	Nil	Diverticulosis
52 M	2	Flexible sigmoidoscopy	Open sigmoid colectomy	4 days	Nil	Diverticulosis
60 F	2	Barium enema	Laparoscopic sigmoid colectomy	4 days	Nil	Diverticulosis
61 F	2	Nil	Laparoscopic sigmoid colectomy	3 days	Nil	Diverticulosis
57 M	3	Nil	Laparoscopic to open sigmoid colectomy	7 days	Anastomotic leak, conversion to Hartmann's procedure; subsequently had colostomy reversal	Diverticulosis
54 F	4	Nil	Open left hemicolectomy	5 days	Nil	Chronic diverticulitis
CT = computed tomography						

abscesses and free intra-abdominal gas.[25] The change in treatment principles in acute diverticulitis was a consequence of the increasing availability and diagnostic accuracy of CT, which has enabled rapid stratification of the acute surgical abdomen and acute diverticulitis disease severity. CT can confirm the diagnosis, identify the presence of diverticular abscesses or collections, and determine the feasibility of radiologically guided drainage.[24,25] This strategy allows for sepsis control without resorting to major surgical intervention.

Several classification systems exist for complicated diverticulitis. These systems aim to determine the severity of acute diverticulitis, predict mortality and guide surgical decisions. Hinchey categorised perforated diverticulitis into four categories, dependent on intraoperative findings.[26] The Hinchey classification has since undergone various modifications to incorporate clinical and radiological information, with the aim of improving its utility as a decision making tool.[27–29] Other commonly used acute diverticulitis classification systems include the Mannheim peritonitis index[30] (patient and disease related factors) and the Charlson co-morbidity index[31] (patient related factors).

Pasternak *et al* evaluated the predictive values of six scoring systems in the decision making process for acute diverticulitis.[32] They concluded that scoring systems based on patient related co-morbidities (eg Charlson co-morbidity index) had greater predictive value for mortality than scores based on locoregional factors (eg Hinchey classification). Nevertheless, no scoring system can as yet replace close and repeated clinical assessment combined with clinical acumen in predicting which patients with complicated acute diverticulitis will require intervention.[33,34]

Several groups have investigated the value of preoperative CT in the prediction of the need for operative intervention in acute diverticulitis. Gielens *et al* retrospectively compared the CT Hinchey classification with intraoperative Hinchey staging.[35] The sensitivity of CT in Hinchey IV disease was 100% but decreased to 42% in Hinchey III acute diverticulitis. The explanation provided by the authors for this finding was the potential understaging of Hinchey II disease (as staged by CT) in the presence of minimal pus found only at operation (Hinchey III). Preoperative CT Hinchey grading also had low predictive value at differentiating intraoperative Hinchey III and IV diverticulitis.

The CT grading system for acute diverticulitis used in this study was based on the work by Siewert *et al*[22] and Dharmarajan *et al*.[16] The data of Siewert *et al* showed that patients with diverticular abscesses of <4cm could be treated successfully using antibiotics without the need for acute surgical intervention.[22] On the other hand, patients with diverticular abscesses of >4cm were candidates for radiologically guided drainage. Dharmarajan *et al* adapted the results from Siewert's study, from which they derived a simple CT grading system for acute perforated diverticulitis.[16] This grading system was used in our study for its ease of use and simplicity.

In our patient group, there was a low operative intervention rate during the acute presentation of complicated diverticulitis, even in the presence of small intra-abdominal abscess (grade 2) or free air (grade 4). This finding was in agreement with the conclusions from Costi *et al*,[23] which showed that conservative management was feasible for patients with free intra-abdominal gas secondary to perforated acute diverticulitis. In their study group of 39 haemodynamically stable patients with perforated diverticulitis, non-operative management was successful in 36 patients (92.3%). Seven of these patients (19.4%) required radiologically guided abscess drainage. The mortality rate from their series was 0%.

In our study, all the patients with grade 4 diverticulitis as identified by CT who proceeded to urgent surgery

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underwent a Hartmann's procedure. This surgical decision was made in the presence of widespread intra-abdominal contamination. Alternative treatment options have been reported in literature, including suture repair of the diverticular perforation, omentoplasty, laparoscopic lavage, proximal diversion, resection of the perforated colon and primary anastomosis.[21,36–39] However, our unit practice was to mostly perform Hartmann's procedure for these patients. A total of 12 Hartmann's procedures were performed in this study, of which 3 cases (25%) had elective reversals. This was consistent with the reported rates of Hartmann's reversal in the literature.[14]

The operative intervention rate in cases with CT results for grade 3 diverticulitis was 100%. This was secondary to failure of conservative management, with one case each of large bowel obstruction, worsening sepsis in a co-morbid elderly patient and failure to drain an abscess under radiological guidance. Despite this, the small absolute numbers of patients suggested to have grade 3 diverticulitis did not allow for valid conclusions to be made about these data.

The absolute postoperative complication rate in this series for acute surgery was 52.9% (9/17) with two patients returning to theatre for either resuturing of abdominal wound dehiscence or refashioning of ischaemic colostomy (Table 2). Elective sigmoid resection was also associated with significant complications, with one anastomotic leak after open sigmoid colectomy, requiring conversion to Hartmann's procedure (Table 3). Indeed, the published data have shown that the morbidity and mortality of elective diverticular resections was greater than for elective malignant colorectal resection.[40]

Our study indicates that despite the increasing interest in radiological scoring systems in predicting the need for either radiological or surgical intervention, decision making should continue to be based on clinical judgement owing to the limitations of the currently available scoring systems. Our data highlight the need for a robust radiological scoring tool to help guide clinicians in their management of complicated diverticular disease.

Study limitations

This study could be criticised for its retrospective nature, lack of strict treatment protocol to streamline patients' management according to the CT staging and also because patients were treated by a group of surgeons with diverse experience, subspecialty interests and views on the management of complicated acute diverticulitis. However, we do believe that these points could be part of the strength of this study. It is increasingly recognised that the natural history of diverticular disease is poorly understood and could be changing. Factors to account for such change include increasing incidence of the disease in the younger population,[22] the availability of a wider range of antibiotics, better management of acutely ill patients[16] and increasing use of the minimally invasive approach.[7]

All these factors have led to progressive change in policy towards less aggressive treatment. This study adds to the existing understanding of the natural history of this condition as decision making was based on patients' clinical response to treatment with no strict protocols that might lead to 'avoidable' surgical intervention. The involvement of a diverse group of surgeons with different subspecialty interests reflects accurately the outcomes in this group of patients with no selection or treatment preference bias.

We also acknowledge that the absolute number of patients was relatively small but the outcome of this study adds to the increasing evidence that surgical intervention in patients with acute complicated diverticulitis should rely on clinical judgement rather than the current scoring systems. In addition, we appreciate that only one consultant radiologist with a specialist interest in gastrointestinal imaging reviewed the CT and carried out the retrospective scoring, and this interest and expertise might not be available in routine practice for emergency CT reporting. Nevertheless, the radiologist was blinded to both the original CT reports and the patients' clinical outcomes.

There have been major changes in the indications for subsequent elective resection of complicated diverticular disease following successful conservative management. Over the last decade, several publications have challenged the previous practice parameters of the main associations of colorectal surgery (the Association of Coloproctology of Great Britain and Ireland, and the American Society of Colon and Rectal Surgeons) that elective surgery should be offered after two episodes of uncomplicated acute diverticulitis or after one episode in young patients.[41–43]

The current literature suggests that there is good clinical and experimental evidence against the previous recommendations for elective resection. Presently, it is believed that expectant management is associated with lower mortality and stoma formation, and entails lower costs. Furthermore, there is no clear evidence that younger patients presenting with acute diverticulitis exhibit a more aggressive form of the disease.[41] These observations indicate our increasing understanding of the natural history of diverticular disease in the elective resection setting and it could be that this is now the time to revisit the natural history of the disease in acute presentation as well.

Conclusions

The use of this simple CT grading system for acute complicated diverticulitis did not predict the need for acute radiological or operative intervention in this small study. Patients with grade 4 diverticulitis as identified by CT (free gas and intra-abdominal free fluid) could still be managed conservatively. Decision making guided by the patient's clinical condition retains a primary role in the management of acute complicated diverticulitis.

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