



A Scoring System to Determine Patients' Risk of Colectomy Within 1 Year After Hospital Admission for Acute Severe Ulcerative Colitis

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BACKGROUND & AIMS: There is consensus on the criteria used to define acute severe ulcerative colitis (ASUC) and on patient management, but it has been a challenge to identify patients at risk for colectomy based on data collected at hospital admission. We aimed to develop a system to determine patients' risk of colectomy within 1 y of hospital admission for ASUC based on clinical, biomarker, and endoscopy data.

METHODS: We performed a retrospective analysis of consecutive patients with ASUC treated with corticosteroids, cyclosporin, or tumor necrosis factor (TNF) antagonists and admitted to 2 hospitals in France from 2002 through 2017. Patients were followed until colectomy or loss of follow up. A total of 270 patients with ASUC were included in the final analysis, with a median follow-up time of 30 months (derivation cohort). Independent risk factors identified by Cox multivariate analysis were used to develop a system to identify patients at risk for colectomy 1 y after ASUC. We developed a scoring system based on these 4 factors (1 point for each item) to identify high-risk (score 3 or 4) vs low-risk (score 0) patients. We validated this system using data from an independent cohort of 185 patients with ASUC treated from 2006 through 2017 at 2 centers in France.

RESULTS: In the derivation cohort, the cumulative risk of colectomy was 12.3% (95% CI, 8.6–16.8). Based on multivariate analysis, previous treatment with TNF antagonists or thiopurines (hazard ratio [HR], 3.86; 95% CI, 1.82–8.18), *Clostridioides difficile* infection (HR, 3.73; 95% CI, 1.11–12.55), serum level of C-reactive protein above 30 mg/L (HR, 3.06; 95% CI, 1.11–8.43), and serum level of albumin below 30 g/L (HR, 2.67; 95% CI, 1.20–5.92) were associated with increased risk of colectomy. In the derivation cohort, the cumulative risks of colectomy within 1 y in patients with scores of 0, 1, 2, 3, or 4 were 0.0%, 9.4% (95% CI, 4.3%–16.7%), 10.6% (95% CI, 5.6%–17.4%), 51.2% (95% CI, 26.6%–71.3%), and 100%. Negative predictive values ranged from 87% (95% CI, 82%–91%) to 92% (95% CI, 88%–95.0%). Findings from the validation cohort were consistent with findings from the derivation cohort.

Abbreviations used in this paper: Anti-TNFs, tumor necrosis factor blockers; ASUC, acute severe ulcerative colitis; CDI, *Clostridioides difficile* infection; CI, confidence interval; CMV, cytomegalovirus; CRP, C-reactive protein; HR, hazard ratio; IBD, inflammatory bowel disease; IBDU, inflammatory bowel disease unclassified; IQR, interquartile range; UC, ulcerative colitis.

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CONCLUSIONS:

We developed a scoring system to identify patients at low-risk vs high-risk for colectomy within 1 y of hospitalization for ASUC, based on previous treatment with TNF antagonists or thiopurines, *C difficile* infection, and serum levels of CRP and albumin. The system was validated in an external cohort.

Keywords: IBD Outcome; CDI; Prognostic Factor; Predictors.

Acute severe ulcerative colitis (ASUC) affects approximately 25% of patients with ulcerative colitis (UC).¹ This complication is well-defined by Truelove and Witts criteria as well as therapeutic management after hospital admission.² Medical treatment, notably intravenous corticosteroids, cyclosporine, and tumor necrosis factor blockers (anti-TNFs), have changed the prognosis of ASUC. However, colectomy is still required in a substantial subgroup of patients. Predictors of colectomy are needed in clinical practice, because morbidity, mortality, and costs increase with the duration of hospitalization before colectomy.^{3–5} Several predictive scores of colectomy in patients with ASUC have been already described⁶ and include clinical and/or biological parameters, notably albumin or C-reactive protein (CRP) level. Although they are strongly associated with the response to corticosteroids,⁷ several points limit their use in clinical practice. They were established before the era of biologics and are generally calculated on day 3 after admission. Moreover, some critical items such as the presence of *Clostridioides difficile* infection (CDI) are not included.^{8,9} Nevertheless, none was created to foresee patients with a low risk of colectomy to allow decreased monitoring. Two recent studies have identified CRP/albumin ratio as a good predictor of colectomy over the medium to long term.^{10,11} One recent review concludes that new scoring systems are required to predict response to treatment and colectomy.⁶ The aims of our study were to identify predictive factors among clinical, biological, endoscopic, and radiologic criteria and to perform a new score assessing the probability of colectomy during the first year after ASUC.

Methods

Patients

A derivation cohort was created by reviewing medical files of consecutive patients with UC, defined by European consensus criteria,² or inflammatory bowel disease unclassified (IBDU) (whose diagnosis remained unclassified at the end of follow-up), who were hospitalized in emergency for inflammatory bowel disease (IBD) flare between 2002 and 2017 at Saint Antoine Hospital, Paris and between 2008 and 2017 at Caen University hospital and treated with intravenous corticosteroids, cyclosporine, or anti-TNFs. In case of recurrence of ASUC during follow-up, only the first episode was considered. Patients with Crohn's disease at the time of hospital

admission or during follow-up and patients without information on albumin and CRP levels at admission were excluded. Date of cohort entry was the date of hospital admission for ASUC. Patients were followed until April 31, 2018 or at last news including loss to follow-up, colectomy, or death, whichever occurred first. Second, an independent cohort including all consecutive patients with ASUC treated between 2006 and 2017 from 2 French centers, Kremlin Bicetre Hospital and Henri Mondor Hospital, was built for external validation. Inclusion criteria were similar between the 2 cohorts, and data were independently collected in each cohort.

Therapeutic Management

Patients hospitalized for ASUC were treated according to standard guidelines.¹² In case of absence of response after 3–5 days of corticosteroids, options for colectomy, cyclosporine, or anti-TNFs as a salvage medical therapy were considered. Cytomegalovirus (CMV) infection was confirmed by presence of inclusion body in histopathologic examination, and testing for CDI was systematic at admission in our centers.

Data Collection

Variables were collected at Saint Antoine Hospital from the SUVIMIC registry (a prospective clinical database of all patients with IBD evaluated by Saint Antoine Hospital digestive disease medical staff), endoscopic and medical records, and collected at Caen University hospital from medical records.

The following variables were collected at cohort entry: age, gender, IBD type (UC or IBDU), comorbidities according to the Charlson index,¹³ previous appendectomy, date of IBD diagnosis, disease extent defined by Montreal classification,² and previous treatment exposure, including thiopurines and anti-TNFs. Clinical variables, such as Truelove and Witts criteria¹⁴ or clinical activity index,¹⁵ the number of stools, extraintestinal manifestations, date of the onset of symptoms, and the use of oral corticosteroids before admission were analyzed. We recorded biological data (hemoglobin, albumin, CRP, white cell count, and platelet count) and microbiological data (CDI and histologic signs of CMV infection), which were obtained during the first full day after admission. Radiologic (disease extent) and endoscopic (Mayo endoscopic score, mucosal damage) variables were collected from original reports at the start of

hospitalization. Then treatment exposures during hospitalization were assessed for the following: drug classes (aminosalicylates, corticosteroids, thiopurines, cyclosporine, and anti-TNFs), date of introduction and withdrawal, and therapy at hospital discharge, including colectomy. During follow-up, occurrences of treatment modifications for IBD, hospitalizations, and colectomy were assessed. In the validation cohort, collected data were age, previous treatment exposure, including thiopurines and anti-TNFs, albumin, and CRP levels, CDI, occurrence of colectomy, and date of last visit.

Outcomes

The primary outcome was the occurrence of colectomy within 1 year after hospital admission. The secondary outcomes included response to corticosteroids, need for rescue therapy, and occurrence of colectomy and were assessed at hospital discharge and end of follow-up.

Statistical Analyses

Continuous data are presented as medians and interquartile ranges (IQRs) and were compared with Wilcoxon–Mann–Whitney test. Categorical variables were summarized as frequencies with percentages and compared with χ^2 or Fisher test. Cumulative risk of colectomy was assessed in the whole cohort. Cox regression was used to assess the relationship between clinical, biological, and endoscopic variables with the risk of colectomy within 1 year. Variables with P values <.10 at univariate analysis were included in multivariate analysis. Sensitivity analysis was performed by excluding patients with IBDU.

According to the coefficient estimates in the multivariate Cox regression analysis, we built a prognostic score. To assess the quality of the prognostic score, patients were classified as having a low, intermediate, or high probability of colectomy. Percentages (95% confidence interval [CI]) of colectomy depending on the calculated score were estimated from 1000 bootstrapped samples of 270 patients (uniform selection with replacement).¹⁶ In the validation cohort, cumulative risk of colectomy at 1 year was assessed according to the developed score. P values <.05 were considered statistically significant. The study was approved by the Saint Antoine Hospital ethics committee for both centers (no. 2014-A01788-39). Statistical analyses were performed by using SAS (version 9.4; SAS, Inc, Cary, NC) and R (version 3.4.2; R Foundation for Statistical Computing, Vienna, Austria).

Results

Derivation Cohort

Baseline characteristics. In the derivation cohort, 421 patients with UC or IBDU were hospitalized and

What You Need to Know

Background

It has been a challenge to identify patients with acute severe ulcerative colitis (ASUC) at risk for colectomy within the next year based on data collected at hospital admission.

Findings

We identified 4 factors associated with increased risk of colectomy within 1 year after hospital admission (previous treatment with tumor necrosis factor antagonists or thiopurines, *Clostridioides difficile* infection, increased serum level of C-reactive protein, and decreased serum level of albumin). We used this information to develop a scoring system that identified patients at high risk vs low risk for colectomy and validated it in an external cohort.

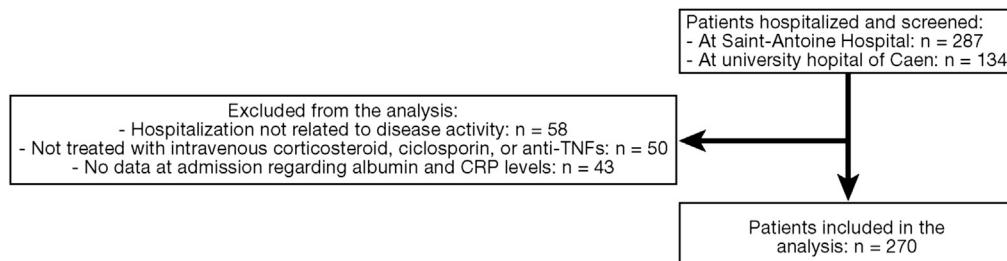
Implications for patient care

This scoring system can be used to identify patients at low risk of colectomy at 1 year (score 0) who can make an early transition to oral therapy and be discharged from the hospital and patients at high risk (scores of 3 or 4) who should be carefully monitored.

screened. Of these, 270 patients were included in the analysis (Figure 1). Baseline characteristics are presented in Table 1. Thirty percent of the patients (81/270) were previously exposed to thiopurines. Among the 34 patients exposed to anti-TNFs before cohort entry, 7 had discontinued anti-TNFs before admission index because of severe skin side effects (1), allergic reactions (2), serious infections (1), primary failure (1), remission (1), and nonadherence (1). Among patients with no missing data to assess the clinical activity index (Lichtiger index) and Truelove and Witts criteria (n = 215, 80% of the total cohort), 83.2% had a clinical activity index above 10, and 75.2% had ASUC defined by True-love and Witts criteria. CRP level above 30 mg/L and albumin level below 30 g/L were observed in 64.8% (175/270) and 44.4% (120/270) of patients, respectively. Endoscopy was performed in 241 patients (89.2%) and an abdominal computed tomography scan in 70 patients (25.9%) (Supplementary Table 1).

Therapeutic management. Before admission index, 121 patients (45%) were treated with oral corticosteroids. Among them, 71 had no response to corticosteroids, and 40 had a recurrence of symptoms during the decrease of corticosteroids. The first-line treatment after hospital admission was intravenous corticosteroids in 94.1% of patients (n = 254), infliximab in 3.7% (n = 10), cyclosporine in 1.5% (n = 4), and adalimumab in 0.7% (2 patients who failed to respond to oral corticosteroids and infliximab during the last year before admission). Thirty-nine percent of patients

Figure 1. Flow chart of study (derivation cohort). Anti-TNFs, tumor necrosis factor blockers; CRP, C-reactive protein.



treated with corticosteroids ($n = 98$) needed a second-line therapy. Among nonresponders to the first line (38%, 102 patients, in any treatment group), 7%, 65%, 25%, and 3% were treated with colectomy, infliximab, cyclosporine, or other treatments (adalimumab or golimumab), respectively. The rate of response to infliximab and cyclosporine was 91% and 85%, respectively. Only 4 patients had a third medical line of treatment. Colectomy was performed in 4.8% of patients ($n = 13$) during the hospitalization after a median duration of 15 days (IQR, 8–19). No patients died during hospitalization.

Long-term follow-up. Median time of follow-up was 30 months (IQR, 7–66). One patient died during the

follow-up as a result of a cholangiocarcinoma. Forty-three percent of patients ($n = 83$) were hospitalized for flare during the first year after ASUC. The cumulative risk of colectomy according to the time since the index hospitalization is shown in Figure 2. Colectomy was performed in 30 (12.3%), 43 (20.1%), and 47 (33.3%) at 1, 5, and 10 years after the index hospitalization, respectively. Among patients with missing data about Lichtiger index and Truelove and Witts criteria at admission, no difference was observed on the rate of colectomy at 1 year (9% versus 11.6% in patients with available data, $P = .77$).

Predictors of colectomy at 1 year. By univariate analysis, patients with colectomy at 1 year were significantly older at diagnosis of IBD (Table 2). Previous treatment with thiopurines or anti-TNFs was associated with increased risk of colectomy (Table 2). Considering previous treatment with thiopurines or anti-TNFs, hazard ratio [HR] was 2.4 (95% CI, 1.19–5.00; $P = .01$). Among patients with no missing data, clinical activity index was not associated with an increased risk of colectomy (HR, 1.07; 95% CI, 0.93–1.22; $P = .36$). Regarding biological parameters, presence of CDI, CRP level above 30 mg/L, and serum albumin level below 30 g/L measured during the first day after admission were predictors (Table 2). By multivariate analysis, 4 criteria were significantly associated with increased risk of colectomy within 1 year after admission: previous treatment with anti-TNFs or thiopurines (HR, 3.86; 95% CI, 1.82–8.18), presence of CDI (HR, 3.73; 95% CI, 1.11–12.55), CRP level above 30 mg/L (HR, 3.06; 95% CI, 1.11–8.43), and albumin level below 30 g/L (HR, 2.67; 95% CI, 1.20–5.92). Results were consistent after exclusion of patients with IBDU. Results were consistent across centers.

We developed a prognostic score based on these 4 predictors. Because the β -coefficients of the Cox multivariate regression analysis varied around 1.19 between 0.98 and 1.35, the same weight for all variables was chosen to simplify: 1 point for each item, from 0 to 4. Forty-one patients (15.2%) had no criteria, 91 patients (33.7%) had 1 criterion, 113 patients (41.8%) had 2 criteria, 24 patients (8.9%) had 3 criteria, and 1 patient (0.4%) had 4 criteria. The cumulative risk of colectomy within 1 year in patients with a score of 0, 1, 2, 3, and 4 items at admission was 0.0%, 9.4% (95% CI, 4.3%–16.7%), 10.6% (95% CI, 5.6%–17.4%), 51.2% (95% CI, 26.6%–71.3%), and 100%, respectively (Figures 3 and 4). Colectomy was performed during

Table 1. Characteristics at Admission (Derivation Cohort)

Characteristic	N = 270
Demographic parameters	
Male	134 (49.6)
Age at admission, y	32.0 (24.0–47.0)
At least one item in Charlson score	41 (15.2)
Duration of disease, y	2.0 (0.0–7.0)
ASUC within 6 mo after diagnosis	80 (29.6)
Disease	
Ulcerative colitis	260 (96.3)
IBDU	10 (3.7)
Extension of disease	
Extensive colitis	162 (60)
Left-sided colitis	101 (37.4)
Proctitis	7 (2.6)
Previously exposed to anti-TNFs or thiopurines (past and current users)	88 (32.6)
Clinical parameters	
Number of stools per day	10.0 (7.0–15.0)
Lichtiger index ^a	12.0 (10.0–14.0)
Extraintestinal manifestation	31 (11.9)
Biological parameters	
CRP, mg/L	53.0 (18.6–110)
Albumin, g/L	30.7 (26.3–35.5)
Hemoglobin, g/dL	11.6 (10.1–13.2)
WCC ($\times 10^9$ per L)	9.9 (7.56–13.0)
Platelet ($\times 10^9$ per L)	388 (305–479)
CMV colitis	5 (5.8)
CDI, n (%)	10 (4.3)

NOTE. Results are expressed as median (interquartile range) for continuous variables and as N (%) for categorical variables.

ASUC, acute severe ulcerative colitis; CDI, *Clostridioides difficile* infection; CMV, cytomegalovirus; CRP, C-reactive protein; IBDU, inflammatory bowel disease unclassified; WCC, white cell count.

^aAmong 215 patients with no missing data to assess the clinical activity index (Lichtiger index).

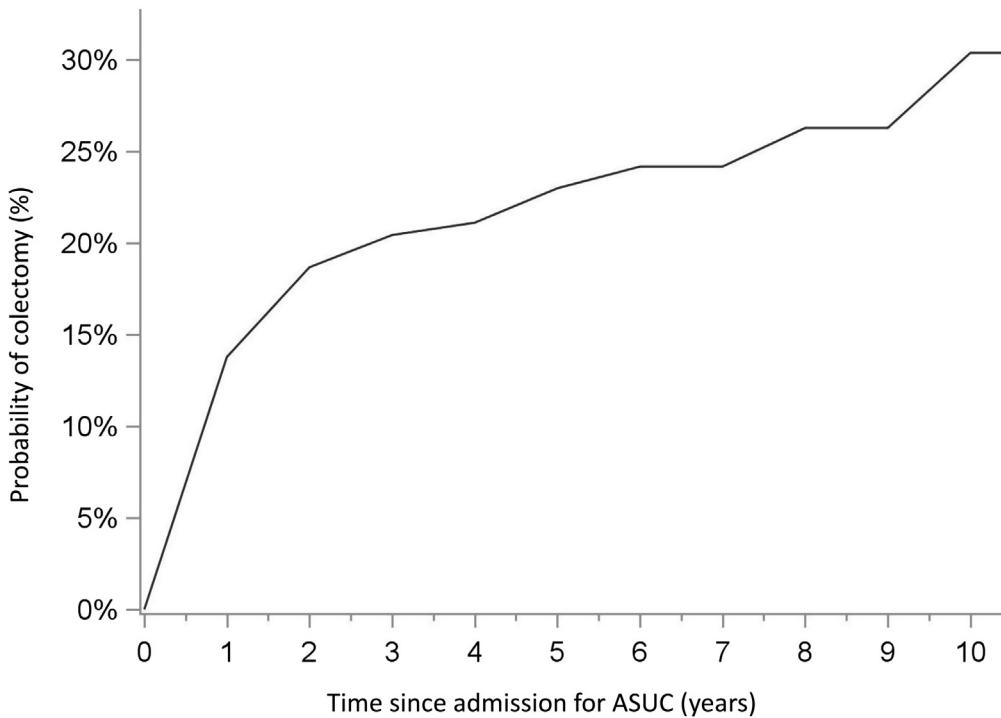


Figure 2. Rate of colectomy according to the time since admission for acute severe ulcerative colitis (ASUC) (derivation cohort).

hospitalization in the patient with 4 criteria. Characteristics of the score are presented in Table 3. The negative predictive value varied between 87% (95% CI, 82%–91%) and 92% (95% CI, 88%–95%). The positive

predictive value increased gradually according to the scores 1, 2, 3, and 4 (9%, 10%, 42%, and 100%, respectively). As estimated with the 95% CI from the bootstrap method, the percentages of patients with a low

Table 2. Clinical and Biochemical Variables of 270 Patients Admitted With ASUC (Derivation Cohort)

	Colectomy at 1 y (n = 30)	No colectomy at 1 y (n = 240)	Hazard ratio (95% CI)	P value
Clinical variables				
Male	16 (53.3)	118 (49.2)	0.86 (0.42–1.76)	.68
Charlson index	0 (0–1)	0 (0–0)	1.18 (0.93–1.52)	.18
Previous appendectomy	3 (10)	9 (3.8)	2.70 (0.82–8.89)	.10
Age at diagnosis (y)	37.0 (25.0–47.0)	26.0 (21.0–40.0)	1.03 (1.01–1.05)	<.01
Age at admission older than 50 (y)	10 (33.3)	49 (20.4)	1.90 (0.89–4.06)	.10
Disease duration (y)	2 (0.0–7.0)	2 (0.0–7.0)	0.99 (0.94–1.04)	.75
ASUC onset within 6 mo after diagnosis	4 (13.3)	76 (31.7)	0.35 (0.12–0.99)	.048
Extensive colitis (E3) (vs E2 + E1)	23 (77)	139 (58)	2.21 (0.9–5.2)	.07
Medication before admission				
Thiopurines	14 (46.7)	67 (27.9)	2.09 (1.02–4.27)	.04
Anti-TNFs	9 (30)	34 (12.6)	3.17 (1.45–6.93)	<.01
Time of flare-up before admission	33.0 (20.0–75.0)	31.0 (16.0–56.0)	1.00 (0.99–1.00)	.55
Oral steroids before admission to treat flare-up	17 (56.7)	104 (43.5)	1.57 (0.76–3.23)	.22
Number of stools	10.0 (7.0–15.0)	10.0 (6.0–15.0)	1.03 (0.99–1.08)	.15
Extraintestinal manifestation	2 (6.9)	29 (12.5)	0.54 (0.13–2.28)	.40
Biochemical variables				
CRP above 30 mg/L	25 (83.3)	150 (62.5)	2.84 (1.09–7.43)	.03
Albumin below 30 g/L	20 (66.7)	100 (41.7)	2.60 (1.22–5.56)	<.01
Hemoglobin (g/dL) ^a	10.8 (9.80–12.2)	11.8 (10.2–13.3)	0.88 (0.75–1.03)	.12
WCC ($\times 10^9$ per L) ^b	9.32 (7.1–13.0)	9.9 (7.6–13.0)	1.00 (1.0–1.0)	.44
Platelet ($\times 10^9$ per L) ^c	395 (328–495)	388 (299–479)	1.00 (0.99–1.00)	.52
Presence of <i>C difficile</i> infection	3 (13.0)	7 (3.4)	3.83 (1.16–12.62)	.03
CMV colitis	2 (18.2)	3 (4.0)	4.32 (0.93–20.07)	.06

ASUC, acute severe ulcerative colitis; CMV, cytomegalovirus; CRP, C-reactive protein; WCC, white cell count.

^aRisk corresponding to an increase of one unit.

^b1000 WCC/mm³.

^c10,000 platelet.

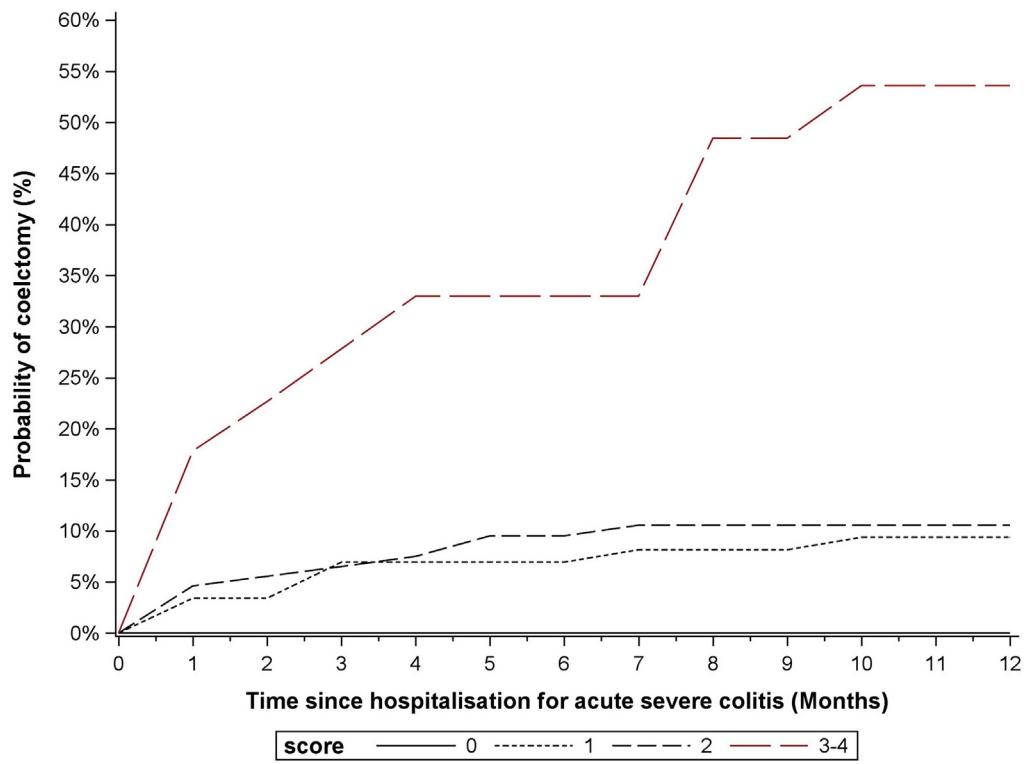


Figure 3. Cumulative probability of colectomy according to the time since admission for acute severe ulcerative colitis (ASUC) (derivation cohort).

(score = 0; n = 41; IQR, 30–53), intermediate (score = 1 or 2; n = 204; IQR, 192–217), and high score (score = 3 or 4; n = 25; IQR, 16–34) were 0.0 (0.0–0.0), 9.9 (5.7–14.2), and 53.3 (30.7–74.9), respectively.

Mycobacterium tuberculosis infection, besides no response to intravenous cyclosporine.

Discussion

Among data on hospital admission of 270 unselected patients with ASUC, 4 predictors of colectomy within 1 year have been identified: previous treatment with anti-TNFs or thiopurines, presence of CDI, CRP level above 30 mg/L, and albumin level below 30 g/L. We combined the variables into a score that is highly predictive of having a colectomy or not within 1 year after admission. Results were consistent in the validation cohort for low-risk and high-risk profile patients.

Our population is similar to other studies, notably regarding clinical and biological characteristics.^{17–19} The rate of CDI (4.3%) is homogenous with recent studies.²⁰ Corticosteroid therapy for ASUC was the cornerstone of first-line treatment in our study (94.0%) as previous studies,²¹ and the overall response rate to corticosteroids in our cohort (61%) was similar with the literature.²² Although no difference was reported regarding efficacy and short-term safety between infliximab and cyclosporine in the 2 randomized controlled trials,^{19,23} a higher proportion of patients were treated with infliximab (65%) compared with cyclosporine (25%) in our study. This may be related to the substantial proportion of patients previously exposed to thiopurines and thus not eligible for cyclosporine and also related to physician preferences, as reported in previous studies.^{12,24} We observed a high response to infliximab (91%) and cyclosporine (85%) compared with a meta-analysis of

Validation Cohort

In the validation cohort, 185 patients were included (100 and 85 from Kremlin Bicetre Hospital and Henri Mondor Hospital, respectively), with a median age at admission of 38.0 years (IQR, 25–51), and 35.6% (66/185) were previously exposed to anti-TNFs or thiopurines. Median CRP and albumin levels were 48.5 mg/L (IQR, 20.2–117.0) and 29.9 g/L (IQR, 25.0–35.0), respectively. CRP above 30 mg/L, albumin below 30 g/L, and CDI were observed in 65.9% (122/185), 49.7% (92/185), and 5.4% (10/185) of patients, respectively. Seven patients were lost to follow-up before 1 year. The cumulative risk of colectomy within 1 year was 21.6% (95% CI, 15.9%–27.9%). In this cohort, cumulative probability of colectomy according to the scores 0, 1, 2, 3, and 4 at admission were 6.2% (95% CI, 0.4%–25.5%) (1/17), 8.4% (95% CI, 3.4%–16.4%) (6/71), 29.4% (95% CI, 19.3%–40.3%) (21/74), 50% (95% CI, 26.3%–69.8%) (10/21), and 50% (95% CI, 0.0%–96.0%) (1/2) (Figure 4 and Supplementary Figure 1), which is consistent with findings from the derivation cohort among patients with a score of 0 (low-risk profile) and score 3–4 (high-risk profile). The patient with a score of 0 who underwent colectomy during hospitalization was 68 years old and had known low-grade colonic dysplasia and a latent

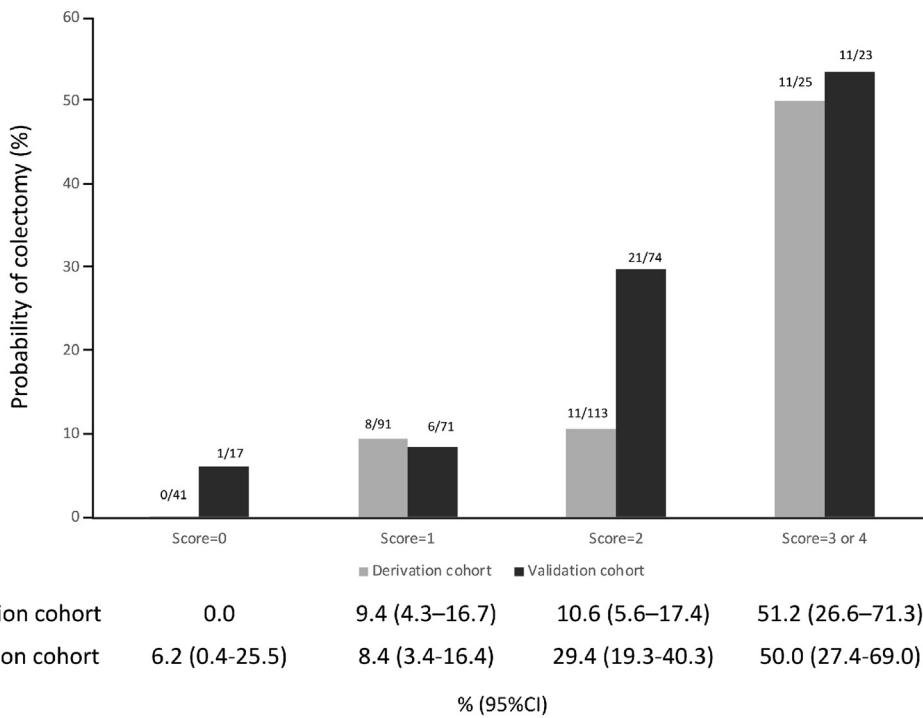


Figure 4. Risk of colectomy within 1 year after acute severe ulcerative colitis according to the predictive score in the derivation and validation cohorts. CI, confidence interval.

nonrandomized studies (74.8% and 55.4%, respectively).²⁴ However, these rates of response are similar to the CySIF study, which observed 86% of response to cyclosporine and 84% to infliximab at day 7.²³ Because the response rate of the second-line therapy was higher, the percentage of colectomy during hospitalization (4.8%) was lower compared with that of literature, which usually ranged from 11% to 25%.^{18,25,26} After 1 year of follow-up, probability of colectomy (12.3%) was nevertheless close to recent studies (12%).¹⁸

Four criteria at admission were associated with colectomy within 1 year after ASUC in multivariate analysis. First, previous exposure to anti-TNFs or thiopurines was predictive of colectomy. Two studies have already reported a strong association between colectomy and previous exposure to immunosuppressants.^{25,27} None reported an association with anti-TNFs, which may be related to the period of inclusion. Second, CDI is a well-known predictor, especially for the long-term risk (odds ratio, 2.96; 95% CI, 1.19–7.34) but not for the short-term risk.^{8,9} Third, a level of albumin below 30 g/L

was already included in previous scores.^{10,28} Last, CRP level, which is also a marker of inflammation, was associated with colectomy in historical cohorts.^{29,30}

From these 4 items, a predictive score of colectomy has been developed. First, an internal validation was performed with bootstrapping technique. Second, a validation cohort was built to assess external validation. Results were consistent in the validation cohort for low-risk and high-risk profile patients. When no criterion is present, the risk of colectomy at 1 year is minimal (0%–6%), allowing an early transition to oral therapy and discharge from hospital. When 1 or 2 criteria are identified, 10%–30% of patients will be operated within 1 year. Among patients with a score of 2, discrepancies were observed between derivation and validation cohorts about the score 2 (10.6%; 95% CI, 5.6%–17.4%) versus 29.4% (95% CI, 19.3%–40.3%). A potential residual confounding cannot be excluded, but this difference may be also related to the physician preference. Indeed, patients with this score range are at intermediate risk, and physician preference may have the highest

Table 3. Characteristics of Score 1 Year After Admission for ASUC From Derivation Cohort

	Negative predictive value (%) (95% CI)	Positive predictive value (%) (95% CI)	Sensitivity (%) (95% CI)	Specificity (%) (95% CI)
Score = 0	87 (82–91)	—	—	83 (78–87)
Score = 1	88 (82–92)	9 (4–17)	27 (12–46)	65 (59–71)
Score = 2	88 (82–93)	10 (5–17)	37 (20–56)	58 (51–64)
Score = 3	92 (88–95)	42 (22–63)	33 (17–53)	94 (90–97)
Score = 4	89 (85–93)	100 (3–100)	3 (0–17)	100 (98–100)

impact on colectomy occurrence in this area of uncertainty. Further studies are required to assess the impact of referent physician preference on the decision of colectomy. Among patients with a score greater than 3, the risk is higher, and colectomy may be discussed earlier, decreasing the morbidity and mortality of surgery. Positive predictive value is similar with those observed in an English cohort published by Lynch et al.⁷

The score developed in this study has several strengths. It is easy to use because only 4 items are included with 1 point for each, improving the reproducibility between physicians, and could be widely used. Because it is assessed at the first day of hospitalization, it can help physicians early in the therapeutic management. Previous treatments with anti-TNFs or thiopurines and CDI have been included for the first time in a predictive score of colectomy after ASUC.

Some limitations need to be discussed. Radiologic and endoscopic criteria were too often lacking to be included in the analysis. Xie et al³¹ have shown a higher performance of the UCEIS to predict colectomy after a median follow-up of 73 months than the Mayo Endoscopic Score. The number of Truelove and Witts criteria and the clinical activity index were not available for all patients. The latter was nevertheless not predictive of colectomy in several studies,^{32,33} and Lindgren et al²⁹ had also included patients with moderately severe flare according to Truelove and Witts criteria. Fecal calprotectin seems to have a predictive value in ASUC, but it was not routinely measured in our centers.^{6,34} Moreover, we focused on colectomy after ASUC, but nowadays, it would be interesting to have predictors of other issues such as mucosal healing or success of specific biologics or small molecules.³⁵ Further studies are required to identify these predictors.

In conclusion, in this exploratory cohort of consecutive patients with ASUC, 4 independent predictors of colectomy within 1 year were identified: previous treatment with anti-TNFs or thiopurines, presence of CDI, CRP level above 30 mg/L, and albumin level below 30 g/L. A score combining these predictors is highly predictive of the occurrence and risk magnitude of colectomy within 1 year after admission, and a replicative cohort confirmed these results.

Supplementary Material

Note: To access the supplementary material accompanying this article, visit the online version of *Clinical Gastroenterology and Hepatology* at www.cghjournal.org, and at <https://doi.org/10.1016/j.cgh.2019.12.036>.

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Conflicts of interest

These authors disclose the following: A. Amiot: fees from AbbVie, Hospira, Takeda, Gilead, Tillotts, Janssen, and Biocodex and travel accommodations from AbbVie, Janssen, Biocodex, Hospira, Tillotts, Ferring, Takeda, and MSD. This author has also received advisory board fees from Gilead, Takeda, and AbbVie. J. H. Lefevre: fees from Takeda, SafeHeal, and Consultant; Biomup travel; Ethicon. C. Landman: fees from AbbVie, Hospira-Pfizer, Janssen-Cilag, and Ferring; travel support from AbbVie, Hospira-Pfizer, Takeda, Janssen-Cilag, and Mayoly Spindler; and research support from Biocodex. H. Sokol: fees from Enterom, Astellas, Roche, Merck, Maat et Danone. P. Seksik: fees from Takeda, AbbVie, Merck-MSD, Astellas, Janssen, and Biocodex; and grants from Biocodex. F. Carbonnel: fees from AbbVie, Amgen, Astra, BMS, Enterome, Ferring, Janssen, Medtronic, Merck, MSD, Pfizer, Pharmacosmos, Pileje, Roche, and Takeda. S. Viennot: fees from AbbVie, Takeda, MSD, Janssen, Astrella, and Ferring. L. Beaugerie: fees from Abbott, AbbVie, MSD, and Ferring Pharmaceuticals. The remaining authors disclose no conflicts.

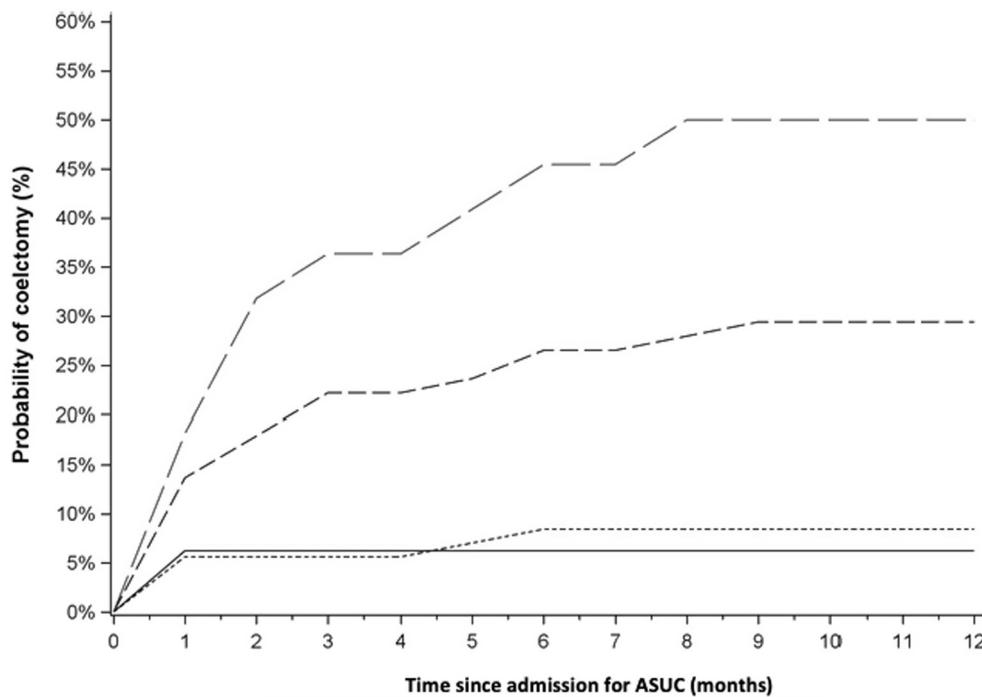
**Supplementary**

Figure 1. Cumulative probability of colectomy according to the time since admission for ASUC and to the score in the validation cohort. ASUC, acute severe ulcerative colitis.

	score															
	0	1	2	3-4	0	1	2	3-4	0	1	2	3-4	0	1	2	3-4
Score=0	17	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Score=1	71	67	67	67	67	66	65	65	65	65	65	65	65	65	65	65
Score=2	74	61	58	54	54	53	51	51	50	49	48	48	48	48	48	48
Score=3-4	23	18	15	14	14	13	12	12	11	11	11	11	11	11	11	11

Supplementary Table 1. Endoscopic and Radiologic Criteria at Admission

	Colectomy at 1 y (n = 30) N (%) or median (IQR)	No colectomy at 1 y (n = 240) N (%) or median (IQR)
Endoscopic criteria^a		
Mayo endoscopic score		
1	4.0 (1)	13.0 (27)
2	20.0 (5)	21.7 (45)
3	76.0 (19)	65.2 (135)
Mucosal damage		
None	4.3 (1)	7.3 (13)
Erosions	13.0 (3)	20.8 (37)
Superficial ulcer	34.8 (8)	40.4 (72)
Deep ulcer	47.8 (11)	31.5 (56)
Radiologic criteria^b		
Disease extent on CT scan		
Left-sided	8.3 (1)	35.1 (20)
Pancolitis	91.7 (11)	64.9 (37)

CT, computed tomography; IQR, interquartile range.

^aAmong 241 patients with no missing data about endoscopic criteria.^bAmong 70 patients with no missing data about radiologic criteria.