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Efficacy of computed tomography for the prediction of colectomy and mortality in patients with *clostridium difficile* infection

Laura Paláu-Dávila [a], Reynaldo Lara-Medrano [a], Adrián A. Negreros-Osuna [b], Matías Salinas-Chapa [b], Elvira Garza-González [c], Eva Marìa Gutierrez-Delgado [a], Adrián Camacho-Ortiz [d, *]

[a] Servicio de Infectología, Hospital Universitario Dr. José Eleuterio González, Universidad Autónoma de Nuevo León, 64460 Monterrey, NL, Mexico
[b] Departamento de Radiología e Imagenología Hospital Universitario Dr. José Eleuterio González, Universidad Autónoma de Nuevo León, 64460 Monterrey, NL, Mexico
[c] Servicio de Gastroenterología, Hospital Universitario Dr. José Eleuterio González, Universidad Autónoma de Nuevo León, 64460 Monterrey, NL, Mexico
[d] Coordinación de Epidemiología Hospitalaria, Hospital Universitario Dr. José Eleuterio González, Universidad Autónoma de Nuevo León, 64460 Monterrey, NL, Mexico

HIGHLIGHTS

- CT predictor scale for the need for colectomy in patients with CDI.
- Abnormal wall thickening, pancolitis and bowel dilation predicted colectomy.
- A five parameter radiological scale was developed with sensitivity and NPV of 100%.
- Abnormal wall thickening increased likelihood of death within 30 days of CDI diagnosis.

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ABSTRACT

Aim.: To develop a CT predictor scale for the need for colectomy and to evaluate predictors of all-cause mortality within 30 days after diagnosis of*C. difficile* infection (CDI).
Methods: We conducted a retrospective study of adult hospitalized patients whounderwent abdominal CT within 72 h of diagnosis of CDI.
Results: Presence of abnormal wall thickening in caecum (OR 8.0; CI 1.37–46.81; p = 0.021), transverse colon (OR 6.7; CI 1.15–35.60; p = 0.034), sigmoid colon (OR 12.6; CI 1.37–115.97; p = 0.025), pancolitis (OR 7.0; CI 1.36–36.01; p = 0.02) and bowel dilation (OR 16.5; CI 2.41–112.83; p = 0.004) predicted colectomy. With these values, a five parameter radiological scale from 0 to 24 was developed (sensitivity and NPV of 100%, cut-off of 6). Furthermore, wall thickening of caecum (OR 6.2; CI 1.06–35.57; p = 0.043), ascending colon (OR 12.0; CI 1.29–111.32; p = 0.029), descending colon (OR 17.0; CI 1.81–160.05; p = 0.013) and sigmoid (OR 10.2; CI 1.10–94.10; p = 0.041) independently predicted mortality within 30 days of CDI diagnosis.
Conclusion: We designed a CT scale to predict colectomy, able to rule out the development of fulminant colitis and the need for surgical procedure. Patients with wall thickening of the caecum, ascending, descending or sigmoid colon were more likely to die within 30 days of CDI diagnosis.

1. Introduction

Clostridium difficile infection (CDI) is associated with severe illness, infection-related mortality of 5% and all-cause mortality of 15–20% [1]. Infection by this bacterial species is diagnosed in stool samples by either immunoassay for toxins A or B, PCR for bacterial DNA detection or anaerobic toxigenic culture. Computed tomography (CT) has shown a sensitivity of 52% and specificity of 93% for the diagnosis of CDI [2], but it is not rutinely used for diagnostic purposes. Several CT findings have been described in association with CDI including wall thickening, pancolitis, low-attenuation mural thickening, the accordion and target sign, pericolonic fat

* Corresponding author.
E-mail address: acamacho_md@yahoo.com (A. Camacho-Ortiz).

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stranding, ascites and most recently, pleural effusion [3,4]. Moreover, CT parameters have been proposed as predictors of severity and complicated *C. difficile* colitis. Among these, a CDI severity score that included several CT findings [5]. However, none has succeeded in adding a predictive value to CT findings on top of other clinical predictors of complicated CDI.

We sought to develop a CT predictor scale for the need for colectomy and to evaluate CT findings as predictors of all-cause mortality within 30 days of diagnosis of *C. difficile* infection.

2. Study and methods

2.1. Study design and population

We performed a retrospective review of hospitalized patients with a diagnosis of CDI between January 1, 2011 to September 30, 2015, who underwent abdominal CT within 72 h of diagnosis. The study was performed at the University Hospital "Dr. José Eleuterio González", a 450-bed tertiary care hospital in Monterrey, Mexico.

Patients included were 18 years or older, and the diagnosis was determined by the Immunocard toxins A&B assay (Meridian Bioscience, Cincinnati, OH, USA), positive PCR (Cepheid Xpert*C. difficile*/Epi) or presence of pseudomembranous colitis on colonoscopy.

Clinical data was collected from the time of diagnosis and throughout hospitalization. The primary outcome was defined as fulminant colitis with colectomy, and the secondary outcome was all-cause mortality within 30 days of diagnosis.

2.2. Radiologic evaluation

Each CT scan was retrospectively reviewed by two radiologists using a standardized form that included the following variables; colonic wall thickening, diffuse colonic involvement (pancolitis), target sign, accordion sign, pericolonic fat stranding, bowel dilation, pleural effusion, peritoneal fluid, bowel pneumatosis, pneumoperitoneum, presence of atheromatous plaques and perirenal fat stranding. Reviewers only knew the diagnosis of CDI but were blinded to the patients' clinical characteristics and outcomes. In the case of discrepancy both reviewers reevaluated the images at the same time for an agreement. All tests were performed on helical CT (GE LightSpeed VCT 64 Slice CT) and included both the abdomen and pelvis.

2.3. Study definitions

Wall thickening was measured in all segments (caecum, ascending, transverse, descending and sigmoid colon and rectum). The measurement was considered abnormal when the wall thickness was >3 mm from caecum to sigmoid colon and >4 mm in the rectum. Bowel dilation was defined as a transversal diameter measurement of >9 cm in the caecum and ascending colon, >6 cm in transverse, descending and sigmoid colon and >7 cm in the rectum. Pancolitis was described when wall thickness was present throughout caecum to the rectum. The accordion sign was reported when markedly thickened haustral folds were observed and give the appearance of alternating bands of high attenuation (mucosal hyperemia) and low attenuation (edematous haustra) (Fig. 1).The target sign was reported when there were mucosal hyperemia and submucosal edema or inflammation and recalled the appearance of a bull's-eye; it was observed at cross-section imaging of the colon. Pericolonic and perirenal fat stranding were defined as increased density of the fat striations adjacent to the colon and kidneys respectively. Peritoneal fluid was noted as any amount of free fluid in the peritoneal cavity with −20 to +20 Hounsfield units. Bowel pneumatosis was described as the presence of gas in the intestinal wall. The presence of pleural effusion, pneumoperitoneum, bowel pneumatosis and atheromatous plaques were also reported. Atheromatous plaques were reported as the presence of calcifications in the superior or inferior mesenteric artery.

2.4. Statistical analysis and scale

Clinical characteristics and demographic variables were described using dispersion methods. Proportions were compared with Pearson chi-squared test or the Fisher exact test. Those with a p value ≤ 0.05 from the univariate analysis served as independent variables in a subsequent logistic regression model, presented as odds ratios with their 95% confidence intervals (CIs).

A scale was elaborated with these predictor variables; points were assigned proportionally to odds ratio and then scaled from 0 to 24.A receiver operator curve (ROC) was constructed, and the area under the curve was analyzed. Sensitivity, specificity, and positive and negative predictive values were calculated. Data were analyzed with SPSS 20 software.

3. Results

Out of176 patients diagnosed with CDI during our study period, 34 underwent abdominal CT within 72 h of diagnosis. Of these34 patients, 20 were male (58.8%) and 14 female (41.2%). Patients had an average of 51.2 years (±16.9). Patients for whom a CT was performed had a mean Charlson comorbidity index of 2.09 (±2.4) and 33 out of 34 patients had previous antibiotic use (97.1%). The ATLAS [6] scoring system was used to evaluate disease severity; in the 34 patients, there was a mean score of 5.9 (range 1–9). Use of steroids or other immunosuppressants was observed in 12 subjects (35.3%).

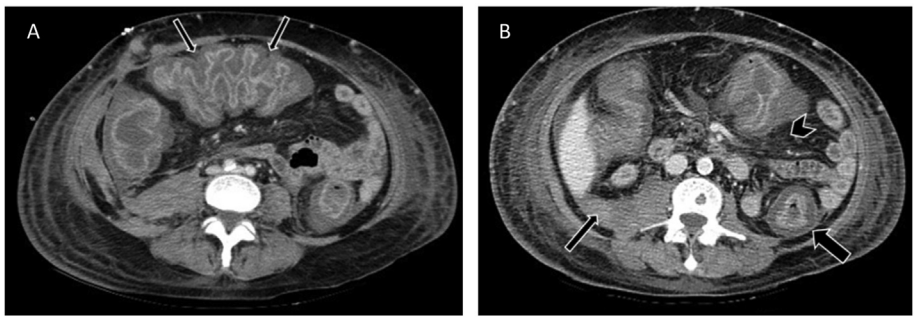

Fig. 1. Image A. Accordion sign in a patient with confirmed *Clostridium difficile* infection in transverse colon (thin arrows). **Image B**. Abdomen CT scan of a patient with confirmed *Clostridium difficile*infection. Colonic wall thickness, target sign *(thick arrow)*, peritoneal fluid *(thin arrow)* and pericolonic fat stranding *(arrowhead)* are shown.