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Original Research Article

Computed tomography predictors of progression and re-presentation in uncomplicated diverticulitis: a retrospective study at two regional Australian hospitals

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ABSTRACT

Background: Acute diverticulitis is a common presentation in Australian hospitals and is primarily assessed with computed tomography (CT). Identifying CT predictors of progression from uncomplicated to complicated diverticulitis, as well as risk factors for re-presentation, is crucial, particularly in regional hospitals with limited interventional radiology services.

Methods: This retrospective study included 20 patients with CT-confirmed uncomplicated diverticulitis (WSES Grade 0, Hinchey Stage I) from Bundaberg Base Hospital (BBH) and Hervey Bay Hospital (HBH) between January 2023 and February 2024. Outcomes assessed were progression to complicated diverticulitis and re-presentation within three months. CT features (e.g., free fluid, free air, abscess formation, wall thickening, fat stranding) and clinical variables (e.g., C-reactive protein CRP) were analyzed. Statistical tests included Fisher's exact test and t-tests, with significance set at $p<0.05$.

Results: Of the 20 patients, 4 progressed to complicated diverticulitis and 16 re-presented with symptoms. Abscess formation was observed exclusively in complicated cases (3/4 vs. 0/16, p=0.003). Free fluid (75.0% vs. 25.0%, p=0.087) and free air (50.0% vs. 6.3%, p=0.081) were more prevalent in complicated cases. Pericolic fat stranding and wall thickening were common but non-specific. Elevated CRP correlated with progression (mean 200.5 vs. 64.5 mg/l, p=0.029). No clear CT predictors were identified for re-presentation, though early cases (<30 days) were likely due to non-resolution and late cases (>30 days, ≤90 days) suggested recurrence.

Conclusion: Abscess, free fluid, free air, and elevated CRP (>100 mg/l) were predictors of progression to complicated diverticulitis, with abscess reaching statistical significance. No definitive CT predictors for re-presentation were identified. Structured CT reporting and prioritization of high-risk patients for admission are particularly important in regional settings with inconsistent interventional radiology access.

Keywords: Regional Hospital Australia, Uncomplicated diverticulitis, Complicated diverticulitis, Computed tomography, Hinchey classification, Risk stratification

INTRODUCTION

Diverticulitis, an inflammatory condition of colonic diverticula, is prevalent in Australia, with risk increasing with age and dietary factors.[1,2] Uncomplicated diverticulitis, defined by the 2020 WSES guidelines as Grade 0 (diverticula, wall thickening, pericolic fat stranding without abscess or perforation) and Hinchey stage I (pericolic inflammation), is typically managed conservatively with dietary modification and selective antibiotics per Australian guidelines.[3-5] CT is the primary imaging modality for diagnosis across hospital settings due to its high sensitivity and specificity.[6] However, progression to WSES Grades 1a–4 or Hinchey

Stages II–IV, or re-presentation within three months, poses challenges, particularly in regional and rural hospitals where inconsistent interventional radiology services necessitate conservative management or transfer.[7,8]

A 2017 multicenter retrospective study by van Dijk et al in the Netherlands identified fluid collections and longer inflamed colon segments as significant predictors of complicated acute diverticulitis, with free fluid and free air showing non-significant trends.[9] Similarly, the WSES guidelines emphasize early recognition of radiological predictors to guide triage.[10] This study investigates CT and clinical features predicting progression and re-presentation in initially uncomplicated diverticulitis, distinguishing early re-presentations (likely non-resolution) from late re-presentations (likely true recurrence).

METHODS

Study design

A retrospective clinical study was conducted of adult patients with CT-confirmed uncomplicated diverticulitis who progressed to a complicated clinical course or re-presented (ED re-presentation within three months) from January 2023 to February 2024. The study spanned Bundaberg Base Hospital (BBH) and Hervey Bay Hospital (HBH) within the Wide Bay Hospital and Health Service, Queensland, under a Human Research Ethics Committee exemption as a quality assurance activity. Patient data were de-identified and stored on secure hospital servers with restricted access, per institutional protocols.

Participants

Eligible patients were adults (≥18 years) with CT-confirmed uncomplicated diverticulitis (WSES Grade 0, Hinchey Stage I) who developed complications (e.g., abscess, free air, free fluid, peritonitis) or re-presented within three months. Re-presentation includes early cases (<30 days), likely reflecting non-resolution of initial disease, and late cases (>30 days, within 90 days), suggesting true recurrence as a new episode.

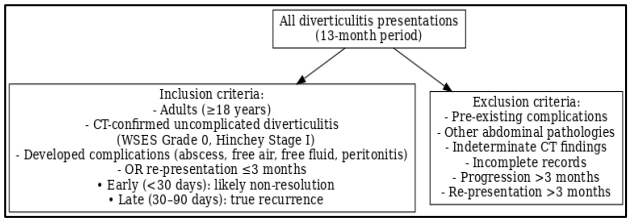

Figure 1: Inclusion and exclusion criteria.

Exclusion criteria included pre-existing complications, other abdominal pathologies, indeterminate CT findings, incomplete records, progression beyond three months, or re-presentation beyond three months. The sample size was pragmatically determined by historical admission rates over a 13-month period, potentially limited by patients seeking follow-up care from general practitioners (GPs) or private hospitals rather than re-presenting to ED.

Variables

Data included demographics (age, gender), clinical variables (CRP, smoking, alcohol, diabetes, immunocompromise, medications, prior diverticulitis), and CT features (colonic wall thickening (mm), pericolic fat stranding, free fluid, free air, abscess (size), segment length (mm)). Outcomes were progression to complicated diverticulitis, re-presentation, time to progression/re-presentation, hospitalization duration, and interventions (e.g., antibiotics, surgery).

Data sources and measurement

Data were extracted from radiology Picture Archiving and Communication Systems (PACS) and electronic medical records. Follow-up CT scans within three months were included when available (16/20 cases). A standardized data collection template ensured consistency, with radiological variables interpreted by a consistent team to minimize bias.

Statistical analysis

Descriptive statistics were generated using Microsoft Excel (Redmond, WA, USA) and SPSS (Chicago, IL, USA). Categorical variables (e.g., presence of free fluid) were summarized as frequencies and percentages, and continuous variables (e.g., CRP) as means and standard deviations (SD).

Fisher's exact test compared CT feature prevalence between complicated and uncomplicated cohorts. T-tests compared CRP levels. Re-presentation was analyzed by timing (early: <30 days, likely non-resolution; late: >30 days, within 90 days, likely recurrence). Missing data were quantified, and a sensitivity analysis excluded cases with incomplete CT data to assess robustness. A p value <0.05 was considered significant.

RESULTS

Patient characteristics

Of 50 diverticulitis presentations, 30 were excluded (15 duplicates, 8 indeterminate CTs, 4 incomplete records, 2 progressions beyond three months, 1 re-presentation beyond three months), yielding 20 patients (4 complicated, 16 uncomplicated with re-presentation within three months).

The complicated cohort (1 BBH, 3 HBH) had a higher mean CRP (200.5 mg/l) than the uncomplicated cohort (64.5 mg/l, p=0.029), with diabetes and

immunocompromise prevalent but not significant. Smoking and alcohol data were missing in 60.0% of cases, and medications were reported in 8/20 cases.

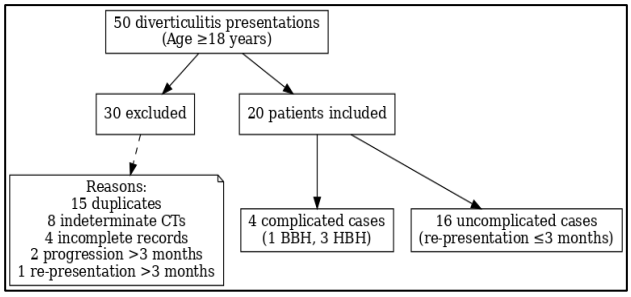

Figure 2: Patient characteristics.

BBH complicated cohort (n=1)

The initial uncomplicated CT showed fat stranding, free fluid, and no abscess or free air. The complicated CT showed fat stranding, free air, free fluid, and a 6.9×4.5 cm abscess (Hinchey Stage II, sigmoid). Progression occurred at 6 days. Intervention made was IV antibiotics.

BBH uncomplicated cohort (n=4)

Initial CTs showed fat stranding (4/4), wall thickening (3/4), free fluid (2/4), and no abscesses or free air. Follow-up CTs (2/4) showed persistent fat stranding (2/2), wall thickening (1/2), and resolved free fluid (1/2). All re-presented to ED with symptoms (e.g., abdominal pain, diarrhea, fever) within 8–59 days (mean 24.3, SD 22.8; 3/4 early <30 days, 1/4 late >30 days, ≤90 days). Interventions included IV/PO antibiotics (4/4), with hospitalization (1–4 days) in 2/4.

HBH complicated cohort (n=3)

Initial uncomplicated CTs showed fat stranding (3/3), wall thickening (1/3), and no free fluid, free air, or abscesses. Complicated CTs showed fat stranding (3/3), wall thickening (3/3), free fluid (2/3), free air (1/3), and abscesses (2/3, e.g., 1.7 cm and 5.4 cm in one case). Hinchey scores ranged from I to III, with sigmoid involvement. Progression occurred within 1–61 days (mean 28.7, SD 30.1). Interventions included IV antibiotics (3/3), surgical resection (2/3), and drainage (1/3).

HBH uncomplicated cohort (n=12)

Initial CTs showed fat stranding (11/12), wall thickening (10/12), free fluid (1/12), and no abscesses or free air. Follow-up CTs (11/12) showed persistent fat stranding (10/11), new free fluid (2/11), new free air (1/11), and no abscesses, with expanded bowel involvement (e.g., entire colon in one case). All re-presented to ED with symptoms (e.g., abdominal pain, nausea, fever) within 4–77 days (mean 24.8, SD 22.4; 8/12 early <30 days, 4/12 late >30 days, ≤90 days). Interventions included IV/PO antibiotics (11/12), surgical resection (1/12), and transfer (1/12).

Re-presentation sub-analysis

All 16 uncomplicated cases re-presented within 4–77 days at HBH (mean 24.8, SD 22.4; 8/12 early <30 days, likely non-resolution; 4/12 late >30 days, ≤90 days, likely recurrence) and 8–59 days at BBH (mean 24.3, SD 22.8; 3/4 early, 1/4 late). Early re-presentations showed free fluid in 3/11 (27.3%, 2 persistent, 1 resolved) vs. 1/5 (20.0%, resolved) in late re-presentations (p=1.000), with persistent fat stranding (9/10 follow-up CTs). Early cases had higher CRP (mean 46.8 mg/l, SD 62.3, n=7; e.g., 143 mg/l in one HBH case) and more IV antibiotics (7/11 vs. 1/5, p=0.165), suggesting non-resolution due to inadequate initial treatment or comorbidities (e.g., diabetes in 3/11, CLL in 1/11). Late re-presentations showed new bowel involvement in 1/5, consistent with recurrence. No clear CT predictors emerged due to missing severity data.

Data analysis

Abscess formation was exclusive to complicated cases (3/4 vs. 0/16, p=0.003). Free fluid (3/4, 75.0% vs. 4/16, 25.0%, p=0.087) and free air (2/4, 50.0% vs. 1/16, 6.3%, p=0.081) were more prevalent in complicated cases. Fat stranding (4/4 vs. 15/16, p=1.000) and wall thickening (3/4 vs. 13/16, p=1.000) were non-specific. Mean CRP was higher in complicated cases (200.5 vs. 64.5 mg/l, p=0.029). Segment length was reported in 2/20 cases (10.0%; 7–12 cm in two HBH cases), precluding analysis. Sensitivity analysis excluding 5/20 cases with missing CT data confirmed abscess and free air as predictors (p<0.05). The sigmoid colon was the primary site in all cases. Table 2 summarizes CT findings, and Table 3 details outcomes.

Table 1: Demographics and clinical variables diverticulitis cohorts at BBH and HBH, January 2023–February 2024.

Variable	BBH complicated (n=1)	BBH uncomplicated (n=4)	HBH complicated (n=3)	HBH uncomplicated (n=12)
Age (years, mean±SD)	36.0±0.0	62.5±29.7	75.7±15.7	70.8±8.9
Gender (M/F)	1/0	4/0	0/3	5/7
CRP (mg/l, mean±SD)	242.0±0.0 (n=1)	74.7 ± 103.9 (n=4)	Not reported (n=0)	54.2±65.9 (n=9)
Smoking, N (%)	1 (100)	1 (25.0)	0 (0)	0 (0)
Alcohol, N (%)	1 (100)	0 (0)	0 (0)	1 (8.3)
Diabetes, N (%)	1 (100)	2 (50.0)	1 (33.3)	3 (25.0)

Continued.

Variable	BBH complicated (n=1)	BBH uncomplicated (n=4)	HBH complicated (n=3)	HBH uncomplicated (n=12)
Immunocompromise, N (%)	1 (100)	0 (0)	1 (33.3)	1 (8.3)
Medications, N (%)	1 (100)	2 (50.0)	1 (33.3)	5 (41.7)
Medication examples	Metformin, amlodipine	Metformin, escitalopram	Amlodipine	Metformin, statins, antidepressants

*CRP missing in 40.0% of cases; smoking/alcohol missing in 60.0%.

Table 2: CT Findings at BBH and HBH, January 2023–February 2024.

CT feature	Complicated (n=4)	Uncomplicated (n=16)	P value (Fisher's exact)
Fat stranding, N (%)	4 (100)	15 (93.8)	1.000
Wall thickening, N (%)	3 (75.0)	13 (81.3)	1.000
Free fluid, N (%)	3 (75.0)	4 (25.0)	0.087
Free air, N (%)	2 (50.0)	1 (6.3)	0.081
Abscess, N (%)	3 (75.0)	0 (0)	0.003
Segment length reported	0/4 (0%)	2/16 (12.5%; 7–12 cm)	Not analyzed (90.0% missing)

*Segment length not reported in 90.0% of cases

Table 3: Outcomes.

Outcome	BBH complicated (n=1)	BBH uncomplicated (n=4)	HBH complicated (n=3)	HBH uncomplicated (n=12)
Time to progression/re-presentation (days, range, mean±SD)	6, 6.0±0.0	8–59, 24.3±22.8	1–61, 28.7±30.1	4–77, 24.8±22.4
Early re-presentation (<30 days, N)	N/A	3	N/A	8
Late re-presentation (>30 days, ≤90 days, N)	N/A	1	N/A	4
Hospitalization (N, %; days, range)	1 (100%), 4	2 (50%), 1–4	3 (100%), 5–14	3 (25%), 1–7
Interventions, N (%)				
IV antibiotics	1 (100)	2 (50)	3 (100)	6 (50)
PO antibiotics	0 (0)	2 (50)	0 (0)	5 (41.7)
Surgical resection	0 (0)	0 (0)	2 (66.7)	1 (8.3)
Drainage	0 (0)	0 (0)	1 (33.3)	0 (0)
Transfer	0 (0)	0 (0)	0 (0)	1 (8.3)

*Early re-presentations (<30 days) likely indicate non-resolution; late re-presentations (>30 days, ≤90 days) suggest recurrence.

DISCUSSION

This study, conducted at two regional hospitals (Bundaberg Base Hospital (BBH) and Hervey Bay Hospital (HBH) within the Wide Bay Hospital and Health Service, Queensland, identifies CT and clinical predictors of progression to complicated diverticulitis and re-presentation (ED re-presentation within three months). The findings may not be broadly representative of other regional hospitals due to variations in interventional radiology access, referral patterns, or patient populations.

Abscess formation

In the study, abscesses were observed exclusively in complicated cases (3/4, 75.0% vs. 0/16, 0% in uncomplicated cases, p=0.003), indicating a strong predictor of progression. Consistent with Dijk et al who reported fluid collections in 25% of complicated vs. 0% of uncomplicated cases (p=0.009) in a larger urban cohort, our findings confirm abscess as a critical marker for complicated diverticulitis.[9] Corresponding to WSES grade 1b and Hinchey stage II, abscesses (1.7–6.9 cm) require antibiotics or drainage.[10,11] In comparison to van Dijk et al's urban Dutch setting with ready access to interventional radiology, which may be less consistent in regional settings, necessitating early referral or conservative management for such cases.[12]

Free fluid and free air

In our study, free fluid was more prevalent in complicated cases (3/4, 75.0% vs. 4/16, 25.0% in uncomplicated cases, p=0.087), and free air was similarly associated with progression (2/4, 50.0% vs. 1/16, 6.3%, p=0.081). In comparison to Dijk et al who observed non-significant trends for free fluid (25% vs. 9%, p=0.201) and free air (31% vs. 25%, p=0.735) in a larger urban cohort, our study suggests a stronger association of free fluid with progression, though limited by a smaller sample size.[9,13,14] Free fluid was present in 4/16 re-

presentation cases (3/4 early (<30 days), likely non-resolution), but was non-specific, resolving in 2/4 cases. Free air's emergence on follow-up CTs signaled progression, consistent with WSES recommendations for inpatient observation.[10]

Pericolic fat stranding and wall thickening

In our study, pericolic fat stranding (4/4, 100% in complicated vs. 15/16, 93.8% in uncomplicated cases, p=1.000) and wall thickening (3/4, 75.0% vs. 13/16, 81.3%, p=1.000) were ubiquitous but non-specific predictors of progression. These findings align with Kircher et al. who noted their lack of specificity.[15] In contrast to van Dijk et al., who found longer inflamed colon segments predictive of complications (85±26 mm vs. 65±21 mm, p=0.007), segment length was reported in only 2/20 cases (10.0%; 7–12 cm in two HBH uncomplicated cases) in our study, precluding analysis due to missing data.[9] Persistent fat stranding in early re-presentations suggests non-resolution, while new bowel involvement in late re-presentations supports recurrence.

Clinical predictors

In our study, elevated CRP was associated with progression to complicated diverticulitis (mean 200.5 mg/L in complicated vs. 64.5 mg/l in uncomplicated cases, p=0.029), with high values (e.g., 242 mg/l) indicating systemic inflammation. This is consistent with Dijk et al's emphasis on clinical markers like CRP for risk stratification, though they did not report specific CRP values.[9,16] High CRP in early re-presentations (e.g., 143 mg/l in one HBH case) suggests non-resolution. Diabetes (2/4 complicated, 5/16 uncomplicated) and immunocompromise (2/4 complicated, 1/16 uncomplicated) were prevalent but not statistically significant (p>0.05). Smoking (2/20, 10.0%) and alcohol (2/20, 10.0%) data were missing in 60.0% of cases, limiting analysis, a challenge also noted by Dijk et al for certain clinical variables, echoing mixed findings in the literature.[9,17]

Non-resolution vs. recurrence

In our study, early re-presentations (<30 days, n=11), likely indicating non-resolution, showed persistent CT findings (e.g., fat stranding in 9/10 follow-up CTs, free fluid in 3/11) and higher CRP (mean 46.8 mg/l, SD 62.3, n=7), suggesting inadequate initial treatment or comorbidities (e.g., diabetes in 3/11, CLL in 1/11). Late re-presentations (>30 days, within 90 days, n=5), likely indicating recurrence, showed new bowel involvement in 1/5 cases. No clear CT predictors for re-presentation emerged, likely due to the dominance of early cases and missing severity data. In comparison to Dijk et al who also faced challenges identifying recurrence predictors due to limited follow-up data, our study's focus on a three-month timeframe and distinction between non-resolution and recurrence provides a novel contribution, though limited by sample size.[9]

Clinical implications

In our study, distinguishing non-resolution from recurrence informs the need for tailored management. Early re-presentations, likely non-resolution, require extended antibiotics or inpatient monitoring, while late re-presentations, likely recurrence, suggest the need for dietary or primary care interventions. Based on our findings, patients with abscess, free fluid, free air, or CRP>100 mg/l should be prioritized for admission, particularly given inconsistent interventional radiology services, to facilitate early monitoring or transfer for complications. Structured CT reporting, as proposed in supplementary appendix A, can guide these decisions by identifying persistent findings (e.g., free fluid) or new changes (e.g., bowel involvement).[10,12,14] While Dijk et al similarly advocated for structured reporting to enhance risk stratification, our study emphasizes its critical role in regional settings where procedural options are limited.[9]

Regional context

In our study, the hospitals had inconsistent interventional radiology services for procedures like percutaneous abscess drainage, necessitating conservative management or patient transfer to tertiary centers. In comparison to Dijk et al urban Dutch setting, where interventional radiology is readily available, our findings highlight the need for structured CT reporting to identify high-risk features (e.g., abscess, free fluid, free air) and guide triage decisions, such as inpatient admission for suspected non-resolution or early transfer for complications.[9] Noting however that these findings may be specific to our context and may not generalize to other regional hospitals with different resource availability or patient demographics.

In the study, the small sample size (n=20) limited statistical power, with only abscess reaching significance (p=0.003). Excluding one re-presentation and two progression events beyond three months ensured temporal alignment with the study's three-month focus but reduced the sample, potentially underestimating long-term outcomes. The sample size may reflect patients seeking GP or private care after their initial episode, biasing toward severe cases. Of 50 presentations, 30 were excluded (15 duplicates, 8 indeterminate CTs, 4 incomplete records, 2 late progressions, 1 late re-presentation). Segment length (90.0% missing), CRP (40.0% missing), and smoking/alcohol (60.0% missing) hindered analysis, similar to data limitations noted by van Dijk et al for some variables. The retrospective design and focus on two regional hospitals (BBH and HBH) may limit generalizability to other regional settings with varying resources. Lack of clinical resolution data limited the distinction between non-resolution and recurrence. Sensitivity analysis confirmed key predictors (p<0.05).

CONCLUSION

In this study at BBH and HBH, abscess, free fluid, and free air on CT, along with elevated CRP (>100 mg/l), predicted progression to complicated diverticulitis within three months, with abscess being statistically significant. No clear CT predictors emerged for re-presentation, with early cases (<30 days, likely non-resolution) showing persistent CT findings and late cases (>30 days, within 90 days, likely recurrence) suggesting new episodes. Excluding events beyond three months ensured alignment with the study's timeframe but reduced sample size. Structured CT reporting, prioritizing patients with high-risk features for admission, is critical in regional settings like BBH and HBH with inconsistent interventional radiology services. These findings may not generalize to other regional hospitals. Prospective studies with clinical resolution data are needed to further distinguish non-resolution from recurrence.

Recommendations

Implement a structured CT reporting template (Supplementary Appendix A) mandating abscess size, free fluid, free air, wall thickening (mm), and segment length (mm). Prioritize admission for patients with abscess, free fluid, free air, or CRP >100 mg/l at BBH and HBH, particularly for suspected non-resolution (<30 days). Extend antibiotic duration for early re-presentations to address non-resolution. Avoid routine repeat CTs unless clinically indicated. Conduct prospective, multicentre studies including primary care data to capture milder cases. Collect clinical resolution data to distinguish non-resolution from recurrence.

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